Mechanics of Materials I:

Fundamentals of Stress & Strain and Axial Loading

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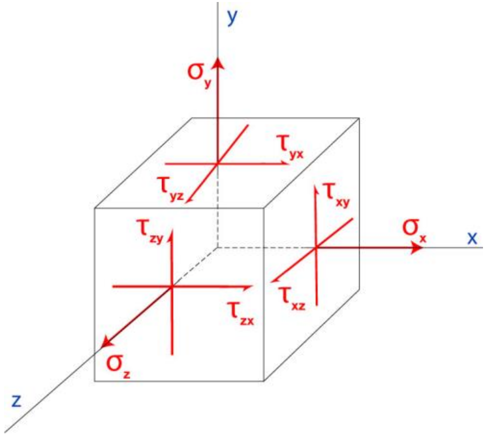
Module 6 Learning Outcome

- Define Two-Dimensional (2D) or Plane Stress

3D State of Stress at a Point
(shown in positive sign convention)



$$\tau_{xy} = \tau_{yx}$$

$$\tau_{yz} = \tau_{zy}$$

$$\tau_{xz} = \tau_{zx}$$

Matrix Notation:

$$\begin{bmatrix} \sigma_x & \tau_{xy} & \tau_{xz} \\ \tau_{yx} & \sigma_y & \tau_{yz} \\ \tau_{zx} & \tau_{zy} & \sigma_z \end{bmatrix}$$

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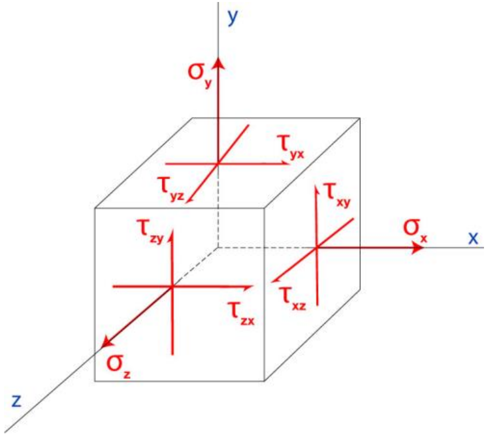


$$\tau_{xy} = \tau_{yx}$$

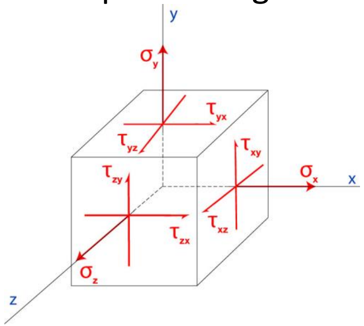
$$\tau_{yz} = \tau_{zy}$$

$$\tau_{xz} = \tau_{zx}$$

For Two-Dimensional (2D) or Plane Stress, all out of plane stresses are zero

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

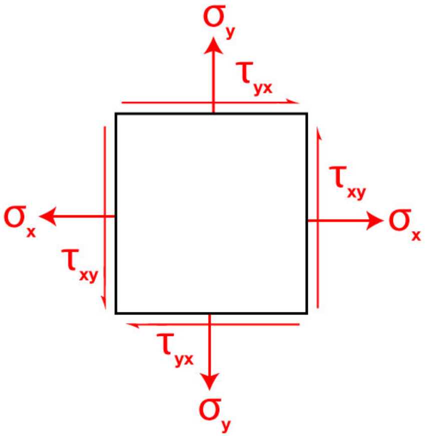
3D State of Stress at a Point
(shown in positive sign convention)



Two-Dimensional (2D) or Plane Stress

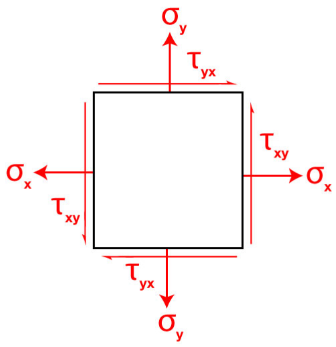
(shown in positive sign convention)

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



Two-Dimensional (2D) or Plane Stress

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



All real world stress situations are three-dimensional, but the plane stress assumption can simplify the analysis without significantly affecting the results. A common example when plane stress might be used is the analysis of thin plates such as the skin panels on aircraft wings.