Some Relevant Equations for CIV100

Equation	Usage
$\sum M, F_{x,y,z} = 0$	Setting up equilibrium equations in 2D and 3D.
$\vec{R} = R\vec{x} + R\vec{y}Rcos\theta(x) + Rsin\theta(y)$	Decomposing 2D vectors
$Rcos\theta = R_x, Rsin\theta = R_y$	Decomposing 2D vectors
$\lvert\lvert R\rvert\rvert = \sqrt{F_{Rx}^2 + F_{Ry}^2 + F_{Rz}^2}$	Magnitude of Resultant force
$\theta = arctan\lvert\frac{F_{Ry}}{F_{Rx}}\rvert$	Direction of Resultant force
$M_o = F \times d$	Moment from force and $\perp$ distance d
$\sum M_{R,CCW} = \sum M_{forces} + \sum M_{ext}$	Sum of Moments
$T = CONSTANT$	Cable forces in pulleys
$F = \omega l$	Resultant from distributed load of intensity ω over l
$M_{pin/hinge} = 0$	Moment at hinges are zero in statics.
$F_{spring} = k\Delta x$	Spring force with spr. const. K
$\vec{F_1} = -\vec{F_2}$	Two Force Member
$u_{AB} = \frac{AB}{\lvert\lvert AB\rvert\rvert}$	Unit vector along AB by dividing by $\lvert\lvert AB\rvert\rvert$
$1 = cos^2\alpha + cos^2\beta + cos^2\gamma$	Angles in 3D using Pyth.
$U_{AB} = \frac{(X_B - X_A)i + (Y_B - Y_A)j + (Z_B - Z_A)k}{\sqrt{(X_B - X_A)^2 + (Y_B - Y_A)^2 + (Z_B - Z_A)^2}}$	Decomposed unit vector in 3D of $\vec{A}$ to $\vec{B}$
$\sum M_o = \sum_i \vec{r}_i \times \vec{F_i}$	3D moment, r is from tail to any point on LOA of $\vec{F}$.
$M_A = u_a \cdot (\vec{r} \times \vec{F})$	Axial moment in 3D, solve with triple scalar product
$\vec{M}_a = \lvert\lvert M_A\rvert\rvert \times \vec{u}_a$	Moment about axis by taking projections
$\sigma = \frac{F}{A}$	Engineering Stress analagous to pressure
$\frac{N}{mm^2} = MPa$	A useful conversion
$\epsilon = \frac{l - l_o}{l}$	Engineering Strain is unitless.
$\sigma = E\epsilon$	Young's Modulus (E) analagous to Hooke's Law
$\Delta L = \frac{PL}{AE}$	Elongation of Truss Members given a real force and area.
$\frac{dV(x)}{dx} = -\omega(x)$	Slope of shear diagram is negative distributed load
$\frac{dM(x)}{dx} = V(x)$	Slope of moment diagram is shear value
$\Delta V(x) = \int -\omega dx$	Change in shear is negative area under distributed load
$\Delta M(x) = \int V dx$	Change in shear is area under shear diagram
$A = hb; \bar{x} = b/2; \bar{y} = h/2$	Rectangular Centroid
$A = \frac{1}{2}hb; \bar{x} = b/3; \bar{y} = h/3$	Triangular Centroid, taken at widest angle.
$\bar{x} = \frac{\sum A_i x_i}{\sum A_i}$	Centroid in general. A_i replacable by weight, mass or length.
$P = \gamma \cdot z = \rho \cdot g \cdot z$	Hydrostatic pressure at a point with head z.
$P_R = \rho \cdot g \cdot z \cdot b \cdot w$	Hydrostatic pressure 3D volumetric resultant.
$F_H = F_x; F_v = F_y \pm W$	Equiv. Liquid block reaction forces, variable F_y orientation
$I_{xx} = \frac{bh^3}{12}; I_{yy} = \frac{b^3h}{12}$	Moments of inertia for rectangular sections.
$Ix' = I_{xx} + A \cdot d^2$	Parallel Axis theorem, I_{xx} designates centroidal axis.
$C = T$	Symmetric bending stress blocks form a couple.
$C_R = V(\sigma_C)$	Interpret resultant bending stress as volume.
$\sigma = \frac{M_z \cdot y}{I_z}$	Beam Bending formula (linear elastic).
$\sigma = \frac{M_{max} \cdot LF \cdot y_{max}}{I_z}$	BBF for design
$S = \frac{I_z}{y_{max}}$	Section modulus for tabular application.
$S_{req} = \frac{M_{max} \times LF}{y_{max}}$	Section modulus for design.
$M_{couple} = F \times d_{sep}$	Moment from force couple