Modulus of Elasticity

- The slope of the initial portion of the stress-strain curve is the modulus of elasticity, or Young's Modulus. The modulus of elasticity is a measure of the stiffness of the material. It is an important design value.

- The modulus of elasticity is determined by the building forces between atoms. It is only slightly affected by alloying.

Measures of Yielding

- Yielding defines the point at which plastic deformation begins. This point may be difficult to determine in some materials, which have gradual transition from elastic to plastic behavior. Therefore, various criteria (depends on the sensitivity of the strain measurements) are used to define yielding.

1. Proportional Limit - This is the highest stress at which stress is directly proportional to strain.

2. Elastic Limit - This is the greatest stress the material can withstand without any measurable permanent strain remaining on the complete release of the load.

3. Yield Strength - This is the stress required to produce a small (0.2% strain) specified amount of plastic deformation.

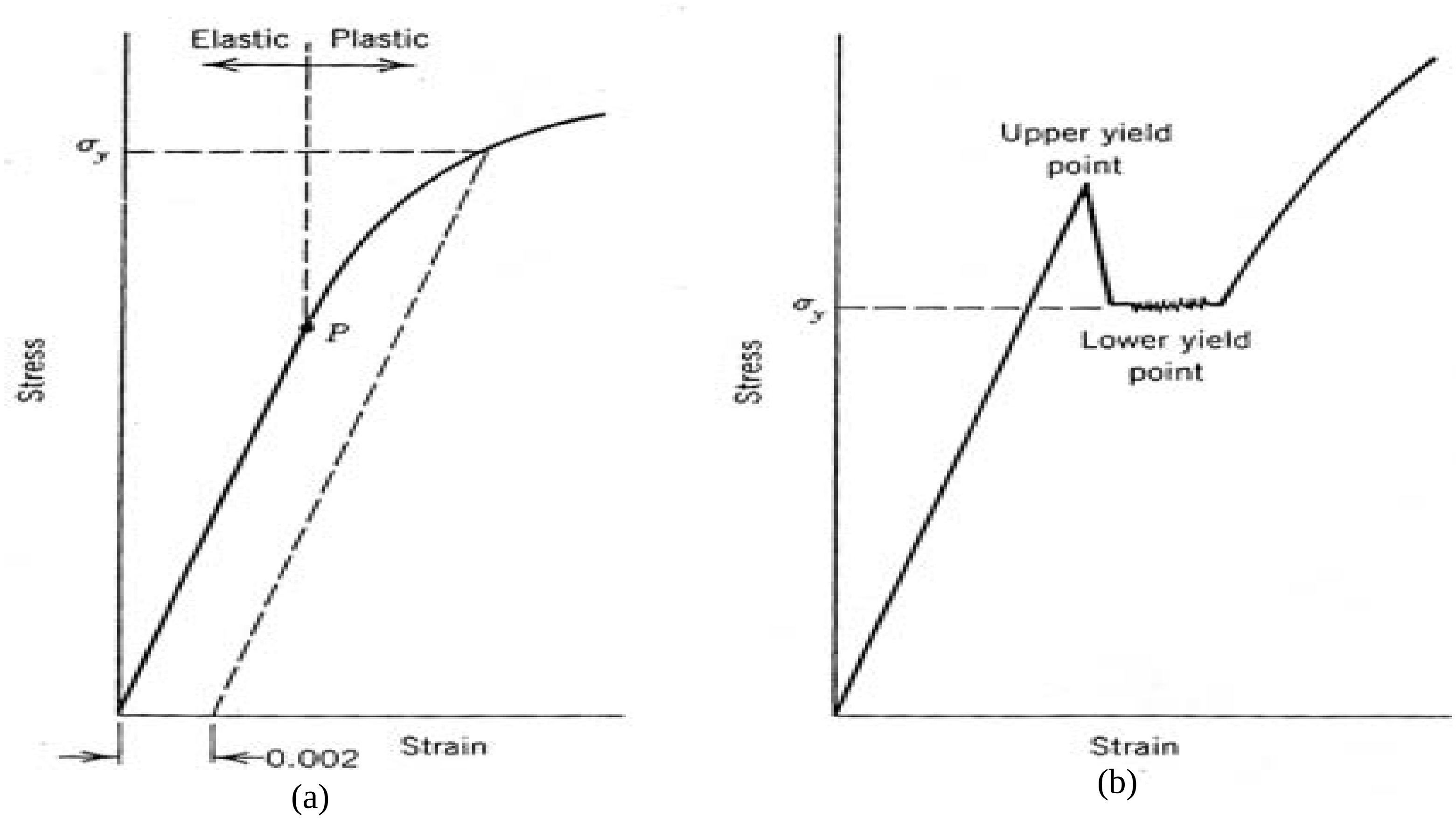


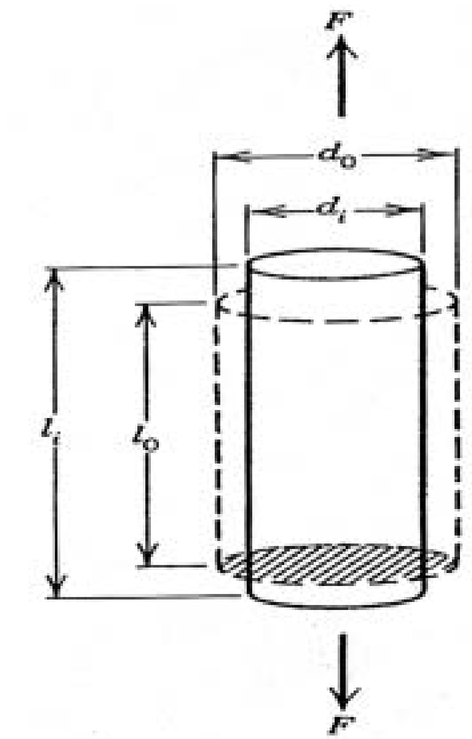
Figure 1-13. (a) Typical stress-strain (type II) behavior for a metal showing elastic and plastic deformations, the proportional limit P, and the yield strength σ_y, as determined using the 0.002 strain offset method.
(b) Representative stress-strain (type IV) behavior found for some steels demonstrating the yield drop (point) phenomenon.

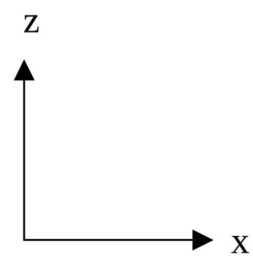
Poisson's Ratio

•If the applied stress is uniaxial (only in the z direction), then $\varepsilon_x = \varepsilon_y$. A parameter termed Poisson's ratio *v* is defined as the ratio of the lateral and axial strains, or

$$v = -\frac{\varepsilon_x}{\varepsilon_z} = -\frac{\varepsilon_y}{\varepsilon_z} \qquad (1.8)$$

Figure 1-14.





$$\varepsilon_z = \frac{\Delta l}{l} = \frac{l - l_o}{l_o} \qquad (1.9)$$

$$\varepsilon_z = \frac{\Delta d}{d_o} = \frac{d - d_o}{d_o} \qquad (1.10)$$