# Important Bending Stress Formulas PDF

Formulas
Examples
with Units

**List of 19**
**Important Bending Stress Formulas**

## 1) Beam of Uniform Strength Formulas

### 1.1) Beam Breadth of Uniform Strength for Simply Supported Beam when Load is at Centre Formula

Evaluate Formula

Formula

$$B = \frac{3 \cdot P \cdot a}{\sigma \cdot d_e^{\,2}}$$

Example with Units

$$96.9529\,\text{mm} = \frac{3 \cdot 0.15\,\text{kN} \cdot 21\,\text{mm}}{1200\,\text{Pa} \cdot 285\,\text{mm}^{\,2}}$$

### 1.2) Beam Depth of Uniform Strength for Simply Supported Beam when Load is at Centre Formula

Evaluate Formula

Formula

$$d_e = \sqrt{\frac{3 \cdot P \cdot a}{B \cdot \sigma}}$$

Example with Units

$$280.6239\,\text{mm} = \sqrt{\frac{3 \cdot 0.15\,\text{kN} \cdot 21\,\text{mm}}{100.0003\,\text{mm} \cdot 1200\,\text{Pa}}}$$

### 1.3) Loading of Beam of Uniform Strength Formula

Evaluate Formula

Formula

$$P = \frac{\sigma \cdot B \cdot d_e^{\,2}}{3 \cdot a}$$

Example with Units

$$0.1547\,\text{kN} = \frac{1200\,\text{Pa} \cdot 100.0003\,\text{mm} \cdot 285\,\text{mm}^{\,2}}{3 \cdot 21\,\text{mm}}$$

### 1.4) Stress of Beam of Uniform Strength Formula

Evaluate Formula

Formula

$$\sigma = \frac{3 \cdot P \cdot a}{B \cdot d_e^{\,2}}$$

Example with Units

$$1163.4314\,\text{Pa} = \frac{3 \cdot 0.15\,\text{kN} \cdot 21\,\text{mm}}{100.0003\,\text{mm} \cdot 285\,\text{mm}^{\,2}}$$

## 2) Section Modulus for Various Shapes Formulas

### 2.1) Allowable Bending Stress Formula

Evaluate Formula

Formula

$$f = 3 \cdot w \cdot \frac{L}{2 \cdot b_{Beam} \cdot d_{Beam}^{\,2}}$$

Example with Units

$$120.1923\,\text{MPa} = 3 \cdot 50\,\text{kN} \cdot \frac{5000\,\text{mm}}{2 \cdot 312\,\text{mm} \cdot 100\,\text{mm}^{\,2}}$$

## 2.2) Beam Width for Uniform Strength in Bending Stress Formula

Evaluate Formula

Formula

$$b_{Beam} = 3 \cdot w \cdot \frac{L}{2 \cdot f \cdot d_{Beam}^{2}}$$

Example with Units

$$312.5\,\text{mm} = 3 \cdot 50\,\text{kN} \cdot \frac{5000\,\text{mm}}{2 \cdot 120\,\text{MPa} \cdot 100\,\text{mm}^{2}}$$

## 2.3) Breadth of Rectangular Shape given Section Modulus Formula

Evaluate Formula

Formula

$$b = \frac{6 \cdot Z}{d^{2}}$$

Example with Units

$$300.0362\,\text{mm} = \frac{6 \cdot 0.04141\,\text{m}^3}{910\,\text{mm}^{2}}$$

## 2.4) Depth of Beam for Uniform Strength in Bending Stress Formula

Evaluate Formula

Formula

$$d_{Beam} = \sqrt{\frac{3 \cdot w \cdot L}{f \cdot 2 \cdot b_{Beam}}}$$

Example with Units

$$100.0801\,\text{mm} = \sqrt{\frac{3 \cdot 50\,\text{kN} \cdot 5000\,\text{mm}}{120\,\text{MPa} \cdot 2 \cdot 312\,\text{mm}}}$$

## 2.5) Depth of Rectangular Shape given Section Modulus Formula

Evaluate Formula

Formula

$$d = \sqrt{\frac{6 \cdot Z}{b}}$$

Example with Units

$$910.0549\,\text{mm} = \sqrt{\frac{6 \cdot 0.04141\,\text{m}^3}{300\,\text{mm}}}$$

## 2.6) Diameter of Circular Shape given Section Modulus Formula

Evaluate Formula

Formula

$$\Phi = \left(\frac{32 \cdot Z}{\pi}\right)^{\frac{1}{3}}$$

Example with Units

$$749.9548\,\text{mm} = \left(\frac{32 \cdot 0.04141\,\text{m}^3}{3.1416}\right)^{\frac{1}{3}}$$

## 2.7) Inner Breadth of Hollow Rectangular Shape Formula

Evaluate Formula

Formula

$$B_i = \frac{\left(6 \cdot Z \cdot D_o\right) + \left(B_o \cdot D_o^{3}\right)}{D_i^{3}}$$

Example with Units

$$2305.284\,\text{mm} = \frac{\left(6 \cdot 0.04141\,\text{m}^3 \cdot 1200\,\text{mm}\right) + \left(800\,\text{mm} \cdot 1200\,\text{mm}^{3}\right)}{900\,\text{mm}^{3}}$$

## 2.8) Inner Depth of Hollow Rectangular Shape Formula

Evaluate Formula

Formula

$$D_i = \left( \frac{\left(6 \cdot Z \cdot D_o\right) + \left(B_o \cdot {D_o}^3\right)}{B_i} \right)^{\frac{1}{3}}$$

Example with Units

$$1497.9385\,\text{mm} = \left( \frac{\left(6 \cdot 0.04141\,\text{m}^3 \cdot 1200\,\text{mm}\right) + \left(800\,\text{mm} \cdot {1200\,\text{mm}}^3\right)}{500\,\text{mm}} \right)^{\frac{1}{3}}$$

## 2.9) Inner Diameter of Hollow Circular Shape in Bending Stress Formula

Evaluate Formula

Formula

$$d_i = \left( \left( {d_o}^4 \right) - \left( 32 \cdot Z \cdot \frac{d_o}{\pi} \right) \right)^{\frac{1}{4}}$$

Example with Units

$$700\,\text{mm} = \left( \left( {700\,\text{mm}}^4 \right) - \left( 32 \cdot 0.04141\,\text{m}^3 \cdot \frac{700\,\text{mm}}{3.1416} \right) \right)^{\frac{1}{4}}$$

## 2.10) Load on Beam for Uniform Strength in Bending Stress Formula

Evaluate Formula

Formula

$$w = \frac{f \cdot \left(2 \cdot b_{Beam} \cdot {d_{Beam}}^2\right)}{3 \cdot L}$$

Example with Units

$$49.92\,\text{kN} = \frac{120\,\text{MPa} \cdot \left(2 \cdot 312\,\text{mm} \cdot {100\,\text{mm}}^2\right)}{3 \cdot 5000\,\text{mm}}$$

## 2.11) Outer Breadth of Hollow Rectangular Shape Formula

Evaluate Formula

Formula

$$B_o = \frac{\left(6 \cdot Z \cdot D_o\right) + \left(B_i \cdot {D_i}^3\right)}{{D_o}^3}$$

Example with Units

$$383.4792\,\text{mm} = \frac{\left(6 \cdot 0.04141\,\text{m}^3 \cdot 1200\,\text{mm}\right) + \left(500\,\text{mm} \cdot {900\,\text{mm}}^3\right)}{{1200\,\text{mm}}^3}$$

## 2.12) Section Modulus of Circular Shape Formula

Evaluate Formula

Formula

$$Z = \frac{\pi \cdot \Phi^{3}}{32}$$

Example with Units

$$0.0414\,\text{m}^3 = \frac{3.1416 \cdot 750\,\text{mm}^{3}}{32}$$

## 2.13) Section Modulus of Hollow Circular Shape Formula

Evaluate Formula

Formula

$$Z = \frac{\pi \cdot \left( d_o^{4} - d_i^{4} \right)}{32 \cdot d_o}$$

Example with Units

$$0.0226\,\text{m}^3 = \frac{3.1416 \cdot \left( 700\,\text{mm}^{4} - 530\,\text{mm}^{4} \right)}{32 \cdot 700\,\text{mm}}$$

## 2.14) Section Modulus of Hollow Rectangular Shape Formula

Evaluate Formula

Formula

$$Z = \frac{\left( B_o \cdot D_o^{3} \right) - \left( B_i \cdot D_i^{3} \right)}{6 \cdot D_o}$$

Example with Units

$$0.1414\,\text{m}^3 = \frac{\left( 800\,\text{mm} \cdot 1200\,\text{mm}^{3} \right) - \left( 500\,\text{mm} \cdot 900\,\text{mm}^{3} \right)}{6 \cdot 1200\,\text{mm}}$$

## 2.15) Section Modulus of Rectangular Shape Formula

Evaluate Formula

Formula

$$Z = \frac{b \cdot d^{2}}{6}$$

Example with Units

$$0.0414\,\text{m}^3 = \frac{300\,\text{mm} \cdot 910\,\text{mm}^{2}}{6}$$

## Variables used in list of Bending Stress Formulas above

- **a** Distance from A end *(Millimeter)*
- **b** Width of Cross Section *(Millimeter)*
- **B** Width of Beam Section *(Millimeter)*
- $b_{Beam}$ Width of Beam *(Millimeter)*
- $B_i$ Inner Breadth of Hollow Rectangular Section *(Millimeter)*
- $B_o$ Outer Breadth of Hollow Rectangular Section *(Millimeter)*
- **d** Depth of Cross Section *(Millimeter)*
- $d_{Beam}$ Depth of Beam *(Millimeter)*
- $d_e$ Effective Depth of Beam *(Millimeter)*
- $d_i$ Inner Diameter of Shaft *(Millimeter)*
- $D_i$ Inner Depth of Hollow Rectangular Section *(Millimeter)*
- $d_o$ Outer Diameter of Shaft *(Millimeter)*
- $D_o$ Outer Depth of Hollow Rectangular Section *(Millimeter)*
- **f** Allowable Bending Stress *(Megapascal)*
- **L** Length of Beam *(Millimeter)*
- **P** Point Load *(Kilonewton)*
- **w** Load on Beam *(Kilonewton)*
- **Z** Section Modulus *(Cubic Meter)*
- **σ** Stress of Beam *(Pascal)*
- **Φ** Diameter of Circular Shaft *(Millimeter)*

## Constants, Functions, Measurements used in list of Bending Stress 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: **Pressure** in Pascal (Pa), Megapascal (MPa) *Pressure Unit Conversion*
- Measurement: **Force** in Kilonewton (kN) *Force Unit Conversion*

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