MTE321 Formulas

Stresses

Deformation Elongation

$$\delta = \frac{PL}{EA}$$

Torsional Sheer Stress

R is the radial distance

$$\tau = \frac{Tr}{J}$$

$$Z_p = \frac{J}{c}$$

$$\tau_{max} = \frac{T}{Z_p}$$

Torsional Deformation

θ is the angle of twist across L
For non-circular shafts K is section polar second moment of area and Q the section polar modulus

$$\theta = \frac{TL}{GJ}$$

$$\tau = \frac{T}{Q}$$

$$\theta = \frac{TL}{GK}$$

Shear Stress

V section shear force, Q is the first moment area, and t is the section thickness

$$\tau_{(y)} = \frac{VQ}{It}$$

$$Rectangular\ Beam\ \tau_{max} = \frac{3V}{2A}$$

$$Solid\ Round\ Beam\ \tau_{max} = \frac{4V}{3A}$$

$$Hollow\ Round\ Beam\ \tau_{max} = \frac{2V}{A}$$

Beam Bending

M is the moment at the section, y is the distance from the neutral axis

$$\sigma_y = -\frac{My}{I}$$

Stress Concentrations

Stress Concentration Factor

K_t is material and loading dependent, values greater than 3 are a waste

$$\sigma_{max} = K_t \sigma_{nom}$$

Curved Beam Bending

$$\sigma_{(r)} = \frac{M(\theta)(R-r)}{Ar(r_c - R)}$$

Thermal Strain

$$\epsilon_x^m = -\alpha \delta T$$

Principle Stresses

$$tan 2\theta_\sigma = \frac{2\tau_{xy}}{\sigma_x - \sigma_y}$$

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