Important Short Axially Loaded Columns with Helical Ties Formulas PDF

Formulas
Examples
with Units

List of 21
Important Short Axially Loaded Columns with Helical Ties Formulas

1) Area of Concrete given Factored Axial Load Formula

Evaluate Formula

Formula

$$A_c = \frac{\left(\frac{P_f}{1.05}\right) - 0.67 \cdot f_y \cdot A_{st}}{0.4 \cdot f_{ck}}$$

Example with Units

$$52450.0119\,\text{mm}^2 = \frac{\left(\frac{583672\,\text{kN}}{1.05}\right) - 0.67 \cdot 450\,\text{MPa} \cdot 452\,\text{mm}^2}{0.4 \cdot 20\,\text{MPa}}$$

2) Area of Cross-section of Spiral Reinforcement given Volume Formula

Evaluate Formula

Formula

$$A_{st} = \frac{V_h}{\pi \cdot \left(d_c - \Phi\right)}$$

Example with Units

$$452\,\text{mm}^2 = \frac{191700\,\text{m}^3}{3.1416 \cdot \left(150\,\text{mm} - 15\,\text{mm}\right)}$$

3) Area of Longitudinal Reinforcement for Columns given Factored Axial Load in Spiral Columns Formula

Evaluate Formula

Formula

$$A_{st} = \frac{\left(\frac{P_f}{1.05}\right) - \left(0.4 \cdot f_{ck} \cdot A_c\right)}{0.67 \cdot f_y}$$

Example with Units

$$452.0003\,\text{mm}^2 = \frac{\left(\frac{583672\,\text{kN}}{1.05}\right) - \left(0.4 \cdot 20\,\text{MPa} \cdot 52450\,\text{mm}^2\right)}{0.67 \cdot 450\,\text{MPa}}$$

4) Characteristic Compressive Strength of Concrete given Factored Axial Load in Spiral Columns Formula

Evaluate Formula

Formula

$$f_{ck} = \frac{\left(\frac{P_f}{1.05}\right) - 0.67 \cdot f_y \cdot A_{st}}{0.4 \cdot A_c}$$

Example with Units

$$20\,\text{MPa} = \frac{\left(\frac{583672\,\text{kN}}{1.05}\right) - 0.67 \cdot 450\,\text{MPa} \cdot 452\,\text{mm}^2}{0.4 \cdot 52450\,\text{mm}^2}$$

5) Characteristic Strength of Compression Reinforcement given Factored Load in Spiral Columns Formula

Evaluate Formula

Formula

$$f_y = \frac{\left(\frac{P_f}{1.05}\right) - \left(0.4 \cdot f_{ck} \cdot A_c\right)}{0.67 \cdot A_{st}}$$

Example with Units

$$450.0003\,\text{MPa} = \frac{\left(\frac{583672\,\text{kN}}{1.05}\right) - \left(0.4 \cdot 20\,\text{MPa} \cdot 52450\,\text{mm}^2\right)}{0.67 \cdot 452\,\text{mm}^2}$$

6) Diameter of Core given Volume of Core Formula

Evaluate Formula

Formula

$$d_c = \sqrt{4 \cdot \frac{V_c}{\pi \cdot P}}$$

Example with Units

$$150.0002\,\text{mm} = \sqrt{4 \cdot \frac{176715\,\text{m}^3}{3.1416 \cdot 10\,\text{mm}}}$$

7) Diameter of Core given Volume of Helical Reinforcement in One Loop Formula

Evaluate Formula

Formula

$$d_c = \left(\frac{V_h}{\pi \cdot A_{st}}\right) + \Phi$$

Example with Units

$$150\,\text{mm} = \left(\frac{191700\,\text{m}^3}{3.1416 \cdot 452\,\text{mm}^2}\right) + 15\,\text{mm}$$

8) Diameter of Spiral Reinforcement given Volume of Helical Reinforcement in one Loop Formula

Evaluate Formula

Formula

$$\Phi = d_c - \left(\frac{V_h}{\pi \cdot A_{st}}\right)$$

Example with Units

$$15\,\text{mm} = 150\,\text{mm} - \left(\frac{191700\,\text{m}^3}{3.1416 \cdot 452\,\text{mm}^2}\right)$$

9) Factored Axial Load on Member of Spiral Columns Formula

Evaluate Formula

Formula

$$P_f = 1.05 \cdot \left(0.4 \cdot f_{ck} \cdot A_c + 0.67 \cdot f_y \cdot A_{st}\right)$$

Example with Units

$$583671.9\,\text{kN} = 1.05 \cdot \left(0.4 \cdot 20\,\text{MPa} \cdot 52450\,\text{mm}^2 + 0.67 \cdot 450\,\text{MPa} \cdot 452\,\text{mm}^2\right)$$

10) Pitch of Spiral Reinforcement given Volume of Core Formula

Evaluate Formula

Formula

$$P = \frac{4 \cdot V_c}{\pi \cdot d_c^2}$$

Example with Units

$$10\,\text{mm} = \frac{4 \cdot 176715\,\text{m}^3}{3.1416 \cdot 150\,\text{mm}^2}$$

11) Volume of Core in Short Axially Loaded Columns with Helical Ties Formula

Evaluate Formula

Formula

$$V_c = \left(\frac{\pi}{4}\right) \cdot d_c^{\,2} \cdot P$$

Example with Units

$$176714.5868\,\text{m}^3 = \left(\frac{3.1416}{4}\right) \cdot 150\,\text{mm}^{\,2} \cdot 10\,\text{mm}$$

12) Volume of Helical Reinforcement in One Loop Formula

Evaluate Formula

Formula

$$V_h = \pi \cdot \left(d_c - \Phi\right) \cdot A_{st}$$

Example with Units

$$191699.9837\,\text{m}^3 = 3.1416 \cdot \left(150\,\text{mm} - 15\,\text{mm}\right) \cdot 452\,\text{mm}^2$$

13) Short Axially Loaded Tied Columns Formulas

13.1) Area of Concrete given Factored Axial Load on Member Formula

Evaluate Formula

Formula

$$A_c = \frac{P_{fm} - 0.67 \cdot f_y \cdot A_{st}}{0.4 \cdot f_{ck}}$$

Example with Units

$$52450\,\text{mm}^2 = \frac{555.878\,\text{kN} - 0.67 \cdot 450\,\text{MPa} \cdot 452\,\text{mm}^2}{0.4 \cdot 20\,\text{MPa}}$$

13.2) Area of Longitudinal Reinforcement for Columns given Factored Axial Load on Member Formula

Evaluate Formula

Formula

$$A_{st} = \frac{P_{fm} - 0.4 \cdot f_{ck} \cdot A_c}{0.67 \cdot f_y}$$

Example with Units

$$452\,\text{mm}^2 = \frac{555.878\,\text{kN} - 0.4 \cdot 20\,\text{MPa} \cdot 52450\,\text{mm}^2}{0.67 \cdot 450\,\text{MPa}}$$

13.3) Area of Longitudinal Reinforcement given Gross Area of Concrete Formula

Evaluate Formula

Formula

$$A_{sc} = p \cdot \frac{A_g}{100}$$

Example with Units

$$30\,\text{mm}^2 = 2 \cdot \frac{1500\,\text{mm}^2}{100}$$

13.4) Factored Axial Load on Member Formula

Evaluate Formula

Formula

$$P_{fm} = \left(0.4 \cdot f_{ck} \cdot A_c\right) + \left(0.67 \cdot f_y \cdot A_{st}\right)$$

Example with Units

$$555.878\,\text{kN} = \left(0.4 \cdot 20\,\text{MPa} \cdot 52450\,\text{mm}^2\right) + \left(0.67 \cdot 450\,\text{MPa} \cdot 452\,\text{mm}^2\right)$$

13.5) Factored Axial Load on Member given Gross Area of Concrete Formula

Evaluate Formula

Formula

$$P_{fm} = \left(0.4 \cdot f_{ck} + \left(\frac{p}{100}\right) \cdot \left(0.67 \cdot f_y - 0.4 \cdot f_{ck}\right)\right) \cdot A_g$$

Example with Units

$$20.805\,\text{kN} = \left(0.4 \cdot 20\,\text{MPa} + \left(\frac{2}{100}\right) \cdot \left(0.67 \cdot 450\,\text{MPa} - 0.4 \cdot 20\,\text{MPa}\right)\right) \cdot 1500\,\text{mm}^2$$

13.6) Gross Area of Concrete given Area of Concrete Formula

Evaluate Formula

Formula

$$A_g = \frac{A_c}{1 - \left(\frac{p}{100}\right)}$$

Example with Units

$$53520.4082\,\text{mm}^2 = \frac{52450\,\text{mm}^2}{1 - \left(\frac{2}{100}\right)}$$

13.7) Gross Area of concrete given Area of Longitudinal Reinforcement Formula

Evaluate Formula

Formula

$$A_g = 100 \cdot \frac{A_{sc}}{p}$$

Example with Units

$$1500\,\text{mm}^2 = 100 \cdot \frac{30\,\text{mm}^2}{2}$$

13.8) Gross Area of Concrete given Factored Axial Load on Member Formula

Evaluate Formula

Formula

$$A_g = \frac{P_{fm}}{0.4 \cdot f_{ck} + \left(\frac{p}{100}\right) \cdot \left(0.67 \cdot f_y - 0.4 \cdot f_{ck}\right)}$$

Example with Units

$$40.0777\,\text{mm}^2 = \frac{555.878\,\text{kN}}{0.4 \cdot 20\,\text{MPa} + \left(\frac{2}{100}\right) \cdot \left(0.67 \cdot 450\,\text{MPa} - 0.4 \cdot 20\,\text{MPa}\right)}$$

13.9) Percentage of Compression Reinforcement given Area of Longitudinal Reinforcement Formula

Evaluate Formula

Formula

$$p = \frac{A_{sc}}{\frac{A_g}{100}}$$

Example with Units

$$2 = \frac{30\,\text{mm}^2}{\frac{1500\,\text{mm}^2}{100}}$$

Variables used in list of Short Axially Loaded Columns with Helical Ties Formulas above

- A_c Area of Concrete *(Square Millimeter)*
- A_g Gross Area of Concrete *(Square Millimeter)*
- A_{sc} Area of Steel Reinforcement in Compression *(Square Millimeter)*
- A_{st} Area of Steel Reinforcement *(Square Millimeter)*
- d_c Diameter of Core *(Millimeter)*
- f_{ck} Characteristic Compressive Strength *(Megapascal)*
- f_y Characteristic Strength of Steel Reinforcement *(Megapascal)*
- p Percentage of Compression Reinforcement
- P Pitch of Spiral Reinforcement *(Millimeter)*
- P_f Factored Load *(Kilonewton)*
- P_{fm} Factored Load on Member *(Kilonewton)*
- V_c Volume of Core *(Cubic Meter)*
- V_h Volume of Helical Reinforcement *(Cubic Meter)*
- Φ Diameter of Spiral Reinforcement *(Millimeter)*

Constants, Functions, Measurements used in list of Short Axially Loaded Columns with Helical Ties 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: **Volume** in Cubic Meter (m^3) *Volume Unit Conversion*
- Measurement: **Area** in Square Millimeter (mm^2) *Area Unit Conversion*
- Measurement: **Pressure** in Megapascal (MPa) *Pressure Unit Conversion*
- Measurement: **Force** in Kilonewton (kN) *Force Unit Conversion*
- Measurement: **Stress** in Megapascal (MPa) *Stress Unit Conversion*

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