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Mohr's Circle Formulas

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List of 14 Mohr's Circle Formulas

Mohr's Circle

Mohr's Circle when a Body is Subjected to Two Mutual Perpendicular and a Simple Shear Stress

1) Condition for Maximum Value of Normal Stress

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

[Open Calculator !\[\]\(de95854c7ee024cfadc48187bbb781b2_img.jpg\)](#)

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

2) Condition for Minimum Normal Stress

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

[Open Calculator !\[\]\(6a9b39b98eb945faa14c645ec99e4eaa_img.jpg\)](#)

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


3) Maximum Value of Normal Stress

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

[Open Calculator !\[\]\(f1c5da15572e3e09d343161be98f508d_img.jpg\)](#)


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



4) Maximum Value of Shear Stress [Open Calculator !\[\]\(4729e517bc6a7cd81c8025b9646574fb_img.jpg\)](#)

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

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

5) Minimum Value of Normal Stress [Open Calculator !\[\]\(e474458956c9a37fbf9586ddb60a7fa1_img.jpg\)](#)


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

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

6) Normal Stress on Oblique Plane with Two Mutually Perpendicular Unequal Stresses [Open Calculator !\[\]\(4fe57c3593bf1b21d272ae7ac8dfaf77_img.jpg\)](#)

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

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

7) Shear Stress on Oblique Plane given Two Mutually Perpendicular and Unequal Stress [Open Calculator !\[\]\(2bae76de5ebbd5c4d7d47162f1673734_img.jpg\)](#)

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

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



Mohr's Circle when a Body is Subjected to Two Mutual Perpendicular Stress which are Unequal and Unlike

8) Normal Stress on Oblique Plane for Two Perpendicular Unequal and Unlike Stress

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

[Open Calculator !\[\]\(23d9fc146e83b5c3013cfa32c784f8d5_img.jpg\)](#)

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

9) Radius of Mohr's Circle for Unequal and Unlike Mutually Perpendicular Stresses

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

[Open Calculator !\[\]\(aa53ad6fea213b8b2226d3077e30533a_img.jpg\)](#)

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

10) Shear Stress on Oblique Plane for Two Perpendicular Unequal and Unlike Stress

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

[Open Calculator !\[\]\(626ce8ac21792b9405bfddfea8e0c96a_img.jpg\)](#)

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

Mohr's Circle when a Body is Subjected to Two Mutual Perpendicular Tensile Stress of Unequal Intensity


11) Maximum Shear Stress

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

[Open Calculator !\[\]\(cbd8541a32dfc32f356f5c6c994b0a21_img.jpg\)](#)

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



12) Normal Stress on Oblique Plane with Two Mutually Perpendicular Forces [Open Calculator](#) 

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

ex

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

13) Radius of Mohr's Circle for Two Mutually Perpendicular Stresses of Unequal Intensities [Open Calculator](#) 

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

ex

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

14) Tangential Stress on Oblique Plane with Two Mutually Perpendicular Forces [Open Calculator](#) 

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

ex

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





Variables Used

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