

# SMITHY SHOP

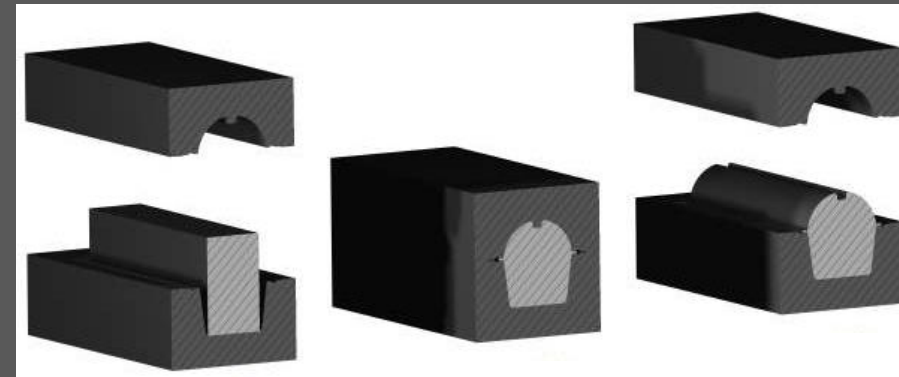
## *Forging Process*

Forging is a manufacturing process involving the plastic deformation of metals, typically at elevated temperatures, using compressive forces exerted through a die or hammer to conform the metal to a desired shape..

Hand forging process is also known as black-smithy work which is commonly production of small jobs using hammers on heated jobs.

## *Forging Process advantages*

- Closing of voids in the metal
- Reduced machining time
- Improve the physical properties of the starting metal



## Defects in Forging

- Unfilled Section: In this some section of the die cavity are not completely filled by the flowing metal.
- Cold Shut: This appears as a small cracks at the corners of the forging.
- Scale Pits: This is seen as irregular depurations on the surface of the forging.
- Die Shift or Miss-match Forging : This is caused by the miss alignment of the die halve, making the two halve of the forging to be improper shape.
- Flakes: These are basically internal ruptures caused by the improper cooling of the large forging.
- Improper Grain Flow or rupture fiber flow lines: This is caused by the improper design of the die, which makes the flow of the metal not flowing the final interred direction







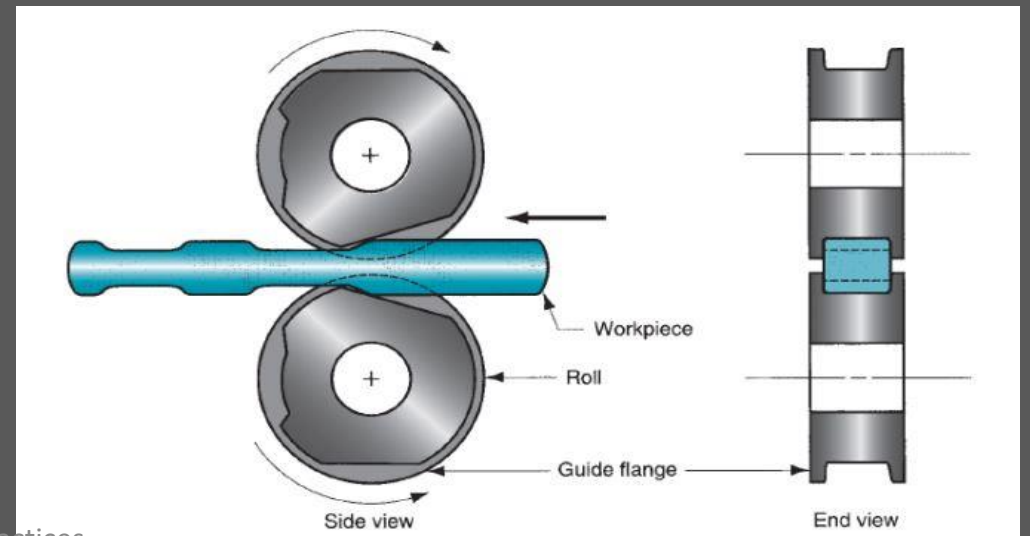
# METHODS OF FORGING

**Hand forging:** Hand forging is made by heating the metal until it is plastic state in an open hearth furnace and there by hammering is done on anvil by smith/sledge hammer with use of open face dies to get the desired shape and size by judgment of an individual.

**Drop forging:** In this process of forming the desired shape by placing a heated bar or billet on the lower half of the forging die and hammering the top half of the die into the metal by means of a power hammer by repeated blows the impact of which compel the plastic metal to conform the shape of the die. This method is used to produce large number of small and medium sized forging of similar parts.

**Press forging:** In this process the heated billet is squeezed between die. The pressure is applied by the forging press which completes the operation in a single stroke. Large forging are generally shaped by thin method

**Roll forging:** Rolling involves the passing of a heated bar between revolving rolls that contains an impression of the required shape. It is used to reduce short thick section to long slender pieces



## **Types of forging :**

- based on temperature : cold, hot and isothermal forging
- based on presses: impact load => forging hammer; gradual pressure => forging press
- Category based on type of forming: Open die forging, impression die forging, flashless forging

## **Hot Work( HW)and Cold Work(CW) in Forging**

HW is performed above the recrystallization temp of the material and CW is done below the recrystallization temp of the material.

Recrystallization Temp- “The approximate minimum temperature at which complete grain growth and rearrangement of molecules of a worked metal occurs within a specified time.”

## **Open-die forging (smith forging)**

In open die forging, the work piece is compressed between two flat platens or dies, thus allowing the metal to flow without any restriction in the sideward direction relative to the die surfaces

## **Impression-die forging**

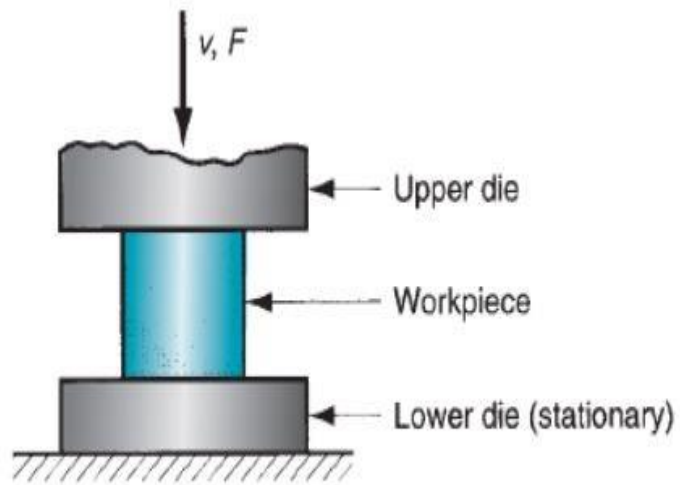
In impression die forging, the die surfaces contain a shape that is given to the work piece during compression, thus restricting the metal flow significantly. There is some extra deformed material outside the die impression which is called as flash. This will be trimmed off later.

## **Flashless forging**

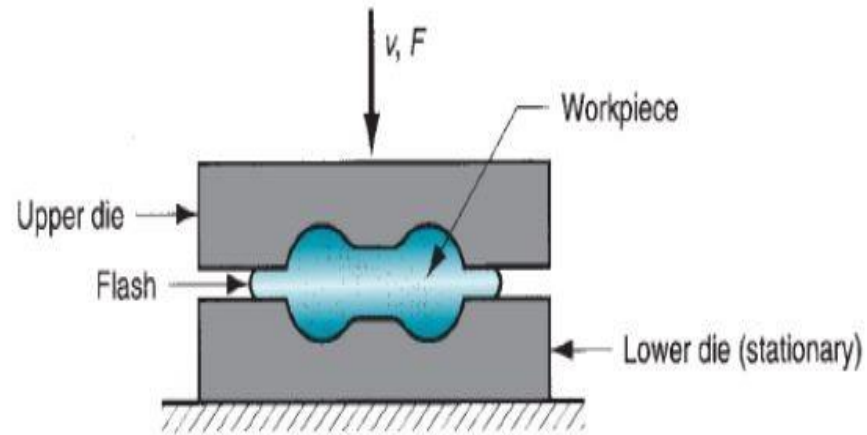
In flashless forging, the work piece is fully restricted within the die and no flash is produced. The amount of initial work piece used must be controlled accurately so that it matches the volume of the die cavity

## **Isothermal forging**

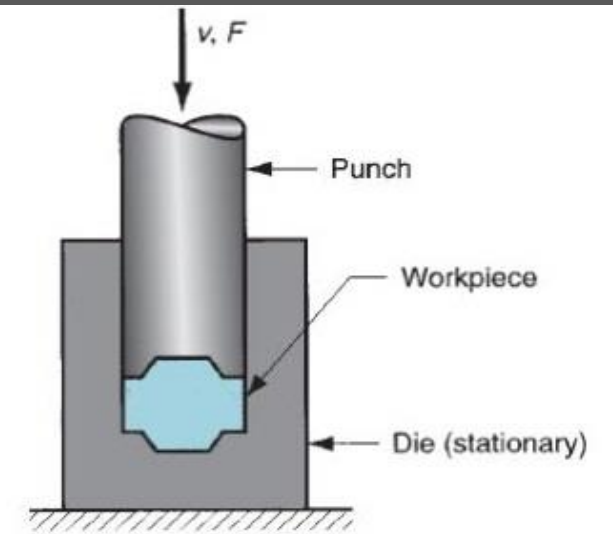
Both die and forging stock keeping same temperature



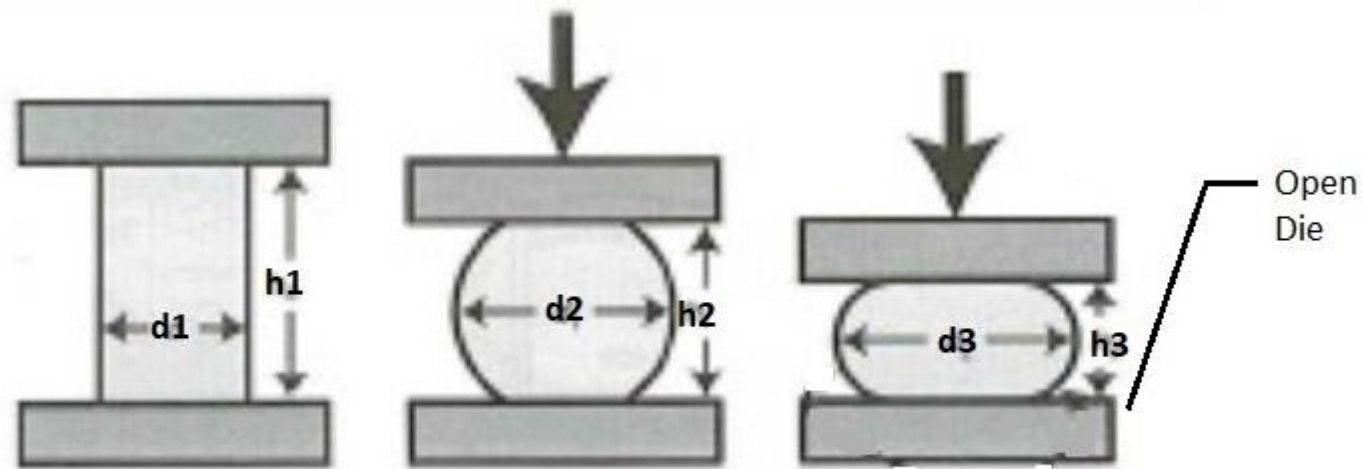
Open die forging



impression die forging



flashless forging



Process Flow of Open Die forging

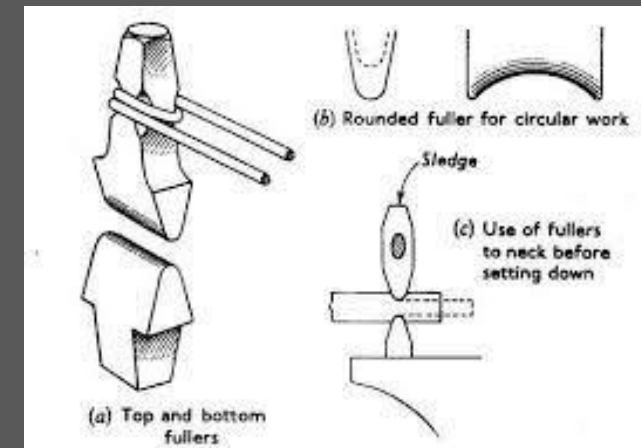
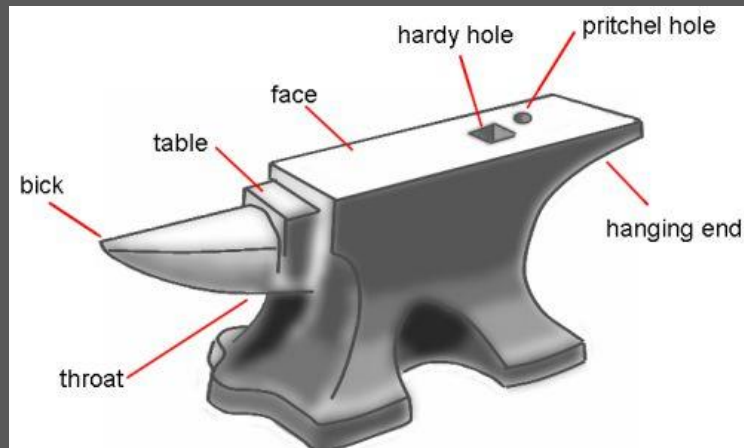
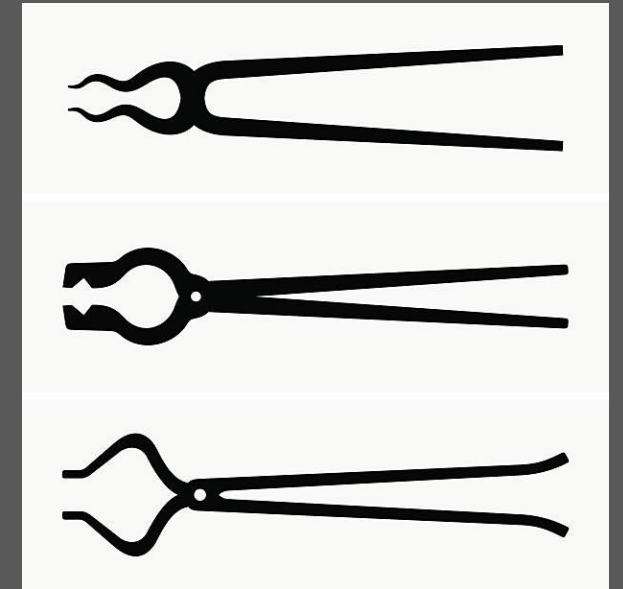
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# Tools and Equipment



Most of the blacksmiths' work is done with hand tools.

- Heating: Hearth or in Furnace
- Holding: Tongs
- Beating : by Hammers over Anvil
- Portable tools: Fullers, Chisels, Swages etc



## **Forge or Heart**

A smith's forge or hearth is used to heat the metal to be shaped. Hearths are used for heating small jobs to be forged by hand. Gas, oil or coal firing may be used for the purpose. The required air for the fire is supplied under pressure by a blower through the pipe into the hearth. The blowers may either be hand operated or power driven

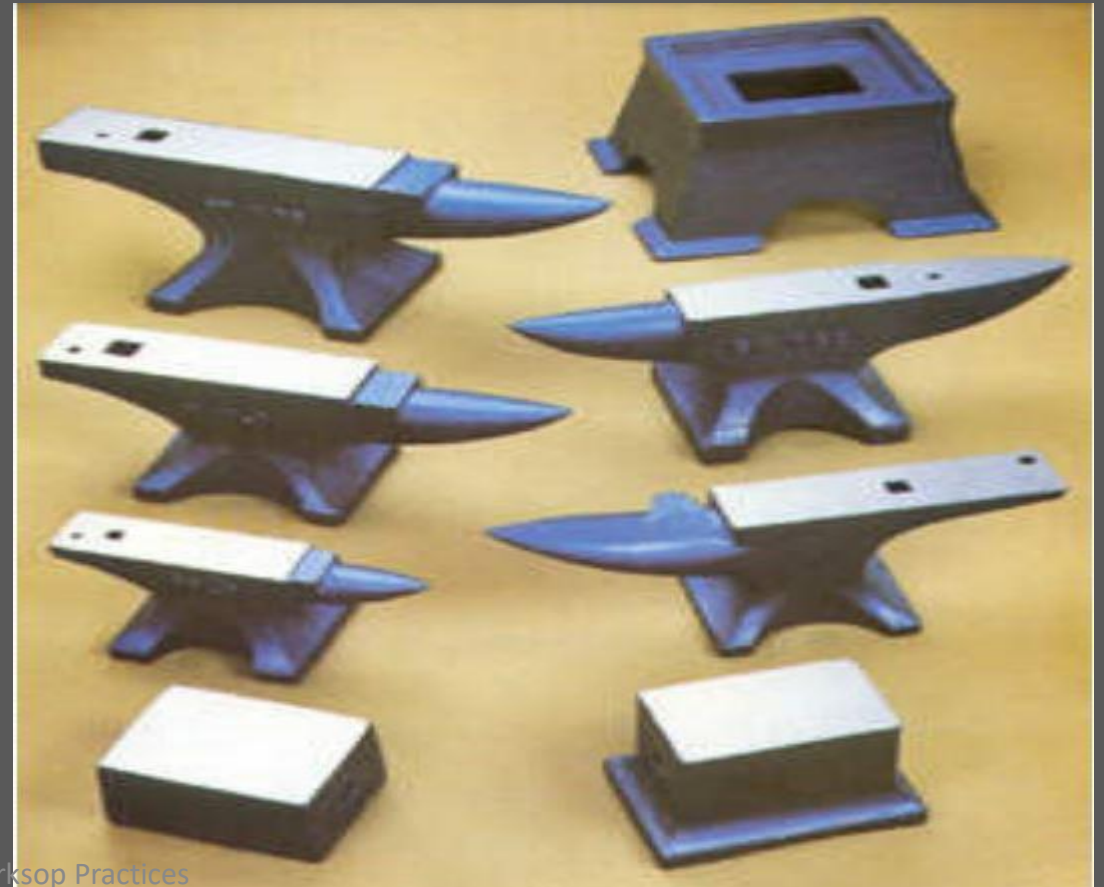
## **ANVIL**

To carry out the forging operations successfully, a proper supporting device is needed which should be capable of withstanding heavy blows rendered to the job. anvil stands as the most appropriate choice for this purpose.

Its body is generally made of cast steel, wrought iron or mild steel provided with a hardened top, about 20 to 25 mm thick. The horn or beak is used in bending the metal or forming curved shapes. The flat step provided, between the top and the horn, is used to support jobs during cutting and is known as chipping block.



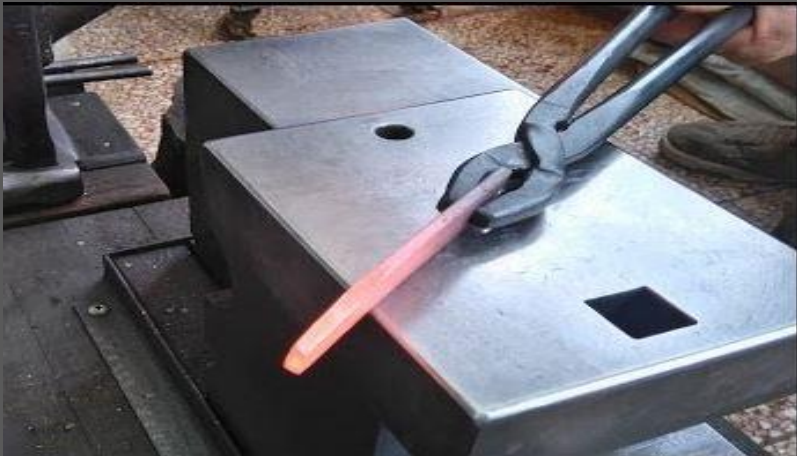
- The flat projecting piece at the back of the anvil is known as tail
- It carries a square hole to accommodate the square shank of the bottom part of various hand tools like swages, fuller. It is called a hardie hole.
- The circular hole provided near the hardie hole is known as pritchel hole.
- The commonly used size of an anvil weighs approximately 50-150 kg although it is manufactured in various sizes.
- The top face of the anvil should stand at about 0.75 m from the floor.



# Tongs

Tongs are used when a piece of metal is too hot or short to go from the forge to the anvil.

Tongs come in every shape and size imaginable. The smith selects the pair most suited for the job he's doing.



## *Different types of Tongs*



Pick up or dandy tongs



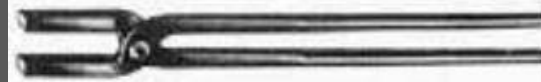
Single bow tongs



Crucible Lift out tongs



Bolt tongs



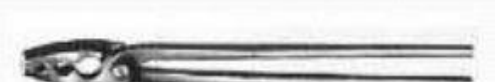
Open Mouth Tongs



Rivet Tongs



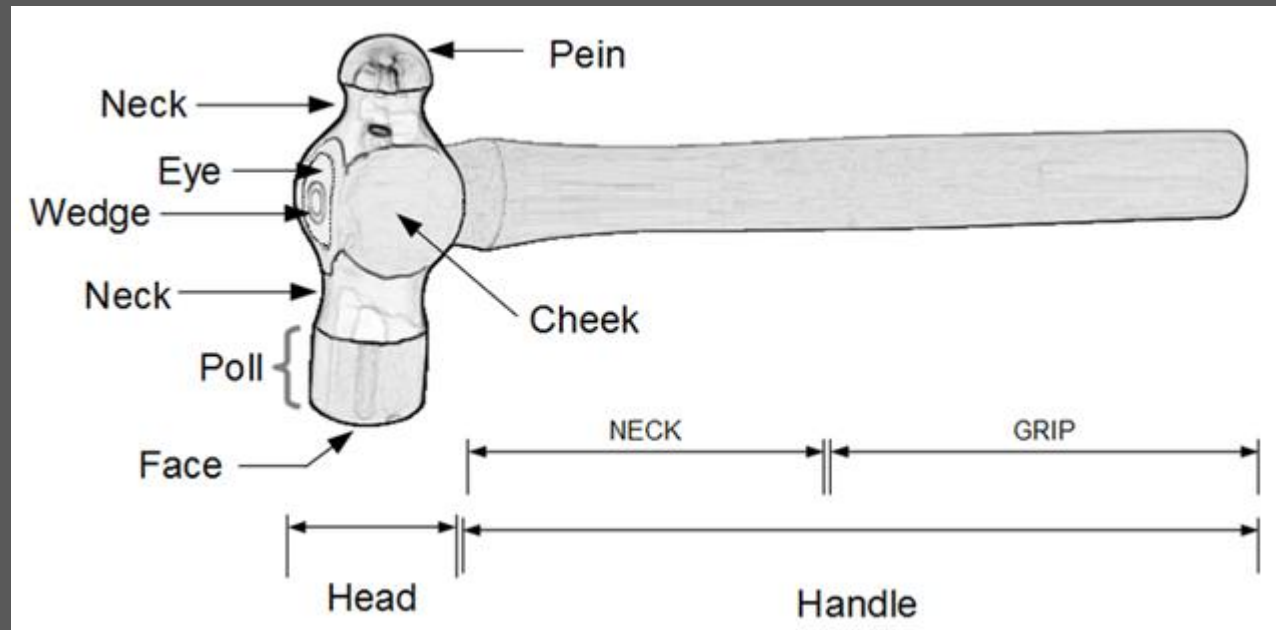
Square Mouth Tongs



Universal Tongs

# Hammer

- Hammers are used by a smith in order to give the required shape to the heated metal piece.
- Hand operated hammers are generally employed for shaping small and light components.
- The face is hardened and polished well and is given slight rounding along the circular edges so that the metal surface is not spoiled by the sharp edges when the former is struck by the hammer.
- The eye is normally made oval or elliptical in shape and accommodates the handle or shaft. For small sized hammers these handles are made of wood , but in case of sledge hammers the handles made of solid bamboos. A steel wedge is always forced into the handle after it is fitted into the hammer so as to prevent the slipping of the hammer off the handle during striking.



## Different classes of Hammers

1. *Ball peen hammer*
2. *Cross peen hammer*
3. *Straight peen hammer*
4. *Sledge hammer*



Ball peen



Cross peen



Sledge

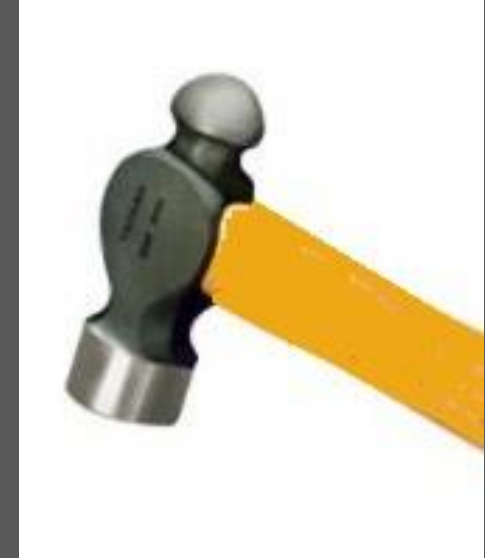


Straight peen



## ***Ball peen Hammer***

- A ball-peen hammer is a type of peening hammer used in metal working.
- Though the process of peening has become rarer in metal fabrication, the ball-peen hammer remains useful for many tasks such as tapping punches and chisels.
- The original function of the hammer was to "peen" riveted or welded material so that it will exhibit the same elastic behavior as the surrounding material.
- Peening is also the method by which steel drums are formed and tuned.
- A ball-peen hammer is also known as an engineer's hammer or a machinist hammer and may be graded by the weight of the head.



## ***Cross peen hammer***

- The peen/ pein is across i.e. at right angle to the axis of the handle of the hammer.
- Weight of the hammer is 0.22 to 0.91 kg.
- The cross peen hammer is used for bending, stretching and hammering into the inside positions of the component.



## ***Straight peen Hammer***

- The peen is straight i.e. parallel to the axis of the handle of the hammers.
- Weight of the hammers is 0.11 0.91 kg.
- The straight peen hammer is used for stretching the metal.



## ***Sledge Hammer***

- A sledge hammer is heavier than a Smith's hand hammer described earlier. The weights vary from 3 to 10 kg are used when heavy blows are required to be imparted to the jobs.
- The striking surface of the sledge hammer is made slightly convex and smooth.
- The aim is that the work-piece metal is not spoiled by the edges of the hammer if they are sharp



# CHISEL

- Chisels are used to cut metals in hot or cold state.
- Those which are used for cutting the metal in hot state are termed as hot chisels and the others used for cutting in cold state are known as cold chisels.
- The main difference between these chisels is in the included angle at the cutting edge.
- A cold chisel carries an included angle of  $60^\circ$  at the cutting edge and the latter is well hardened and tempered. It is made of high carbon steel.
- A hot chisel can be made of medium carbon steel as there is no need of hardening. It is used to cut the metal in plastic state. The included angle of its cutting edge is  $30^\circ$ .



Hot chisel

## HOT CHISEL

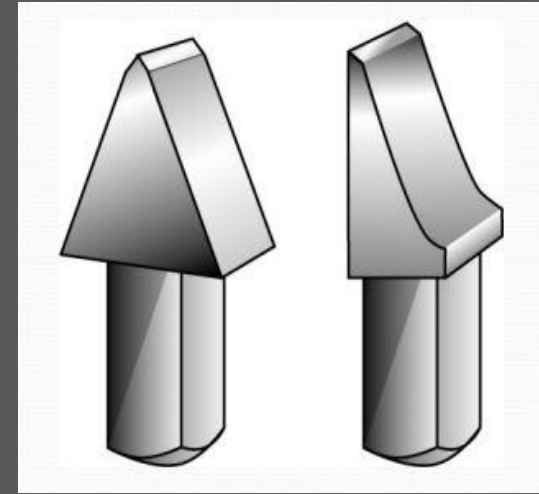
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## Cold & Hot Chisels

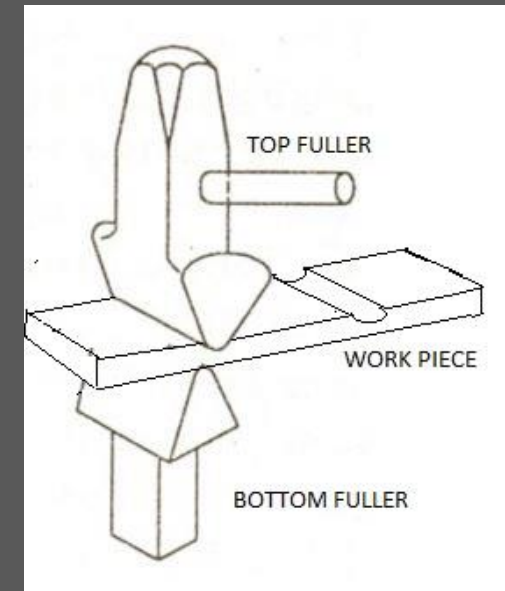
# Hardie

- A hardie is chisel.
- It has a square shank and is mounted in the hardie hole of the anvil.
- To cut a bar the hardie and cold set are used together.



# Fullers

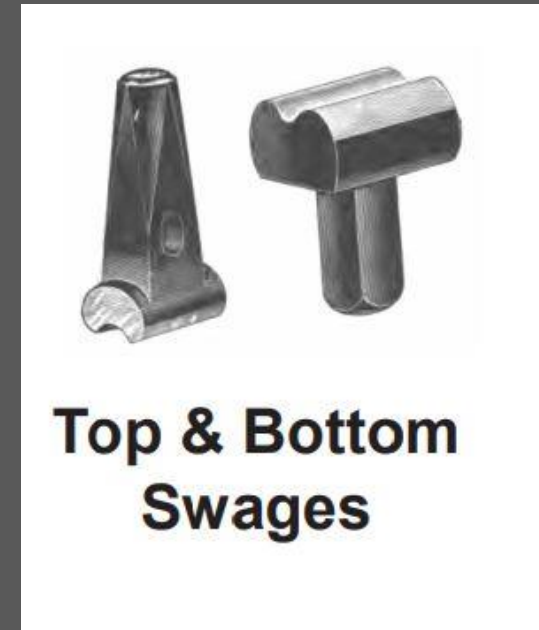
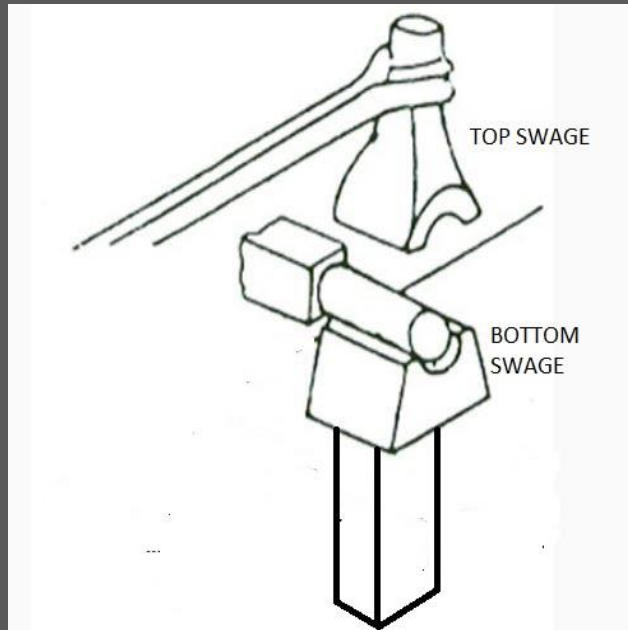
- These tools are made of high carbon steel in different sizes to suit the various types of jobs.
- They are usually used in pairs, consisting of a top and a bottom fuller. Their working edges are normally rounded.
- They, are employed for making necks by reducing the cross-section of a job and also in drawing out.





# Swages

- Like fullers, they are also made of high carbon steel in two parts called the top and bottom swages.
- Their working faces carry circular grooves to suit the size of the work. They are available in various sizes.
- The top swage carries a handle and the bottom swage a square shank to fit the hardie hole of the anvil during the operation.
- They are used for increasing the length of a circular rod or for finishing the circular surface of a job after forging.



# Swage block

- It is usually a block of cast steel or cast iron carrying a number of slots of different shapes and sizes along its four side faces and through holes from its top face to bottom face.
- This is used as a support in punching holes and forming different shapes. The job to be given a desired shape is kept on a similar shaped slot, which acts as a bottom swage, and then the top swage is applied on the other side of the job.
- The holes in the top and bottom face are used in punching. Their use prevents the punch from spoiling by striking against a hard surface after the hole has been punched.



# Operations of Smithy Shop

Smith forging is done on anvil.

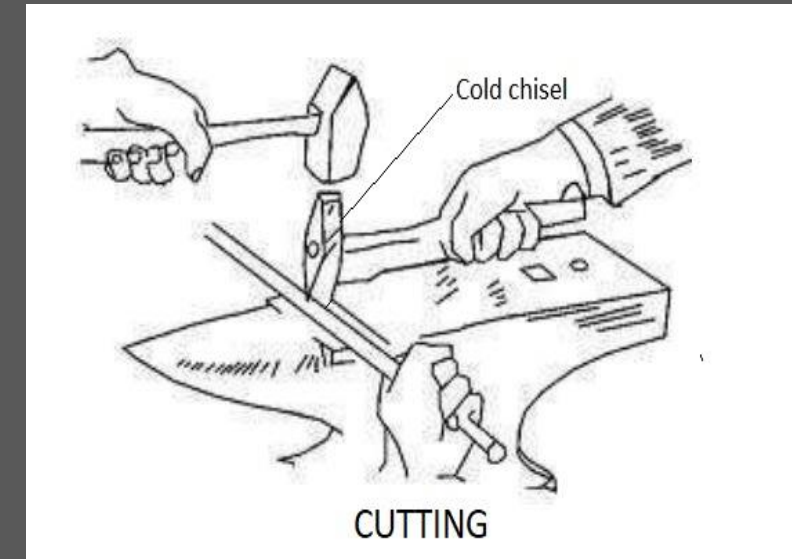
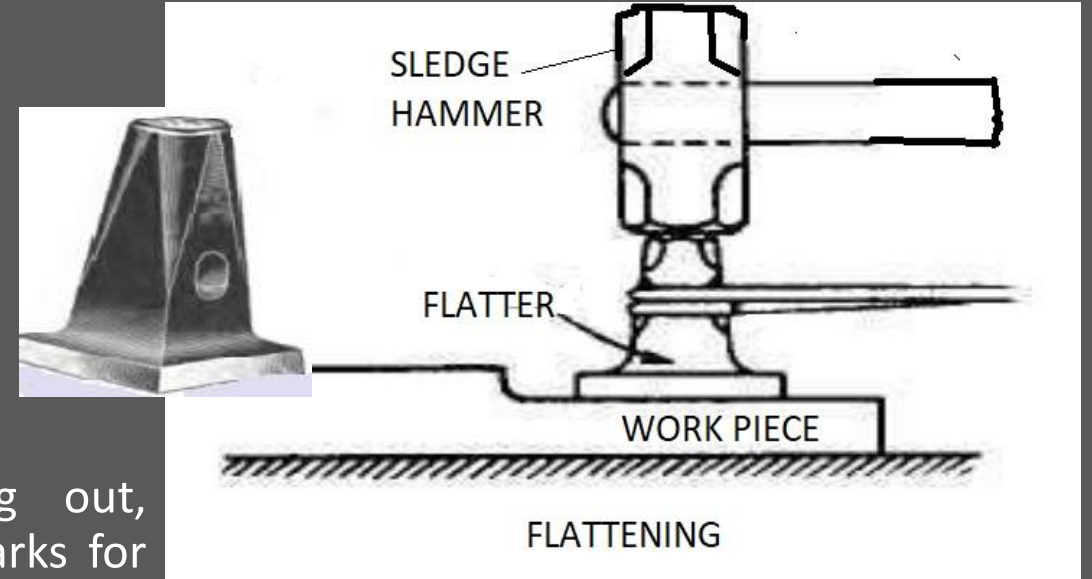
The operations of smith forging are;

- **Flattening**

Flattening The flattening is carried out after drawing out, fullering or any other operation to remove the fullering marks for leveling and finishing flat surfaces

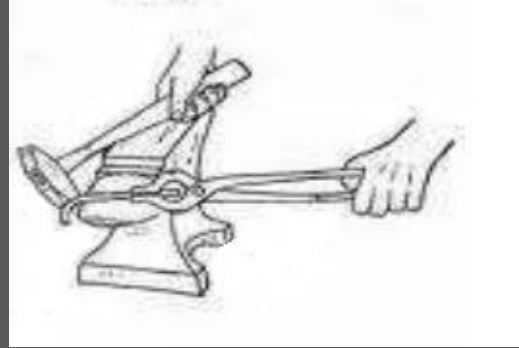
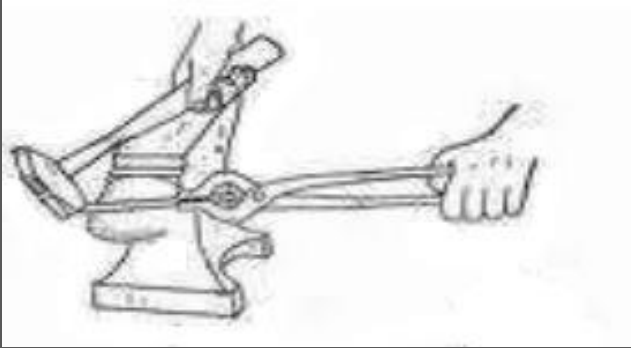
- **Cutting**

It is a form of chiseling where a long piece of stock is cut into several length required. Notches is made and chisel is placed over notch then hammered then turn 180 Degree and chisel placed opposite the metal cut-off in two pieces.



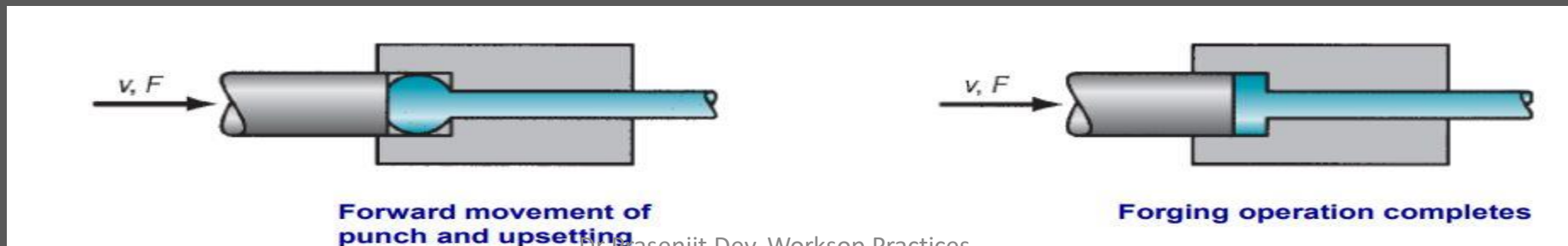
## Bending

It is an important operation in forging and is very frequently used. The bends may be either sharp cornered, angle bends or they may be composed of more gradual curve. The angle bend may be made by hammering the metal over the edge of the anvil, or over a block of metal held in the hardie hole



## Upsetting or Jumping

It is a deformation operation in which a cylindrical work piece is increased in diameter with reduction in length. In industry practice, it is done as closed die forging. Upset forging is widely used in the fastener industries to form heads on nails, bolts, and similar products.





# Model :1

## **Aim**

To make circular ring from a circular rod of 6mm diameter and length of 250mm by cold forge techniques.

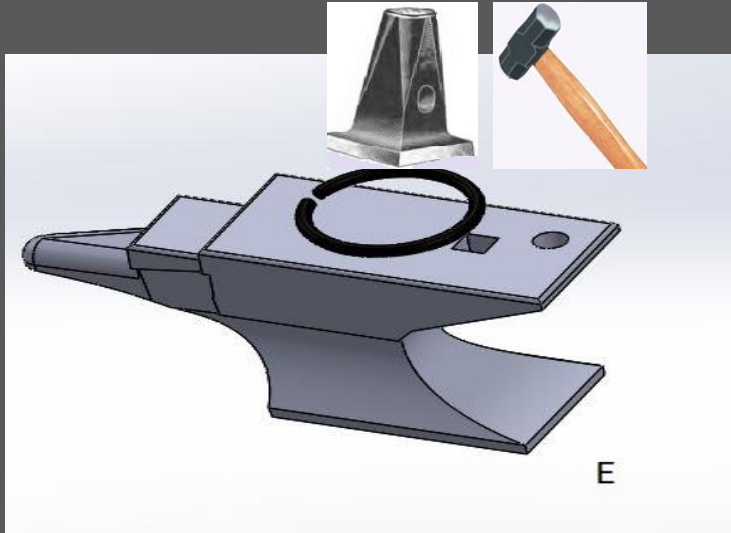
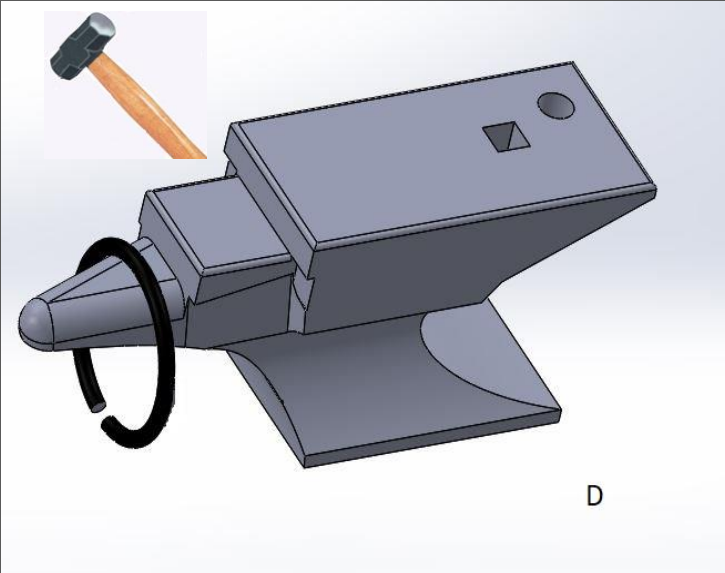
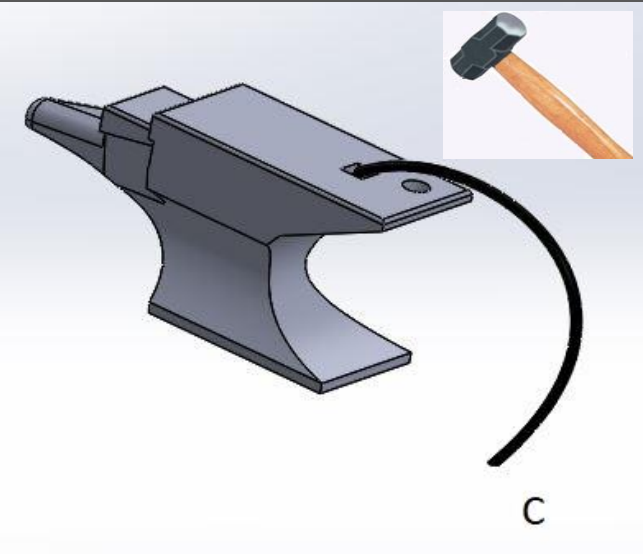
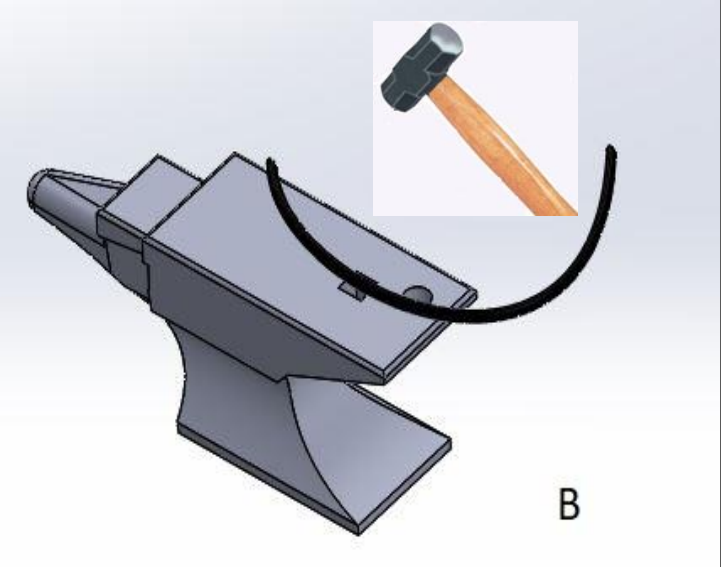
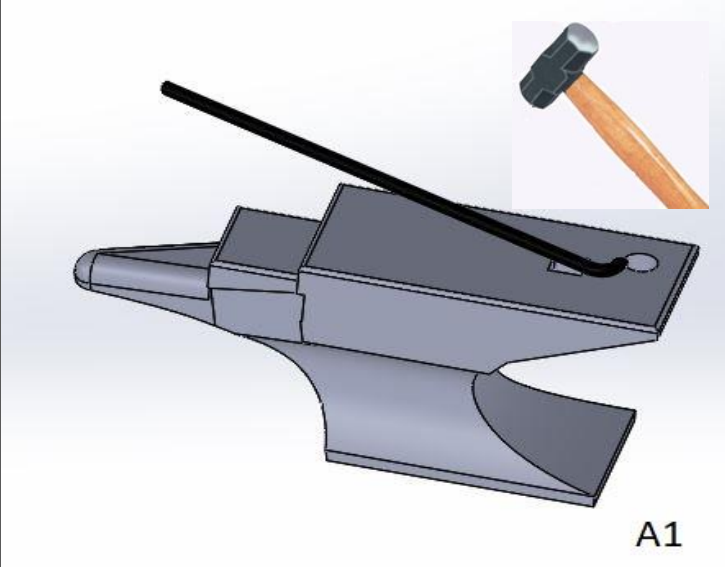
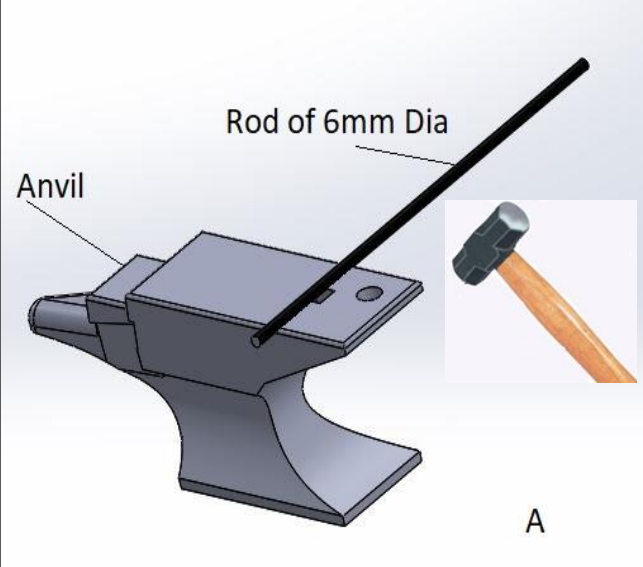
## **Tools & Equipment:**

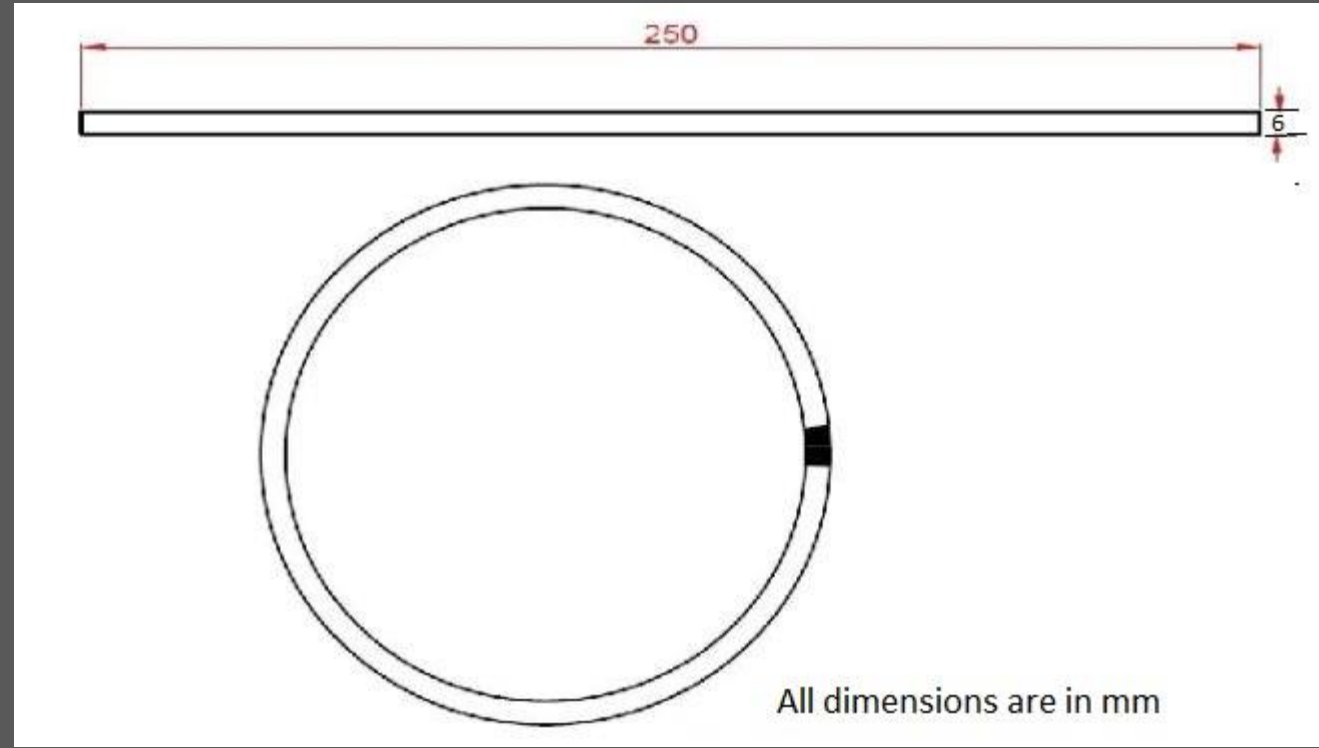
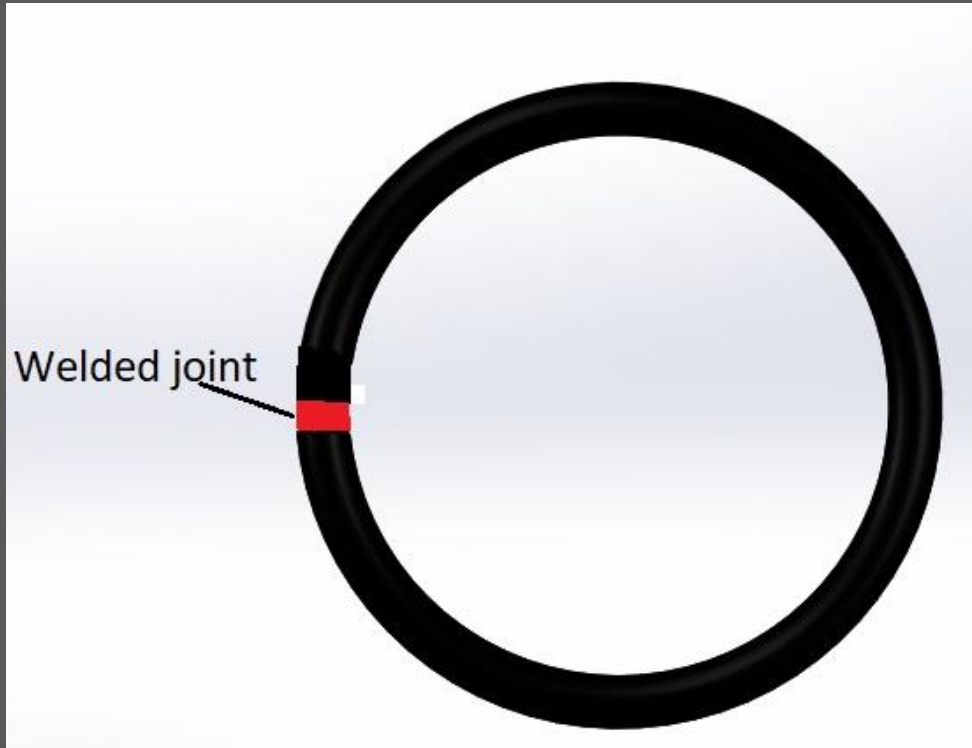
Flatter, Sledge hammer, Anvil

## **Procedure**

- 1) Fix the 6 mm diameter rod in the vice and cut the final length of the model to be forged using hacksaw.
- 2) Hold the round rod in hand and place it in the anvil also check the straightness of rod – Refer Figure A
- 3) Strike the rod by sledge hammer from ends and also keep the rod above the hardie hole then bending process will be easy -Refer Figure A1 &B
- 4) Repeat the process of striking the rod with the help of hammer, tong & flatter to get into the shape
- 5) Use Horn part in Anvil for getting full circular bending -Refer Figure C
- 6) With the help of flatter, open faced dies finish the work piece to the final dimension and surface finish – Refer Figure D
- 7) Now both the end of the work piece is welded using arc weld. Then cool the specimen by dipping in water and surface finish it.

**Result** : The job is thus made according to the given dimensions





The job is thus made according to the given dimensions and the ring joint is welded by normal arc welding process