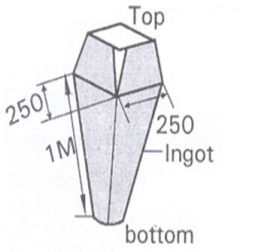
INTRODUCTION AND CONCEPTS OF ROLLING, FORGING AND EXTRUSION

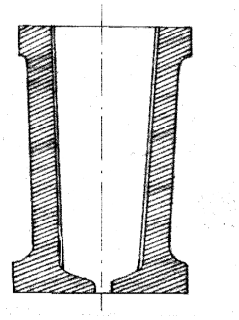
In mechanical working process the raw material is the metal in some form which is subjected to external force.

The raw material is obtained by pouring molten metal into a metallic mould and after solidification the solid metal is taken out. This will have a given cross section such as square or rectangle or circular etc,. and of a given length. This is referred to as Ingot.



Typical Ingot Casting.

Typi



Ingot is the starting raw metal for all metal working process.

Molten metal from the furnace is taken and poured into metal moulds and allowed to cool or solidify. The cooled solid metal mass is then taken out of the mould. This solid metal is referred to as Ingot.

This Ingot is later on converted to other forms by mechanical working.

Let us see the conversion through

Rolling and Forging

Rolling: It is a process wherein the ingot is passed between the gaps of two rotating rolls to get deformation. It is similar to sugar cane juice making …. Here there will be two rotating cylindrical rolls between which sugar cane is passed and crushed to get the juice. The sugar cane is getting crushed.

Forging: Here the metal is pressed between two hard surfaces to get a reduced section.

It is similar to pressing a model clay ball between two fingers or palms. The clay gets crushed to smaller thickness.

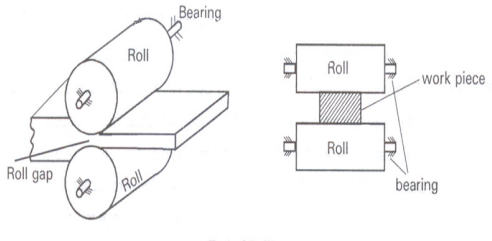
a) Rolling Route

*Molten metal → poured into metal moulds and cooled →Ingot (≈250x250mm)
*Ingot→ rolled→Blooms(≈200x200mm)
*Bloom→rolled→Billets(≈150x150mm)
*Billet→rolled→Bars/Rods(≈40x40mm)
*Bar→drawn into Wires(<5mm dia.)
*Billet→rolled→Slabs(t<b)
*Billet→rolled Structural shapes I,U,L,V etc.
*Slabs→Plates(t<<b and t>>4mm)
*Plate→Sheets(t<4mm)→Foils(microns)
b)Forging Route
*Ingot→Open die→Blooms→Billets→Bars
*Ingot→Closed die→Shaped objects like crank shaft, spanner, connecting rod etc.,
As said earlier one has to apply external force or load or stress to bring about the deformation in the metal.
We shall learn what types of stresses are present in each of the mechanical working process.

***Rolling --- Direct Compressive Stress**

Here Plastic deformation takes place in metal when passed through a set of two rotating cylindrical rolls.

As the hot metal is passed through the gaps of two rotating rolls the metal is dragged inside and the compression of the metal takes place and the cross section is reduced. During the process there is a contact point at the start and an exit point at the other end. During these points the metal is in complete contact with the rolls and the metal experiences direct compressive stress as shown in the figure.



Typical Rolling process

***Forging ----- Direct Compressive Stress**

Here a simple open type forging is taken for discussion. There will be two flat hard surfaces called as dies. The gap between the dies can be adjusted and the metal is placed between the two dies and load is applied. When the dies press against the metal it gets squeezed and the cross section is reduced. The metal will experience direct compressive stress. Fig.shows this.

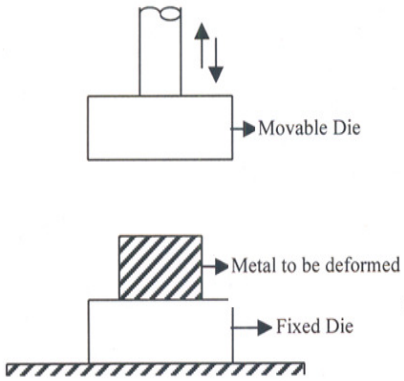


Fig (a)

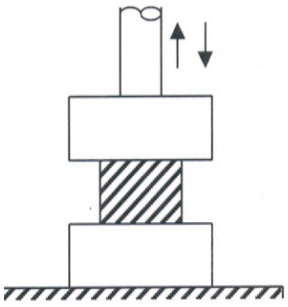
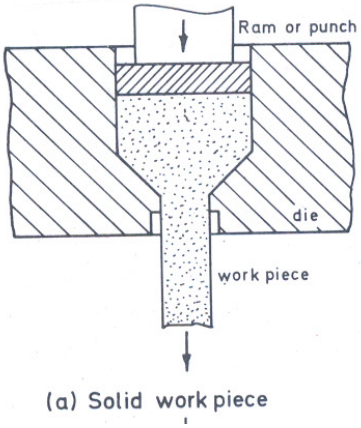
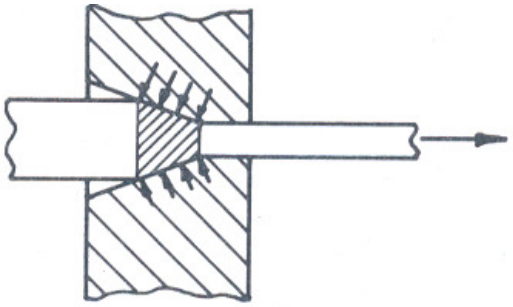


Fig (b)

***Extrusion and Wire Drawing Indirect Compression**

Here a conical die is used for deforming the metal. The die is a converging one.
In Extrusion the metal is pushed from one end towards the conical opening and the cross section is reduced.
In Wire drawing the metal is pulled from the front end of the conical end and the cross section is reduced.
In both cases the metal is subjected to indirect compressive stress.Fig. shows this.

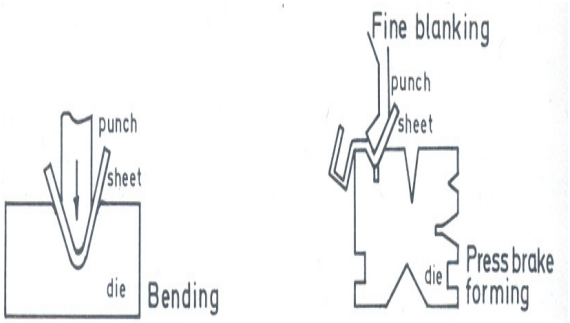




Extrusion

***Bending of Sheet ----Bending Stress**

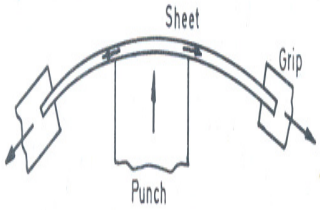
Two dies with matching contours are used. The metal in the form of sheet is placed on the bottom die and the top die is brought in contact with the metal and force is applied and the metal takes the contour of the dies. The metal is subjected to differential stresses on either side of the sheet resulting in bending stresses in the metal. Fig. shows this.



Processes making use of bending stresses

***Stretching of Sheet ---Tensile Stress**

Here sheet metal is held between grippers and the sheet is made to press against a contoured mandrel. The process is repeated to get a permanent change in the shape. Normally this is used to deform large surfaces. The sheet is being stretched and hence experiences tensile stresses. Fig. shows this.

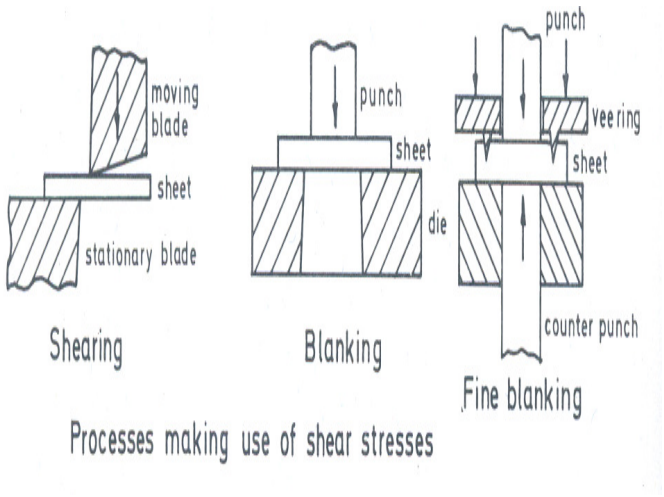


Stretch forming

Process making use of tensile stress

***Shearing of Sheet ----Shear Stress**

This is used to cut the sheet into two pieces. Here two sharp edges called as shears are used(similar to scissors). The sheet metal is kept between the two shears and force is applied. The metal pieces get separated. Fig. shows this.



Processes making use of shear stresses

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