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# Column Base Plate Design Formulas

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# List of 15 Column Base Plate Design Formulas

## Column Base Plate Design

### 1) Area of Base Plate given Nominal Bearing Strength

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

[Open Calculator !\[\]\(a870788d6ed9b8fd294b7654a8c8526b\_img.jpg\)](#)

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

### 2) Area of Supporting Concrete given Nominal Bearing Strength

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

[Open Calculator !\[\]\(c50c8b7b2cc2cf9ff925edec0ee94c0d\_img.jpg\)](#)

$$\text{ex } 1399.966\text{mm}^2 = 700\text{mm}^2 \cdot \left(\left(\frac{132.6\text{Pa}}{110.31\text{Pa} \cdot 0.85}\right)^2\right)$$



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

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

[Open Calculator !\[\]\(cbe80b694ebd74fcfe136a095b608235\_img.jpg\)](#)

$$ex \quad 34.23527\text{mm} = 75\text{mm} \cdot \sqrt{2 \cdot \frac{39381\text{kN}}{0.9 \cdot 350\text{kN} \cdot 40\text{mm} \cdot 30\text{mm}}}$$

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

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

[Open Calculator !\[\]\(3e2231b1ad3ca8da8658228c00dd08e0\_img.jpg\)](#)

$$ex \quad 32.86586\text{mm} = 72\text{mm} \cdot \sqrt{2 \cdot \frac{39381\text{kN}}{0.9 \cdot 350\text{kN} \cdot 40\text{mm} \cdot 30\text{mm}}}$$

### 5) Factored Load given Base Plate Area

$$fx \quad P_u = A_1 \cdot 0.85 \cdot \phi_c \cdot (f'_c)$$

[Open Calculator !\[\]\(0d5ec72f61334709c3fc9450209b754f\_img.jpg\)](#)

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



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

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

[Open Calculator !\[\]\(e78f798d4ea5c530c9db49e7d26e6b95\_img.jpg\)](#)

$$\text{ex } 32.28798\text{mm} = (75\text{mm})^2 \cdot \left( 2 \cdot \frac{39381\text{kN}}{0.9 \cdot 350\text{kN} \cdot 40\text{mm} \cdot (33\text{mm})^2} \right)$$

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

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

[Open Calculator !\[\]\(05be7c7a8995decd503647c99211f7c2\_img.jpg\)](#)

$$\text{ex } 29.75666\text{mm} = (72\text{mm})^2 \cdot \left( 2 \cdot \frac{39381\text{kN}}{0.9 \cdot 350\text{kN} \cdot 40\text{mm} \cdot (33\text{mm})^2} \right)$$

## 8) Length Rectangular Base for Wide-Flange Column

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

[Open Calculator !\[\]\(fe3aebe81acea8d45108cd2768939da7\_img.jpg\)](#)

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



## 9) Nominal Bearing Strength of Concrete

[Open Calculator !\[\]\(bd1a142de767a21e5362c595f844a4ff\_img.jpg\)](#)

$$f_x \quad f_p = (f'_c) \cdot 0.85 \cdot \sqrt{\frac{A_2}{A_1}}$$

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

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

[Open Calculator !\[\]\(830769b31eeeaca920791081939ff8ba\_img.jpg\)](#)

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

$$ex \quad 72.29387mm = \frac{33mm}{\sqrt{2 \cdot \frac{39381kN}{0.9 \cdot 350kN \cdot 40mm \cdot 30mm}}}$$

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

[Open Calculator !\[\]\(47734e4656765d20df4fdbd5b7aff048\_img.jpg\)](#)

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

$$ex \quad 72.29387mm = \frac{33mm}{\sqrt{2 \cdot \frac{39381kN}{0.9 \cdot 350kN \cdot 40mm \cdot 30mm}}}$$



## 12) Required Area of Base Plate for Factored Load

$$fx \quad A_1 = \frac{P_u}{0.85 \cdot \phi_c \cdot (f'_c)}$$

[Open Calculator !\[\]\(d3fb9f94af8b26d1c844efa9a98805b0\_img.jpg\)](#)

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

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

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

[Open Calculator !\[\]\(e1d6102fe77919492c04879c8450f1f5\_img.jpg\)](#)

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

## 14) Width Parallel to Flanges

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

[Open Calculator !\[\]\(ab4e2b3fc7e7887b7a72f548aa6f5e60\_img.jpg\)](#)

$$ex \quad 23.33333\text{mm} = \frac{700\text{mm}^2}{30\text{mm}}$$



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

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

[Open Calculator !\[\]\(9dfdaff1d86ba3c1f8353b4d1b61b8c5\_img.jpg\)](#)

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







## Variables Used

- $A_1$  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)
- $\phi_c$  Strength Reduction Factor





## Constants, Functions, Measurements used

- **Function:** **sqrt**, sqrt(Number)  
*Square root function*
- **Measurement:** **Length** in Millimeter (mm)  
*Length Unit Conversion* 
- **Measurement:** **Area** in Square Millimeter (mm<sup>2</sup>)  
*Area Unit Conversion* 
- **Measurement:** **Force** in Kilonewton (kN)  
*Force Unit Conversion* 
- **Measurement:** **Stress** in Pascal (Pa)  
*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](#) 
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