Important Cold Formed or Light Weighted Steel Structures Formulas PDF

Formulas
Examples
with Units

List of 15
Important Cold Formed or Light Weighted Steel Structures Formulas

1) Allowable Design Strength Formula

Evaluate Formula

Formula

$$R_a = \frac{R_n}{f_s}$$

Example with Units

$$833.3333\,\text{MPa} = \frac{1500\,\text{MPa}}{1.8}$$

2) Compressive Stress when Basic Design Stress restricted to 20000 psi Formula

Evaluate Formula

Formula

$$f_c = 24700 - 470 \cdot w_t$$

Example with Units

$$18.59\,\text{kN/m}^2 = 24700 - 470 \cdot 13$$

3) Compressive Stress when Flat Width Ratio is between 10 and 25 Formula

Evaluate Formula

Formula

$$f_c = \left(\frac{5 \cdot f_b}{3}\right) - 8640 - \left(\left(\frac{1}{15}\right) \cdot \left(f_b - 12950\right) \cdot w_t\right)$$

Example with Units

$$18.5833\,\text{kN/m}^2 = \left(\frac{5 \cdot 20\,\text{kN/m}^2}{3}\right) - 8640 - \left(\left(\frac{1}{15}\right) \cdot \left(20\,\text{kN/m}^2 - 12950\right) \cdot 13\right)$$

4) Depth of Stiffener Lip Formula

Evaluate Formula

Formula

$$d = 2.8 \cdot t \cdot \left(\left(w_t\right)^2 - 144\right)^{\frac{1}{6}}$$

Example with Units

$$143.638\,\text{mm} = 2.8 \cdot 30\,\text{mm} \cdot \left(\left(13\right)^2 - 144\right)^{\frac{1}{6}}$$

5) Elastic Local Buckling Stress Formula

Evaluate Formula

Formula

$$f_{cr} = \frac{k \cdot \pi^2 \cdot E_s}{12 \cdot w_t^2 \cdot \left(1 - \mu^2\right)}$$

Example with Units

$$2139.1951\,\text{MPa} = \frac{2 \cdot 3.1416^2 \cdot 200000\,\text{MPa}}{12 \cdot 13^2 \cdot \left(1 - 0.3^2\right)}$$

6) Flat Width Ratio for Deflection Determination Formula

Evaluate Formula

Formula

$$w_t = \frac{5160}{\sqrt{f_{uc}}}$$

Example with Units

$$13.3231 = \frac{5160}{\sqrt{0.15\,\text{MPa}}}$$

7) Flat Width Ratio for Safe Load Determination Formula

Evaluate Formula

Formula

$$w_t = \frac{4020}{\sqrt{f_{uc}}}$$

Example with Units

$$10.3796 = \frac{4020}{\sqrt{0.15\,\text{MPa}}}$$

8) Flat Width Ratio given Depth of Stiffener Lip Formula

Evaluate Formula

Formula

$$w_t = \sqrt{\left(\frac{d}{2.8 \cdot t}\right)^6 + 144}$$

Example with Units

$$13 = \sqrt{\left(\frac{143.638\,\text{mm}}{2.8 \cdot 30\,\text{mm}}\right)^6 + 144}$$

9) Flat Width Ratio given Plate Slenderness Factor Formula

Evaluate Formula

Formula

$$w_t = \lambda \cdot \sqrt{\frac{k \cdot E_s}{f_{emax}}} \cdot \left(\frac{1}{1.052}\right)$$

Example with Units

$$12.9797 = 0.326 \cdot \sqrt{\frac{2 \cdot 200000\,\text{MPa}}{228\,\text{MPa}}} \cdot \left(\frac{1}{1.052}\right)$$

10) Flat Width Ratio of Stiffened Element using Elastic Local Buckling Stress Formula

Evaluate Formula

Formula

$$w_t = \sqrt{\frac{k \cdot \pi^2 \cdot E_s}{12 \cdot f_{cr} \cdot \left(1 - \mu^2\right)}}$$

Example with Units

$$13 = \sqrt{\frac{2 \cdot 3.1416^2 \cdot 200000\,\text{MPa}}{12 \cdot 2139.195\,\text{MPa} \cdot \left(1 - 0.3^2\right)}}$$

11) Flat Width Ratio of Stiffened Element using Moment of Inertia Formula

Evaluate Formula

Formula

$$w_t = \sqrt{\left(\frac{I_{min}}{1.83 \cdot t^4}\right)^2 + 144}$$

Example with Units

$$12.997 = \sqrt{\left(\frac{7.4\text{E+}6\,\text{mm}^4}{1.83 \cdot 30\,\text{mm}^4}\right)^2 + 144}$$

12) Minimum Allowable Moment of Inertia Formula

Evaluate Formula

Formula

$$I_{min} = 1.83 \cdot \left(t^4\right) \cdot \sqrt{\left(w_t^2\right) - 144}$$

Example with Units

$$7.4\text{E+}6\,\text{mm}^4 = 1.83 \cdot \left(30\,\text{mm}^4\right) \cdot \sqrt{\left(13^2\right) - 144}$$

13) Nominal Strength using Allowable Design Strength Formula

Evaluate Formula

Formula

$$R_n = f_s \cdot R_a$$

Example with Units

$$1499.994\,\text{MPa} = 1.8 \cdot 833.33\,\text{MPa}$$

14) Plate Slenderness Factor Formula

Evaluate Formula

Formula

$$\lambda = \left(\frac{1.052}{\sqrt{k}}\right) \cdot w_t \cdot \sqrt{\frac{f_{emax}}{E_s}}$$

Example with Units

$$0.3265 = \left(\frac{1.052}{\sqrt{2}}\right) \cdot 13 \cdot \sqrt{\frac{228\,\text{MPa}}{200000\,\text{MPa}}}$$

15) Reduction Factor for Cold Form Strength Determination Formula

Evaluate Formula

Formula

$$\rho = \frac{1 - \left(\frac{0.22}{\lambda}\right)}{\lambda}$$

Example

$$0.9974 = \frac{1 - \left(\frac{0.22}{0.326}\right)}{0.326}$$

Variables used in list of Cold Formed or Light Weighted Steel Structures Formulas above

- **d** Depth of Stiffener Lip *(Millimeter)*
- E_s Modulus of Elasticity for Steel Elements *(Megapascal)*
- f_b Design Stress *(Kilonewton per Square Meter)*
- f_c Maximum Compressive Stress of Concrete *(Kilonewton per Square Meter)*
- f_{cr} Elastic Local Buckling Stress *(Megapascal)*
- f_{emax} Maximum Compressive Edge Stress *(Megapascal)*
- f_s Safety Factor for Design Strength
- f_{uc} Computed Unit Stress of Cold formed Element *(Megapascal)*
- I_{min} Minimum Area Moment of Inertia *(Millimeter⁴)*
- **k** Local Buckling Coefficient
- R_a Allowable Design Strength *(Megapascal)*
- R_n Nominal Strength *(Megapascal)*
- **t** Thickness of Steel Compression Element *(Millimeter)*
- w_t Flat Width Ratio
- **λ** Plate Slenderness Factor
- **μ** Poission Ratio for Plates
- **ρ** Reduction Factor

Constants, Functions, Measurements used in list of Cold Formed or Light Weighted Steel Structures 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: **Pressure** in Megapascal (MPa), Kilonewton per Square Meter (kN/m²) *Pressure Unit Conversion*
- Measurement: **Second Moment of Area** in Millimeter⁴ (mm⁴) *Second Moment of Area Unit Conversion*
- Measurement: **Stress** in Megapascal (MPa) *Stress Unit Conversion*

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