Mechanics of Materials I:

Fundamentals of Stress & Strain and Axial Loading

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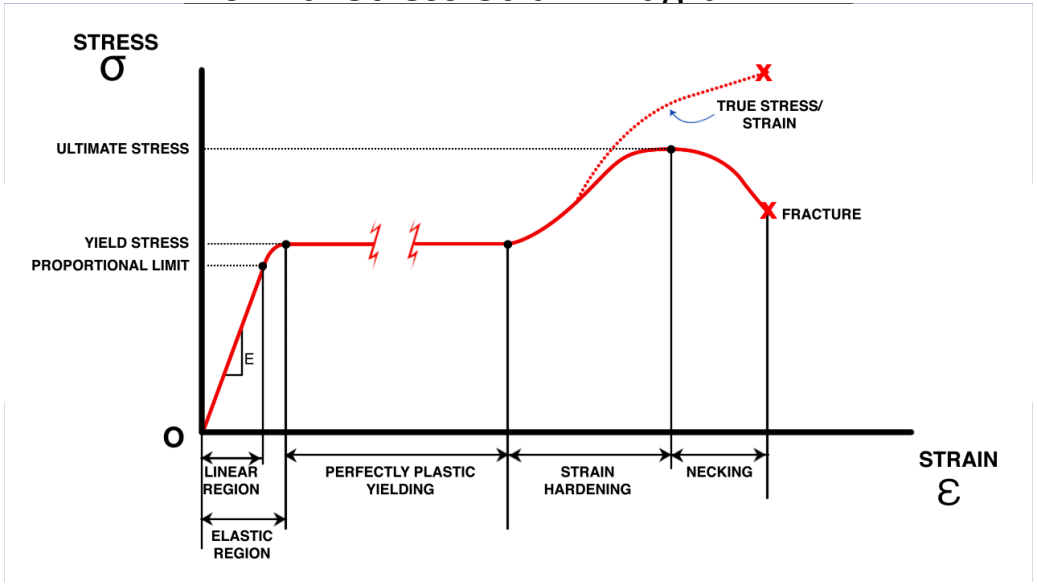
Mechanics of Materials I:
Fundamentals of Stress & Strain and Axial Loading

- ✓ Internal Forces due to External Loads
- ✓ Axial Centric Loads
- ✓ Normal Stress and Shear Stress
- ✓ General State of Stress at a Point (3D)
- ✓ Plane Stress (2D)
- ✓ Normal Strain and Shear Strain
- ✓ Stress-Strain Diagrams
- ✓ Mechanical Properties of Materials
- ✓ Linear Elastic Behavior, Hooke's Law, and Poisson's Ratio
- ✓ Stresses on Inclined Planes
- ✓ Principal Stresses and Max Shear Stress
- ✓ Mohr's Circle for Plane Stress
- ✓ Stress Concentrations
- ✓ Mohr's Circle for Plane Strain
- ✓ Strain Transformation and Measuring Strains
- ✓ Factor of Safety and Allowable Stresses/Loads
- ✓ Nonlinear Behavior and Plasticity
- ❑ Statically Indeterminate Structures
- ❑ Thermal and Pre-strain Effects

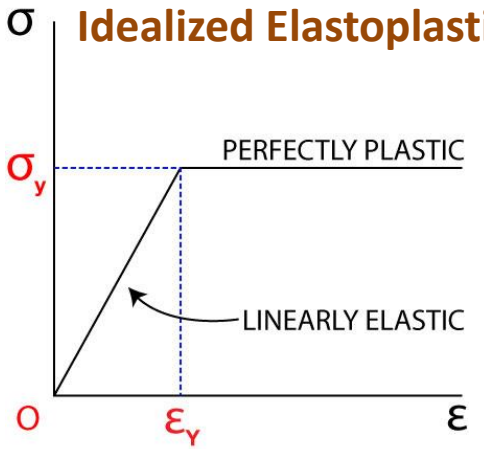
Module 42 Learning Outcomes

- Describe the idealized elastoplastic material assumption
- Develop an expression for the displacement of a prismatic bar subjected to an axial centric load in the elastic region

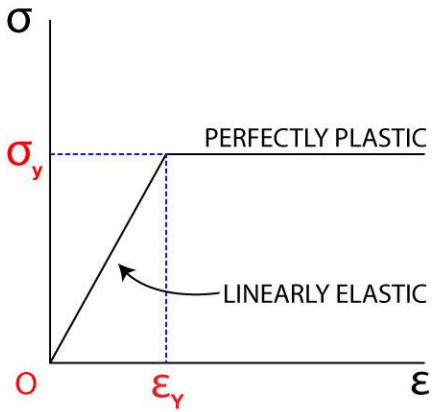
Normal Stress-Strain Diagram



Idealized Elastoplastic Material



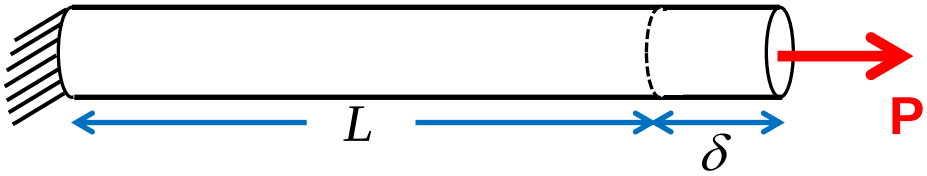
Yield Stress
and
Proportional Limit
are assumed to be
the same



Prismatic Bar

- straight longitudinal axis
- same cross section throughout its length

Axial Centric Loading



Transverse Cut, N=P

Normal Stress

Force per unit area perpendicular to the cut surface

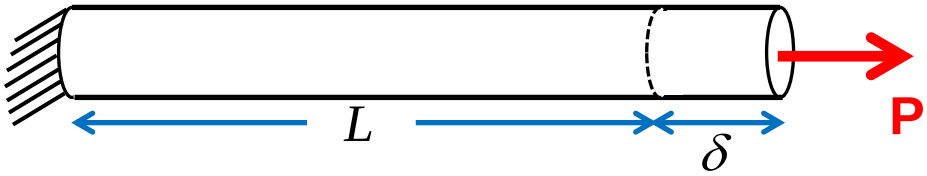
$$\sigma = \frac{N}{A}$$

Normal Strain

Elongation per unit length

$$\varepsilon = \frac{\delta}{L}$$

Axial Centric Loading



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Normal Stress

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

Normal Strain

Elongation per unit length

$$\varepsilon = \frac{\delta}{L}$$

$$\sigma = E\varepsilon$$

$$\frac{P}{A} = E\frac{\delta}{L}$$

$$\delta = \frac{PL}{AE}$$