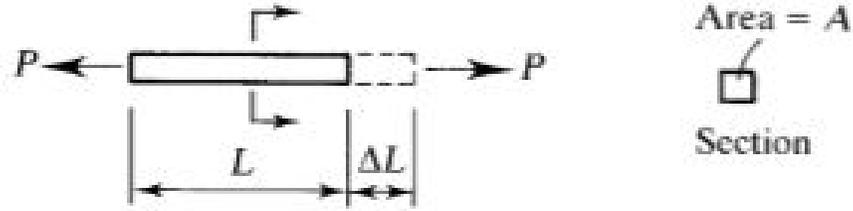


STRESS-STRAIN RELATIONSHIPS IN STRUCTURAL STEEL

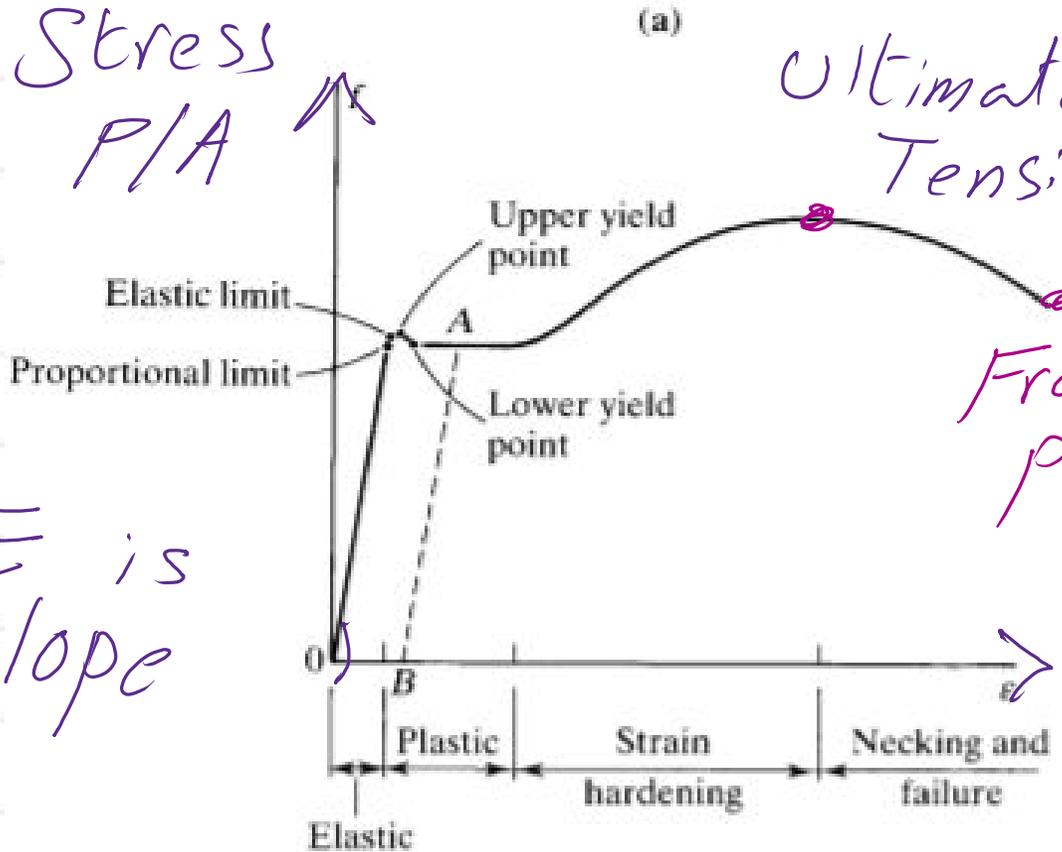
If a piece of ductile structural steel is subjected to a tensile force, it will begin to elongate. If the tensile force is increased at a constant rate, the amount of elongation will increase linearly within certain limits. In other words, elongation will double when the stress goes from 6000 to 12,000 psi (pounds per square inch). When the tensile stress reaches a value roughly equal to three-fourths of the ultimate strength of the steel, the elongation will begin to increase at a greater rate without a corresponding increase in the stress.

Prepared by Eng.Maged Kamel.



$$f = \frac{P}{A} \quad \text{and} \quad \epsilon = \frac{\Delta L}{L}$$

Stress
 P/A



where

f = axial tensile stress

A = cross-sectional area

ϵ = axial strain

L = length of specimen

ΔL = change in length

Fracture point

Strain

$$\frac{\Delta L}{L}$$

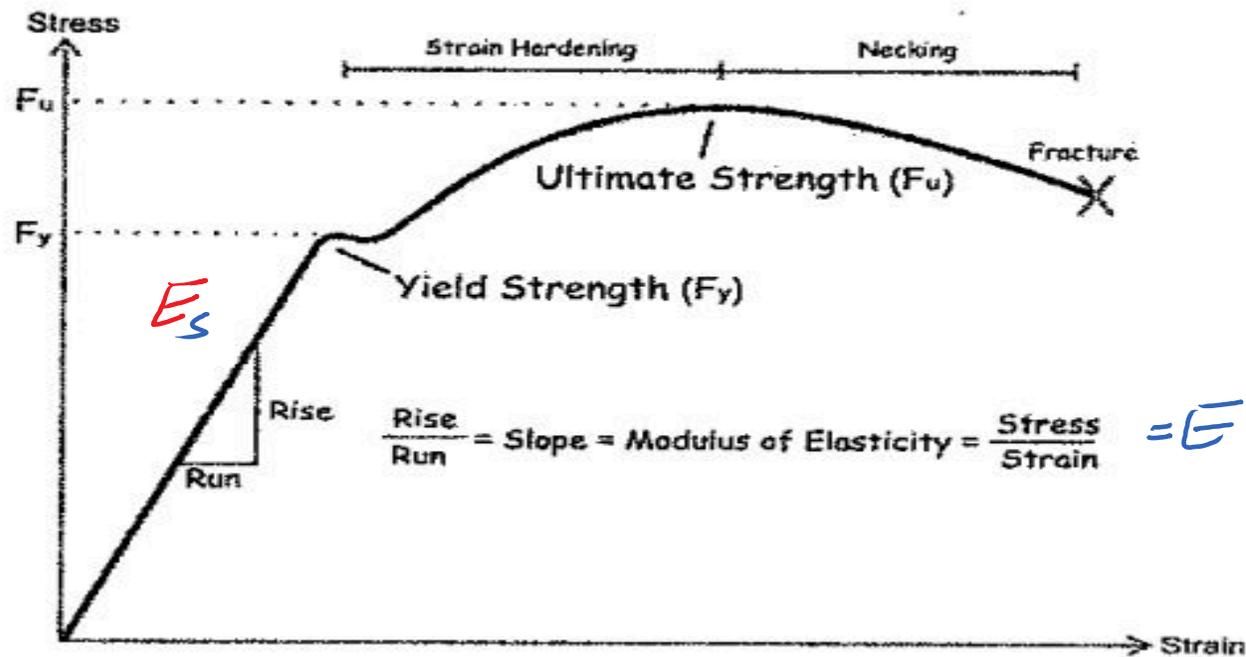
(Not to scale)

E is slope

(b)

Prepared by Eng. Maged Kamel.

Tensile Test Curve - Hooke's Law.



$$E = 29000 \text{ ksi}$$

For steel

$$E_s = 200 \text{ GPa}$$

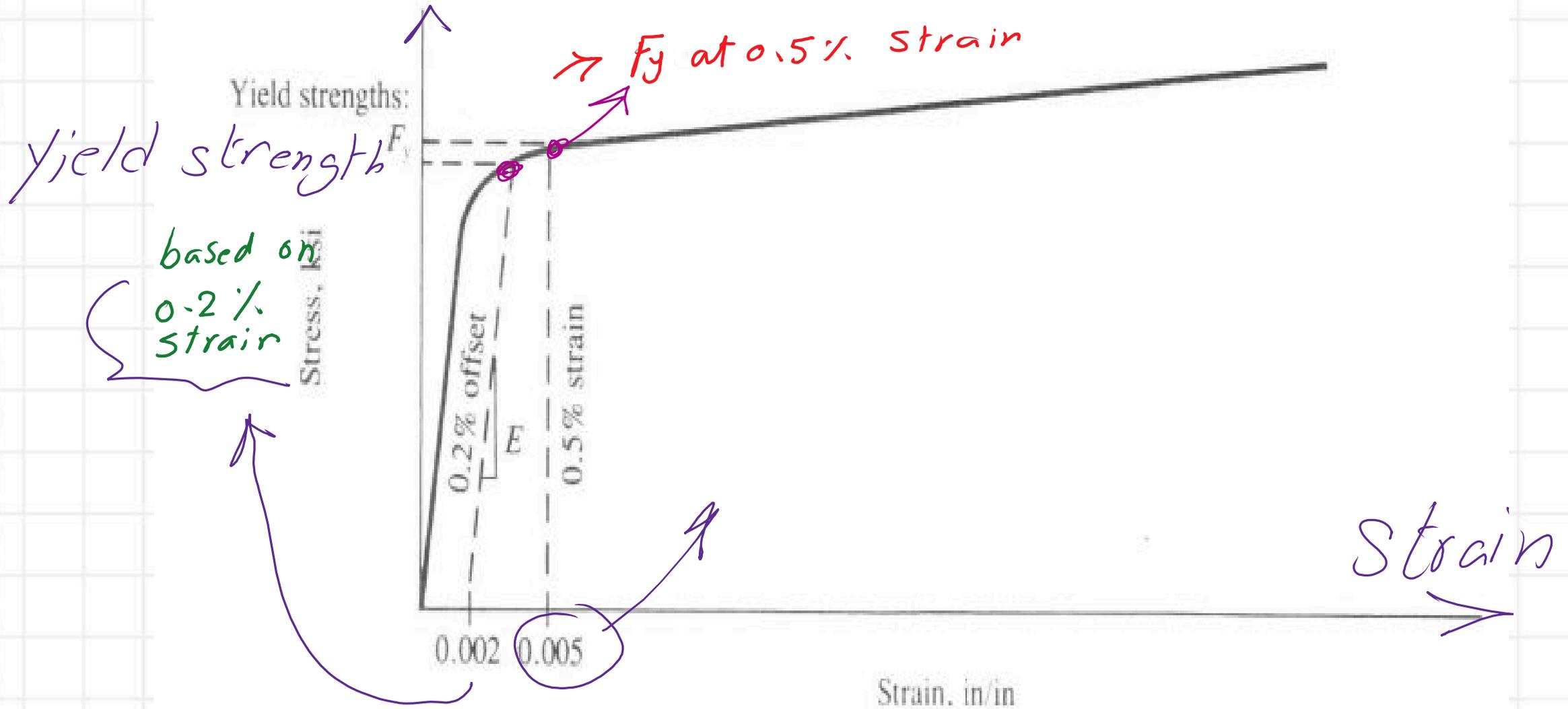
SI-units

Hooke's Law

For most tensile testing of materials, notice that the initial portion of the relationship between the applied force and the elongation of the specimen is linear. In this linear region, the line obeys the relationship defined as "Hooke's Law" where the ratio of stress to strain is a constant. E is the slope of the line in this region where stress (f) is proportional to strain (ϵ) and is called the "Modulus of Elasticity" or "Young's Modulus".

Prepared by Eng. Maged Kamel.

High strength steel - Graph



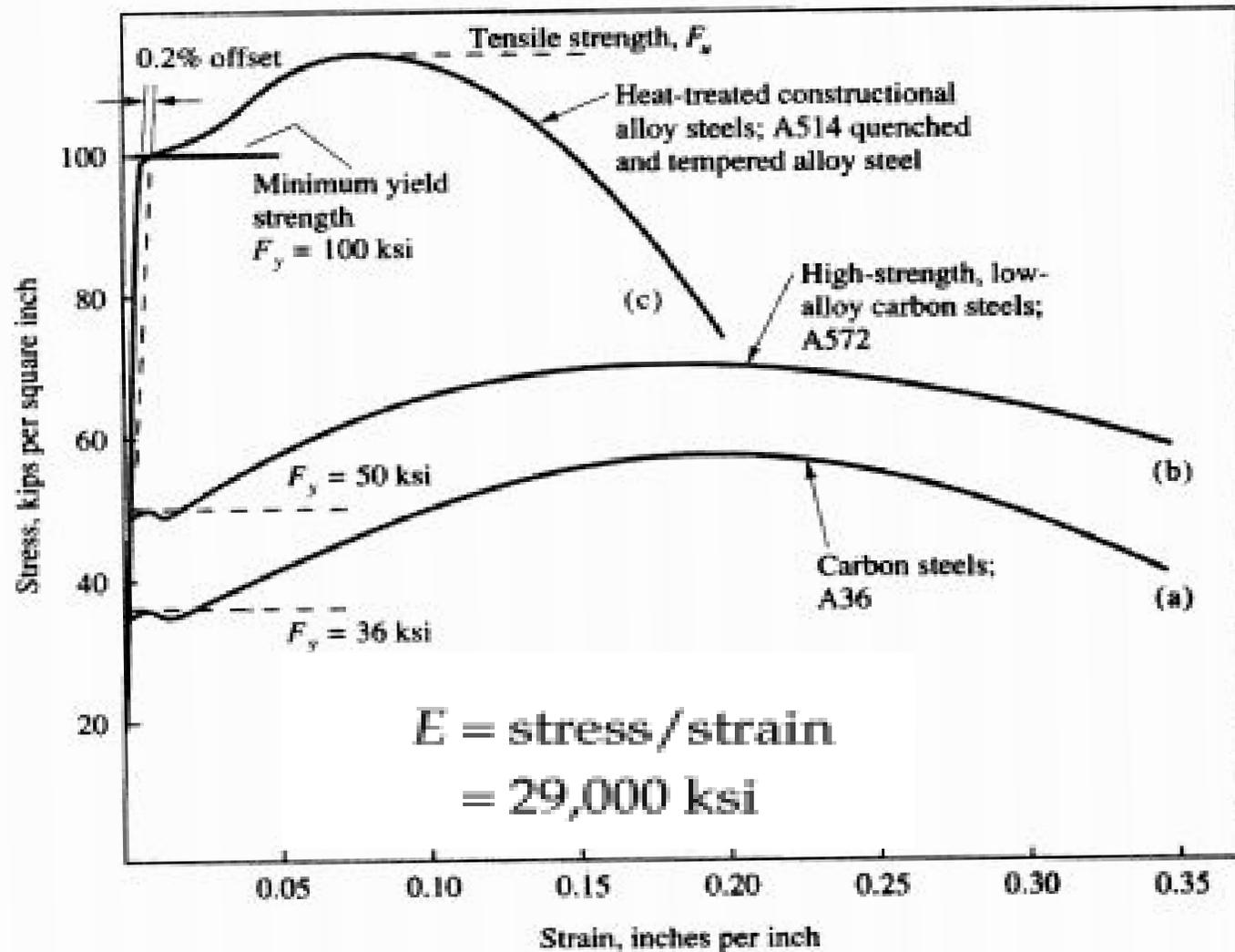
Structural Steel Composition

The following is the composition of two well-known grades of structural steel: ASTM 572 and ASTM A36. While other structural steel grades possess analogous compositions, they may also have extra alloys or have undergone additional processing.

Grade	Carbon	Manganese	Phosphorus	Sulfur	Silicone
A36	0.25-0.29%	1.03%	0.04%	0.05%	0.28%
A572	0.18-0.23%	0.5-0.7%	0.035% max	0.04% max	0.150-0.3%
A514*	0.12-0.21%	0.85%	Not specified	Not specified	0.28%

As with most steels, A36 has a density of $7,800 \text{ kg/m}^3$ (0.28 lb/cu in). Young's modulus for A36 steel is 200 GPa (29,000,000 psi).^[2] A36 steel has a Poisson's ratio of 0.26, and a shear modulus of 75 GPa (10,900,000 psi).

Prepared by Eng.Maged Kamel.



Carbon steels [edit]

- [A36](#) - structural shapes and plate.
- [A53](#) - structural pipe and tubing.
- [A500](#) - structural pipe and tubing.
- [A501](#) - structural pipe and tubing.
- [A529](#) - structural shapes and plate.
- [A1085](#) - structural pipe and tubing.

High strength low alloy steels [edit]

- [A441](#) - structural shapes and plates.
- [A572](#) - structural shapes and plates.
- [A618](#) - structural pipe and tubing.
- [A992](#) - Possible applications are W or S I-Beams.
- [A913](#) - Quenched and Self Tempered (QST) W shapes.
- [A270](#) - structural shapes and plates.

Grade	Yield Point	Tensile Point
A36	36 ksi	58-80 ksi
A572	42-65 ksi*	0.5-0.7%
A514	100 ksi	110-130 ksi

Prepared by Eng.Maged Kamel.