Plastic Deformation

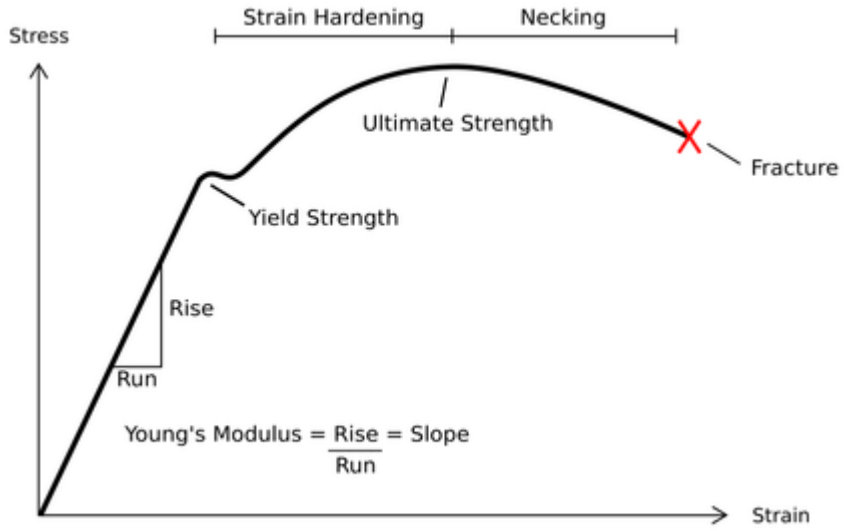
Deformation is the change in dimensions or form under the action of applied load. Deformation is caused either by mechanical action of external load or by various physical and physicochemical processes. *The plastic deformation or mechanical forming is act of solid state by remains the volume & mass are conserved with displaced article contents from place to other*. The process of deformation are consists of the following sequence stages show in fig.

(a) Elastic deformation

(b) Plastic deformation

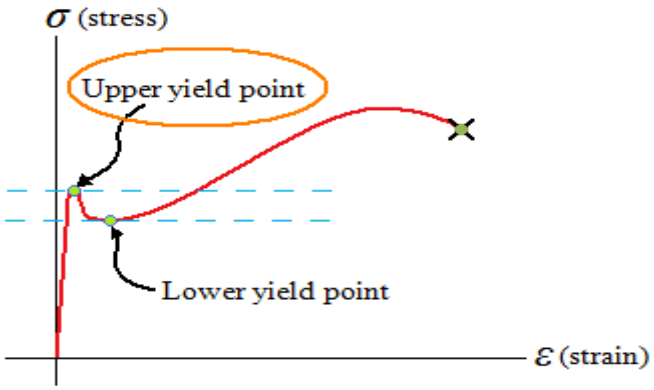
(c) Fracture

Depending on the type of material, size and geometry of the object, and the forces applied, various types of deformation may result. The image to the right shows the engineering stress -strain diagram for a typical ductile material such as steel.



Upper yield point is the point after which the plastic deformation starts. This is due to the fact that the dislocations in the crystalline structure start moving. But after a while, the dislocations become too much in number and they restrict each others movement. This is called strain hardening and lower yield point is the point after which strain hardening begins. Beyond the elastic limit plastic deformation occurs and strains are not totally recoverable. There will be thus permanent deformation or

permanent set when load is removed. These two points are termed as upper and lower yield points respectively.



From figure you can easily understand that, When ductile material is stretched beyond elastic point, material starts to show plastic behavior. A point at which Maximum load or stress required to initiate the plastic deformation of material such point is called as Upper yield point. And a point at which minimum load or stress required to maintain the plastic behavior of material such a point is called as Lower yield point. Upper yield point is unstable in nature but lower yield point is stable in nature. so while designing the components we consider the lower yield point of material.

- Yeild point is that point during the loading of the specimen when it begins to deform plastically.
- Upper yeild point is a situation where load starts reducing and strain starats increasing.
- At Lower yeild point Load remains same but strain get increases

Upper yield point is the max load at which deformation starts, starting of deformation means dislocations are started moving in the material. So this type of phenomenon is called permanent deformation by slip (slip mechanism). As the slip is taking place in the material , it offers less resistance to the material and hence curve falls slightly (stress is the measurement of resistance offered by the material during the application of load). And it reaches to some stress (lower yiled point stress) which is the minimum stress required to maintain the deformation in the mateial.. And at the lower yield point for the low carbon steels (mild steels) the stress strain cure is in some wave nature , this is because to break bonds with impurites while dislocations are moving out of the material , hence resistance increases and decreases periodically

after that strain hardening takes place which increases resistance slowly by increasing of dislocations in the material.

What exactly happens in the region between the elastic limit and the yield point? Since the region falls outside of the elastic region, there is bound to be some yielding (else the definition of elastic limit would stand pointless), so why doesn't the elastic limit and the yield point coincide? Elastic limit is a value of stress upto which material can be deformed elastically under load, after unloading it will return to it's original dimension. Beyond elastic limit, material will start deform plastically which is characterized with **permanent deformation.**

The yield strength is defined as the stress which will produce a small amount of permanent deformation, generally equal to a strain of 0.002 or 0.2%. So, in the region between the elastic limit and the yield point, material just deforms plastically,although on extremely small scale.

"ELASTIC LIMIT

is the maximum stress within a solid material that can arise before the onset of permanent deformation. When stresses up to the elastic limit are removed, the material resumes its original size and shape. Stresses beyond the elastic limit cause a material to yield or flow. For such materials the elastic limit marks the end of elastic behaviour and the beginning of plastic behaviour.

YIELD POINT

is the amount of stress in a solid at the onset of permanent deformation. The yield point, **alternatively called the elastic limit**, marks the end of elastic behaviour and the beginning of plastic behaviour. When stresses less than the yield point are removed, the material returns to its original shape." Region between elastic point and yield point is known as Elastoplastic region. In ductile materials(like mild steel) this elastoplastic region is large as compare to brittle materials(cast iron).In this region material is partial elastic and partial plastic. It means if a material is loaded up to its Elastoplastic region, then material will not recover its whole deformation. Elastic Limit-point up to which material shows elastic behaviour Yield Point- material starts going into plastic state.