Relações de Propriedades do Material

Coeficiente de Poisson

$$\nu = -\frac{\epsilon_{\text{lat}}}{\epsilon_{\text{long}}}$$

Lei de Hooke Generalizada

$$\epsilon_x = \frac{1}{E}[\sigma_x - \nu(\sigma_y + \sigma_z)]$$

$$\epsilon_y = \frac{1}{E}[\sigma_y - \nu(\sigma_x + \sigma_z)]$$

$$\epsilon_z = \frac{1}{E}[\sigma_z - \nu(\sigma_x + \sigma_y)]$$

$$\gamma_{xy} = \frac{1}{G}\tau_{xy}, \quad \gamma_{yz} = \frac{1}{G}\tau_{yz}, \quad \gamma_{zx} = \frac{1}{G}\tau_{zx}$$

onde

$$G = \frac{E}{2(1+\nu)}$$

Relações entre *w, V, M*

$$\frac{dV}{dx} = -w(x), \qquad \frac{dM}{dx} = V$$

Curva Elástica

$$\frac{1}{\rho} = \frac{M}{EI}$$

$$EI\frac{d^4v}{dx^4} = -w(x)$$

$$EI\frac{d^3v}{dx^3} = V(x)$$

$$EI\frac{d^2v}{dx^2} = M(x)$$

Flambagem

Carga axial crítica

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

Tensão crítica

$$\sigma_{\text{cr}} = \frac{\pi^2 E}{(KL/r)^2}, r = \sqrt{I/A}$$

Fórmula da secante

$$\sigma_{\text{máx}} = \frac{P}{A}\left[1 + \frac{ec}{r^2}\sec\left(\frac{L}{2r}\sqrt{\frac{P}{EA}}\right)\right]$$

Métodos de Energia

Conservação de energia

$$U_e = U_i$$

Energia de deformação

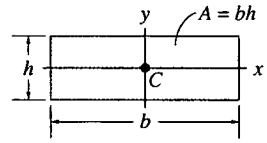
$$U_i = \frac{N^2L}{2AE} \quad \textit{carga axial constante}$$

$$U_i = \int_0^L \frac{M^2dx}{EI} \quad \textit{momento fletor}$$

$$U_i = \int_0^L \frac{f_sV^2dx}{2GA} \quad \textit{cisalhamento transversal}$$

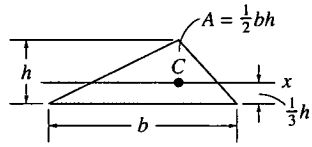
$$U_i = \int_0^L \frac{T^2dx}{2GJ} \quad \textit{momento de torção}$$

Propriedades Geométricas dos Elementos de Área



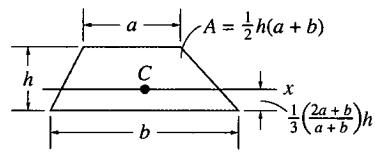
Área retangular

$I_x = \frac{1}{12}bh^3$
$I_y = \frac{1}{12}hb^3$

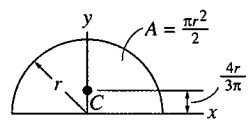


Área triangular

$I_x = \frac{1}{36}bh^3$

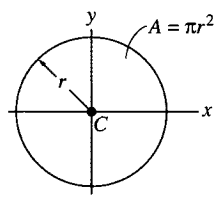


Área trapezoidal



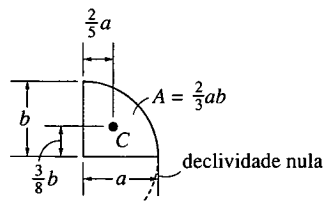
Área semicircular

$I_x = \frac{1}{8}\pi r^4$
$I_y = \frac{1}{8}\pi r^4$

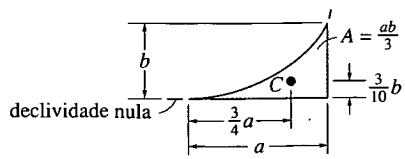


Área circular

$I_x = \frac{1}{4}\pi r^4$
$I_y = \frac{1}{4}\pi r^4$



Área semiparabólica



Área parabólica