Important Column Base Plate Design Formulas PDF

Formulas
Examples
with Units

List of 15
Important Column Base Plate Design Formulas

1) Area of Base Plate given Nominal Bearing Strength Formula

Evaluate Formula

Formula

$$A_1 = \frac{A_2}{\left(\frac{f_p}{f'c \cdot 0.85}\right)^2}$$

Example with Units

$$700.017\,\text{mm}^2 = \frac{1400\,\text{mm}^2}{\left(\frac{132.6\,\text{Pa}}{110.31\,\text{Pa} \cdot 0.85}\right)^2}$$

2) Area of Supporting Concrete given Nominal Bearing Strength Formula

Evaluate Formula

Formula

$$A_2 = A_1 \cdot \left(\left(\frac{f_p}{f'c \cdot 0.85}\right)^2\right)$$

Example with Units

$$1399.9659\,\text{mm}^2 = 700\,\text{mm}^2 \cdot \left(\left(\frac{132.6\,\text{Pa}}{110.31\,\text{Pa} \cdot 0.85}\right)^2\right)$$

3) Base Plate Thickness given Projection of Base Plate beyond Flange and Parallel to Web Formula

Evaluate Formula

Formula

$$t = m \cdot \sqrt{2 \cdot \frac{P_u}{0.9 \cdot F_y \cdot B \cdot N}}$$

Example with Units

$$34.2353\,\text{mm} = 75\,\text{mm} \cdot \sqrt{2 \cdot \frac{39381\,\text{kN}}{0.9 \cdot 350\,\text{kN} \cdot 40\,\text{mm} \cdot 30\,\text{mm}}}$$

4) Base Plate Thickness given Projection of Base Plate beyond Flange and Perpendicular to Web Formula

Evaluate Formula

Formula

$$t = n \cdot \sqrt{2 \cdot \frac{P_u}{0.9 \cdot F_y \cdot B \cdot N}}$$

Example with Units

$$32.8659\,\text{mm} = 72\,\text{mm} \cdot \sqrt{2 \cdot \frac{39381\,\text{kN}}{0.9 \cdot 350\,\text{kN} \cdot 40\,\text{mm} \cdot 30\,\text{mm}}}$$

5) Factored Load given Base Plate Area Formula

Evaluate Formula

Formula

$$P_u = A_1 \cdot 0.85 \cdot \phi_c \cdot f'c$$

Example with Units

$$39380.67\,\text{kN} = 700\,\text{mm}^2 \cdot 0.85 \cdot 0.6 \cdot 110.31\,\text{Pa}$$

6) Length Rectangular Base for Projection of Base Plate beyond Flange and Parallel to Web Formula

Evaluate Formula

Formula

$$N = m^2 \cdot \left(2 \cdot \frac{P_u}{0.9 \cdot F_y \cdot B \cdot t^2} \right)$$

Example with Units

$$32.288\,\text{mm} = 75\,\text{mm}^2 \cdot \left(2 \cdot \frac{39381\,\text{kN}}{0.9 \cdot 350\,\text{kN} \cdot 40\,\text{mm} \cdot 33\,\text{mm}^2} \right)$$

7) Length Rectangular Base for Projection of Base Plate beyond Flange and Perpendicular to Web Formula

Evaluate Formula

Formula

$$N = n^2 \cdot \left(2 \cdot \frac{P_u}{0.9 \cdot F_y \cdot B \cdot t^2} \right)$$

Example with Units

$$29.7566\,\text{mm} = 72\,\text{mm}^2 \cdot \left(2 \cdot \frac{39381\,\text{kN}}{0.9 \cdot 350\,\text{kN} \cdot 40\,\text{mm} \cdot 33\,\text{mm}^2} \right)$$

8) Length Rectangular Base for Wide-Flange Column Formula

Evaluate Formula

Formula

$$N = \frac{A_1}{B}$$

Example with Units

$$17.5\,\text{mm} = \frac{700\,\text{mm}^2}{40\,\text{mm}}$$

9) Nominal Bearing Strength of Concrete Formula

Evaluate Formula

Formula

$$f_p = f'c \cdot 0.85 \cdot \sqrt{\frac{A_2}{A_1}}$$

Example with Units

$$132.6016\,\text{Pa} = 110.31\,\text{Pa} \cdot 0.85 \cdot \sqrt{\frac{1400\,\text{mm}^2}{700\,\text{mm}^2}}$$

10) Projection of Base Plate beyond Flange and Parallel to Web Formula

Evaluate Formula

Formula

$$m = \frac{t}{\sqrt{2 \cdot \frac{P_u}{0.9 \cdot F_y \cdot B \cdot N}}}$$

Example with Units

$$72.2939\,\text{mm} = \frac{33\,\text{mm}}{\sqrt{2 \cdot \frac{39381\,\text{kN}}{0.9 \cdot 350\,\text{kN} \cdot 40\,\text{mm} \cdot 30\,\text{mm}}}}$$

11) Projection of Base Plate beyond Flange and Perpendicular to Web Formula

Evaluate Formula

Formula

$$n = \frac{t}{\sqrt{2 \cdot \frac{P_u}{0.9 \cdot F_y \cdot B \cdot N}}}$$

Example with Units

$$72.2939\,\text{mm} = \frac{33\,\text{mm}}{\sqrt{2 \cdot \frac{39381\,\text{kN}}{0.9 \cdot 350\,\text{kN} \cdot 40\,\text{mm} \cdot 30\,\text{mm}}}}$$

12) Required Area of Base Plate for Factored Load Formula

Evaluate Formula

Formula

$$A_1 = \frac{P_u}{0.85 \cdot \phi_c \cdot f'c}$$

Example with Units

$$700.0059\,\text{mm}^2 = \frac{39381\,\text{kN}}{0.85 \cdot 0.6 \cdot 110.31\,\text{Pa}}$$

13) Specified Compressive Strength of Concrete using Nominal Bearing Strength Formula

Evaluate Formula

Formula

$$f'c = \left(\frac{f_p}{0.85}\right) \cdot \sqrt{\frac{A_1}{A_2}}$$

Example with Units

$$110.3087\,\text{Pa} = \left(\frac{132.6\,\text{Pa}}{0.85}\right) \cdot \sqrt{\frac{700\,\text{mm}^2}{1400\,\text{mm}^2}}$$

14) Width Parallel to Flanges Formula

Evaluate Formula

Formula

$$B = \frac{A_1}{N}$$

Example with Units

$$23.3333\,\text{mm} = \frac{700\,\text{mm}^2}{30\,\text{mm}}$$

15) Yield Load for Projection of Base Plate beyond Flange and Parallel to Web Formula

Evaluate Formula

Formula

$$F_y = m^2 \cdot \left(2 \cdot \frac{P_u}{0.9 \cdot N \cdot B \cdot t^2}\right)$$

Example with Units

$$376.6931\,\text{kN} = 75\,\text{mm}^2 \cdot \left(2 \cdot \frac{39381\,\text{kN}}{0.9 \cdot 30\,\text{mm} \cdot 40\,\text{mm} \cdot 33\,\text{mm}^2}\right)$$

Variables used in list of Column Base Plate Design Formulas above

- A_1 Area of Base Plate *(Square Millimeter)*
- A_2 Area of supporting Concrete *(Square Millimeter)*
- **B** Width *(Millimeter)*
- f_p Nominal Bearing Strength *(Pascal)*
- F_y Yield Load *(Kilonewton)*
- $f'c$ Specified Compressive Strength of Concrete *(Pascal)*
- **m** Projection of Base Plate Beyond Flange *(Millimeter)*
- **n** Projection of Base Plate Beyond Edge *(Millimeter)*
- **N** Length *(Millimeter)*
- P_u Factored Load *(Kilonewton)*
- **t** Thickness *(Millimeter)*
- ϕ_c Strength Reduction Factor

Constants, Functions, Measurements used in list of Column Base Plate Design Formulas above

- 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: **Force** in Kilonewton (kN)
  Force Unit Conversion
- Measurement: **Stress** in Pascal (Pa)
  Stress Unit Conversion

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