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Doubly Reinforced Rectangular Sections Formulas

Calculators!

Examples!

Conversions!

List of 18 Doubly Reinforced Rectangular Sections Formulas

Doubly Reinforced Rectangular Sections

1) Force Acting on Compressive Steel

Open Calculator

fx $C_{s'} = F_T - C_c$

ex $10N = 760N - 750N$

2) Force Acting on Tensile Steel

Open Calculator

fx $F_T = C_c + C_{s'}$

ex $760.2N = 750N + 10.2N$

3) Moment Resistance in Compression

Open Calculator

fx $M_R = 0.5 \cdot \left(f_{ec} \cdot j \cdot W_b \cdot \left(d^2\right)\right) \cdot \left(K + 2 \cdot m_{Elastic} \cdot \rho' \cdot \left(1 - \left(\frac{D}{K \cdot d}\right)\right)\right)$

ex $1.666138N^*m = 0.5 \cdot \left(10.01MPa \cdot 0.8 \cdot 18mm \cdot \left((5mm)^2\right)\right) \cdot \left(0.65 + 2 \cdot 0.6 \cdot 0.60 \cdot \left(1 - \left(\frac{2.01mm}{0.65 \cdot 5mm}\right)\right)\right)$

4) Moment Resistance of Tensile Steel given Area

Open Calculator

fx $M_{TS} = (A_s) \cdot (f_{TS}) \cdot (j_d)$

ex $1.2E^\wedge 6kN^*m = (100.0mm^2) \cdot (24kgf/m^2) \cdot (50mm)$

5) Moment Resisting Capacity of Compressive Steel given Stress

Open Calculator

fx $M'_s = 2 \cdot f'_s \cdot A_{s'} \cdot (d - D)$

ex $0.01608kN^*m = 2 \cdot 134.449MPa \cdot 20mm^2 \cdot (5mm - 2.01mm)$

6) Stress in Extreme Compression Surface given Moment Resistance

Open Calculator

fx $f_{ec} = 2 \cdot \frac{M_R}{\left(j \cdot W_b \cdot \left(d^2\right)\right) \cdot \left(K + 2 \cdot m_{Elastic} \cdot \rho'\right) \cdot \left(1 - \left(\frac{D}{K \cdot d}\right)\right)}$

ex $17.00547MPa = 2 \cdot \frac{1.6N^*m}{\left(0.8 \cdot 18mm \cdot \left((5mm)^2\right)\right) \cdot (0.65 + 2 \cdot 0.6 \cdot 0.60) \cdot \left(1 - \left(\frac{2.01mm}{0.65 \cdot 5mm}\right)\right)}$

7) Stress in Tensile Steel to Stress in Extreme Compression Surface Ratio

Open Calculator

fx $$fsc_{ratio} = \frac{k}{2} \cdot \left(\rho_T - \left(\frac{\rho' \cdot (K_d - d')}{D_{centroid} - K_d} \right) \right)$$

ex $$3.944147 = \frac{0.61}{2} \cdot \left(12.9 - \left(\frac{0.031 \cdot (100.2\text{mm} - 50.01\text{mm})}{51.01\text{mm} - 100.2\text{mm}} \right) \right)$$

8) Total Compression on Concrete

Open Calculator

fx $$C_b = C_{s'} + C_c$$

ex $$760.2\text{N} = 10.2\text{N} + 750\text{N}$$

9) Total Compressive force on Beam Cross Section

Open Calculator

fx $$C_b = C_c + C_{s'}$$

ex $$760.2\text{N} = 750\text{N} + 10.2\text{N}$$

Check for Stress in Beams

10) Distance from Neutral Axis to Compressive Reinforcing Steel

Open Calculator

fx $$c_{sc} = f_{sc} \cdot \frac{I_A}{2 \cdot n \cdot B_M}$$

ex $$25.22282\text{mm} = 8.49\text{MPa} \cdot \frac{10\text{E}7\text{mm}^4}{2 \cdot 0.34 \cdot 49.5\text{kN*m}}$$

11) Distance from Neutral Axis to Face of Concrete

Open Calculator

fx $$K_d = f_{\text{fiber concrete}} \cdot \frac{I_A}{B_M}$$

ex $$100.202\text{mm} = 49.6\text{MPa} \cdot \frac{10\text{E}7\text{mm}^4}{49.5\text{kN*m}}$$

12) Distance from Neutral Axis to Tensile Reinforcing Steel

Open Calculator

fx $$c_s = f_{\text{unit stress}} \cdot \frac{I_A}{n \cdot B_M}$$

ex $$594.7712\text{mm} = 100.1\text{MPa} \cdot \frac{10\text{E}7\text{mm}^4}{0.34 \cdot 49.5\text{kN*m}}$$

13) Moment of Inertia of Transformed Beam Section

Open Calculator

fx $$I_{TB} = \left(0.5 \cdot b \cdot \left(K_d^2\right)\right) + 2 \cdot \left(m_{Elastic} - 1\right) \cdot A_{s'} \cdot \left(c_{sc}^2\right) + m_{Elastic} \cdot \left(c_s^2\right) \cdot A$$

ex $$2.124283\text{kg·m}^2 = \left(0.5 \cdot 26.5\text{mm} \cdot \left((100.2\text{mm})^2\right)\right) + 2 \cdot (0.6 - 1) \cdot 20\text{mm}^2 \cdot \left((25.22\text{mm})^2\right) + 0.6 \cdot \left((595\text{mm})\right.$$

14) Total Bending Moment given Unit Stress in Extreme Fiber of Concrete

Open Calculator

fx $$B_M = f_{\text{fiber concrete}} \cdot \frac{I_A}{K_d}$$

ex $$49.501\text{kN*m} = 49.6\text{MPa} \cdot \frac{10\text{E}7\text{mm}^4}{100.2\text{mm}}$$

15) Total Bending Moment given Unit Stress in Tensile Reinforcing Steel

Open Calculator

fx $$Mb_R = f_{\text{unit stress}} \cdot \frac{I_A}{n \cdot c_s}$$

ex $$49.48097\text{N*m} = 100.1\text{MPa} \cdot \frac{10\text{E}7\text{mm}^4}{0.34 \cdot 595\text{mm}}$$

16) Unit Stress in Compressive Reinforcing Steel

Open Calculator

fx $$f_{sc} = 2 \cdot n \cdot B_M \cdot \frac{c_{sc}}{I_A}$$

ex $$8.489052\text{MPa} = 2 \cdot 0.34 \cdot 49.5\text{kN*m} \cdot \frac{25.22\text{mm}}{10\text{E}7\text{mm}^4}$$

17) Unit Stress in Extreme Fiber of Concrete

Open Calculator

fx $$f_{\text{fiber concrete}} = B_M \cdot \frac{K_d}{I_A}$$

ex $$49.599\text{MPa} = 49.5\text{kN*m} \cdot \frac{100.2\text{mm}}{10\text{E}7\text{mm}^4}$$

18) Unit Stress in Tensile Reinforcing Steel

Open Calculator

fx $$f_{\text{unit stress}} = n \cdot B_M \cdot \frac{c_s}{I_A}$$

ex $$100.1385\text{MPa} = 0.34 \cdot 49.5\text{kN*m} \cdot \frac{595\text{mm}}{10\text{E}7\text{mm}^4}$$

Variables Used

- **A** Area of Tension Reinforcement *(Square Meter)*
- **A_s** Area of Steel required *(Square Millimeter)*
- **$A_{s'}$** Area of Compression Reinforcement *(Square Millimeter)*
- **b** Beam Width *(Millimeter)*
- **B_M** Bending Moment of Considered Section *(Kilonewton Meter)*
- **C_b** Total Compression on Beam *(Newton)*
- **C_c** Total Compression on Concrete *(Newton)*
- **c_s** Distance Neutral to Tensile Reinforcing Steel *(Millimeter)*
- **$C_{s'}$** Force on Compressive Steel *(Newton)*
- **c_{sc}** Distance Neutral to Compressive Reinforcing Steel *(Millimeter)*
- **d** Distance to Centroid of Tensile Steel *(Millimeter)*
- **d'** Effective Cover *(Millimeter)*
- **D** Distance to Centroid of Compressive Steel *(Millimeter)*
- **$D_{centroid}$** Centroidal Distance of Tension Reinforcement *(Millimeter)*
- **f_{ec}** Stress in Extreme Compression Surface *(Megapascal)*
- **$f_{fiber\ concrete}$** Unit Stress in Fiber of Concrete *(Megapascal)*
- **f'_s** Stress in Compressive Steel *(Megapascal)*
- **f_{sc}** Unit Stress in Compressive Reinforcing Steel *(Megapascal)*
- **F_T** Force on Tension Steel *(Newton)*
- **f_{TS}** Tensile Stress in Steel *(Kilogram-Force per Square Meter)*
- **$f_{unit\ stress}$** Unit Stress in Tensile Reinforcing Steel *(Megapascal)*
- **fsc_{ratio}** Tensile to Compressive Stress Ratio
- **I_A** Moment of Inertia of Beam *(Millimeter^4)*
- **I_{TB}** Moment of Inertia Transformed Beam *(Kilogram Square Meter)*
- **j** Constant j
- **j_d** Distance between Reinforcements *(Millimeter)*
- **k** Ratio of Depth
- **K** Constant k
- **K_d** Distance from Compression Fiber to NA *(Millimeter)*
- **$m_{Elastic}$** Modular Ratio for Elastic Shortening
- **M_R** Moment Resistance in Compression *(Newton Meter)*
- **M'_s** Moment Resistance of Compressive Steel *(Kilonewton Meter)*
- **M_{TS}** Moment Resistance of Tensile Steel *(Kilonewton Meter)*

- **Mb_R** Bending Moment *(Newton Meter)*
- **n** Elasticity Ratio of Steel to Concrete
- **W_b** Width of Beam *(Millimeter)*
- **ρ'** Value of ρ'
- **ρ_T** Tension Reinforcement Ratio
- **$\rho^{'}$** Compression Reinforcement Ratio

Constants, Functions, Measurements used

- Measurement: **Length** in Millimeter (mm)
  Length Unit Conversion
- Measurement: **Area** in Square Millimeter (mm^2), Square Meter (m^2)
  Area Unit Conversion
- Measurement: **Pressure** in Megapascal (MPa), Kilogram-Force per Square Meter (kgf/m^2)
  Pressure Unit Conversion
- Measurement: **Force** in Newton (N)
  Force Unit Conversion
- Measurement: **Moment of Inertia** in Kilogram Square Meter ($kg \cdot m^2$)
  Moment of Inertia Unit Conversion
- Measurement: **Moment of Force** in Newton Meter (N*m), Kilonewton Meter (kN*m)
  Moment of Force Unit Conversion
- Measurement: **Second Moment of Area** in Millimeter^4 (mm^4)
  Second Moment of Area Unit Conversion

Check other formula lists

- **Doubly Reinforced Rectangular Sections Formulas**
- **Singly Reinforced Sections Formulas**

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