● Chapter 2: Elastic Behaviour

❖ Hooke's Law: The extension of a spring is proportional to the applied force

$$F = k*x$$

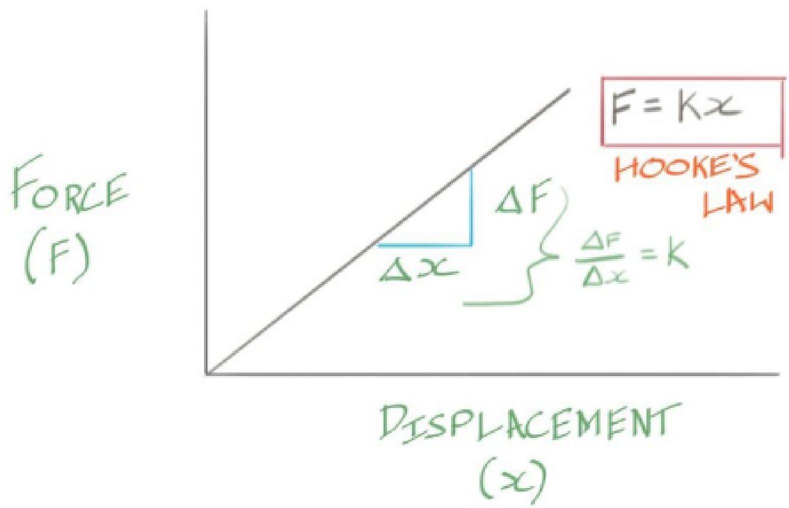
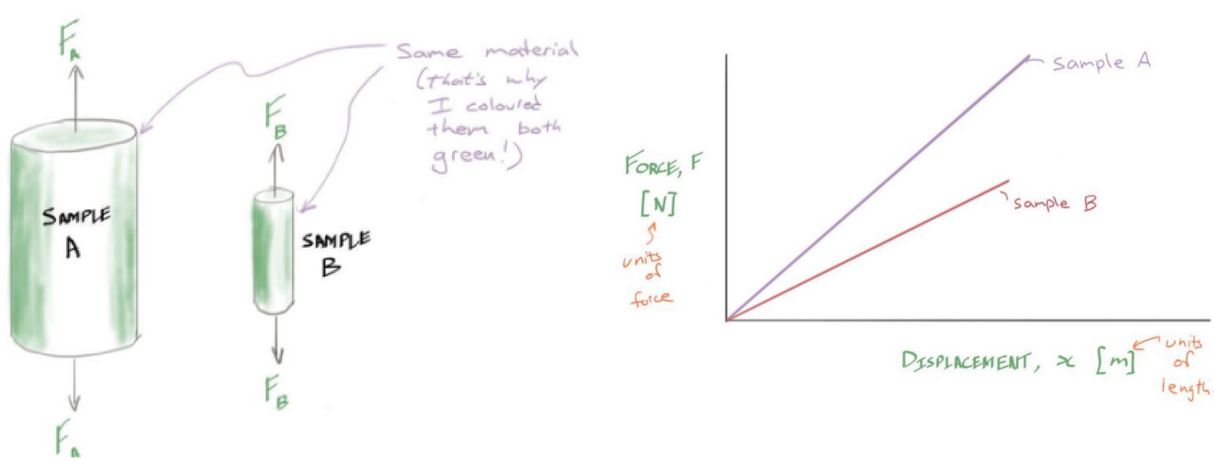


Figure 2: A general linear force versus displacement plot.

❖ Experiment:

- ➢ Consider two cylindrical samples of the **same** material
- ➢ Strength is **same**
- ➢ Sample A is longer and has greater cross sectional area
- ➢ Sample B is shorter and has smaller cross sectional area
- ➢ Sample A requires more Force for Elongation- thicker sample supports more load
- ➢ Sample A has higher spring constant-steeper



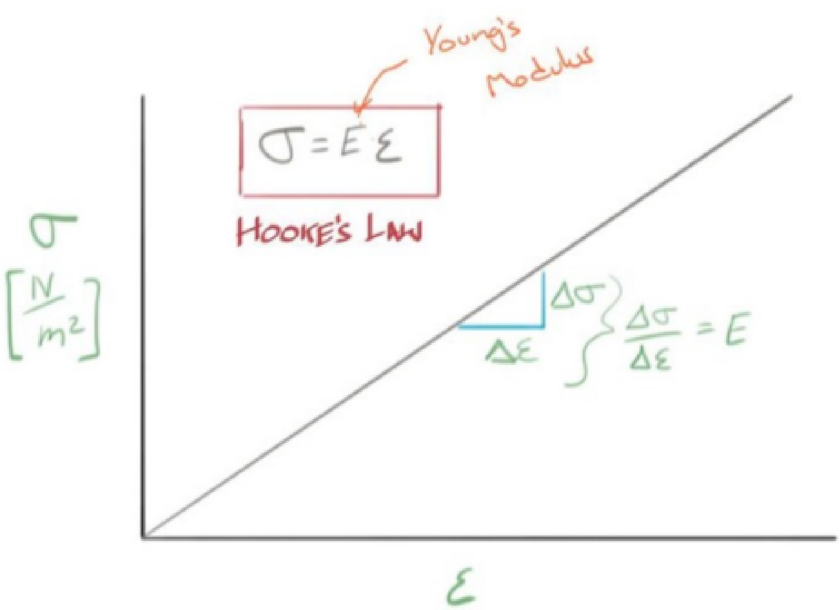
- Engineering Stress: force exerted per unit initial cross-sectional area of a material
  - Unit: N/m^2 or Pa

$$\sigma = \frac{F}{Ao}$$

- Engineering Strain: extension per unit length
  - No unit- Dimensionless

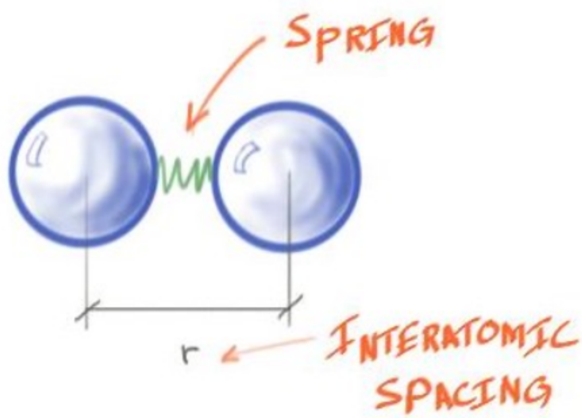
$$\varepsilon = \frac{\triangle l}{l0}$$

- STRESS-STRAIN CURVE
  - Stress y-axis
  - Strain x-axis
  - Slope is Young's Modulus (E)
  - Young's Modulus = Stress/Strain
    - Unit- Pa

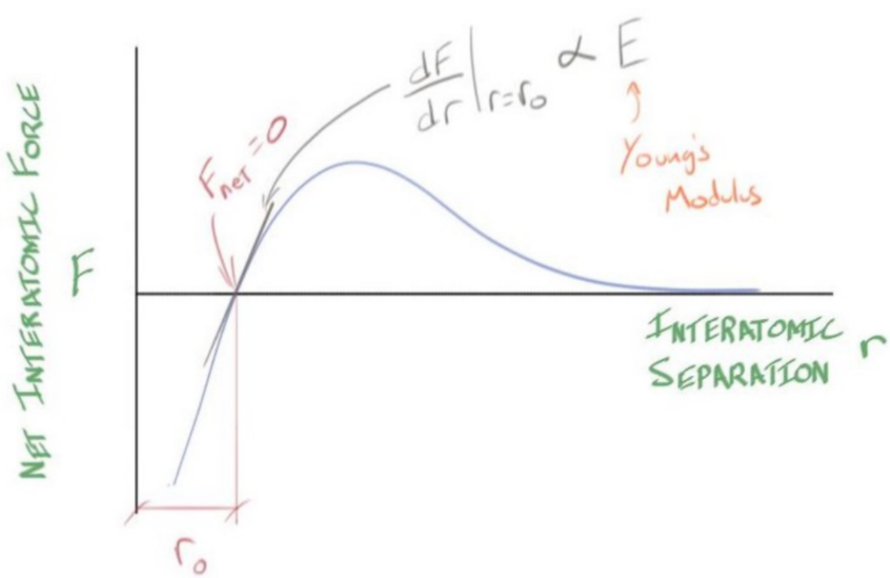


- ELASTIC DEFORMATION:
  - During elastic deformation the sample dimensions return to their **original** dimensions upon unloading.
  - During elastic deformation atoms return to their **original** positions upon unloading.
  - Tensile Strain is recoverable

- Model for Net force between atoms in a solid:
  - What if we modeled atoms in a solid as spheres connected to one another by little springs



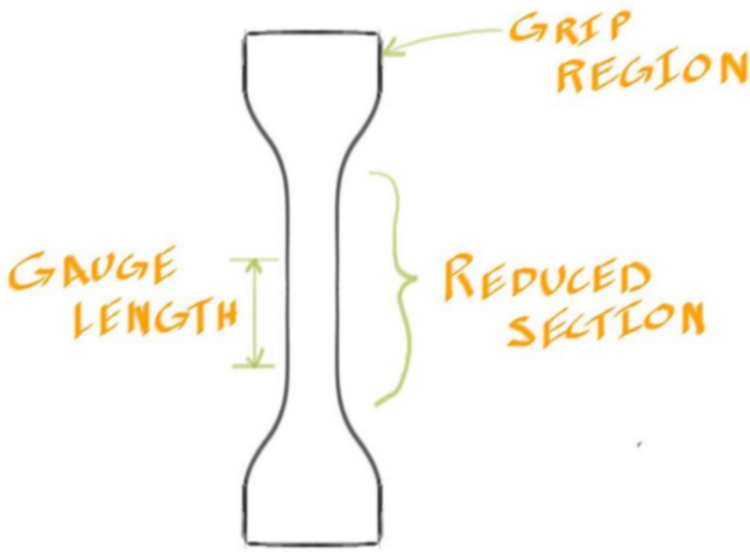
  - There is an attractive force that pulls the atoms together, but then as the atoms get closer to each other there is a repulsive force that becomes significant.



- ➢ the letter “r” is used for interatomic spacing
- ➢ The point where the net force is equal to zero corresponds to the atoms at rest and so the value of the interatomic spacing at that point defines the so-called, equilibrium interatomic spacing.
- ➢ Young’s modulus is directly proportional to the spring constant of the tiny little interatomic spring

❖ **<u>How is the stress-strain curve formed:</u>**

- ➢ Use a tensile specimen
- ➢ These tensile specimens may be either cylindrical or rectangular in cross-section.



- ➢ Grip region: Where we grip the sample
    - Stress in grip region is lower due to large cross-sectional area
    - So we can squeeze it really hard without worrying about impacting the experiment
- ➢ Reduced Section: Section in the middle with parallel sides
    - Smaller cross sectional area
- ➢ Gauge Length: The initial length of the strain gauge is where we define the initial length l0
    - Always shorter than reduced section

❖ UNIAXIAL TENSILE TEST:

- ■ Powerful grips to hold sample
- ■ A load cell
- ■ Accurate means to determine strain