

Tutorial 5: Mohr's circle

APL 104 - 2023 (Solid Mechanics)

1. The stress tensor at a point is given by the following matrix in Cartesian coordinate system:

$$[\underline{\underline{\sigma}}] = \begin{bmatrix} -4 & 4 & 0 \\ 4 & -4 & 0 \\ 0 & 0 & 3 \end{bmatrix}$$

- (a) Draw Mohr's circle corresponding to this state for traction on planes whose normals lie in $(x - y)$ plane. What are the principal stress components and the corresponding principal normals? What is the maximum shear traction and on what plane does it act?
 - (b) Using Mohr's circle idea, find out the normal and shear tractions on a plane whose normal lies in $(x - y)$ plane and makes an angle of 7.5° from x-axis in clockwise direction.
2. The stress tensor at a point is denoted by the following matrix in Cartesian coordinate system:

$$[\underline{\underline{\sigma}}] = \begin{bmatrix} -7 & 6\sqrt{3} & 0 \\ 6\sqrt{3} & 5 & 0 \\ 0 & 0 & 3 \end{bmatrix}$$

- (a) Draw Mohr's circle corresponding to this state for tractions in $(x - y)$ plane. What are the principal stress components and the direction of principal planes? What is the maximum shear traction and on what plane does it act?
 - (b) Using Mohr's circle idea, find out the normal and shear tractions on a plane whose normal lies in $(x - y)$ plane and makes an angle of 15° from x -axis in clockwise direction.
 - (c) Find out the octahedral normal and shear stress components corresponding to this state of stress.
 - (d) Decompose the given stress matrix into hydrostatic and deviatoric part.
3. Suppose the state of stress at a point is as follows in $(x - y - z)$ coordinate system.

$$[\underline{\underline{\sigma}}] = \begin{bmatrix} -2 & 4\sqrt{3} & 0 \\ 4\sqrt{3} & 6 & 0 \\ 0 & 0 & 4 \end{bmatrix}$$

- (a) Find out the center and radius of corresponding Mohr's circle.

- (b) Find out (σ, τ) on a plane whose normal makes an angle 15° anti-clockwise from x -axis.
- (c) What are the values of the principal stress components?
- (d) Obtain the orientation of principal stress planes.