



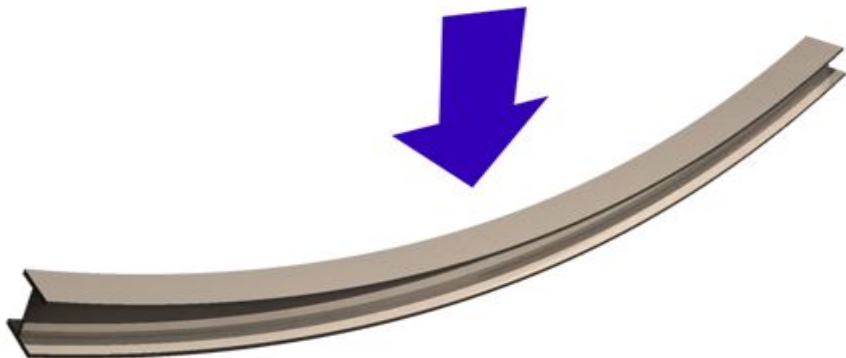
# Material properties

We'll focus on:

- Elasticity and plasticity
- Stages in elastic and plastic deformation(tensile testing)
- Hardness
- Fatigue , fracture toughness and creep(materials problems in aircraft construction)
- Basic thermal properties(ex)

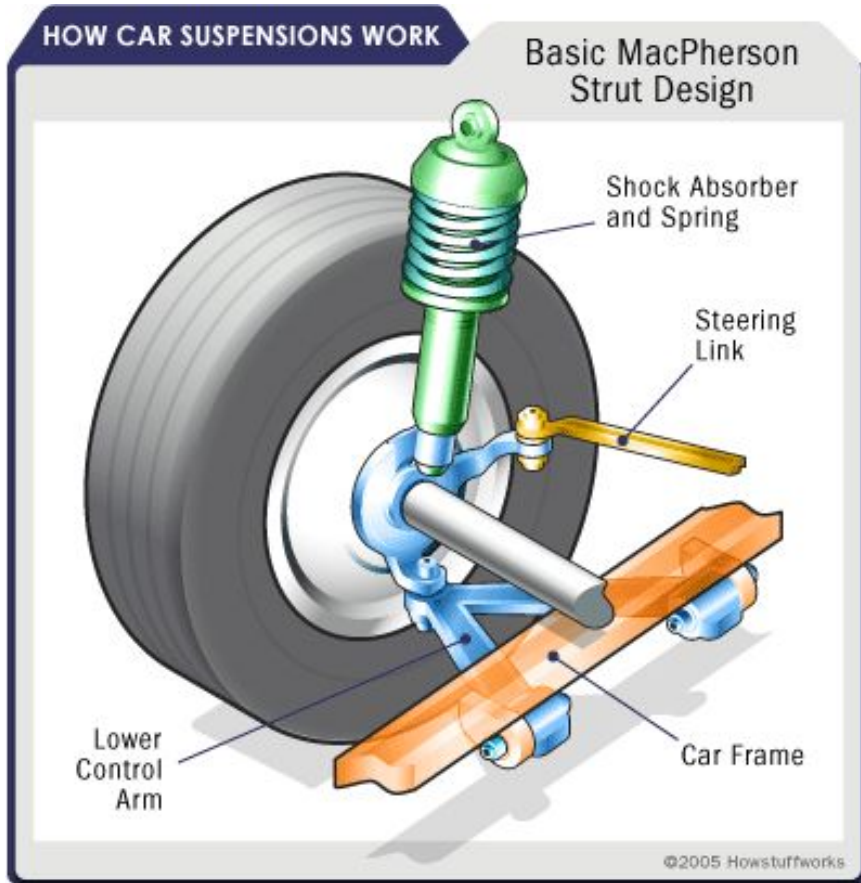
# Types of force and deformation

<u>TENSION</u>	<u>COMPRESSION</u>	<u>BENDING</u>	<u>SHEAR</u>	<u>TORSION</u>
<p>TENSILE STRENGTH</p> <p>*It will <b>extend</b>(lengthen)</p> <p>*<b>Tension fracture</b></p>	<p>COMPRESSIVE STRESS</p> <p>*It will <b>compress</b>(shorten)</p> <p>*<b>Compression fracture</b> (crush,buckle)</p>	<p>BENDING STRESS</p> <p>*It will <b>bend</b>(deflect , flex)</p> <p>*Beams usually <b>sag</b> or <b>hog</b>.</p>	<p>SHEAR STRESS</p> <p>It will deform very little , failing suddenly.</p>	<p>TORSIONAL STRESS</p> <p>*It will <b>twist</b></p> <p>*<b>Torsional rigidity</b></p> <p>*<b>Shear ,torsion rupture</b></p>



When vertical members can no longer resist a load they either **crush** or **buckle** (bending out of shape)

# How are the springs(in car suspension)made springy?



Spring act like a cushion , providing comfort and performance, allowing the wheel to maintain contact with road surface when travel over a bump. Spring must be ***elastic***.

# ***Elasticity and plasticity***

**Elasticity**-ability to extend significantly, but still return to their original shape(rubber)

Low elasticity , strong => **stiff**

Low elasticity , weak => **brittle** (glass)

**Plasticity**-ability to change shape significantly, but DO NOT return to their original shape

Can be plastically deformed by hammering or rolling=> malleable(lead , Pb)

Can be stretched into a long length=> ductile(Cu)

# Stages in elastic and plastic deformation

## Point 0-1:

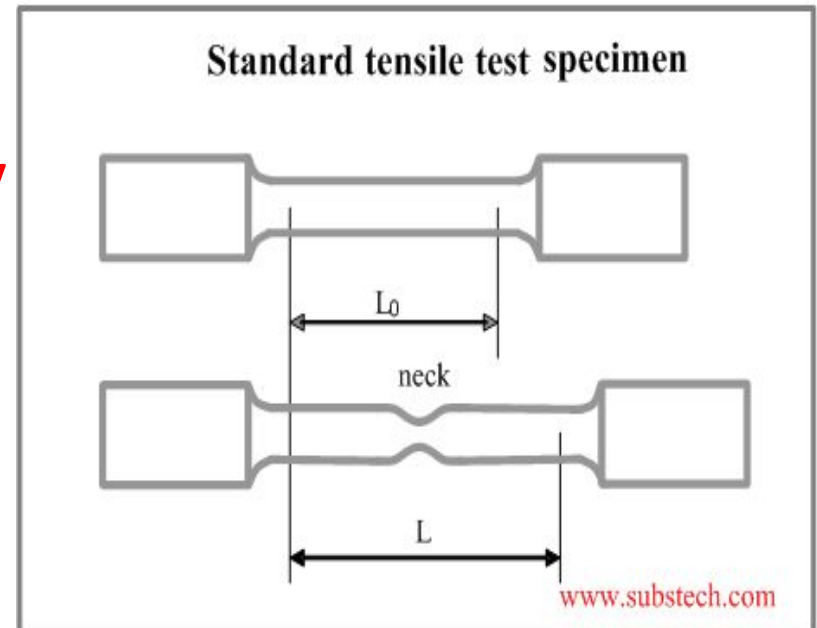
The extension of the bar is proportional to the increase in tension.

## Point1:

The limit of proportionality

## Point2:

The elastic limit



# Stages in elastic and plastic deformation

Point 3:

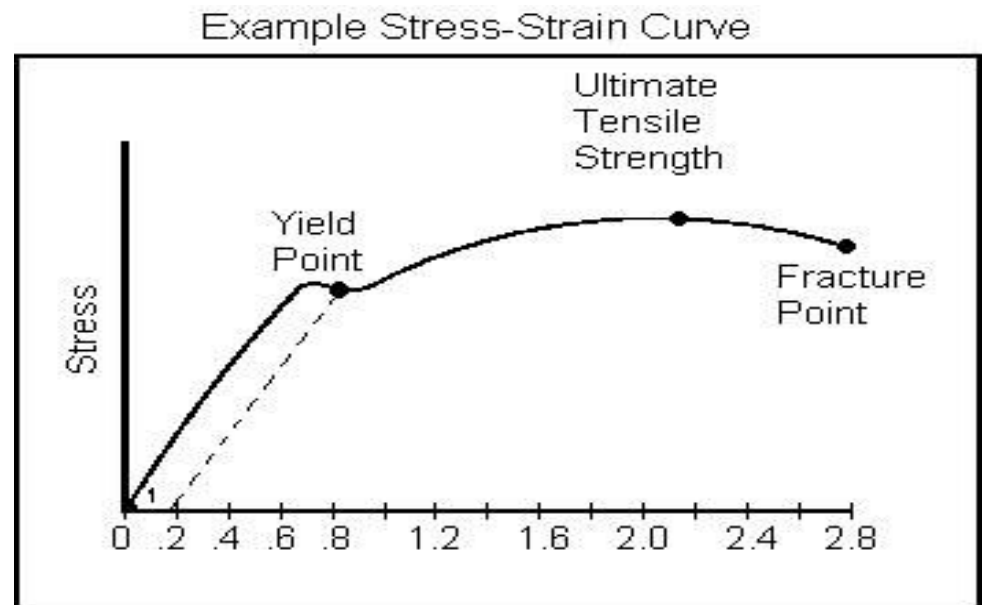
The Yield point

Point 4:

UTS-the Ultimate Tensile Strength

Point 5:

The fracture point



# *Heat treating metal*

- The properties of a metal can be changed by heat treating it – that is , heating and cooling the metal.





# *The main types of heat treatment*

- *Quenching*(quenched metal is harder , but tends to be more brittle)
- *Annealing*(annealed metal is generally softer and more elastic)
- *Tempering*(tempered metal possesses a balance between hardness and elasticity)
- *Age hardening, surface hardening*

# Hardness

- Affects a material's **durability**
- Can be defined in two ways:
  - Scratch hardness
  - Indentation hardness



# *Fatigue / creep*

There are two important problems:

- **Fatigue** (caused by cyclic loads)
- **Creep** (components become permanently damaged)





- Springs are made from wire(wire made from **ductile** metal)
- When the wire manufactured , it is stretched beyond its **elastic limit and even yield point**
- To put back the springiness to a spring , it is **tempered**

# ***Comparing copper or aluminium as materials for electrical wires***



- ***The thermal conductivity*** of copper is 40% greater than that of aluminium. Copper is a much more effective thermal conductor.
- Copper has ***a coefficient of thermal expansion*** apprx. 40% lower than that of aluminium.

TO BE CONTINUED

