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Short Axially Loaded Columns with Helical Ties Formulas

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List of 21 Short Axially Loaded Columns with Helical Ties Formulas

Short Axially Loaded Columns with Helical Ties

1) Area of Concrete given Factored Axial Load

Open Calculator

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

$$52450.01\text{mm}^2 = \frac{\left(\frac{583672\text{kN}}{1.05}\right) - 0.67 \cdot 450\text{MPa} \cdot 452\text{mm}^2}{0.4 \cdot 20\text{MPa}}$$

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

Open Calculator

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

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

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

Open Calculator

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

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

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

Open Calculator

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

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

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

Open Calculator

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

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

6) Diameter of Core given Volume of Core

Open Calculator

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

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

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

Open Calculator

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

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

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

Open Calculator

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

$$14.99999\text{mm} = 150\text{mm} - \left(\frac{191700\text{m}^3}{\pi \cdot 452\text{mm}^2}\right)$$

9) Factored Axial Load on Member of Spiral Columns

Open Calculator

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

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

10) Pitch of Spiral Reinforcement given Volume of Core

Open Calculator

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

$$10.00002\text{mm} = \frac{4 \cdot 176715\text{m}^3}{\pi \cdot (150\text{mm})^2}$$

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

Open Calculator

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

$$176714.6\text{m}^3 = \left(\frac{\pi}{4}\right) \cdot (150\text{mm})^2 \cdot 10\text{mm}$$

12) Volume of Helical Reinforcement in One Loop

Open Calculator

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

$$191700\text{m}^3 = \pi \cdot (150\text{mm} - 15\text{mm}) \cdot 452\text{mm}^2$$

Short Axially Loaded Tied Columns

13) Area of Concrete given Factored Axial Load on Member

Open Calculator

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

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

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

Open Calculator

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

$$-1389.864418\text{mm}^2 = \frac{555.878\text{kN} - 0.4 \cdot 20\text{MPa} \cdot 52450\text{mm}^2}{0.67 \cdot 450\text{MPa}}$$

15) Area of Longitudinal Reinforcement given Gross Area of Concrete

Open Calculator

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

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

16) Factored Axial Load on Member

Open Calculator

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

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

17) Factored Axial Load on Member given Gross Area of Concrete

Open Calculator

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

ex

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

18) Gross Area of Concrete given Area of Concrete

Open Calculator

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

ex

$$53520.41\text{mm}^2 = \frac{52450\text{mm}^2}{1 - \left(\frac{2}{100}\right)}$$

19) Gross Area of concrete given Area of Longitudinal Reinforcement

Open Calculator

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

ex

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

20) Gross Area of Concrete given Factored Axial Load on Member

Open Calculator

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

ex

$$40.07772\text{mm}^2 = \frac{555.878\text{kN}}{0.4 \cdot 20\text{MPa} + \left(\frac{2}{100}\right) \cdot (0.67 \cdot 450\text{MPa} - 0.4 \cdot 20\text{MPa})}$$

21) Percentage of Compression Reinforcement given Area of Longitudinal Reinforcement

Open Calculator

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

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

Variables Used

- 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

- Constant: **pi**, 3.14159265358979323846264338327950288
  Archimedes' constant
- Function: **sqrt**, sqrt(Number)
  Square root function
- Measurement: **Length** in Millimeter (mm)
  Length Unit Conversion
- Measurement: **Volume** in Cubic Meter (m³)
  Volume Unit Conversion
- Measurement: **Area** in Square Millimeter (mm²)
  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

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**
- **Ultimate Strength Design of Concrete Columns Formulas**

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