FORMULÁRIO - Resistência dos Materiais – 2019.v2

Forças Internas em vigas - diagramas

$$V_i(x) = V_{i-1}(a) + P_i + \int_a^x \omega_i(x)\,dx\,; \quad M_i(x) = M_{i-1}(a) + M_i + \int_a^x V_i(x)\,dx\,; \quad a \le x < b$$

Elasticidade

$$\varepsilon = \frac{\delta}{L}; \quad \sigma = \frac{P}{A}; \quad \sigma = E\varepsilon; \quad \delta^T = \alpha \cdot \Delta T \cdot L;$$

$$G = \frac{E}{2(1+\upsilon)}; \quad \upsilon = -\frac{\varepsilon_y}{\varepsilon_x} = -\frac{\varepsilon_z}{\varepsilon_x}; \quad \sigma_m = \frac{\sigma_x+\sigma_y+\sigma_z}{3};$$

$$K = \frac{E}{3(1-2\upsilon)}; \quad e = \frac{\Delta V}{V} \approx \varepsilon_x + \varepsilon_y + \varepsilon_z; \ \sigma_m = eK$$

$$\begin{cases} \varepsilon_x = \frac{\sigma_x}{E} - \frac{\upsilon}{E}(\sigma_y + \sigma_z) \\ \varepsilon_y = \frac{\sigma_y}{E} - \frac{\upsilon}{E}(\sigma_x + \sigma_z) \\ \varepsilon_z = \frac{\sigma_z}{E} - \frac{\upsilon}{E}(\sigma_x + \sigma_y) \end{cases} \qquad \begin{cases} \tau_{xy} = G\gamma_{xy} \\ \tau_{xz} = G\gamma_{xz} \\ \tau_{yz} = G\gamma_{yz} \end{cases}$$

$$\varepsilon_{xy} = \frac{\gamma_{xy}}{2}; \ \varepsilon_{xz} = \frac{\gamma_{xz}}{2}; \ \varepsilon_{yz} = \frac{\gamma_{yz}}{2}$$

Estado plano de tensão

$$\sigma_\theta = \frac{\sigma_x+\sigma_y}{2} + \frac{\sigma_x-\sigma_y}{2}cos(2\theta) + \tau_{xy}sen(2\theta); \ \ \tau_\theta = -\frac{\sigma_x-\sigma_y}{2}sen(2\theta) + \tau_{xy}cos(2\theta);$$

$$\begin{Bmatrix}\sigma_1\\ \sigma_2\end{Bmatrix} = \frac{\sigma_x+\sigma_y}{2}\begin{Bmatrix}+\\ -\end{Bmatrix}\sqrt{\left(\frac{\sigma_x-\sigma_y}{2}\right)^2 + \tau_{xy}^2}; \ \ \tau_{max} = \frac{\sigma_1-\sigma_2}{2}; \ tg(2\theta_p) = \frac{2\tau_{xy}}{\sigma_x-\sigma_y}; \ tg(2\theta_s) = -\frac{\sigma_x-\sigma_y}{2\tau_{xy}};$$

Torção

Secção Circular $\tau = \frac{T\rho}{J}; \ \phi = \frac{TL}{JG};$

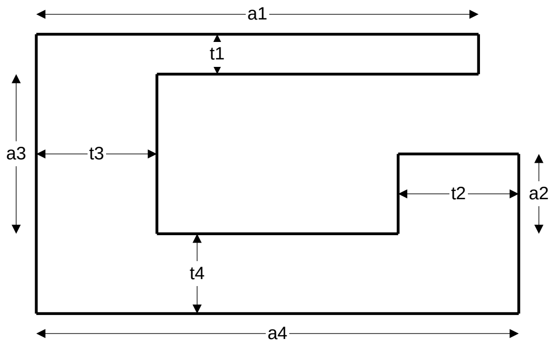
$$J = \frac{\pi}{2}c^4; \ J = \frac{\pi}{2}(c_2^4 - c_1^4);$$

Potência: $P = \omega \cdot T$; 1cv = 735,5W

Paredes Finas

Aberto $\tau_{max} = \frac{3Tt_{max}}{\sum a_i t_i^3}$; $\phi = \frac{3TL}{G\sum a_i t_i^3}$

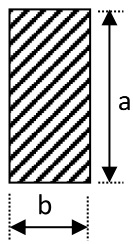
Fechado $\tau_{max} = \frac{T}{2At_{min}}$; $\phi = \frac{TL}{4A^2G}\sum\frac{a_i}{t_i}$



Secção Retangular

$$\tau_{max} = \frac{T}{c_1 ab^2};$$

$$\phi = \frac{TL}{c_2 ab^3 G}$$



a/b	c_1	c_2
1.0	0.208	0.1406
1.2	0.219	0.1661
1.5	0.231	0.1958
2.0	0.246	0.229
2.5	0.258	0.249
3.0	0.267	0.263
4.0	0.282	0.281
5.0	0.291	0.291
10.0	0.312	0.312
∞	0.333	0.333

Flexão

Tensão Normal

$$\sigma_x = -\frac{M_z y}{I_z} + \frac{M_y z}{I_y} + \frac{P}{A} \qquad \frac{d^2y}{dx^2} = \frac{M_z(x)}{EI_z};$$

Cálculo do momento de Inércia

$$\bar{y} = \frac{\sum A_i \bar{y}_i}{A}; \ I_z = I_z^{(i)} + d_i^2 A_i$$

Inercia

$$I_z = \frac{bh^3}{12}$$

Retangular: $\tau = \frac{6V}{bh^3}\left(\frac{h^2}{4} - y^2\right)$; Circular: $\tau = \frac{4}{3}\frac{V}{\pi R^2}\left(1 - \frac{r^2}{R^2}\right)^{\frac{3}{2}}$; $I_z = \frac{\pi d^4}{64}$

Critérios

Tresca: $\begin{cases} \sigma_{eq} = max(|\sigma_1|, |\sigma_2|) \\ \sigma_{eq} = |\sigma_1 - \sigma_2| \end{cases}$ von Mises: $\sigma_{eq} = \sqrt{{\sigma_1}^2 - \sigma_1\sigma_2 + {\sigma_2}^2}$