DEPARTMENT OF MECHANICAL ENGINEERING
College of Engineering Thalassery

ME202 Advanced Mechanics of Solids

Tutorial-2: Analysis of Stress - II

1. The state of stress at a point is characterized by the components $\sigma_x = 100, \sigma_y = -40, \sigma_z = 80, \tau_{xy} = \tau_{yz} = \tau_{zx} = 0$ all in $10^6 N/m^2$. Determine the extreme values of shear stresses, their associated normal stresses, the octahedral shear stress and its associated normal stress.

2. The state of stress at a point is given by $\sigma_x = \sigma_y = \sigma_z = \tau_{xy} = \tau_{yz} = \tau_{zx} = \rho$. Determine principal stresses and directions.

3. A cross-section of the wall of a dam is shown in Figure 2. The pressure of water on face OB is also shown. The stresses at any point (x, y) are given by the following expressions

$$\sigma_x = -\gamma y$$

$$\sigma_y = \left(\frac{\rho}{tan\beta} - \frac{2\gamma}{\tan^3 \beta} \right)$$

$$\tau_{xy} = \frac{-\gamma x}{\tan^2 \beta}$$

$$\tau_{yz} = \tau_{xz} = \sigma_z = 0$$

where γ is the specific weight of water and ρ the specific weight of the dam material.
Consider an element OCD and show that this element is in equilibrium under the action of the external

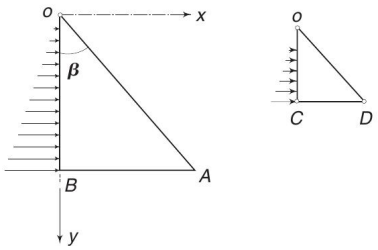

Figure 1: Problem 3

forces (water pressure and gravity force) and the internally distributed forces across the section CD

4. At a point in a stressed material, the principal stresses acting are given by, $\sigma_1 = 120Pa, \sigma_2 = 60Pa, \sigma_3 = 20Pa$. Find the normal and shear stress on a plane whose normal is inclined at an angle of 40^O to the σ_1 axis in the plane containing σ_1 and σ_3 stresses and 50^O to the σ_1 axis in the plane containing σ_1 and σ_2 stresses. Find also the normal and shear stresses on Octahedral Planes.

5. The state of stress at a particular point relative to the xyz coordinate system is given by the stress matrix

$$\tau_{ij} = \begin{bmatrix} 15 & 10 & -10 \\ 10 & 10 & 0 \\ -10 & 0 & 40 \end{bmatrix} MPa$$

Determine the normal stress and magnitude and direction of the shear stress on a surface intersecting the point and parallel to the plane given by the equation $2x - y + 3z = 9$

6. (a) Decompose the given stress in to hydrostatic and deviatoric parts.

$$\tau_{ij} = \begin{bmatrix} 57 & 0 & 24 \\ 0 & 50 & 0 \\ 24 & 0 & 42 \end{bmatrix} kPa$$

   (b) What is the octahedral normal and shear stress of hydrostatic part

   (c) What is the octahedral normal and shear stress of deviatoric part?

7. The stress field of a body is given by $\sigma_x = 20x^2 + y^2$, $\sigma_y = 30x^3 + 200$, $\sigma_z = 30(y^2 + z^2)$, $\tau_{xy} = zx$, $\tau_{xz} = y^2z$, $\tau_{yz} = x^3y$. Find out the components of body force required for satisfying the equilibrium of the body