OFPPT

مكتب التكوين المهني وإنعاش الشغل

Office de la Formation Professionnelle
et de la Promotion du Travail

Direction Recherche et Ingénierie de la Formation

Examen de fin de formation , Session Juin 2008

Eléments de correction

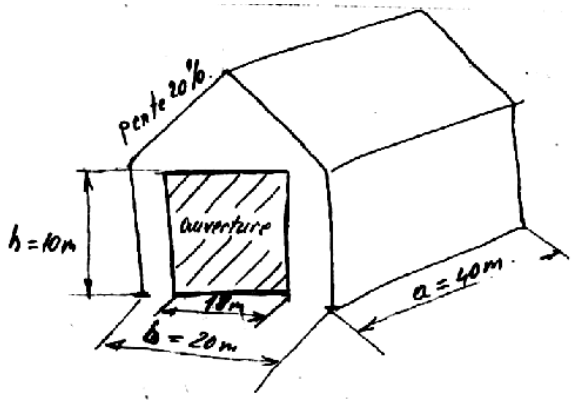
Filière : TSBECM **Epreuve : Théorique**

Niveau : Technicien spécialisé

Durée : H **Barème : /40**

Corrigé

① .



$\alpha = \arctg 0,2 = \underline{11,31°}$

$S_p = 20 \times 10 + \frac{20 \times 2}{2} = 220\ m^2$

$S_{ouverture} = 18 \times 10 = 180\ m^2$

$\mu = \frac{180}{220} \times 100 = \underline{82\%}$ totalement ouverte.

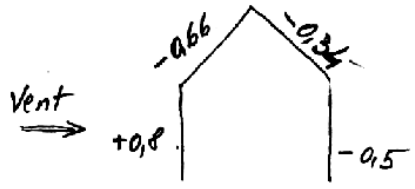
$\lambda_a = \frac{h}{a} = \frac{12}{40} = 0,3$.

$\boxed{\delta_a = 1}$ à partir de λ_b.

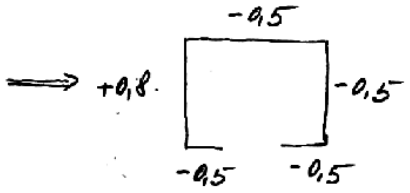
$\lambda_b = \frac{h}{b} = \frac{12}{20} = 0,6$.

$\boxed{\delta_b = 0,88}$

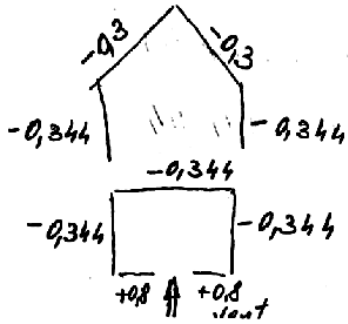
Ce Vent long panne gauche à droite



$ce = -(1,3 \cdot 1 - 0,8) = -0,5$.

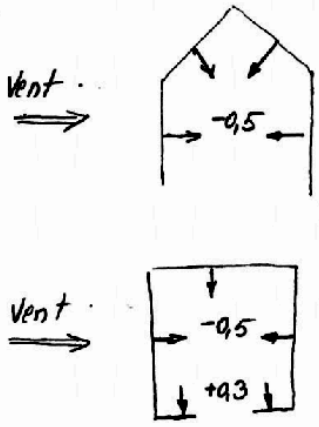


Ce Vent avant-arrière pignon



$ce = -(1,3\ 0,88 - 0,8) = 0,344$.

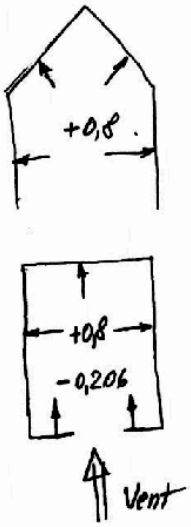
ci vent long panne gauche à droite



$c_i = -(1,3 \cdot 1 - 0,8) = -0,5$

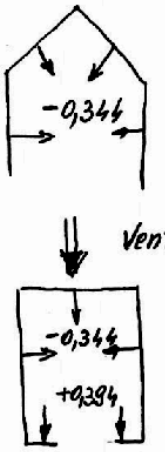
$c_i = +0,6(1,8 - 1,3 \cdot 1) = +0,3$

ci vent pignon avant - arrière



$c_i = -0,6\,(1,3 \cdot 0,88 - 0,8) = -0,20064 \approx -0,206$

ci vent pignon arrière - avant



$c_i = +0,6\,(1,8 - 1,3 \cdot 0,88) =$

$c_i = +0,3936 \approx +0,394.$

2 Nous avons une articulation.

lorsque.

- $h_p \leq 300\ mm$.

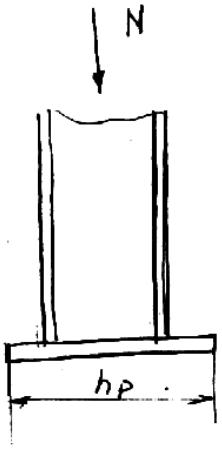
ou.

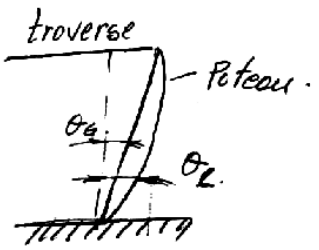
$300 < h_p < 600$.

et

$\theta_L \cdot h_p \leq 3m$.

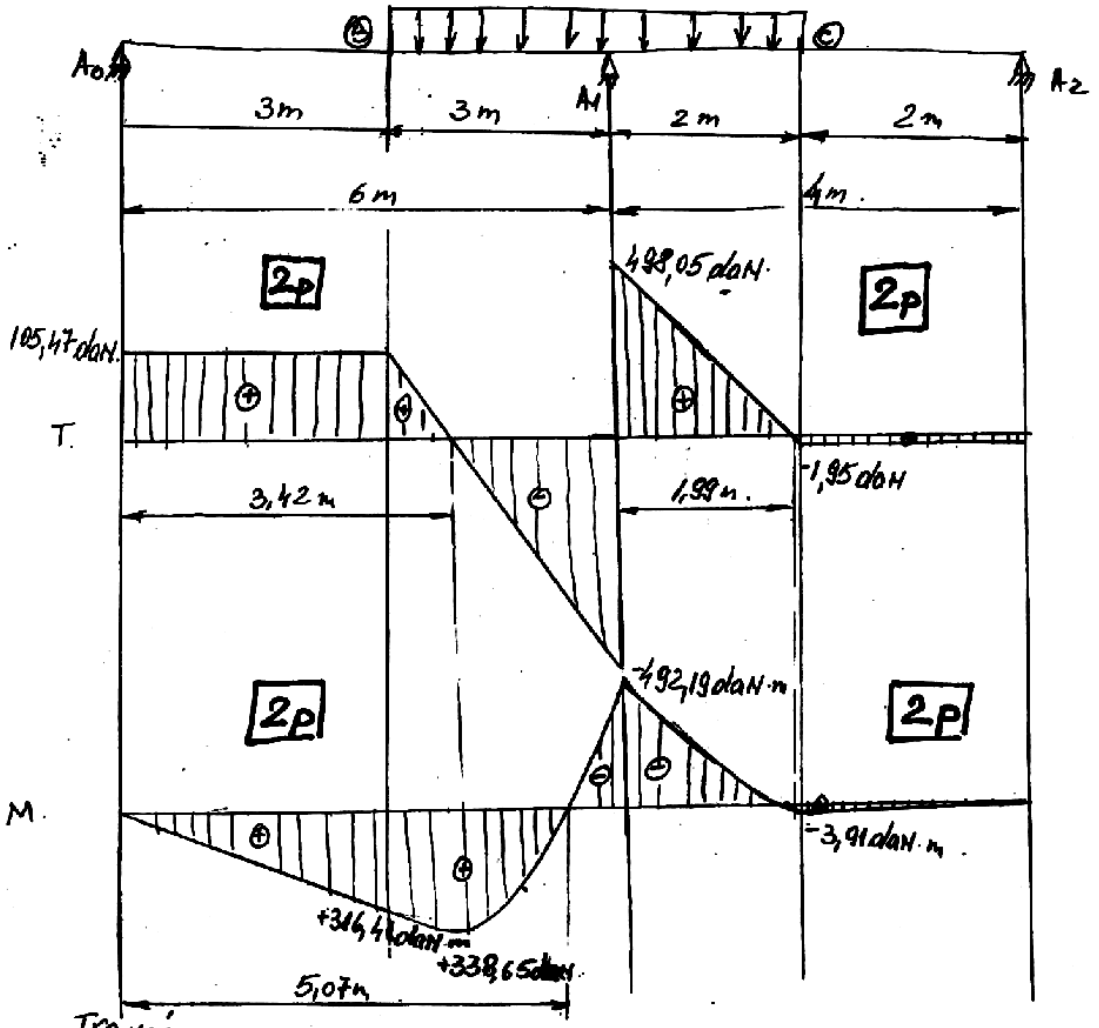
$N \cdot h_c \cdot \theta_L \leq 1500\ N \cdot m$.





La poutre sur 3 appuis
PRS $I_x = 300\ cm^4$

$q = 250\ daN/m$.



Travée $A_0 - A_1$

$$\theta'_{A_1} = + \frac{3 q l^3_{A_0-A_1}}{128 EI} = w'_{A_1}$$

Travée $A_1 - A_2$.

$$\theta''_{A_1} = - \frac{3 q l^3_{A_1-A_2}}{128 EI} = w''_{A_1}$$

$$M_{K-1} \cdot l_K + 2 M_K (l_K + l_{K+1}) + M_{K+1} \cdot l_{K+1} = 6 EI (w'' - w'_K)$$

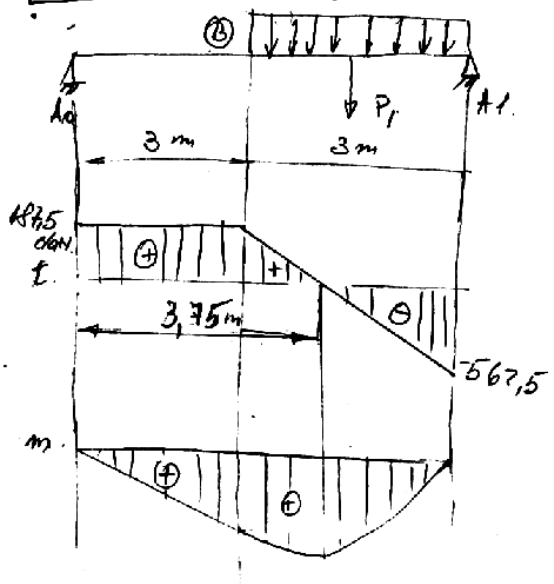
$$M_{A_0}^{0} \cdot 6 + 2 M_{A_1} (6+4) + M_{A_2}^{0} \cdot 4 = 6 EI \left(- \frac{3 \cdot 250 \cdot 6^3}{128 \cdot EI} + \frac{3 \cdot 250 \cdot 4^3}{128 \cdot EI} \right)$$

$$2 \cdot 10 \cdot M_{A_1} = - \frac{6 EI \cdot 210000}{128 EI}$$

$$M_{A_1} = \frac{6 \cdot 210000}{2 \cdot 10 \cdot 128} = -492,187\ daN.m.$$

$$\boxed{M_{A_1} = -492,187 = -492,19\ daN.m.} \qquad \boxed{1\ P}$$

A0 – A1 $\quad q = 250\ daN/m.$



$P = 3 \cdot 250 = 750\ daN.$

$\Sigma F_y = R_{A0} + R_{A1} - P_1 = 0.$

$\Sigma M_{A1} = R_{A0} \cdot 6 - P_1 \cdot 1,5 = 0.$

$R_{A0} = \frac{P_1 \cdot 1,5}{6} = \frac{750 \cdot 1,5}{6} =$

$R_{A0} = 187,5\ daN.$

$R_{A1} = 562,5\ daN.$

$t_{A0-B} = R_{A0} = const = 187,5\ daN.$ $\quad x \in (0-3)$

$t_{B-A1} = R_{A0} - q \cdot x = 187,5 - 250 \cdot x$ $\quad x \in (3-6)$

$t = 0 \quad x = \frac{187,5}{250} = 0,75\ m.$

$m = 0.$ $\quad x = 0.$

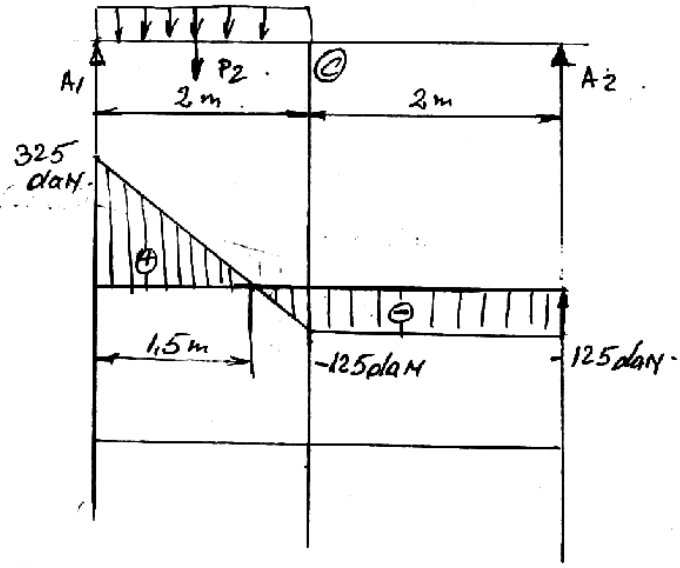
$m_{A0-B} = R_A \cdot x = 187,5 \cdot x \Rightarrow$ $\quad x \in (0\,3)$

$m_{B-A1} = R_A \cdot x - \frac{q(x-3)^2}{2}$ $\quad x \in (3-6)$

$m_{A1} = 0.$

$m_{B} = 187,5 \cdot 3 = 562,5\ daN \cdot m.$ $\quad x = 3$

A1 – A2 $\quad q = 250\ daN/m.$



$P_2 = 2 \cdot 250 = 500\ daN.$

$\Sigma F_y = R_{A1} + R_{A2} - P_2 = 0.$

$\Sigma M_{A2} = R_{A1} \cdot 4 - P_2 \cdot 5 = 0.$

$R_{A1} = \frac{P_2 \cdot 5}{4} = \frac{500 \cdot 3}{4} = 375\ daN.$

$R_{A2} = +125\ daN$

$t_{A1} = 0.$

$t_{A1-C} = R_{A1} - q \cdot x = 375 - 250x$ $\quad x \in (0\,2)$

$t_{x=2} = 375 - 250 \cdot 2 = -125\ daN.$

$t_{C-A2} = const = 125\ daN$ $\quad x \in (2-4)$

$t = 0 \quad x = \frac{375}{250} = 1,5$

$m_{A0} = 0.$

$m_{A1-C} = R_{A1} \cdot x - \frac{qx^2}{2} = 375 \cdot x - \frac{250 \cdot x^2}{2}$ $\quad x \in (0-2)$

$M_{C-A2} = R_{A1} \cdot x - P_2 (x-1)$

$x \in (2-4)$

$A_0 - A_1$

$T = t + \frac{M_K - M_{K-1}}{l_K}$ (0)

$T_{\substack{A_0-B \\ x\in(0\ 3)}} = R_{A_0} - \frac{492,19}{6} = 187,5 + 82,03 = 105,47$ daN . constant .

$T_{\substack{B \\ x=3}} = 105,47$ daN . m .

$T_{\substack{B-A_1 \\ x\in(3-6)}} = 105,47 - 250\cdot(x-3) \Rightarrow$ **$T=0 \quad x = \frac{105,47 + 2503}{250} = 3,42$ m .**

$T_{A_1} = 105,47 - 250 \cdot 3 = -644,53$ daN

$A_1 - A_2$

$T = t + \frac{M_K - M_{K-1}}{l_K}$ (0)

$T_{A_1} = R_{A_1} + \frac{492,19}{4} = 498,05$ daN

$T_{\substack{A_1-C \\ x\in(0\ 2)}} = R_{A_1} - 2x + \frac{M_{A_1}}{4} = 375 - 250 \cdot x + \frac{492,19}{4}$

$T_{\substack{C \\ x=2}} = 375 - 250 \cdot 2 + 123,05 = -1,95$ daN

$T_{C-A_2} = cst = -1,95$ $\quad T=0 \quad x = \frac{375 + 123,05}{250} = 1,99$ m .

$R_K = T_K' - T_K'$

$R_{A0} = 105,47$ daN $\quad R_{A_1} = 498,05 + 644,53 = 1142,58$ daN .

2p **$R_{A_1} = 1142,58$ daN**

$R_{A2} = +1,95$ daN

Moments fléchissants

A0 - A1

$$M = m + \frac{M_K - M_{K-1}}{l_K} \cdot x + M_{K-1}$$

$$M_{\substack{A0-C \\ x \in (0\ 3)}} = 187,5 \cdot x - 82,03 \cdot x + 0$$

$$M_{\substack{C \\ x=3}} = 105,47 \cdot 3 = \underline{\underline{316,41 \text{ daN.m}}}$$

$M = 0 \quad x = 5,07$

$$M_{\substack{C-A1 \\ x \in (3 \div 6)}} = R_{A0} \cdot x - \frac{2(x-3)^2}{2}$$

$$M_{\substack{max \\ x=3,42}} = 105,47 \cdot 3,42 - \frac{250(3,42-3)^2}{2} = \underline{\underline{338,65 \text{ daN.m}}}$$

2 P

A1 - A2

$$M_{A1-C} = 375 \cdot x - \frac{250 \cdot x^2}{2} + \frac{492,19}{4} \cdot x - 492,19$$

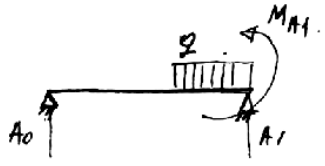
$$M_{\substack{max \\ x=1,99}} = 375 \cdot 1,99 - \frac{250 \cdot 1,99^2}{2} + \frac{492,19}{4} 1,99 - 492,19 = \underline{+3,91 \text{ daN.m}}$$

2 P

$M = 0 \quad x = 1,82 \text{ m}$

Flèches

A0 - A1



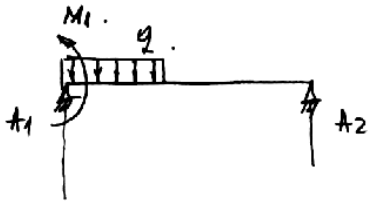
$$f_q = -\frac{5 \cdot 25\,600^4}{768 \cdot 2,1 \cdot 10^6 \cdot 300} = -\underline{3,348 \text{ cm}}$$

$$f_{M1} = \frac{492,19 \cdot 100 \cdot 600^2}{16 \cdot 2,1 \cdot 10^6 \cdot 300} = +\underline{1,7578 \text{ cm}}$$

$f = -1,59 \text{ cm}$ $\quad 1/300 = \frac{600}{300} = 2 \text{cm}$

OK

1 P



$$f_q = \frac{-5 \cdot 2,5 \cdot 400^4}{768 \cdot 2,1 \cdot 10^6 \cdot 300} = -0,66 \text{ cm}$$

$$f_{M1} = \frac{492,19 \cdot 100 \cdot 400^2}{16 \cdot 2,1 \cdot 10^6 \cdot 300} = +0,781 \text{ cm}$$

$f = +0,121 \text{ cm}$ $\quad 1/300 = \frac{400}{300} = 1,33$

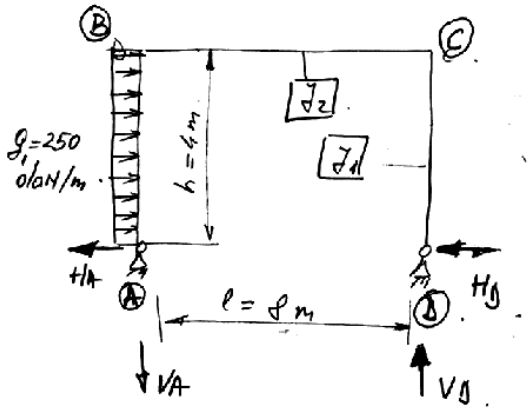
1 P

$K = \frac{J_2}{J_1} \cdot \frac{h}{\ell}$

$J_2 = J_1$

$k = \frac{h}{\ell} = \frac{4}{8} = 0,5$

$\boxed{K = 0,5}$



$N = 2K + 3 = 2 \cdot 0,5 + 3 = 4.$

$\boxed{N = 4}$

$\boxed{M_B} = \frac{q h^2}{4}\left[-\frac{K}{2N} + 1\right] = \frac{250 \cdot 4^2}{4}\left[-\frac{0,5}{2 \cdot 4} + 1\right] = +837,5$ daN.m

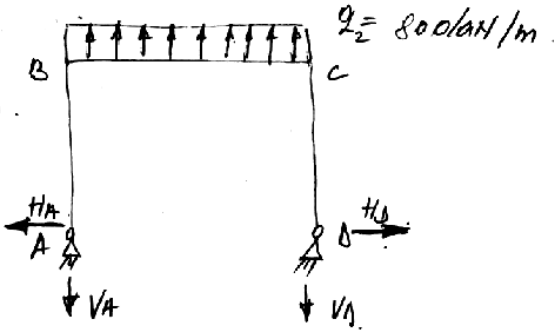
$\boxed{M_C} = \frac{q h^2}{4}\left[-\frac{K}{2N} - 1\right] = \frac{250 \cdot 4^2}{4}\left[-\frac{0,5}{2 \cdot 4} - 1\right] = -1062,5$ daNm

$V_D = -V_A = \frac{q h^2}{2\ell} = \frac{250 \cdot 4^2}{2 \cdot 8} = +250$ daN.

$\boxed{V_A = -250 \text{ daN}}$ $\boxed{V_D = +250 \text{ daN}}$

$H_D = -\frac{M_C}{h} = -\frac{-1062,5}{4} = +265,625$ daN.

$H_A = -(2h - H_D) = -(250 \cdot 4 - 265,625) = -734,375$ daN



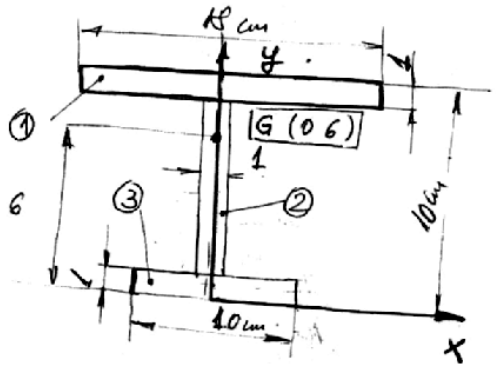
$M_B = M_C = \frac{q \ell^2}{4N} = \frac{80 \cdot 8^2}{4 \cdot 4} = +320$ daN.m

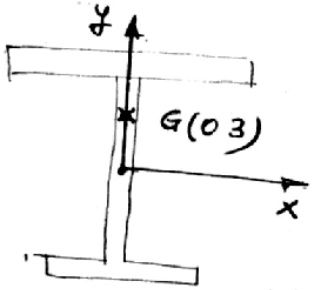
$V_A = V_D = -\frac{q \ell}{2} = -\frac{80 \cdot 8}{2} = -320$ daN

$H_A = -H_D = \frac{M_B}{h} = \frac{320}{4} = -80$ daN

$\boxed{H_A = -80 \text{ daN}}$
$\boxed{H_D = +80 \text{ daN}}$

4





Pièce	S	x	y	μ_x	μ_y
1	18×1=18	0	+9,5	9,5·18=171	0
2	8×1=8	0	+5	5·8=40	0
3	10×1=10	0	+0,5	0,5·10=5	0
tot	36			216	0

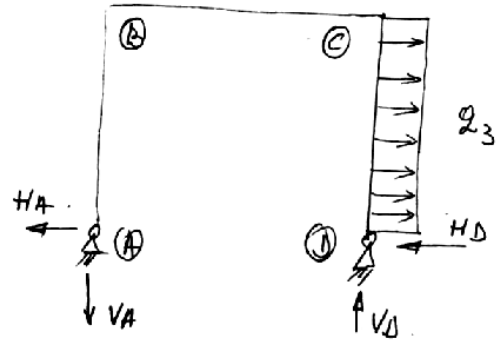
$$x_G = \frac{\mu_y}{S} = 0$$

$$y_G = \frac{\mu_x}{S} = \frac{216}{36} = 6\ cm$$

Pièce	S	Δx	Δy	I_x	I_y
1	18	0	3,5	$\frac{18.1^3}{12} + 3,5^2 18 = 2,22$	$\frac{18^3.1}{12} = 486$
2	8	0	1	$\frac{8^3.1}{12} + 1^2 8 = 50,67$	$\frac{1^3 8}{12} = 0,66$
3	10	0	-5,5	$\frac{10.1^3}{12} + (-5,5)^2 10 = 303,33$	$\frac{10^3.1}{12} = 83,33$
tot	36	0		$I_x = 576\ cm^4$	$I_y = 570\ cm^4$

$I_x = 576\ cm^4$

$I_y = 570\ cm^4$



$$M_B = -\frac{qh^2}{4}\left(-\frac{K}{2N}-1\right) = -\frac{100\cdot 4^2}{4}\left[-\frac{0,5}{2\cdot 4}-1\right] = +425 \text{ daN.m}$$

$$M_C = -\frac{qh^2}{4}\left(-\frac{K}{2N}+1\right) = -\frac{100\cdot 4^2}{4}\left[-\frac{0,5}{2\cdot 4}+1\right] = -375 \text{ daN m}$$

$$V_A = -V_D = \frac{qh^2}{2\ell} = -\frac{100\,4^2}{2\cdot 8} = -100 \text{ daN}$$

$V_A = -100$ daN.
$V_D = +100$ daN.

$$H_A = -\frac{M_B}{h} = \frac{-425}{4} = -106,25 \text{ daN}$$

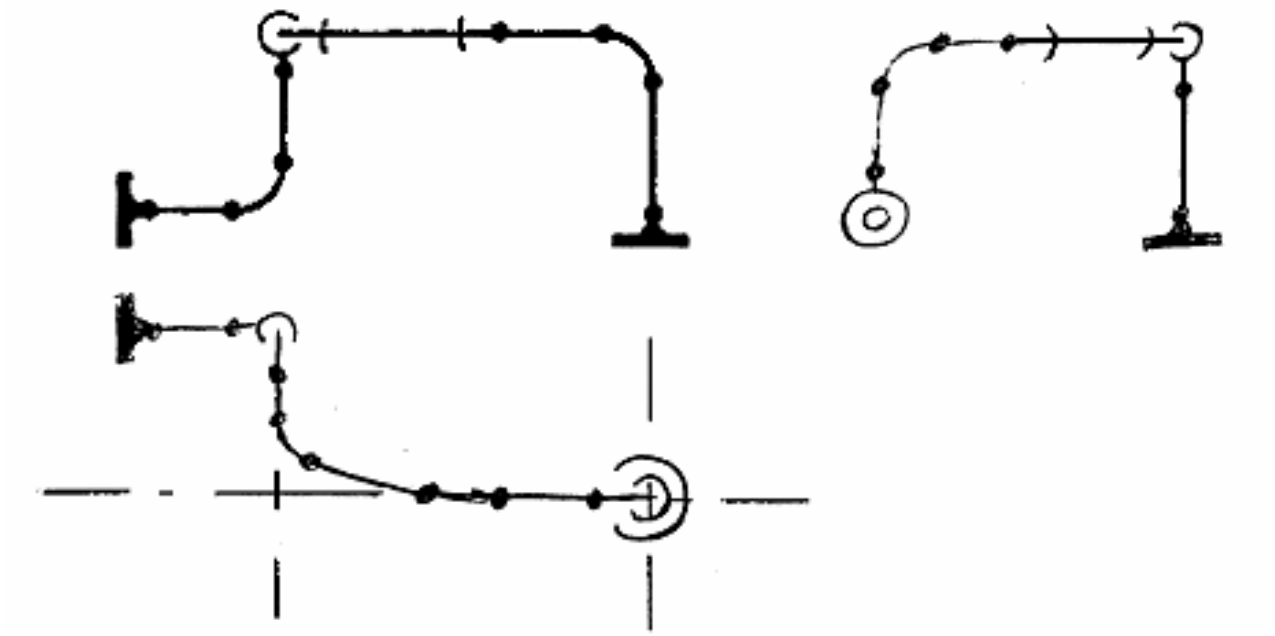
$$H_D = -(q\cdot h - H_A) = -(100\cdot 4 - 106,25) = -293,75 \text{ daN}$$

Cas	V_A	V_D	H_A	H_D	M_B	M_C
1	-250	+250	-134,375	-265,625	+937,5	-1062,5
2	-320	-320	-80	+80	+320	+320
3	-100	+100	-106,25	-293,75	+425	-375
tot	-670	+30	-920,625	-469,375	1682,5	-1117,5

TUYAUTERIE : **/6pts**

Exercice 1 : /3pts

Sur la même feuille et à l'aide des instruments de dessin , dessiner la vue de dessus et la vue de gauche de la ligne de tuyauterie ci-dessous :



Exercice 2 : /3pts

Faire la perspective isométrique de la ligne de tuyauterie suivante :