FORMULAIRE MEC2405

Section 1 : révision MEC1420

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

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

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

Torsion section ouverte

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

Torsion section fermée

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

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

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

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

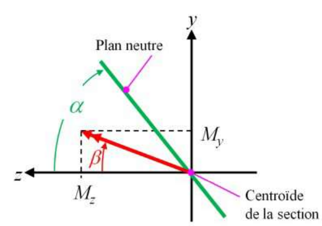
$$\tan(2\theta_1) = \frac{2\tau_{xy}}{\sigma_x - \sigma_y}$$

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

Section 2 : flexion gauche

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

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



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

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

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

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

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

$$I = Ar^2$$

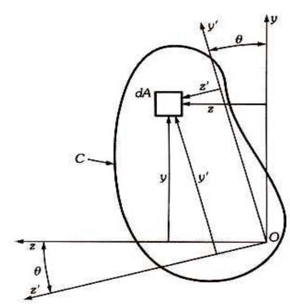


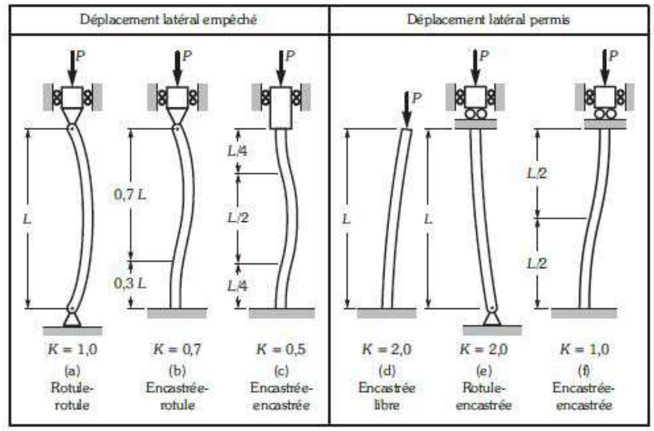
Figure A.4 Réaction du système d'axes. Le système d'axes y' et z' fait avec le système d'axes y et z un angle θ.

Section 3 : Instabilité et flambement

$$P_{cr} = \frac{\pi^2 EI}{(KL)^2}$$

$$\sigma_{cr} = \frac{P_{cr}}{A} = \frac{\pi^2 E}{\left(\frac{KL}{r}\right)^2}$$

$$r = \sqrt{\frac{I}{A}}$$



Code ACNOR $\quad C_r = \phi A S_Y \left(1 + \lambda^{2n}\right)^{\frac{-1}{n}} \qquad \lambda = \frac{KL}{r}\sqrt{\frac{S_Y}{\pi^2 E}} \qquad F_{amp} = \frac{1}{1 - \frac{C}{P_{cr}}}$

Flexion 2 plans $\quad \frac{C}{C_r} + \frac{F_{amp} M_z}{M_{rz}} + \frac{F_{amp} M_y}{M_{ry}} \le 1$

Flexion 1 plan $\quad \frac{C}{C_r} \le 1,0 \qquad \frac{C}{C_{ri}} + \frac{F_{amp/i} M_i}{M_{ri}} \le 1,0$

Section 4 : Énergie de déformation

Énergie de déformation $\quad U = \sum \frac{P_i^2 L}{2AE} + \sum \frac{T_i^2 L}{2GJ} + \sum \int \frac{M_i^2 dx}{2EI} + \sum \int \frac{V_i^2 dx}{2A_c G}$

Théorème de Castigliano $\quad \frac{dU}{dF} = \sum P_i \frac{\frac{\partial P_i}{\partial F} L}{AE} + \sum T_i \frac{\frac{\partial T_i}{\partial F} L}{GJ} + \sum \int M_i \frac{\frac{\partial M_i}{\partial F} dx}{EI} + \sum \int V_i \frac{\frac{\partial V_i}{\partial F} dx}{A_c G}$

Théorème de Maxwell-Betti $\quad \sum_{i=1}^{n} (\overline{P}_i)_I \cdot (\overline{\delta}_i)_{II} = \sum_{j=1}^{m} (\overline{P}_j)_{II} \cdot (\overline{\delta}_j)_I$