



Beams, Columns and Other Members Design Methods Formulas

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List of 16 Beams, Columns and Other Members Design Methods Formulas

Beams, Columns and Other Members Design Methods 🗗

Beams 🗗

1) Straight Beam Deflection

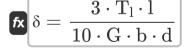
$$\delta = \left(rac{k_{
m b} \cdot T_{
m l} \cdot \left(
m l
ight)^3}{E_{
m c} \cdot I}
ight) + \left(rac{k_{
m s} \cdot T_{
m l} \cdot
m l}{G \cdot A}
ight)$$

Open Calculator

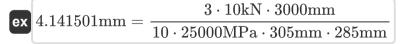
ex

$$19.92665 \text{mm} = \left(\frac{0.85 \cdot 10 \text{kN} \cdot \left(3000 \text{mm}\right)^3}{30000 \text{MPa} \cdot 3.56 \text{kg} \cdot \text{m}^2}\right) + \left(\frac{0.75 \cdot 10 \text{kN} \cdot 3000 \text{mm}}{25000 \text{MPa} \cdot 50625 \text{mm}^2}\right)$$

2) Tapered Beam Deflection for Mid-Span Concentrated Load



Open Calculator







3) Tapered beam Deflection for Uniformly Distributed Load

$$\delta = \frac{3 \cdot T_1 \cdot l}{20 \cdot G \cdot b \cdot d}$$

Open Calculator

 $3 \cdot 10 \text{kN} \cdot 3000 \text{mm}$ = 2.070751mm = $\frac{1}{20 \cdot 25000$ MPa $\cdot 305$ mm $\cdot 285$ mm

Rectangular Beams with Tensile Reinforcing Only

4) Bending Moment of Beam due to Stress in Concrete

Open Calculator $\mathbf{K} = \left(rac{1}{2}
ight) \cdot f_c \cdot k \cdot j \cdot b \cdot d^2$

 $\mathbf{ex} = 35.07772 \text{kN*m} = \left(\frac{1}{2}\right) \cdot 7.3 \text{MPa} \cdot 0.458 \cdot 0.847 \cdot 305 \text{mm} \cdot (285 \text{mm})^2$

5) Bending Moment of Beam due to Stress in Steel

 $\mathbf{K} \, \mathbf{M} = \mathbf{f}_{\mathrm{s}} \cdot \mathbf{p} \cdot \mathbf{j} \cdot \mathbf{b} \cdot \mathbf{d}^2$ Open Calculator

 $\mathbf{ex} \ 35.18893 \, \mathrm{kN^*m} = 130 \, \mathrm{MPa} \cdot 0.0129 \cdot 0.847 \cdot 305 \, \mathrm{mm} \cdot (285 \, \mathrm{mm})^2$

6) Stress in Concrete using Working-Stress Design

 $\mathbf{f}_{c} = \frac{2 \cdot M}{\mathbf{k} \cdot \mathbf{i} \cdot \mathbf{b} \cdot \mathbf{d}^{2}}$ $2 \cdot 35 \text{kN*m}$

[ex] 7.283826 MPa = --- $0.458 \cdot 0.847 \cdot 305 \text{mm} \cdot (285 \text{mm})^2$





Open Calculator

7) Stress in Steel by Working-Stress Design

 $\mathbf{f_s} = rac{\mathbf{M}}{\mathbf{A_s \cdot i \cdot d}}$

Open Calculator

8) Stress in Steel using Working-Stress Design

 $\mathbf{f_s} = rac{\mathbf{M}}{\mathbf{p} \cdot \mathbf{j} \cdot \mathbf{b} \cdot \mathbf{d}^2}$

Open Calculator

Shear and Diagonal Tension in Beams G

9) Cross-Sectional Area of Web Reinforcement

 $\mathbf{A}_{\mathrm{v}} = (\mathrm{V} - \mathrm{V'}) \cdot rac{\mathrm{s}}{\mathrm{f}_{\mathrm{v}} \cdot \mathrm{d}}$

Open Calculator

 $\mathbf{ex} egin{aligned} 8789.474 \mathrm{mm}^2 &= (500.00 \mathrm{N} - 495 \mathrm{N}) \cdot rac{50.1 \mathrm{mm}}{100 \mathrm{MPa} \cdot 285 \mathrm{mm}} \end{aligned}$

10) Effective Depth given Cross-Sectional Area of Web Reinforcement 💪

 $\mathbf{f} \mathbf{d} = rac{(\mathbf{V} - \mathbf{V}') \cdot \mathbf{s}}{\mathbf{f}_{\mathbf{v}} \cdot \mathbf{A}_{\mathbf{v}}}$

Open Calculator

 $= \frac{(500.00 \mathrm{N} - 495 \mathrm{N}) \cdot 50.1 \mathrm{mm} }{285.5677 \mathrm{mm}}$







11) Effective Depth of Beam given Shearing Unit Stress in Reinforced Concrete

 $\mathbf{f} \mathbf{x} d = \frac{V}{b \cdot v}$

Open Calculator 🗗

 $= \frac{500.00 \text{N}}{305 \text{mm} \cdot 0.005752 \text{MPa}}$

12) Shear Carried by Concrete given Cross-Sectional Area of Web Reinforcement

 $V' = V - \left(rac{\mathrm{A_v} \cdot \mathrm{f_v} \cdot \mathrm{d}}{\mathrm{s}}
ight)$

Open Calculator 🗗

 $\boxed{ \texttt{ex} \left[495.0099 \text{N} = 500.00 \text{N} - \left(\frac{8772 \text{mm}^2 \cdot 100 \text{MPa} \cdot 285 \text{mm}}{50.1 \text{mm}} \right) \right] }$

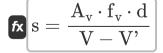
13) Shearing Unit Stress in Reinforced Concrete Beam

 $\mathbf{f} \mathbf{x} = rac{V}{\mathbf{b} \cdot \mathbf{d}}$

Open Calculator 🚰

 $oxed{ex} 0.005752 ext{MPa} = rac{500.00 ext{N}}{305 ext{mm} \cdot 285 ext{mm}}$

14) Stirrups Spacing given Cross-Sectional Area of Web Reinforcement



Open Calculator 🗗

 $= \frac{8772 \text{mm}^2 \cdot 100 \text{MPa} \cdot 285 \text{mm}}{500.00 \text{N} - 495 \text{N}}$





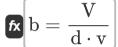
15) Total Shear given Cross-Sectional Area of Web Reinforcement 🗗



Open Calculator

$$V = \left(rac{A_{
m v} \cdot f_{
m v} \cdot d}{
m s}
ight) + V'$$

16) Width of Beam given Shearing Unit Stress in Reinforced Concrete Beam 🗗



Open Calculator 🚰

$$= \frac{500.00 \mathrm{N}}{285 \mathrm{mm} \cdot 0.005752 \mathrm{MPa}}$$



Variables Used

- A Cross-Sectional Area of Beam (Square Millimeter)
- As Cross-Sectional Area of Tensile Reinforcing (Square Millimeter)
- A_v Cross-Sectional Area of Web Reinforcement (Square Millimeter)
- **b** Width of Beam (Millimeter)
- **d** Effective Depth of Beam (Millimeter)
- Ec Modulus of Elasticity of Concrete (Megapascal)
- **f**_c Compressive Stress in Extreme Fiber of Concrete (Megapascal)
- **f**_S Stress in Reinforcement (Megapascal)
- f_v Allowable Unit Stress in Web Reinforcement (Megapascal)
- **G** Shear Modulus (Megapascal)
- I Moment of Inertia (Kilogram Square Meter)
- | Ratio of Distance between Centroid
- k Ratio of Depth
- k_b Beam Loading Constant
- k_s Support Condition Constant
- I Beam Span (Millimeter)
- M Bending Moment (Kilonewton Meter)
- p Ratio of Cross-Sectional Area
- S Stirrup Spacing (Millimeter)
- T_I Total Beam Load (Kilonewton)
- V Shearing Unit Stress (Megapascal)
- V Total Shear (Newton)
- V' Shear that Concrete should carry (Newton)
- δ Deflection of Beam (Millimeter)





Constants, Functions, Measurements used

- Measurement: Length in Millimeter (mm)
 Length Unit Conversion
- Measurement: Area in Square Millimeter (mm²)
 Area Unit Conversion
- Measurement: Pressure in Megapascal (MPa)
 Pressure Unit Conversion
- Measurement: Force in Kilonewton (kN), Newton (N)
 Force Unit Conversion
- Measurement: Moment of Inertia in Kilogram Square Meter (kg·m²)
 Moment of Inertia Unit Conversion
- Measurement: Moment of Force in Kilonewton Meter (kN*m)
 Moment of Force Unit Conversion
- Measurement: Stress in Megapascal (MPa)
 Stress Unit Conversion





Check other formula lists

- Beams, Columns and Other Members Design Methods
 Formulas
- Deflection Computations, Column Moments and Torsion Formulas
- Frames and Flat Plate Formulas
- Mix Design, Modulus of Elasticity and Tensile Strength of Concrete Formulas
- Working Stress Design Formulas



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