Mechanics of Materials I:

Fundamentals of Stress & Strain and Axial Loading

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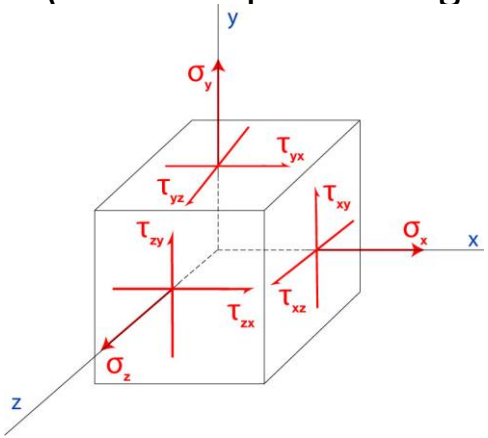
Module 7 Learning Outcomes

- Review Normal Stress
- Define/Discuss Nominal Stress (Engineering Stress)
- Define/Discuss True Stress

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



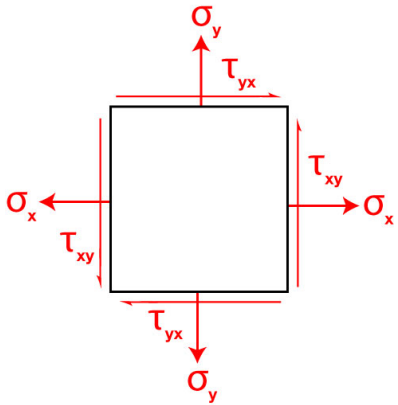
$$\tau_{xy} = \tau_{yx}$$

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

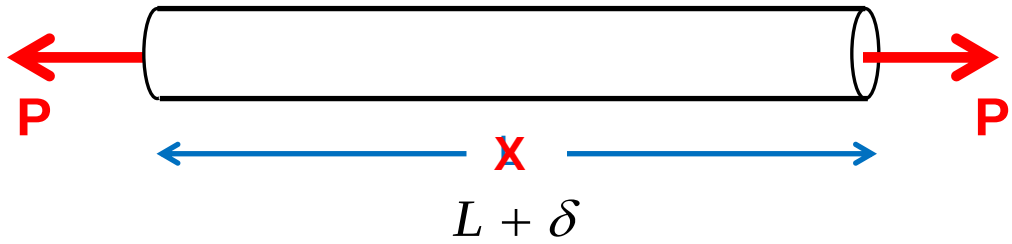
$$\tau_{xz} = \tau_{zx}$$

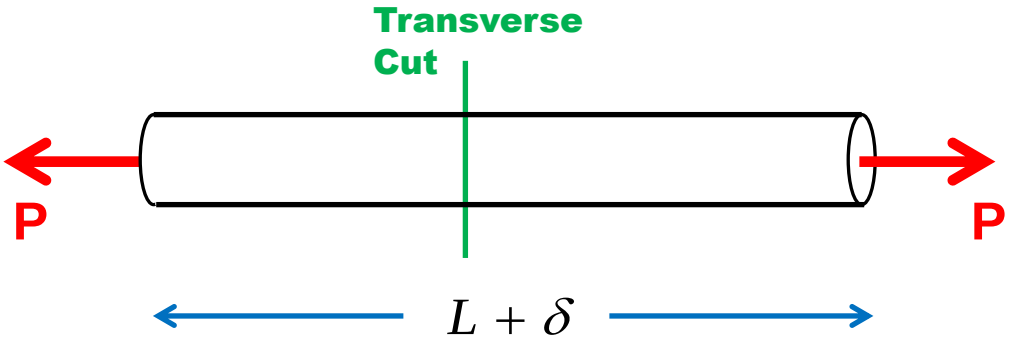
For Two-Dimensional (2D) or Plane Stress,
all out of plane stresses are zero

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

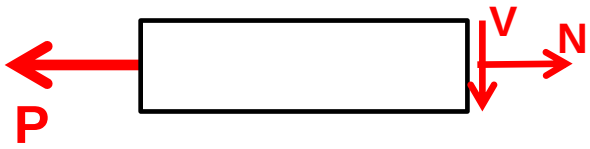


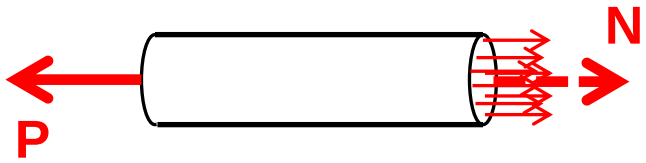
Axial Centric Loading



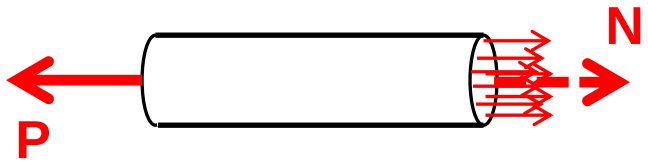


For Transverse Cut, N=P





Assume
Uniformly
Distributed



Assume
Uniformly
Distributed

Normal Stress

Force per unit area
perpendicular to the cut surface

$$\sigma = \frac{N}{A}$$

Sign Convention

(+) Tension
(-) Compression

Nominal Stress (Engineering Stress)

$$\sigma = \frac{N}{A_O}$$

initial cross-sectional area

True Stress

$$\sigma = \frac{N}{A}$$

larger

actual area becomes smaller when the specimen fails

Worksheet:

A flat steel alloy bar has an initial thickness of 10 mm and an initial width of 60 mm. It is subjected to a total axial load in tension of 60 kN.
Determine the nominal axial stress (engineering stress) in the bar.

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A flat steel alloy bar has an initial thickness of 10 mm and an initial width of 60 mm. It is subjected to a total axial load in tension of 60 kN. Determine the nominal axial stress (engineering stress) in the bar.

$$\sigma = \frac{P}{A_o} = \frac{60{,}000\ N}{(10\ mm)(60\ mm)} = 100\ N/mm^2 = \underline{\underline{100\ MPa}}\ ANS$$