Material properties

We'll focus on:

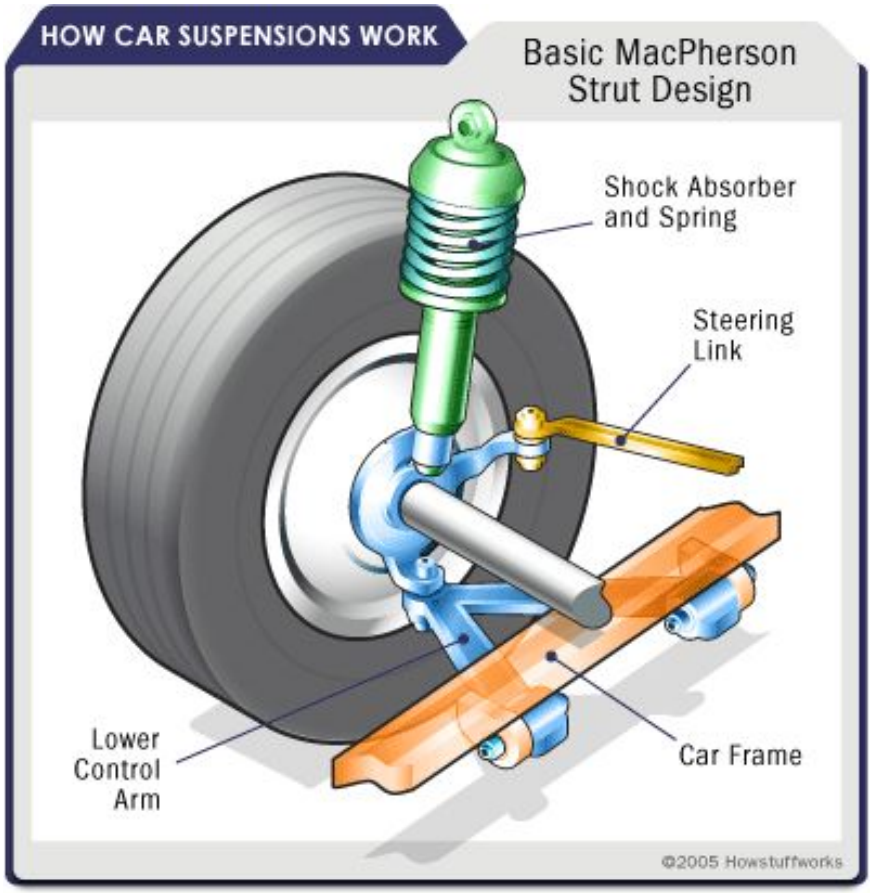
- Elasticity and plasticity
- Stages in elastic and plastic deformation(tensile testing)
- Hardness
- Fatigue , fracture toughness and creep(materials problems in aircraft construction)
- Basic thermal properties(ex)

Types of force and deformation

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

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:

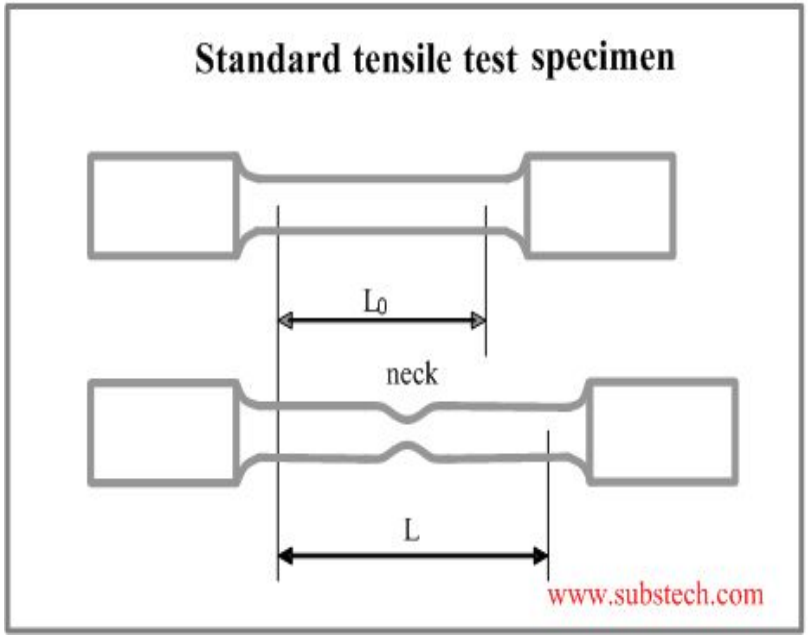
The extention of the bar is proportional to the increase in tension.

Point1:

The limit of proportionality

Point2:

The elastic limit



Stages in elastic and plastic deformation

Point 3:

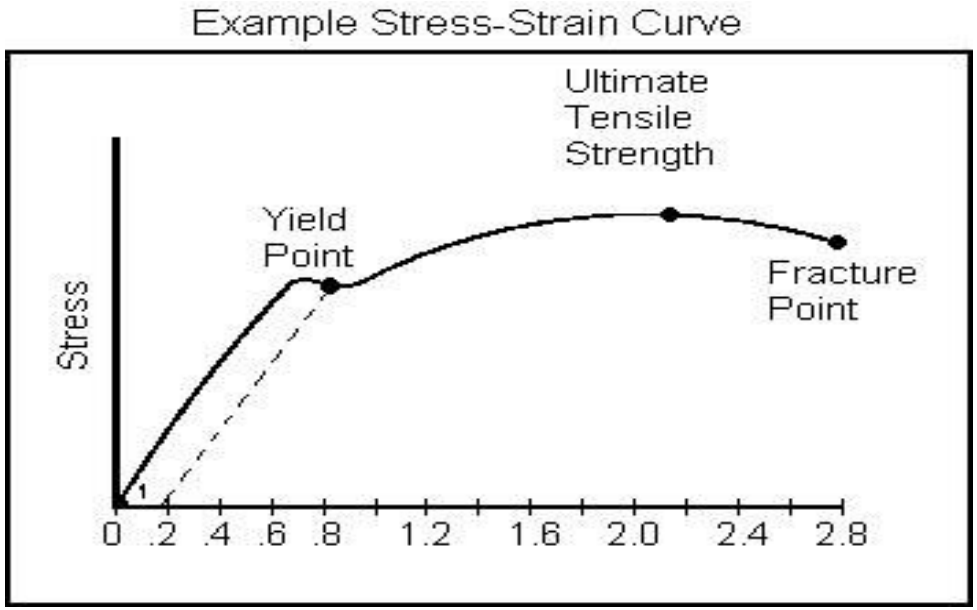
The Yield point

Point 4:

UTS-the Ultimate Tensile Strength

Point5:

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 elastisity)
- *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