Tutorial 5: Mohr's circle

APL 108 - F2025 (Mechanics of Solids)

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

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

   (a) Draw Mohr's circle corresponding to this state for traction on planes whose normals lie in the $(x-y)$ 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 the x-axis in the clockwise direction.

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

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

   (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 the $(x-y)$ plane and makes an angle of 15° from x-axis inthe 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 the hydrostatic and deviatoric parts.

3. Suppose the state of stress at a point is as follows in $(x-y-z)$ coordinate system.

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

   (a) Find out the center and radius of the 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.