

## **Cisaillement**

### Exercice 1

Contrainte de cisaillement  $\tau$

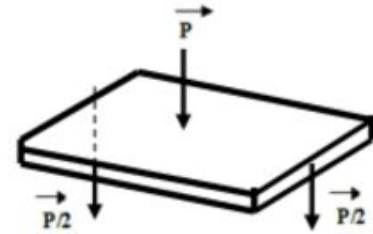
$$\tau = \frac{F}{A}$$

$A = 6 \times$  surface d'un boulon

$$A_{\text{boulons}} = 6 \frac{\pi d^2}{4} = 6 \frac{\pi (12 \cdot 10^{-2})^2}{4} = 0,00067824 \text{ m}^2$$

Le cisaillement (charge  $P$ ) est supporté par les six surfaces des boulons (on peut aussi utiliser  $F=P/2$  est diviser sur 3 surfaces des boulons)

$$\tau = \frac{P}{A_{\text{boulons}}} = \frac{36 \cdot 10^3}{0,00067824} = 53,07 \text{ Mpa}$$



### Exercice 2

Pour calculer les contraintes selon chaque axe, il faut calculer les composantes des forces selon x,y,z

$$F_z = P \cos 60^\circ = 6,8 \cdot 10^3 \cos 60^\circ = 3400 \text{ N}$$

$$F_x = P \cos 30^\circ \cos 25^\circ = 6,8 \cdot 10^3 \cos 30^\circ \cos 25^\circ = 5337,22 \text{ N}$$

$$F_y = -P \cos 30^\circ \sin 25^\circ = -6,8 \cdot 10^3 \cos 30^\circ \sin 25^\circ = -2488,78 \text{ N}$$

$$\sigma_x = \frac{F_x}{A_{\text{colle}}} = \frac{5337,22}{30,24 \cdot 10^{-6}} = 7,41 \text{ Mpa}$$

$$\tau_{xz} = \frac{F_z}{A_{\text{colle}}} = \frac{3400}{30,24 \cdot 10^{-6}} = 4,72 \text{ Mpa}$$

$$\tau_{xy} = \frac{F_y}{A_{\text{colle}}} = -\frac{2488,78}{30,24 \cdot 10^{-6}} = -3,45 \text{ Mpa}$$

### **Exercice 3**

**La pièce A :**

$$\frac{F_A}{S_A} \leq 185 \text{ Mpa} \quad \text{Compression}$$

$$F_A \leq S_A \cdot 185 \cdot 10^6$$

$$S_A = \frac{\pi}{4} ((45,5)^2 - (43)^2) = 173,769 \cdot 10^{-6} \text{ m}^2$$

$$F_A \leq 185 \cdot 173,769 \quad F_A \leq 32147,30 \text{ N}$$

**La pièce B :**

$$\frac{F_B}{S_B} \leq 185 \text{ Mpa} \quad \text{Compression}$$

$$S_B = \frac{\pi}{4} ((43)^2 - (40)^2) = 195,563 \cdot 10^{-6} \text{ m}^2$$

$$F_B \leq S_B \cdot 185 \cdot 10^6$$

$$F_B \leq 185 \cdot 195,563 \quad F_B \leq 36\,179,335 \text{ N}$$

$$F_{\max} = 32147,30 \text{ N}$$

**La colle :**

$$\tau = \frac{F_{\max}}{A_{\text{colle}}}$$

$$A_{\text{colle}} = \pi r a = \pi \cdot 43 \cdot a = 135,088 \cdot 10^{-6} \text{ m}^2$$

$$\tau = \frac{32\,147,30}{135,088 \cdot a} \leq 14 \cdot 10^6$$

$$a \geq \frac{32\,147,30}{135,088 \cdot 14}$$

$$a \geq 16,99 \text{ mm} \approx 17 \text{ mm}$$

$$a_{\min} = 17 \text{ mm}$$

## Exercice 5

$$\sum F_H = 0$$

$$F - R_C - R_d = 0$$

$$\sum M/O = 0 \quad R_C l = R_d l \quad R_C = R_d$$

On peut avoir  $R_C = R_d$  par symétrie (sans calcul)

$$F = 2R_C = 2R_d = \frac{1500}{2} = 750 \text{ N}$$

$$\sigma_c = \sigma_d = \frac{750}{30.4 \cdot 10^{-6}} = 6,25 \text{ Mpa}$$

$$\sigma_A = \frac{1500}{30.3 \cdot 10^{-6}} = 16,66 \text{ Mpa}$$

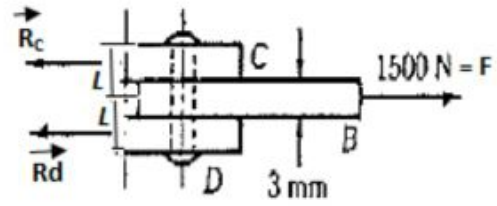
$$\tau = \frac{F_C}{2 \cdot A_{\text{cisaillement}}}$$

Puisque nous avons deux plans de cisaillement

$$A_{\text{cisaillement}} = \frac{\pi d^2}{4}$$

$$A_{\text{cisaillement}} = \frac{\pi}{4} (5 \cdot 10^{-3})^2 = 19,6349 \cdot 10^{-6} \text{ m}^2$$

$$\tau = \frac{1500}{2 \cdot 19,6349 \cdot 10^{-6}} = 38,1972 \text{ Mpa}$$



## Exercice 7

### a /Equilibre

$$\sum \vec{F}_V = \vec{0} \quad V_C = P$$

$$\sum \vec{F}_H = \vec{0} \quad H_C = H_B$$

$$\sum M/C = 0 \quad H_B l \cos 30^\circ - \frac{Pl}{2} \sin 30^\circ = 0$$

$$H_B = H_C = \frac{P}{2} \tan 30^\circ$$

$$R_C = \sqrt{H_C^2 + V_C^2} \quad R_C = \sqrt{\left(\frac{P}{2} \tan 30^\circ\right)^2 + P^2} = P \sqrt{\left(\frac{\tan 30^\circ}{2}\right)^2 + 1} = \rho l A g \left( \left(\frac{\tan 30^\circ}{2}\right)^2 + 1 \right)^{1/2}$$

$$R_C = 21\,564,72 \text{ N}$$

### b /Equilibre

$$\sum \vec{F}_{\text{normales}} = \vec{0}$$

$$N_a - \rho A g a \cos 30^\circ - H_B \cos 60^\circ = 0$$

$$N_a = \rho A g \left( a \cos 30^\circ + l \sin 30^\circ \frac{\tan 30^\circ}{2} \right)$$

$$\sum \vec{F}_{\text{tangentielles}} = \vec{0}$$

$$T_A + H_B \cos 30^\circ - \rho A g a \sin 30^\circ = 0$$

$$T_A = \rho A g \left( a \sin 30^\circ - \frac{l}{2} \tan 30^\circ \cos 30^\circ \right)$$

$$\sigma_n = \frac{N_a}{A} = \frac{\rho A g}{2} \left( \frac{2a}{l} + (\tan 30^\circ)^2 \right) \cos 30^\circ \quad \text{Compression}$$

$$\tau = \frac{\rho g l}{2} \sin 30^\circ \left( \frac{2a}{l} - 1 \right) \quad \text{Dirige vers t si } \left( \frac{2a}{l} - 1 \right) > 0 \quad a > \frac{l}{2}$$

$$\tau = 0 \quad \text{si } a = \frac{l}{2}$$

$$\text{Dirige vers (-t) si } \left( \frac{2a}{l} - 1 \right) < 0 \quad a < \frac{l}{2}$$

