



## **Principal Stresses Formulas**

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## **List of 22 Principal Stresses Formulas**

## Principal Stresses 2

1) Angle of Obliquity

$$\phi = a an\!\left(rac{ au}{\sigma_{
m n}}
ight)$$

Open Calculator

$$= a \tan \left( rac{2.4 ext{MPa}}{0.250 ext{MPa}} 
ight)$$

2) Major Principal Stress if Member is Subjected to Two Perpendicular Direct Stress and Shear Stress

$$\sigma_{
m major} = rac{\sigma_{
m x}+\sigma_{
m y}}{2} + \sqrt{\left(rac{\sigma_{
m x}-\sigma_{
m y}}{2}
ight)^2 + au^2}$$

Open Calculator 🚰

3) Maximum Axial Force

$$extstyle \mathbf{P}_{\mathrm{axial}} = \mathbf{\sigma} \cdot \mathbf{A}$$

Open Calculator

$$0.0768 \mathrm{kN} = 0.012 \mathrm{MPa} \cdot 6400 \mathrm{mm}^2$$

4) Minor Principal Stress if Member is Subjected to Two Perpendicular Direct Stress and Shear Stress

$$\sigma_{
m minor} = rac{\sigma_{
m x}+\sigma_{
m y}}{2} - \sqrt{\left(rac{\sigma_{
m x}-\sigma_{
m y}}{2}
ight)^2 + au^2}$$

$$= \frac{2}{1.754683 \text{MPa}} = \frac{0.5 \text{MPa} + 0.8 \text{MPa}}{2} - \sqrt{\left(\frac{0.5 \text{MPa} - 0.8 \text{MPa}}{2}\right)^2 + (2.4 \text{MPa})^2}$$





## 5) Resultant Stress on Oblique Section given Stress in Perpendicular Directions

$$\sigma_{
m R} = \sqrt{\sigma_{
m n}^2 + au^2}$$

Open Calculator

$$\mathbf{ex}$$
 2.412986MPa =  $\sqrt{(0.250\text{MPa})^2 + (2.4\text{MPa})^2}$ 

## 6) Safe Stress given Safe Value of Axial Pull

$$\sigma = rac{\mathrm{P_{safe}}}{\mathrm{A}}$$

Open Calculator

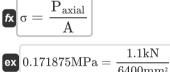
#### 7) Safe Value of Axial Pull

fx 
$$P_{safe} = \sigma_w \cdot A$$

Open Calculator

$$\texttt{ex} \ 38.4 \text{kN} = 6 \text{MPa} \cdot 6400 \text{mm}^2$$

#### 8) Stress along Maximum Axial Force



Open Calculator

# Normal Stress

## 9) Equivalent Stress by Distortion Energy Theory

$$\sigma_{
m e} = rac{1}{\sqrt{2}} \cdot \sqrt{\left(\sigma_1 - \sigma_2
ight)^2 + \left(\sigma_2 - \sigma_3
ight)^2 + \left(\sigma_3 - \sigma_1
ight)^2}$$

$$41.05127 \mathrm{N/m^2} = rac{1}{\sqrt{2}} \cdot \sqrt{\left(87.5 - 51.43 \mathrm{N/m^2}
ight)^2 + \left(51.43 \mathrm{N/m^2} - 96.1 \mathrm{N/m^2}
ight)^2 + \left(96.1 \mathrm{N/m^2} - 87.5
ight)^2}$$



## 10) Normal Stress across Oblique Section 🚰

 $\sigma_{
m n} = \sigma \cdot \left( \cos ( heta_{
m oblique}) 
ight)^2$ 

Open Calculator 2

 $0.011196 \mathrm{MPa} = 0.012 \mathrm{MPa} \cdot (\cos(15^{\circ}))^2$ 

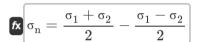
## 11) Normal Stress for Principal Planes at Angle of 0 Degrees given Major and Minor Tensile Stress

$$\sigma_{
m n}=rac{\sigma_1+\sigma_2}{2}+rac{\sigma_1-\sigma_2}{2}$$

Open Calculator

 $extbf{ex} 124 ext{MPa} = rac{124 ext{MPa} + 48 ext{MPa}}{2} + rac{124 ext{MPa} - 48 ext{MPa}}{2}$ 

## 12) Normal Stress for Principal Planes at Angle of 90 degrees



Open Calculator

 $oxed{ex} \left[ 48 ext{MPa} = rac{124 ext{MPa} + 48 ext{MPa}}{2} - rac{124 ext{MPa} - 48 ext{MPa}}{2} 
ight]$ 

## 13) Normal Stress for Principal Planes when Planes are at Angle of 0 Degree

$$\sigma_{
m n}=rac{\sigma_1+\sigma_2}{2}+rac{\sigma_1-\sigma_2}{2}$$

Open Calculator

 $extbf{ex} 124 ext{MPa} = rac{124 ext{MPa} + 48 ext{MPa}}{2} + rac{124 ext{MPa} - 48 ext{MPa}}{2}$ 

## 14) Normal Stress on Oblique Section given Stress in Perpendicular Directions

$$\sigma_{
m n} = rac{\sigma_1 + \sigma_2}{2} + rac{\sigma_1 - \sigma_2}{2} \cdot \cos(2 \cdot heta_{
m oblique})$$

Open Calculator

 $\boxed{ 118.909 \text{MPa} = \frac{124 \text{MPa} + 48 \text{MPa}}{2} + \frac{124 \text{MPa} - 48 \text{MPa}}{2} \cdot \cos(2 \cdot 15^\circ) }$ 

## 15) Normal Stress using Obliquity 🚰

$$\sigma_{
m n} = rac{ au}{ an(\phi)}$$

Open Calculator

 $\mathbf{ex}$   $2.4\mathrm{MPa} = \frac{2.4\mathrm{MPa}}{\tan(45\degree)}$ 



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#### 16) Stress Amplitude

$$\sigma_{
m a} = rac{\sigma_{
m max} - \sigma_{
m min}}{2}$$

Open Calculator

## Shear Stress

## 17) Condition for Maximum or Minimum Shear Stress given Member under Direct and Shear Stress 🛂

Open Calculator 🚰

$$heta_{ ext{plane}} = rac{1}{2} \cdot a an igg(rac{\sigma_{ ext{x}} - \sigma_{ ext{y}}}{2 \cdot au}igg)$$

$$oxed{ex} ext{-1.788167}^\circ = rac{1}{2} \cdot a anigg(rac{0.5 ext{MPa} - 0.8 ext{MPa}}{2 \cdot 2.4 ext{MPa}}igg)$$

## 18) Maximum Shear Stress given Major and Minor Tensile Stress

fx  $au_{ ext{max}} = rac{\sigma_1 - \sigma_2}{2}$ 

Open Calculator 🚰

## 19) Maximum Shear Stress given Member is under Direct and Shear Stress 🗗

 $au_{ ext{max}} = rac{\sqrt{\left( ext{s}_{ ext{x}} - ext{s}_{ ext{y}}
ight)^2 + 4 \cdot au^2}}{2}$ 

Open Calculator 2

#### 20) Shear Stress using Obliquity

fx 
$$au = an(\phi) \cdot \sigma_n$$

$$\textbf{ex} \ 0.25 \text{MPa} = \tan(45\degree) \cdot 0.250 \text{MPa}$$



## Tangential Stress

21) Tangential Stress across Oblique Section

$$\sigma_{
m t} = rac{\sigma}{2} \cdot \sin ig( 2 \cdot heta_{
m oblique} ig)$$

Open Calculator

22) Tangential Stress on Oblique Section given Stress in Perpendicular Directions





#### Variables Used

- A Area of Cross-Section (Square Millimeter)
- Paxial Maximum Axial Force (Kilonewton)
- P<sub>safe</sub> Safe Value of Axial Pull (Kilonewton)
- θoblique Angle made by Oblique Section with Normal (Degree)
- θ<sub>plane</sub> Plane Angle (Degree)
- σ Stress in Bar (Megapascal)
- σ<sub>1</sub> Normal Stress 1
- σ<sub>1</sub> Major Tensile Stress (Megapascal)
- σ<sub>2</sub> Normal Stress 2 (Newton per Square Meter)
- σ<sub>2</sub> Minor Tensile Stress (Megapascal)
- σ<sub>3</sub> Normal Stress 3 (Newton per Square Meter)
- σ<sub>a</sub> Stress Amplitude (Newton per Square Meter)
- σ<sub>P</sub> Equivalent Stress (Newton per Square Meter)
- σ<sub>maior</sub> Major Principal Stress (Megapascal)
- σ<sub>max</sub> Maximum Stress at Crack Tip (Newton per Square Meter)
- σ<sub>min</sub> Minimum Stress (Newton per Square Meter)
- σ<sub>minor</sub> Minor Principal Stress (Megapascal)
- σ<sub>n</sub> Normal Stress (Megapascal)
- σ<sub>R</sub> Resultant Stress (Megapascal)
- σ<sub>t</sub> Tangential Stress (Megapascal)
- σ<sub>w</sub> Safe Stress (Megapascal)
- σ<sub>x</sub> Stress acting along x-direction (Megapascal)
- $\sigma_v$  Stress acting along y-direction (Megapascal)
- Φ Angle of Obliquity (Degree)
- τ Shear Stress (Megapascal)
- $au_{ extbf{max}}$  Maximum Shear Stress (Megapascal)





#### Constants, Functions, Measurements used

- Function: atan, atan(Number)

  Inverse tan is used to calculate the angle by applying the tangent ratio of the angle, which is the opposite side divided by the adjacent side of the right triangle.
- Function: cos, cos(Angle)

  Cosine of an angle is the ratio of the side adjacent to the angle to the hypotenuse of the triangle.
- Function: 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.
- Function: 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.
- Function: tan, tan(Angle)
   The tangent of an angle is a trigonometric ratio of the length of the side opposite an angle to the length of the side adjacent to an angle in a right triangle.
- Measurement: Area in Square Millimeter (mm²)

  Area Unit Conversion
- Measurement: Pressure in Megapascal (MPa), Newton per Square Meter (N/m²) Pressure Unit Conversion
- Measurement: Force in Kilonewton (kN)
  Force Unit Conversion ✓
- Measurement: Angle in Degree (°)
   Angle Unit Conversion
- Measurement: Stress in Megapascal (MPa)
   Stress Unit Conversion





#### **Check other formula lists**

Principal Stresses Formulas

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