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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

Open Calculator

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

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

Open Calculator

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

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

Open Calculator

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

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

Open Calculator

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

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

Open Calculator

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

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

Open Calculator

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

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

Open Calculator

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

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

Open Calculator

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

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

Open Calculator

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

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

Open Calculator

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

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

Open Calculator

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

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

12) Inner Depth of Hollow Rectangular Shape

Open Calculator

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

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

Open Calculator

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

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

14) Load on Beam for Uniform Strength in Bending Stress

Open Calculator

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

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

15) Outer Breadth of Hollow Rectangular Shape

Open Calculator

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

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

16) Section Modulus of Circular Shape

Open Calculator

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

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

17) Section Modulus of Hollow Circular Shape

Open Calculator

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

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

18) Section Modulus of Hollow Rectangular Shape

Open Calculator

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

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

19) Section Modulus of Rectangular Shape

Open Calculator

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

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

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 (m^3)
  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**
- **Principal Stress Formulas**
- **Slope and Deflection Formulas**

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