

Strain Energy

Strain Energy = Work done

Or, Force x Displacement

$$U = (\sigma^2/2E) \times \text{Volume}$$

Unit: Nm, or kNm, or Nmm

Strain Energy DUE TO

1. Elastic

1. Resilience
2. Proof Resilience
3. Modulus of Resilience

2. Loading

1. Gradual
2. Sudden
3. Impact
4. Shock

3. Effects

1. Shear
2. Bending
3. Torsion

Some definitions

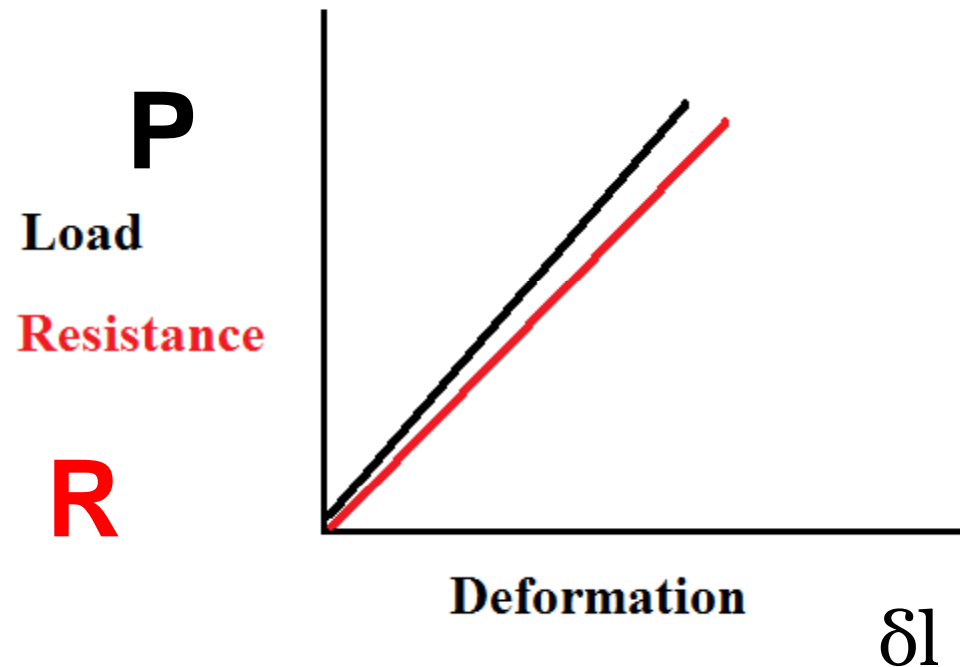
- 'Elasticity' can be defined as the ability of a **body to store energy**
- 'Resilience' can be defined as the ability of a **body to regain its original shape**

Work Done = Work Stored

Work Done = $\frac{1}{2} P \delta l$

Work Stored = $\frac{1}{2} \sigma A \delta l$

Strain Energy = $\frac{1}{2} R \delta l$



Strain Energy DUE TO Action

- Gradual

$$\sigma = P/A; \quad u = (\sigma^2/2E) V$$

- Sudden

$$\sigma = 2P/A; \quad u = (\sigma^2/4E) V$$

- Impact

$$\sigma = P/A + \sqrt{[(P/A)^2 + (2EPh)/(Al)]}; \quad u = ?$$

- Shock

$$u = (\sigma^2/2E) V$$

Strain Energy DUE TO Effect

- Shear

$$u = (\tau^2/2G) \times V$$

- Bending

$$u = \int_0^l \{(M^2) dx / (2EI)\}$$

- Torsion

$$u = (\tau^2/4G) \times V \leftarrow \text{Solid Shaft}$$

$$u = (\tau^2/4G) \times [(D^2 + d^2)/d^2] \times V \leftarrow \text{Hollow Shaft}$$