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$$FS=\frac{\sigma_y}{\sigma_{allow}} \text{ and } FS=\frac{\tau_y}{\tau_{allow}};\quad FS=\frac{\sigma_u}{\sigma_{allow}} \text{ and } FS=\frac{\tau_u}{\tau_{allow}};\quad \sigma=E\varepsilon;\ \tau=G\gamma$$

$$\sigma=\frac{F}{A};\quad \tau_{aver}=\frac{F}{A};\quad \delta=\sum_{i=1}^{n}\frac{P_iL_i}{E_iA_i};\quad \delta=\frac{PL}{EA};\quad \delta=\int_0^L\frac{P(x)}{EA(x)}dx;\quad \upsilon=\frac{\varepsilon_{lateral}}{\varepsilon_{longitudinal}}$$

Power & Torsion:

$$\phi=\frac{TL}{GI_p};\quad I_p(\text{Solid Shaft of diam.} = d)=\frac{\pi d^4}{32};\quad I_p\left(\text{Hollow Shaft}\begin{cases}d_o \text{ :outer diam.}\\ d_i \text{ :inner diam.}\end{cases}\right)=\frac{\pi\left(d_o^4-d_i^4\right)}{32}$$

$$\tau_{\max}=\frac{T(d/2)}{I_p};\quad \tau=\frac{T\rho}{I_p}\left(\text{where } 0\le\rho\le r=\tfrac{d}{2}\right);\quad G=\frac{E}{2(1+\upsilon)};\quad P(\text{power})=\omega T;\ \omega=2\pi f$$

$$\frac{dV}{dx}=-q;\quad \frac{dM}{dx}=\text{V}\quad\Leftrightarrow\quad\begin{cases}\int_A^B dV=V_A-V_B=-\int_A^B q\,dx=-(\text{Area of the loading diagram bt. A and B})\\ \int_A^B dM=M_A-M_B=\int_A^B V\,dx=(\text{Area of the shear-force diagram bt. A and B})\end{cases}$$

$$\kappa(\text{curvature})=\frac{1}{\rho}=\frac{d\theta}{ds}=\frac{-\varepsilon_x}{y};\quad \sigma_x=\frac{-M_zy}{I_z};\quad \tau=\frac{VQ}{Ib};\quad f=\frac{VQ}{I};\quad Q=\int y\,\text{dA}$$

Mohr's Circle, Stress Trans. & Princ. Stresses:

$$\sigma_{x1},\sigma_{y1}=\sigma_{aver}\pm\sigma_{diff}\cos(2\theta)\pm\tau_{xy}\sin(2\theta);\quad \sigma_{aver}=\frac{\sigma_x+\sigma_y}{2};\quad \sigma_{diff}=\frac{\sigma_x-\sigma_y}{2}$$

$$\tau_{x1y1}=-\sigma_{diff}\sin(2\theta)+\tau_{xy}\cos(2\theta);\quad \sigma_{1,2}=\sigma_{aver}\pm R;\quad R=\sqrt{\left(\sigma_{diff}\right)^2+\left(\tau_{xy}\right)^2}$$

Hooke's law for plane stress & vessels:

$$\begin{cases}\varepsilon_x=\frac{1}{E}\left(\sigma_x-\upsilon\sigma_y\right)\\ \varepsilon_y=\frac{1}{E}\left(\sigma_y-\upsilon\sigma_x\right)\\ \varepsilon_z=\frac{-\upsilon}{E}\left(\sigma_y+\sigma_x\right)\end{cases}\quad\begin{cases}\sigma_x=\frac{E}{1-\upsilon^2}\left(\varepsilon_x+\upsilon\varepsilon_y\right)\\ \sigma_y=\frac{E}{1-\upsilon^2}\left(\varepsilon_y+\upsilon\varepsilon_x\right)\\ e(\text{dilatation})=\frac{\Delta V}{V}=\varepsilon_x+\varepsilon_y+\varepsilon_z\end{cases}$$

Thin-walled spherical vessel: $\sigma=\frac{pr}{2t}$

Thin-walled cylindrical vessel: $\begin{cases}\sigma_{axial}=\frac{pr}{2t}\\ \sigma_{hoop}=\frac{pr}{t}\end{cases}$

Deflection & Buckling

$$\begin{cases}EI\frac{d^2v}{dx^2}=M\\ \theta(slope)=\frac{dv}{dx}\end{cases}\quad\begin{cases}\text{Pinned-Pinned Column } K=1; & \text{Fixed-Free Column } K=2\\ \text{Fixed-Fixed Column } K=0.5; & \text{Fixed-Pinned Column } K=0.699\end{cases}\quad\Leftrightarrow\quad P_{cr}=\frac{\pi^2EI}{(KL)^2}$$