Important Timber Beams and Columns Formulas PDF

Formulas
Examples
with Units

List of 19
Important Timber Beams and Columns Formulas

1) Beams Formulas

1.1) Beam Depth for Extreme Fiber Stress in Rectangular Timber Beam Formula

Evaluate Formula

Formula

$$h = \sqrt{\frac{6 \cdot M}{f_s \cdot b}}$$

Example with Units

$$199.92\,\text{mm} = \sqrt{\frac{6 \cdot 2500\,\text{N*m}}{2.78\,\text{MPa} \cdot 135\,\text{mm}}}$$

1.2) Beam Depth given Horizontal Shearing Stress Formula

Evaluate Formula

Formula

$$h = \frac{3 \cdot V}{2 \cdot b \cdot H}$$

Example with Units

$$199.9818\,\text{mm} = \frac{3 \cdot 660000\,\text{N}}{2 \cdot 135\,\text{mm} \cdot 36.67\,\text{MPa}}$$

1.3) Beam Width given Extreme Fiber Stress for Rectangular Timber Beam Formula

Evaluate Formula

Formula

$$b = \frac{6 \cdot M}{f_s \cdot (h)^2}$$

Example with Units

$$134.8921\,\text{mm} = \frac{6 \cdot 2500\,\text{N*m}}{2.78\,\text{MPa} \cdot (200.0\,\text{mm})^2}$$

1.4) Beam Width given Horizontal Shearing Stress Formula

Evaluate Formula

Formula

$$b = \frac{3 \cdot V}{2 \cdot h \cdot H}$$

Example with Units

$$134.9877\,\text{mm} = \frac{3 \cdot 660000\,\text{N}}{2 \cdot 200.0\,\text{mm} \cdot 36.67\,\text{MPa}}$$

1.5) Bending Moment using Extreme Fiber Stress for Rectangular Timber Beam Formula

Evaluate Formula

Formula

$$M = \frac{f_s \cdot b \cdot (h)^2}{6}$$

Example with Units

$$2502\,\text{N*m} = \frac{2.78\,\text{MPa} \cdot 135\,\text{mm} \cdot (200.0\,\text{mm})^2}{6}$$

1.6) Extreme Fiber Stress for Rectangular Timber Beam given Section Modulus Formula

Evaluate Formula

Formula

$$f_s = \frac{M}{S}$$

Example with Units

$$2.7778\,\text{MPa} = \frac{2500\,\text{N*m}}{900000\,\text{mm}^3}$$

1.7) Extreme Fiber Stress in Bending for Rectangular Timber Beam Formula

Evaluate Formula

Formula

$$f_s = \frac{6 \cdot M}{b \cdot h^2}$$

Example with Units

$$2.7778\,\text{MPa} = \frac{6 \cdot 2500\,\text{N*m}}{135\,\text{mm} \cdot 200.0\,\text{mm}^2}$$

1.8) Horizontal Shearing Stress in Rectangular Timber Beam Formula

Evaluate Formula

Formula

$$H = \frac{3 \cdot V}{2 \cdot b \cdot h}$$

Example with Units

$$36.6667\,\text{MPa} = \frac{3 \cdot 660000\,\text{N}}{2 \cdot 135\,\text{mm} \cdot 200.0\,\text{mm}}$$

1.9) Horizontal Shearing Stress in Rectangular Timber Beam given Notch in Lower Face Formula

Evaluate Formula

Formula

$$H = \left(\frac{3 \cdot V}{2 \cdot b \cdot d_{notch}}\right) \cdot \left(\frac{h}{d_{notch}}\right)$$

Example with Units

$$38.5711\,\text{MPa} = \left(\frac{3 \cdot 660000\,\text{N}}{2 \cdot 135\,\text{mm} \cdot 195\,\text{mm}}\right) \cdot \left(\frac{200.0\,\text{mm}}{195\,\text{mm}}\right)$$

1.10) Modified Total End Shear for Concentrated Loads Formula

Evaluate Formula

Formula

$$V_1 = \frac{10 \cdot P \cdot \left(l_{beam} - x\right) \cdot \left(\left(\frac{x}{h}\right)^2\right)}{9 \cdot l_{beam} \cdot \left(2 + \left(\frac{x}{h}\right)^2\right)}$$

Example with Units

$$46.5098\,\text{N} = \frac{10 \cdot 15000\,\text{N} \cdot \left(3000\,\text{mm} - 15\,\text{mm}\right) \cdot \left(\left(\frac{15\,\text{mm}}{200.0\,\text{mm}}\right)^2\right)}{9 \cdot 3000\,\text{mm} \cdot \left(2 + \left(\frac{15\,\text{mm}}{200.0\,\text{mm}}\right)^2\right)}$$

1.11) Modified Total End Shear for Uniform Loading Formula

Evaluate Formula

Formula

$$V_1 = \left(\frac{W}{2}\right) \cdot \left(1 - \left(\frac{2 \cdot h}{l_{beam}}\right)\right)$$

Example with Units

$$43.3333\,\text{N} = \left(\frac{100\,\text{N}}{2}\right) \cdot \left(1 - \left(\frac{2 \cdot 200.0\,\text{mm}}{3000\,\text{mm}}\right)\right)$$

1.12) Section Modulus given Height and Breadth of Section Formula

Evaluate Formula

Formula

$$S = \frac{b \cdot h^2}{6}$$

Example with Units

$$900000\,\text{mm}^3 = \frac{135\,\text{mm} \cdot 200.0\,\text{mm}^2}{6}$$

1.13) Total Shear given Horizontal Shearing Stress Formula

Evaluate Formula

Formula

$$V = \frac{2 \cdot H \cdot h \cdot b}{3}$$

Example with Units

$$660060\,\text{N} = \frac{2 \cdot 36.67\,\text{MPa} \cdot 200.0\,\text{mm} \cdot 135\,\text{mm}}{3}$$

2) Columns Formulas

2.1) Allowable Unit Stress at Angle to Grain Formula

Evaluate Formula

Formula

$$c' = \frac{c \cdot c_\perp}{c \cdot \left(\sin\left(\theta\right)^2\right) + c_\perp \cdot \left(\cos\left(\theta\right)^2\right)}$$

Example with Units

$$1.8065\,\text{MPa} = \frac{2.0001\,\text{MPa} \cdot 1.4\,\text{MPa}}{2.0001\,\text{MPa} \cdot \left(\sin\left(30°\right)^2\right) + 1.4\,\text{MPa} \cdot \left(\cos\left(30°\right)^2\right)}$$

2.2) Allowable Unit Stress on Timber Columns for Single Member Formula

Evaluate Formula

Formula

$$P|A = \frac{3.619 \cdot E}{\left(\frac{L}{k_G}\right)^2}$$

Example with Units

$$0.0007\,\text{MPa} = \frac{3.619 \cdot 50\,\text{MPa}}{\left(\frac{1500\,\text{mm}}{3\,\text{mm}}\right)^2}$$

2.3) Allowable Unit Stress on Timber Columns of Circular Cross Section Formula

Evaluate Formula

Formula

$$P|A = \frac{0.22 \cdot E}{\left(\frac{L}{d}\right)^2}$$

Example with Units

$$0.1956\,\text{MPa} = \frac{0.22 \cdot 50\,\text{MPa}}{\left(\frac{1500\,\text{mm}}{200\,\text{mm}}\right)^2}$$

2.4) Allowable Unit Stress on Timber Columns of Square or Rectangular Cross Section Formula

Evaluate Formula

Formula

$$P|A = \frac{0.3 \cdot E}{\left(\frac{L}{d}\right)^2}$$

Example with Units

$$0.2667\,\text{MPa} = \frac{0.3 \cdot 50\,\text{MPa}}{\left(\frac{1500\,\text{mm}}{200\,\text{mm}}\right)^2}$$

2.5) Elasticity Modulus given Allowable Unit Stress of Square or Rectangular Timber Columns Formula

Evaluate Formula

Formula

$$E = \frac{P|A \cdot \left(\left(\frac{L}{d}\right)^2\right)}{0.3}$$

Example with Units

$$333.75\,\text{MPa} = \frac{1.78\,\text{MPa} \cdot \left(\left(\frac{1500\,\text{mm}}{200\,\text{mm}}\right)^2\right)}{0.3}$$

2.6) Elasticity Modulus using Allowable Unit Stress of Circular Timber Columns Formula

Evaluate Formula

Formula

$$E = \frac{P|A \cdot \left(\left(\frac{L}{d}\right)^2\right)}{0.22}$$

Example with Units

$$455.1136\,\text{MPa} = \frac{1.78\,\text{MPa} \cdot \left(\left(\frac{1500\,\text{mm}}{200\,\text{mm}}\right)^2\right)}{0.22}$$

Variables used in list of Timber Beams and Columns Formulas above

- **b** Width of Beam *(Millimeter)*
- **c** Allowable Unit Stress Parallel to Grain *(Megapascal)*
- **c'** Allowable Unit Stress at Angle to Grain *(Megapascal)*
- $c_{\perp}$ Allowable Unit Stress Perpendicular to Grain *(Megapascal)*
- **d** Least Dimension *(Millimeter)*
- d_{notch} Depth of Beam above Notch *(Millimeter)*
- **E** Modulus of Elasticity *(Megapascal)*
- f_s Maximum Fiber Stress *(Megapascal)*
- **h** Depth of Beam *(Millimeter)*
- **H** Horizontal Shearing Stress *(Megapascal)*
- k_G Radius of Gyration *(Millimeter)*
- **L** Unsupported Length of Column *(Millimeter)*
- l_{beam} Span of Beam *(Millimeter)*
- **M** Bending Moment *(Newton Meter)*
- **P** Concentrated Load *(Newton)*
- **P|A** Allowable Unit Stress *(Megapascal)*
- **S** Section Modulus *(Cubic Millimeter)*
- **V** Total Shear *(Newton)*
- V_1 Modified Total End Shear *(Newton)*
- **W** Total Uniformly Distributed Load *(Newton)*
- **x** Distance from Reaction to Concentrated Load *(Millimeter)*
- **θ** Angle between Load and Grain *(Degree)*

Constants, Functions, Measurements used in list of Timber Beams and Columns Formulas above

- Functions: **cos**, cos(Angle)
  Cosine of an angle is the ratio of the side adjacent to the angle to the hypotenuse of the triangle.
- Functions: **sin**, sin(Angle)
  Sine is a trigonometric function that describes the ratio of the length of the opposite side of a right triangle to the length of the hypotenuse.
- 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 Millimeter (mm^3)
  Volume Unit Conversion
- Measurement: **Pressure** in Megapascal (MPa)
  Pressure Unit Conversion
- Measurement: **Force** in Newton (N)
  Force Unit Conversion
- Measurement: **Angle** in Degree (°)
  Angle Unit Conversion
- Measurement: **Moment of Force** in Newton Meter (N*m)
  Moment of Force Unit Conversion
- Measurement: **Stress** in Megapascal (MPa)
  Stress Unit Conversion

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