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# Mohr's Circle of Stresses Formulas

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## List of 14 Mohr's Circle of Stresses Formulas

### Mohr's Circle of Stresses

#### When a Body is subjected to two Mutual Perpendicular Principal Tensile stresses of Unequal Intensity

##### 1) Maximum Shear Stress

$$f_x \tau_{\max} = \frac{\sqrt{(\sigma_x - \sigma_y)^2 + 4 \cdot \tau^2}}{2}$$

[Open Calculator !\[\]\(de95854c7ee024cfadc48187bbb781b2\_img.jpg\)](#)

$$ex \ 55.26753MPa = \frac{\sqrt{(95MPa - 22MPa)^2 + 4 \cdot (41.5MPa)^2}}{2}$$

##### 2) Normal Stress on Oblique Plane with Two Mutually Perpendicular Forces

$$f_x \sigma_{\theta} = \frac{\sigma_x + \sigma_y}{2} + \frac{\sigma_x - \sigma_y}{2} \cdot \cos(2 \cdot \theta_{\text{plane}}) + \tau \cdot \sin(2 \cdot \theta_{\text{plane}})$$

[Open Calculator !\[\]\(6a9b39b98eb945faa14c645ec99e4eaa\_img.jpg\)](#)

$$ex \ 112.6901MPa = \frac{95MPa + 22MPa}{2} + \frac{95MPa - 22MPa}{2} \cdot \cos(2 \cdot 30^\circ) + 41.5MPa \cdot \sin(2 \cdot 30^\circ)$$

##### 3) Radius of Mohr's Circle for Two Mutually Perpendicular Stresses of Unequal Intensities

$$f_x R = \frac{\sigma_{\text{major}} - \sigma_{\text{minor}}}{2}$$

[Open Calculator !\[\]\(f1c5da15572e3e09d343161be98f508d\_img.jpg\)](#)

$$ex \ 25.5MPa = \frac{75MPa - 24MPa}{2}$$

##### 4) Tangential Stress on Oblique Plane with Two Mutually Perpendicular Forces

$$f_x \sigma_t = \frac{\sigma_x - \sigma_y}{2} \cdot \sin(2 \cdot \theta_{\text{plane}}) - \tau \cdot \cos(2 \cdot \theta_{\text{plane}})$$

[Open Calculator !\[\]\(166772600a13ad0a433053f90fe45649\_img.jpg\)](#)

$$ex \ 10.85993MPa = \frac{95MPa - 22MPa}{2} \cdot \sin(2 \cdot 30^\circ) - 41.5MPa \cdot \cos(2 \cdot 30^\circ)$$



## When a Body is subjected to two Mutual Perpendicular Principal Tensile stresses along with Simple Shear Stress

### 5) Condition for Maximum Value of Normal Stress

$$fx \theta_{\text{plane}} = \frac{a \tan\left(\frac{2 \cdot \tau}{\sigma_x - \sigma_y}\right)}{2}$$

[Open Calculator !\[\]\(a03a7eb2f4046e1d3c76772003e549ea\_img.jpg\)](#)

$$ex \ 24.33389^\circ = \frac{a \tan\left(\frac{2 \cdot 41.5 \text{MPa}}{95 \text{MPa} - 22 \text{MPa}}\right)}{2}$$

### 6) Condition for Minimum Normal Stress

$$fx \theta_{\text{plane}} = \frac{a \tan\left(\frac{2 \cdot \tau}{\sigma_x - \sigma_y}\right)}{2}$$

[Open Calculator !\[\]\(5361750c22c4e047a52f4eac1ec2d4cc\_img.jpg\)](#)

$$ex \ 24.33389^\circ = \frac{a \tan\left(\frac{2 \cdot 41.5 \text{MPa}}{95 \text{MPa} - 22 \text{MPa}}\right)}{2}$$

### 7) Maximum Value of Normal Stress

$$fx \ \sigma_{n,\text{max}} = \frac{\sigma_x + \sigma_y}{2} + \sqrt{\left(\frac{\sigma_x - \sigma_y}{2}\right)^2 + \tau^2}$$

[Open Calculator !\[\]\(b792654f2cef9719eabeb6c5be00811e\_img.jpg\)](#)

$$ex \ 113.7675 \text{MPa} = \frac{95 \text{MPa} + 22 \text{MPa}}{2} + \sqrt{\left(\frac{95 \text{MPa} - 22 \text{MPa}}{2}\right)^2 + (41.5 \text{MPa})^2}$$


### 8) Maximum Value of Shear Stress

$$fx \ \tau_{\text{max}} = \sqrt{\left(\frac{\sigma_x - \sigma_y}{2}\right)^2 + \tau^2}$$

[Open Calculator !\[\]\(84f47badaad7772cd95667a7c387a639\_img.jpg\)](#)

$$ex \ 55.26753 \text{MPa} = \sqrt{\left(\frac{95 \text{MPa} - 22 \text{MPa}}{2}\right)^2 + (41.5 \text{MPa})^2}$$



9) Minimum Value of Normal Stress [Open Calculator](#) 


$$fx \quad \sigma_{n,\min} = \frac{\sigma_x + \sigma_y}{2} - \sqrt{\left(\frac{\sigma_x - \sigma_y}{2}\right)^2 + \tau^2}$$

$$ex \quad 3.232469MPa = \frac{95MPa + 22MPa}{2} - \sqrt{\left(\frac{95MPa - 22MPa}{2}\right)^2 + (41.5MPa)^2}$$

10) Normal Stress on Oblique Plane with Two Mutually Perpendicular Unequal Stresses [Open Calculator](#) 



$$fx \quad \sigma_{\theta} = \frac{\sigma_{\text{major}} + \sigma_{\text{minor}}}{2} + \frac{\sigma_{\text{major}} - \sigma_{\text{minor}}}{2} \cdot \cos(2 \cdot \theta_{\text{plane}})$$

$$ex \quad 62.25MPa = \frac{75MPa + 24MPa}{2} + \frac{75MPa - 24MPa}{2} \cdot \cos(2 \cdot 30^\circ)$$

11) Shear Stress on Oblique Plane given Two Mutually Perpendicular and Unequal Stress [Open Calculator](#) 

$$fx \quad \sigma_t = \frac{\sigma_{\text{major}} - \sigma_{\text{minor}}}{2} \cdot \sin(2 \cdot \theta_{\text{plane}})$$

$$ex \quad 22.08365MPa = \frac{75MPa - 24MPa}{2} \cdot \sin(2 \cdot 30^\circ)$$

When a Body is subjected to two Mutual Perpendicular Principal Tensile stresses which are Unequal and Unlike 12) Normal Stress on Oblique Plane for Two Perpendicular Unequal and Unlike Stress [Open Calculator](#) 

$$fx \quad \sigma_{\theta} = \frac{\sigma_{\text{major}} - \sigma_{\text{minor}}}{2} + \frac{\sigma_{\text{major}} + \sigma_{\text{minor}}}{2} \cdot \cos(2 \cdot \theta_{\text{plane}})$$


$$ex \quad 50.25MPa = \frac{75MPa - 24MPa}{2} + \frac{75MPa + 24MPa}{2} \cdot \cos(2 \cdot 30^\circ)$$



13) Radius of Mohr's Circle for Unequal and Unlike Mutually Perpendicular Stresses [Open Calculator !\[\]\(bd1a142de767a21e5362c595f844a4ff\_img.jpg\)](#)

$$\text{fx } R = \frac{\sigma_{\text{major}} + \sigma_{\text{minor}}}{2}$$

$$\text{ex } 49.5\text{MPa} = \frac{75\text{MPa} + 24\text{MPa}}{2}$$

14) Shear Stress on Oblique Plane for Two Perpendicular Unequal and Unlike Stress [Open Calculator !\[\]\(830769b31eeeaca920791081939ff8ba\_img.jpg\)](#)

$$\text{fx } \sigma_t = \frac{\sigma_{\text{major}} + \sigma_{\text{minor}}}{2} \cdot \sin(2 \cdot \theta_{\text{plane}})$$

$$\text{ex } 42.86826\text{MPa} = \frac{75\text{MPa} + 24\text{MPa}}{2} \cdot \sin(2 \cdot 30^\circ)$$





## Variables Used

- **R** Radius of Mohr's circle (Megapascal)
- **$\theta_{\text{plane}}$**  Plane Angle (Degree)
- **$\sigma_{\text{major}}$**  Major Principal Stress (Megapascal)
- **$\sigma_{\text{minor}}$**  Minor Principal Stress (Megapascal)
- **$\sigma_{\text{n,max}}$**  Maximum Normal Stress (Megapascal)
- **$\sigma_{\text{n,min}}$**  Minimum Normal Stress (Megapascal)
- **$\sigma_{\text{t}}$**  Tangential Stress on Oblique Plane (Megapascal)
- **$\sigma_{\text{x}}$**  Stress Along x Direction (Megapascal)
- **$\sigma_{\text{y}}$**  Stress Along y Direction (Megapascal)
- **$\sigma_{\theta}$**  Normal Stress on Oblique Plane (Megapascal)
- **T** Shear Stress in Mpa (Megapascal)
- **$T_{\text{max}}$**  Maximum Shear Stress (Megapascal)



## Constants, Functions, Measurements used

- **Function: atan**, atan(Number)  
*Inverse trigonometric tangent function*
- **Function: cos**, cos(Angle)  
*Trigonometric cosine function*
- **Function: sin**, sin(Angle)  
*Trigonometric sine function*
- **Function: sqrt**, sqrt(Number)  
*Square root function*
- **Function: tan**, tan(Angle)  
*Trigonometric tangent function*
- **Measurement: Angle** in Degree (°)  
*Angle Unit Conversion* 
- **Measurement: Stress** in Megapascal (MPa)  
*Stress Unit Conversion* 



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