Structures

- Agenda:
  - Beams
    - Bending
    - Examples

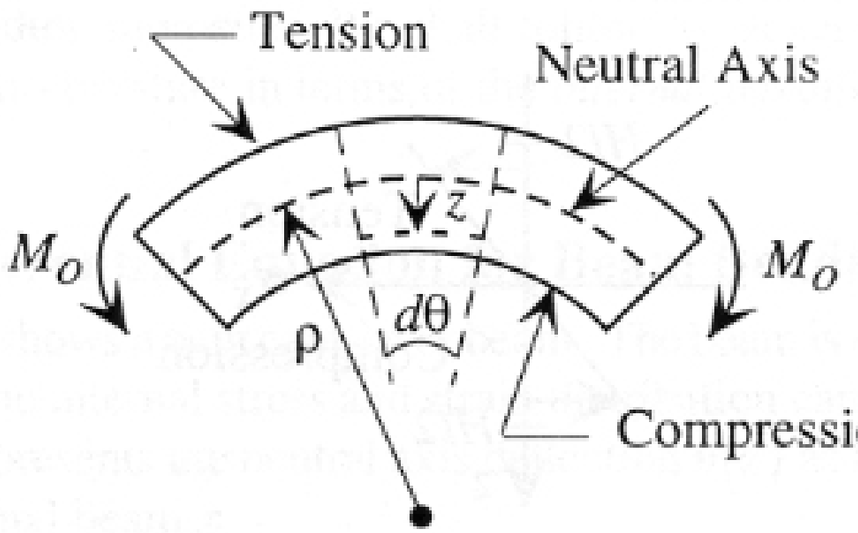
- Reading: Senturia, Ch. 9, pp.211-219.

Last lecture

- Axial loading
  - Spring constant $k_{axial} = \frac{EWH}{L}$
- Bending
  - Reaction force $F_R = F$
  - Reaction moment $M_R = FL$
  - Shear force $V = F$
  - Internal bending moment $M(x) = -F(L - x)$
  - For distributed loading
    - $q = -\frac{dV}{dx}$
    - $V = \frac{dW}{dx}$

Bending of Beams

- **Stress in a beam with pure bending**:
  - Assume small deflections, i.e., "no strain in neutral axis"



Ref. Senturia, pg 211.

The length of the differential element, $dL = (\rho - z)d\theta$ where, $\rho =$ the radius of curvature. At the neutral axis $(z = 0)$, $dx = \rho d\theta$, therefore, $dL = dx - \frac{z}{\rho}dx$.

So the corresponding stresses and strains can be expressed as

$$\varepsilon_x = -\frac{z}{\rho} \quad \text{and} \quad \sigma_x = -\frac{zE}{\rho}$$