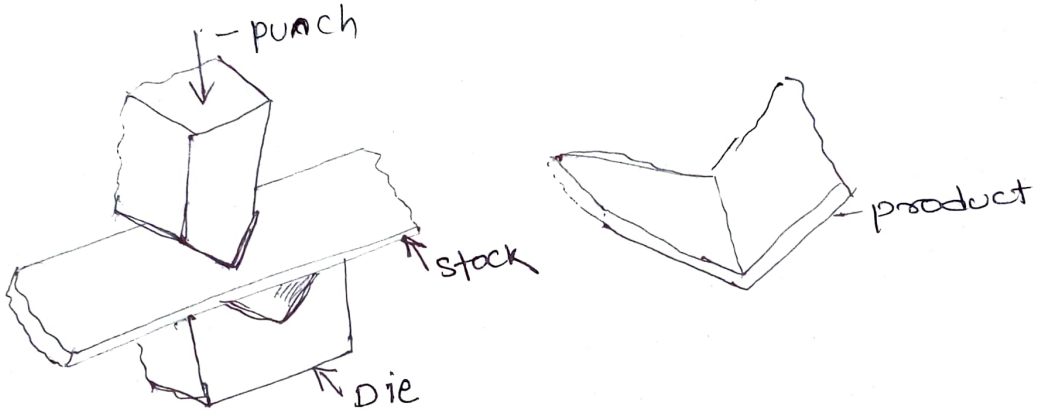
# PRODUCTION TECHNOLOGY

## CHAPTER-1

### Metal Forming Processes :-

Metal forming means, the shape that is formed on the metal sheet or strip depends upon the shape of the punch and die used to produce the workpiece.




→ Depending upon the nature of the desired configuration, the formed shape may be gradually developed over a progressive sequence of operations, or it may be simultaneously formed.

According to metal forming process, ~~there~~ Extrusion & Rolling forming process are there.

~~Extrusion~~ :-

~~Defination:~~

→ Forming of Metal depends upon ~~the~~ or described as hot working and cold working condition.

→ Hot working and cold working depends upon the metal recrystallisation temperature.

→ The temperature at which the new grains are formed in the metal is known as recrystallisation temperature.

## Hot working :→

The working of metals above the recrystallisation temperature is called hot working.

→ This temperature should not be too high to reach the solidus temperature, otherwise the metal will burn and become unsuitable for use.

There are various hot working processes

(i) Hot rolling (iii) Hot forging etc.

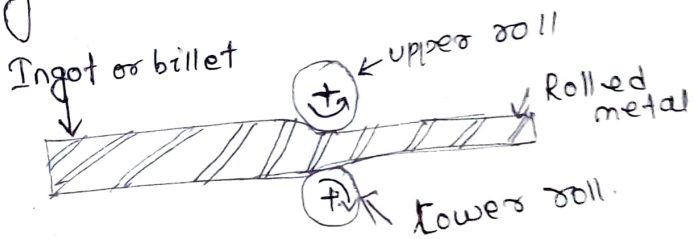
(ii) Hot extrusion.

## Hot rolling :→

### Defination of rolling :→

Rolling was the first metal shaping process. It is the most rapid method of converting large section into desired shapes.

→ The forming of bars, plates, sheets, rails angles I-Beams and other structural sections are made by hot rolling.




The operation consists of passing the hot ingot through at least two rolls rotating in opposite directions at the same speed.

→ The space between the rolls is adjusted to confo to the desired thickness of the rolled section.

→ The rolls, thus squeeze the passing ingot to reduce its cross-section and increase its length

* The ingot are casted in moulds of suitable form and are used in rolling mills as raw materials for preparing desired sections.

→ The first operation to the ingot is carried out at the blooming mill where it is rolled to blooms

→ The bloom has a square cross-section with a minimum size of 150 mm × 150 mm.

→ The blooms are cut up in lengths convenient for the subsequent reducing process into billets.
→ The billet is smaller than a bloom and has a minimum size of 50 mm × 50 mm.
→ The billet converted into bar after the successive stages of reductions.
→ The ingot or bloom are rolled to slabs, it have rectangular cross-section with width 250 mm and thickness 50 mm.
→ The materials commonly hot rolled are aluminium, (Al), copper (Cu), magnesium (Mg) their alloys and many grades of steel.
→ The final product of the rolling mill is to be sheets, plates or strips.

## Types of Rolling Mills :→

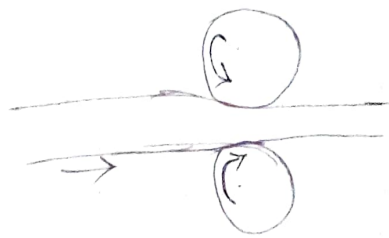
Rolling Mills may be classified according to the number and arrangement of the rolls:-

Hot
- (a) Two high rolling mill
- (b) Three high rolling mill

Cold
- (c) Four high rolling mill.
- (d) A Tandem mill of three four high stands
- (e) cluster rolling mill.

### (a) Two high Rolling Mill :→

- A two high rolling mill may further be classified as a reversing mill and non reversing mill.



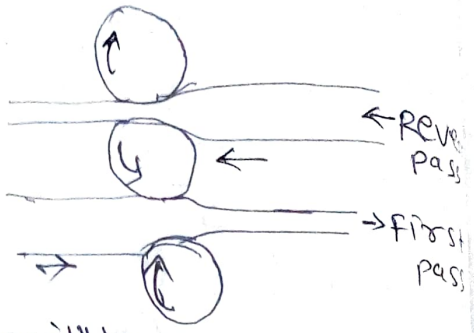
→ It has two high rolling mill
→ In a two-high reversing mill the rolls rotate first in one direction and then in the other so that the rolled metal may pass back and forth through the rolls several times.
This type is used in blooming and slabbing mills and for roughing work in plate, rails,

→ A Two high non-reversing mill has two rolls which revolve continuously in the same direction, so less power mostly used.

(b) Three-high Rolling Mill :→

→ It consists of a roll stand with three parallel rolls one above the other.

→ Adjacent rolls rotate in opposite directions so that material may be passed between the top and middle rolls in one direction and the bottom and middle rolls in the opposite one.




→ In a three high rolling mill the workpiece is rolled on both the forward and return passes.

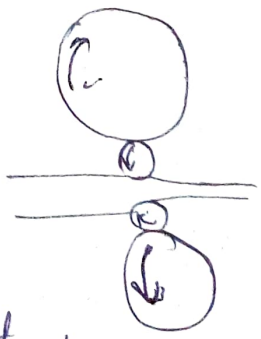
→ First of all the workpiece passes through the bottom and the middle rolls and then returning between the middle and top rolls so that thickness is reduced at each pass.

→ Mechanically operated lifting tables are used which move vertically on either side of the stand so that the workpiece is fed automatically into the roll gap.

→ This mill used as blooming mills and finish rolli

(c) Four high Rolling Mills :→

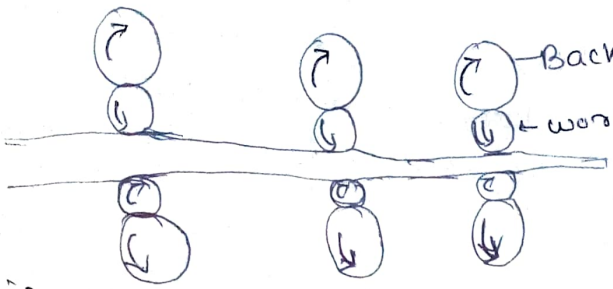
The four high rolling mill consists of four rolls, two of which are working rolls and the other two are backing up rolls.



→ The backing up rolls have larger diameter and are used to prevent the diflection of small working rolls.

→ This is used for rolling of slabs.

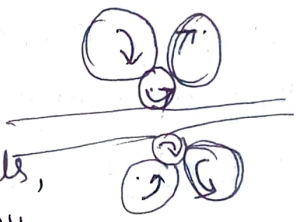
(d) Tandem Rolling Mill :→




It is a set of two or three stands of rolls set in parallel alignment so that a continuous pass may be made through each one successively without change of direction of the material or pause in the rolling process.

(e) Cluster Rolling Mill :→

The cluster mill consists of two working rolls and four or more backing up rolls.



→ For rolling hard thin materials, it may be necessary to employ work rolls of very small diameter but of considerable length.
It is used in cold rolling mill.

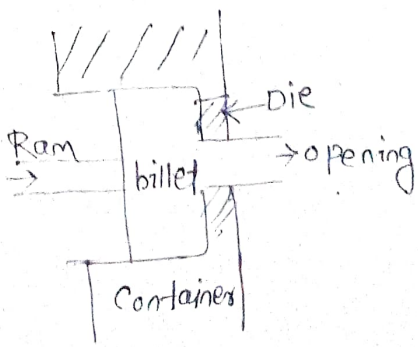
Extrusion :→

Def$^n$ :→ Extrusion is a manufacturing process that produces continuous lengths of uniform, non-uniform cross-sectional area ~~by forcing~~ by forcing a metal billet through a pre-shaped die to create objects with a specific shape and profile.

→ Extrusion is mainly a hot working process.

→ Extrusion press has three major components

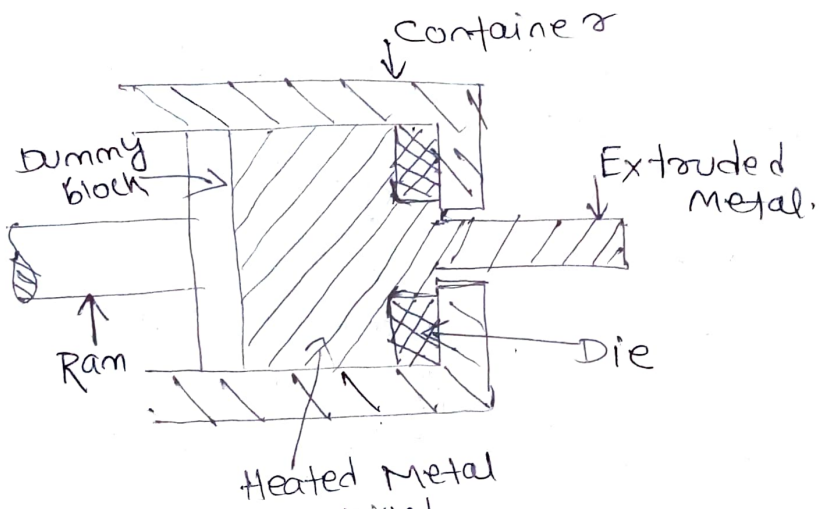
① The container
② Die
③ Ram.



→ Extrusion process is used to manufacture
(i) Rod (ii) Tubes,
(iii) A variety of circular, square, rectangular, hexagonal and other shapes both in solid of hollow form.
(iv) Channel I, Z, T,
Automobile, air-craft, ship industry.
Military uses.
nuclear power industries.
→ It is applied in non-ferrous field (Al, Cu, Mg) limited applied in steel, steel alloys & Stainless Steel.

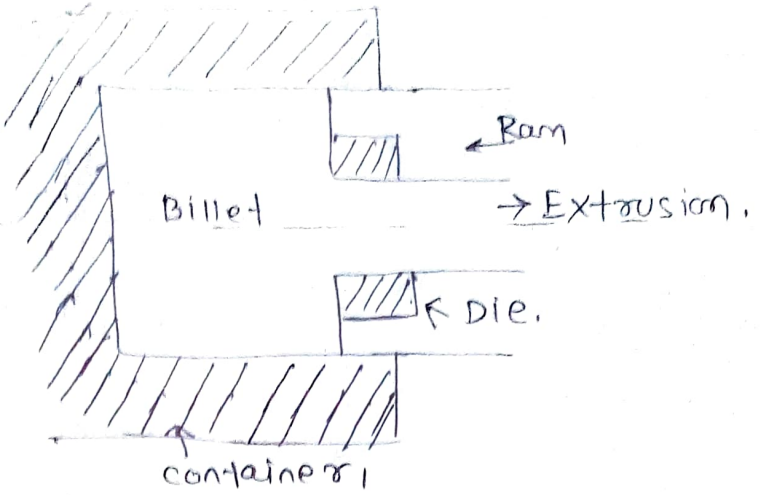
Methods of Extrusion :→
(i) Direct Extrusion
(ii) Indirect extrusion
(iii) Impact Extrusion or cold Extrusion.

Direct Extrusion :→




→ It is also called forward Extrusion.
→ In this method, the heated round billet is placed into the die chamber and the dummy block and ram is placed into position.
→ The pressure is applied only a small amount of metal remains unextruded.
→ It is then cut to the required length and removed.
→ Tube Extrusion is a form of direct extrusion.

Indirect Extrusion :→




→ It is also called backward extrusion.
→ It is similar to direct extrusion except that the extruded part is forced through the ram stem.
→ Since there is no frictional force between the billet and the container wall, therefore less force is required by this method.

Cold working process :→

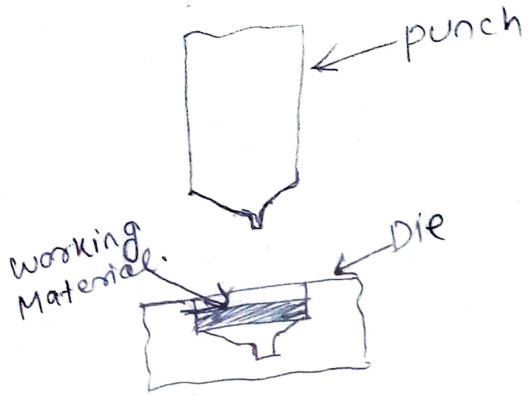
Metal working below the recrystallisation temperature is called cold working process.
→ It is of different types
(i) Cold rolling.
(ii) cold extrusion.
(iii) Cold forging etc.

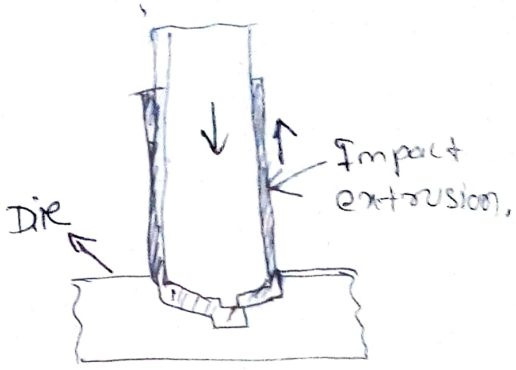
Cold rolling :→

It is generally employed for bars of all shapes, rods, sheets and strips, in order to provide a smooth and bright surface finish.
→ It is also used to finish the hot rolled components to close tolerences and improve their toughness and hardness.

Cold Extrusion :→

The principle of cold extrusion is exactly similar to hot extrusion.




The most common cold extrusion process is impact extrusion.

→ The operation of cold extrusion is performed with the help of a punch and die.

→ The working material is placed in position into a die and struck from top by a punch operating at high pressure and speed.

→ The metal flows up along the surface of the punch forming a cup shaped component.

→ when the punch moves up compressed air is used to separate the component from the punch.

→ The thickness of the side walls is determined by the amount of clearance between the punch and die.

→ The process of impact extrusion is limited to soft and ductile materials such as lead, tin, (Pb) (Sn) alluminium, zinc and some of other alloys. (Al) (Zn)

→ shaving cream & tooth paste tube such thin walled products are made by impact extrusion.

## Difference between Hot Rolling and Cold Rolling

| Hot Rolling | Cold Rolling |
| --- | --- |
| 1- Metal is fed to the rolls after being heated above the recrystallization temperature. | 1- Metal is fed to the rolls when it is below its recrystallization temperature. |
| 2- Hot rolled metal does not show work hardening effect | 2- The metal shows the work hardening effect after being cold rolled. |
| 3- Experimental measurements are difficult to make | 3- Experimental measurements can be easily carried out in cold rolling. |
| 4- Heavy reduction in area of the workpiece can be obtained. | 4- Heavy reduction is not possible. |
| 5- Roll radius is generally larger than that used in cold rolling | 5- Roll radius is smaller. |
| 6- Surface finish is not good | 6- Surface is smooth & oxide free in this rolling. |
| 7- Cold tolerances on dimensions can not be attained. | 7- dimension can be finished to close tolerances. |
| 8- co-efficient of friction between the rolls and the stock is higher. | 8- co-efficient of friction between the rolls and the stock is comparatively lower. |
| 9- Mechanical properties are improved. | 9- Hardness increases, Excessive cold working generate cracks. |
| 10- Very thin sections are not obtained by this rolling | 10- Very thin foils as 0.020 mm can be made. |

Difference between Hot working and cold working.

## Hot working

1- The working of metals above the recrystallisation temperature is called hot working.

2- The grain structure of the metal is refined.

3- Deformation of the metal is easy, with a small pressure applied on it.

4- It produce poor surface finish.

5- Close tolerances cannot be maintained.

## Cold working

1- The working of metals below the recrystallisation temperature is called cold working.

2- distortion of the grain structure is created.

3- Deformation of metal is too difficult with a small pressure applied on it, so high pressure is need for it.

4- It produce good surface finish.

5- close tolerances easily maintained.