# COMMONLY USED FORMULAS IN STRUCTURAL ANALYSIS

## CALCULATING ACTUAL STRESS:

bending: $f_b = \frac{M}{S}$

axial: $f_a = \frac{P}{A}$

shear: $f_v = \frac{3}{2}\frac{V}{A}$ (rectangular cross section only)

## SECTION PROPERTIES FOR A RECTANGULAR CROSS SECTION:

$I = \frac{bd^3}{12}$ $S = \frac{I}{c} = \frac{bd^2}{6}$ $A = bd$

## MIDSPAN DEFLECTION OF A SIMPLY-SUPPORTED, UNIFORMLY LOADED BEAM:

$\Delta = \frac{5wL^4}{384EI}$ note: *w* denotes the distributed load (e.g. kips per foot)

## BUCKLING THEORY:

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

$$f_{cr} = \frac{P_{cr}}{A} = \frac{\pi^2 EI}{(kL)^2 A} = \frac{\pi^2 E}{\left(\frac{kL}{r}\right)^2}$$

$$r = \sqrt{\frac{I}{A}}$$

DESIGN CRITERIA: (actual stress) $\leq$ (allowable stress)

- Bending stress: $f_b \leq F_b$
- Shear stress: $f_v \leq F_v$
- Axial stress: $f_a \leq F_a$

  where $F_a$ is the allowable stress in tension or compression.

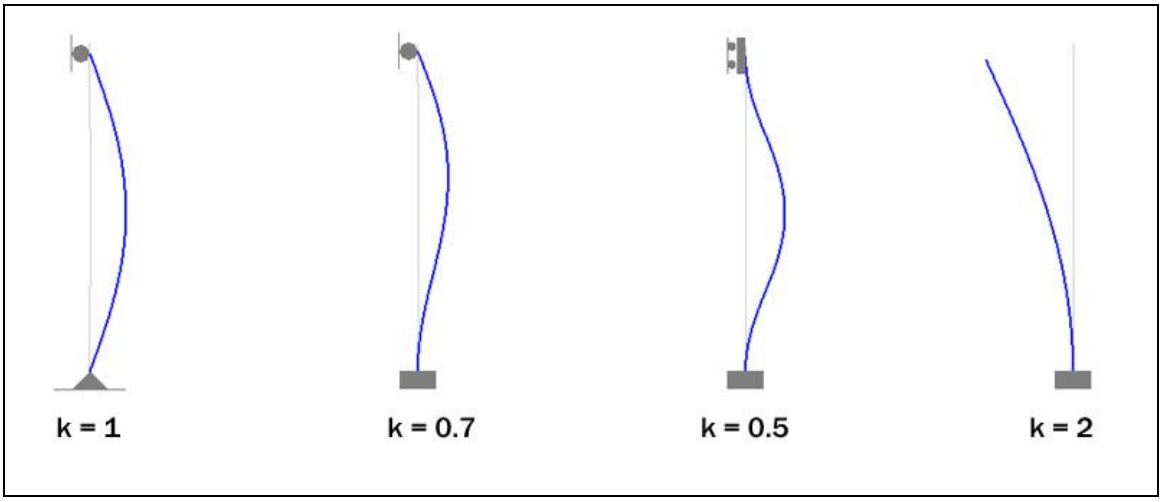
The allowable compression stress is the smallest of:

| | |
|---|---|
| allowable crushing stress | $F_c$ |
| allowable weak-axis buckling stress | $F_{cr_y}$ |
| allowable strong-axis buckling stress | $F_{cr_x}$ |

where the allowable buckling stress is:

$$F_{cr} = \frac{f_{cr}}{\text{Factor of Safety}}$$

- Effective length factors for various column end conditions:




- Interaction formula for combined bending and axial stress:

$$\frac{f_a}{F_a} + \frac{f_b}{F_b} \leq 1$$