Formulaire MEC2405 - Résistance des matériaux II

Chapitre 1 à 6 inclusivement

$$\sigma_x = \frac{F}{A} \qquad \sigma_x = \frac{pr_m}{2t} \qquad \sigma_\theta = \frac{pr_m}{t}$$

$$\sigma_x = -\frac{M_z y}{I_z} = -\frac{M_z}{S_z} \qquad I = \frac{bh^3}{12} \qquad I = \frac{\pi r^4}{4} \qquad I = \pi r^3 t$$

$$\tau_{x\theta} = \frac{Tr}{J} \qquad \tau = \frac{VQ}{Ib} \qquad J = \frac{\pi r^4}{2} \qquad J = 2\pi r^3 t$$

Torsion section ouverte

$$\tau_{xi} = \frac{Tt}{J} \qquad J = \sum \frac{bt^3}{3}$$

Torsion section fermée

$$\tau_{xs} = \frac{T}{2\bar{A}t} \qquad J = \frac{4\bar{A}^2}{\int \frac{ds}{t}}$$

Chapitre 7 Superposition de contraintes (état plan de contrainte sur la surface *z*)

$$\sigma_{x'} = \frac{\sigma_x + \sigma_y}{2} + \frac{\sigma_x - \sigma_y}{2}\cos(2\theta) + \tau_{xy}\sin(2\theta) \qquad \tau_{x'y'} = -\frac{\sigma_x - \sigma_y}{2}\sin(2\theta) + \tau_{xy}\cos(2\theta)$$

$$\sigma_{1,2} = \frac{\sigma_x + \sigma_y}{2} \pm \sqrt{\left(\frac{\sigma_x - \sigma_y}{2}\right)^2 + \tau_{xy}^2} \qquad \tan(2\theta_1) = \frac{2\tau_{xy}}{\sigma_x - \sigma_y}$$

$$\sigma_{x'} + \sigma_{y'} = \sigma_x + \sigma_y = \sigma_1 + \sigma_2$$

Chapitre 8 Déformations

$$\varepsilon_{x'} = \frac{\varepsilon_x + \varepsilon_y}{2} + \frac{\varepsilon_x - \varepsilon_y}{2}\cos(2\theta) + \frac{\gamma_{xy}}{2}\sin(2\theta) \qquad \frac{\gamma_{x'y'}}{2} = -\frac{\varepsilon_x - \varepsilon_y}{2}\sin(2\theta) + \frac{\gamma_{xy}}{2}\cos(2\theta)$$

$$\varepsilon_{x'} + \varepsilon_{y'} = \varepsilon_x + \varepsilon_y = \varepsilon_1 + \varepsilon_2$$

Chapitre 9 Relations contraintes / déformations / température

$$\varepsilon_x = \frac{1}{E}\left[\sigma_x - \nu(\sigma_y + \sigma_z)\right] + \alpha\Delta T \qquad \gamma_{xy} = \frac{\tau_{xy}}{G}$$

$$\varepsilon_y = \frac{1}{E}\left[\sigma_y - \nu(\sigma_z + \sigma_x)\right] + \alpha\Delta T \qquad \gamma_{yz} = \frac{\tau_{yz}}{G}$$

$$\varepsilon_z = \frac{1}{E}\left[\sigma_z - \nu(\sigma_y + \sigma_x)\right] + \alpha\Delta T \qquad \gamma_{xz} = \frac{\tau_{xz}}{G}$$

Énergie de déformation

$$U = \frac{1}{2}\int_V \left(\sigma_x\varepsilon_x + \sigma_y\varepsilon_y + \sigma_z\varepsilon_z + \tau_{xy}\gamma_{xy} + \tau_{yz}\gamma_{yz} + \tau_{zx}\gamma_{zx}\right)dV$$

Chapitre 10 Critères de défaillance

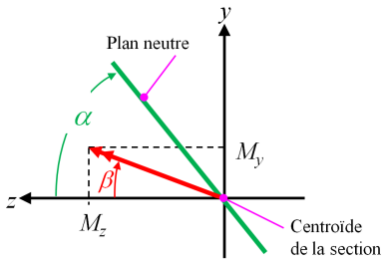
Tresca $\qquad \tau_{\max} = \frac{\sigma_{\max} - \sigma_{\min}}{2} = \frac{S_Y}{2} \qquad FS = \frac{S_Y}{\sigma_{\max} - \sigma_{\min}} = \frac{S_Y}{2\tau_{\max}} \qquad S_{S_Y} = \frac{S_Y}{2}$

Von Mises $\qquad \sqrt{\frac{1}{2}\left[(\sigma_1 - \sigma_2)^2 + (\sigma_2 - \sigma_3)^2 + (\sigma_3 - \sigma_1)^2\right]} = S_Y \qquad S_{S_Y} = 0{,}577 S_Y$

Chapitre 17 Notions avancées de flexion

$$\bar{y}_i = \frac{\sum A_i \bar{y}_i}{\sum A_i} \qquad \tan\beta = \frac{M_y}{M_z} \qquad \tan\alpha = \frac{M_z I_{yz} + M_y I_z}{M_y I_{yz} + M_z I_y} = \frac{I_{yz} + I_z \tan\beta}{I_{yz}\tan\beta + I_y}$$

$$\sigma_x = -\frac{1}{I_y I_z - I_{yz}^2}\left[\left(M_y I_{yz} + M_z I_y\right) y - \left(M_z I_{yz} + M_y I_z\right) z\right]$$



$$\sigma_x = -\left[\frac{M_y}{I_{yz}^*} + \frac{M_z}{I_z^*}\right] y + \left[\frac{M_z}{I_{yz}^*} + \frac{M_y}{I_y^*}\right] z$$

$$I_y^* = \frac{I_y I_z - I_{yz}^2}{I_z} \quad ; \quad I_z^* = \frac{I_y I_z - I_{yz}^2}{I_y} \quad ; \quad I_{yz}^* = \frac{I_y I_z - I_{yz}^2}{I_{yz}}$$

$$I_{yz} = \sum\left(I_{y_i z_i} + \bar{y}_i \bar{z}_i A\right)$$

$$I_{y'} = \frac{I_y + I_z}{2} + \frac{I_y - I_z}{2}\cos 2\theta - I_{yz}\sin 2\theta$$

$$I_{z'} = \frac{I_y + I_z}{2} - \frac{I_y - I_z}{2}\cos 2\theta + I_{yz}\sin 2\theta$$

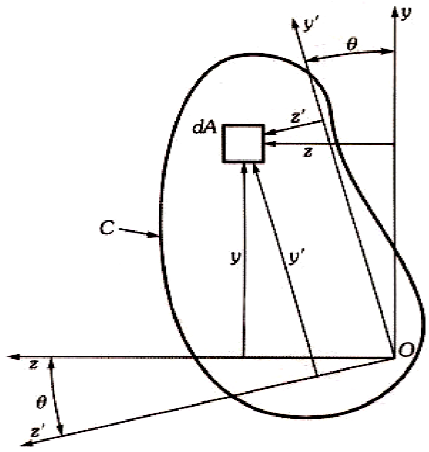


Figure A.4 Réaction du système d'axes. Le système d'axes *y'* et *z'* fait avec le système d'axes *y* et *z* un angle *θ*.

Chapitre 14 Énergie de déformation

Théorème de réciprocité $\sum_{i=1}^{n}\left(\bar{P}_i\right)_I \bullet \left(\bar{\delta}_i\right)_{II} = \sum_{j=1}^{m}\left(\bar{P}_j\right)_{II} \bullet \left(\bar{\delta}_j\right)_I$