



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

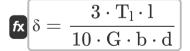
$$\delta = \left(rac{\mathrm{k_b}\cdot\mathrm{T_l}\cdot\left(\mathrm{l}
ight)^3}{\mathrm{E_c}\cdot\mathrm{I}}
ight) + \left(rac{\mathrm{k_s}\cdot\mathrm{T_l}\cdot\mathrm{l}}{\mathrm{G}\cdot\mathrm{A}}
ight)$$

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

$$\mathbf{ex} = \frac{3 \cdot 10 \mathrm{kN} \cdot 3000 \mathrm{mm}}{10 \cdot 25000 \mathrm{MPa} \cdot 305 \mathrm{mm} \cdot 285 \mathrm{mm}}$$



3) Tapered beam Deflection for Uniformly Distributed Load

$$\delta = rac{3 \cdot \mathrm{T_l} \cdot \mathrm{l}}{20 \cdot \mathrm{G} \cdot \mathrm{h} \cdot \mathrm{d}}$$

Open Calculator

Open Calculator

Open Calculator

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

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

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

- 5) Bending Moment of Beam due to Stress in Steel
- $\mathbf{K} \, \mathbf{M} = \mathbf{f}_{\mathrm{s}} \cdot \mathbf{p} \cdot \mathbf{j} \cdot \mathbf{b} \cdot \mathbf{d}^2$

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

- 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 = --- $0.458 \cdot 0.847 \cdot 305 \text{mm} \cdot (285 \text{mm})^2$





7) Stress in Steel by Working-Stress Design

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

Open Calculator

 $ext{ex} 129.3404 ext{MPa} = rac{35 ext{kN*m}}{1121 ext{mm}^2 \cdot 0.847 \cdot 285 ext{mm}}$

8) Stress in Steel using Working-Stress Design

 $\mathbf{f}_{\mathrm{s}} = rac{\mathrm{M}}{\mathrm{p}\cdot\mathrm{j}\cdot\mathrm{b}\cdot\mathrm{d}^2}$

Open Calculator

Shear and Diagonal Tension in Beams

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

9) Cross-Sectional Area of Web Reinforcement

 $8789.474 ext{mm}^2 = (500.00 ext{N} - 495 ext{N}) \cdot rac{50.1 ext{mm}}{100 ext{MPa} \cdot 285 ext{mm}}$

Open Calculator

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

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

Open Calculator



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11) Effective Depth of Beam given Shearing Unit Stress in Reinforced Concrete Beam [7

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

Open Calculator

500.00N= 285.0042mm = $\frac{1}{305$ mm $\cdot 0.005752$ MPa

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

 $V' = V - \left(\frac{A_v \cdot f_v \cdot d}{\varsigma} \right)$

Open Calculator

= $495.0099N = 500.00N - \left(\frac{8772mm^2 \cdot 100MPa \cdot 285mm}{50.1mm}\right)$

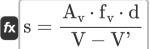
13) Shearing Unit Stress in Reinforced Concrete Beam 🗗

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

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





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

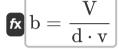


Open Calculator

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

$$\boxed{ 499.9901 \text{N} = \left(\frac{8772 \text{mm}^2 \cdot 100 \text{MPa} \cdot 285 \text{mm}}{50.1 \text{mm}} \right) + 495 \text{N} }$$

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



Open Calculator

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



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 🔽
- **Braced and Unbraced Frames** Formulas
- Deflection Computations, Column Moments and Torsion Formulas

- Flat Plate Construction Formulas
- Mix Design, Modulus of Elasticity and Tensile Strength of Concrete Formulas C
- Working Stress Design Formulas



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