Important Shear Stress in Circular Section Formulas PDF

Formulas
Examples
with Units

List of 19
Important Shear Stress in Circular Section Formulas

1) Average Shear Stress Formulas

1.1) Average Shear Force for Circular Section Formula

Evaluate Formula

Formula

$$F_s = \pi \cdot r^2 \cdot \tau_{avg}$$

Example with Units

$$226.1947\,\text{kN} = 3.1416 \cdot 1200\,\text{mm}^2 \cdot 0.05\,\text{MPa}$$

1.2) Average Shear Stress for Circular Section Formula

Evaluate Formula

Formula

$$\tau_{avg} = \frac{F_s}{\pi \cdot r^2}$$

Example with Units

$$0.0011\,\text{MPa} = \frac{4.8\,\text{kN}}{3.1416 \cdot 1200\,\text{mm}^2}$$

1.3) Average Shear Stress for Circular Section given Maximum Shear Stress Formula

Evaluate Formula

Formula

$$\tau_{avg} = \frac{3}{4} \cdot \tau_{max}$$

Example with Units

$$8.25\,\text{MPa} = \frac{3}{4} \cdot 11\,\text{MPa}$$

1.4) Shear Force in Circular Section Formula

Evaluate Formula

Formula

$$F_s = \frac{\tau_{beam} \cdot I \cdot B}{\frac{2}{3} \cdot \left(r^2 - y^2\right)^{\frac{3}{2}}}$$

Example with Units

$$0.875\,\text{kN} = \frac{6\,\text{MPa} \cdot 0.00168\,\text{m}^4 \cdot 100\,\text{mm}}{\frac{2}{3} \cdot \left(1200\,\text{mm}^2 - 5\,\text{mm}^2\right)^{\frac{3}{2}}}$$

1.5) Shear Force using Maximum Shear Stress Formula

Evaluate Formula

Formula

$$F_s = \frac{3 \cdot I \cdot \tau_{max}}{r^2}$$

Example with Units

$$38.5\,\text{kN} = \frac{3 \cdot 0.00168\,\text{m}^4 \cdot 11\,\text{MPa}}{1200\,\text{mm}^2}$$

1.6) Shear Stress Distribution for Circular Section Formula

Evaluate Formula

Formula

$$\tau_{max} = \frac{F_s \cdot \frac{2}{3} \cdot \left(r^2 - y^2 \right)^{\frac{3}{2}}}{I \cdot B}$$

Example with Units

$$32.9134\,\text{MPa} = \frac{4.8\,\text{kN} \cdot \frac{2}{3} \cdot \left(1200\,\text{mm}^2 - 5\,\text{mm}^2 \right)^{\frac{3}{2}}}{0.00168\,\text{m}^4 \cdot 100\,\text{mm}}$$

2) Maximum Shear Stress Formulas

2.1) Maximum Shear Force given Radius of Circular Section Formula

Evaluate Formula

Formula

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

Example with Units

$$37322.1207\,\text{kN} = 11\,\text{MPa} \cdot \frac{3}{4} \cdot 3.1416 \cdot 1200\,\text{mm}^2$$

2.2) Maximum Shear Stress for Circular Section Formula

Evaluate Formula

Formula

$$\tau_{max} = \frac{F_s}{3 \cdot I} \cdot r^2$$

Example with Units

$$1.3714\,\text{MPa} = \frac{4.8\,\text{kN}}{3 \cdot 0.00168\,\text{m}^4} \cdot 1200\,\text{mm}^2$$

2.3) Maximum Shear Stress for Circular Section given Average Shear Stress Formula

Evaluate Formula

Formula

$$\tau_{max} = \frac{4}{3} \cdot \tau_{avg}$$

Example with Units

$$0.0667\,\text{MPa} = \frac{4}{3} \cdot 0.05\,\text{MPa}$$

2.4) Maximum Shear Stress given Radius of Circular Section Formula

Evaluate Formula

Formula

$$\tau_{beam} = \frac{4}{3} \cdot \frac{F_s}{\pi \cdot r^2}$$

Example with Units

$$0.0014\,\text{MPa} = \frac{4}{3} \cdot \frac{4.8\,\text{kN}}{3.1416 \cdot 1200\,\text{mm}^2}$$

3) Moment of Inertia Formulas

3.1) Area Moment of Considered Area about Neutral Axis Formula

Evaluate Formula

Formula

$$A_y = \frac{2}{3} \cdot \left(r^2 - y^2 \right)^{\frac{3}{2}}$$

Example with Units

$$1.2\text{E}{+9}\,\text{mm}^3 = \frac{2}{3} \cdot \left(1200\,\text{mm}^2 - 5\,\text{mm}^2 \right)^{\frac{3}{2}}$$

3.2) Moment of Inertia of Circular Section Formula

Evaluate Formula

Formula

$$I = \frac{\pi}{4} \cdot r^4$$

Example with Units

$$1.6286\,\text{m}^4 = \frac{3.1416}{4} \cdot 1200\,\text{mm}^4$$

3.3) Moment of Inertia of Circular Section given Maximum Shear Stress Formula

Evaluate Formula

Formula

$$I = \frac{F_s}{3 \cdot \tau_{max}} \cdot r^2$$

Example with Units

$$0.0002\,\text{m}^4 = \frac{4.8\,\text{kN}}{3 \cdot 11\,\text{MPa}} \cdot 1200\,\text{mm}^2$$

3.4) Moment of Inertia of Circular Section given Shear Stress Formula

Evaluate Formula

Formula

$$I = \frac{F_s \cdot \frac{2}{3} \cdot \left(r^2 - y^2\right)^{\frac{3}{2}}}{\tau_{beam} \cdot B}$$

Example with Units

$$0.0092\,\text{m}^4 = \frac{4.8\,\text{kN} \cdot \frac{2}{3} \cdot \left(1200\,\text{mm}^2 - 5\,\text{mm}^2\right)^{\frac{3}{2}}}{6\,\text{MPa} \cdot 100\,\text{mm}}$$

4) Radius of Circular Section Formulas

4.1) Radius of Circular Section given Average Shear Stress Formula

Evaluate Formula

Formula

$$r = \sqrt{\frac{F_s}{\pi \cdot \tau_{avg}}}$$

Example with Units

$$174.8077\,\text{mm} = \sqrt{\frac{4.8\,\text{kN}}{3.1416 \cdot 0.05\,\text{MPa}}}$$

4.2) Radius of Circular Section given Maximum Shear Stress Formula

Evaluate Formula

Formula

$$r = \sqrt{\frac{4}{3} \cdot \frac{F_s}{\pi \cdot \tau_{max}}}$$

Example with Units

$$13.6088\,\text{mm} = \sqrt{\frac{4}{3} \cdot \frac{4.8\,\text{kN}}{3.1416 \cdot 11\,\text{MPa}}}$$

4.3) Radius of Circular Section given Width of Beam at Considered Level Formula

Evaluate Formula

Formula

$$r = \sqrt{\left(\frac{B}{2}\right)^2 + y^2}$$

Example with Units

$$50.2494\,\text{mm} = \sqrt{\left(\frac{100\,\text{mm}}{2}\right)^2 + 5\,\text{mm}^2}$$

4.4) Width of Beam at Considered Level given Radius of Circular Section Formula

Evaluate Formula

Formula

$$B = 2 \cdot \sqrt{r^2 - y^2}$$

Example with Units

$$2399.9792\,\text{mm} = 2 \cdot \sqrt{1200\,\text{mm}^2 - 5\,\text{mm}^2}$$

4.5) Width of Beam at Considered Level given Shear Stress for Circular Section Formula

Evaluate Formula

Formula

$$B = \frac{F_S \cdot \frac{2}{3} \cdot \left(r^2 - y^2\right)^{\frac{3}{2}}}{I \cdot \tau_{beam}}$$

Example with Units

$$548.5571\,\text{mm} = \frac{4.8\,\text{kN} \cdot \frac{2}{3} \cdot \left(1200\,\text{mm}^2 - 5\,\text{mm}^2\right)^{\frac{3}{2}}}{0.00168\,\text{m}^4 \cdot 6\,\text{MPa}}$$

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

- A_y First Moment of Area *(Cubic Millimeter)*
- **B** Width of Beam Section *(Millimeter)*
- F_s Shear Force on Beam *(Kilonewton)*
- **I** Moment of Inertia of Area of Section *(Meter⁴)*
- **r** Radius of Circular Section *(Millimeter)*
- **y** Distance from Neutral Axis *(Millimeter)*
- τ_{avg} Average Shear Stress on Beam *(Megapascal)*
- τ_{beam} Shear Stress in Beam *(Megapascal)*
- τ_{max} Maximum Shear Stress on Beam *(Megapascal)*

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

- constant(s): **pi**, 3.14159265358979323846264338327950288 *Archimedes' constant*
- 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: **Pressure** in Megapascal (MPa) *Pressure Unit Conversion*
- Measurement: **Force** in Kilonewton (kN) *Force Unit Conversion*
- Measurement: **Second Moment of Area** in Meter⁴ (m⁴) *Second Moment of Area Unit Conversion*
- Measurement: **First Moment of Area** in Cubic Millimeter (mm³) *First Moment of Area Unit Conversion*

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