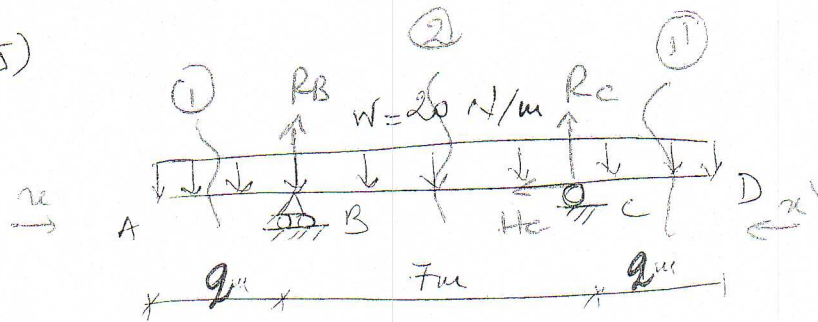


Corrigé de l'examen de RDM
du 05/05/2024

Exo 1 : (7pts)



1. Réactions d'appuis :

0,75pt $R_B = \frac{wL}{2} = 110 \text{ N}$

0,75pt $R_C = \frac{wL}{2} = 110 \text{ N}$

$H_C = 0 \text{ N}$ (0,5pt)

2. Expressions de $T(x)$ et $M(x)$

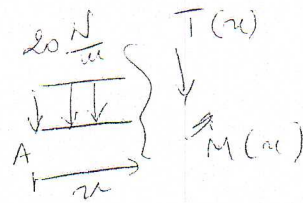
* Coupe ① entre A et B $0 \leq x \leq 2 \text{ m}$

① $T(x) : T(x) + 20x = 0$

$T(x) = -20x$ (0,5pt)

pour $x = 0 \rightarrow T(A) = 0 \text{ N}$

$x = 2 \text{ m} \rightarrow T(B) = -40 \text{ N}$



① $M(x) : M(x) + \frac{20x^2}{2} = 0 \rightarrow M(x) = -10x^2$ (0,5pt)

pour $x = 0 \rightarrow M(A) = 0 \text{ N.m}$

$x = 2 \text{ m} \rightarrow M(B) = -40 \text{ N.m}$

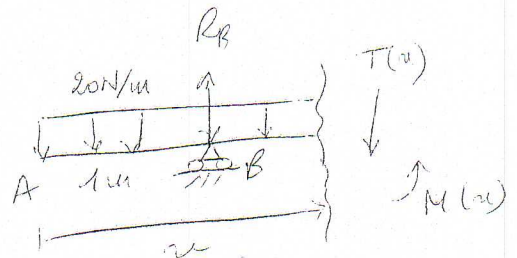
* Coupe ② entre B et C $2 \leq x \leq 5 \text{ m}$

② $T(x) : T(x) + 20x - R_B = 0$

$T(x) = -20x + 110$ (0,5pt)

pour $x = 2 \text{ m} \rightarrow T(B) = 70 \text{ N}$

$x = 5 \text{ m} \rightarrow T(C) = -90 \text{ N}$



$$I_y = I_y^{(1)} - I_y^{(2)} - I_y^{(3)}$$

$$I_y^{(1)} = \frac{(11,2)^4}{12} = 5245,06 \text{ mm}^4 \quad (1)$$

$$I_y^{(2)} = \frac{(3)^4}{12} + 9 \cdot (3,5)^2 = 6,75 + 110,25 = 117 \text{ mm}^4$$

$$I_y^{(3)} = \frac{(4,2)^4}{36} + 8,82 \cdot (1,4)^2 = 8,64 + 17,29 = 25,93 \text{ mm}^4$$

Exo 3. (5 pts)

1. Calcul du diamètre minimal

$$\tau \leq \tau_{adm} \rightarrow \frac{I}{S} \leq \tau_{lim}$$

$$\leq \tau_{lim}$$

$$\text{avec } S = \frac{\pi d^2}{4} \rightarrow \frac{4I}{\pi d^2} \leq \tau_{lim} \rightarrow d^2 \geq \frac{4I}{\pi \tau_{lim}}$$

$$\rightarrow d \geq \sqrt{\frac{4I}{\pi \tau_{lim}}}$$

2. Calcul de la Contrainte de Cisaillement

$$\tau = \frac{I}{S} \quad , \quad S = \frac{\pi d^2}{4}$$

3. Calcul de la déformation angulaire :

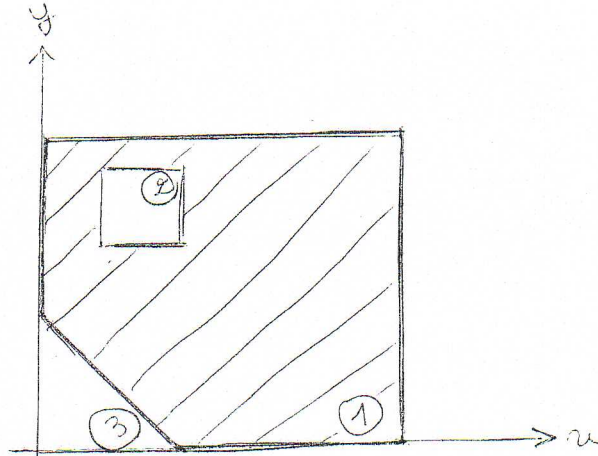
$$\tau = G \cdot j \rightarrow j = \frac{\tau}{G}$$

Exo 2 (8pts)

1. Coordonnées du CG

$$X_G = \frac{\sum x_i s_i}{\sum s_i} \quad (0,5)$$

$$Y_G = \frac{\sum y_i s_i}{\sum s_i}$$



| sectr | surface (mm ²) | x _i (mm) | y _i (mm) |
|-------|----------------------------|---------------------|---------------------|
| ① | 125,44 | 5,6 | 5,6 |
| ② | 9 | 3,5 | 8,7 |
| ③ | 8,82 | 1,4 | 1,4 |
| Total | 107,62 | / | / |

$$X_G = \frac{5,6 \times 125,44 - 3,5 \times 9 - 1,4 \times 8,82}{107,62} = \frac{658,616}{107,62}$$

$$X_G = 6,119 \text{ mm} \quad (0,5)$$

$$Y_G = \frac{5,6 \times 125,44 - 8,7 \times 9 - 1,4 \times 8,82}{107,62} = \frac{611,816}{107,62}$$

$$Y_G = 5,685 \text{ mm} \quad (0,5)$$

2. Calcul des moments d'inertie :

$$I_x = I_x^{\text{①}} - I_x^{\text{②}} - I_x^{\text{③}} \quad (0,5)$$

$$I_x^{\text{①}} = \frac{(11,2)^4}{3} = 5245,06 \text{ mm}^4 \quad (1)$$

$$I_x^{\text{②}} = \frac{(3)^4}{12} + 9 (8,7)^2 = 6,75 + 681,21 = 687,96 \text{ mm}^4$$

$$I_x^{\text{③}} = \frac{(4,2)^4}{36} + 8,82 (1,4)^2 = 8,64 + 17,29 = 25,93 \text{ mm}^4.$$

$$M(x) : M(x) + \frac{20x^2}{2} - R_B(x-2) = 0$$

$$M(x) = -10x^2 + R_B(x-2)$$

$$\rightarrow M(x) = -10x^2 + 110x - 220$$

(0,5 pt)

pour $x = 2m \rightarrow$

$x = 9m \rightarrow$

$$M(B) = -40 \text{ N.m}$$

$$M(C) = -40 \text{ N.m}$$

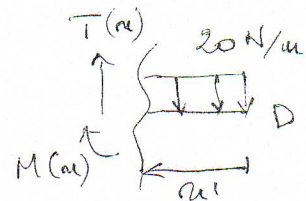
* Coupe (I') entre D et C $0 \leq x' \leq 1m$

$$T(x') : T(x') - 20x' = 0$$

$$T(x') = 20x' \quad (0,5 \text{ pt})$$

pour $x' = 0 \rightarrow T(D) = 0 \text{ N}$

$x' = 1m \rightarrow T(C) = 20 \text{ N}$



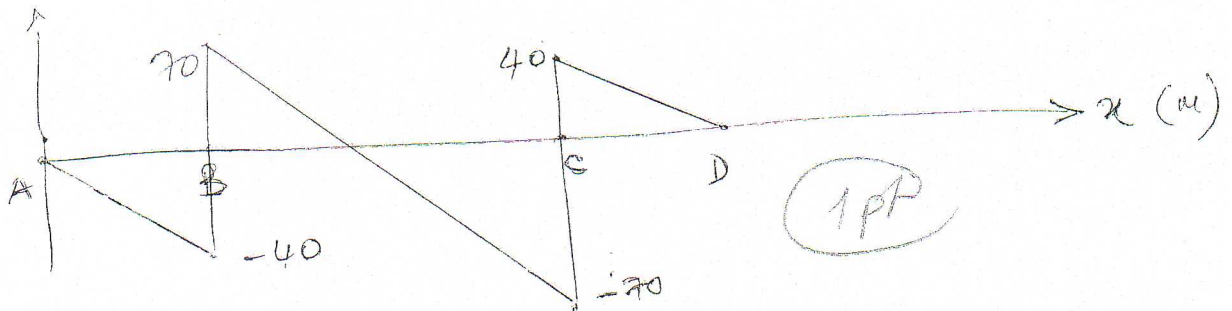
$$M(x') : M(x') + \frac{20x'^2}{2} = 0$$

$$M(x') = -10x'^2 \quad (0,5 \text{ pt})$$

pour $x' = 0 \rightarrow M(D) = 0 \text{ N.m}$

$x' = 1m \rightarrow M(C) = -40 \text{ N.m}$

$T(x) \text{ (N)}$



$M(x) \text{ N.m}$

