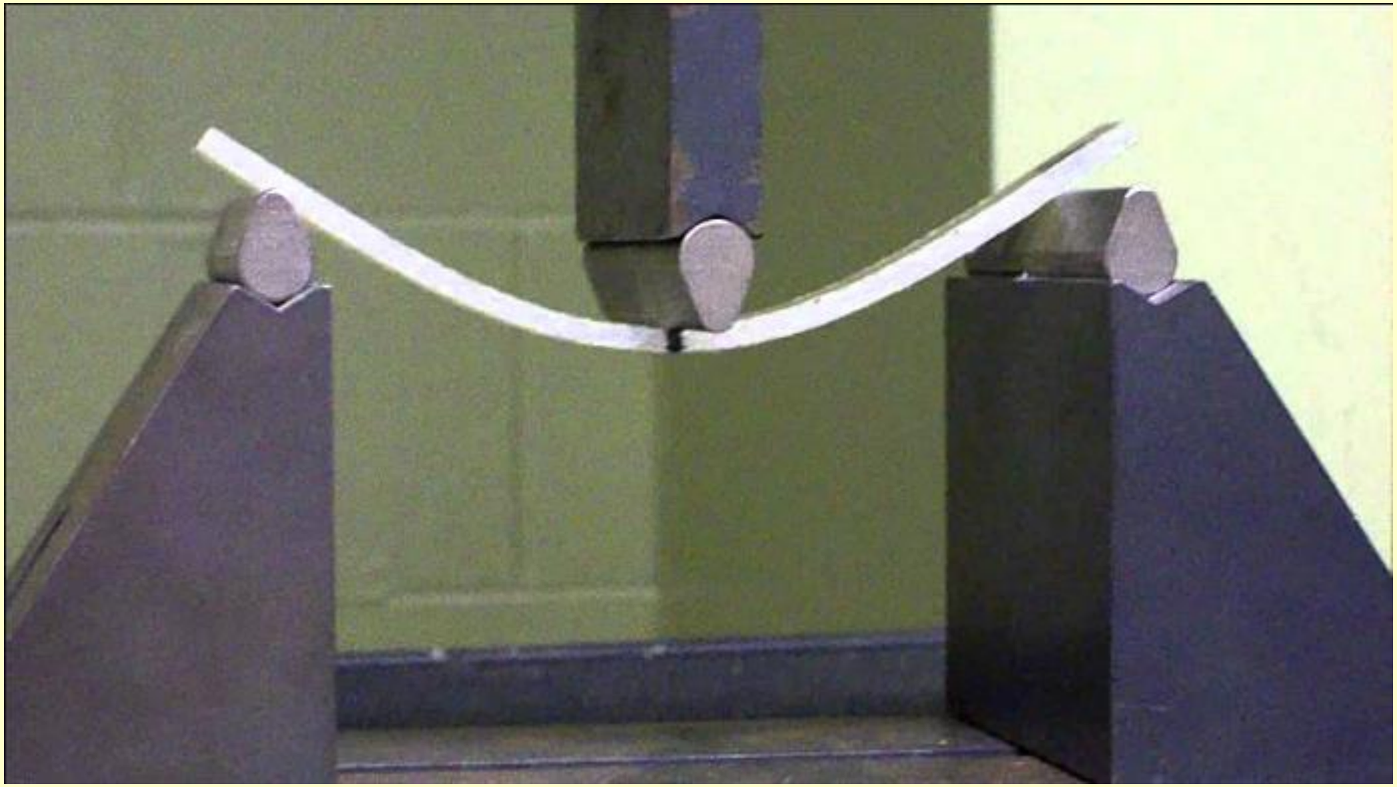
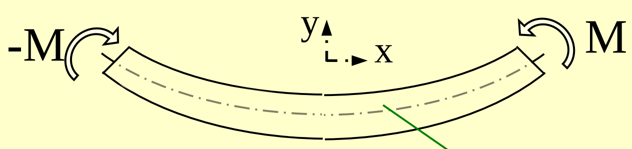
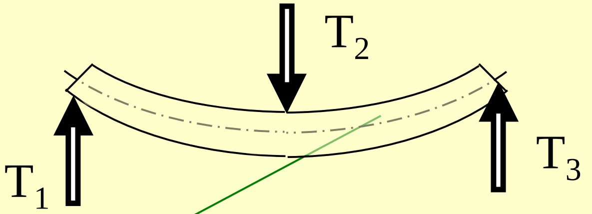
S72-1 - Flexion



S72-1 - Flexion

Définition :





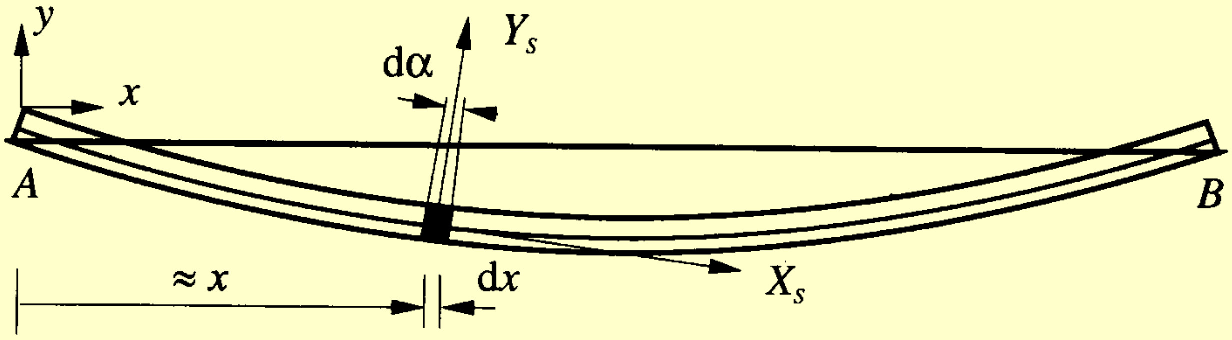
Lm : ligne moyenne

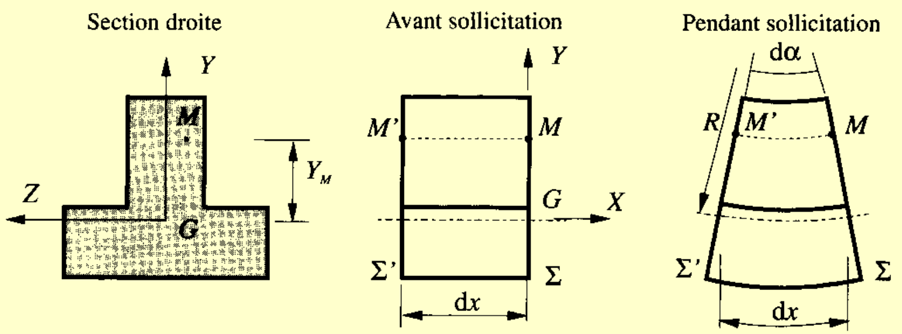
Torseur de cohésion :

$$\{T_{coh}\} = \{E_2 \rightarrow E_1\} = {}_G\left\{\begin{matrix}\vec{R} \\ \overrightarrow{M_G}\end{matrix}\right\} = {}_G\left\{\begin{matrix}0 & 0 \\ Ty & 0 \\ 0 & Mfz\end{matrix}\right\}_{(G,\vec{x},\vec{y},\vec{z})}$$

Relation entre l'effort tranchant et le moment fléchissant : $$\frac{dMfz}{dx} = -Ty$$

Etude de la contrainte normale:



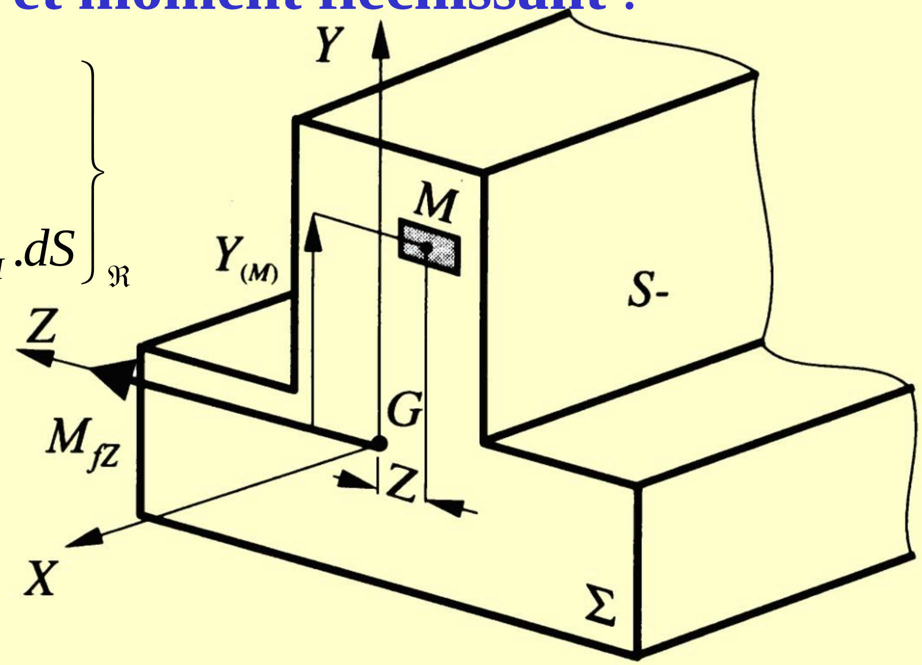


$$\varepsilon = -Y_M \frac{d\alpha}{dx}$$

$$\sigma_M = -E.Y_M \frac{d\alpha}{dx}$$

Relation entre contrainte normale et moment fléchissant :

$$\left\{S_g / S_d -\right\} = {}_M\left\{\begin{matrix} \sigma_M.dS & 0 \\ 0 & 0 \\ 0 & 0 \end{matrix}\right\}_{\Re} = {}_G\left\{\begin{matrix} \sigma_M.dS & 0 \\ 0 & 0 \\ 0 & -Y.\sigma_M.dS \end{matrix}\right\}_{\Re}$$



$$Mfz = -\int_S Y.\sigma M.dS$$

$$Mfz = -\frac{\sigma}{Y_M}\int_S Y^2.dS$$

$$\boxed{\sigma_M = -\frac{Mfz.Y_M}{\int_S Y^2.dS}} \Longrightarrow \boxed{\sigma_{max} = \frac{M_{fz}}{\frac{I_{Gz}}{y_{max}}}}$$

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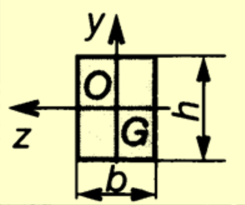
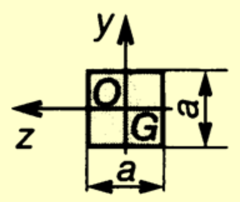
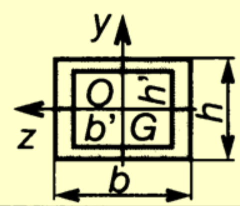
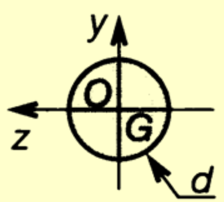
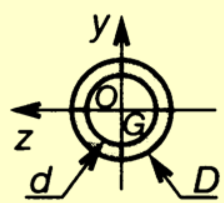
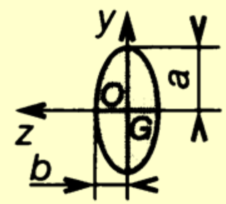
Moments quadratiques:

VALEURS DE MOMENTS QUADRATIQUES PARTICULIERS						
SECTIONS PRÉSENTANT UNE SYMÉTRIE CENTRALE						
Sections (S) / Caractéristiques						
I_{Gy}	$\frac{hb^3}{12}$	$\frac{a^4}{12}$	$\frac{hb^3 - h'b'^3}{12}$	$\frac{\pi d^4}{64}$	$\frac{\pi}{64}(D^4 - d^4)$	$0{,}784\,a\,b^3$
I_{Gz}	$\frac{bh^3}{12}$	$\frac{a^4}{12}$	$\frac{bh^3 - b'h'^3}{12}$	$\frac{\pi d^4}{64}$	$\frac{\pi}{64}(D^4 - d^4)$	$0{,}784\,a^3\,b$
$I_O = I_G$	$\frac{bh}{12}(b^2 + h^2)$	$\frac{a^4}{6}$	$I_{Gy} + I_{Gz}$	$\frac{\pi d^4}{32}$	$\frac{\pi}{32}(D^4 - d^4)$	$\frac{\pi}{4}ab(a^2 + b^2)$
Module de flexion * μ_{Gy}	$\frac{hb^2}{6}$	$\frac{a^3}{3}$	$\frac{bh^3 - b'h'^3}{6b}$	$\frac{\pi d^3}{16}$	$\frac{\pi}{16D}(D^4 - d^4)$	$0{,}784\,a\,b^2$
Module de flexion * μ_{Gz}	$\frac{bh^2}{6}$	$\frac{a^3}{3}$	$\frac{bh^3 - b'h'^3}{6h}$	$\frac{\pi d^3}{16}$	$\frac{\pi}{16D}(D^4 - d^4)$	$0{,}784\,b\,a^2$

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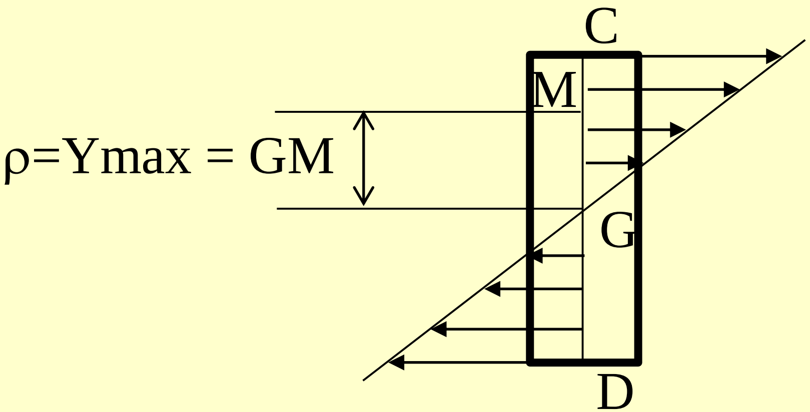
Contrainte normale maximale :

$$\boxed{\sigma_{max} = \frac{M_{fz}}{\frac{I_{Gz}}{y_{max}}}}$$

Module
de flexion

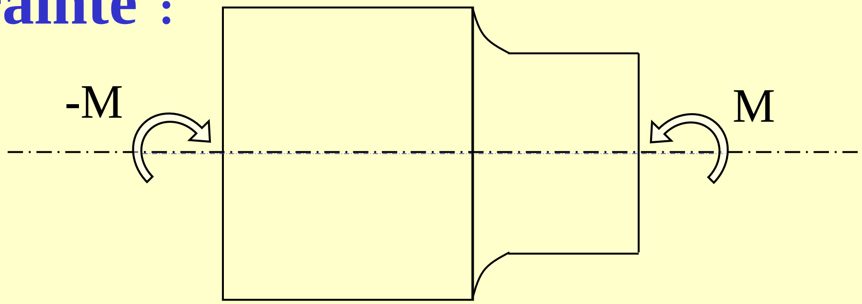


Condition de résistance à la contrainte normale:

$$\sigma_0 < R_{pe} = \frac{R_e}{s}$$

Concentration de contrainte :

Chargement :

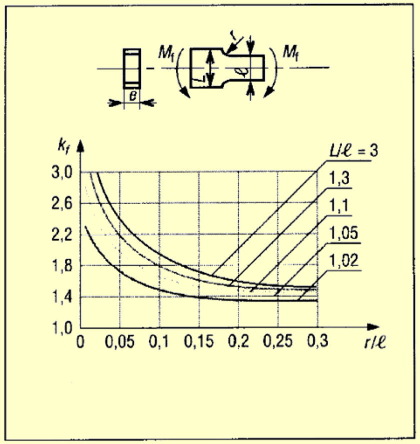


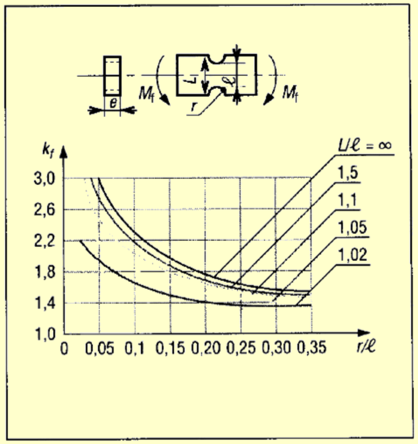
Contrainte :

$$\sigma_{maxi} = K_{ts}\ \sigma_0 \qquad \text{avec} \qquad \sigma_0 = \frac{M_{fz}}{\dfrac{I_{Gz}}{\rho_y}}$$

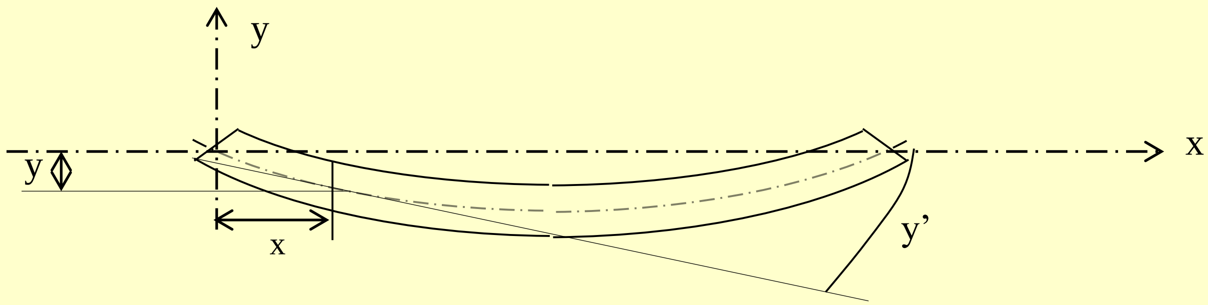
Détermination du Kt :

Lecture d’abaques





Déformation :



$$EI_{Gz}\, y'' = Mfz$$

tangente $\Rightarrow$ **y' = angle entre tan à la déformation et l'axe x**

déformation $\Rightarrow$ **y = écart entre Lm et axe x**

flèche $\Rightarrow$ $$f = y_{maxi}$$

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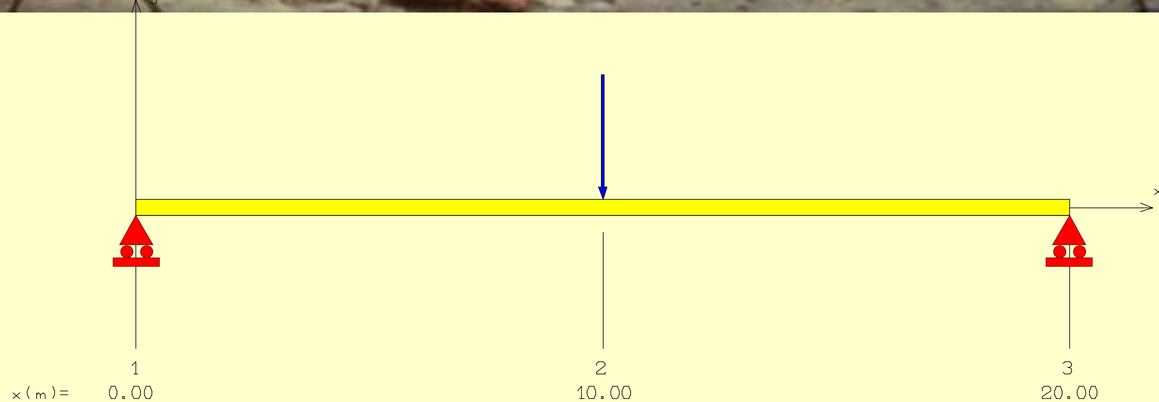
Exemple de résolution :



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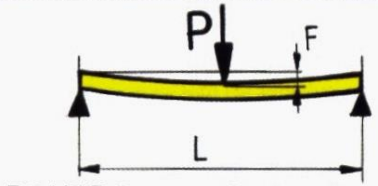
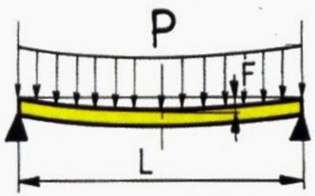
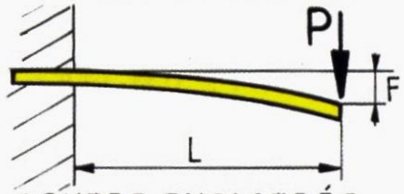
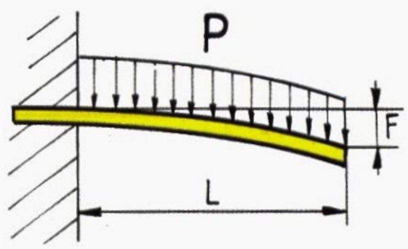
Chargements basiques:

Disposition des charges	MOMENT FLÉCHISSANT EN Kg/mm	FLÈCHE MAXI EN M/M	TAUX TRAVAIL MAXI EN Dan/mm²
 POUTRE sur 2 Appuis	$\frac{P \times L}{4}$	$\frac{P \times L^3}{48 \times E \times I}$	$\frac{Mf}{\frac{I}{V}}$
	$\frac{P \times L}{8}$	$\frac{5 \times P \times L^3}{384 \times E \times I}$ $\frac{P \times L}{8} \times \frac{5 \times L^2}{48 \times E \times I}$	$\frac{Mf}{\frac{I}{V}}$ AU MILIEU
 POUTRE ENCASTRÉE	$P \times L$	$\frac{P \times L^3}{3 \times E \times I}$	$\frac{Mf}{\frac{I}{V}}$ A L'ENCASTREMEN
	$\frac{P \times L}{2}$	$\frac{P \times L^3}{8 \times E \times I}$	$\frac{Mf}{\frac{I}{V}}$
A.MORIN	E - MODULE D'ELASTICITÉ I - INERTIE SECTION Mf - MOMENT FLÉCHISSANT		