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Allowable Design for Column Formulas

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List of 15 Allowable Design for Column Formulas

Allowable Design for Column

Allowable-Stress Design Approach (AISC)

1) Allowable Bearing Pressure given Area of Lowest Column of Structure

$$fx \quad F_p = \frac{P}{A}$$

Open Calculator 

$$ex \quad 17MPa = \frac{59.5N}{3.5m^2}$$

2) Allowable Bearing Pressure when Full Area of Support is Occupied by Base Plate

$$fx \quad F_p = 0.35 \cdot f'_c$$

Open Calculator 

$$ex \quad 19.25MPa = 0.35 \cdot 55.0MPa$$

3) Area of Foundation of Lowest Column of Structure

$$fx \quad A = \frac{P}{F_p}$$

Open Calculator 

$$ex \quad 3.5m^2 = \frac{59.5N}{17MPa}$$



4) Base Plate Thickness

$$fx \quad t_p = 2 \cdot l \cdot \left(\sqrt{\frac{f_p}{F_y}} \right)$$

[Open Calculator !\[\]\(cbe80b694ebd74fcfe136a095b608235_img.jpg\)](#)

$$ex \quad 70.014\text{mm} = 2 \cdot 25\text{mm} \cdot \left(\sqrt{\frac{100\text{MPa}}{51\text{MPa}}} \right)$$

5) Bearing Pressure on Base Plate

$$fx \quad f_p = \frac{(t_p^2) \cdot F_y}{(2 \cdot l)^2}$$

[Open Calculator !\[\]\(3e2231b1ad3ca8da8658228c00dd08e0_img.jpg\)](#)

$$ex \quad 99.96\text{MPa} = \frac{((70\text{mm})^2) \cdot 51\text{MPa}}{(2 \cdot 25\text{mm})^2}$$

6) Depth of Section of Column for Equivalent Cantilever Dimension

$$fx \quad d = (n'^2) \cdot \frac{16}{b_f}$$

[Open Calculator !\[\]\(0d5ec72f61334709c3fc9450209b754f_img.jpg\)](#)

$$ex \quad 40\text{mm} = ((5)^2) \cdot \frac{16}{10\text{mm}}$$



7) Equivalent Cantilever Dimension

$$f_x \quad n' = \left(\frac{1}{4} \right) \cdot \sqrt{d \cdot b_f}$$

[Open Calculator !\[\]\(e78f798d4ea5c530c9db49e7d26e6b95_img.jpg\)](#)

$$ex \quad 4.031129 = \left(\frac{1}{4} \right) \cdot \sqrt{26\text{mm} \cdot 10\text{mm}}$$

8) Load using Area of Lowest Column of Structure

$$f_x \quad P = F_p \cdot A$$

[Open Calculator !\[\]\(05be7c7a8995decd503647c99211f7c2_img.jpg\)](#)

$$ex \quad 59.5\text{N} = 17\text{MPa} \cdot 3.5\text{m}^2$$

9) Width of Flange Column for Equivalent Cantilever Dimension

$$f_x \quad b_f = (n')^2 \cdot \frac{16}{d}$$

[Open Calculator !\[\]\(fe3aebe81acea8d45108cd2768939da7_img.jpg\)](#)

$$ex \quad 15.38462\text{mm} = \left((5)^2 \right) \cdot \frac{16}{26\text{mm}}$$

10) Yield Strength of Base Plate

$$f_x \quad F_y = (2 \cdot l)^2 \cdot \frac{f_p}{(t_p)^2}$$

[Open Calculator !\[\]\(899d8b7697d64725bf017d3296cfcf1b_img.jpg\)](#)

$$ex \quad 51.02041\text{MPa} = (2 \cdot 25\text{mm})^2 \cdot \frac{100\text{MPa}}{(70\text{mm})^2}$$



Allowable Design Loads for Aluminium Columns

11) Allowable Compressive Stress for Aluminium Columns

[Open Calculator !\[\]\(e2376d476d06eb31946dc01a69a4403a_img.jpg\)](#)

$$fx \quad F_e = \frac{c \cdot \pi^2 \cdot E}{\left(\frac{L}{\rho}\right)^2}$$

$$ex \quad 54.83114MPa = \frac{4 \cdot \pi^2 \cdot 50MPa}{\left(\frac{3000mm}{500mm}\right)^2}$$

12) Allowable Compressive Stress for Aluminium Columns given Column Yield Stress

[Open Calculator !\[\]\(0b5e7e25e8775f7e7e80906ada4f0021_img.jpg\)](#)

$$fx \quad F_e = F_{ce} \cdot \left(1 - \left(K \cdot \left(\frac{\frac{L}{\rho}}{\pi \cdot \sqrt{c \cdot \frac{E}{F_{ce}}}} \right)^k \right) \right)$$

$$ex \quad 14.17368MPa = 15MPa \cdot \left(1 - \left(0.385 \cdot \left(\frac{\frac{3000mm}{500mm}}{\pi \cdot \sqrt{4 \cdot \frac{50MPa}{15MPa}}} \right)^3 \right) \right)$$



13) Length of Column given Allowable Compressive Stress for Aluminium Columns

$$\text{fx } L = \sqrt{\frac{c \cdot \pi^2 \cdot E}{\frac{F_e}{(\rho)^2}}}$$

[Open Calculator !\[\]\(d3fb9f94af8b26d1c844efa9a98805b0_img.jpg\)](#)

$$\text{ex } 2995.391\text{mm} = \sqrt{\frac{4 \cdot \pi^2 \cdot 50\text{MPa}}{\frac{55\text{MPa}}{(500\text{mm})^2}}}$$

14) Radius of Gyration of Column given Allowable Compressive Stress for Aluminium Columns

$$\text{fx } \rho = \sqrt{\frac{F_e \cdot L^2}{c \cdot (\pi^2) \cdot E}}$$

[Open Calculator !\[\]\(e1d6102fe77919492c04879c8450f1f5_img.jpg\)](#)

$$\text{ex } 500.7693\text{mm} = \sqrt{\frac{55\text{MPa} \cdot (3000\text{mm})^2}{4 \cdot (\pi^2) \cdot 50\text{MPa}}}$$

15) Transition from Long to Short Column Range

$$\text{fx } \lambda = \pi \cdot \left(\sqrt{c \cdot k \cdot \frac{E}{F_{ce}}} \right)$$

[Open Calculator !\[\]\(ab4e2b3fc7e7887b7a72f548aa6f5e60_img.jpg\)](#)

$$\text{ex } 19.86918 = \pi \cdot \left(\sqrt{4 \cdot 3 \cdot \frac{50\text{MPa}}{15\text{MPa}}} \right)$$








Variables Used

- **A** Area of Foundation (Square Meter)
- **b_f** Width of Flange (Millimeter)
- **c** End Fixity Coefficient
- **d** Depth of Section of Column (Millimeter)
- **E** Modulus of Elasticity (Megapascal)
- **f'_c** 28-Day Compressive Strength of Concrete (Megapascal)
- **F_{ce}** Column Yield Stress (Megapascal)
- **F_e** Allowable Column Compressive Stress (Megapascal)
- **f_p** Bearing Pressure on Base Plate (Megapascal)
- **F_p** Allowable Bearing Pressure (Megapascal)
- **F_y** Yield Strength of Base Plate (Megapascal)
- **k** Aluminum Constant
- **K** Aluminum Alloy Constant K
- **l** Maximum Cantilever Dimension (Millimeter)
- **L** Effective Length of Column (Millimeter)
- **n'** Equivalent Cantilever Dimension
- **P** Columns Axial Load (Newton)
- **t_p** Base Plate Thickness (Millimeter)
- **λ** Slenderness Ratio of Column
- **ρ** Radius of Gyration of Column (Millimeter)



Constants, Functions, Measurements used

- **Constant:** **pi**, 3.14159265358979323846264338327950288
Archimedes' constant
- **Function:** **sqrt**, sqrt(Number)
Square root function
- **Measurement:** **Length** in Millimeter (mm)
Length Unit Conversion 
- **Measurement:** **Area** in Square Meter (m²)
Area Unit Conversion 
- **Measurement:** **Pressure** in Megapascal (MPa)
Pressure Unit Conversion 
- **Measurement:** **Force** in Newton (N)
Force Unit Conversion 
- **Measurement:** **Stress** in Megapascal (MPa)
Stress Unit Conversion 



Check other formula lists

- [Allowable Design for Column Formulas](#) 
- [Column Base Plate Design Formulas](#) 
- [Columns of Special Materials Formulas](#) 
- [Eccentric Loads on Columns Formulas](#) 
- [Elastic Flexural Buckling of Columns Formulas](#) 
- [Short Axially Loaded Columns with Helical Ties Formulas](#) 
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