Important Shear Stress in I Section Formulas PDF

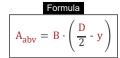


List of 33

Important Shear Stress in I Section Formulas

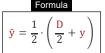
1) Shear Stress Distribution in Flange Formulas 🕝

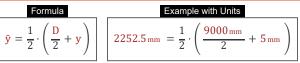
1.1) Area of Flange or Area above Considered Section Formula 🕝



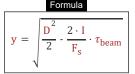


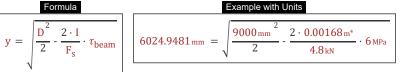
1.2) Distance of CG of Considered Area of Flange from Neutral Axis in I Section Formula 🕝





1.3) Distance of Considered Section from Neutral Axis given Shear Stress in Flange Formula





1.4) Distance of Lower Edge of Flange from Neutral Axis Formula [7]



Formula Example with Units
$$y = \frac{d}{2}$$

$$225_{mm} = \frac{450_{mm}}{2}$$

Evaluate Formula

Evaluate Formula

Evaluate Formula (

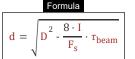
Evaluate Formula (

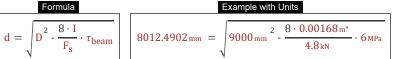
1.5) Distance of Upper Edge of Flange from Neutral Axis Formula 🕝





1.6) Inner Depth of I-section given Shear Stress in Lower Edge of Flange Formula 🕝





Evaluate Formula (

1.7) Moment of Inertia of I section given Shear Stress in Lower Edge of Flange Formula 🕝

$$I = \frac{F_{S}}{8 \cdot \tau_{beam}} \cdot \left(D^{2} - d^{2}\right)$$

$$I = \frac{F_{S}}{8 \cdot \tau_{beam}} \cdot \left(D^{2} - d^{2}\right) = \frac{4.8 \text{ kN}}{8 \cdot 6 \text{ MPa}} \cdot \left(9000 \text{ mm}^{2} - 450 \text{ mm}^{2}\right)$$

Evaluate Formula (

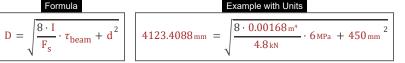
1.8) Moment of Inertia of Section for I-section Formula [7]

Formula
$$I = \frac{F_s}{2 \cdot \tau_{beam}} \cdot \left(\frac{D^2}{2} - y^2\right)$$

Formula Example with Units
$$I = \frac{F_{s}}{2 \cdot \tau_{beam}} \cdot \left(\frac{D^{2}}{2} - y^{2}\right) = 0.0162 \, \text{m}^{4} = \frac{4.8 \, \text{kN}}{2 \cdot 6 \, \text{MPa}} \cdot \left(\frac{9000 \, \text{mm}}{2} - 5 \, \text{mm}^{2}\right)$$

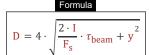
1.9) Outer Depth of I section given Shear Stress in Lower Edge of Flange Formula 🗂

$$D = \sqrt{\frac{8 \cdot I}{F_S} \cdot \tau_{beam} + d^2}$$





1.10) Outer Depth of I-section given Shear Stress in Flange Formula 🕝





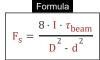


1.11) Shear Force in Flange of I-section Formula C

$$F_{s} = \frac{2 \cdot I \cdot \tau_{beam}}{\frac{D^{2}}{2} - y^{2}}$$

Formula Example with Units
$$F_{S} = \frac{2 \cdot I \cdot \tau_{beam}}{\frac{D^{2}}{2} \cdot y^{2}} \qquad 0.4978 \, \text{kN} = \frac{2 \cdot 0.00168 \, \text{m}^{4} \cdot 6 \, \text{MPa}}{\frac{9000 \, \text{mm}}{2} \cdot 5 \, \text{mm}}^{2}$$

1.12) Shear Force in Lower Edge of Flange in I-section Formula C



Formula Example with Units
$$F_{S} = \frac{8 \cdot I \cdot \tau_{beam}}{D^{2} - d^{2}}$$

$$0.9981 \, \text{kN} = \frac{8 \cdot 0.00168 \, \text{m}^{4} \cdot 6 \, \text{MPa}}{9000 \, \text{mm}^{2} - 450 \, \text{mm}^{2}}$$

Evaluate Formula 🕝

1.13) Shear Stress in Flange of I-section Formula C

Formula

 $\tau_{beam} = \frac{F_s}{2 \cdot I} \cdot \left(\frac{D^2}{2} - y^2\right) \left| \quad \left| \quad 57.8571 \, \text{MPa} \right| = \frac{4.8 \, \text{kN}}{2 \cdot 0.00168 \, \text{m}^4} \cdot \left(\frac{9000 \, \text{mm}}{2} - 5 \, \text{mm}^2\right) \right|$

Example with Units

Evaluate Formula (

1.14) Shear Stress in Lower Edge of Flange of I-section Formula 🕝

Formula

Example with Units

 $\tau_{beam} = \frac{F_s}{8 \cdot I} \cdot \left(\ D^2 - d^2 \right) \ \left| \ \ 28.8562 \, \text{MPa} \ = \frac{4.8 \, \text{kN}}{8 \cdot 0.00168 \, \text{m}^4} \cdot \left(\ 9000 \, \text{mm}^2 - 450 \, \text{mm}^2 \right) \ \right|$

 $B = \frac{A_{abv}}{\frac{D}{2} - y} \qquad 1.4238 \,\text{mm} = \frac{6400 \,\text{mm}^2}{\frac{9000 \,\text{mm}}{2} - 5 \,\text{mm}}$

1.15) Width of Section given Area above Considered Section of Flange Formula 🕝 Evaluate Formula (

Evaluate Formula (

2) Shear Stress Distribution in Web Formulas [7]

2.1) Distance of Considered Level from Neutral Axis at Junction of Top of Web Formula [7]

 $y = \frac{d}{2}$ 225 mm = $\frac{450 \text{ mm}}{2}$

Evaluate Formula (

2.2) Maximum Shear Force in I Section Formula

 $F_{S} = \frac{\tau_{max} \cdot I \cdot b}{\frac{B \cdot \left(D^{2} \cdot d^{2}\right)}{8} + \frac{b \cdot d^{2}}{8}} \left| \quad \right| \quad 0.1281 \, \text{kN} \\ = \frac{11 \, \text{MPa} \cdot 0.00168 \, \text{m}^{4} \cdot 7 \, \text{mm}}{\frac{100 \, \text{mm} \cdot \left(9000 \, \text{mm}^{2} \cdot 450 \, \text{mm}^{2}\right)}{8} + \frac{7 \, \text{mm} \cdot 450 \, \text{mm}^{2}}{9}} \right| \quad \left| \quad 0.1281 \, \text{kN} \right| = \frac{11 \, \text{MPa} \cdot 0.00168 \, \text{m}^{4} \cdot 7 \, \text{mm}}{\frac{100 \, \text{mm} \cdot \left(9000 \, \text{mm}^{2} \cdot 450 \, \text{mm}^{2}\right)}{8} + \frac{7 \, \text{mm} \cdot 450 \, \text{mm}^{2}}{9}} \right| \quad \left| \quad 0.1281 \, \text{kN} \right| = \frac{11 \, \text{MPa} \cdot 0.00168 \, \text{m}^{4} \cdot 7 \, \text{mm}}{\frac{100 \, \text{mm} \cdot \left(9000 \, \text{mm}^{2} \cdot 450 \, \text{mm}^{2}\right)}{8} + \frac{7 \, \text{mm} \cdot 450 \, \text{mm}^{2}}{9}} \right| \quad \left| \quad 0.1281 \, \text{kN} \right| = \frac{11 \, \text{MPa} \cdot 0.00168 \, \text{m}^{4} \cdot 7 \, \text{mm}}{\frac{100 \, \text{mm} \cdot \left(9000 \, \text{mm}^{2} \cdot 450 \, \text{mm}^{2}\right)}{8}} + \frac{7 \, \text{mm} \cdot 450 \, \text{mm}^{2}}{9} \right| \quad \left| \quad 0.1281 \, \text{kN} \right| = \frac{11 \, \text{MPa} \cdot 0.00168 \, \text{m}^{4} \cdot 7 \, \text{mm}}{\frac{100 \, \text{mm} \cdot \left(9000 \, \text{mm}^{2} \cdot 450 \, \text{mm}^{2}\right)}{8}} + \frac{7 \, \text{mm} \cdot 450 \, \text{mm}^{2}}{9} \right| \quad \left| \quad 0.1281 \, \text{kN} \right| = \frac{11 \, \text{MPa} \cdot 0.00168 \, \text{m}^{4} \cdot 7 \, \text{mm}}{\frac{100 \, \text{mm} \cdot \left(9000 \, \text{mm}^{2} \cdot 450 \, \text{mm}^{2}\right)}{8}} + \frac{10 \, \text{mm}^{2} \cdot 450 \, \text{mm}^{2}}{9} \right| \quad \left| \quad 0.1281 \, \text{kN} \right| = \frac{11 \, \text{MPa} \cdot 0.00168 \, \text{m}^{4} \cdot 7 \, \text{mm}}{\frac{100 \, \text{mm}^{2} \cdot 450 \, \text{mm}^{2}}{9}} + \frac{10 \, \text{mm}^{2} \cdot 450 \, \text{mm}^{2}}{9} \right| \quad \left| \quad 0.1281 \, \text{kN} \right| = \frac{11 \, \text{mm}^{2} \cdot 450 \, \text{mm}^{2}}{9} + \frac{10 \, \text{mm}^{2} \cdot 450 \, \text{mm}^{2}}$

Example with Units

Evaluate Formula [

2.3) Maximum Shear Stress in I Section Formula C

Formula

Evaluate Formula 🕝

 $\tau_{\text{max}} = \frac{F_{\text{S}}}{I \cdot b} \cdot \left(\frac{B \cdot \left(D^2 - d^2\right)}{8} + \frac{b \cdot d^2}{8} \right)$

 $412.3045\,\text{MPa} \; = \frac{4.8\,\text{kN}}{0.00168\,\text{m}^4\,\cdot\,7\,\text{mm}} \cdot \left(\; \frac{100\,\text{mm}\,\cdot\left(\;9000\,\text{mm}^{\;2}\,\cdot\,450\,\text{mm}^{\;2}\right)}{8} \; + \; \frac{7\,\text{mm}\,\cdot\,450\,\text{mm}^{\;2}}{8} \; \right) \; \left| \; \frac{100\,\text{mm}\,\cdot\left(\;9000\,\text{mm}^{\;2}\,\cdot\,450\,\text{mm}^{\;2}\right)}{8} \; + \; \frac{7\,\text{mm}\,\cdot\,450\,\text{mm}^{\;2}}{8} \; \right| \; \left| \; \frac{100\,\text{mm}\,\cdot\left(\;9000\,\text{mm}^{\;2}\,\cdot\,450\,\text{mm}^{\;2}\right)}{8} \; + \; \frac$

2.4) Moment of Flange Area about Neutral Axis Formula 🕝

$$I = \frac{B \cdot \left(D^2 - d^2\right)}{C}$$

Evaluate Formula (

Evaluate Formula (

$$I = \frac{B \cdot (D^2 - d^2)}{8}$$

$$1.01 \, \text{m}^4 = \frac{100 \, \text{mm} \cdot (9000 \, \text{mm}^2 - 450 \, \text{mm}^2)}{8}$$

2.5) Moment of Inertia of I-Section given Maximum Shear Stress and Force Formula 🕝

$$I = \frac{F_s}{\tau_{beam} \cdot b} \cdot \left(\frac{B \cdot \left(D^2 - d^2\right)}{8} + \frac{b \cdot d^2}{8} \right)$$

Example with Units

$$0.1154\,\text{m}^4 = \frac{4.8\,\text{kN}}{6\,\text{MPa}\,\cdot7\,\text{mm}} \cdot \left(\frac{100\,\text{mm}\,\cdot\left(\,9000\,\text{mm}^{\,\,2}\,\cdot\,450\,\text{mm}^{\,\,2}\,\right)}{8} + \frac{7\,\text{mm}\,\cdot450\,\text{mm}^{\,\,2}}{8}\right)$$

2.6) Moment of Inertia of I-Section given Shear Stress of Web Formula [7]

$$I = \frac{F_s}{\tau_{beam} \cdot b} \cdot \left(\frac{B}{8} \cdot \left(D^2 - d^2\right) + \frac{b}{2} \cdot \left(\frac{d^2}{4} - y^2\right)\right)$$

Example with Units

$$0.1154\,\text{m}^{_{4}} = \frac{4.8\,\text{kN}}{6\,\text{MPa}\,\cdot7\,\text{mm}}\cdot\left(\frac{100\,\text{mm}}{8}\cdot\left(9000\,\text{mm}^{^{2}}-450\,\text{mm}^{^{2}}\right) + \frac{7\,\text{mm}}{2}\cdot\left(\frac{450\,\text{mm}^{^{2}}}{4}-5\,\text{mm}^{^{2}}\right)\right)$$

2.7) Moment of Inertia of Section given Shear Stress at Junction of Top of Web Formula C

Evaluate Formula C

Evaluate Formula (

Evaluate Formula

$$I = \frac{F_{s} \cdot B \cdot \left(D^{2} - d^{2}\right)}{8 \cdot \tau_{beam} \cdot b} \quad \boxed{0.1154_{m^{4}} = \frac{4.8_{kN} \cdot 100_{mm} \cdot \left(9000_{mm}^{2} - 450_{mm}^{2}\right)}{8 \cdot 6_{MPa} \cdot 7_{mm}}}$$

2.8) Moment of Shaded Area of Web about Neutral Axis Formula 🕝

$$I = \frac{b}{2} \cdot \left(\frac{d^2}{4} - y^2\right)$$

$$I = \frac{b}{2} \cdot \left(\frac{d^2}{4} - y^2\right) \left[0.0002 \, m^4 = \frac{7 \, mm}{2} \cdot \left(\frac{450 \, mm^2}{4} - 5 \, mm^2\right) \right]$$

2.9) Shear Force at Junction of Top of Web Formula C



 $F_{s} = \frac{8 \cdot I \cdot b \cdot \tau_{beam}}{B \cdot \left(D^{2} - d^{2}\right)} \left[0.0699_{kN} = \frac{8 \cdot 0.00168_{m^{4}} \cdot 7_{mm} \cdot 6_{MPa}}{100_{mm} \cdot \left(9000_{mm}^{2} - 450_{mm}^{2}\right)} \right]$

Example with Units

Evaluate Formula (

2.10) Shear Force in Web Formula C

 $F_{s} = \frac{I \cdot b \cdot \tau_{beam}}{\frac{B \cdot \left(D^{2} - d^{2}\right)}{g} + \frac{b}{2} \cdot \left(\frac{d^{2}}{4} - y^{2}\right)}$

Evaluate Formula

$$0.0699_{\text{kN}} = \frac{0.00168_{\text{m}^4} \cdot 7_{\text{mm}} \cdot 6_{\text{MPa}}}{\frac{100_{\text{mm}} \cdot \left(9000_{\text{mm}}^2 \cdot 450_{\text{mm}}^2\right)}{8} + \frac{7_{\text{mm}}}{2} \cdot \left(\frac{450_{\text{mm}}^2}{4} - 5_{\text{mm}}^2\right)}$$

2.11) Shear Stress at Junction of Top of Web Formula 🕝

Example with Units

Evaluate Formula (

Formula

 $\tau_{beam} = \frac{F_s \cdot B \cdot \left(\ D^2 - d^2 \right)}{8 \cdot I \cdot b} \ \left| \ 412.2321 \, \text{MPa} \ = \frac{4.8 \, \text{kN} \, \cdot 100 \, \text{mm} \, \cdot \left(\ 9000 \, \text{mm}^{\ 2} - 450 \, \text{mm}^{\ 2} \right)}{8 \cdot 0.00168 \, \text{m}^4 \, \cdot 7 \, \text{mm}} \right|$

2.12) Shear Stress in Web Formula 🕝

Formula

Evaluate Formula [

$$\tau_{beam} = \frac{F_s}{I \cdot b} \cdot \left(\frac{B}{8} \cdot \left(D^2 - d^2 \right) + \frac{b}{2} \cdot \left(\frac{d^2}{4} - y^2 \right) \right)$$

Example with Units

$$412.3044 \, \text{MPa} = \frac{4.8 \, \text{kN}}{0.00168 \, \text{m}^4 \cdot 7 \, \text{mm}} \cdot \left(\frac{100 \, \text{mm}}{8} \cdot \left(9000 \, \text{mm}^2 - 450 \, \text{mm}^2\right) + \frac{7 \, \text{mm}}{2} \cdot \left(\frac{450 \, \text{mm}^2}{4} - 5 \, \text{mm}^2\right)\right)$$

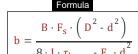
2.13) Thickness of Web Formula C

Example with Units

Evaluate Formula

$$b = \frac{2 \cdot I}{\frac{d^2}{4} - y^2} \qquad 66.4032 \,\text{mm} = \frac{2 \cdot 0.00168 \,\text{m}^4}{\frac{450 \,\text{mm}}{4} - 5 \,\text{mm}^2}$$

2.14) Thickness of Web given Maximum Shear Stress and Force Formula 🕝



Example with Units
$$486.8052 \, \text{mm} = \frac{100 \, \text{mm} \cdot 4.8 \, \text{kN} \cdot \left(9000 \, \text{mm}^2 - 450 \, \text{mm}^2\right)}{8 \cdot 0.00168 \, \text{m}^4 \cdot 6 \, \text{MPa} - 4.8 \, \text{kN} \cdot 450 \, \text{mm}^2}$$

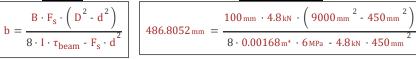
Evaluate Formula (

Evaluate Formula [

Evaluate Formula

Evaluate Formula (

Evaluate Formula 🕝

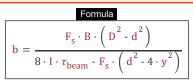


2.15) Thickness of Web given Shear Stress at Junction of Top of Web Formula 🕝

$$b = \frac{F_s \cdot B \cdot \left(D^2 - d^2\right)}{8 \cdot I \cdot \tau_{beam}}$$

Formula Example with Units
$$b = \frac{F_{\text{S}} \cdot B \cdot \left(\text{ D}^2 - \text{d}^2 \right)}{8 \cdot I \cdot \tau_{\text{beam}}} \quad \boxed{ 480.9375 \, \text{mm} = \frac{4.8 \, \text{kN} \cdot 100 \, \text{mm} \cdot \left(9000 \, \text{mm}^2 - 450 \, \text{mm}^2 \right)}{8 \cdot 0.00168 \, \text{m}^4 \cdot 6 \, \text{MPa}}$$

2.16) Thickness of Web given Shear Stress of Web Formula



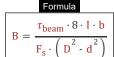
$$486.8023 \, \text{mm} = \frac{4.8 \, \text{kN} \cdot 100 \, \text{mm} \cdot \left(9000 \, \text{mm}^2 - 450 \, \text{mm}^2\right)}{8 \cdot 0.00168 \, \text{m}^4 \cdot 6 \, \text{MPa} - 4.8 \, \text{kN} \cdot \left(450 \, \text{mm}^2 - 4 \cdot 5 \, \text{mm}^2\right)}$$

2.17) Width of Section given Moment of Flange Area about Neutral Axis Formula 🦵

$$B = \frac{8 \cdot I}{D^2 - d^2}$$

Formula Example with Units
$$B = \frac{8 \cdot I}{D^2 - d^2} = 0.1663 \, \text{mm} = \frac{8 \cdot 0.00168 \, \text{m}^4}{9000 \, \text{mm}^2 - 450 \, \text{mm}^2}$$

2.18) Width of Section given Shear Stress at Junction of Top of Web Formula 🗂



Formula Example with Units
$$B = \frac{\tau_{beam} \cdot 8 \cdot I \cdot b}{F_{s} \cdot \left(D^{2} - d^{2}\right)} = \frac{6 \, \text{MPa} \cdot 8 \cdot 0.00168 \, \text{m}^{4} \cdot 7 \, \text{mm}}{4.8 \, \text{kN} \cdot \left(9000 \, \text{mm}^{2} - 450 \, \text{mm}^{2}\right)}$$

Variables used in list of Shear Stress in I Section Formulas above

- A_{abv} Area of Section above Considered Level (Square Millimeter)
- **b** Thickness of Beam Web (Millimeter)
- **B** Width of Beam Section (Millimeter)
- d Inner Depth of I Section (Millimeter)
- D Outer Depth of I section (Millimeter)
- F_S Shear Force on Beam (Kilonewton)
- **y** Distance from Neutral Axis (Millimeter)
- **y** Distance of CG of Area from NA (Millimeter)

I Moment of Inertia of Area of Section (Meter⁴)

- τ_{heam} Shear Stress in Beam (Megapascal)
- τ_{max} Maximum Shear Stress on Beam (Megapascal)

Constants, Functions, Measurements used in list of Shear Stress in I Section Formulas above

- 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: Area in Square Millimeter (mm²)
 Area Unit Conversion
- Measurement: Pressure in Megapascal (MPa)
 Pressure Unit Conversion
- Measurement: Force in Kilonewton (kN)
 Force Unit Conversion
- Measurement: Second Moment of Area in Meter⁴ (m⁴)



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- Important Shear Stress in I Section
 Formulas (*)
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Mixed fraction

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