CHIKOUCHE M.A
Résistance Des Matériaux

Faculté de technologie

1985
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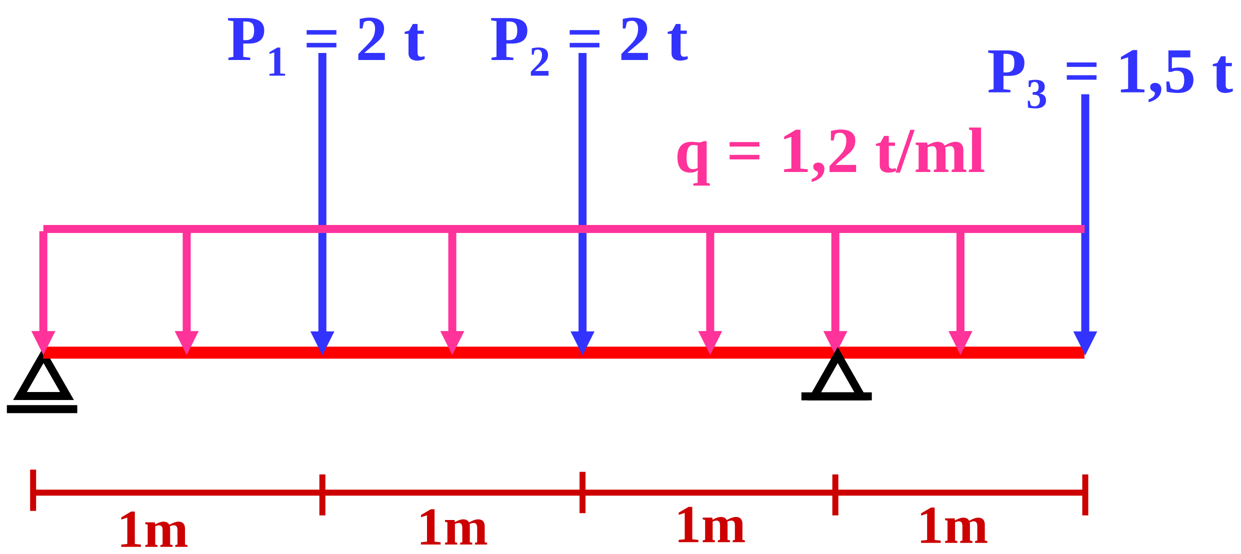
Département de Génie Civil

Série N° 04

La flexion simple

Exercice 1

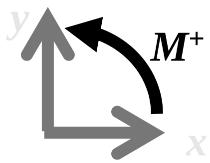
Sachant que la contrainte critique σ_{cr} = 3000 Kg/cm², le coefficient de sécurité C_s = 2 et la section de la poutre étant carrée (h=b).
Calculer la côte (b) de la poutre.



Solution Ex 1

1-Construction du diagramme équivalent des forces et l'établissement des equations d'équilibre, on trouve

$$\Sigma F_{/x} = 0 \Rightarrow R_{B_x} = 0$$

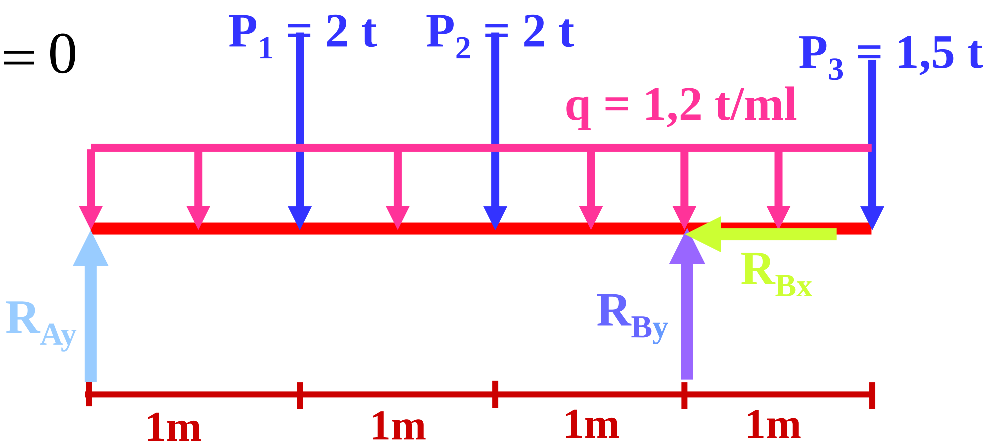


$$\Sigma F_{/y} = 0 \Rightarrow R_{A_y} + R_{B_y} = 10.3$$

$$\Sigma M_{/A} = 0 \Rightarrow 3R_{B_y} - 2 - 4 - 6 - 9.6 = 0$$

$$\Rightarrow R_{B_y} = 7.2\,[t]$$

$$Donc: R_{B_y} = 7.2\,[t]; \quad R_{A_y} = 3.1\,[t]$$



Solution Ex 1

2-Calcul du moment fléchissant et de l'effort tranchant.

$$0 \le x < 1m$$

$$T(x) = 3.1 - 1.2x \begin{cases} T(0) = 3.1\,[t] \\ T(1) = 1.9\,[t] \end{cases}$$

$$M(x) = 3.1x - 1.2\frac{x^2}{2} \begin{cases} M(0) = 0 \\ M(1) = 2.5\,[t.m] \end{cases}$$

$$1 \le x < 2m$$

$$T(x) = 3.1 - 2 - 1.2 - 1.2(x-1) \begin{cases} T(1) = -0.1\,[t] \\ T(2) = -1.3\,[t] \end{cases}$$

$$M(x) = 3.1x - 2(x-1) - 1.2(x-0.5) - 1.2\frac{(x-1)^2}{2} \begin{cases} M(1) = 2.5\,[t.m] \\ M(2) = 1.8\,[t.m] \end{cases}$$

Solution Ex 1

2-Calcul du moment fléchissant et de l'effort tranchant.

$$2 \le x < 3m$$

$$T(x) = 3.1 - 2 - 2 - 2.4 - 1.2(x-2) \begin{cases} T(2) = -3.3\,[t] \\ T(3) = -4.5\,[t] \end{cases}$$

$$M(x) = 3.1x - 2(x-1) - 2(x-2) - 2.4(x-1) - 1.2\frac{(x-2)^2}{2} \begin{cases} M(2) = 1.8\,[t.m] \\ M(3) = -2.1\,[t.m] \end{cases}$$

$$3 \le x < 4m$$

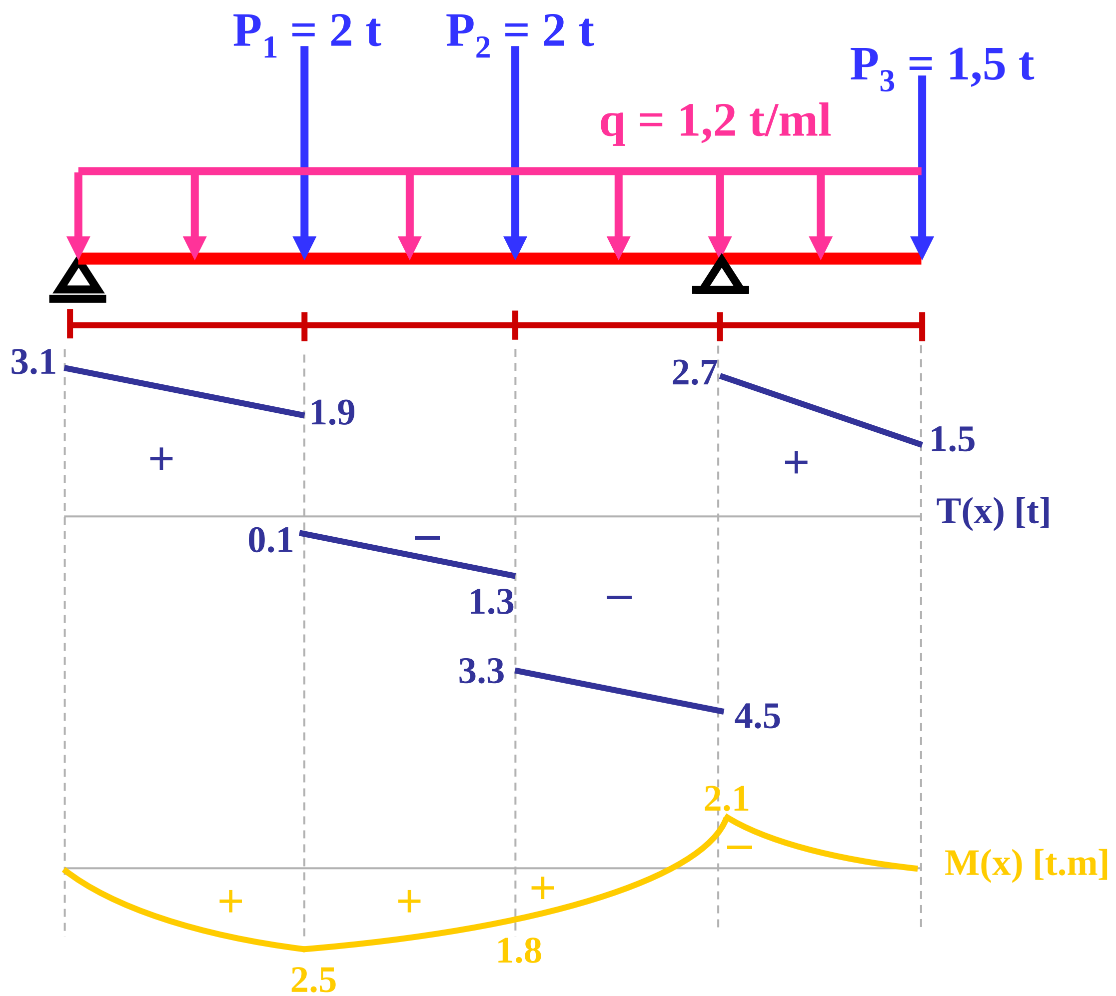
$$T(x) = 3.1 - 2 - 2 + 7.2 - 3.6 - 1.2(x-3) \begin{cases} T(3) = 2.7\,[t] \\ T(4) = 1.5\,[t] \end{cases}$$

$$M(x) = 3.1x - 2(x-1) - 2(x-2) + 7.2(x-3) - 3.6(x-1.5) - 1.2\frac{(x-3)^2}{2}$$

$$\begin{cases} M(3) = -2.1\,[t.m] \\ M(4) = 0 \end{cases}$$

Solution Ex 1

2-Le tracé du diagramme de T(x) et M(x).



Solution Ex 1

Le moment fléchissant maximal est 2.5 [t.m]. Sachant que :

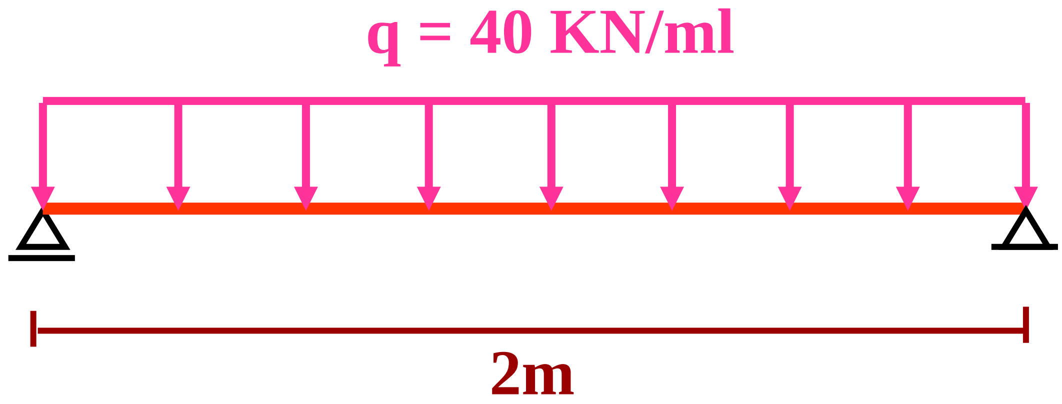
$$h = b; \quad I = \frac{b^4}{12}; \quad y = \frac{b}{2}; \quad \sigma_{adm} = 1500\,[Kg/cm^2]$$

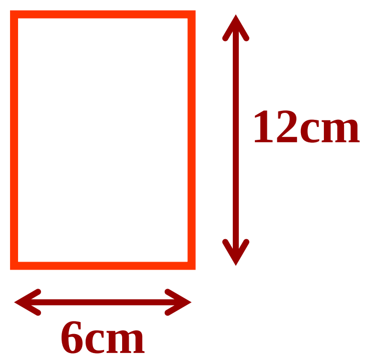
$$\sigma = \frac{M}{I}y = \frac{6M}{b^3} \le \sigma_{adm}$$

$$b \ge \sqrt[3]{\frac{6 \times 2.5 \times 1000 \times 100}{1500}} \Rightarrow b \ge 10\,[cm]$$

Exercice 2

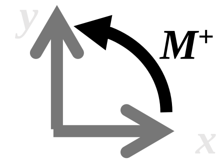
Vérifier la résistance de la poutre ci-dessous sachant que la résistance admissible σ_{adm} = 160 N/mm².



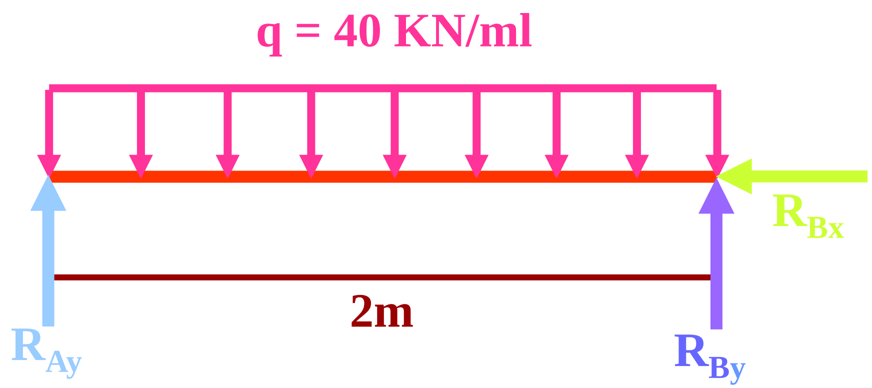


Solution Ex 2

1-Construction du diagramme équivalent des forces et l'établissement des equations d'équilibre, on trouve



$$\Sigma F_{/x} = 0 \Rightarrow R_{B_x} = 0$$



$$\Sigma F_{/y} = 0 \Rightarrow R_{A_y} + R_{B_v} = 80$$

$$\Sigma M_{/A} = 0 \Rightarrow 2R_{B_v} - 80 = 0$$

$$\Rightarrow R_{B_v} = 40\,[KN]$$

$$Donc: R_{B_v} = 40\,[KN]; \quad R_{A_v} = 40\,[KN]$$

Solution Ex 2

2-Calcul du moment fléchissant et de l'effort tranchant.

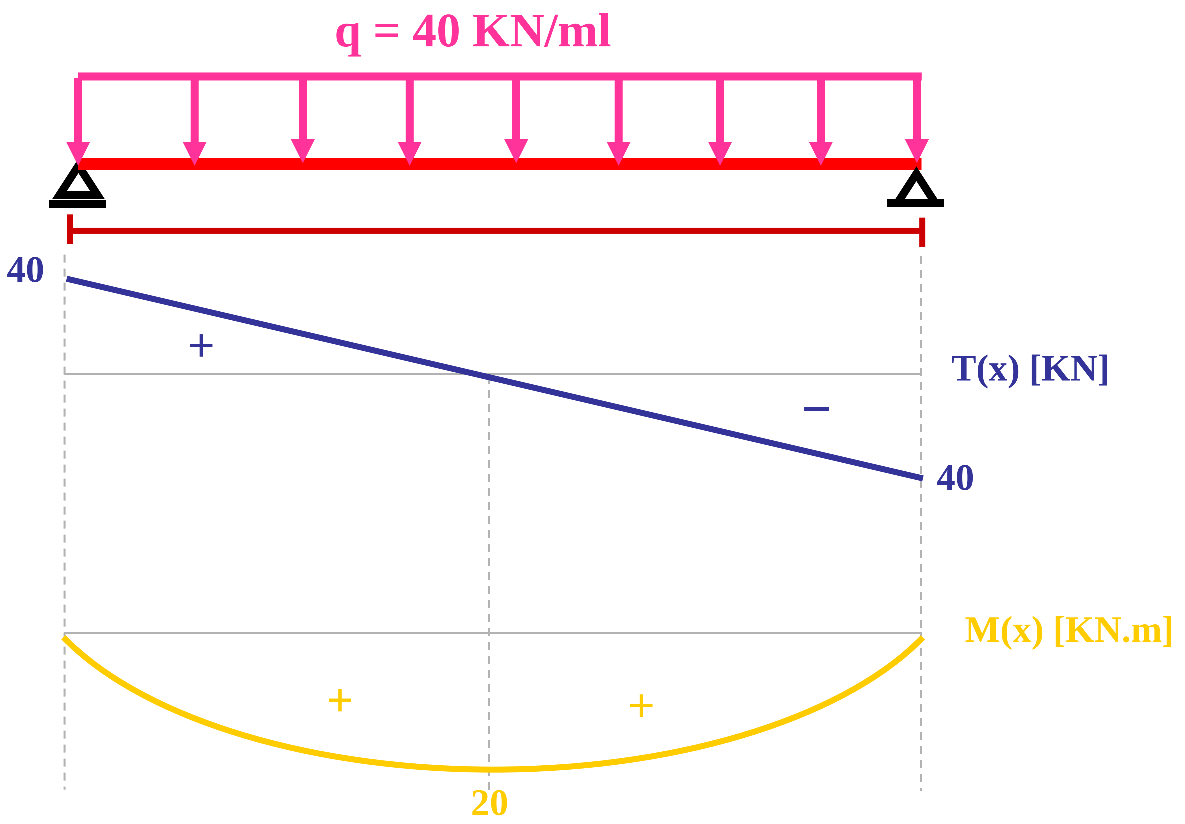
$$0 \le x < 2m$$

$$T(x) = 40 - 40x \begin{cases} T(0) = 40\,[KN] \\ T(2) = -40\,[KN] \\ T(x) = 0 \Rightarrow x = 1m \end{cases}$$

$$M(x) = 40x - 40\frac{x^2}{2} \begin{cases} M(0) = 0 \\ M(2) = 0 \\ M(1) = 20\,[KN.m] \end{cases}$$

Solution Ex 2

2-Le tracé du diagramme de T(x) et M(x).



Solution Ex 2

Le moment fléchissant maximal est 20 [KN.m]. Sachant que :

$$I = \frac{hb^3}{12} = \frac{60 \times 120^3}{12}; \quad y = \frac{h}{2}; \quad \sigma_{adm} = 160\,[N/mm^2]$$

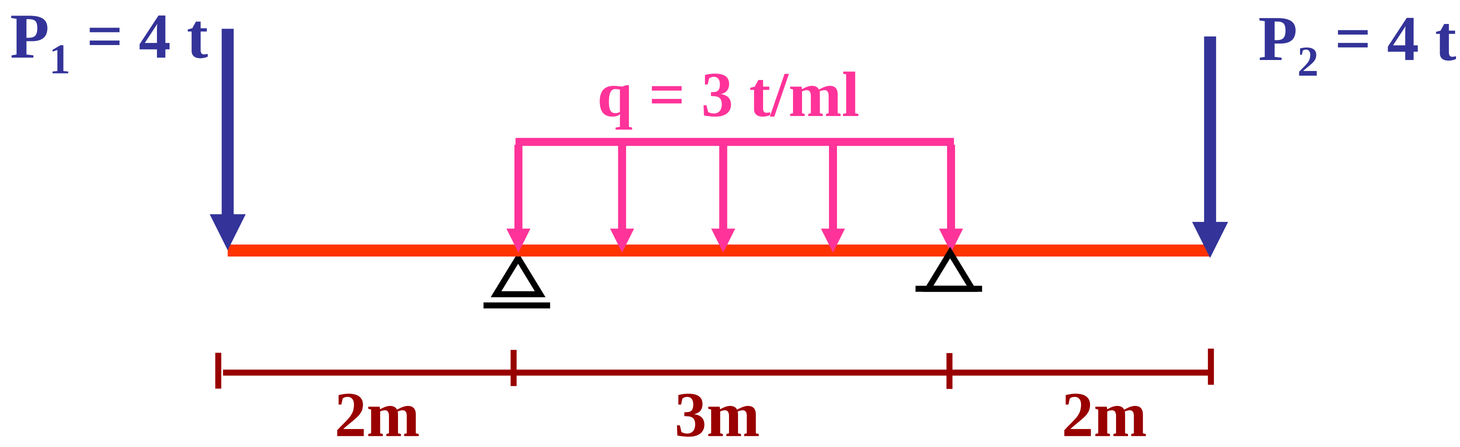
$$\sigma = \frac{M}{I} y \Rightarrow \sigma_{\max} = \frac{20 \times 10^6}{864 \times 10^4} \times 60$$

$$\sigma_{\max} = 138.89\,[N/mm^2]$$

$$\sigma_{\max} < \sigma_{adm}$$

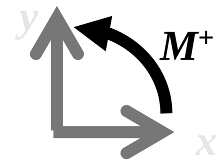
Exercice 3

Déterminer le diamètre de la section de la poutre ci-dessous, sachant que σ_{cr} = 3000 Kg/cm^2 et C_s = 2.



Solution Ex 3

1-Construction du diagramme équivalent des forces et l'établissement des equations d'équilibre, on trouve

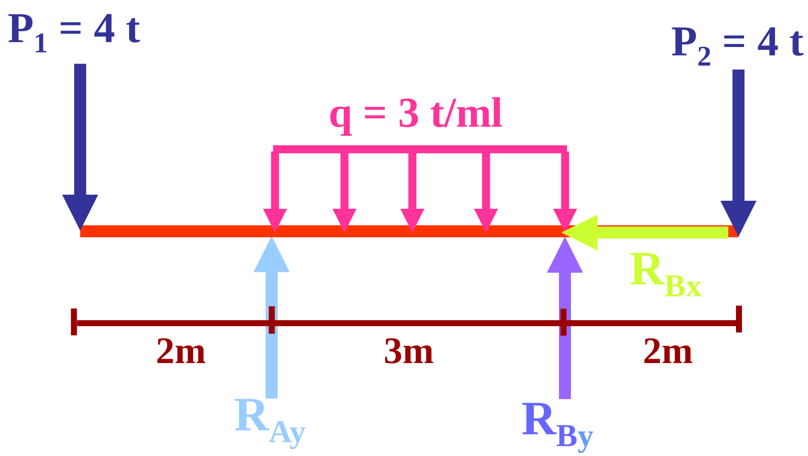


$$\Sigma F_{/x} = 0 \Rightarrow R_{B_x} = 0$$

$$\Sigma F_{/y} = 0 \Rightarrow R_{A_y} + R_{B_y} = 17$$

$$\Sigma M_{/A} = 0 \Rightarrow 3R_{B_y} - 25.5 = 0$$

$$\Rightarrow R_{B_y} = 8.5\,[t]$$



$$Donc: R_{B_y} = 8.5\,[t]; \quad R_{A_y} = 8.5\,[t]$$

Solution Ex 3

2-Calcul du moment fléchissant et de l'effort tranchant.

$$0 \le x < 2m$$

$$T(x) = -4$$

$$M(x) = -4x \begin{cases} M(0) = 0 \\ M(2) = -8\,[t.m] \end{cases}$$

$$2 \le x < 5m$$

$$T(x) = -4 + 8.5 - 3(x-2) \begin{cases} T(2) = 4.5[t] \\ T(5) = -4.5[t] \\ T(x) = 0 \Rightarrow x = 3.5m \end{cases}$$

$$M(x) = -4x + 8.5(x-2) - 3\frac{(x-2)^2}{2} \begin{cases} M(2) = -8\,[t.m] \\ M(5) = -8\,[t.m] \\ M(3.5) = -4.625\,[t.m] \end{cases}$$

Solution Ex 3

2-Calcul du moment fléchissant et de l'effort tranchant.

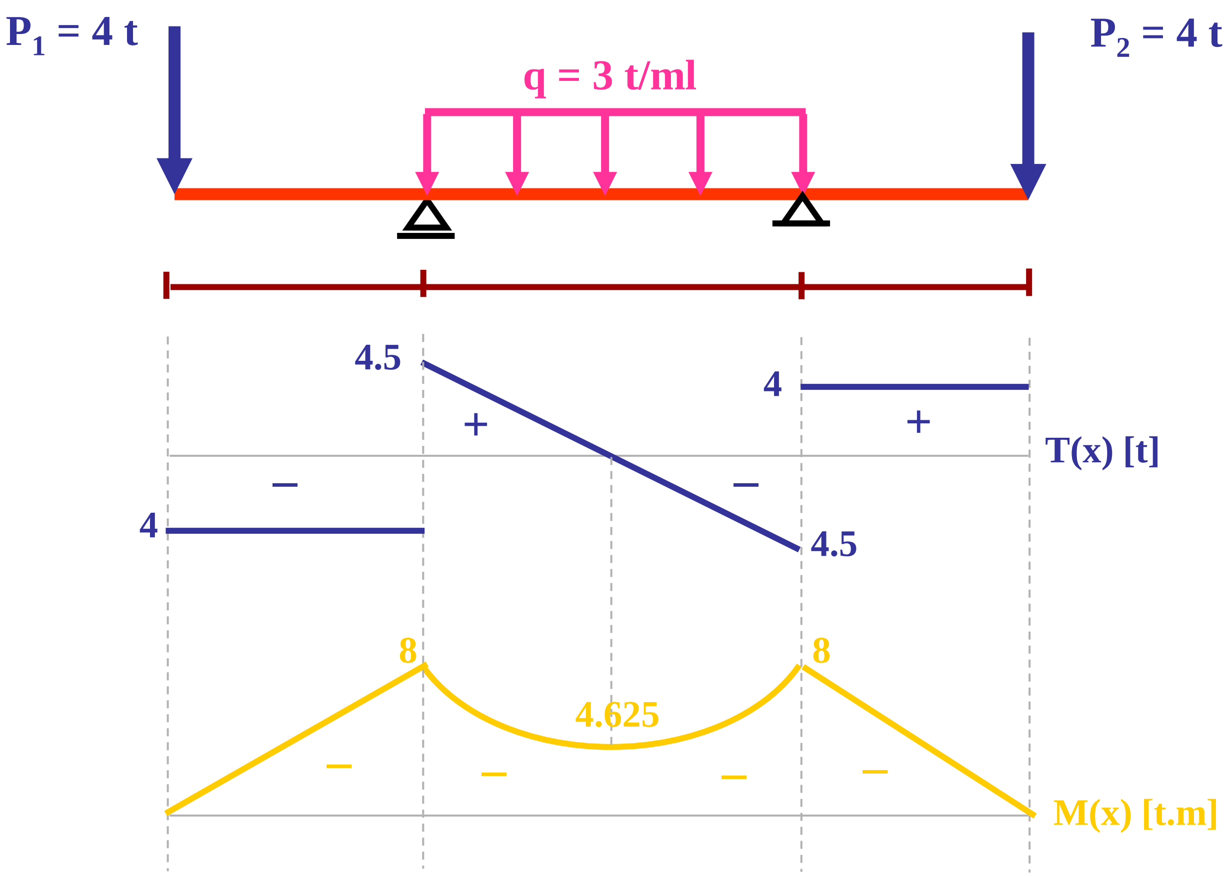
$$5 \le x < 7m$$

$$T(x) = -4 + 8.5 - 9 + 8.5 = 4$$

$$M(x) = -4x + 8.5(x-2) - 9(x-3.5) + 8.5(x-5) \begin{cases} M(5) = -8\,[t.m] \\ M(7) = 0 \end{cases}$$

Solution Ex 3

2-Le tracé du diagramme de T(x) et M(x).



Solution Ex 3

Le moment fléchissant maximal est 8 [t.m]. Sachant que :

$$I = \frac{\pi}{64} D^4; \quad y = \frac{D}{2}; \quad \sigma_{adm} = 1500\,[Kg / cm^2]$$

$$\sigma = \frac{M}{I} y \leq \sigma_{adm} \Rightarrow D \geq \sqrt[3]{\frac{32M}{\pi \sigma_{adm}}}$$

$$\Rightarrow D \geq \sqrt[3]{\frac{32 \times 8 \times 10^5}{\pi \times 1500}}$$

$$\Rightarrow D \geq 17.56\,[cm]$$


Merci