

BREVET DE TECHNICIEN SUPÉRIEUR

Constructions Métalliques

SESSION 2015

E4. ANALYSE ET CALCUL DES STRUCTURES

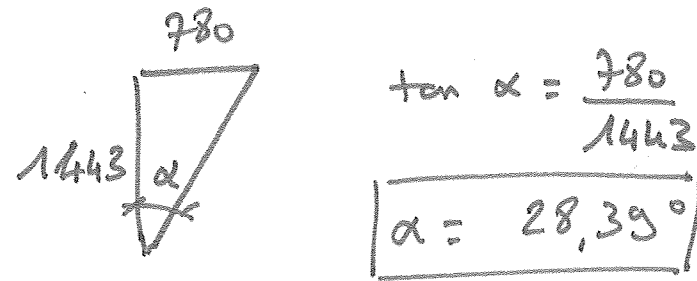
U4.1 Mécanique

Éléments indicatifs de corrigé

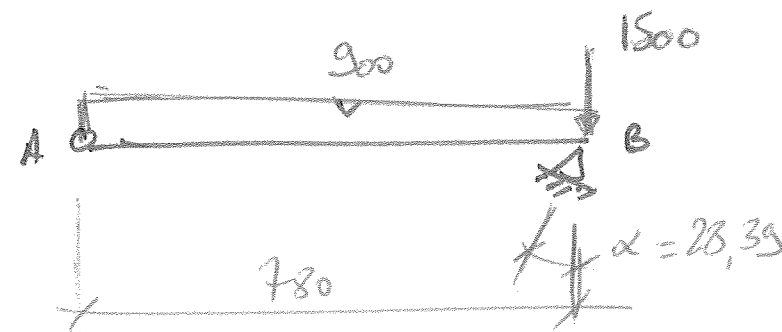
CODE ÉPREUVE : CMMECA	EXAMEN : BREVET DE TECHNICIEN SUPÉRIEUR		SPÉCIALITÉ : CONSTRUCTIONS METALLIQUES
SESSION 2015	SUJET	Épreuve U4.1 Mécanique	Calculatrice autorisée : oui
Durée : 4h	Coefficient : 3	CORRECTION	Page : 1/6

1. Etude du palier

1.1 Buton BC bi-articulé
 Force de direction connue : (BC)
 (Solide soumis à 2 forces)



1.2



$$B_x = B_y \cdot \tan \alpha$$

Application du PFS

$$\sum M_A = 0 \rightarrow B_y \times 0,78 - 900 \times \frac{0,78^2}{2} - 1500 \times 0,78 = 0$$

$$B_y = \frac{1443,8}{0,78} = 1851 \uparrow$$

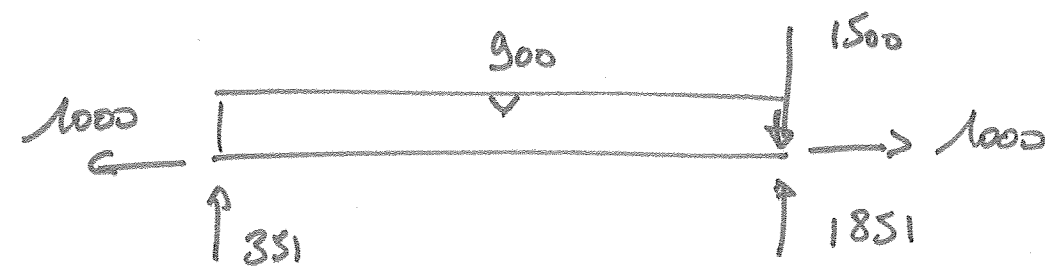
$$B_x = B_y \cdot \tan \alpha = 1851 \cdot \tan 28,39 = 999,9 \rightarrow$$

$$\sum F_x = 0 \rightarrow A_x + 999,9 = 0$$

$$A_x = -999,9 \leftarrow$$

$$\sum F_y = 0 \rightarrow A_y - 900 \times 0,78 - 1500 + 1851 = 0$$

$$A_y = 351 \uparrow$$



1.3 cf. DRI

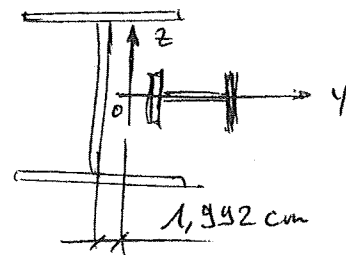
2. Étude de la section

2.1) Recherche du CG

$$y = \frac{\sum S_i \cdot y_i}{\sum S_i} = \frac{76,84 \times 0 + 21,24 \times 4,2}{76,84 + 21,24} = \underline{1,992 \text{ cm}}$$

$$z = \underline{0 \text{ cm}} \text{ (situé sur l'axe de symétrie)}$$

CG (1,992 ; 0)

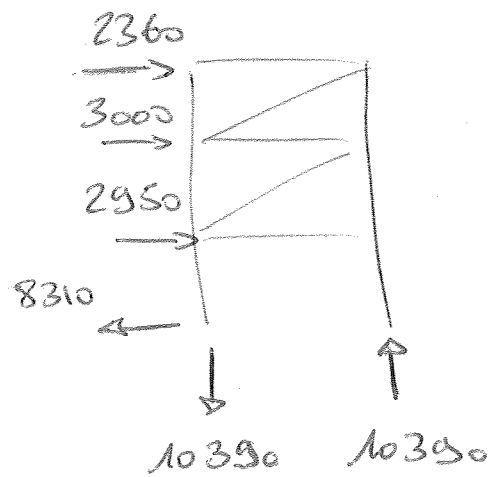


2.2) $I_{Gy} = 7763 + 133,8 = \underline{7896,8 \text{ cm}^4}$

$$I_{Gz} = \left[2769 + 76,84 \times 1,992^2 \right] + \left[349,2 + 21,24 \times 7,208^2 \right]$$
$$= \underline{4526,63 \text{ cm}^4}$$

3. Etude de la poutre

3.1)



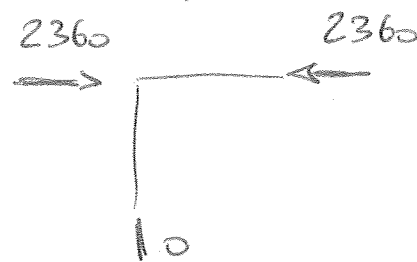
$$\sum M_G = 0 \rightarrow M_y = 10390 \text{ (}\uparrow\text{)}$$

$$\sum F_y = 0 \rightarrow G_y = -10390 \text{ (}\downarrow\text{)}$$

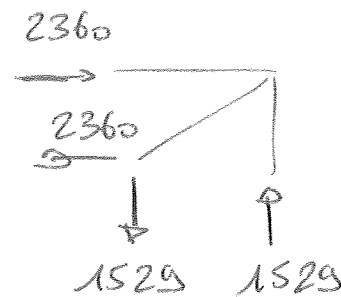
$$\sum F_x = 0 \rightarrow G_x = -8310 \text{ (}\leftarrow\text{)}$$

3.2)

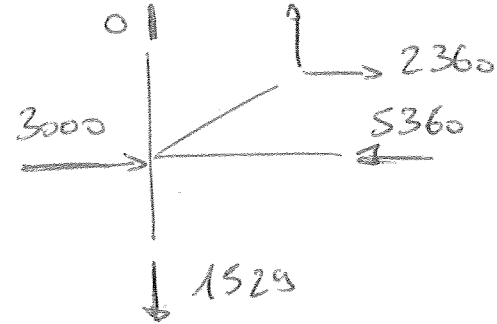
noeud A



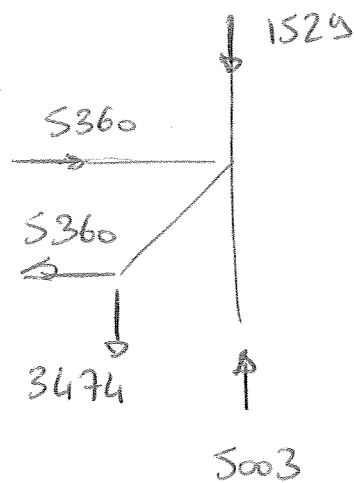
noeud B



noeud C

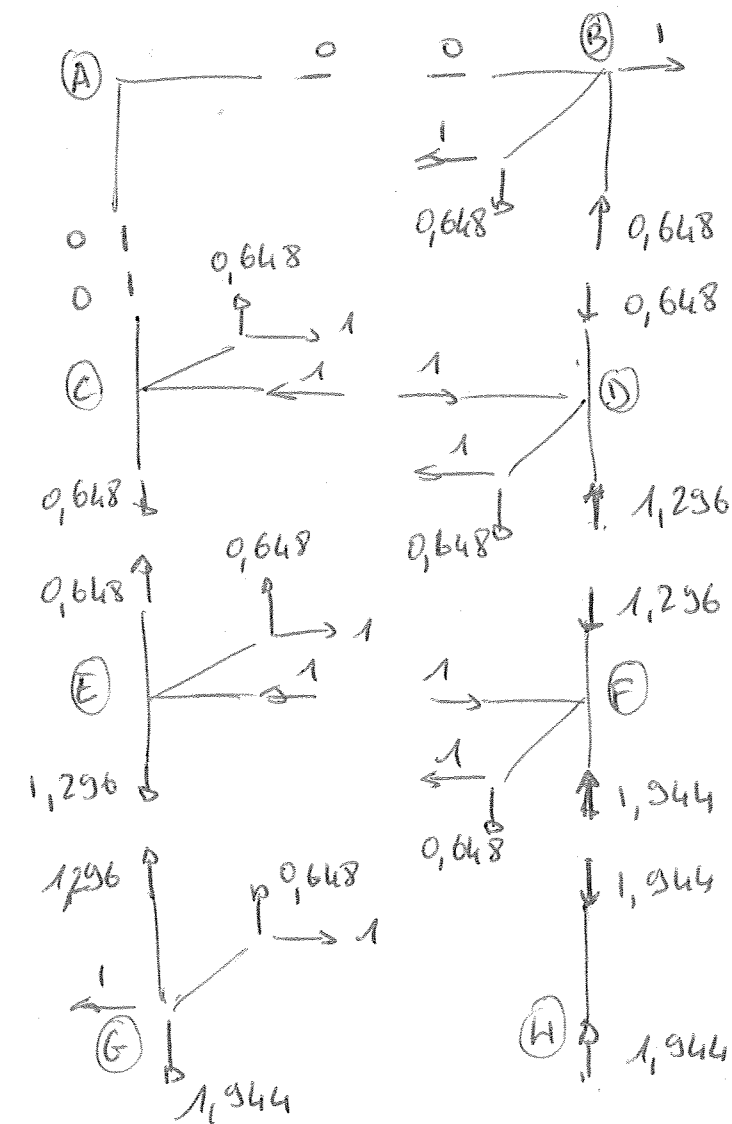
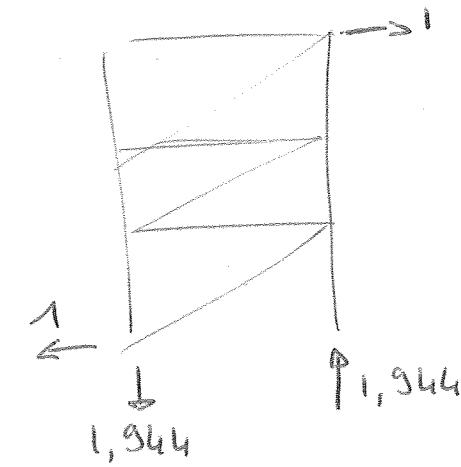


noeud D



3.3)

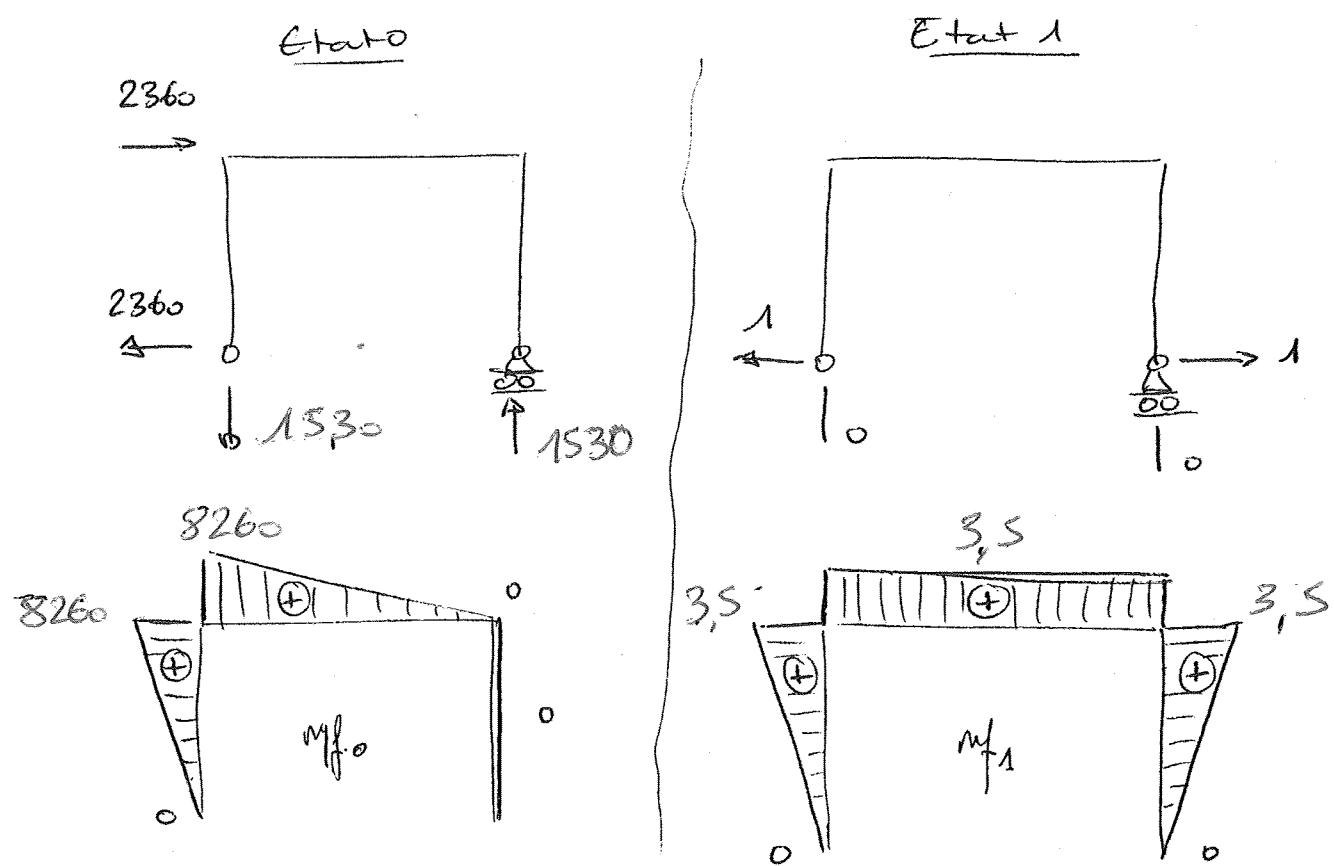
Recherche SB



4. Etude solution alternative.

4.1) Structure hyperstatique de d° 1

4.2) $\delta_{11} \cdot X_1 = -\delta_{10}$



$$\Delta \begin{cases} I_{CA} = I_{BD} = 2769 \text{ cm}^4 \\ I_{AB} = 7763 \text{ cm}^4 \end{cases}$$

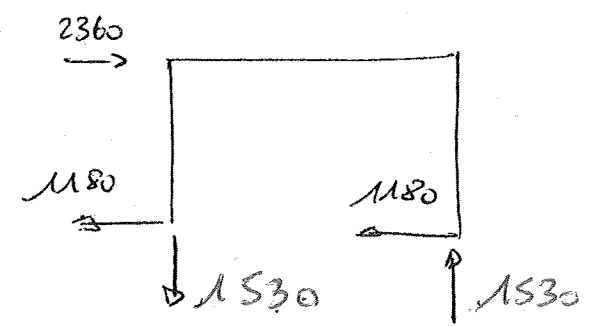
$$\delta_{11} = 2 \times \left[\frac{350}{E \cdot I_{CA}} \times \frac{1}{3} \times 350^2 \right] + \left[\frac{540}{E I_{AB}} \times 350^2 \right] = \frac{18844}{E}$$

$$\delta_{10} = \left[\frac{350}{E I_{CA}} \times \frac{1}{3} \times 350 \times 826000 \right] + \left[\frac{540}{E I_{AB}} \times \frac{1}{2} \times 350 \times 826000 \right]$$

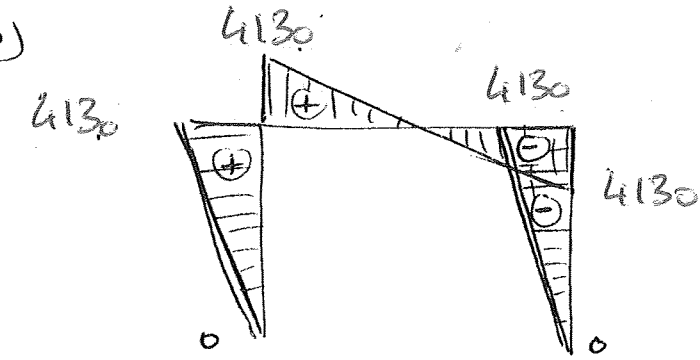
$$= \frac{22235696}{E}$$

$$\rightarrow X_1 = \frac{-\delta_{10}}{\delta_{11}} = -1180 \rightarrow \underline{Dx = 1180 \text{ daN} (\leftarrow)}$$

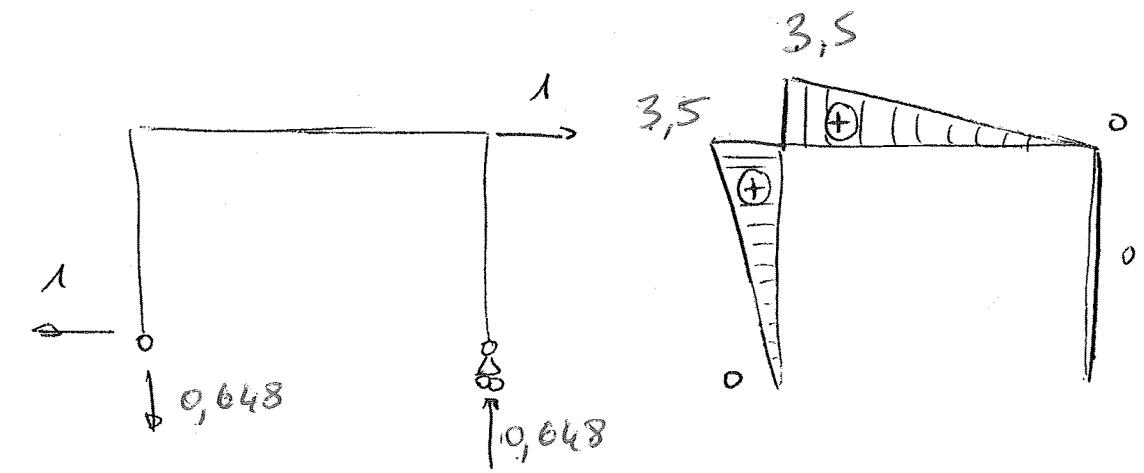
Bilan



4.3)



4.4)



$$\delta_{Balt} = \frac{3,5}{2,1 \times 2769} \times \frac{1}{3} \times 4130 \times 3,5 + \frac{5,4}{2,1 \times 7763} \times \frac{1}{6}$$

$$\times 4130 \times 3,5$$

$$\underline{\delta_{Balt} = 3,638 \text{ cm} (-)}$$

Document réponse DR1

Échelles :

Forces : 1 cm → 500 daN

Moments : 1 cm → 50 daN.m

Diagramme de N

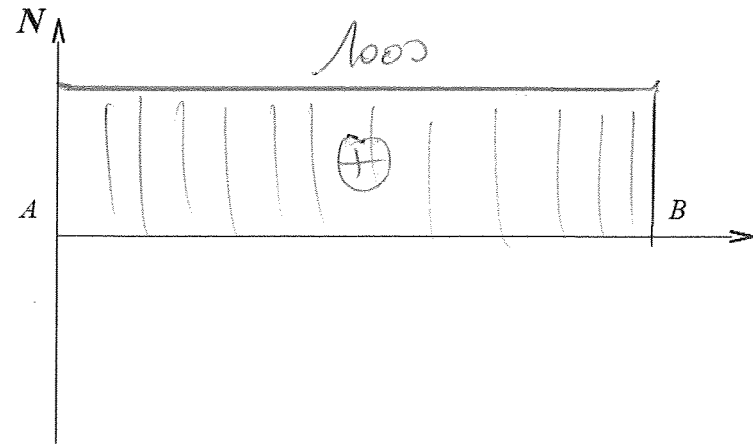


Diagramme de Vz

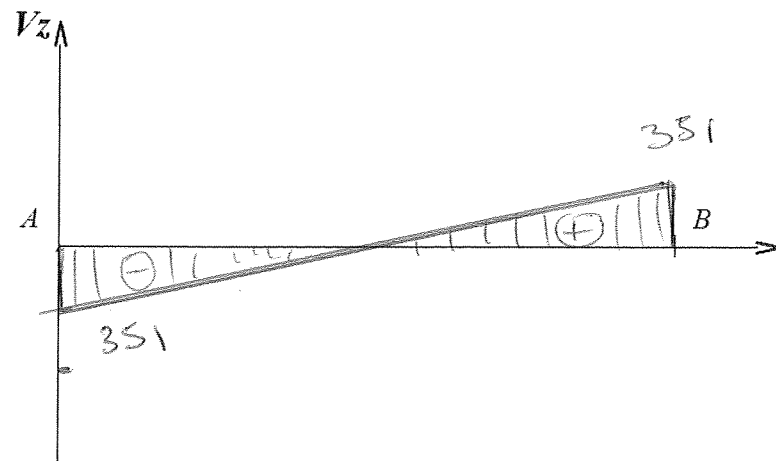
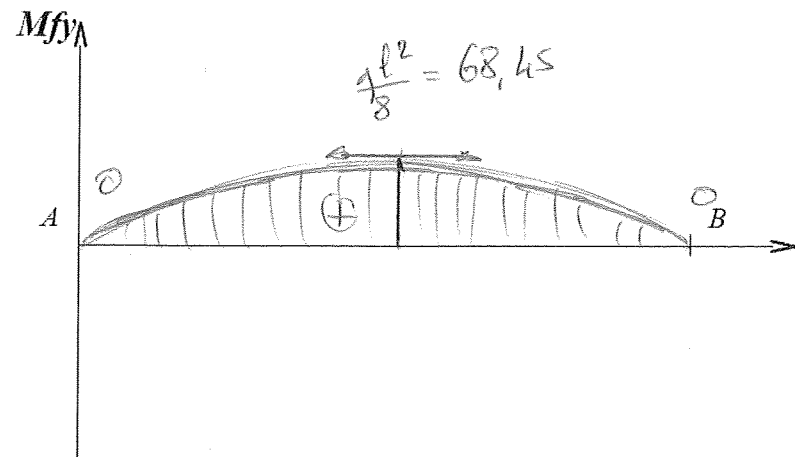


Diagramme de Mfy



Document réponse DR2

Efforts dans les barres en daN :

- EF : 8310 (compression)
- EG : 5003 (traction)
- FG : 9902 (traction)
- FH : 10390 (compression)

Tableau de valeurs

Barre	N Effort sous charge réelles	n Effort sous charge unitaire	L Longueur de la barre	A Aire de la section	$\frac{Nn}{A} \times L$
Précisez les unités	daN	daN	cm	cm ²	
AB	-2360	0	540	1643	0
AC	0	0	350	76,84	0
BC	2812	1,192	643,5	9,4	225462
BD	-1529	-0,648	350	76,84	4513
CD	-5360	-1	540	45,95	62990
CE	1529	0,648	350	76,84	4513
DE	6387	1,192	643,5	9,4	521187
DF	-5003	-1,296	350	76,84	29534
EF	-8310	-1	540	45,95	97658
EG	5003	1,296	350	76,84	29534
FG	9902	1,192	643,5	9,4	808016
FH	10390	-1,944	350	76,84	92000

$$\delta_B = \frac{1879407}{E} = 0,895 \text{ cm}$$