Manufacturing Processes

INTRODUCTION

- How observant are you of your surroundings?
- Let’s explore how basic things in our surroundings make the basis of many complex processes
- Then these examples (i.e. relate to real life examples)

LESSON PLAN

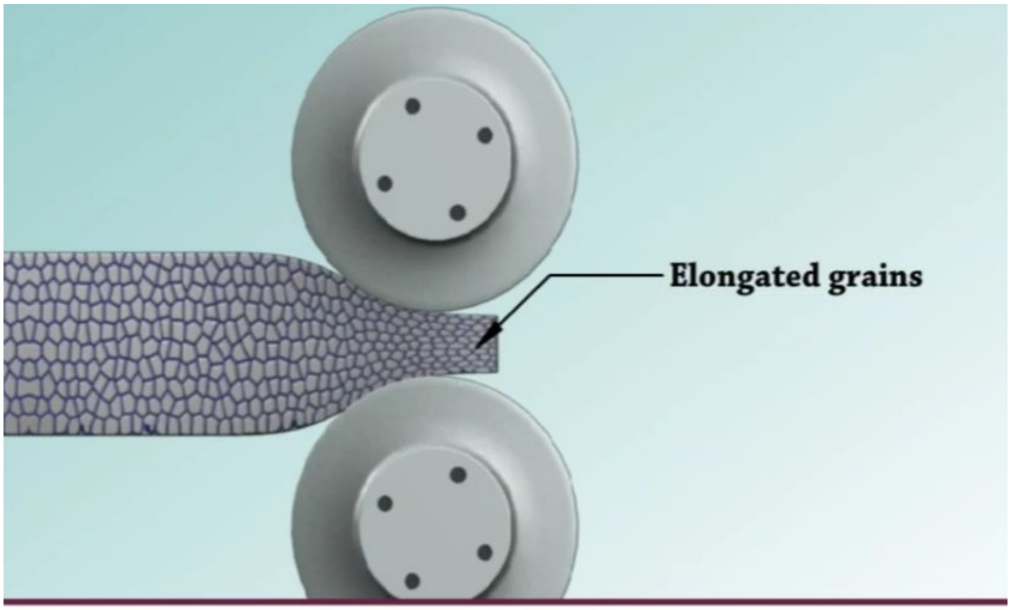
- In this series we are going to explore some of the manufacturing processes such as rolling, extrusion and forging. We will also take a look at some modern day processes.
- One activity - students will be given a finished product and now they have to place the rollers as such to get that finished product. (engage them)

ROLLING

Rolling is a metal forming process in which the thickness of the work is reduced by compressive forces exerted by two rolls rotating in opposite directions.

Depending on the temperature of the stock it can be classified as a hot and cold rolling process.

In the hot working process, the metal is changing its grain structure because it is heated above its recrystallisation temperature, now there is a new set of strain-free grains in the metal and this process needs less amount of force which correspondingly reduces the quality of the surface finish of that metal. The grains at the end are elongated and deformed.



Grains are elongated in the direction of rolling and recrystallization process takes place.

Cold rolling process is done below the recrystallization temperature of the metal, the force is much more required than the hot working process to pass the metal from the rollers and this process offers good surface finish. The grains are only elongated and not deformed.

(OPTIONAL ↓)

HOT ROLLING	COLD ROLLING
Temperature of the billet is kept above the recrystallisation temperature. For eg. for steel it is kept at nearly 1700℉ or 926.667℃	Temperature of the billet is kept below the recrystallisation temperature, near to room temperature
Less force is required	A higher force is required as grains are not deformed
Grains at the end are elongated and deformed	Grains at the end are only elongated and not deformed
It requires less processing and thus cheaper	Additional processing for cold finished products is required which increases the price
Hot finished product shrinks as it cools down, due to which shrinkage allowance is provided	Since this process is carried out at lower temperatures there is no shrinkage
Hot rolled steel is ideal where dimensional tolerances aren't as important as overall material strength, and where surface finish isn't a key concern	Cold rolled steel is often used for more techn ically precise applications
• A scaled surface—a remnant of cooling from extreme temperatures • Slightly rounded edges and corners for bar and plate products (due to shrinkage and less precise finishing) • Slight distortions, where cooling may result in slightly trapezoidal forms, as opposed to perfectly	• Better, more finished surfaces with closer tolerances • Smooth surfaces that are often oily to the touch • Bars are true and square, and often have well-defined edges and corners • Tubes have better concentric uniformity and

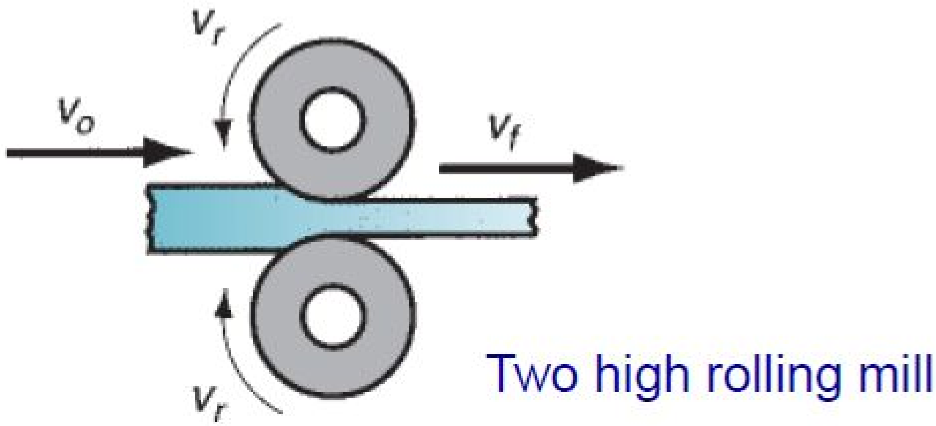
squared angles	straightness
As grains are deformed the strength decreases	Cold rolled steels are typically harder and stronger
Hot rolled sheets are generally used in shipbuilding, bridges, boilers, welded structures for various heavy machines, and many other products	Cold-rolled sheets are used for stampings, exterior panels, and other parts used in automobile, aerospace and house hold appliance industries.

Recrystallization Temperatures

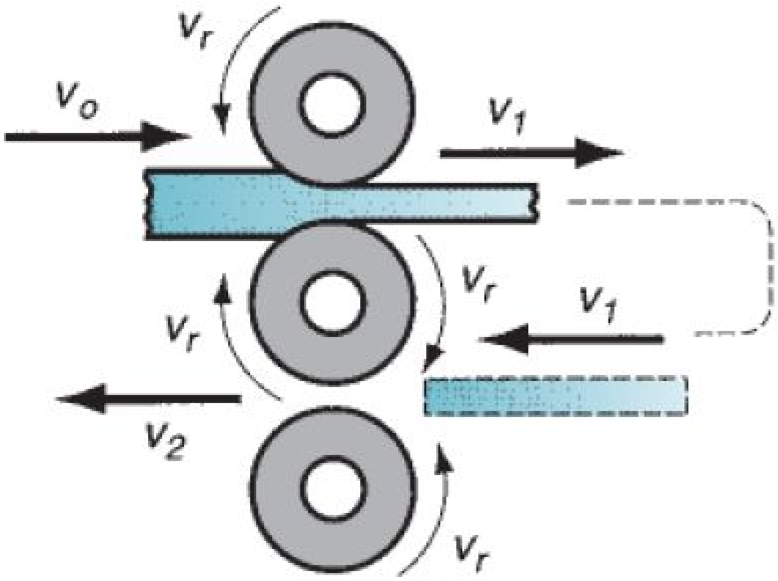
Metal	Recrystallization temperature °F (°C)
Aluminum	300 (150)
Copper	390 (200)
Gold	390 (200)
Iron	840 (450)
Lead	Below room temperature
Magnesium	300 (150)
Nickel	1100 (590)
Silver	390 (200)
Tin	390 (200)
Zinc	At room temperature

TYPES OF MILLS

Two high rolling mill: This type of rolling mill consists of two rolls rotating in opposite directions.

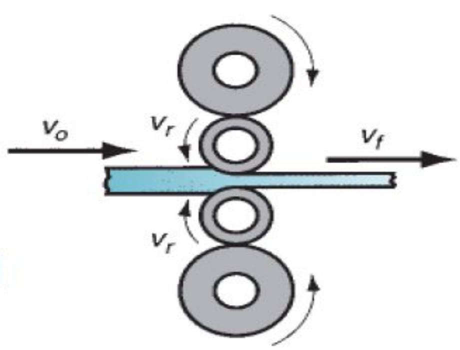


Three high rolling mill: In this case, there are three rolls one above the other. At a time, for single pass, two rolls will be used. The roll direction will not be changed in this case. The top two rolls will be used for first reduction and the sheet is shifted to the bottom two rolls and further reduction is done. This cycle is continued till actual reduction is attained.



Three high rolling mill

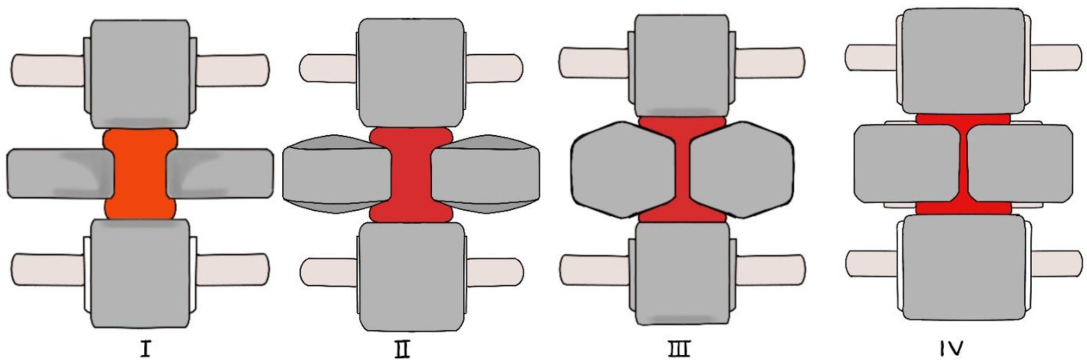
Four high rolling mill: This consists of two small rolls for thickness reduction and two large backing rolls to support the small rolls. The small rolls will reduce the roll force required as the roll-sheet contact area will be reduced. The large backing rolls are required to reduce the elastic roll deflection of small rolls when sheet passes between them.

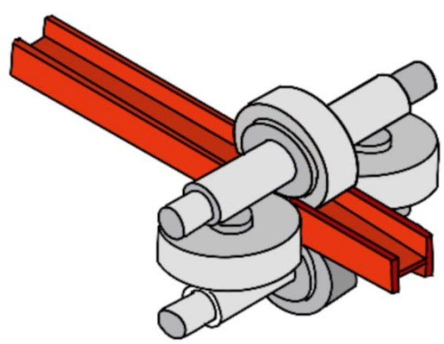


Four high rolling mill

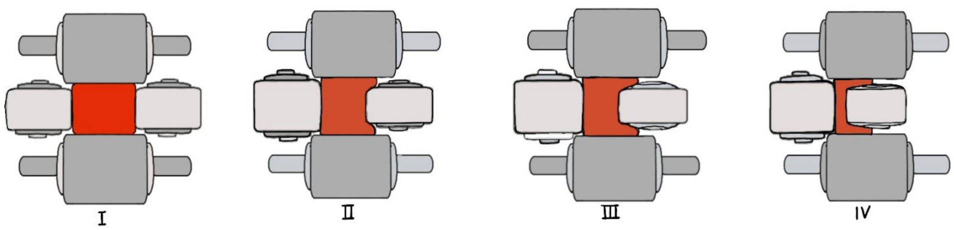
There are a variety of the shapes which can be produced by the rolling and these may be in the form of a square section, in the form of the plates, in the form of the T section, like this in the form of I section, L section, C sections. So let’s explore the possibilities with a fun activity :

FOR I SHAPED BEAM- [**https://youtu.be/sOpa9jtrTXI**](https://youtu.be/sOpa9jtrTXI)





FOR C SHAPED BEAM- We will do just the 3rd and 4th step of the above video in one half.



FOR 'T' SHAPED- SAME AS I SHAPED BEAM, JUST THE LOWER PORTION OF I BEAM WILL BE REMOVED BY INCREASING THE LENGTH OF THE LOWER SO THAT THE ROLLERS ROLLS OVER THE BOTTOM PART ALSO