Important Equations

Elongation

Displacement due to Normal Force:

$$\delta_N = \int_0^L \frac{N}{EA} dx \tag{1}$$

Displacement due to Heating:

$$\delta_T = \int_0^L \alpha \, \Delta T \, dx \tag{2}$$

Displacement due to Prestress:

$$\delta_P = -\int_0^L \frac{P}{EA} dx = -2 \, n \, p \tag{3}$$

Moment of Inertia

First Moment of Inertia:

$$Q_x = \int_A y \, dA \tag{4}$$

Second Moment of Inertia:

$$I_x = \int_A y^2 \, dA \tag{5}$$

Polar Moment of Inertia:

$$I_p = \int_A x^2 + y^2 \, dA = I_x + I_y \tag{6}$$

$$I_p = \frac{4A_m^2}{\oint_0^{L_m} \frac{ds}{dt}} \tag{7}$$

Tension/Compression

Due to Normal Force:

$$\sigma_N = \frac{N}{A} \tag{8}$$

Due to Moment:

$$\sigma_M = -\frac{Mc}{I} \tag{9}$$

Total Tension/Compression:

$$\sigma_T = \sigma_N + \sigma_M \tag{10}$$

Shear Force

Shear Flow:

$$q_b = \frac{VQ}{I} = \frac{nV_b}{s} \tag{11}$$

Shear Stress:

$$\tau = \frac{q}{t} = \frac{VQ}{It} \tag{12}$$

Torsion

Shear Stress:

$$\tau = \frac{T\varrho}{I_p} = \frac{T}{2tA_m} \tag{13}$$

Angle of Rotation:

$$\phi = \int_0^L \frac{T}{GI_p} dx \tag{14}$$

Bending

Differential Equations:

$$q = EIu'''' \tag{15}$$

$$V = EIu''' \tag{16}$$

$$M = EIu'' \tag{17}$$

$$\theta = u' \tag{18}$$

$$\delta = u \tag{19}$$

Vergeet Me Nietjes / Forget Me Nots:

Load:	θ:	δ:
q	$\frac{qL^3}{6EI}$	$\frac{qL^4}{8EI}$
P	$\frac{PL^2}{2EI}$	$\frac{PL^3}{3EI}$
T	$\frac{TL}{EI}$	$\frac{TL^2}{2EI}$