Engineering Materials

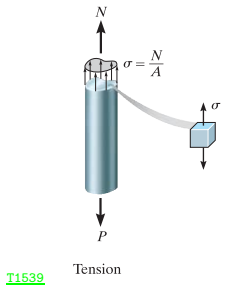
Dr. Md. Zahurul Haq, *Ph.D., CEA, FBSME, FIEB*

Professor
Department of Mechanical Engineering
Bangladesh University of Engineering & Technology (BUET)
Dhaka-1000, Bangladesh

http://zahurul.buet.ac.bd/

ME 101 : Introduction to Mechanical Engineering
http://zahurul.buet.ac.bd/ME101/

Stress and Strain



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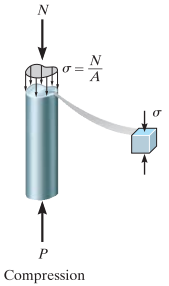

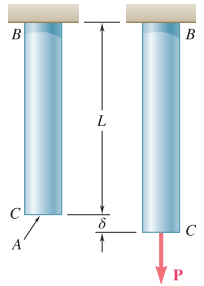

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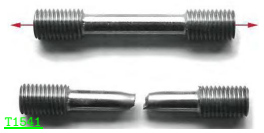
Stress, $\sigma = \frac{N}{A}$ *Strain,* $\epsilon = \frac{\delta}{L}$

- **stress**: intensity and direction of internal force acting at a given point on a particular plane.
- **strain**: dimensionless displacement produced in solid as a result of stress.

Ductile and Brittle Materials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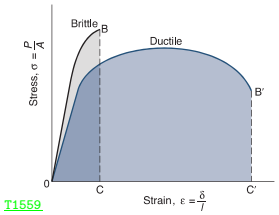

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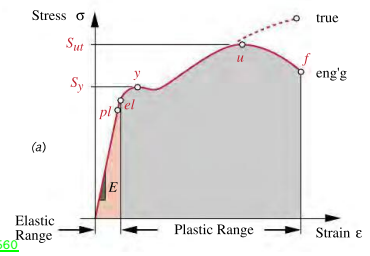
Ductile material failure. *Brittle material failure.* *Stess-stress relationship.*

- **ductile material:** can sustain elongation greater than 5% before fracture. Example: metals like steel, copper etc.
- **brittle material:** fractures at strain below 5%. Example: concrete, glass, wood etc.

Ductile Materials



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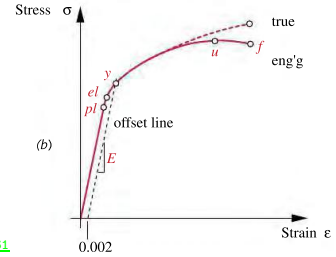

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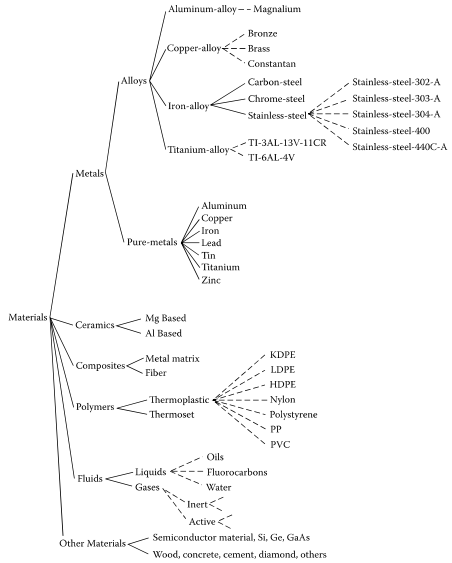
- **Proportional limit** (point pl): Stress at which the stress-strain curve first deviates from linear behavior.
- **Elastic limit** (point el): Highest stress the material can withstand and still return exactly to its original length when unloaded.
- **Yield strength,** S_y: is determined by starting a line at a deformation of 0.002.
- **Ultimate strength,** S_{ut}: Maximum stress reached in $\sigma - \epsilon$ diagram.

Engineering Materials

1. Metals and alloys
2. Ceramics
3. Polymers
4. Composite materials
5. Liquids and gases
6. Other materials



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Typical Characteristics of Common Materials

Metals and Alloys	Ceramics	Polymers
Strong	Strong	Weak
Tough	Brittle	Durable
Stiff	Stiff	Compliant
High electrical conductivity	Electrically insulating	Electrically insulating
High thermal conductivity	Low thermal conductivity	Low thermal conductivity
Easy processing	Difficult processing	Easy fabrication
Susceptible to corrosion	Corrosion resistance	Corrosion resistance
Easily available	Light weight	Low cost
	Temperature resistance	Temperature sensitive

Composites	Liquids and Gases	Semiconductor Materials
Strong	Material flows	Specialized characteristics
Fatigue resistant	Inert or corrosive	Not good electrical conductor
Stiff	Wide range of properties	Not good electrical insulator
Range of electrical conductivity	Low electrical conductivity	Electrical insulator at low temperatures
Range of thermal conductivity	Low thermal conductivity	Electronic properties altered by doping
Versatile	Versatile	Wide range of other properties
Low weight	Generally low weight	
Low cost	Generally low cost	

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