

# ANALYSE LIMITE

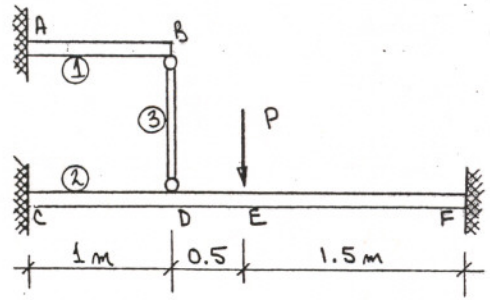
Pour le montage illustré, on donne les propriétés suivantes :

Poutre AB:  $Z_x = 75 \times 10^3 \text{ mm}^3$

Poutre CF:  $Z_x = 150 \times 10^3 \text{ mm}^3$

Tige BD :  $A = 100 \text{ mm}^2$

Le montage est fait d'acier doux dont  $S_y = 250 \text{ MPa}$



On demande de :

a) Dessiner tous les mécanismes possibles d'effondrement plastique de cette structure.

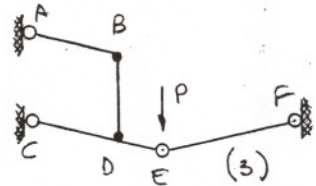
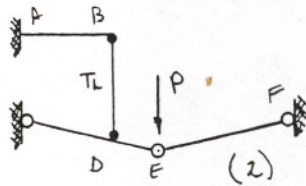
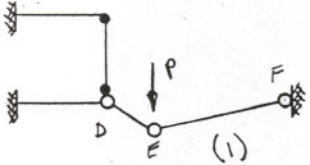
b) De calculer la charge limite pour un seul de ces mécanismes.

$$(M_L)_{AB} = 75 \times 10^3 \times 250 \text{ MPa} = 18.75 \text{ kJ}\cdot\text{m} = M_{AB}$$

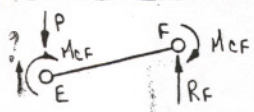
$$(M_L)_{CF} = 150 \times 10^3 \times 250 \text{ MPa} = 37.5 \text{ kJ}\cdot\text{m} = M_{CF}$$

$$(T_L)_{BD} = 100 \times 250 \text{ MPa} = 25 \text{ kN} = T_{BD}$$

3 MÉCANISMES D'EFFONDREMENT.



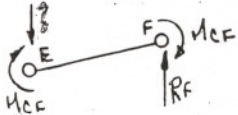
SOLUTION DE (1)



$$\sum M/E = 0 \rightarrow 1.5 R_F = 2 M_{CF}$$

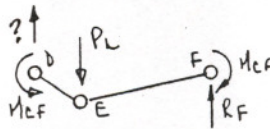
$$R_F = 4 M_{CF} / 3$$

Solution de (2)



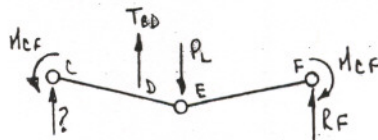
$$\sum M/E = 0 \rightarrow 1.5 R_F = 2 M_{CF}$$

$$R_F = 4 M_{CF} / 3$$



$$\sum M/D = 0 \rightarrow 0.5 P_L = 2 R_F$$

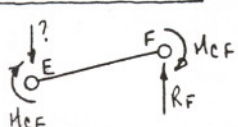
$$P_L = 4 R_F = \frac{16}{3} M_{CF} = 200 \text{ kN}$$



$$\sum M/C = 0 \rightarrow 1.5 P_L = 3 R_F + T_{BD}$$

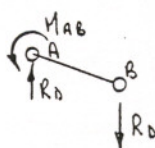
$$P_L = (4 M_{CF} + T_{BD}) / 1.5 = 117 \text{ kN}$$

SOLUTION DE (3)

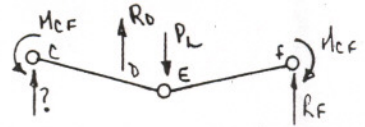


$$\sum M/E = 0 \rightarrow 1.5 R_F = 2 M_{CF}$$

$$R_F = 4 M_{CF} / 3$$



$$\sum M/A = 0 \rightarrow R_D = M_{AB}$$

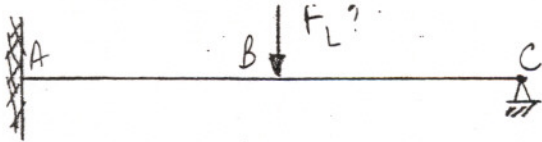


$$\sum M/C = 0 \rightarrow 1.5 P_L = 3 R_F + R_D$$

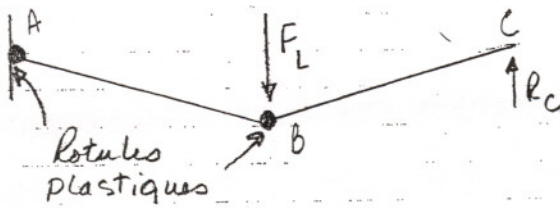
$$P_L = (4 M_{CF} + M_{AB}) / 1.5$$

$$P_L = 112.5$$

Exemple 12.3



1 Mécanisme d'effondrement seulement :



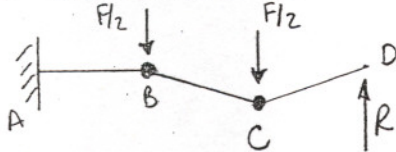
$$\sum M_A^T = 0 = M_L - F_L \cdot \frac{L}{2} + R_C L \quad (a)$$

$$\sum M_B^T = 0 = -M_L + R_C \cdot \frac{L}{2} = 0$$

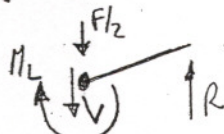
$$M_L = R_C \cdot L/2 \quad (b)$$

EXEMPLE 12.4 P. 261

1. Mécanisme 1



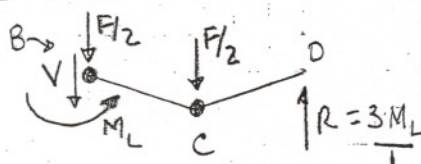
- sur CD :



$$\sum M_C^T = 0 = -M_L + R \cdot \frac{L}{3}$$

$$M_L = \frac{RL}{3} \quad (a)$$

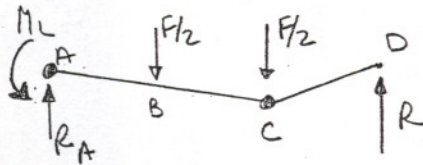
- sur BCD



$$\sum M_B^T = 0 = M_L - \frac{F \cdot L}{2} + R \cdot \frac{2L}{3} \quad (b)$$

(a) et (b)  $\Rightarrow F = 18 M_L / L$

2. Mécanisme 2

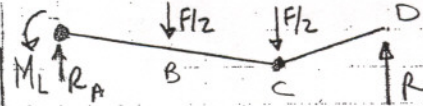


- sur CD :

identique au mécanisme 1 :

$$M_L = \frac{RL}{3} \quad (d)$$

- sur ABCD :



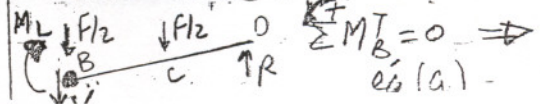
$$\sum M_A^T = M_L - \frac{F \cdot L}{2} - \frac{F \cdot 2L}{3} + R L = 0 \quad (e)$$

(d) et (e)  $\Rightarrow F = 8 M_L / L$

Mécanisme 3 :

- sur ABCD ; même équation que pour mécanisme 2 :  
ég (e) identique à e) (e)

- sur BCD :



$$\sum M_B^T = 0 \Rightarrow \text{ég (a)}$$