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Bending Stress Formulas

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List of 19 Bending Stress Formulas

Bending Stress

Beam of Uniform Strength

1) Beam Breadth of Uniform Strength for Simply Supported Beam when Load is at Centre

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

[Open Calculator !\[\]\(de95854c7ee024cfadc48187bbb781b2_img.jpg\)](#)

$$\text{ex } 96.95291\text{mm} = \frac{3 \cdot 0.15\text{kN} \cdot 21\text{mm}}{1200\text{Pa} \cdot (285\text{mm})^2}$$

2) Beam Depth of Uniform Strength for Simply Supported Beam when Load is at Centre

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

[Open Calculator !\[\]\(6a9b39b98eb945faa14c645ec99e4eaa_img.jpg\)](#)

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



3) Loading of Beam of Uniform Strength

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

[Open Calculator !\[\]\(cbe80b694ebd74fcfe136a095b608235_img.jpg\)](#)

$$\text{ex } 0.154715\text{kN} = \frac{1200\text{Pa} \cdot 100.0003\text{mm} \cdot (285\text{mm})^2}{3 \cdot 21\text{mm}}$$

4) Stress of Beam of Uniform Strength

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

[Open Calculator !\[\]\(3e2231b1ad3ca8da8658228c00dd08e0_img.jpg\)](#)

$$\text{ex } 1163.431\text{Pa} = \frac{3 \cdot 0.15\text{kN} \cdot 21\text{mm}}{100.0003\text{mm} \cdot (285\text{mm})^2}$$

Section Modulus for Various Shapes

5) Allowable Bending Stress

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

[Open Calculator !\[\]\(b792654f2cef9719eabeb6c5be00811e_img.jpg\)](#)

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



6) Beam Width for Uniform Strength in Bending Stress

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

[Open Calculator !\[\]\(e78f798d4ea5c530c9db49e7d26e6b95_img.jpg\)](#)

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

7) Breadth of Rectangular Shape given Section Modulus

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

[Open Calculator !\[\]\(05be7c7a8995decd503647c99211f7c2_img.jpg\)](#)

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

8) Depth of Beam for Uniform Strength in Bending Stress

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

[Open Calculator !\[\]\(fe3aebe81acea8d45108cd2768939da7_img.jpg\)](#)

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



9) Depth of Rectangular Shape given Section Modulus

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

[Open Calculator !\[\]\(e2376d476d06eb31946dc01a69a4403a_img.jpg\)](#)

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

10) Diameter of Circular Shape given Section Modulus

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

[Open Calculator !\[\]\(0b5e7e25e8775f7e7e80906ada4f0021_img.jpg\)](#)

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

11) Inner Breadth of Hollow Rectangular Shape

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

[Open Calculator !\[\]\(bd3b31712ad9bab5a241210fa6925cdd_img.jpg\)](#)

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



12) Inner Depth of Hollow Rectangular Shape

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

[Open Calculator !\[\]\(d3fb9f94af8b26d1c844efa9a98805b0_img.jpg\)](#)

ex

$$1497.939\text{mm} = \left(\frac{(6 \cdot 0.04141\text{m}^3 \cdot 1200\text{mm}) + (800\text{mm} \cdot 1200\text{mm}^3)}{500\text{mm}} \right)^{\frac{1}{3}}$$

13) Inner Diameter of Hollow Circular Shape in Bending Stress

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

[Open Calculator !\[\]\(73002692dd5e7a64e60946be3158e719_img.jpg\)](#)

ex

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

14) Load on Beam for Uniform Strength in Bending Stress

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

[Open Calculator !\[\]\(aab88c0d099e5d18d6533a97b13ec28d_img.jpg\)](#)

ex

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



15) Outer Breadth of Hollow Rectangular Shape

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

[Open Calculator !\[\]\(9dfdaff1d86ba3c1f8353b4d1b61b8c5_img.jpg\)](#)

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

16) Section Modulus of Circular Shape

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

[Open Calculator !\[\]\(2b376d1a92330ab09dad2665d2f89bf5_img.jpg\)](#)

$$\text{ex } 0.041417\text{m}^3 = \frac{\pi \cdot 750\text{mm}^3}{32}$$

17) Section Modulus of Hollow Circular Shape

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

[Open Calculator !\[\]\(c444627dab9fee9a1550c053ffaaaae2_img.jpg\)](#)

$$\text{ex } 0.022608\text{m}^3 = \frac{\pi \cdot (700\text{mm}^4 - 530\text{mm}^4)}{32 \cdot 700\text{mm}}$$



18) Section Modulus of Hollow Rectangular Shape

[Open Calculator !\[\]\(3d8c13c92b853674f749aac6fa869926_img.jpg\)](#)

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

$$\text{ex } 0.141375\text{m}^3 = \frac{(800\text{mm} \cdot 1200\text{mm}^3) - (500\text{mm} \cdot (900\text{mm})^3)}{6 \cdot 1200\text{mm}}$$

19) Section Modulus of Rectangular Shape

[Open Calculator !\[\]\(17acf1afa8cdf0b67c53d4865a5ed469_img.jpg\)](#)

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

$$\text{ex } 0.041405\text{m}^3 = \frac{300\text{mm} \cdot (910\text{mm})^2}{6}$$



Variables Used

- **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

- **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:** **Pressure** in Pascal (Pa), Megapascal (MPa)
Pressure Unit Conversion 
- **Measurement:** **Force** in Kilonewton (kN)
Force Unit Conversion 



Check other formula lists

- [Mohr's Circle of Stresses Formulas](#) 
- [Beam Moments Formulas](#) 
- [Bending Stress Formulas](#) 
- [Combined Axial and Bending Loads Formulas](#) 
- [Elastic Stability of Columns Formulas](#) 
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