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# Shear Stress Formulas

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# List of 42 Shear Stress Formulas

## Shear Stress

## Horizontal Shear Flow

### 1) Area given Horizontal Shear Flow

Open Calculator

fx $$A = \frac{I \cdot \tau}{V \cdot y}$$

ex $$3.193548\text{m}^2 = \frac{36000000\text{mm}^4 \cdot 55\text{MPa}}{24.8\text{kN} \cdot 25\text{mm}}$$

### 2) Distance from Centroid given Horizontal Shear Flow

Open Calculator

fx $$y = \frac{I \cdot \tau}{V \cdot A}$$

ex $$24.9496\text{mm} = \frac{36000000\text{mm}^4 \cdot 55\text{MPa}}{24.8\text{kN} \cdot 3.2\text{m}^2}$$

### 3) Horizontal Shear Flow

Open Calculator

fx $$\tau = \frac{V \cdot A \cdot y}{I}$$

ex $$55.11111\text{MPa} = \frac{24.8\text{kN} \cdot 3.2\text{m}^2 \cdot 25\text{mm}}{36000000\text{mm}^4}$$

### 4) Moment of Inertia given Horizontal Shear Flow

Open Calculator

fx $$I = \frac{V \cdot A \cdot y}{\tau}$$

ex $$3.6\text{E\^{}}7\text{mm}^4 = \frac{24.8\text{kN} \cdot 3.2\text{m}^2 \cdot 25\text{mm}}{55\text{MPa}}$$

### 5) Shear given Horizontal Shear Flow

Open Calculator

fx $$V = \frac{I \cdot \tau}{y \cdot A}$$

ex $$24.75\text{kN} = \frac{36000000\text{mm}^4 \cdot 55\text{MPa}}{25\text{mm} \cdot 3.2\text{m}^2}$$

## Longitudinal Shear Stress

### 6) Area given Longitudinal Shear Stress

Open Calculator

fx $$A = \frac{\tau \cdot I \cdot b}{V \cdot y}$$

ex $$0.958065\text{m}^2 = \frac{55\text{MPa} \cdot 36000000\text{mm}^4 \cdot 300\text{mm}}{24.8\text{kN} \cdot 25\text{mm}}$$

### 7) Breadth for given Longitudinal Shear Stress

Open Calculator

fx $$b = \frac{V \cdot A \cdot y}{I \cdot \tau}$$

ex $$1002.02\text{mm} = \frac{24.8\text{kN} \cdot 3.2\text{m}^2 \cdot 25\text{mm}}{36000000\text{mm}^4 \cdot 55\text{MPa}}$$

### 8) Maximum Distance from Neutral Axis to Extreme Fiber given Longitudinal Shear Stress

Open Calculator

fx $$y = \frac{\tau \cdot I \cdot b}{V \cdot A}$$

ex $$7.484879\text{mm} = \frac{55\text{MPa} \cdot 36000000\text{mm}^4 \cdot 300\text{mm}}{24.8\text{kN} \cdot 3.2\text{m}^2}$$

### 9) Moment of Inertia given Longitudinal Shear Stress

Open Calculator

fx $$I = \frac{V \cdot A \cdot y}{\tau \cdot b}$$

ex $$0.00012\text{mm}^4 = \frac{24.8\text{kN} \cdot 3.2\text{m}^2 \cdot 25\text{mm}}{55\text{MPa} \cdot 300\text{mm}}$$

## I-Beam

### 10) Breadth of Flange Given Longitudinal Shear Stress in Web for I beam

Open Calculator

fx $$b_f = \frac{8 \cdot I \cdot \tau \cdot b_w}{V \cdot \left(D^2 - d_w^2\right)}$$

ex $$39.93339\text{mm} = \frac{8 \cdot 36000000\text{mm}^4 \cdot 55\text{MPa} \cdot .040\text{m}}{24.8\text{kN} \cdot \left((800\text{mm})^2 - (15\text{mm})^2\right)}$$

### 11) Breadth of Web given Longitudinal Shear Stress in Web for I beam

Open Calculator

fx $$b_w = \left(\frac{b_f \cdot V}{8 \cdot \tau \cdot I}\right) \cdot \left(D^2 - d_w^2\right)$$

ex $$0.250417\text{m} = \left(\frac{250\text{mm} \cdot 24.8\text{kN}}{8 \cdot 55\text{MPa} \cdot 36000000\text{mm}^4}\right) \cdot \left((800\text{mm})^2 - (15\text{mm})^2\right)$$

### 12) Longitudinal Shear Stress in Flange at Lower Depth of I beam

Open Calculator

fx $$\tau = \left(\frac{V}{8 \cdot I}\right) \cdot \left(D^2 - d_w^2\right)$$

ex $$55.09174\text{MPa} = \left(\frac{24.8\text{kN}}{8 \cdot 36000000\text{mm}^4}\right) \cdot \left((800\text{mm})^2 - (15\text{mm})^2\right)$$

### 13) Longitudinal Shear Stress in Web for I beam

Open Calculator

fx $$\tau = \left(\frac{b_f \cdot V}{8 \cdot b_w \cdot I}\right) \cdot \left(D^2 - d_w^2\right)$$

ex $$344.3234\text{MPa} = \left(\frac{250\text{mm} \cdot 24.8\text{kN}}{8 \cdot .040\text{m} \cdot 36000000\text{mm}^4}\right) \cdot \left((800\text{mm})^2 - (15\text{mm})^2\right)$$

### 14) Maximum Longitudinal Shear Stress in Web for I beam

Open Calculator

fx $$\tau_{maxlongitudinal} = \left(\left(\frac{b_f \cdot V}{8 \cdot b_w \cdot I} \cdot \left(D^2 - d_w^2\right)\right)\right) + \left(\frac{V \cdot d_w^2}{8 \cdot I}\right)$$

ex
$$344.3427\text{MPa} = \left(\left(\frac{250\text{mm} \cdot 24.8\text{kN}}{8 \cdot .040\text{m} \cdot 36000000\text{mm}^4} \cdot \left((800\text{mm})^2 - (15\text{mm})^2\right)\right)\right) + \left(\frac{24.8\text{kN} \cdot (15\text{mm})^2}{8 \cdot 36000000\text{mm}^4}\right)$$

### 15) Moment of Inertia given Longitudinal Shear Stress at lower edge in Flange of I beam

Open Calculator

fx $$I = \left(\frac{V}{8 \cdot \tau}\right) \cdot \left(D^2 - d_w^2\right)$$

ex $$3.6\text{E}\hat{}7\text{mm}^4 = \left(\frac{24.8\text{kN}}{8 \cdot 55\text{MPa}}\right) \cdot \left((800\text{mm})^2 - (15\text{mm})^2\right)$$

### 16) Moment of Inertia given Longitudinal Shear Stress in Web for I beam

Open Calculator

fx $$I = \left(\frac{b_f \cdot V}{8 \cdot \tau \cdot b_w}\right) \cdot \left(D^2 - d_w^2\right)$$

ex $$2.3\text{E}\hat{}8\text{mm}^4 = \left(\frac{250\text{mm} \cdot 24.8\text{kN}}{8 \cdot 55\text{MPa} \cdot .040\text{m}}\right) \cdot \left((800\text{mm})^2 - (15\text{mm})^2\right)$$

### 17) Moment of Inertia given Maximum Longitudinal Shear Stress in Web for I beam

Open Calculator

fx $$I = \frac{\left(\frac{b_f \cdot V}{8 \cdot b_w}\right) \cdot \left(D^2 - d_w^2\right)}{\tau_{max}} + \frac{\frac{V \cdot d_w^2}{8}}{\tau_{max}}$$

ex $$3\text{E}\hat{}8\text{mm}^4 = \frac{\left(\frac{250\text{mm} \cdot 24.8\text{kN}}{8 \cdot .040\text{m}}\right) \cdot \left((800\text{mm})^2 - (15\text{mm})^2\right)}{42\text{MPa}} + \frac{\frac{24.8\text{kN} \cdot (15\text{mm})^2}{8}}{42\text{MPa}}$$

### 18) Polar Moment of Inertia given Torsional Shear Stress

Open Calculator

fx $$J = \frac{T \cdot R}{\tau_{max}}$$

ex $$2.22619\text{mm}^4 = \frac{0.85\text{kN*m} \cdot 110\text{mm}}{42\text{MPa}}$$

### 19) Transverse Shear for Longitudinal Shear Stress in Web for I Beam

Open Calculator

fx $$V = \frac{8 \cdot I \cdot \tau \cdot b_w}{b_f \cdot \left(D^2 - d_w^2\right)}$$

ex $$3.961393\text{kN} = \frac{8 \cdot 36000000\text{mm}^4 \cdot 55\text{MPa} \cdot .040\text{m}}{250\text{mm} \cdot \left((800\text{mm})^2 - (15\text{mm})^2\right)}$$

### 20) Transverse Shear force given Maximum Longitudinal Shear Stress in Web for I beam

Open Calculator

fx $$V = \frac{\tau_{maxlongitudinal} \cdot b_w \cdot 8 \cdot I}{\left(b_f \cdot \left(D^2 - d_w^2\right)\right) + \left(b_w \cdot \left(d_w^2\right)\right)}$$

ex $$18.00604\text{kN} = \frac{250.01\text{MPa} \cdot .040\text{m} \cdot 8 \cdot 36000000\text{mm}^4}{\left(250\text{mm} \cdot \left((800\text{mm})^2 - (15\text{mm})^2\right)\right) + \left(.040\text{m} \cdot \left((15\text{mm})^2\right)\right)}$$

### 21) Transverse Shear given Longitudinal Shear Stress in Flange for I beam

Open Calculator

fx $$V = \frac{8 \cdot I \cdot \tau}{D^2 - d_w^2}$$

ex $$24.7587\text{kN} = \frac{8 \cdot 36000000\text{mm}^4 \cdot 55\text{MPa}}{(800\text{mm})^2 - (15\text{mm})^2}$$

## Longitudinal Shear Stress for Rectangular Section

### 22) Average Longitudinal Shear Stress for Rectangular Section

Open Calculator

fx $$q_{avg} = \frac{V}{b \cdot d}$$

ex $$0.183704\text{MPa} = \frac{24.8\text{kN}}{300\text{mm} \cdot 450\text{mm}}$$

### 23) Breadth for given Maximum Longitudinal Shear Stress for Rectangular Section

Open Calculator

fx $$b = \frac{3 \cdot V}{2 \cdot \tau_{maxlongitudinal} \cdot d}$$

ex $$0.330653\text{mm} = \frac{3 \cdot 24.8\text{kN}}{2 \cdot 250.01\text{MPa} \cdot 450\text{mm}}$$

### 24) Breadth given Average Longitudinal Shear Stress for Rectangular Section

Open Calculator

fx $$b = \frac{V}{q_{avg} \cdot d}$$

ex $$300.006\text{mm} = \frac{24.8\text{kN}}{0.1837\text{MPa} \cdot 450\text{mm}}$$

### 25) Depth given Average Longitudinal Shear Stress for Rectangular Section

Open Calculator

$$d = \frac{V}{q_{avg} \cdot b}$$

$$450.0091\text{mm} = \frac{24.8\text{kN}}{0.1837\text{MPa} \cdot 300\text{mm}}$$

### 26) Maximum Longitudinal Shear Stress for Rectangular Section

Open Calculator

$$\tau_{maxlongitudinal} = \frac{3 \cdot V}{2 \cdot b \cdot d}$$

$$275.5556\text{MPa} = \frac{3 \cdot 24.8\text{kN}}{2 \cdot 300\text{mm} \cdot 450\text{mm}}$$

### 27) Transverse Shear given Average Longitudinal Shear Stress for Rectangular Section

Open Calculator

$$V = q_{avg} \cdot b \cdot d$$

$$24.7995\text{kN} = 0.1837\text{MPa} \cdot 300\text{mm} \cdot 450\text{mm}$$

### 28) Transverse Shear given Maximum Longitudinal Shear Stress for Rectangular Section

Open Calculator

$$V = \left(\tau_{maxlongitudinal} \cdot b \cdot d \cdot \left(\frac{2}{3}\right)\right)$$

$$0.022501\text{kN} = \left(250.01\text{MPa} \cdot 300\text{mm} \cdot 450\text{mm} \cdot \left(\frac{2}{3}\right)\right)$$

## Longitudinal Shear Stress for Solid Circular Section

### 29) Average Longitudinal Shear Stress for Solid Circular Section

Open Calculator

$$q_{avg} = \frac{V}{\pi \cdot r^2}$$

$$0.18423\text{MPa} = \frac{24.8\text{kN}}{\pi \cdot (207\text{mm})^2}$$

## 30) Maximum Longitudinal Shear Stress for Solid Circular Section

Open Calculator

fx $$\tau_{maxlongitudinal} = \frac{4 \cdot V}{3 \cdot \pi \cdot r^2}$$

ex $$245.6404\text{MPa} = \frac{4 \cdot 24.8\text{kN}}{3 \cdot \pi \cdot (207\text{mm})^2}$$

## 31) Radius given Average Longitudinal Shear Stress for Solid Circular Section

Open Calculator

fx $$r = \sqrt{\frac{V}{\pi \cdot q_{avg}}}$$

ex $$207.2986\text{mm} = \sqrt{\frac{24.8\text{kN}}{\pi \cdot 0.1837\text{MPa}}}$$

## 32) Radius given Maximum Longitudinal Shear Stress for Solid Circular Section

Open Calculator

fx $$r = \sqrt{\frac{4 \cdot V}{3 \cdot \pi \cdot \tau_{maxlongitudinal}}}$$

ex $$0.006488\text{mm} = \sqrt{\frac{4 \cdot 24.8\text{kN}}{3 \cdot \pi \cdot 250.01\text{MPa}}}$$

## 33) Transverse Shear given Average Longitudinal Shear Stress for Solid Circular Section

Open Calculator

fx $$V = q_{avg} \cdot \pi \cdot r^2$$

ex $$24.72861\text{kN} = 0.1837\text{MPa} \cdot \pi \cdot (207\text{mm})^2$$

## 34) Transverse Shear given Maximum Longitudinal Shear Stress for Solid Circular Section

Open Calculator

fx $$V = \frac{\tau_{max} \cdot \pi \cdot r^2 \cdot 3}{4}$$

ex $$4240.344\text{kN} = \frac{42\text{MPa} \cdot \pi \cdot (207\text{mm})^2 \cdot 3}{4}$$

## Maximum Stress of a Triangular Section

### 35) Base of Triangular Section given Maximum Shear Stress

Open Calculator

fx $$b_{tri} = \frac{3 \cdot V}{\tau_{max} \cdot h_{tri}}$$

ex $$31.63265\text{mm} = \frac{3 \cdot 24.8\text{kN}}{42\text{MPa} \cdot 56\text{mm}}$$

### 36) Base of Triangular Section given Shear Stress at Neutral Axis

Open Calculator

fx $$b_{tri} = \frac{8 \cdot V}{3 \cdot \tau_{NA} \cdot h_{tri}}$$

ex $$31.42862\text{mm} = \frac{8 \cdot 24.8\text{kN}}{3 \cdot 37.5757\text{MPa} \cdot 56\text{mm}}$$

### 37) Height of Triangular Section given Maximum Shear Stress

Open Calculator

fx $$h_{tri} = \frac{3 \cdot V}{b_{tri} \cdot \tau_{max}}$$

ex $$55.35714\text{mm} = \frac{3 \cdot 24.8\text{kN}}{32\text{mm} \cdot 42\text{MPa}}$$

### 38) Height of Triangular Section given Shear Stress at Neutral Axis

Open Calculator

fx $$h_{tri} = \frac{8 \cdot V}{3 \cdot b_{tri} \cdot \tau_{NA}}$$

ex $$55.00008\text{mm} = \frac{8 \cdot 24.8\text{kN}}{3 \cdot 32\text{mm} \cdot 37.5757\text{MPa}}$$

### 39) Maximum Shear Stress of Triangular Section

Open Calculator

fx $$\tau_{max} = \frac{3 \cdot V}{b_{tri} \cdot h_{tri}}$$

ex $$41.51786\text{MPa} = \frac{3 \cdot 24.8\text{kN}}{32\text{mm} \cdot 56\text{mm}}$$

## 40) Shear Stress at Neutral Axis in Triangular Section

Open Calculator

fx $$\tau_{NA} = \frac{8 \cdot V}{3 \cdot b_{tri} \cdot h_{tri}}$$

ex $$36.90476\text{MPa} = \frac{8 \cdot 24.8\text{kN}}{3 \cdot 32\text{mm} \cdot 56\text{mm}}$$

## 41) Transverse Shear Force of Triangular Section given Maximum Shear Stress

Open Calculator

fx $$V = \frac{h_{tri} \cdot b_{tri} \cdot \tau_{max}}{3}$$

ex $$25.088\text{kN} = \frac{56\text{mm} \cdot 32\text{mm} \cdot 42\text{MPa}}{3}$$

## 42) Transverse Shear Force of Triangular Section given Shear Stress at Neutral Axis

Open Calculator

fx $$V = \frac{3 \cdot b_{tri} \cdot h_{tri} \cdot \tau_{NA}}{8}$$

ex $$25.25087\text{kN} = \frac{3 \cdot 32\text{mm} \cdot 56\text{mm} \cdot 37.5757\text{MPa}}{8}$$

## Variables Used

- **$A$** Cross Sectional Area *(Square Meter)*
- **$b$** Breadth of Rectangular Section *(Millimeter)*
- **$b_f$** Width of Flange *(Millimeter)*
- **$b_{tri}$** Base of Triangular Section *(Millimeter)*
- **$b_w$** Width of Web *(Meter)*
- **$d$** Depth of Rectangular Section *(Millimeter)*
- **$D$** Overall Depth of I Beam *(Millimeter)*
- **$d_w$** Depth of Web *(Millimeter)*
- **$h_{tri}$** Height of Triangular Section *(Millimeter)*
- **$I$** Area Moment of Inertia *(Millimeter⁴)*
- **$J$** Polar Moment of Inertia *(Millimeter⁴)*
- **$q_{avg}$** Average Shear Stress *(Megapascal)*
- **$r$** Radius of Circular Section *(Millimeter)*
- **$R$** Radius of Shaft *(Millimeter)*
- **$T$** Torsional Moment *(Kilonewton Meter)*
- **$V$** Shear Force *(Kilonewton)*
- **$y$** Distance from Neutral Axis *(Millimeter)*
- **$\tau$** Shear Stress *(Megapascal)*
- **$\tau_{max}$** Maximum Shear Stress *(Megapascal)*
- **$\tau_{maxlongitudinal}$** Maximum Longitudinal Shear Stress *(Megapascal)*
- **$\tau_{NA}$** Shear Stress at Neutral Axis *(Megapascal)*

## Constants, Functions, Measurements used

- Constant: **pi**, 3.14159265358979323846264338327950288
  *Archimedes' constant*
- Function: **sqrt**, sqrt(Number)
  *Square root function*
- Measurement: **Length** in Millimeter (mm), Meter (m)
  *Length Unit Conversion*
- Measurement: **Area** in Square Meter ($m^2$)
  *Area Unit Conversion*
- Measurement: **Force** in Kilonewton (kN)
  *Force Unit Conversion*
- Measurement: **Torque** in Kilonewton Meter (kN*m)
  *Torque Unit Conversion*
- Measurement: **Second Moment of Area** in Millimeter$^4$ ($mm^4$)
  *Second Moment of Area Unit Conversion*
- Measurement: **Stress** in Megapascal (MPa)
  *Stress 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
- Shear Stress Formulas
- Slope and Deflection Formulas
- Strain Energy Formulas
- Torsion Formulas



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