Important Allowable-Stress Design Formulas PDF

Formulas
Examples
with Units

List of 17
Important Allowable-Stress Design Formulas

1) Allowable-Stress Design for Building Beams Formulas

1.1) Allowable Stress for Solid Compression Flange having Area not Less than Tension Flange Formula

Evaluate Formula

Formula

$$F_b = \frac{12000 \cdot C_b}{\frac{l_{max} \cdot d}{A_f}}$$

Example with Units

$$367.3087\,\text{MPa} = \frac{12000 \cdot 1.960}{\frac{1921\,\text{mm} \cdot 350\,\text{mm}}{10500\,\text{mm}^2}}$$

1.2) Allowable Stress given Simplifying Term between 0.2 and 1 Formula

Evaluate Formula

Formula

$$F_b = \frac{(2 - Q) \cdot F_y}{3}$$

Example with Units

$$156.5054\,\text{MPa} = \frac{(2 - 0.121935) \cdot 250\,\text{MPa}}{3}$$

1.3) Allowable Stress when Simplifying Term Greater than 1 Formula

Evaluate Formula

Formula

$$F_b = \frac{F_y}{3 \cdot Q}$$

Example with Units

$$683.4242\,\text{MPa} = \frac{250\,\text{MPa}}{3 \cdot 0.121935}$$

1.4) Maximum Fiber Stress in Bending for Laterally Supported Compact Beams and Girders Formula

Evaluate Formula

Formula

$$F_b = 0.66 \cdot F_y$$

Example with Units

$$165\,\text{MPa} = 0.66 \cdot 250\,\text{MPa}$$

1.5) Maximum Fiber Stress in Bending for Laterally Supported Noncompact Beams and Girders Formula

Evaluate Formula

Formula

$$F_b = 0.60 \cdot F_y$$

Example with Units

$$150\,\text{MPa} = 0.60 \cdot 250\,\text{MPa}$$

1.6) Maximum Unsupported Length of Compression Flange-1 Formula

Evaluate Formula

Formula

$$l_{max} = \frac{76.0 \cdot b_f}{\sqrt{F_y}}$$

Example with Units

$$21629.9792\,\text{mm} = \frac{76.0 \cdot 4500\,\text{mm}}{\sqrt{250\,\text{MPa}}}$$

1.7) Maximum Unsupported Length of Compression Flange-2 Formula

Evaluate Formula

Formula

$$l_{max} = \frac{20000}{\frac{F_y \cdot d}{A_f}}$$

Example with Units

$$2400\,\text{mm} = \frac{20000}{\frac{250\,\text{MPa} \cdot 350\,\text{mm}}{10500\,\text{mm}^2}}$$

1.8) Modifier for Moment Gradient Formula

Evaluate Formula

Formula

$$C_b = 1.75 + \left(1.05 \cdot \left(\frac{M_1}{M_2}\right)\right) + \left(0.3 \cdot \left(\frac{M_1}{M_2}\right)^2\right)$$

Example with Units

$$1.9609 = 1.75 + \left(1.05 \cdot \left(\frac{10\,\text{kN*m}}{52.5\,\text{kN*m}}\right)\right) + \left(0.3 \cdot \left(\frac{10\,\text{kN*m}}{52.5\,\text{kN*m}}\right)^2\right)$$

1.9) Simplifying Term for Allowable Stress Equations Formula

Evaluate Formula

Formula

$$Q = \frac{\left(\frac{l_{max}}{r}\right)^2 \cdot F_y}{510000 \cdot C_b}$$

Example with Units

$$0.1219 = \frac{\left(\frac{1921\,\text{mm}}{87\,\text{mm}}\right)^2 \cdot 250\,\text{MPa}}{510000 \cdot 1.960}$$

2) Allowable-Stress Design for Building Columns Formulas

2.1) Allowable Compressive Stress when Slenderness Ratio is Greater than Cc Formula

Evaluate Formula

Formula

$$F_a = \frac{12 \cdot \pi^2 \cdot E_s}{23 \cdot \left(\frac{k \cdot l}{r}\right)^2}$$

Example with Units

$$1539.7727\,\text{MPa} = \frac{12 \cdot 3.1416^2 \cdot 200000\,\text{MPa}}{23 \cdot \left(\frac{0.75 \cdot 3000\,\text{mm}}{87\,\text{mm}}\right)^2}$$

2.2) Allowable Compressive Stress when Slenderness Ratio is Less than Cc Formula

Evaluate Formula

Formula

$$F_a = \frac{\left(1 - \left(\frac{\left(\frac{k \cdot l}{r}\right)^2}{2 \cdot C_c^{\,2}}\right)\right) \cdot F_y}{F_s}$$

Example with Units

$$140.6352\,\text{MPa} = \frac{\left(1 - \left(\frac{\left(\frac{0.75 \cdot 3000\,\text{mm}}{87\,\text{mm}}\right)^2}{2 \cdot 125.66^2}\right)\right) \cdot 250\,\text{MPa}}{1.74}$$

2.3) Effective Length Factor Formula

Evaluate Formula

Formula

$$k = \frac{l}{l'}$$

Example with Units

$$0.75 = \frac{3000\,\text{mm}}{4000\,\text{mm}}$$

2.4) Factor for Unbraced Segment of any Cross-Section Formula

Evaluate Formula

Formula

$$C_c = \frac{1986.66}{\sqrt{F_y}}$$

Example with Units

$$125.6474 = \frac{1986.66}{\sqrt{250\,\text{MPa}}}$$

2.5) Safety Factor for Allowable Compressive Stress Formula

Evaluate Formula

Formula

$$F_s = \frac{5}{3} + \left(\frac{3 \cdot \left(\frac{k \cdot l}{r}\right)}{8 \cdot C_c}\right) - \left(\frac{\left(\frac{k \cdot l}{r}\right)^3}{8 \cdot C_c^{\,3}}\right)$$

Example with Units

$$1.7428 = \frac{5}{3} + \left(\frac{3 \cdot \left(\frac{0.75 \cdot 3000\,\text{mm}}{87\,\text{mm}}\right)}{8 \cdot 125.66}\right) - \left(\frac{\left(\frac{0.75 \cdot 3000\,\text{mm}}{87\,\text{mm}}\right)^3}{8 \cdot 125.66^{\,3}}\right)$$

2.6) Slenderness Ratio Used for Separation Formula

Evaluate Formula

Formula

$$C_c = \sqrt{\frac{2 \cdot \left(\pi^2\right) \cdot E_s}{F_y}}$$

Example with Units

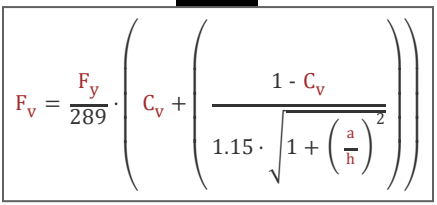
$$125.6637 = \sqrt{\frac{2 \cdot \left(3.1416^2\right) \cdot 200000\,\text{MPa}}{250\,\text{MPa}}}$$

3) Allowable-Stress Design for Shear in Buildings Formulas

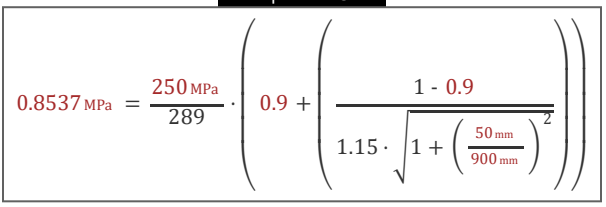
3.1) Allowable Shear Stress with Tension Field Action Formula

Evaluate Formula

Formula



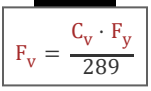
Example with Units



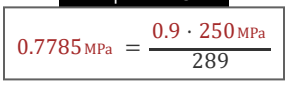
3.2) Allowable Shear Stress without Tension Field Action Formula

Evaluate Formula

Formula



Example with Units



Variables used in list of Allowable-Stress Design Formulas above

- **a** Spacing of Stiffeners *(Millimeter)*
- A_f Area of Compression Flange *(Square Millimeter)*
- b_f Width of Compression Flange *(Millimeter)*
- C_b Moment Gradient Factor
- C_c Factor for Allowable Stress Design
- C_v Stress Buckling Coefficient
- **d** Beam Depth *(Millimeter)*
- E_s Modulus of Elasticity of Steel *(Megapascal)*
- F_a Allowable Compression Stress *(Megapascal)*
- F_b Maximum Fiber Stress *(Megapascal)*
- F_s Safety Factor
- F_v Allowable Shear Stress *(Megapascal)*
- F_y Yield Stress of Steel *(Megapascal)*
- **h** Height of Web *(Millimeter)*
- **k** Effective Length Factor
- **l** Effective Column Length *(Millimeter)*
- **l'** Actual Unbraced Length *(Millimeter)*
- l_{max} Maximum Unbraced Length *(Millimeter)*
- M_1 Smaller Beam End Moment *(Kilonewton Meter)*
- M_2 Larger Beam End Moment *(Kilonewton Meter)*
- **Q** Simplifying Term for Fb
- **r** Radius of Gyration *(Millimeter)*

Constants, Functions, Measurements used in list of Allowable-Stress Design Formulas above

- constant(s): **pi**, 3.14159265358979323846264338327950288 *Archimedes' constant*
- Functions: **sqrt**, sqrt(Number) *A square root function is a function that takes a non-negative number as an input and returns the square root of the given input number.*
- Measurement: **Length** in Millimeter (mm) *Length Unit Conversion*
- Measurement: **Area** in Square Millimeter (mm²) *Area Unit Conversion*
- Measurement: **Pressure** in Megapascal (MPa) *Pressure Unit Conversion*
- Measurement: **Moment of Force** in Kilonewton Meter (kN*m) *Moment of Force Unit Conversion*
- Measurement: **Stress** in Megapascal (MPa) *Stress Unit Conversion*

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