

(1)

Stress - Strain

Definition:

$$\text{Stress} = \frac{\text{Force}}{\text{Area}} \quad \text{N m}^{-2} \quad \text{or Pa}$$

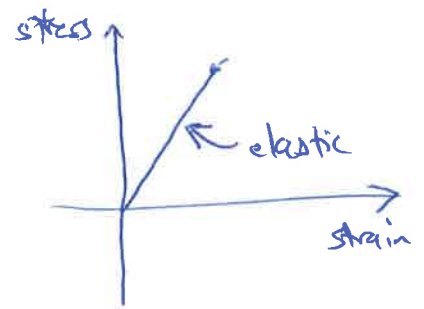
$$\text{Strain} = \frac{\text{extension}}{\text{original length}} \quad \text{v} \quad (\text{1D definition})$$

For elastic portion of stress-strain curve:

$$\text{Stress} \propto \text{Strain}$$

i.e.

$$\text{Stress} = K \text{ Strain}$$

in typical symbolic: $\sigma = k \epsilon$

(Hooke's Law.)

(2)

Examples

- ①. A wire of length 2.5 m undergoes a strain of 0.2. What is the extension?

$$\frac{\text{extension}}{\text{length}} = 0.2$$

$$\text{extension} = \frac{2.5 \times 0.2}{1} \text{ m}$$

- ②. A wire of cross-sectional area 0.2 cm^2 and natural length 1.5 m has a mass of 50 kg suspended from one end. Calculate the strain if Modulus of Elasticity is $5 \times 10^{11} \text{ Pa}$ (Assume $g = 9.8 \text{ ms}^{-2}$).



$$\text{Stress} = \frac{\text{Force}}{\text{Area}} = \frac{50 \times 9.8}{0.2 \times 10^{-4}}$$

$$\text{Stress} = 2.45 \times 10^7 \text{ Pa}$$

from Hooke's law

$$\text{Stress} = k \text{ Strain}$$

$$\therefore \text{Strain} = \frac{\text{Stress}}{k} = \frac{2.45 \times 10^7}{5 \times 10^{11}}$$

$$\text{Strain} = 0.49 \times 10^{-4}$$