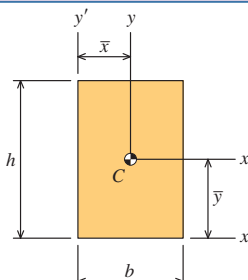
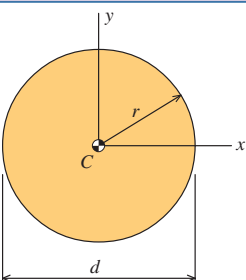
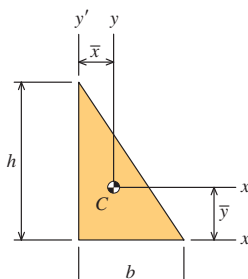
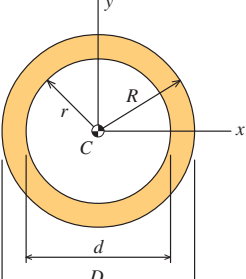
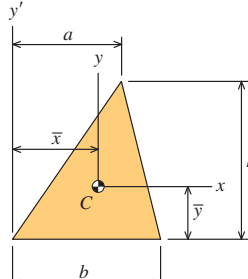
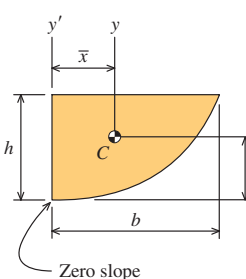
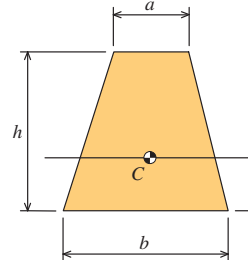
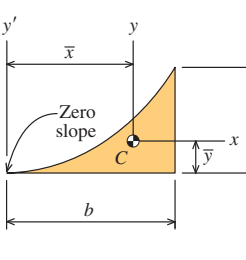
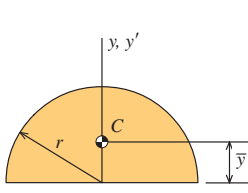
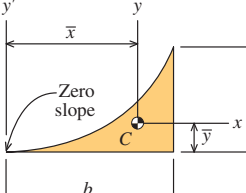


CE 2210 Quiz

Name: _____

Table A.1 Properties of Plane Figures

<p>1. Rectangle</p>  $A = bh$ $\bar{y} = \frac{h}{2} \quad I_x = \frac{bh^3}{12}$ $\bar{x} = \frac{b}{2} \quad I_y = \frac{hb^3}{12}$ $I_{x'} = \frac{bh^3}{3} \quad I_{y'} = \frac{hb^3}{3}$	<p>6. Circle</p>  $A = \pi r^2 = \frac{\pi d^2}{4}$ $I_x = I_y = \frac{\pi r^4}{4} = \frac{\pi d^4}{64}$
<p>2. Right Triangle</p>  $A = \frac{bh}{2}$ $\bar{y} = \frac{h}{3} \quad I_x = \frac{bh^3}{36}$ $\bar{x} = \frac{b}{3} \quad I_y = \frac{hb^3}{36}$ $I_{x'} = \frac{bh^3}{12} \quad I_{y'} = \frac{hb^3}{12}$	<p>7. Hollow Circle</p>  $A = \pi(R^2 - r^2) = \frac{\pi}{4}(D^2 - d^2)$ $I_x = I_y = \frac{\pi}{4}(R^4 - r^4)$ $= \frac{\pi}{64}(D^4 - d^4)$
<p>3. Triangle</p>  $A = \frac{bh}{2}$ $\bar{y} = \frac{h}{3} \quad I_x = \frac{bh^3}{36}$ $\bar{x} = \frac{(a+b)}{3} \quad I_y = \frac{bh}{36}(a^2 - ab + b^2)$ $I_{x'} = \frac{bh^3}{12}$	<p>8. Parabola</p>  $y' = \frac{h}{b^2}x'^2$ $A = \frac{2bh}{3}$ $\bar{x} = \frac{3b}{8} \quad \bar{y} = \frac{3h}{5}$ <p>Zero slope</p>
<p>4. Trapezoid</p>  $A = \frac{(a+b)h}{2}$ $\bar{y} = \frac{1}{3} \left(\frac{2a+b}{a+b} \right) h$ $I_x = \frac{h^3}{36(a+b)}(a^2 + 4ab + b^2)$	<p>9. Parabolic Spandrel</p>  $y' = \frac{h}{b^2}x'^2$ $A = \frac{bh}{3}$ $\bar{x} = \frac{3b}{4} \quad \bar{y} = \frac{3h}{10}$ <p>Zero slope</p>
<p>5. Semicircle</p>  $A = \frac{\pi r^2}{2}$ $\bar{y} = \frac{4r}{3\pi} \quad I_x = \left(\frac{\pi}{8} - \frac{8}{9\pi} \right) r^4$ $I_{x'} = I_{y'} = \frac{\pi r^4}{8}$	<p>10. General Spandrel</p>  $y' = \frac{h}{b^n}x'^n$ $A = \frac{bh}{n+1}$ $\bar{x} = \frac{n+1}{n+2}b \quad \bar{y} = \frac{n+1}{4n+2}h$ <p>Zero slope</p>

Fundamental Mechanics of Materials Equations

Common Greek letters

α	Alpha	μ	Mu
β	Beta	ν	Nu
γ	Gamma	π	Pi
Δ, δ	Delta	ρ	Rho
ε	Epsilon	Σ, σ	Sigma
θ	Theta	τ	Tau
κ	Kappa	ϕ	Phi
λ	Lambda	ω	Omega

Basic definitions

Average normal stress in an axial member

$$\sigma_{\text{avg}} = \frac{F}{A}$$

Average direct shear stress

$$\tau_{\text{avg}} = \frac{V}{A_V}$$

Average bearing stress

$$\sigma_b = \frac{F}{A_b}$$

Average normal strain in an axial member

$$\varepsilon_{\text{long}} = \frac{\Delta L}{L} = \frac{\delta}{L}$$

$$\varepsilon_{\text{lat}} = \frac{\Delta d}{d} \quad \text{or} \quad \frac{\Delta t}{t} \quad \text{or} \quad \frac{\Delta h}{h}$$

Average normal strain caused by temperature change

$$\varepsilon_T = \alpha \Delta T$$

Average shear strain

$$\gamma = \text{change in angle from } \frac{\pi}{2} \text{ rad}$$

Hooke's law (one-dimensional)

$$\sigma = E\varepsilon \quad \text{and} \quad \tau = G\gamma$$

Poisson's ratio

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

Relationship between E , G , and ν

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

Definition of allowable stress

$$\sigma_{\text{allow}} = \frac{\sigma_{\text{failure}}}{\text{FS}} \quad \text{or} \quad \tau_{\text{allow}} = \frac{\tau_{\text{failure}}}{\text{FS}}$$

Factor of safety

$$\text{FS} = \frac{\sigma_{\text{failure}}}{\sigma_{\text{actual}}} \quad \text{or} \quad \text{FS} = \frac{\tau_{\text{failure}}}{\tau_{\text{actual}}}$$

Axial deformation

Deformation in axial members

$$\delta = \frac{FL}{AE} \quad \text{or} \quad \delta = \sum_i \frac{F_i L_i}{A_i E_i}$$

Force-temperature-deformation relationship

$$\delta = \frac{FL}{AE} + \alpha \Delta T L$$

Torsion

Maximum torsion shear stress in a circular shaft

$$\tau_{\text{max}} = \frac{Tc}{J}$$

where the polar moment of inertia J is defined as:

$$J = \frac{\pi}{2} [R^4 - r^4] = \frac{\pi}{32} [D^4 - d^4]$$

Angle of twist in a circular shaft

$$\phi = \frac{TL}{JG} \quad \text{or} \quad \phi = \sum_i \frac{T_i L_i}{J_i G_i}$$

Power transmission in a shaft

$$P = T\omega$$

Power units and conversion factors

$$1 \text{ W} = \frac{1 \text{ N} \cdot \text{m}}{\text{s}} \quad 1 \text{ hp} = \frac{550 \text{ lb} \cdot \text{ft}}{\text{s}} = \frac{6,600 \text{ lb} \cdot \text{in.}}{\text{s}}$$

$$1 \text{ Hz} = \frac{1 \text{ rev}}{\text{s}} \quad 1 \text{ rev} = 2\pi \text{ rad}$$

$$1 \text{ rpm} = \frac{2\pi \text{ rad}}{60 \text{ s}}$$

Gear relationships between gears A and B

$$\frac{T_A}{R_A} = \frac{T_B}{R_B} \quad R_A \phi_A = -R_B \phi_B \quad R_A \omega_A = R_B \omega_B$$

$$\text{Gear ratio} = \frac{R_A}{R_B} = \frac{D_A}{D_B} = \frac{N_A}{N_B}$$

Six rules for constructing shear-force and bending-moment diagrams

Rule 1: $\Delta V = P_0$

Rule 2: $\Delta V = V_2 - V_1 = \int_{x_1}^{x_2} w(x) dx$

Rule 3: $\frac{dV}{dx} = w(x)$

Rule 4: $\Delta M = M_2 - M_1 = \int_{x_1}^{x_2} V dx$

Rule 5: $\frac{dM}{dx} = V$

Rule 6: $\Delta M = -M_0$

Flexure

Flexural strain and stress

$$\varepsilon_x = -\frac{1}{\rho} y \quad \sigma_x = -\frac{E}{\rho} y$$

Flexure Formula

$$\sigma_x = -\frac{My}{I_z} \quad \text{or} \quad \sigma_{\max} = \frac{Mc}{I} = \frac{M}{S} \quad \text{where } S = \frac{I}{c}$$

Transformed-section method for beams of two materials [where material (2) is transformed into an equivalent amount of material (1)]

$$n = \frac{E_2}{E_1} \quad \sigma_{x1} = -\frac{My}{I_{\text{transformed}}} \quad \sigma_{x2} = -n \frac{My}{I_{\text{transformed}}}$$

Bending due to eccentric axial load

$$\sigma_x = \frac{F}{A} - \frac{My}{I_z}$$

Unsymmetric bending of arbitrary cross sections

$$\sigma_x = \left[\frac{I_z z - I_{yz} y}{I_y I_z - I_{yz}^2} \right] M_y + \left[\frac{-I_y y + I_{yz} z}{I_y I_z - I_{yz}^2} \right] M_z$$

or

$$\sigma_x = -\frac{(M_z I_y + M_y I_{yz}) y}{I_y I_z - I_{yz}^2} + \frac{(M_y I_z + M_z I_{yz}) z}{I_y I_z - I_{yz}^2}$$

$$\tan \beta = \frac{M_y I_z + M_z I_{yz}}{M_z I_y + M_y I_{yz}}$$

Unsymmetric bending of symmetric cross sections

$$\sigma_x = \frac{M_y z}{I_y} - \frac{M_z y}{I_z} \quad \tan \beta = \frac{M_y I_z}{M_z I_y}$$

Bending of curved bars

$$\sigma_x = -\frac{M(r_n - r)}{rA(r_c - r_n)} \quad \text{where } r_n = \frac{A}{\int_A \frac{dA}{r}}$$

Horizontal shear stress associated with bending

$$\tau_H = \frac{VQ}{It} \quad \text{where } Q = \sum \bar{y}_i A_i$$

Shear flow formula

$$q = \frac{VQ}{I}$$

Shear flow, fastener spacing, and fastener shear relationship

$$q s \leq n_f V_f = n_f \tau_f A_f$$

For circular cross sections,

$$Q = \frac{2}{3} r^3 = \frac{1}{12} d^3 \quad (\text{solid sections})$$

$$Q = \frac{2}{3} [R^3 - r^3] = \frac{1}{12} [D^3 - d^3] \quad (\text{hollow sections})$$

Beam deflections

Elastic curve relations between w , V , M , θ , and v for constant EI

Deflection = v

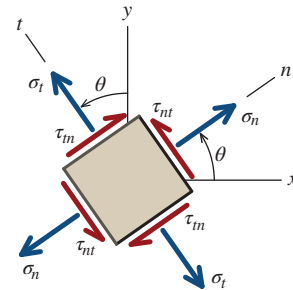
Slope = $\frac{dv}{dx} = \theta$ (for small deflections)

Moment $M = EI \frac{d^2 v}{dx^2}$

Shear $V = \frac{dM}{dx} = EI \frac{d^3 v}{dx^3}$

Load $w = \frac{dV}{dx} = EI \frac{d^4 v}{dx^4}$

Plane stress transformations



Stresses on an arbitrary plane

$$\sigma_n = \sigma_x \cos^2 \theta + \sigma_y \sin^2 \theta + 2\tau_{xy} \sin \theta \cos \theta$$

$$\sigma_t = \sigma_x \sin^2 \theta + \sigma_y \cos^2 \theta - 2\tau_{xy} \sin \theta \cos \theta$$

$$\tau_{nt} = -(\sigma_x - \sigma_y) \sin \theta \cos \theta + \tau_{xy} (\cos^2 \theta - \sin^2 \theta)$$

or

$$\sigma_n = \frac{\sigma_x + \sigma_y}{2} + \frac{\sigma_x - \sigma_y}{2} \cos 2\theta + \tau_{xy} \sin 2\theta$$

$$\sigma_t = \frac{\sigma_x + \sigma_y}{2} - \frac{\sigma_x - \sigma_y}{2} \cos 2\theta - \tau_{xy} \sin 2\theta$$

$$\tau_{nt} = -\frac{\sigma_x - \sigma_y}{2} \sin 2\theta + \tau_{xy} \cos 2\theta$$

Principal stress magnitudes

$$\sigma_{p1,p2} = \frac{\sigma_x + \sigma_y}{2} \pm \sqrt{\left(\frac{\sigma_x - \sigma_y}{2}\right)^2 + \tau_{xy}^2}$$

Orientation of principal planes

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

Maximum in-plane shear stress magnitude

$$\tau_{\max} = \pm \sqrt{\left(\frac{\sigma_x - \sigma_y}{2}\right)^2 + \tau_{xy}^2} \quad \text{or} \quad \tau_{\max} = \frac{\sigma_{p1} - \sigma_{p2}}{2}$$

$$\sigma_{\text{avg}} = \frac{\sigma_x + \sigma_y}{2}$$

$$\tan 2\theta_s = -\frac{\sigma_x - \sigma_y}{2\tau_{xy}} \quad \text{note: } \theta_s = \theta_p \pm 45^\circ$$

Absolute maximum shear stress magnitude

$$\tau_{\text{abs max}} = \frac{\sigma_{\max} - \sigma_{\min}}{2}$$

Normal stress invariance

$$\sigma_x + \sigma_y = \sigma_n + \sigma_t = \sigma_{p1} + \sigma_{p2}$$

Plane strain transformations

Strain in arbitrary directions

$$\varepsilon_n = \varepsilon_x \cos^2 \theta + \varepsilon_y \sin^2 \theta + \gamma_{xy} \sin \theta \cos \theta$$

$$\varepsilon_t = \varepsilon_x \sin^2 \theta + \varepsilon_y \cos^2 \theta - \gamma_{xy} \sin \theta \cos \theta$$

$$\gamma_{nt} = -2(\varepsilon_x - \varepsilon_y) \sin \theta \cos \theta + \gamma_{xy} (\cos^2 \theta - \sin^2 \theta)$$

or

$$\varepsilon_n = \frac{\varepsilon_x + \varepsilon_y}{2} + \frac{\varepsilon_x - \varepsilon_y}{2} \cos 2\theta + \frac{\gamma_{xy}}{2} \sin 2\theta$$

$$\varepsilon_t = \frac{\varepsilon_x + \varepsilon_y}{2} - \frac{\varepsilon_x - \varepsilon_y}{2} \cos 2\theta - \frac{\gamma_{xy}}{2} \sin 2\theta$$

$$\gamma_{nt} = -(\varepsilon_x - \varepsilon_y) \sin 2\theta + \gamma_{xy} \cos 2\theta$$

Principal strain magnitudes

$$\varepsilon_{p1,p2} = \frac{\varepsilon_x + \varepsilon_y}{2} \pm \sqrt{\left(\frac{\varepsilon_x - \varepsilon_y}{2}\right)^2 + \left(\frac{\gamma_{xy}}{2}\right)^2}$$

Orientation of principal strains

$$\tan 2\theta_p = \frac{\gamma_{xy}}{\varepsilon_x - \varepsilon_y}$$

Maximum in-plane shear strain

$$\gamma_{\max} = \pm 2 \sqrt{\left(\frac{\varepsilon_x - \varepsilon_y}{2}\right)^2 + \left(\frac{\gamma_{xy}}{2}\right)^2} \quad \text{or} \quad \gamma_{\max} = \varepsilon_{p1} - \varepsilon_{p2}$$

$$\varepsilon_{\text{avg}} = \frac{\varepsilon_x + \varepsilon_y}{2}$$

Normal strain invariance

$$\varepsilon_x + \varepsilon_y = \varepsilon_n + \varepsilon_t = \varepsilon_{p1} + \varepsilon_{p2}$$

Generalized Hooke's law

Normal stress/normal strain relationships

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

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

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

$$\sigma_x = \frac{E}{(1+\nu)(1-2\nu)} [(1-\nu)\varepsilon_x + \nu(\varepsilon_y + \varepsilon_z)]$$

$$\sigma_y = \frac{E}{(1+\nu)(1-2\nu)} [(1-\nu)\varepsilon_y + \nu(\varepsilon_x + \varepsilon_z)]$$

$$\sigma_z = \frac{E}{(1+\nu)(1-2\nu)} [(1-\nu)\varepsilon_z + \nu(\varepsilon_x + \varepsilon_y)]$$

Shear stress/shear strain relationships

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

where

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

Volumetric strain or Dilatation

$$e = \frac{\Delta V}{V} = \varepsilon_x + \varepsilon_y + \varepsilon_z = \frac{1-2\nu}{E} (\sigma_x + \sigma_y + \sigma_z)$$

Bulk modulus

$$K = \frac{E}{3(1-2\nu)}$$

Normal stress/normal strain relationships for plane stress

$$\varepsilon_x = \frac{1}{E} (\sigma_x - \nu\sigma_y)$$

$$\varepsilon_y = \frac{1}{E} (\sigma_y - \nu\sigma_x)$$

$$\varepsilon_z = -\frac{\nu}{E} (\sigma_x + \sigma_y)$$

$$\varepsilon_z = -\frac{\nu}{1-\nu} (\varepsilon_x + \varepsilon_y)$$

$$\sigma_x = \frac{E}{1-\nu^2} (\varepsilon_x + \nu\varepsilon_y)$$

$$\sigma_y = \frac{E}{1-\nu^2} (\varepsilon_y + \nu\varepsilon_x)$$

Shear stress/shear strain relationships for plane stress

$$\gamma_{xy} = \frac{1}{G} \tau_{xy} \quad \text{or} \quad \tau_{xy} = G\gamma_{xy}$$

Thin-walled pressure vessels

Tangential stress and strain in spherical pressure vessel

$$\sigma_t = \frac{pr}{2t} = \frac{pd}{4t} \quad \varepsilon_t = \frac{pr}{2tE}(1-\nu)$$

Longitudinal and circumferential stresses in cylindrical pressure vessels

$$\sigma_{\text{long}} = \frac{pr}{2t} = \frac{pd}{4t} \quad \varepsilon_{\text{long}} = \frac{pr}{2tE}(1-2\nu)$$

$$\sigma_{\text{hoop}} = \frac{pr}{t} = \frac{pd}{2t} \quad \varepsilon_{\text{hoop}} = \frac{pr}{2tE}(2-\nu)$$

Thick-walled pressure vessels

Radial stress in thick-walled cylinder

$$\sigma_r = \frac{a^2 p_i - b^2 p_o}{b^2 - a^2} - \frac{a^2 b^2 (p_i - p_o)}{(b^2 - a^2)r^2}$$

or

$$\sigma_r = \frac{a^2 p_i}{b^2 - a^2} \left(1 - \frac{b^2}{r^2}\right) - \frac{b^2 p_o}{b^2 - a^2} \left(1 - \frac{a^2}{r^2}\right)$$

Circumferential stress in thick-walled cylinder

$$\sigma_\theta = \frac{a^2 p_i - b^2 p_o}{b^2 - a^2} + \frac{a^2 b^2 (p_i - p_o)}{(b^2 - a^2)r^2}$$

or

$$\sigma_\theta = \frac{a^2 p_i}{b^2 - a^2} \left(1 + \frac{b^2}{r^2}\right) - \frac{b^2 p_o}{b^2 - a^2} \left(1 + \frac{a^2}{r^2}\right)$$

Maximum shear stress

$$\tau_{\text{max}} = \frac{1}{2}(\sigma_\theta - \sigma_r) = \frac{a^2 b^2 (p_i - p_o)}{(b^2 - a^2)r^2}$$

Longitudinal normal stress in closed cylinder

$$\sigma_{\text{long}} = \frac{a^2 p_i - b^2 p_o}{b^2 - a^2}$$

Radial displacement for internal pressure only

$$\delta_r = \frac{a^2 p_i}{(b^2 - a^2)rE} [(1-\nu)r^2 + (1+\nu)b^2]$$

Radial displacement for external pressure only

$$\delta_r = -\frac{b^2 p_o}{(b^2 - a^2)rE} [(1-\nu)r^2 + (1+\nu)a^2]$$

Radial displacement for external pressure on solid cylinder

$$\delta_r = -\frac{(1-\nu)p_o r}{E}$$

Contact pressure for interference fit connection of thick cylinder onto a thick cylinder

$$p_c = \frac{E\delta(c^2 - b^2)(b^2 - a^2)}{2b^3(c^2 - a^2)}$$

Contact pressure for interference fit connection of thick cylinder onto a solid cylinder

$$p_c = \frac{E\delta(c^2 - b^2)}{2bc^2}$$

Failure theories

Mises equivalent stress for plane stress

$$\sigma_M = [\sigma_{p1}^2 - \sigma_{p1}\sigma_{p2} + \sigma_{p2}^2]^{1/2} = [\sigma_x^2 - \sigma_x\sigma_y + \sigma_y^2 + 3\tau_{xy}^2]^{1/2}$$

Column buckling

Euler buckling load

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

Euler buckling stress

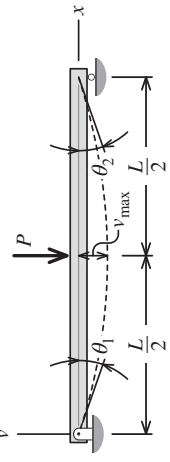
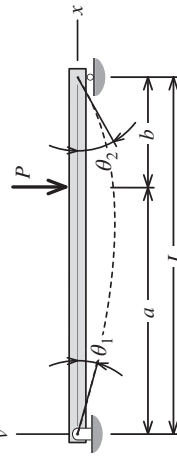
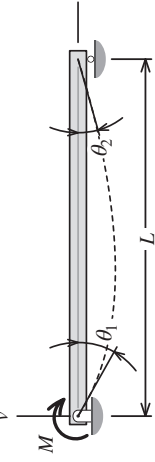
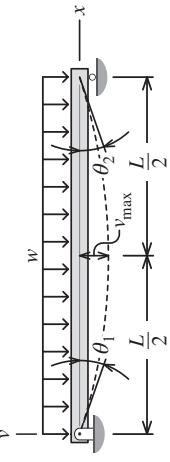
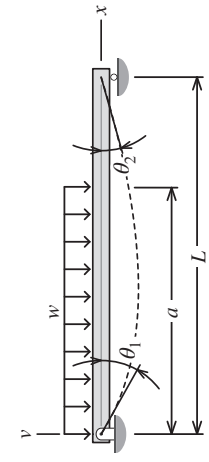
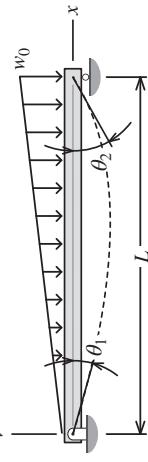
$$\sigma_{cr} = \frac{\pi^2 E}{(KL/r)^2}$$

Radius of gyration

$$r^2 = \frac{I}{A}$$

Secant formula

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

	Beam	Slope	Deflection	Elastic Curve
1		$\theta_1 = -\theta_2 = -\frac{PL^2}{16EI}$	$v_{\max} = -\frac{PL^3}{48EI}$	$v = -\frac{Px}{48EI}(3L^2 - 4x^2)$ <p>for $0 \leq x \leq \frac{L}{2}$</p>
2		$\theta_1 = -\frac{Pb(L^2 - b^2)}{6LEI}$ $\theta_2 = +\frac{Pa(L^2 - a^2)}{6LEI}$	$v = -\frac{Pa^2b^2}{3LEI}$ <p>at $x = a$</p>	$v = -\frac{Pbx}{6LEI}(L^2 - b^2 - x^2)$ <p>for $0 \leq x \leq a$</p>
3		$\theta_1 = -\frac{ML}{3EI}$ $\theta_2 = +\frac{ML}{6EI}$	$v_{\max} = -\frac{ML^2}{9\sqrt{3}EI}$ <p>at $x = L\left(1 - \frac{\sqrt{3}}{3}\right)$</p>	$v = -\frac{Mx}{6LEI}(2L^2 - 3Lx + x^2)$
4		$\theta_1 = -\theta_2 = -\frac{wL^3}{24EI}$	$v_{\max} = -\frac{5wL^4}{384EI}$	$v = -\frac{wx}{24EI}(L^3 - 2Lx^2 + x^3)$
5		$\theta_1 = -\frac{wa^2}{24LEI}(2L - a)^2$ $\theta_2 = +\frac{wa^2}{24LEI}(2L^2 - a^2)$	$v = -\frac{wa^3}{24LEI}(4L^2 - 7aL + 3a^2)$ <p>at $x = a$</p>	$v = -\frac{wx}{24LEI}(Lx^3 - 4aLx^2 + 2a^2x^2 + 4a^2L^2 - 4a^3L + a^4)$ <p>for $0 \leq x \leq a$</p> $v = -\frac{wa^2}{24LEI}(2x^3 - 6Lx^2 + a^2x + 4L^2x - a^2L)$ <p>for $a \leq x \leq L$</p>
6		$\theta_1 = -\frac{7w_0L^3}{360EI}$ $\theta_2 = +\frac{w_0L^3}{45EI}$	$v_{\max} = -0.00652\frac{w_0L^4}{EI}$ <p>at $x = 0.5193L$</p>	$v = -\frac{w_0x}{360LEI}(7L^4 - 10L^2x^2 + 3x^4)$

Cantilever Beams

	Beam	Slope	Deflection	Elastic Curve
7		$\theta_{\max} = -\frac{PL^2}{2EI}$	$v_{\max} = -\frac{PL^3}{3EI}$	$v = -\frac{Px^2}{6EI}(3L - x)$
8		$\theta_{\max} = -\frac{PL^2}{8EI}$	$v_{\max} = -\frac{5PL^3}{48EI}$	$v = -\frac{Px^2}{12EI}(3L - 2x) \quad \text{for } 0 \leq x \leq \frac{L}{2}$ $v = -\frac{PL^2}{48EI}(6x - L) \quad \text{for } \frac{L}{2} \leq x \leq L$
9		$\theta_{\max} = -\frac{ML}{EI}$	$v_{\max} = -\frac{ML^2}{2EI}$	$v = -\frac{Mx^2}{2EI}$
10		$\theta_{\max} = -\frac{wL^3}{6EI}$	$v_{\max} = -\frac{wL^4}{8EI}$	$v = -\frac{wx^2}{24EI}(6L^2 - 4Lx + x^2)$
11		$\theta_{\max} = -\frac{w_0L^3}{24EI}$	$v_{\max} = -\frac{w_0L^4}{30EI}$	$v = -\frac{w_0x^2}{120EI}(10L^3 - 10L^2x + 5Lx^2 - x^3)$