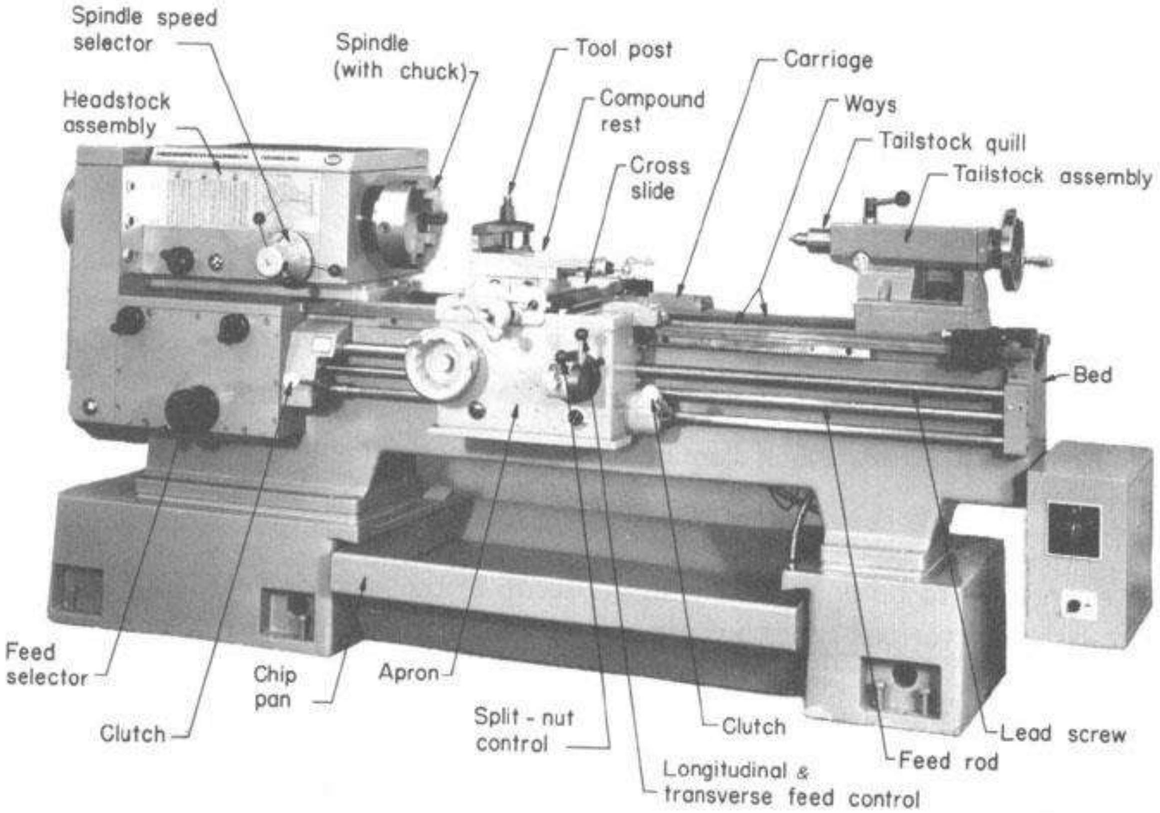
DEPARTMENT OF MECHANICAL ENGINEERING

34421E83-WORKSHOP PRACTICES

LAB MANUAL



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CONTENT

WORKSHOP PRACTICES
LAB MANUAL

Instructions for Laboratory

- The objective of the laboratory is learning. The experiments are designed to illustrate phenomena in different areas of Workshop and to expose you to uses of instruments. Conduct the job with interest and an attitude of learning.

- You need to come well prepared for the job.

- Work quietly and carefully (the whole purpose of experimentation is to make reliable measurements!) and equally share the work with your partners.

- All presentations of job and diagram should be neatly and carefully done.

- Diagrams should be neatly drawn with pencil. Always display units.

- Come equipped with scales, pencils etc.

- Do not fiddle idly with apparatus. Handle instruments with care. Report any breakage to the Instructor. Return all the equipment you have signed out for the purpose of your experiment.

1. STUDY OF LATHE

1.INTRODUCTION

Lathe is one of the most versatile and widely used machine tools all over the world. It is commonly known as the mother of all other machine tool. The main function of a lathe is to remove metal from a job to give it the required shape and size. The job is secure1y and rigid1y held in the chuck or in between centers on the lathe machine and then turn it against a single point cutting tool which wi1l remove meta1 from the job in the form of chips. Fig. 1 shows the working principle of lathe. An engine lathe is the most basic and simplest form of the lathe. It derives its name from the early lathes, which obtained their power from engines. Besides the simple turning operation as described above, lathe can be used to carry out other operations also, such as drilling, reaming, boring, taper turning, knurling, screw thread cutting, grinding etc.

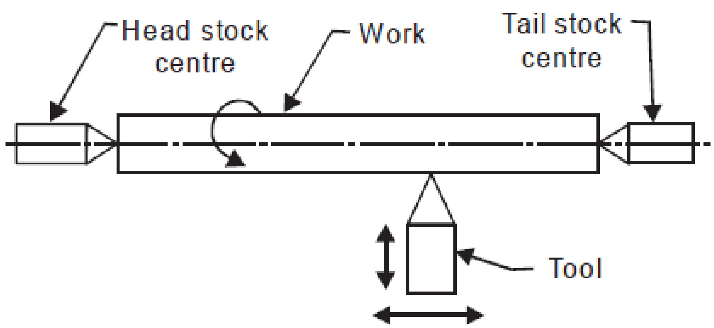


Fig.1.1 Working principal of lathe machine

1.2 CONSTRUCTION OF LATHE MACHINE

A simple lathe comprises of a bed made of grey cast iron on which headstock, tailstock, carriage and other components of lathe are mounted. Fig. 2 shows the different parts of engine lathe or central lathe. The major parts of lathe machine are given as under:

1. Bed
2. Head stock
3. Tailstock
4. Carriage
5. Feed mechanism
6. Thread cutting mechanism

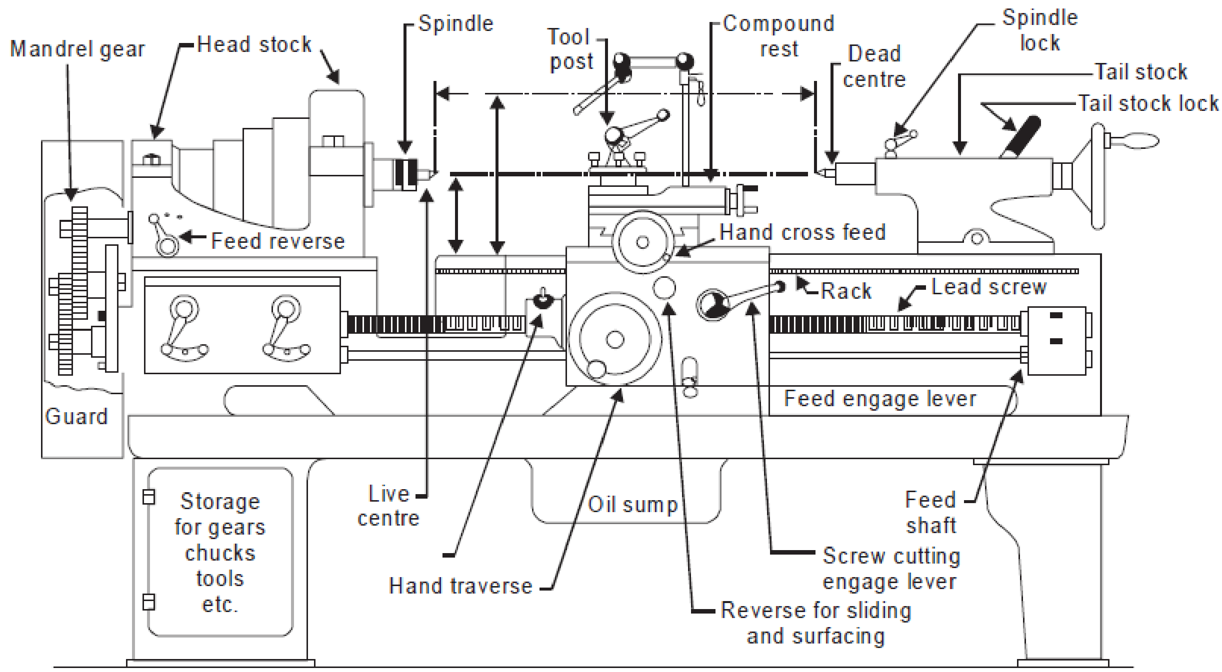


Fig 1.2 Different parts of engine lathe or central lathe

1.2.1 Bed

The bed of a lathe machine is the base on which all other parts of lathe are mounted. It is massive and rigid single piece casting made to support other active parts of lathe. On left end of the bed, headstock of lathe machine is located while on right side tailstock is located. The carriage of the machine rests over the bed and slides on it. On the top of the bed there are two sets of guideways-innerways and outerways. The innerways provide sliding surfaces for the tailstock and the outerways for the carriage. The guideways of the lathe bed may be flat and inverted V shape. Generally cast iron alloyed with nickel and chromium

material is used for manufacturing of the lathe bed.

1.2.2 Head Stock

The main function of headstock is to transmit power to the different parts of a lathe. It comprises of the headstock casting to accommodate all the parts within it including gear train arrangement. The main spindle is adjusted in it, which possesses live centre to which the work can be attached. It supports the work and revolves with the work, fitted into the main spindle of the headstock. The cone pulley is also attached with this arrangement, which is used to get various spindle speed through electric motor. The back gear arrangement is used for obtaining a wide range of slower speeds. Some gears called change wheels are used to produce different velocity ratio required for thread cutting.

1.2.3 Tail Stock

Fig 1.3 shows the tail stock of central lathe, which is commonly used for the objective of primarily giving an outer bearing and support the circular job being turned on centers. Tail stock can be easily set or adjusted for alignment or non-alignment with respect to the spindle centre and carries a centre called dead centre for supporting one end of the work. Both live and dead centers have 60° conical points to fit centre holes in the circular job, the other end tapering to allow for good fitting into the spindles. The dead centre can be mounted in ball bearing so that it rotates with the job avoiding friction of the job with dead centre as it important to hold heavy jobs.

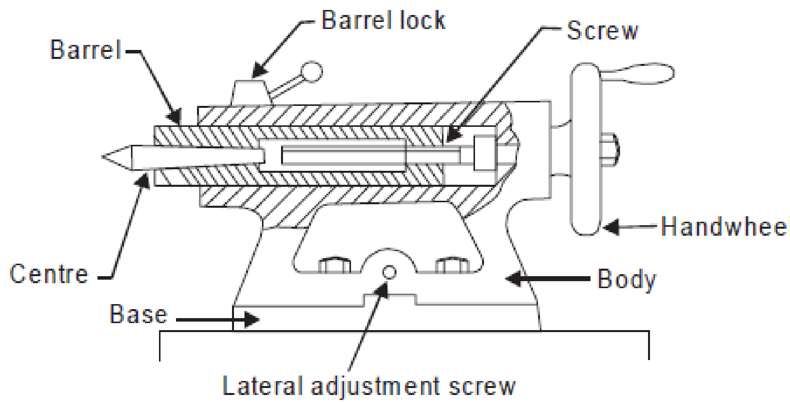


Fig 1.3 Tail stock of central lathe

1.2.4 Carriage

Carriage is mounted on the outer guide ways of lathe bed and it can move in a direction parallel to the spindle axis. It comprises of important parts such as apron, cross-slide, saddle, compound rest, and tool post. The lower part of the carriage is termed the apron in which there are gears to constitute apron mechanism for adjusting the direction of the feed using clutch mechanism and the split half nut for automatic feed. The cross-slide is basically mounted on the carriage, which generally travels at right angles to the spindle axis. On the cross-slide, a saddle is mounted in which the compound rest is adjusted which can rotate and fix to any desired angle. The compound rest slide is actuated by a screw, which rotates in a nut fixed to the saddle. The tool post is an important part of carriage, which fits in a tee-slot in the compound rest and holds the tool holder in place by the tool post screw. Fig 1.4 shows the tool post of centre lathe.

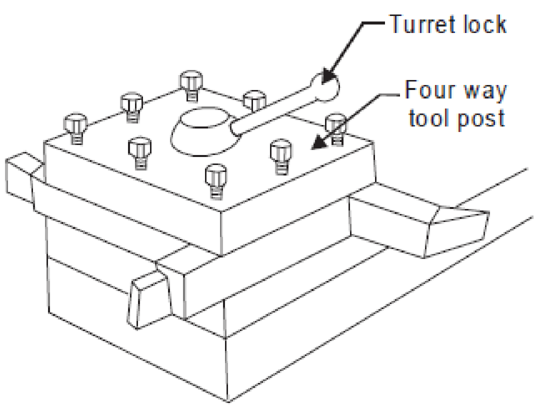


Fig 1.4 Tool post of centre lathe

1.2.5 Feed Mechanism

Feed mechanism is the combination of different units through which motion of headstock spindle is transmitted to the carriage of lathe machine. Following units play role in feed mechanism of a lathe machine-

1. End of bed gearing
2. Feed gear box
3. Lead screw and feed rod

4. Apron mechanism

The gearing at the end of bed transmits the rotary motion of headstock spindle to the feed gear box. Through the feed gear box the motion is further transmitted either to the feed shaft or lead screw, depending on whether the lathe machine is being used for plain turning or screw cutting. The feed gear box contains a number of different sizes of gears. The feed gear box provides a means to alter the rate of feed, and the ration between revolutions of the headstock spindle and the movement of carriage for thread cutting by changing the speed of rotation of the feed rod or lead screw. The apron is fitted to the saddle. It contains gears and clutches to transmit motion from the feed rod to the carriage, and the half nut which engages with the lead screw during cutting threads. Thread Cutting Mechanism The half nut or split nut is used for thread cutting in a lathe. It engages or disengages the carriage with the lead screw so that the rotation of the leadscrew is used to traverse the tool along the workpiece to cut screw threads. The direction in which the carriage moves depends upon the position of the feed reverse lever on the headstock.

1.3 ACCESSORIES AND ATTACHMENTS OF LATHE

There are many lathe accessories provided by the lathe manufacturer along with the lathe, which support the lathe operations. The important lathe accessories include centers, catch plates and carriers, chucks, collets, face plates, angle plates, mandrels, and rests. These are used either for holding and supporting the work or for holding the tool. Attachments are additional equipments provided by the lathe manufacturer along with the lathe, which can be used for specific operations. The lathe attachment includes stops, ball turning rests, thread chasing dials, milling attachment, grinding attachment, gear cutting attachment, turret attachment and crank pin turning attachments and taper turning attachment.

1.3.1 Lathe centers

The most common method of holding the job in a lathe is between the two centers generally known as live centre (head stock centre) and dead centre (tailstock centre). They are made of very hard materials to resist deflection and wear and they are used to hold and support the cylindrical jobs.

1.3.2 Carriers or driving dog and catch plates

These are used to drive a job when it is held between two centers. Carriers or driving dogs are attached to the end of the job by a setscrew. A use of lathe dog for holding and supporting the job is shown in Fig. 5. Catch plates are either screwed or bolted to the nose of the headstock spindle. A projecting pin from the catch plate or carrier fits into the slot provided in either of them. This imparts a positive drive between the lathe spindle and job.

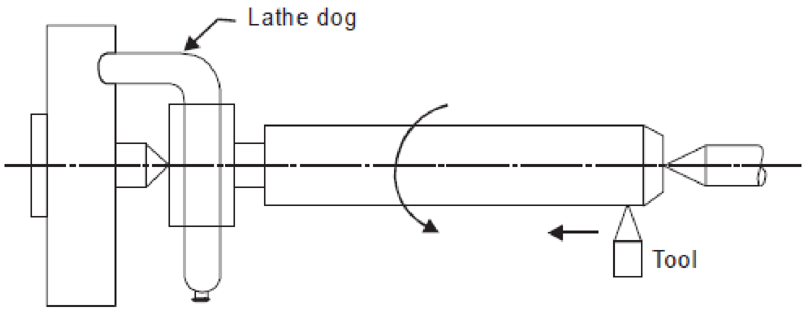


Fig 1.5 Lathe dog

1.3.3 Chucks

Chuck is one of the most important devices for holding and rotating a job in a lathe. It is basically attached to the headstock spindle of the lathe. The internal threads in the chuck fit on to the external threads on the spindle nose. Short, cylindrical, hol1ow objects or those of irregular shapes, which cannot be conveniently mounted between centers, are easily and rigidly held in a chuck.. Jobs of short length and large diameter or of irregular shape, which cannot be conveniently mounted between centers, are held quickly and rigidly in a chuck. There are a number of types of lathe chucks, e.g.

(1) Three jaws or universal

(2) Four jaw independent chuck

(3) Magnetic chuck

(4) Collet chuck

(5) Air or hydraulic chuck operated chuck

(6) Combination chuck

(7) Drill chuck.

1.3.4 Face plates

Face plates are employed for holding jobs, which cannot be conveniently held between centers or by chucks. A face plate possesses the radial, plain and T slots for holding jobs or work-pieces by bolts and clamps. Face plates consist of a circular disc bored out and threaded to fit the nose of the lathe spindle. They are heavily constructed and have strong thick ribs on the back. They have slots cut into them, therefore nuts, bolts, clamps and angles are used to hold the jobs on the face plate. They are accurately machined and ground.

1.3.5 Angle plates

Angle plate is a cast iron plate having two faces machined to make them absolutely at right angles to each other. Holes and slots are provided on both faces so that it may be clamped on a faceplate and can hold the job or workpiece on the other face by bolts and clamps. The plates are used in conjunction with a face plate when the holding surface of the job should be kept horizontal.

1.3.6 Mandrels

A mandrel is a device used for holding and rotating a hollow job that has been previously drilled or bored. The job revolves with the mandrel, which is mounted between two centers. It is rotated by the lathe dog and the catch plate and it drives the work by friction. Different types of mandrels are employed according to specific requirements. It is hardened and tempered steel shaft or bar with 60° centers, so that it can be mounted between centers. It holds and locates a part from its center hole. The mandrel is always rotated with the help of a lathe dog; it is never placed in a chuck for turning the job. A mandrel unlike an arbor is a job holding device rather than a cutting tool holder. A bush can be faced and turned by holding the same on a mandrel between centers. It is generally used in order to machine the entire length of a hollow job.

1.3.7 Rests

A rest is a lathe device, which supports a long slender job, when it is turned between centers or by a chuck, at some intermediate point to prevent bending of the job due to its own weight and vibration set up due to the cutting force that acts on it. The two types of rests commonly used for supporting a long job in an engine lathe are the steady or centre rest and the follower rest.

1.4 SPECIFICATION OF LATHE

The size of a lathe is generally specified by the following means:

(*a*) Swing or maximum diameter that can be rotated over the bed ways

(*b*) Maximum length of the job that can be held between head stock and tail stock centres

(*c*) Bed length, which may include head stock length also

(*d*) Maximum diameter of the bar that can pass through spindle or collect chuck of capstan lathe.

Fig 1.6 illustrates the elements involved in specifications of a lathe. The following data also contributes to specify a common lathe machine.

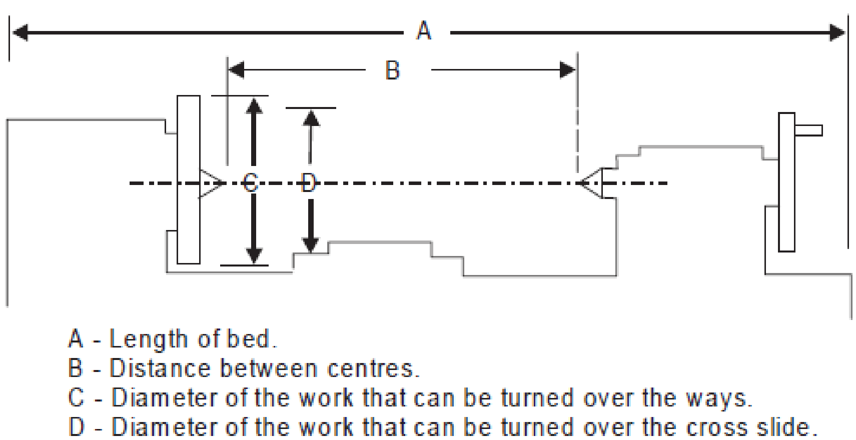


Fig 1.6 Specifications of a lathe

(*i*) Maximum swing over bed

(*ii*) Maximum swing over carriage

(*iii*) Height of centers over bed

(*iv*) Maximum distance between centers

(*v*) Length of bed

(*vi*) Width of bed

(*vii*) Morse taper of center

(*viii*) Diameter of hole through spindle

(*ix*) Face plate diameter

(*x*) Size of tool post

(*xi*) Number of spindle speeds

(*xii*) Lead screw diameter and number of threads per cm.

(*xiii*) Size of electrical motor

(*xiv*) Pitch range of metric and inch threads etc.

1.5 CUTTING SPEED

Cutting speed for lathe work may be defined as the rate in meters per minute at which the surface of the job moves past the cutting tool. Machining at a correct cutting speed is highly important for good tool life and efficient cutting. Too slow cutting speeds reduce productivity and increase manufacturing costs whereas too high cutting speeds result in overheating of the tool and premature failure of the cutting edge of the tool. The following factors affect the cutting speed:

(*i*) Kind of material being cut,

(*ii*) Cutting tool material,

(*iii*) Shape of cutting tool,

(*iv*) Rigidity of machine tool and the job piece and

(*v*) Type of cutting fluid being used.

Calculation of cutting speed Cs, in meters per minute

$Cs = ((22/7) \times D \times N)) /1000$

Where

D is diameter of job in mm.

N is in RPM

1.6 FEED

Feed is defined as the distance that a tool advances into the work during one revolution of the headstock spindle. It is usually given as a linear movement per revolution of the spindle or job. During turning a job on the center lathe, the saddle and the tool post move along the bed of the lathe for a particular feed for cutting along the length of the rotating job.

Exp. No. 1.1

Facing and Plain Turning

AIM

To perform the facing and plain turning in a centre lathe on the given cylindrical work piece for the given dimensions.

MATERIALS REQUIRED

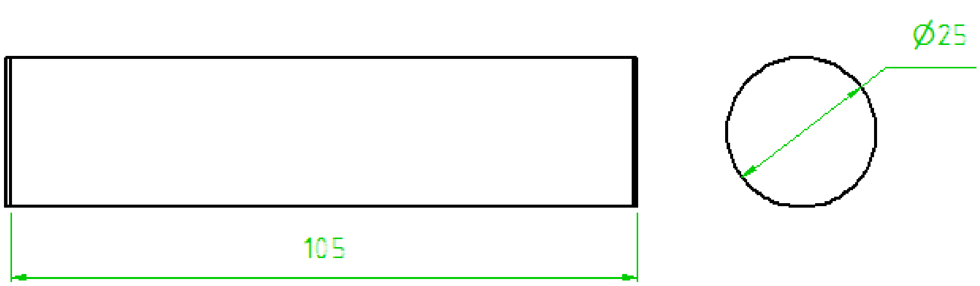
Mild steel rod of diameter 25 mm and length 105 mm

TOOLS REQUIRED

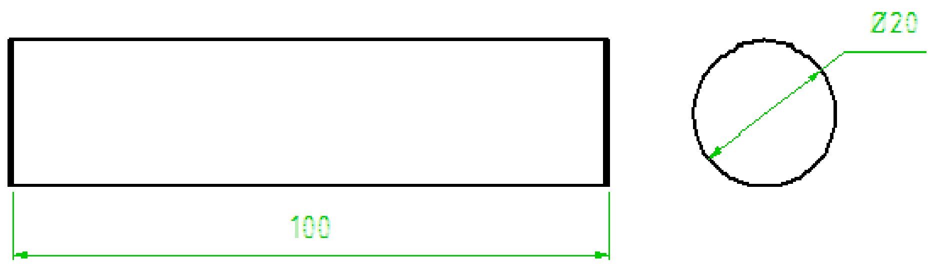
Single point cutting tool, vernier caliper, chuck key & tool post key

PROCEDURE

1. The dimensions of the given cylindrical work piece is checked
2. The work piece is held in the chuck properly and tightened by chuck key
3. The single point cutting tool is held on tool post and tightened by tool post key
4. The facing operation is done on both side of the work piece to get the required length
5. The plain turning operation is done on work piece to get the initial dimension
6. Then the plain turning operation is further continued to specific dimension to form steps
7. Finally the dimensions are checked using vernier caliper before work piece is removed from the chuck.



BEFORE MACHINING



AFTER MACHINING

All dimensions are in mm

RESULT

Thus the work piece for the required dimensions is obtained by performing facing & plain turning operations in lathe.

Exp. No. 1.2

Step Turning and Chamfering

AIM

To perform the Step Turning and Chamfering in a centre lathe on the given cylindrical work piece for the given dimensions.

MATERIALS REQUIRED

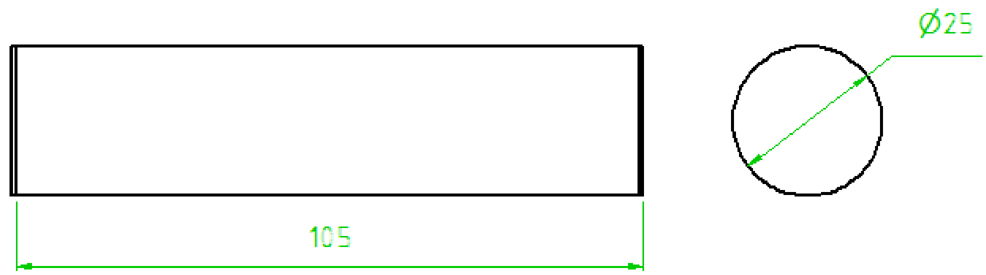
Mild steel rod of diameter 25 mm and length 105 mm

TOOLS REQUIRED

Single point cutting tool, Chamfer tool, vernier caliper, and chuck key & tool post key

PROCEDURE

1. The dimensions of the given cylindrical work piece is checked
2. The work piece is held in the chuck properly and tightened by chuck key
3. The single point cutting tool is held on tool post and tightened by tool post key
4. The facing operation is done on both side of the work piece to get the required length
5. The plain turning operation is done on work piece to get the initial dimension
6. Then the plain turning operation is further continued to specific dimension to form steps
7. Thus the step turning operation is done on the given work piece
8. Then using Chamfer tool the chamfering operation is done on the workpiece.
9. Finally the dimensions are checked using vernier caliper before work piece is removed from the chuck.



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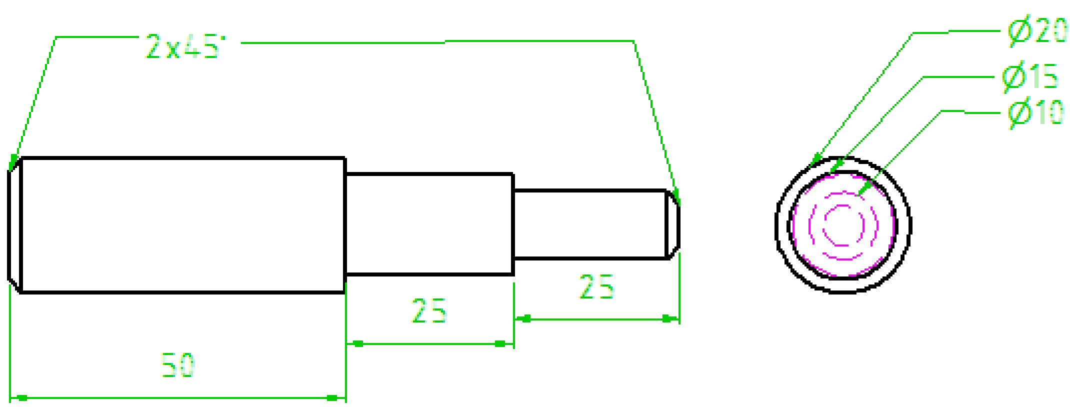


AFTER MACHINING

All dimensions are in mm

RESULT

Thus the work piece for the required dimensions is obtained by performing Step Turning and Chamfering operations in lathe.

Exp. No.1.3 Date:

Drilling, Tapping and Reaming

AIM

To perform the drilling, Boring and Reaming in a drilling Machine on the given work piece for the given dimensions.

MATERIALS REQUIRED

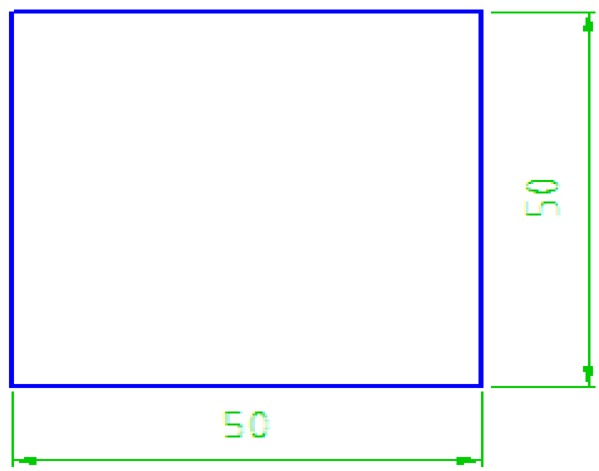
Mild steel Plate of Length 50x50 mm

TOOLS REQUIRED

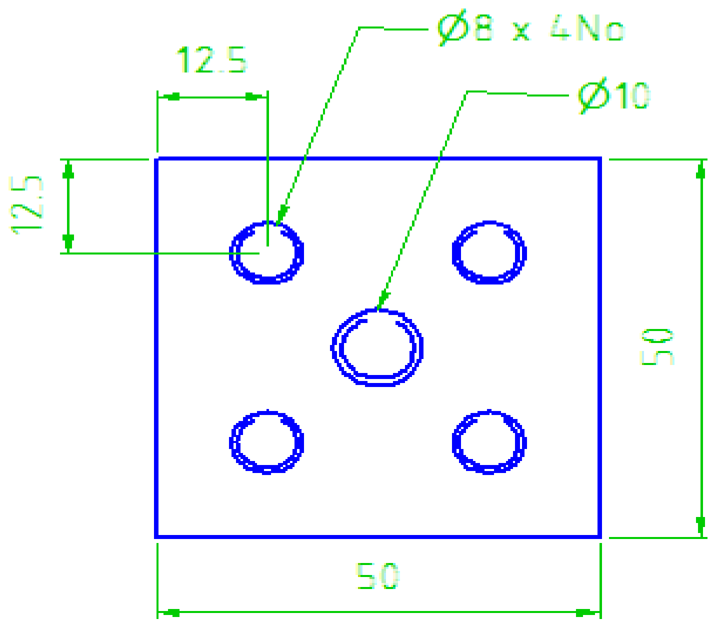
Steel rule,
Flat file (rough and smooth),
Drill bit (8 mm, 10 mm, 10.5 mm),Reaming tool,
Try square

PROCEDURE

1. The work piece was fitted in the vice and filed to the required dimensions.
2. The squareness of the work piece was checked.
3. Drawing punches were made for various drills.
4. The job was fitted on the radial drilling machine.
5. The 10 mm & 8 mm drill bit were used for drilling in the required place and drilling operation was made on the work piece.
6. Boring was done on the 10mm hole using the boring tool.
7. Reaming was done on the 8 mm hole using the Reaming tool size of 8 mm diameter.
8. The work piece was removed from the radial drilling machine.



BEFORE
MACHINING



AFTER
MACHINING

All dimensions are in mm

RESULT

Thus the work piece for the required dimensions is obtained by performing drilling,Boring and Reaming in a drilling Machine.

2. STUDY OF FITTING

2.1 INTRODUCTION

Machine tools are capable of producing work at a faster rate, but, there are occasions when components are processed at the bench. Sometimes, it becomes necessary to replace or repair component which must be fit accurately with another component on reassembly. This involves a certain amount of hand fitting. The assembly of machine tools, jigs, gauges, etc, involves certain amount of bench work. The accuracy of work done depends upon the experience and skill of the fitter.

The term ‘bench work’ refers to the production of components by hand on the bench, where as fitting deals which the assembly of mating parts, through removal of metal, to obtain the required fit.

Both the bench work and fitting requires the use of number of simple hand tools and considerable manual efforts. The operations in the above works consist of filing, chipping, scraping, sawing drilling, and tapping.

2.2 HOLDING TOOLS

2.2.1 Bench vice

The bench vice is a work holding device. It is the most commonly used vice in a fitting shop. The bench vice is shown in Figure 1.1.

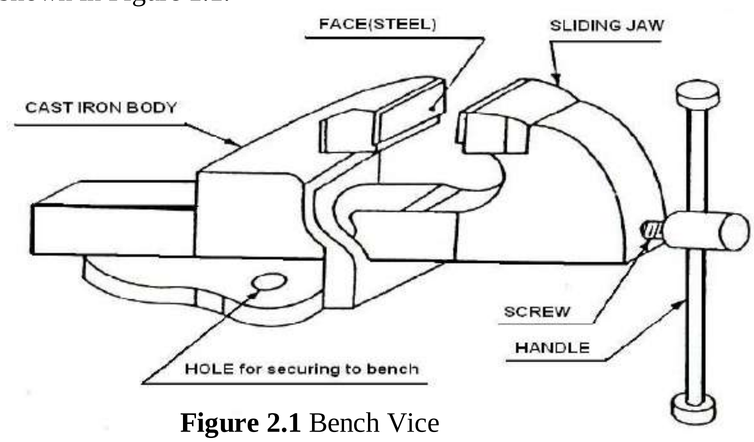


Figure 2.1 Bench Vice

It is fixed to the bench with bolts and nuts. The vice body consists of two main parts, fixed jaw and movable jaw. When the vice handle is turned in a clockwise direction, the sliding jaw forces the work against the fixed jaw. Jaw plates are made of hardened steel.

Serrations on the jaws ensure a good grip. Jaw caps made of soft material are used to protect finished surfaces, gripped in the vice. The size of the vice is specified by the length of the jaws.

The vice body is made of cast Iron which is strong in compression, weak in tension and so fractures under shocks and therefore should never be hammered.

2.2.2 V-block

V-block is rectangular or square block with a V groove on one or both sides opposite to each other. The angle of the ‘V’ is usually 90^0. V-block with a clamp is used to hold cylindrical work securely, during layout of measurement, for measuring operations or for drilling for this the bar is faced longitudinally in the V groove and the screw of V-clamp is tightened. This grip the rod is firm with its axis parallel to the axis of the V groove.

2.2.3 C-Clamp

This is used to hold work against an angle plate or v-block or any other surface, when gripping is required.

Its fixed jaw is shaped like English alphabet 'C' and the movable jaw is round in shape and directly fitted to the threaded screw at the end. The working principle of this clamp is the same as that of the bench vice.

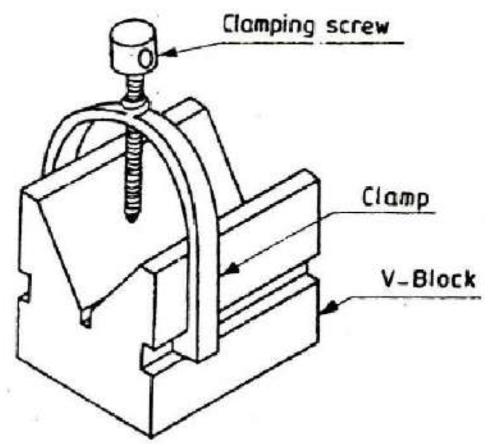


Figure 2.2 V-block

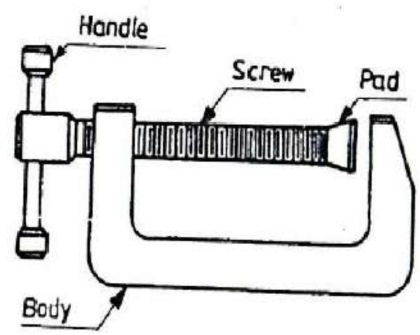


Figure 2.3 C-clamp

2.3 MARKING AND MEASURING TOOLS

2.3.1 Surface plate

The surface plate is machined to fine limits and is used for testing the flatness of the work piece. It is also used for marking out small box and is more precious than the marking table. The degree of the finished depends upon whether it is designed for bench work in a fitting shop or for using in an inspection room; the surface plate is made of Cast Iron, hardened Steel or Granite stone. It is specified by length, width, height and grade. Handles are provided on two opposite sides, to carry it while shifting from one place to another.

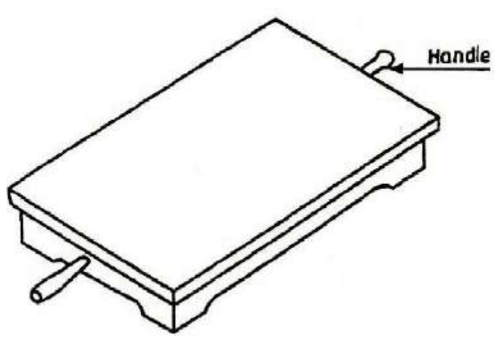


Figure 2.4 Surface plate

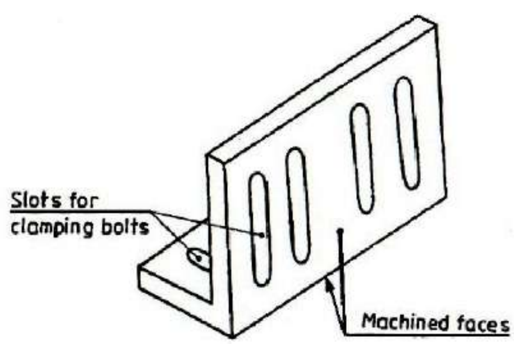


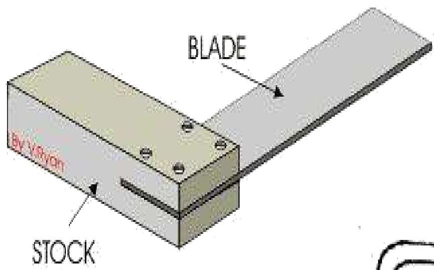
Figure 2.5 Angle plate

2.3.2 Try square

It is measuring and marking tool for 90^0 angle. In practice, it is used for checking the squareness of many types of small works when extreme accuracy is not required. The blade of the Try square is made of hardened steel and the stock of cast Iron or steel. The size of the Try square is specified by the length of the blade.

2.3.3 Scriber

A Scriber is a slender steel tool, used to scribe or mark lines on metal work pieces. It is made of hardened and tempered High Carbon Steel. The Tip of the scriber is generally ground at $12^{o}$to 15^{o} . It is generally available in lengths, ranging from 125mm to 250mm .It has two pointed ends the bent end is used for marking lines where the straight end cannot reach.



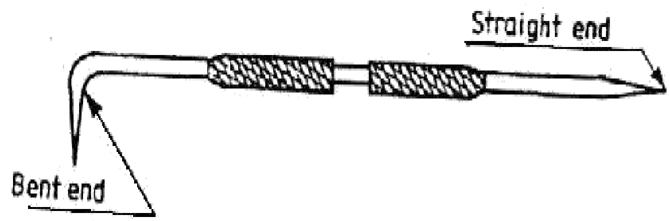


Figure 2.6 Try square

Figure 2.7 Scriber

2.3.4 Odd leg Caliper

This is also called ‘Jenny Caliper’ or Hermaphrodite. This is used for marking parallel liners from a finished edge and also for locating the center of round bars; it has one leg pointed like a divider and the other leg bent like a caliper. It is specified by the length of the leg up to the hinge point.

2.3.5 Divider

It is basically similar to the calipers except that its legs are kept straight and pointed at the measuring edge. This is used for marking circles, arcs laying out perpendicular lines, by setting lines. It is made of case hardened mild steel or hardened and tempered low carbon steel. Its size is specified by the length of the leg**.**

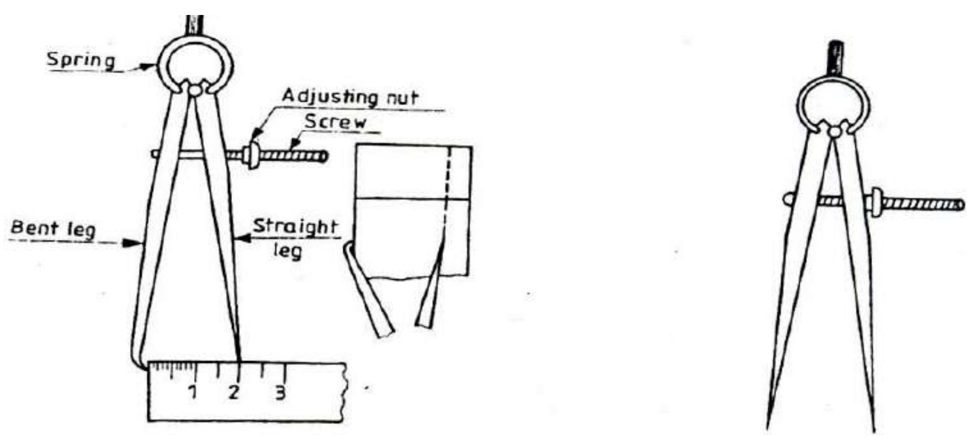


Figure 2.8 Odd leg caliper and divider

2.3.6 Trammel

Trammel is used for drawing large circles or arcs.

2.3.7 Punches

These are used for making indentations on the scribed lines, to make them visible clearly. These are made of high carbon steel.

A punch is specified by its length and diameter (say as 150’ 12.5mm). It consists of a cylindrical knurled body, which is plain for some length at the top of it. At the other end, it is ground to a point. The tapered point of the punch is hardened over a length of 20 to 30mm.

Dot punch is used to lightly indent along the layout lines, to locate center of holes and to provide a small center mark for divider point, etc. for this purpose, the punch is ground to a conical point having 60° included angle.

Centre punch is similar to the dot punch, except that it is ground to a conical point having 90°included angle. It is used to mark the location of the holes to be drilled.

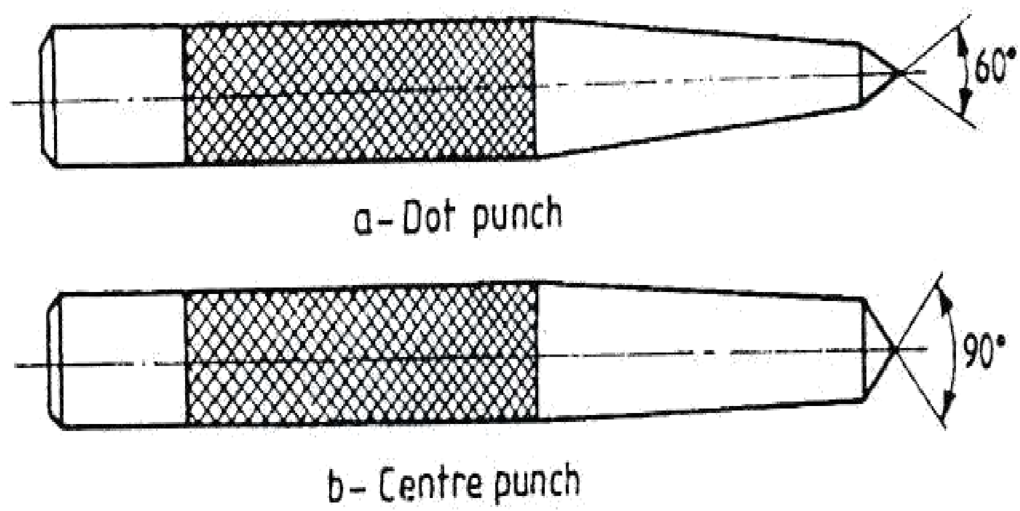


Figure 2.9 Punches

2.3.8 Calipers

They are indirect measuring tools used to measure or transfer linear dimensions. These are used with the help of a steel Rule to check inside and outside measurements. These are made of Case hardened mild steel or hardened and tempered low carbon steel. While using, but the legs of the caliper are set against the surface of the work, whether inside or outside and the distance between the legs is measured with the help of a scale and the same can be transferred to another desired place. These are specified by the length of the leg. In the case of outside caliper, the legs are bent inwards and in the case of inside caliper, the legs bent outwards.

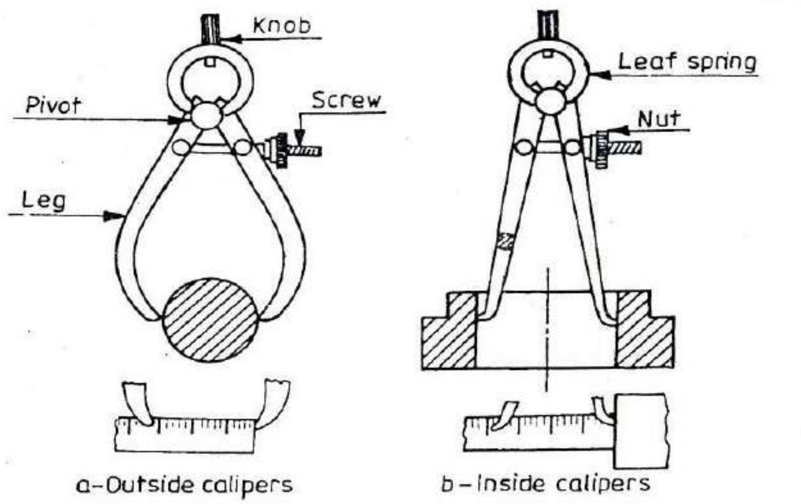


Figure 2.10 Calipers

2.3.9 Vernier Calipers

These are used for measuring outside as well as inside dimensions accurately. It may also be used as a depth gauge. It has two jaws. One jaw is formed at one end of its main scale and the other jaw is made part of a vernier scale.

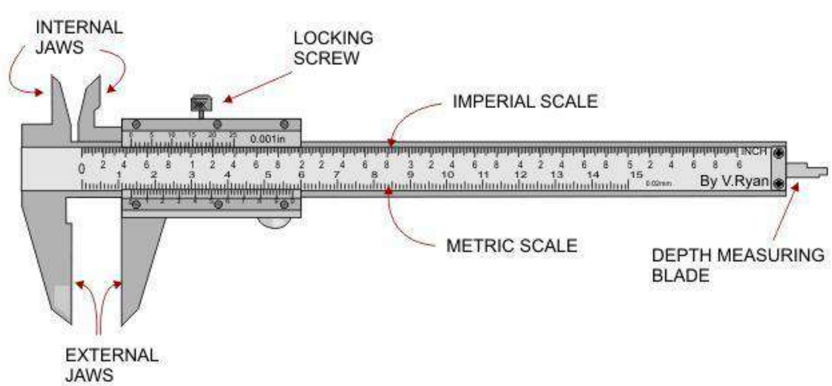


Figure 2.11 Vernier caliper

2.3.10 Vernier Height Gauge

The Vernier Height gauge clamped with a scriber. It is used for Lay out work and offset scriber is used when it is required to take measurement from the surface, on which the gauge is standing. The accuracy and working principle of this gauge are the same as those of the vernier calipers. It's size is specified by the maximum height that can be measured by it. It is made of Nickel Chromium Steel.

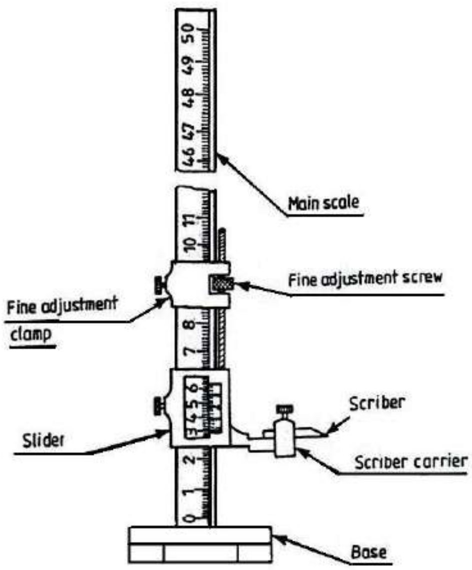


Figure 2.12 Vernier Height gauge

1.4 CUTTING TOOLS

2.4.1 Hack Saw

The Hack Saw is used for cutting metal by hand. It consists of a frame, which holds a thin blade, firmly in position. Hacksaw blade is specified by the number of teeth for centimeter. Hacksaw blades have a number of teeth ranging from 5 to 15 per centimeter (cm). Blades having lesser number of teeth per cm are used for cutting soft materials like aluminum, brass and bronze. Blades having larger number of teeth per centimeter are used for cutting hard materials like steel and cast Iron.

Hacksaw blades are classified as (i) All hard and (ii) flexible type. The all hard blades are made of H.S.S, hardened and tempered throughout to retain their cutting edges longer. These are used to cut hard metals. These blades are hard and brittle and can break easily by twisting and forcing them into the work while sawing. Flexible blades are made of H.S.S or low alloy steel but only the teeth are hardened and the rest of the blade is soft and flexible. These are suitable for use by unskilled or semiskilled persons.

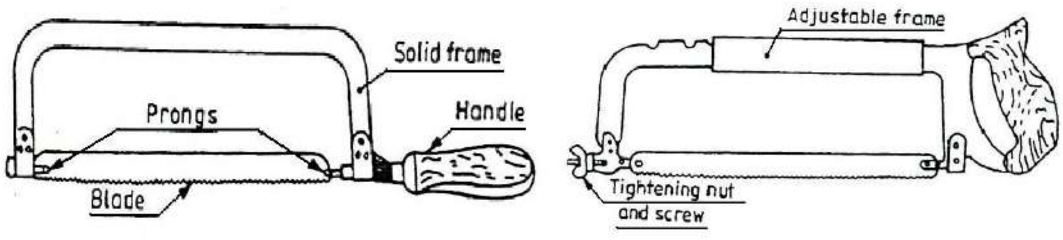


Figure 2.13 Hacksaw frame with blade

The teeth of the hacksaw blade are staggered, as shown in figure and known as a ‘set of teeth’. These make slots wider than the blade thickness, preventing the blade from jamming.

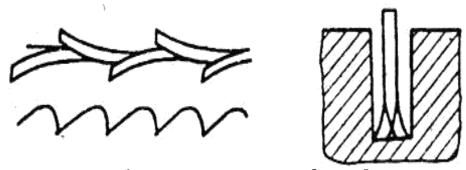


Figure 2.14 Set of teeth

2.4.2 Chisels

Chisels are used for removing surplus metal or for cutting thin sheets. These tools are made from 0.9% to 1.0% carbon steel of octagonal or hexagonal section. Chisels are annealed, hardened and tempered to produce a tough shank and hard cutting edge. Annealing relieves the internal stresses in a metal. The cutting angle of the chisel for general purpose is about 60°.

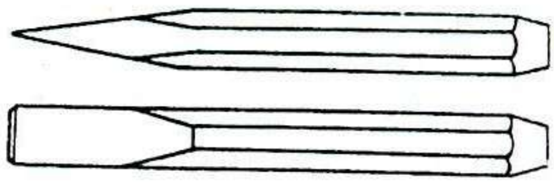


Figure 2.15 Flat chisel

2.4.3 Twist Drill

Twist drills are used for making holes. These are made of High speed steel. Both straight and taper shank twist drills are used. The parallel shank twist drill can be held in an ordinary self – centering drill check. The tapper shank twist drill fits into a corresponding tapered bore provided in the drilling machine spindle.

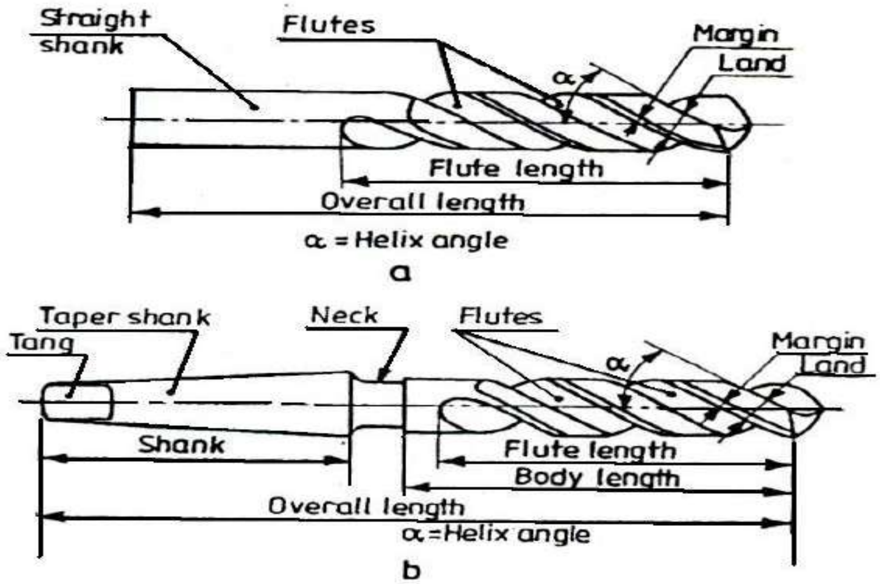


Figure 2.16 Twist drills

2.4.4 Taps and Tap wrenches

A tap is a hardened and steel tool, used for cutting internal thread in a drill hole. Hand Taps are usually supplied in sets of three in each diameter and thread size. Each set consists of a tapper tap, intermediate tap and plug or bottoming tap. Taps are made of high carbon steel or high speed steel.

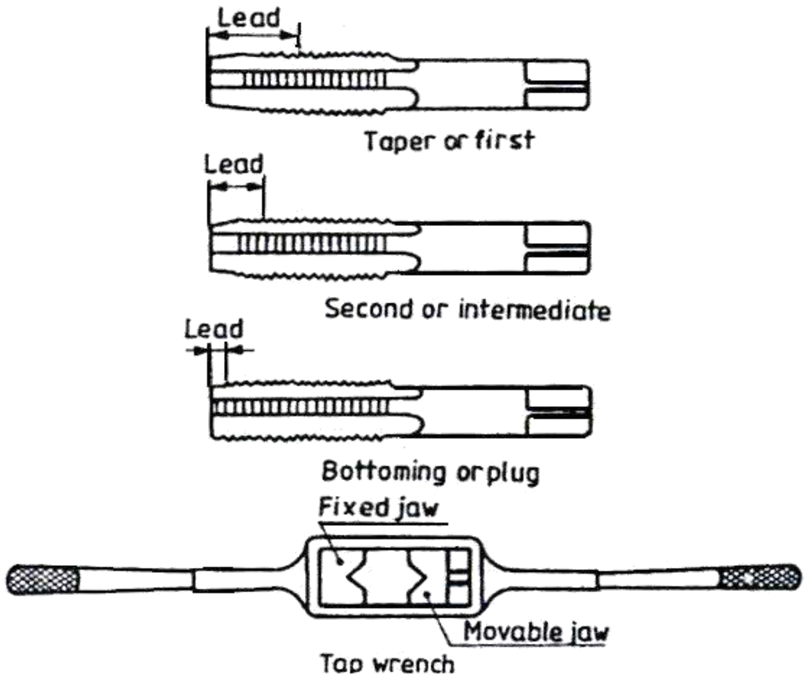


Figure 2.17 Taps and tap wrench

2.4.5 Dies and die holders

Dies are the cutting tools used for making external thread. Dies are made either solid or split type. They are fixed in a die stock for holding and adjusting the die gap. They are made of Steel or High Carbon Steel.

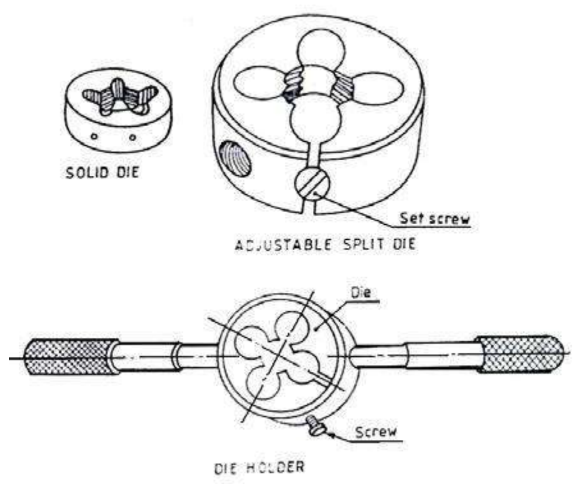


Figure 2.18 Dies and die holder

2.4.6 Bench Drilling Machine

Holes are drilled for fastening parts with rivets, bolts or for producing internal thread. Bench drilling machine is the most versatile machine used in a fitting shop for the purpose. Twist drills, made of tool steel or high speed steel are used with the drilling machine for drilling holes.

Following are the stages in drilling work

1. Select the correct size drills, put it into the check and lock it firmly

2. Adjust the speed of the machine to suit the work by changing the belt on the pulleys. Use high speed for small drills and soft materials and low speed for large diameter drills and hard materials.

3. Layout of the location of the pole and mark it with a centre punch.

4. Hold the work firmly in the vice on the machine table and clamp it directly on to the machine table.

6. Put on the power, locate the punch mark and apply slight pressure with the Feed Handle. Once drilling is commenced at the correct location, apply enough pressure and continue drilling. When drilling steel apply cutting oil at the drilling point.

7. Release the pressure slightly, when the drill point pierces the lower surface of the metal. This prevents the drill catching and damaging the work or drill.

8. On completion of drilling retrace the drill out of the work and put off the power supply.

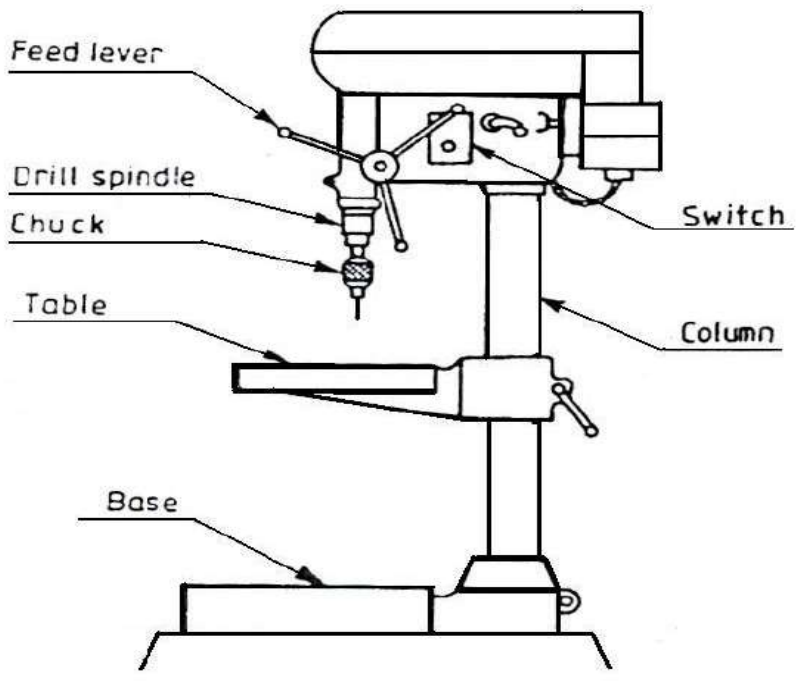


Figure 2.19 Bench drill

2.5 FINISHING TOOLS

2.5.1 Reamers

Reaming is an operation of sizing and finishing a drilled hole, with the help of a cutting tool called reamer having a number of cutting edges. For this, a hole is first drilled, the size of which is slightly smaller than the finished size and then a hand reamer or machine reamer is used for finishing the hole to the correct size.

Hand Reamer is made of High Carbon Steel and has left hand spiral flutes so that, it is prevented from screwing into the whole during operation. The Shank end of the reamer is made straight so that it can be held in a tap wrench. It is operated by hand, with a tap wrench fitted on the square end of the reamer and with the work piece held in the vice. The body of the reamer is given a slight tapper at its working end, for its easy entry into the whole during operation, it is rotated only in clock wise direction and also while removing it from the whole.

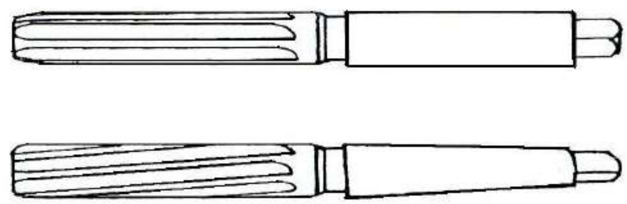


Figure 2.20 Reamers

2.5.2 Files

Filing is one of the methods of removing small amounts of material from the surface of a metal part. A file is hardened steel too, having small parallel rows of cutting edges or teeth on its surfaces.

On the faces, the teeth are usually diagonal to the edge. One end of the file is shaped to fit into a wooden handle. The figure shows various parts of a hand file. The hand file is parallel in width and tapering slightly in thickness, towards the tip. It is provided with double cut teeth. On the faces, single cut on one edge and no teeth on the other edge, which is known as a safe edge.

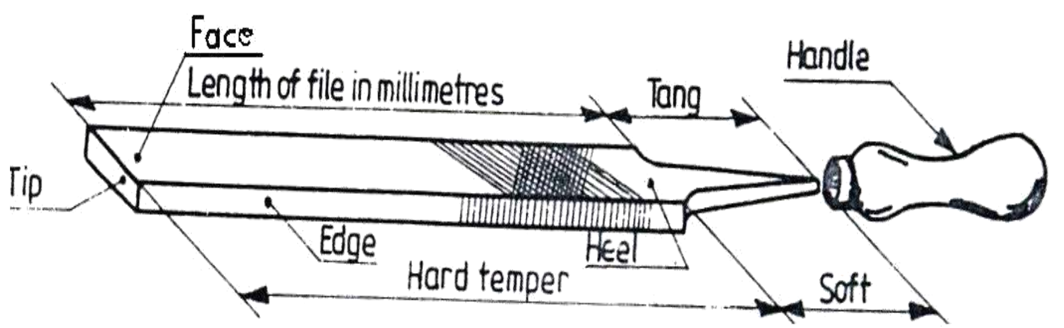


Figure 2.21 Parts of a hand file

Files are classified according to their shape, cutting teeth and pitch or grade of the teeth. The figure shows the various types of files based on their shape.

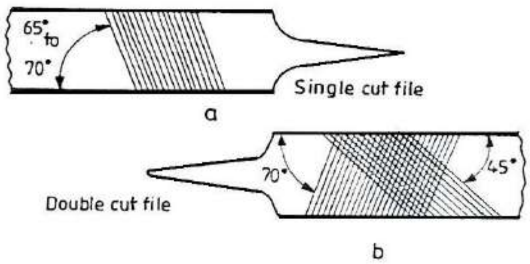


Figure 2.22 Single and double cut files

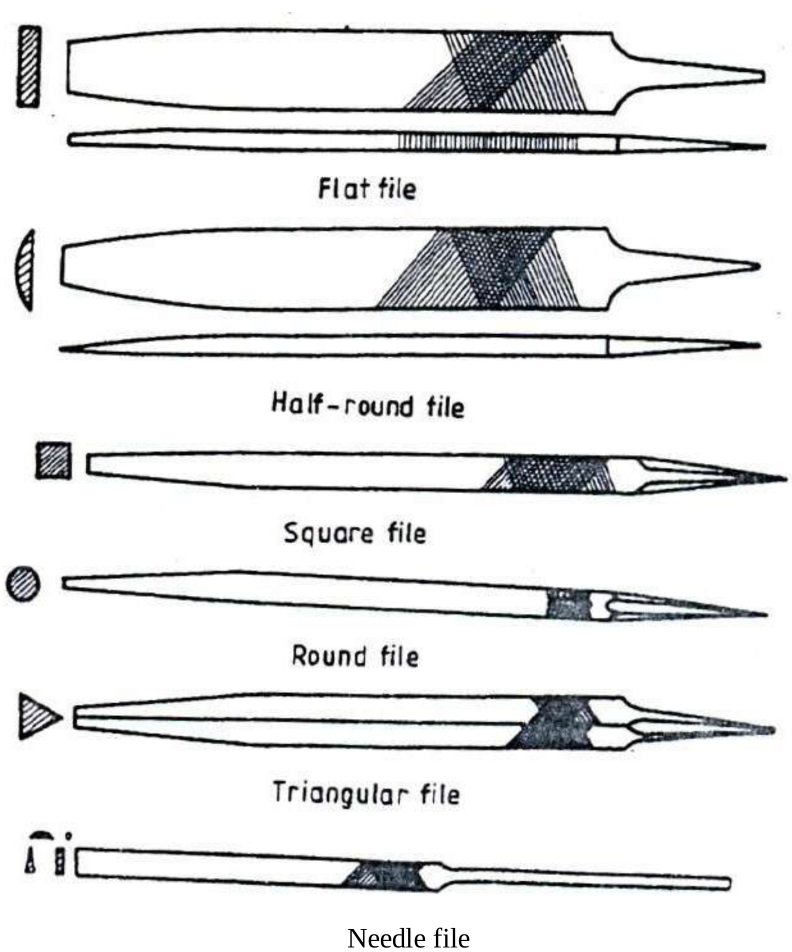
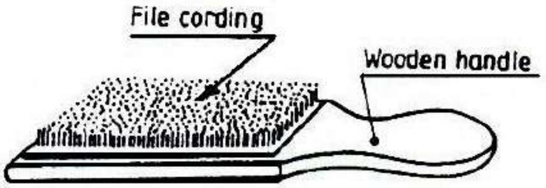


Figure 2.23 Types of files

2.6 MISCELLANEOUS TOOLS

2.6.1 File card

It is a metal brush, used for cleaning the files, to free them from filings, clogged in between the teeth.



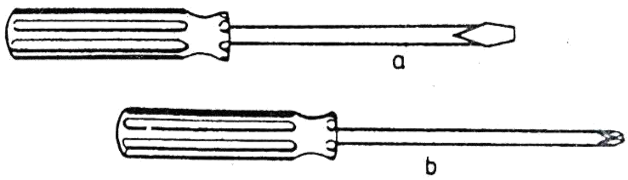


Figure 2.24 File card

2.6.2 Spirit level

It is used to check the leveling of machines.

2.6.3 Ball Peen Hammer

Ball Peen Hammers are named, depending upon their shape and material and specified by their weight. A ball peen hammer has a flat face which is used for general work and a ball end, particularly used for riveting.

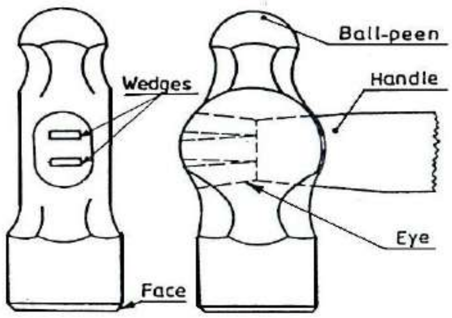


Figure 2.25 Ball peen hammer

2.6.4 Cross Peen Hammer

It is similar to ball peen hammer, except the shape of the peen. This is used for chipping, riveting, bending and stretching metals and hammering inside the curves and shoulders.

2.6.5 Straight Peen Hammer

This is similar to cross peen hammer, but its peen is in line with the hammer handle. It is used for swaging, riveting in restricted places and stretching metals.

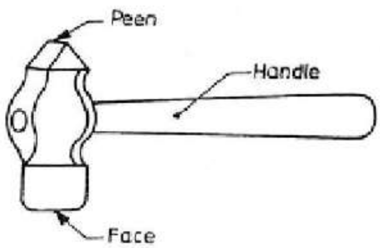


Figure 2.26 Cross peen hammer

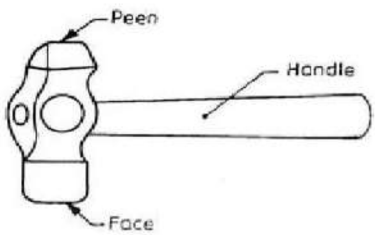


Figure 2.27 Straight peen hammer

1.6.6 Screw driver

A screw driver is designed to turn screws. The blade is made of steel and is available in different lengths and diameters. The grinding of the tip to the correct shape is very important.

A star screw driver is specially designed to fit the head of star screws. The end of the blade is fluted instead of flattened.

The screw driver is specified by the length of the metal part from handle to the tip.

2.6.7 Spanners

A spanner or wrench is a tool for turning nuts and bolts. It is usually made of forged steel. There are many kinds of spanners. They are named according to the application. The size of the spanner denotes the size of the bolt on which it can work.

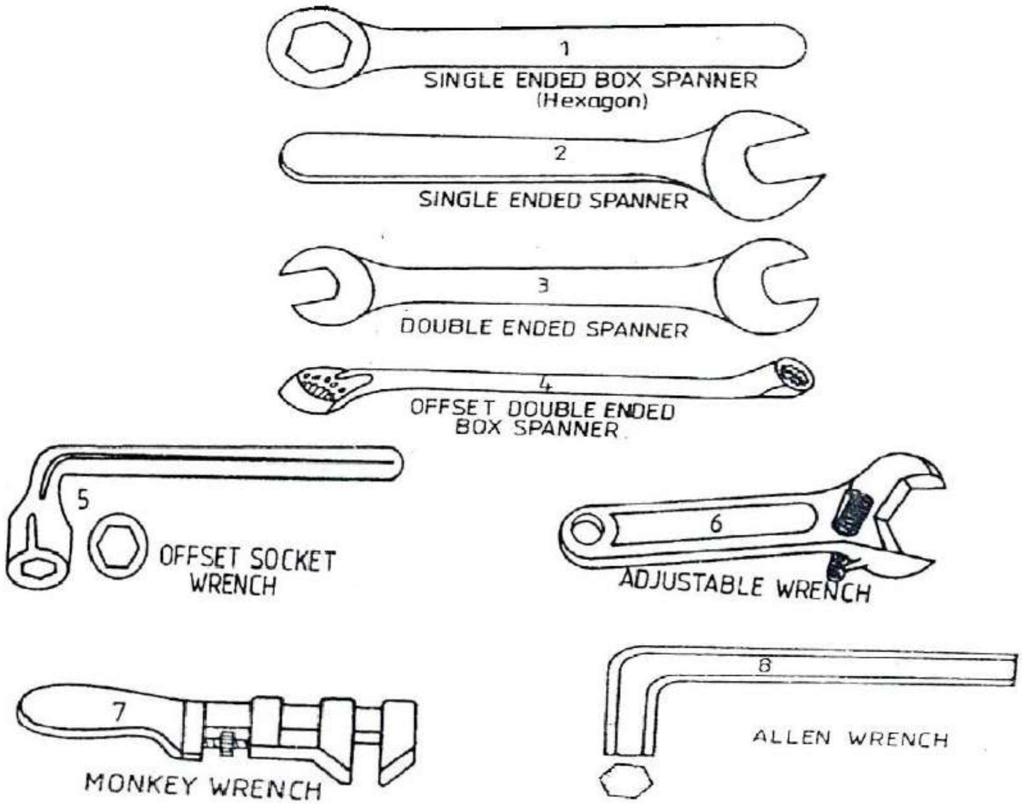


Figure 2.28 Spanners

2.7 Safe Practice

The following are some of the safe and correct work practices in bench work and fitting shop, with respect to the tools used

1. Keep hands and tools wiped clean and free of dirt, oil and grease. Dry tools are safer to use than slippery tools.

2. Do not carry sharp tools on pockets.

3. Wear leather shoes and not sandals.

4. Don’t wear loose clothes.

5. Do no keep working tools at the edge of the table.

6. Position the work piece such that the cut to be made is close to the vice. This practice prevents springing, saw breakage and personal injury.

7. Apply force only on the forward (cutting) stroke and relieve the force on the return stroke while sawing and filing.

8. Do not hold the work piece in hand while cutting.

9. Use the file with a properly fitted tight handle.

10. After filing, remove the burrs from the edges of the work, to prevent cuts to the fingers.

12. Do not use vice as an anvil. While sawing, keep the blade straight; otherwise it will break

13. Do not use a file without handle.

14. Clean the vice after use.

2.8 Models for Practice

Prepare the models, as per the dimensions and fits shown in below.

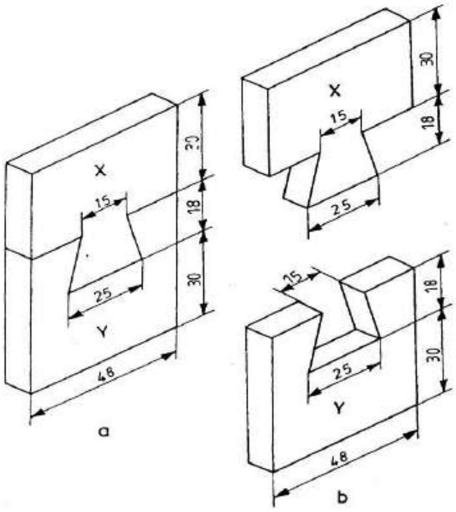


Figure 2.30: Dovetail Fitting

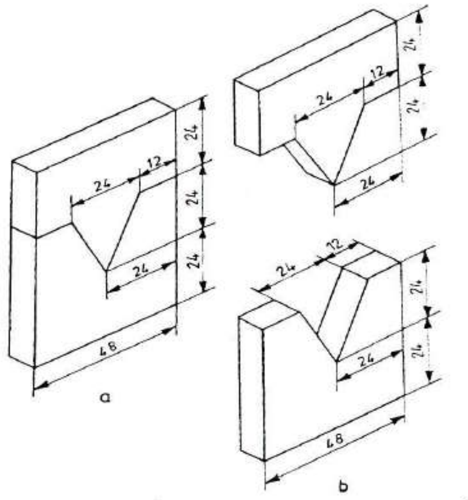


Figure 2.31: V fitting

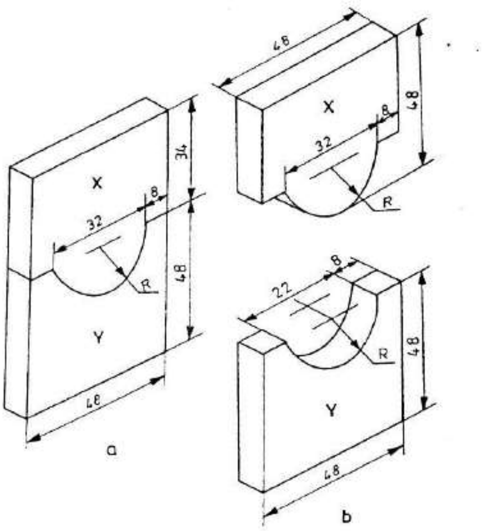


Figure 2.32: Half round fitting

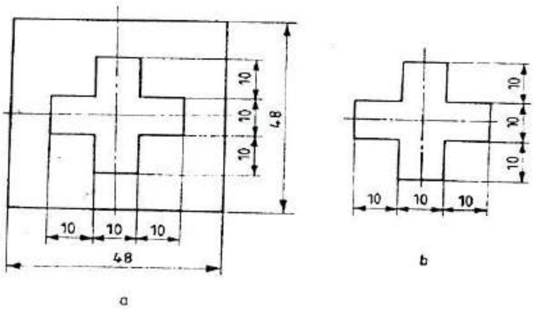


Figure 2.33: Cross fitting

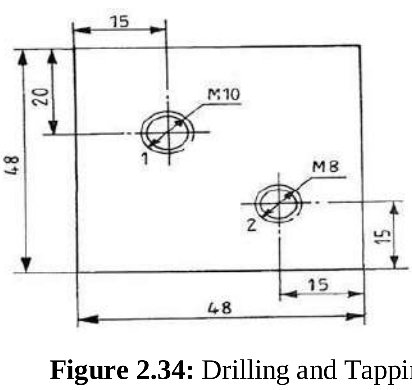


Figure 2.34: Drilling and Tapping

Ex.No: 2.1 **L FITTING**
Date :

Aim: To prepare a "L" fitting as per the given dimensions

Materials required: M.S. plates 30mm X 30mm X 4mm 2 no's

Tools required:

1.	Steel rule	300mm
2.	Scriber	200mm
3.	Try square	200mm
4.	Dot punch	100mm
5.	Flat file	300mm
6.	Hack saw	300mm
7.	Triangular file	300mm
8.	Chisel	200mm

Procedure:

1. Take M.S plates, mark the dimensions as per the diagram by using steel rule and scriber on chalk applied surface
2. Filing the edges to remove excess material and burrs.
3. Punch dots along the marked lines with dot punch.
4. Cut the unwanted material with the help of hacksaw and chisel.
5. Filing cutting edges with square file to get surface finish of the edges.

Precautions:

1. Cut the material along marked lines towards removing side
2. Hold hacksaw proper position to cut the material
3. Remove burrs properly by filing.
4. Do not test sharpness of cutting tools on your body
5. Hold the work piece firmly in bench vice while cutting.

Result :

Required square fit is prepared as per the given dimensions.

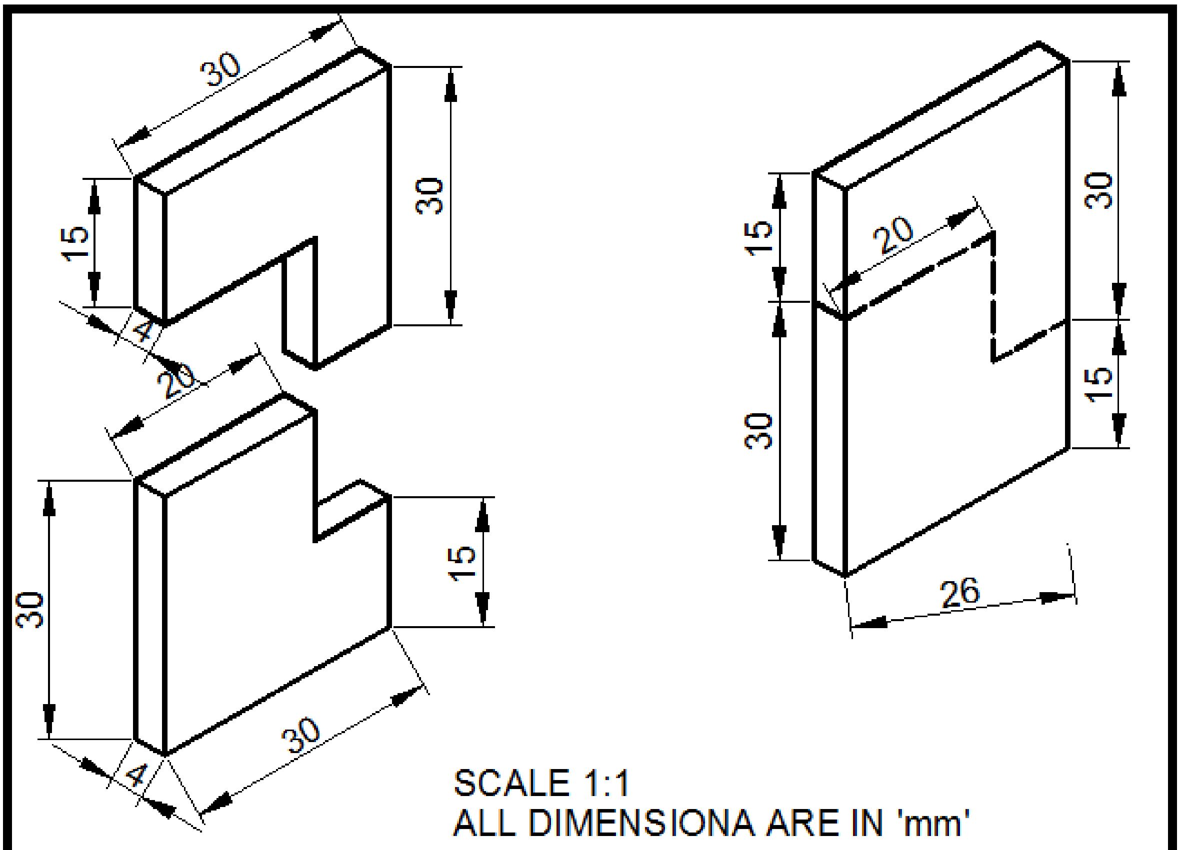

30
15
30
4
20
30
15
30
4
15
20
30
30
15
26
SCALE 1:1
ALL DIMENSIONA ARE IN 'mm'

Fig 1 . L - FIT

Ex.No: 2.2 **V FITTING**
Date :

Aim: - To make a V-Fit from the given mid steel pieces.

Materials required:
Mild steel flat (40*40*3mm)

Tools and equipment required:
1.6"try square
2. 6"sriber
3. Odd leg caliper
4 Blades (12 TPI)
5.10"rough file
6.10"smooth file
7.10"triangle file
8. Knife Edge file
9. Dot punch
10. Ball peen hammer (0.5 Ib)
11. Steel Rule
12. 12"hack saw Frame

Sequence of Operations:
1. Filling
2. Marking
3. Punching
4. Sawing
5. Filling
6. Finishing

Procedure:
1. The given mild steel flat piece is checked for given dimensions.
2. One edge of given is filled with rough and smooth files and checked with try square for straightness.
3. An adjacent edge is also filled such that it is square to first edge and checked with try square.
4. Wet chalk is applied on one side of the flat and dried for marking.
5. Lines are marked according to given figure, using odd leg caliper and steel rule.
6. Using the dot punch, punches are made along the marked lines.
7. The excess materials removed from the remaining two edges with try square level up to half of the marked dots.
8. Finally buts are removed by the filling on the surface of the fitted job.

PRECAUTIONS:
1. The perpendicularity of face ends edges is checked perfectly by using try square.
2. Finishing is given by using only with smooth files.
3. Marking is done without parallax error.

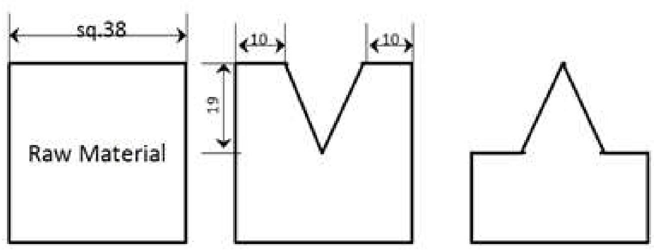


Figure 2.38: V Fitting

Result:
The V –fitting is done successfully

FITTING VIVA QUESTIONS

1. Name the work piece material?
2. In how many ways you can classify fitting tools?
3. What is hacksaw blade material?
4. What is the purpose of Triangular file?
5. Name different types of files?
6. What is difference between chipping and Filing?
7. Name different types of Chisels?
8. What is C-clamp?
9. What is the importance of Try – square?
10. Mention the difference between dot punch and centre punch?
11. What is the difference between inside and outside calliper?
12. What is the purpose of Round file?
13. What is difference between single and double cut files?
14. Why dot punching is necessary?
15. What is the purpose of using scriber?
16. Compare Hand saw & Hack saw?
17. Where we can use half round file?
18. Material removal takes place while moving the hack saw in (forward / backward) which direction?
19. When & where smooth and rough files are used?
20. Name the tools used to perform chipping & Filing operations?
21. In how many ways you can classify files?
22. Name the sequence of operations in fitting?
23. What are the tools used to perform above operations?

3.STUDY OF FOUNDRY

3.1 Introduction

3.1.1 Pattern

A pattern is a model or the replica of the object (to be casted). It is embedded in molding sand and suitable ramming of molding sand around the pattern is made. The pattern is then withdrawn for generating cavity (known as mold) in molding sand.

3.1.2 Common Pattern Materials

The common materials used for making patterns are wood, metal, plastic, plaster, wax or Mercury.

3.1.3 Types Of Pattern

The types of the pattern and the description of each are given as under.

1. One piece or solid pattern 2. Two piece or split pattern 3. Cope and drag pattern 4. Three-piece or multi- piece pattern 5. Loose piece pattern 6. Match plate pattern 7. Follow board pattern 8. Gated pattern 9. Sweep pattern 10. Skeleton pattern 11. Segmental or part pattern

1. Single-piece or solid pattern: Solid pattern is made of single piece without joints, partings lines or loose pieces. It is the simplest form of the pattern. Typical single piece pattern is shown in Fig. 4.1.

2. Two-piece or split pattern: When solid pattern is difficult for withdrawal from the mold cavity, then solid pattern is split in two parts. Split pattern is made in two pieces which are joined at the parting line by means of dowel pins. The splitting at the parting line is done to facilitate the withdrawal of the pattern. A typical example is shown in Fig. 10.2

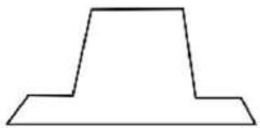


Fig. 10.1 Single piee pattern

Fig 3.1 Single Piece Pattern

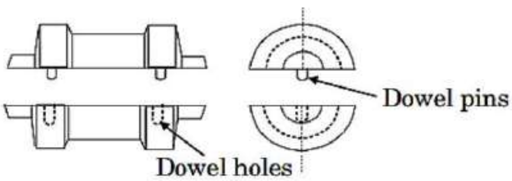


Fig 3.2 Two Piece Pattern

3.2 Molding Sand

The general sources of receiving molding sands are the beds of sea, rivers, lakes, granular elements of rocks, and deserts.

Molding sands may be of two types namely natural or synthetic. Natural molding sands contain sufficient binder. Whereas synthetic molding sands are prepared artificially using basic sand molding constituents (silica sand in 88-92%, binder 6-12%, water or moisture content 3-6%) and other additives in proper proportion by weight with perfect mixing and mulling in suitable equipments.

3.2.1 Binder

In general, the binders can be either inorganic or organic substance. The inorganic group includes clay sodium silicate and port land cement etc. In foundry shop, the clay acts as binder which may be Kaolonite, Ball Clay, Fire Clay, Limonite, Fuller’s earth and Bentonite. Binders included in the organic group are dextrin, molasses, cereal binders, linseed oil and resins like phenol formaldehyde, urea formaldehyde etc. Organic binders are mostly used for core making.

Among all the above binders, the bentonite variety of clay is the most common. However, this clay alone cannot develop bonds among sand grins without the presence of moisture in molding sand and core sand.

3.2.2 Additives

Additives are the materials generally added to the molding and core sand mixture to develop some special property in the sand. Some common used additives for enhancing the properties of molding and core sands are discussed as under.

1. **Coal dust:** Coal dust is added mainly for producing a reducing atmosphere during casting.
2. **Corn flour:** It belongs to the starch family of carbohydrates and is used to increase the collapsibility of the molding and core sand
3. **Dextrin:** Dextrin belongs to starch family of carbohydrates that behaves also in a manner similar to that of the corn flour. It increases dry strength of the molds.
4. **Sea coal:** Sea coal is the fine powdered bituminous coal which positions its place among the pores of the silica sand grains in molding sand and core sand
5. **Wood flour:** This is a fibrous material mixed with a granular material like sand; its relatively long thin fibers prevent the sand grains from making contact with one another.
6. **Silica flour:** It is called as pulverized silica and it can be easily added up to 3% which increases the hot strength and finish on the surfaces of the molds and cores.

3.2.3 Kinds of Moulding Sand

Molding sands can also be classified according to their use into number of varieties which are described below.

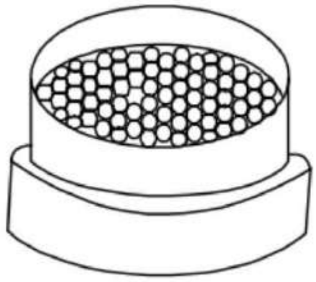
1. **Green sand:** Green sand is also known as tempered or natural sand which is a just prepared mixture of silica sand with 18 to 30 percent clay, having moisture content from 6 to 8%. The clay and water furnish the bond for green sand. It is fine, soft, light, and porous.
2. **Dry sand:** Green sand that has been dried or baked in suitable oven after the making mold and core is called dry sand. It possesses more strength, rigidity and thermal stability.
3. **Loam sand:** Loam is mixture of sand and clay with water to a thin plastic paste. Loam sand possesses high clay as much as 30-50% and 18% water.
4. **Facing sand:** Facing sand is just prepared and forms the face of the mould. It is directly next to the surface of the pattern and it comes into contact molten metal when the mould is poured. Initial coating around the pattern and hence for mold surface is given by this sand. This sand is subjected severest conditions and must possess, therefore, high strength refractoriness.
5. **Backing sand:** Backing sand or floor sand is used to back up the facing sand and is used to fill the whole volume of the molding flask.
6. **Parting sand:** Parting sand without binder and moisture is used to keep the green sand not to stick to the pattern and also to allow the sand on the parting surface the cope and drag to separate without clinging
7. **Core sand:** Core sand is used for making cores and it is sometimes also known as oil sand. This is highly rich silica sand mixed with oil binders such as core oil which composed of linseed oil, resin, light mineral oil and other bind materials.

3.2.4 Properties of Molding Sand

The basic properties required in molding sand and core sand are described as under.

1. **Refractoriness:** Refractoriness is defined as the ability of molding sand to withstand high temperatures without breaking down or fusing thus facilitating to get sound casting. It is a highly important characteristic of molding sands. Refractoriness can only be increased to a limited extent
2. **Permeability:** It is also termed as porosity of the molding sand in order to allow the escape of any air, gases or moisture present or generated in the mould when the molten metal is poured into it. All these gaseous generated during pouring and solidification process must escape otherwise the casting becomes defective
3. **Cohesiveness:** It is property of molding sand by virtue which the sand grain particles interact and attract each other within the molding sand.

4. **Green strength:** The green sand after water has been mixed into it, must have sufficient strength and toughness to permit the making and handling of the mould. For this, the sand grains must be adhesive, i.e. They must be capable of attaching themselves to another body
5. **Dry strength:** As soon as the molten metal is poured into the mould, the moisture in the sand layer adjacent to the hot metal gets evaporated and this dry sand layer must have sufficient strength to its shape in order to avoid erosion of mould wall during the flow of molten metal
6. **Flowability or plasticity:** It is the ability of the sand to get compacted and behave like a fluid. It will flow uniformly to all portions of pattern when rammed and distribute the ramming pressure evenly all around in all directions
7. **Adhesiveness:** It is property of molding sand to get stick or adhere with foreign material such sticking of molding sand with inner wall of molding box.
8. **Collapsibility:** After the molten metal in the mould gets solidified, the sand mould must be collapsible so that free contraction of the metal occurs and this would naturally avoid the tearing or cracking of the contracting metal.



3.2.5 HAND TOOLS USED IN FOUNDRY SHOP

Hand riddle: It consists of a screen of standard circular wire mesh equipped with circular wooden frame. It is generally used for cleaning the sand for removing foreign material such as nails, shot metal, splinters of wood etc. from it. Even power operated riddles are available for riddling large volume of sand.

Shovel: It consists of a steel pan fitted with a long wooden handle. It is used in mixing, tempering and conditioning the foundry sand by hand. It is also used for moving and transforming the molding sand to the container and molding box or flask.

Fig. Showel

Showel

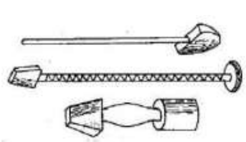


Fig. Rammers

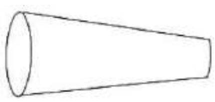
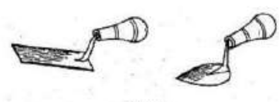


Fig.Sprue Pin



Trowels

Rammers: Rammers are shown in Fig. These are required for striking the molding sand mass in the molding box to pack or compact it uniformly all around the pattern.

Sprue pin: It is a tapered rod of wood or iron which is placed or pushed in cope to join mold cavity while the molding sand in the cope is being rammed.

Trowels: These are used for finishing flat surfaces and comers inside a mould. Common shapes of trowels are shown as under. They are made of iron with a wooden handle.

Lifter: A lifter is a finishing tool used for repairing the mould and finishing the mould sand. Lifter is also used for removing loose sand from mould**.**

Fig. Lifter

Strike off bar: It is a flat bar, made of wood or iron to strike off the excess sand from the top of a box after ramming. It's one edge made beveled and the surface perfectly smooth and plane.

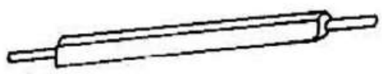
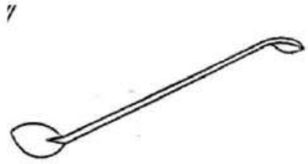


Fig. Strike off bar

Vent wire: It is a thin steel rod or wire carrying a pointed edge at one end and a wooden handle or a bent loop at the other. After ramming and striking off the excess sand it is used to make small

Vent wire

Fig. Vent Wire



holes, called vents, in the sand mould to allow the exit of gases and steam during casting.

Slicks: They are also recognized as small double ended mold finishing tool which are generally used for repairing and finishing the mold surfaces and their edges after withdrawal of the pattern

Fig. Slicks

Swab: Swab is shown in Fig. It is a small hemp fiber brush used for moistening the edges of sand mould, which are in contact with the pattern surface before withdrawing the pattern. It is used for sweeping away the molding sand from the mold surface and pattern.

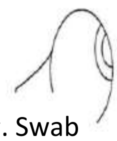


Fig. Swab

Gate cutter: Gate cutter Fig. It is a small shaped piece of sheet metal commonly used to cut runners and feeding gates for connecting sprue hole with the mold cavity.

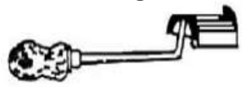
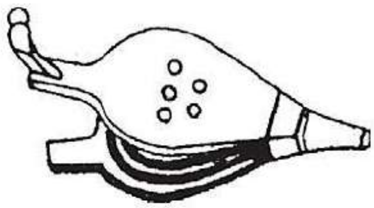


Fig. Gate Cutter

Bellows: Bellows gun is shown in Fig. It is hand operated leather made device equipped with compressed air jet to blow or pump air when operated. It is used to blow away the loose or unwanted sand from the surfaces of mold cavities.

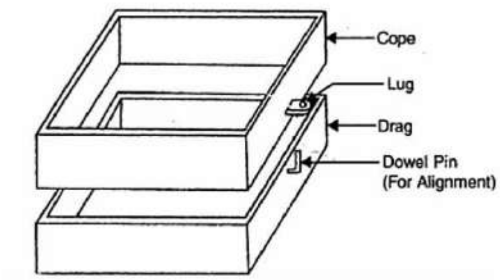
Draw spike: Draw spike is shown Fig. It is a tapered steel rod having a loop or ring at its one end and a sharp point at the other. It may have screw threads on the end to engage metal pattern for it withdrawal from the mold.

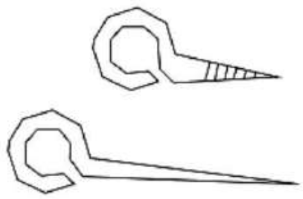
Sprue Pin: It is a tapered wooden pin, used to make a hole in the cope through which the molten metal is poured into the mould.

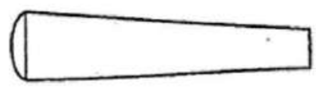


3.2.6 Molding Box:

Moulding box is also called molding flask. It is frame or box of wood or metal. It is made of two parts cope and drag as shown in figure.







EXP: 3.1 **MOULD FOR A SINGLE PIECE PATTERN** **Date:**

Aim:
To prepare a sand mold, using the given single piece pattern.

Raw Material Required:

Moulding sand, Parting sand, facing sand, baking sand, single piece solid pattern, bottom board, moulding boxes etc.

Tools Required:

1. Molding board
2. Drag and cope boxes
3. Molding sand
4. Parting sand
5. Rammer
6. Strike-off bar
7. Bellows
8. Riser and sprue pins
9. Gate cutter
10. Vent rod
11. Draw spike
12. Wire Brush

Sequence of operations:

1. Sand preparation
2. Placing the mould flask(drag) on the moulding board/ moulding platform
3. Placing the pattern at the centre of the moulding flask
4. Ramming the drag
5. Placing runner and riser
6. Ramming the cope
7. Removal of the pattern, runner, riser
8. Gate cutting

Procedure:

Mould Making

1. First a bottom board is placed either on the molding platform or on the floor, making the surface even.
2. The drag molding flask is kept upside down on the bottom board along with the drag part of the pattern at the centre of the flask on the board.
3. Dry facing sand is sprinkled over the board and pattern to provide a non-sticky layer.
4. Freshly prepared molding sand of requisite quality is now poured into the drag and on the pattern to a thickness of 30 to 50 mm.

5. Rest of the drag flask is completely filled with the backup sand and uniformly rammed to compact the sand.
6. After the ramming is over, the excess sand in the flask is completely scraped using a flat bar to the level of the flask edges.
7. Now with a vent wire which is a wire of 1 to 2 mm diameter with a pointed end, vent holes are in the drag to the full depth of the flask as well as to the pattern to facilitate the removal of gases during casting solidification. This completes the preparation of the drag.
8. Now finished drag flask is rolled over to the bottom board exposing the pattern.
9. Using a slick, the edges of sand around the pattern is repaired
10. The cope flask on the top of the drag is located aligning again with the help of the pins of the drag box.
11. Sprue of the gating system for making the sprue passage is located at a small distance of about 50 mm from the pattern. The sprue base, runners and in-gates are also located as shown risers are also placed. Freshly prepared facing sand is poured around the pattern.
12. The moulding sand is then poured in the cope box. The sand is adequately rammed, excess sand is scraped and vent holes are made all over in the cope as in the drag.
13. The sprue and the riser are carefully withdrawn from the flask
14. Later the pouring basin is cut near the top of the sprue.
15. The cope is separated from the drag any loose sand on the cope and drag interface is blown off with the help of the bellows.
16. Now the cope and the drag pattern halves are withdrawn by using the draw spikes and rapping the pattern all around to slightly enlarge the mould cavity so that the walls are not spoiled by the withdrawing pattern.
17. The runners and gates are to be removed or to be cut in the mould carefully without spoiling the mould.
18. Any excess or loose sand is applied in the runners and mould cavity is blown away using the bellows.
19. Now the facing paste is applied all over the mould cavity and the runners which would give the finished casting a good surface finish.
20. A dry sand core is prepared using a core box. After suitable baking, it is placed in the mould cavity.
21. The cope is placed back on the drag taking care of the alignment of the two by means of the pins.
22. The mould is ready for pouring molten metal. The liquid metal is allowed to cool and become solid which is the casting desired.

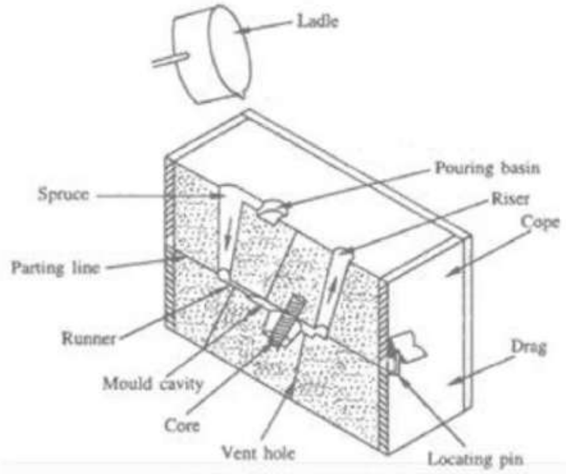
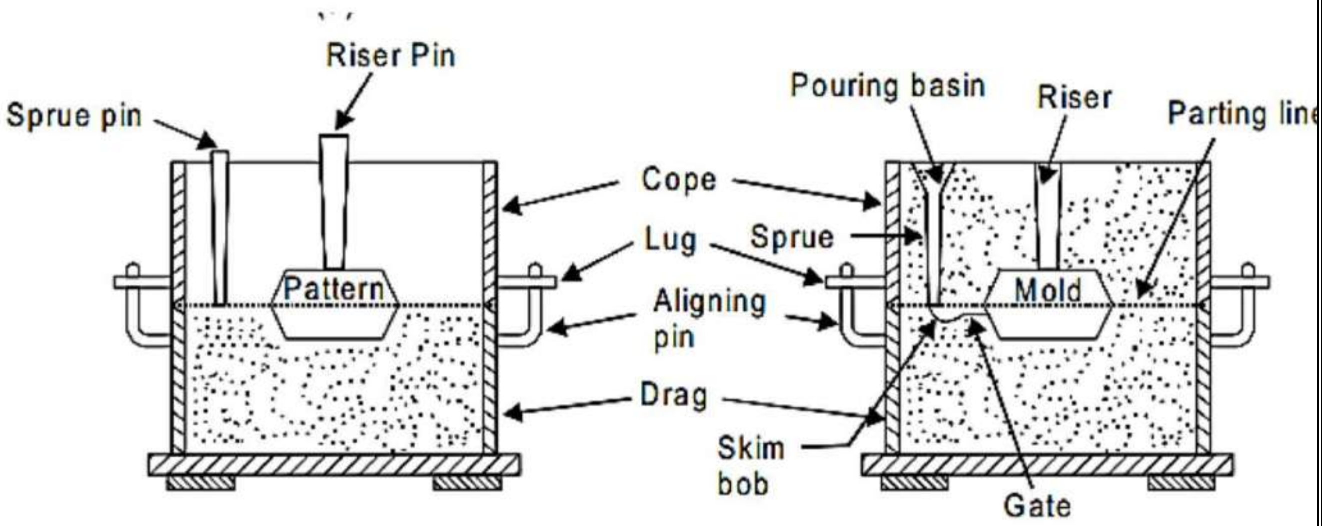


Fig. 6.1 Cross section of a sand mould



Result:

The required mould cavity is prepared using the given Single /solid Pattern.

EXP: 3.2 **MOULD FOR A SPLIT PATTERN**

Aim:
To prepare a sand mold, using the given Split-piece pattern.

Raw Material required:
Moulding sand, Parting sand, facing sand, baking sand, pattern, bottom board, moulding boxes.

Tools Required:

1. Molding board
2. Drag and cope boxes
3. Molding sand
4. Parting sand
5. Rammer
6. Strike-off bar
7. Bellows
8. Riser and sprue pins
9. Gate cutter
10. Vent rod
11. Draw spike
12. Wire Brush

Sequence of operations:

1. Sand preparation
2. Placing the mould flask(drag) on the moulding board/ moulding platform
3. Placing the split pattern at the centre of the moulding flask
4. Ramming the drag
5. Placing the pattern at the centre of the moulding flask (Cope box)
6. Placing runner and riser
7. Ramming the cope
8. Removal of the pattern, runner, riser
9. Gate cutting

Procedure:

Mould Making

1. First a bottom board is placed either on the molding platform or on the floor, making the surface even.
2. The drag molding flask is kept upside down on the bottom board along with the drag part of the pattern at the centre of the flask on the board.
3. Dry facing sand is sprinkled over the board and pattern to provide a non-sticky layer.
4. Freshly prepared molding sand of requisite quality is now poured into the drag and on the split-pattern to a thickness of 30 to 50 mm.

5. Rest of the drag flask is completely filled with the backup sand and uniformly rammed to compact the sand.
6. After the ramming is over, the excess sand in the flask is completely scraped using a flat bar to the level of the flask edges.
7. Now with a vent wire which is a wire of 1 to 2 mm diameter with a pointed end, vent holes are in the drag to the full depth of the flask as well as to the pattern to facilitate the removal of gases during casting solidification. This completes the preparation of the drag.
8. Now finished drag flask is rolled over to the bottom board exposing the pattern.
9. Using a slick, the edges of sand around the pattern is repaired and cope half of the pattern is placed over the drag pattern, aligning it with the help of dowel pins
10. The cope flask on the top of the drag is located aligning again with the help of the pins of the drag box.
11. Dry parting sand is sprinkled all over the drag surface and on the pattern
12. Sprue of the gating system for making the sprue passage is located at a small distance of about 50 mm from the pattern. The sprue base, runners and ingates are also located as shown risers are also placed. Freshly prepared facing sand is poured around the pattern.
13. The moulding sand is then poured in the cope box. The sand is adequately rammed, excess sand is scraped and vent holes are made all over in the cope as in the drag.
14. The sprue and the riser are carefully withdrawn from the flask
15. Later the pouring basin is cut near the top of the sprue.
16. The cope is separated from the drag any loose sand on the cope and drag interface is blown off with the help of the bellows.
17. Now the cope and the drag pattern halves are withdrawn by using the draw spikes and rapping the pattern all around to slightly enlarge the mould cavity so that the walls are not spoiled by the withdrawing pattern.
18. The runners and gates are to be removed or to be cut in the mould carefully without spoiling the mould.
19. Any excess or loose sand is applied in the runners and mould cavity is blown away using the bellows.
20. Now the facing paste is applied all over the mould cavity and the runners which would give the finished casting a good surface finish.
21. A dry sand core is prepared using a core box. After suitable baking, it is placed in the mould cavity.
22. The cope is placed back on the drag taking care of the alignment of the two by means of the pins.
23. The mould is ready for pouring molten metal. The liquid metal is allowed to cool and become solid which is the casting desired.

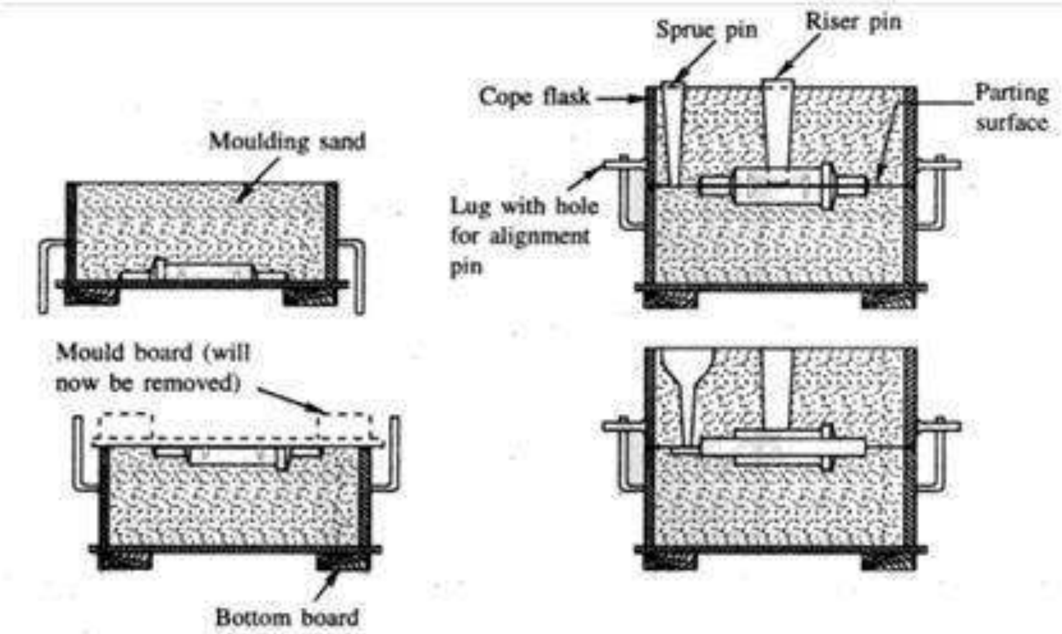
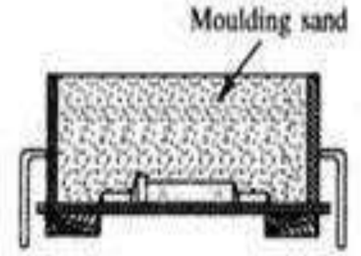
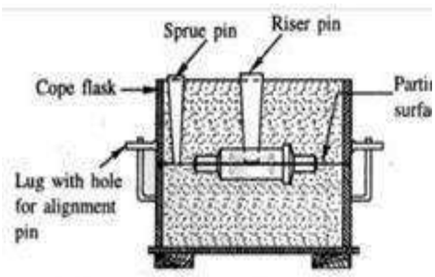


Fig. 6.2 Sand mould making procedure

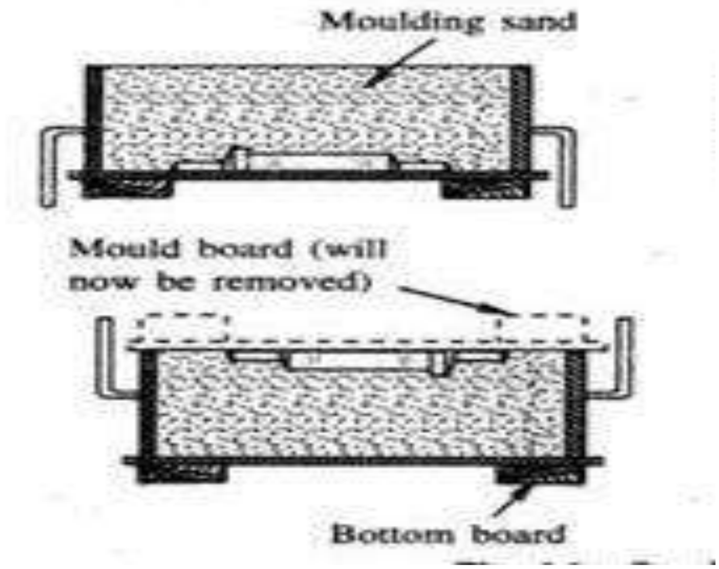
Step-1: Place Drag part of the pattern on mould board and filled with mould sand



Step -2: Turn drag box upside down and Place cope box over drag box



Step -3: place cope part of the pattern, riser, Sprue, runner in position and filled with mould sand.



Step-4: Finally the Mould cavity is produced by removing the pattern.

Result:

The required mould cavity is prepared using the given Split Pattern.

FOUNDRY SECTION VIVA QUESTIONS

1. What are the main ingredients of good moulding sand?
Silica sand, clay, coal dust/saw dust and traces of magnesium potassium etc

2.What are the main properties required for a good molding sand?
Cohesiveness, adhesiveness, collapse-ability, refractoriness, porosity, flow ability, plasticity, permeability etc

3. Can you tell the name of bottom and top parts of the moulding box?
Drag and cope

4. What are the defects found in a casting?
Blow holes, sand spots, swell, shrinkage, hot tear gas porosity, run outs, shifts etc

5. What is meant by foundry?
Foundry is the place where casting is being done

6. What is the name of item used to smooth the mould cavity?
Graphite powder and plumbago.

7. What is the name of tool used to blow off the loose particles from the mould cavity?
Bellow

8.What is meant by sprue pin?
Sprue pin is used to provide the runner hole through which molten metal is being poured into the mould cavity

9. What is the tool used to compact the moulding sand?
Hand Rammer and peen rammer

10. What is the purpose of draft in pattern?
Draft is the taper provided in the pattern for the easy removal of the pattern from the molding sand.

11. What are the materials to be charged in a cupola furnace?
Coke, lime stone, cast iron, scrap iron etc

12. What is the purpose of laddle in a foundry shop?
Laddle is used to collect the molten metal from the cupola furnace.

13. Why a tapering is provided on the sprue pin?
Sprue pin the portion through which the molten metal is poured into the mould cavity, when the molten metal is poured the velocity of the liquid metal will be going on increasing so a negative pressure will be created around the liquid metal and the air will be rushing to the mould cavity. This can be avoided if we provide taper on the sprue pin.

14. What are the main tools used in the Foundry shop?

Shovel, Trowel, Riddle, Gate cutter, Slick, Scooping spoon, Lifter, vent rod, Draw spike,

15. Explain the term Gate related to mould?
 Gate is the path way of molten metal to the mould cavity usually cut on the top face of the drag.

16. What is meant by green sand moulding?

17. What is the optimum water content for making a mould cavity.7%

18. What is meant by core and core print?
 Core is used for making void space in a casting. core print is the impression in mould cavity where the core has to be placed.

4.STUDY OF CARPENTRY

4.1 Introduction

Carpentry may be defined as the process of making wooden components. It starts from a marketable form of wood and ends with finished products. It deals with the building work, furniture, cabinet making. Etc. joinery, i.e., preparation of joints is one of the important operations in all wood works. It deals with the specific work of carpenter like making different types of joints to form a finished product.

4.2 Timber

Timber is the name given to the wood obtained from well grown trees. The trees are cut, sawn into various sizes to suit building purposes.

The word, ‘grain’, as applied to wood, refers to the appearance or pattern of the wood on the cut surfaces. The grain of the wood is a fibrous structure and to make it strong, the timber must be so cut, that the grains run parallel to the length.

4.2.1 Timber Sizes

Timber sold in the market is in various sizes and shapes. The following are the common shapes and sizes. a. Log b. Balk c. Post d. Plank e. Board f. Reapers

1. A sawn timber piece, below 175 mm in width and 30 to 50 mm in thickness.
2. Sawn timber pieces of assorted and non-standard sizes, which do not confirm to the above shapes and sizes.

4.2.2 Classification of Timber

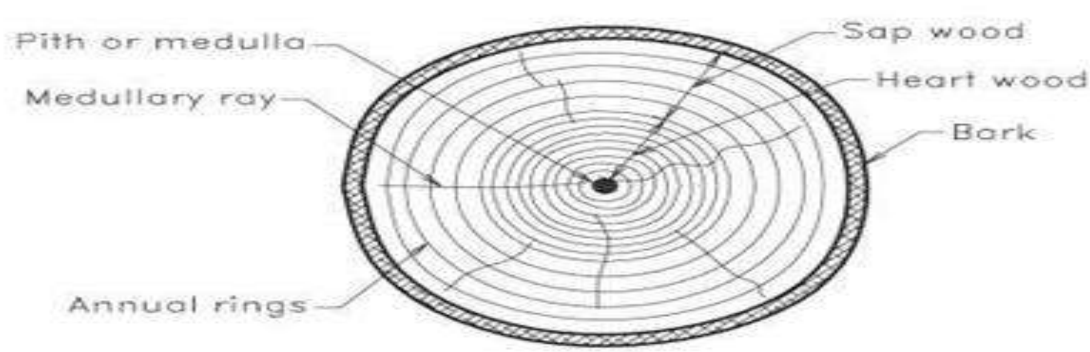
Wood suitable for construction and other engineering purposes is called timber. Woods in general are divided into two broad categories: Soft woods and Hard woods.

Soft woods are obtained from conifers, kair, deodar, chir, walnut and seemal. Woods obtained from teak, sal, oak, shisham, beach, ash mango, neem and babul are known as hard wood, but it is highly durable.

Another classification of woods is based on the name of the trees like teak, babul, shisham, neem, kair, chir, etc.

4.2.3 Seasoning of Wood

A newly felled tree contains considerable moisture content. If this is not removed, the timber is likely to wrap, shrink, crack or decay. Seasoning is the art of extracting the moisture content under controlled conditions, at a uniform rate, from all the parts of the timber. Only seasoned wood should be used for all carpentry works. Seasoning makes the wood resilient and lighter. Further, it ensures that the wood will not distort after it is made into an object.



4.2.4 Characteristics of Good Timber:-

The good timber must possess the following characteristics:

a. It should have minimum moisture content, i.e., the timber should be well seasoned.
b. The grains of wood should be straight and long.
c. It must retain its straightness after seasoning.
d. It should produce near metallic sound on hammering.
e. It should be free from knots or cracks.
f. It should be of uniform color, throughout the part of the wood.
g. It should respond well to the finishing and polishing operations.
h. During driving the nails and screw, it should not split easily.

4.3 Marking and Measuring Tools

Accurate marking and measurement is very essential in carpentry work, to produce parts to exact size. To transfer dimensions onto the work; the following are the marking and measuring tools that are required in a carpentry shop.

4.3.1 Steel Rule and Steel Tape

Steel rule is a simple measuring instrument consisting of a long, thin metal strip with a marked scale of unit divisions. It is an important tool for linear measurement. Steel tape is used for large measurements, such as marking on boards and checking the overall dimensions of the work.

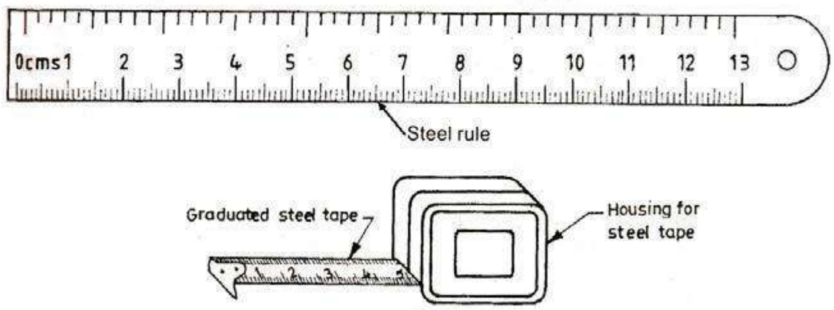
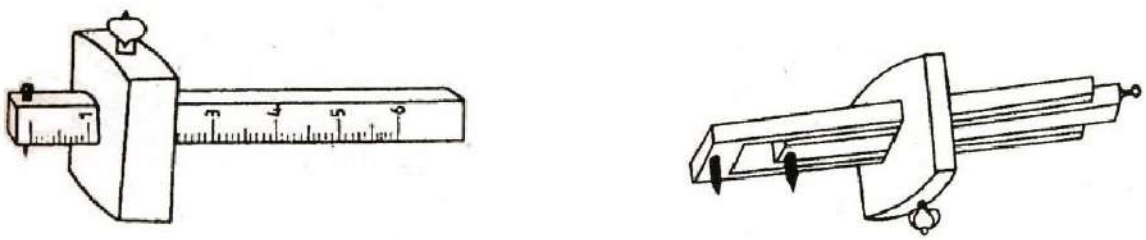


Figure 4.1: Steel rule and Steel tape

4.3.2 Marking Gauge

It is a tool used to mark lines parallel to the edge of a wooden piece. It consists of a square wooden stem with a sliding wooden stock (head) on it. On the stem is fitted a marking pin, made of steel. The stock is set at any desired distance from the marking point and fixed in position by a screw. It must be ensured that the marking pin projects through the stem, about 3 mm and the end are sharp enough to make a very fine line. A mortise gauge consists of two pins. In this, it is possible to adjust the distance between the pins, to draw two parallel lines on the stock.



a. Marking gauge b. Mortise gauge

Figure 4.2: Marking gauges

4.3.3 Try square

It is used for marking and testing the squareness and straightness of planed surfaces. It consists of a steel blade, fitted in a cast iron stock. It is also used for checking the planed surfaces for flatness. Its size varies from 150 to 300 mm, according to the length of the blade. It is less accurate when compared to the try square used in the fitting shop.

Figure 4.3: Try square

4.3.4 Compass and divider

Compass and divider, are used for marking arcs and circles on the planed surfaces of the wood.

4.3.5 Scriber or marking knife

It is used for marking on timber. It is made of steel having one end pointed and the other end formed into a sharp cutting edge.

4.3.6 Bevel

It is used for laying out and checking angles. The blade of the bevel is adjustable and may be held in place by a thumb screw. After it is set to the desired angle, it can be used in much the same way as a try square. A good way to set it to the required angle is to mark the angle on a surface and then adjust the blade to fit the angle.

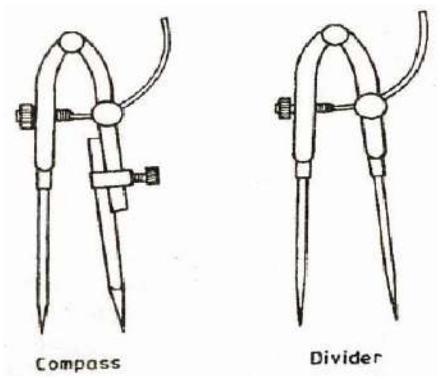


Figure 4.4: Compass and Divider

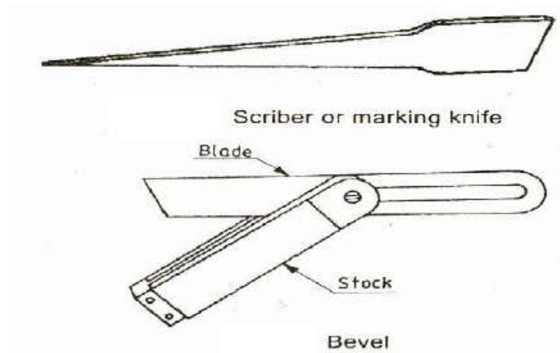


Figure 4.5: Scriber and Bevel

4.4 Holding Tools

4.4.1 Carpenter's vice

Figure 2.6 shows the carpenter's bench vice, used as a work holding device in a carpenter shop. Its one jaw is fixed to the side of the table while the other is movable by means of a screw and a handle. The Carpenter's vice jaws are lined with hard wooden' faces.

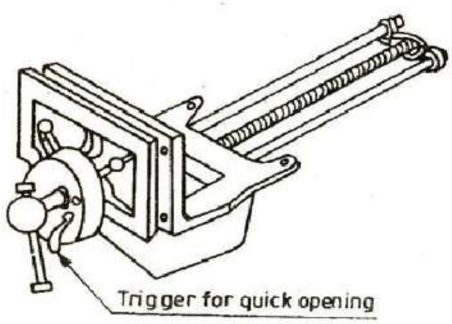


Figure 4.6: Carpenter’s vice

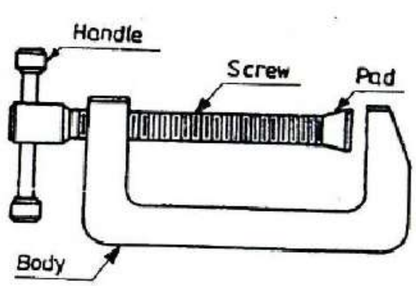


Figure 4.7: C-clamp

4.4.2 C-clamp

Figure 2.7 shows a C-clamp, which is used for holding small works.

4.4.3 Bar cramp

Figure 2.8 shows a bar cramp. It is made of steel bar of T-section, with malleable iron fittings and a steel screw. It is used for holding wide works such as frames or tops.

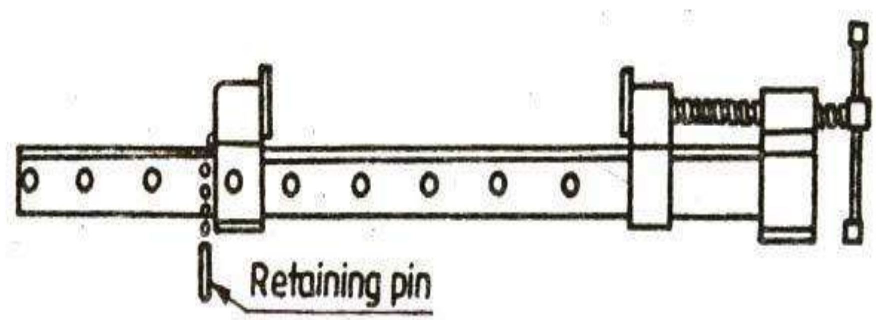


Figure 4.8: Bar cramp

4.5 Planing Tools

Planing is the operation used to produce flat surfaces on wood. A plane is a hand tool used for this purpose. The cutting blade used in a plane is very similar to a chisel. The blade of a plane is fitted in a wooden or metallic block, at an angle.

4.5.1 Jack Plane

It is the most commonly used general purpose plane. It is about 35 cm long. The cutting iron (blade) should have a cutting edge of slight curvature. It is used for quick removal of material on rough work and is also used in oblique planning.

4.5.2 Smoothing Plane

It is used for finishing work and hence, the blade should have a straight cutting edge. It is about 20 to 25 cm long. Being short, it can follow even the slight depressions in the stock, better than the jack plane. It is used after using the jack plane.

4.5.3 Rebate Plane

It is used for making a rebate. A rebate is a recess along the edge of a piece of wood, which is generally used for positioning glass in frames and doors.

4.5.4 Plough Plane

It is used to cut grooves, which are used to fix panels in a door. Figure 2.9 shows the various types of planes mentioned above.

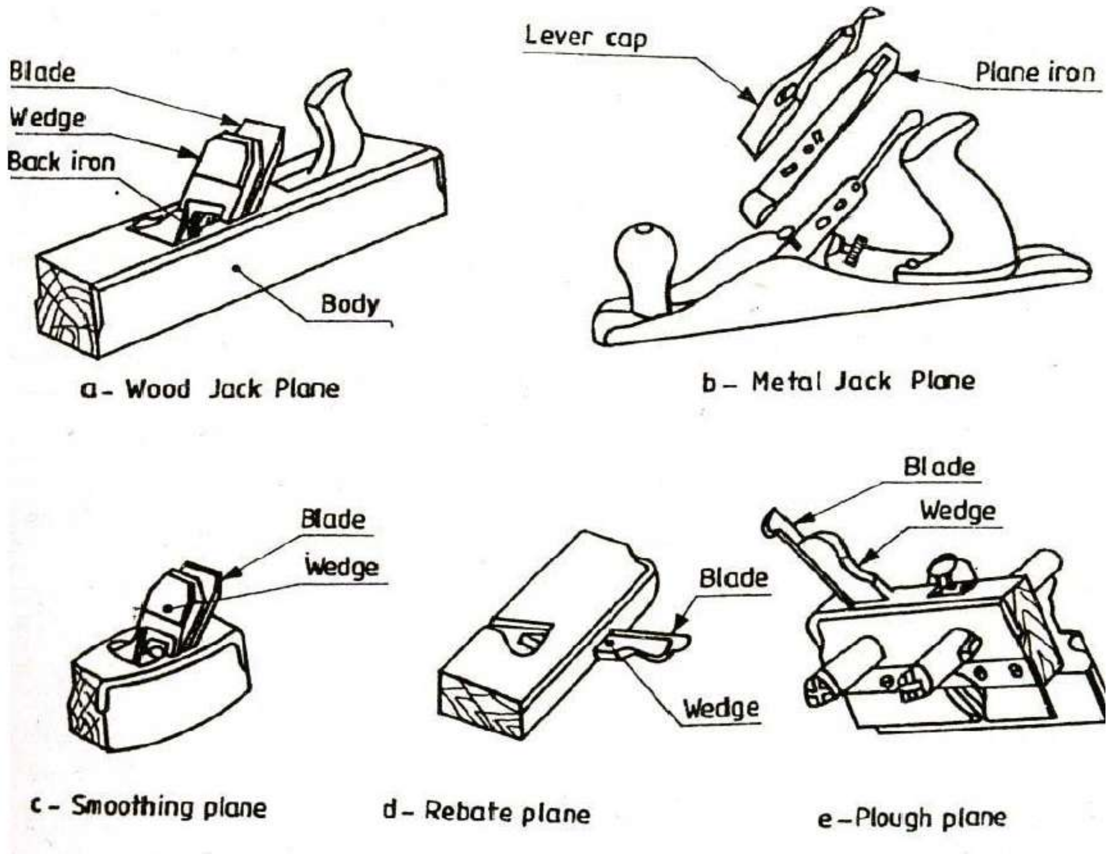


Figure 4.9: Types of planes

4.6 Cutting Tools

4.6.1 Saws

A saw is used to cut wood into pieces. There are different types of saws, designed to suit different purposes. A saw is specified by the length of its toothed edge.

4.6.1.1 Cross cut or hand saw

It is used to cut across the grains of the stock. The teeth are so set that the saw kerf will be wider than the blade thickness. This allows the blade to move freely in the cut, without sticking.

4.6.1.2 Rip saw

It is used for cutting the stock along the grains. The cutting edge of this saw makes a steeper angle, i.e., about 60° whereas that of crosscut saw makes an angle of 45° with the surface of the stock.

4.6.1.3 Tenon saw

It is used for cutting the stock either along or across the grains. It is used for cutting tenons and in fine cabinet work. However, it is used for small and thin cuts. The blade of this saw is very thin and so it is stiffened with a thick back steel strip. Hence, this is sometimes called as back saw. In this, the teeth are shaped like those of cross cut saw.

4.6.1.4 Compass saw

It has a narrow, longer and stronger tapering blade, which is used for heavy works. It is mostly used in radius cutting. The blade of this saw is fitted with an open type wooden handle.

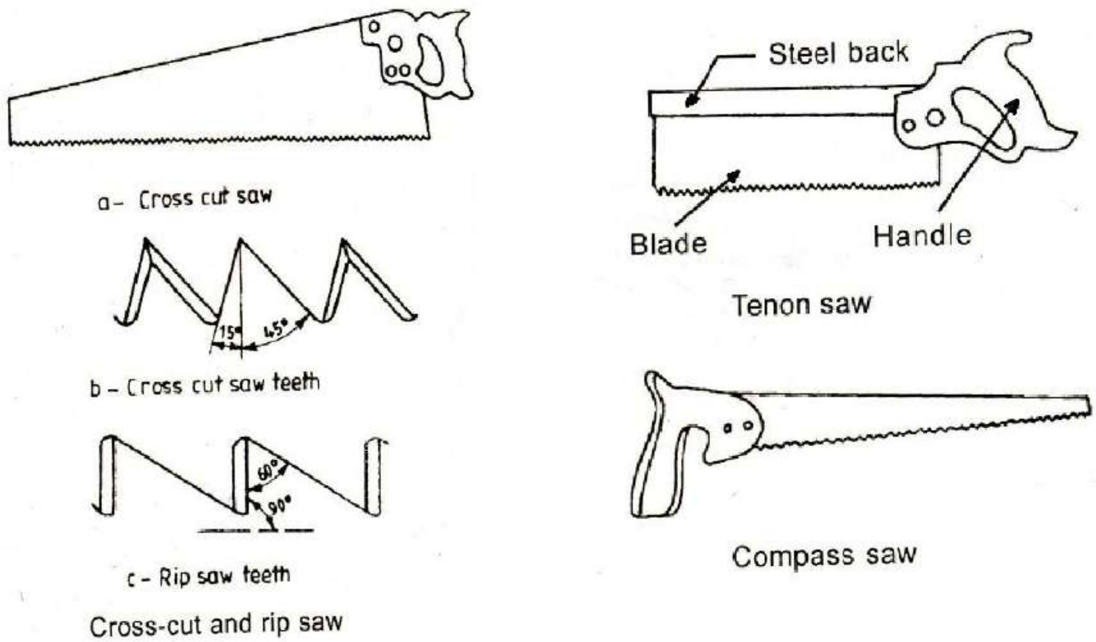


Figure 4.10: Types of saws

4.6.2 Chisels

Chisels are used for cutting and shaping wood accurately. Wood chisels are made in various blade widths, ranging from 3 to 50 mm. They are also made in different blade lengths. Most of the wood chisels are made into tang type, having a steel shank which fits inside the handle. These are made of forged steel or tool steel blades.

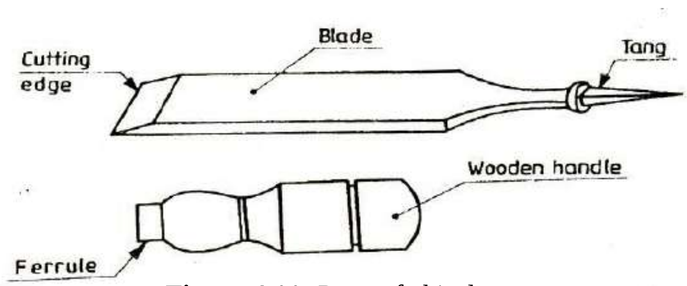


Figure 4.11: Parts of chisel

4.6.2.1 Firmer chisel

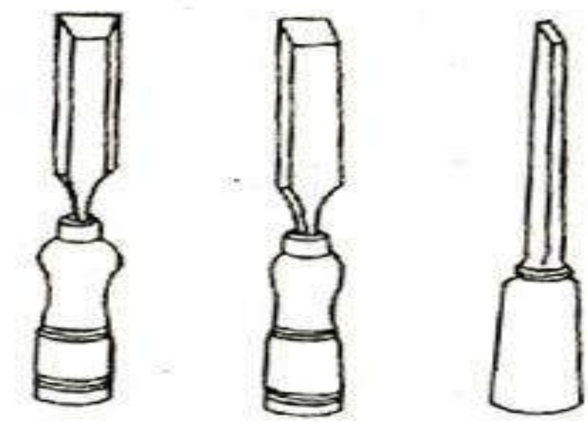
The word 'firmer' means 'stronger' and hence firmer chisel is stronger than other chisels. It is a general purpose chisel and is used either by hand pressure or by a mallet. The blade of a firmer chisel is flat, as shown in below figure.

4.6.2.2 Dovetail chisel

It has a blade with a beveled back, as shown in below figure, due to which it can enter sharp comers for finishing, as in dovetail joints.

4.6.2.3 Mortise chisel

It is used for cutting mortises and chipping inside holes, etc. The cross section of the mortise chisel is proportioned to withstand heavy blows during mortising. Further, the cross section is made stronger near the shank.



a. Firmer b. Dovetail c. Mortise

Figure 4.12: Types of chisels

4.7 Drilling and Boring Tools

4.7.1 Carpenter's brace

It is used for rotating auger bits, twist drills, etc., to produce holes in wood. In some designs, braces are made with ratchet device. With this, holes may be made in a corner where complete revolution of the handle cannot be made. The size of a brace is determined by its sweep.

4.7.2 Auger bit

It is the most common tool used for making holes in wood. During drilling, the lead screw of the bit guides into the wood, necessitating only moderate pressure on the brace. The helical flutes on the surface carry the chips to the outer surface.

4.7.3 Hand drill

Carpenter's brace is used to make relatively large size holes; whereas hand drill is used for drilling small holes. A straight shank drill is used with this tool. It is small, light in weight and may be conveniently used than the brace. The drill bit is clamped in the chuck at its end and is rotated by a handle attached to gear and pinion arrangement.

4.7.4 Gimlet

It has cutting edges like a twist drill. It is used for drilling large diameter holes with the hand pressure.

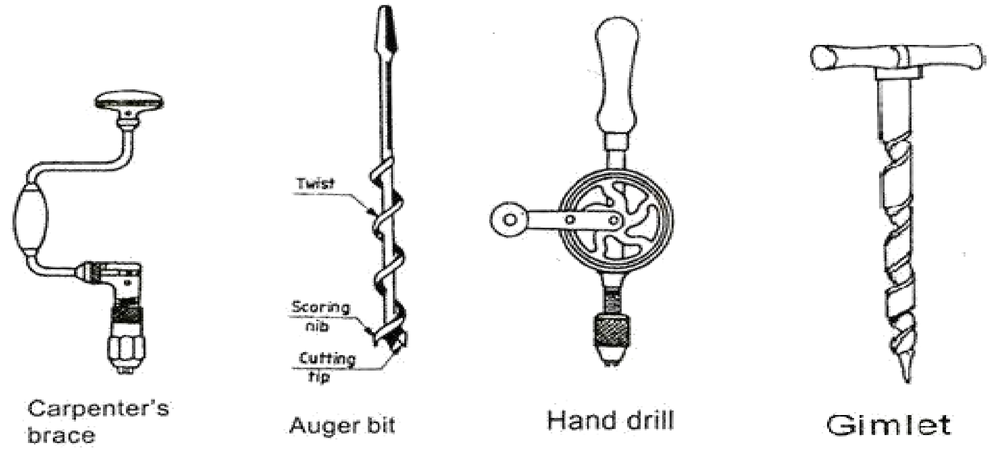


Figure 4.13: Drilling tools

4.8 Miscellaneous Tools

4.8.1 Mallet

It is used to drive the chisel, when considerable force is to be applied, which may be the case in making deep rough cuts. Steel hammer should not be used for the purpose, as it may damage the chisel handle. Further, for better control, it is better to apply a series of light taps with the mallet rather than a heavy single blow.

4.8.2 Pincer

It is made of two forged steel arms with a hinged joint and is used for pulling out small nails from wood. The inner faces of the pincer jaws are beveled and the outer faces are plain. The end of one arm has a ball and the other has a claw. The beveled jaws and the claw are used for pulling out small nails, pins and screws from the wood.

4.8.3 Claw Hammer

It has a striking flat face at one end and the claw at the other, as shown in figure. The face is used to drive nails into wood and for other striking purposes and the claw for extracting relatively large nails out of wood. It is made of cast steel and weighs from 0.25 kg to 0.75 kg.

4.8.4 Screw Driver

It is used for driving screws into wood or unscrewing them. The screw driver of a carpenter is different from the other common types, as shown in below figure.

The length of a screw driver is determined by the length of the blade. As the length of the blade increases, the width and thickness of the tip also increase.

4.8.5 Wood rasp file

It is a finishing tool used to make the wood surface smooth, remove sharp edges, finish fillets and other interior surfaces. Sharp cutting teeth are provided on its surface for the purpose. This file is exclusively used in wood work.

4.8.6 Bradawl

It is a hand operated tool, used to bore small holes for starting a screw or large nail.

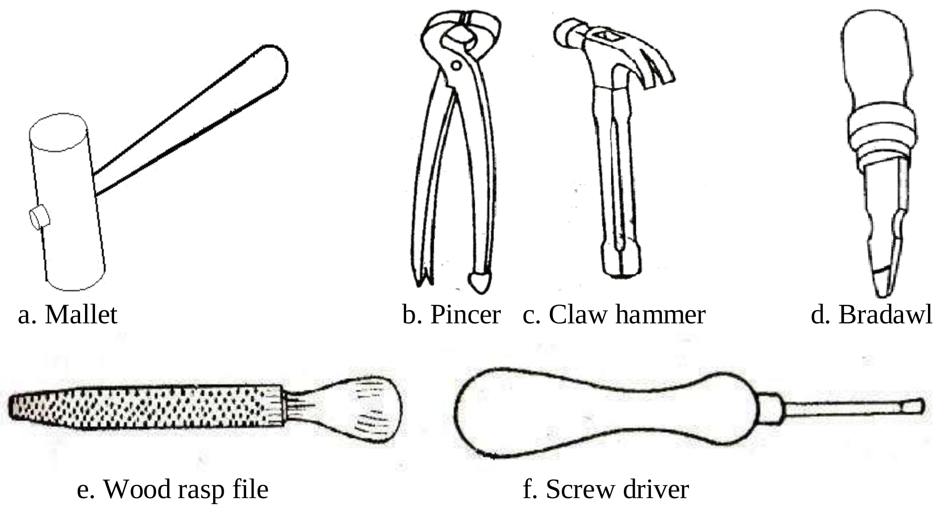


Figure 4.14: Miscellaneous tools

4.9 Wood Joints

There are many kinds of joints used to connect wood stock. Each joint has a definite use and requires lay in out, cutting them together. The strength of the joint depends upon amount of contact area. If a particular joint does not have much contact area, then it must be reinforced with nails, screws or dowels. The figure 2.15 shows some commonly used wood joints.

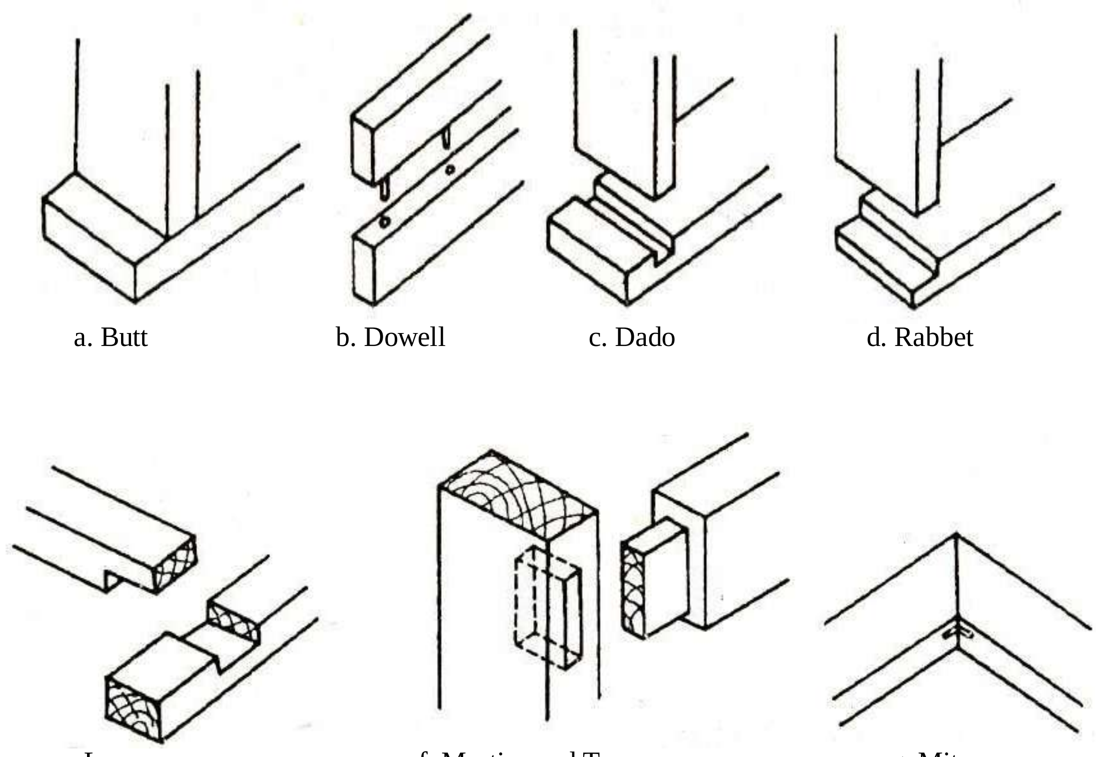


Figure 4.15: Common wood joints

4.9.1 Lap joints

In lap joints, an equal amount of wood is removed from each piece, as shown in figure 2.16. Lap joints are easy to layout, using a try square and a marking gauge. Follow the procedure suggested for sawing and removing the waste stock. If the joint is found to be too tight, it is better to reduce the width of the mating piece, instead of trimming the shoulder of the joint. This type of joint is used for small boxes to large pieces of furniture.

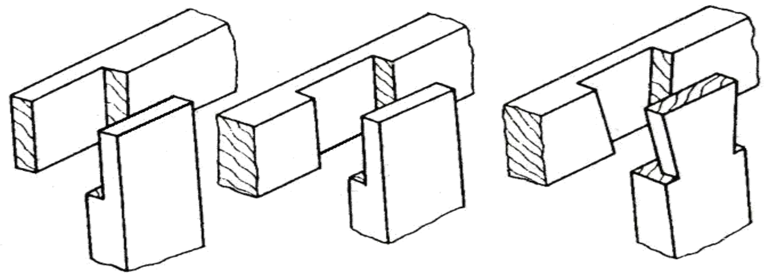


Figure 4.16: Lap joints

4.9.2 Mortise and Tenon Joints

It is used in the construction of quality furniture. It results in a strong joint and requires considerable skill to make it. The following are the stages involved in the work.

a. Mark the mortise and tenon layouts.
b. Cut the mortise first by drilling series of holes within the layout line, chiseling out the waste stock and trimming the corners and sides.
c. Prepare the tenon by cutting and chiseling.
d. Check the tenon size against the mortise that has been prepared and adjust it if necessary.

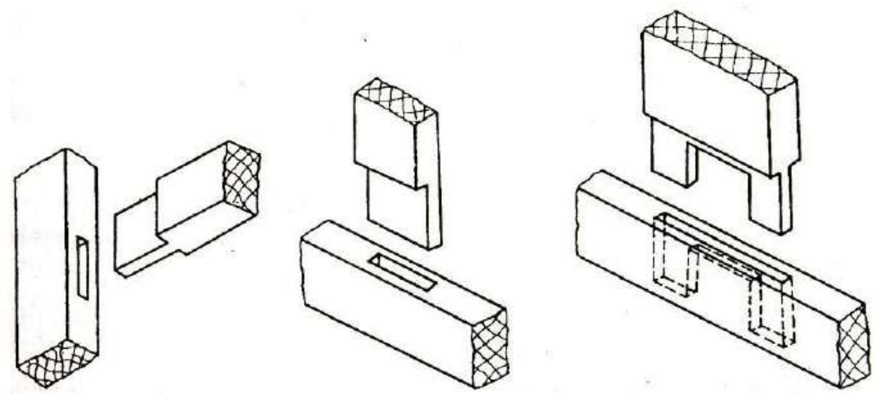


Figure 4.17: Mortise and Tenon joints

4.9.3 Bridle Joint

This is the reverse of mortise and tenon joint in form. The marking out of the joint is the same as for mortise and tenon joint. This joint is used where the members are of square or near square section and unsuitable for mortise and tenon joint.

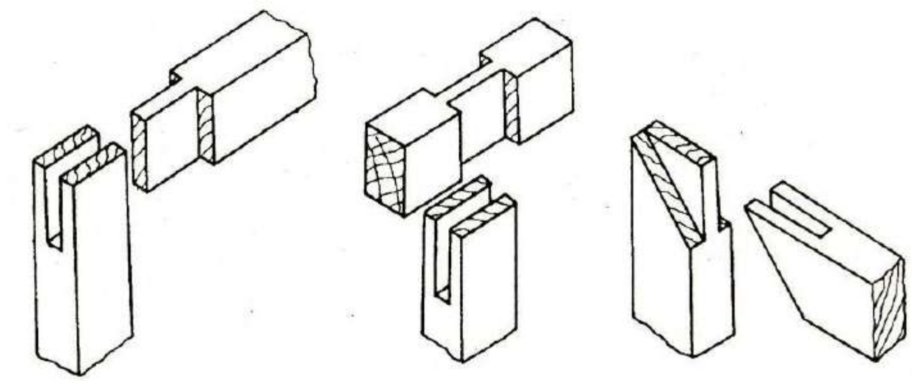


Figure 4.18: Bridle joint

4.10 Safe Practice

The following are some of the safe and correct work practices in carpentry shop, with respect to the tools used

1. Tools that are not being used should always be kept at their proper places.
2. Make sure that your hands are not in front of sharp edged tools while you are using them.
3. Use only sharp tools. A dull tool requires excessive pressure, causing the tool to slip.
4. Wooden pieces with nails, should never be allowed to remain on the floor.
5. Be careful when you are using your thumb as a guide in cross cutting and ripping.
6. Test the sharpness of the cutting edge of chisel on wood or paper, but not on your hand.
7. Never chisel towards any part of the body.
8. Do not use chisels where nails are present. Do not uses chisel as a screw driver.
9. Do not use a saw with a loose handle.
10. Always use triangular file for sharpening the teeth.
11. Do not use a saw on metallic substances.
12. Do not use mallet to strike nails.
13. Do not use plane at the places, where a nail is driven in the wood.

Ex.No: 4.1 **HALF LAP JOINT**
Date :

Aim:-
To make a half lap joint as shown in Fig, from the given reaper of size 50 x 35 x 250 mm.

Tools required:-
Carpenter's vice, steel rule, jack plane, try square, marking gauge, 25 111m firmer chisel, 6 mm mortise chisel, Cross cut saw, tenon saw, scriber and mallet.

Sequence of operations:-
1. The wooden pieces are made into two halves and are checked for dimensions.
2. One side of pieces is planned with jack plane and for strraightness.
3. An adajacent side is planned and checked for squareness with a try square.
4. Marking gauge is set and lines are marked at 40-50 mm to make the thickness and width according to given figure.
5. The excess material is planned to correct size.
6. Using tenon saw, the portions to be removed are cut in both the pieces.
7. The excess material in X is chiseled with mortise chisel.
8. The excess material in Y in chiseled to suit X.
9. The end of both the pieces is chiseled to exact lengths.

Precautions:-
1. Reaper should be free from moisture.
2. Marking is done without parallax error.
3. Care should be taken while chiseling .
4. Matching of x and y pieces should be tight.

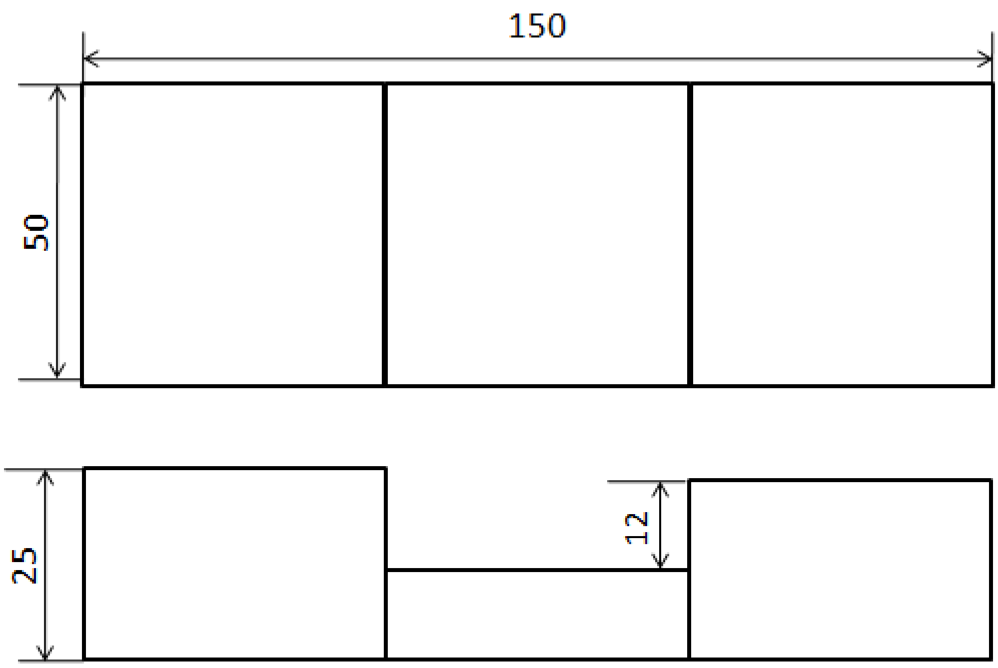
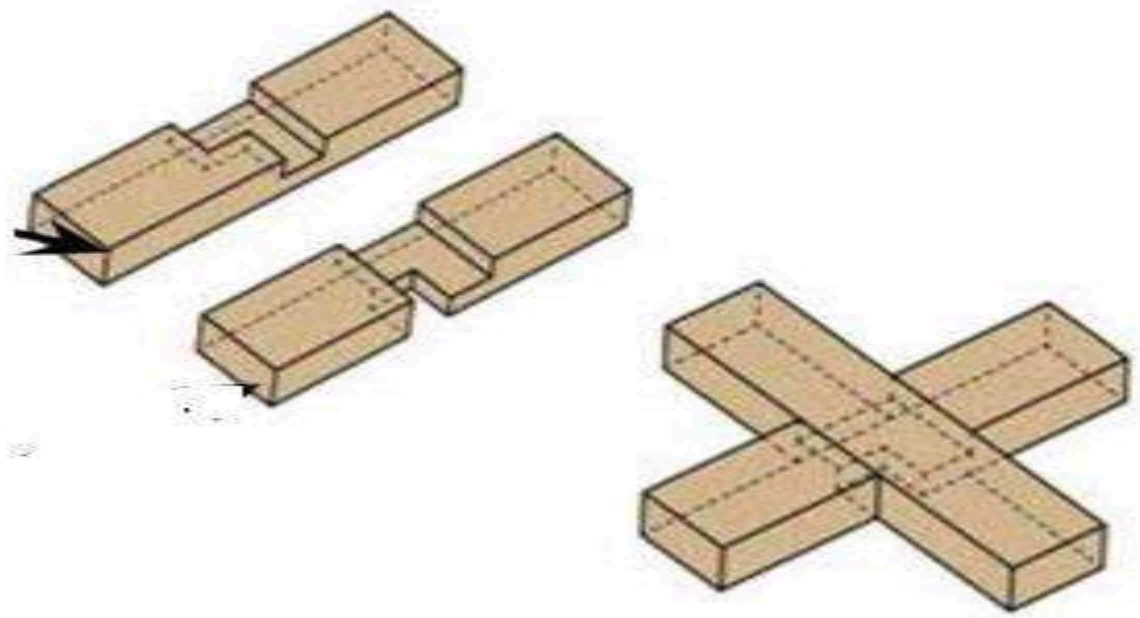


Figure 4.19: Half Lap Joint



Operation to be Carried Out:
1. Planning
2. Marking
3. Sawing
4. Chiseling
5. Finishing

Result:

The cross half lap joint is made success fully.

Ex.No: 4.3 **DOVE TAIL LAP JOINT**
Date :

Aim:-

To make a dovetail lap joint as shown in Figure 2.20, from the given reaper of size 50 x 35 x 250 mm.

Tools required:-

Carpenter's vice, steel rule, jack plane, try square, marking gauge, 25 mm firmer chisel, cross cut saw, tenon saw, scriber and mallet.

Sequence of operations;-

1. The given reaper is checked to ensure its correct size.
2. The reaper is firmly clamped in the carpenter's vice and any two adjacent faces are planed by the jack plane
3. And the two faces are checked for squareness with the try square.
4. Marking gauge is set and lines are drawn at 30 and 145 mm, to mark the thickness and width of the model respectively.
5. The excess material is first chiseled out with firmer chisel and then planed to correct size.
6. The mating dimensions of the parts X and Yare then marked using scale and marking gauge.
7. Using the cross cut saw, the portions to be removed are cut in both the pieces, followed by chiseling and also the parts X and Yare separated by cross cutting, using the tenon saw.
8. The ends of both the parts are chiseled to exact lengths.
9. A fine finishing is given to the parts, if required so that, proper fitting is obtained.
10. The parts are fitted to obtain a slightly tight joint.

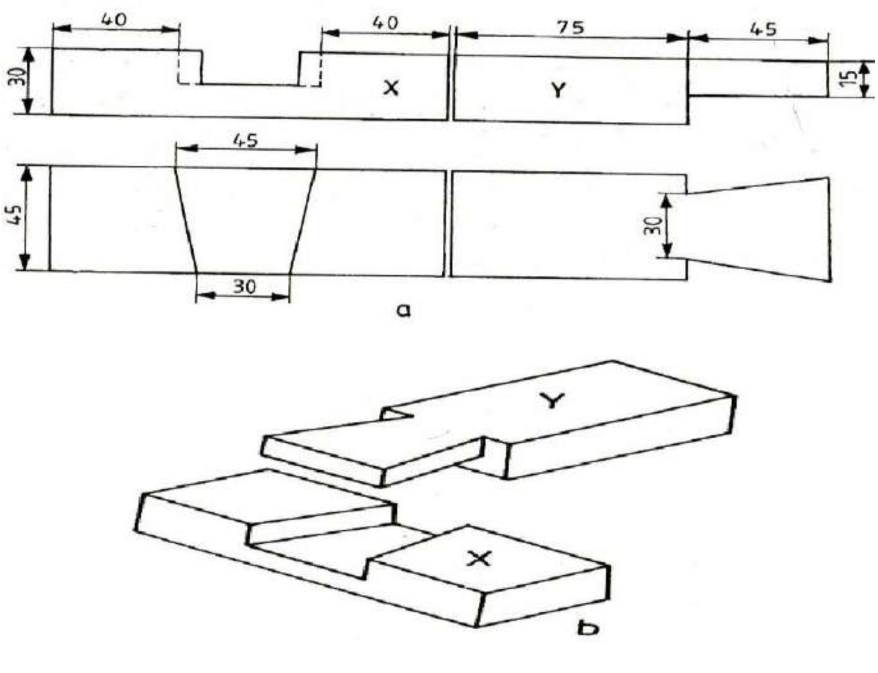


Figure 4.20: Dove Tail Lap Joint

Result:-

The dovetail lap joint is thus made by following the above sequence of operations.

CARPENTARY VIVA QUESTIONS

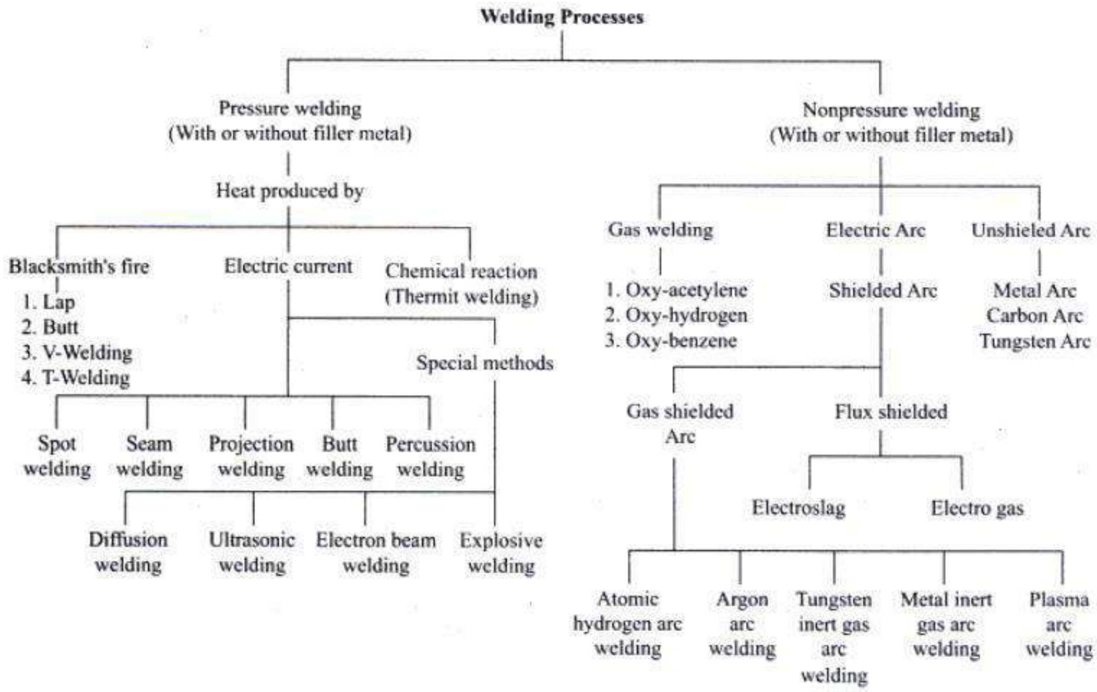
1. Classification of Timber?
2. What are the applications of wood?
3. What are the defects in wood?
4. Which tool is used to check squareness?
5. What is the difference between marking and mortise gauge?
6. Which type of saw is used for small and mortise gauge?
7. Which is C-clamp? What are the applications of C-clamp?
8. Give the name of Chisel for making Dove – tail joints?
9. What type of hammer is used for removing nails?
10. What issued for making small holes?
11. What issued for making big holes?
12. Which type of file is used for carpentry for finishing?
13. To strengthen the joints which is used?
14. Which point is used for construction of quality furniture?
15. In lap points how much amount of wood is removed from each piece?
16. Which point is used for widening points?
17. Which are used for alignement?
18. What is the application of carpenter's vice?
19. What is Bar Comp?
20. What is Mortise gauge?
21. What is jackplane?
22. What is difference between Ripsaw and tenon saw?
23. For making holes in wood how many types of drills are uses?
24. Claw hammer is used for which purpose?
25. Bevel is used for which purpose in carpentry shop?

5. STUDY OF WELDING

5.1 Introduction

Welding is a process for joining two similar or dissimilar metals by fusion. It joins different metals/alloys, with or without the application of pressure and with or without the use of filler metal. The fusion of metal takes place by means of heat. The heat may be generated either from combustion of gases, electric arc, electric resistance or by chemical reaction.

Welding provides a permanent joint but it normally affects the metallurgy of the components. It is therefore usually accompanied by post weld heat treatment for most of the critical components. The welding is widely used as a fabrication and repairing process in industries. Some of the typical applications of welding include the fabrication of ships, pressure vessels, automobile bodies, off-shore platform, bridges, welded pipes, sealing of nuclear fuel and explosives, etc.



Most of the metals and alloys can be welded by one type of welding process or the other. However, some are easier to weld than others. To compare this ease in welding term 'weldability' is often used. The weldability may be defined as property of a metal which indicates the ease with which it can be welded with other similar or dissimilar metals.

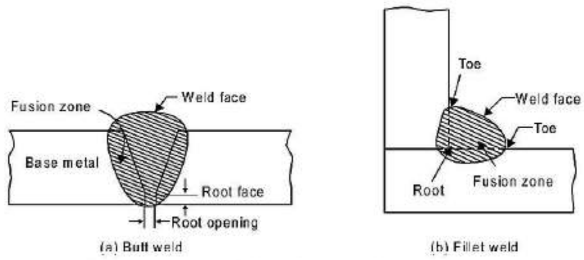


Fig. 17.1 Terminological elements of welding process

Elements of welding process used with common

Terminology of welding process

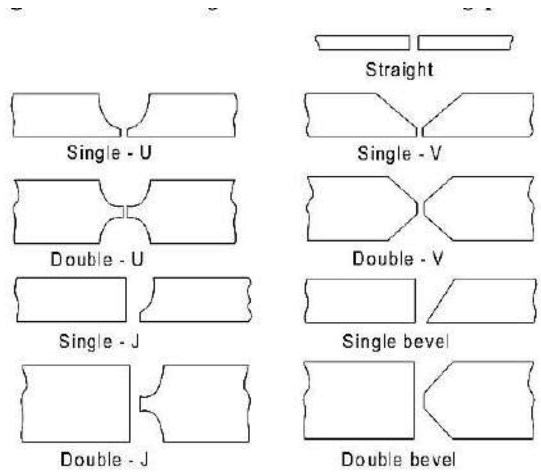
welding joints such as base metal, fusion zone, weld face, root face, root opening toe and root are depicted in Figure.

5.2 Edge preparations

For welding the edges of joining surfaces of metals are prepared first. Different edge preparations may be used for welding butt joints, which are given in Figure.

5.3 Welding joints

Some common welding joints are shown in Figure. Welding joints are of generally of two major kinds namely lap joint and butt joint. The main types are described as under.



1. **Lap weld joint**

2. Single-Lap Joint

This joint, made by overlapping the edges of the plate, is not recommended for most work. The single lap has very little resistance to bending. It can be used satisfactorily for joining two cylinders that fit inside one another.

3. Double-Lap Joint

This is stronger than the single-lap joint but has the disadvantage that it requires twice as much welding.

4. Tee Fillet Weld

This type of joint, although widely used, should not be employed if an alternative design is possible.

5.4 Butt weld joint

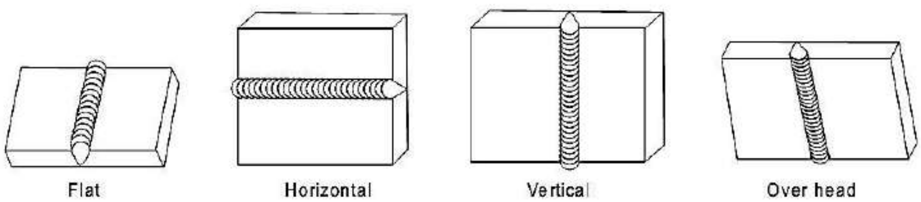
a. Single-Vee Butt Weld
It is used for plates up to 15.8 mm thick. The angle of the vee depends upon the technique being used, the plates being spaced approximately 3.2 mm.

b. Double-Vee Butt Weld
It is used for plates over 13 mm thick when the welding can be performed on both sides of the plate. The top vee angle is either 60° or 80°, while the bottom angle is 80°, depending on the technique being used.

5.5 Welding Positions

As shown in Figure, there are four types of welding positions, which are given as:

a. Flat or down hand position
b. Horizontal position
c. Vertical position
d. Overhead position



5.5.1 Flat or Down-hand Welding Position

The flat position or down hand position is one in which the welding is performed from the upper side of the joint and the face of the weld is approximately horizontal.

5.5.2 Horizontal Welding Position

In horizontal position, the plane of the work piece is vertical and the deposited weld head is horizontal. This position of welding is most commonly used in welding vessels and reservoirs.

5.5.3 Vertical Welding Position

In vertical position, the plane of the work-piece is vertical and the weld is deposited upon a vertical surface. It is difficult to produce satisfactory welds in this position due to the effect of the force of gravity on the molten metal.

5.5.4 Overhead Welding Position

The overhead position is probably even more difficult to weld than the vertical position. Here the pull of gravity against the molten metal is much greater.

5.6 Arc Welding Processes

The process, in which an electric arc between an electrode and a work-piece or between two electrodes is utilized to weld base metals, is called an arc welding process. The basic principle of arc welding is shown in Figure1. However the basic elements involved in arc welding process are shown in Figure2. Most of these processes use some shielding gas while others employ coatings or fluxes to prevent the weld pool from the surrounding atmosphere.

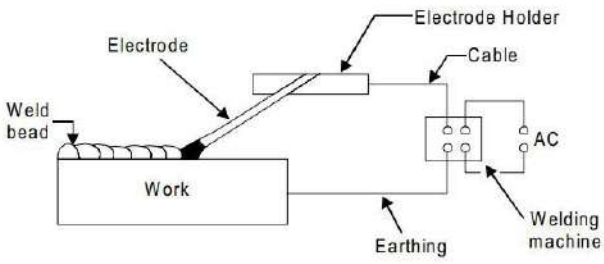


Fig1.The basic principle of arc welding

1) Switch box.
2) Secondary terminals
3) Welding machine.
4) Current reading scale.
5) Current regulating hand wheel.
6) Leather apron.
7) Asbestos hand gloves.
8) Protective glasses strap
9) Electrode holder.
10) Hand shield
11) Channel for cable protection.
12) Welding cable.
13) Chipping hammer.
14) Wire brush.
15) Earth clamp.
16) Welding table (metallic).
17) Job.

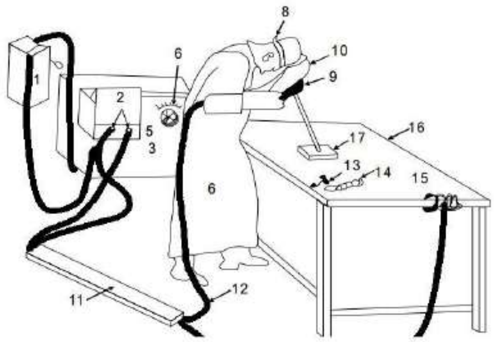


Fig2.The basic elements of arc welding

5.7 Arc Welding Equipment

Arc welding equipment, setup and related tools and accessories are shown in Figure. However some common tools of arc welding are shown separately through Figure. Few of the important components of arc welding setup are described as under.

5.7.1 Arc welding power source

Both direct current (DC) and alternating current (AC) are used for electric arc welding, each having its particular applications. DC welding supply is usually obtained from generators driven by electric motor or if no electricity is available by internal combustion engines. For AC welding supply, transformers are predominantly used for almost all Arc-welding where mains electricity supply is available. They have to step down the usual supply voltage (200-400 volts) to the normal open circuit welding voltage (50-90 volts). The following factors influence the selection of a power source:

a. Type of electrodes to be used and metals to be welded
b. Available power source (AC or DC)
c. Required output
d. Duty cycle
e. Efficiency
f. Initial costs and running costs
g. Available floor space
h. Versatility of equipment

3.5.2 Welding cable

Welding cables are required for conduction of current from the power source through the electrode holder, the arc, the work piece and back to the welding power source. These are insulated copper or aluminum cables.

5.7.3 Electrode holder

Electrode holder is used for holding the electrode manually and conducting current to it. These are usually matched to the size of the lead, which in turn matched to the amperage output of the arc welder.

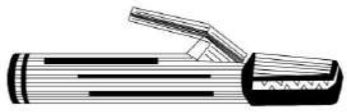


Fig. Electrode Holder

Electrode holders are available in sizes that range from 150 to 500 Amps.

5.7.4 Welding Electrodes

An electrode is a piece of wire or a rod of a metal or alloy, with or without coatings. An arc is set up between electrode and work piece. Welding electrodes are classified into following types-

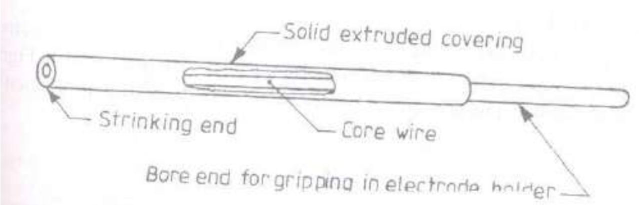


Fig. Parts of a electrode

(i) Consumable Electrodes
(a) Bare Electrodes
(b) Coated Electrodes
(ii) Non-consumable Electrodes
(a) Carbon or Graphite Electrodes
(b) Tungsten Electrodes

Consumable electrode is made of different metals and their alloys. The end of this electrode starts melting when arc is struck between the electrode and work piece. Thus consumable electrode itself acts as a filler metal. Bare electrodes consist of a metal or alloy wire without any flux coating on them. Coated electrodes have flux coating which starts melting as soon as an electric arc is struck. This coating on melting performs many functions like prevention of joint from atmospheric contamination, arc stabilizers etc.

Non-consumable electrodes are made up of high melting point materials like carbon, pure tungsten or alloy tungsten etc. These electrodes do not melt away during welding. But practically, the electrode length goes on decreasing with the passage of time, because of oxidation and vaporization of the electrode material during welding.

The materials of non-consumable electrodes are usually copper coated carbon or graphite, pure tungsten, thoriated or zirconiated tungsten.

5.7.5 Hand Screen

Hand screen used for protection of eyes and supervision of weld bead.

5.7.6 Chipping hammer

Chipping Hammer is used to remove the slag by striking.

5.7.7. Wire brush

Wire brush is used to clean the surface to be weld.

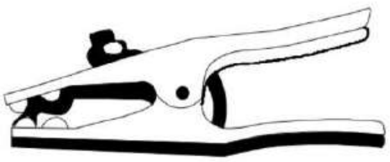
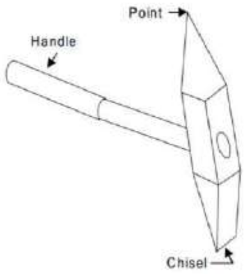


Fig. 17.11 Earth clamp



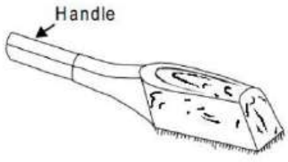


Fig. Earth Clamp Fig. Chipping Hammer Fig. WireBrush

5.7.8. Protective clothing

Operator wears the protective clothing such as apron to keep away the exposure of direct heat to the body.

`5.8 Safety Recommendations for ARC Welding

The beginner in the field of arc welding must go through and become familiar with these general safety recommendations which are given as under.

1. The body or the frame of the welding machine shall be efficiently earthed. Pipe lines containing gases or inflammable liquids or conduits carrying electrical conductors shall not be used for a ground return circuit All earth connections shall be mechanically strong and electrically adequate for the required current.

2. Welding arc in addition to being very is a source of infra-red and ultra-violet light also; consequently the operator must use either helmet or a hand-shield fitted with a special filter glass to protect eyes

3. Excess ultra-violet light can cause an effect similar to sunburn on the skin of the welder

4. The welder's body and clothing are protected from radiation and burns caused by sparks and flying globules of molten metal with the help of the following:

5. Gloves protect the hands of a welder.

6. Leather or asbestos apron is very useful to protect welder's clothes and his trunk and thighs while seated he is doing welding.

7. For overhead welding, some form of protection for the head is required

8. Leather skull cap or peaked cap will do the needful.

9. Leather jackets and 1ather leggings are also available as clothes for body protection.

10. Welding equipment shall be inspected periodically and maintained in safe working order at all times

11. Arc welding machines should be of suitable quality.

12. All parts of welding set shall be suitably enclosed and protected to meet the usual service conditions.

EXPT NO: 5.1 **LAP JOINT**

Aim:

To make a Lap joint, using the given two M.S pieces and by arc welding.

Material Supplied:

Mild steel plate of size 100X50X5 mm – 2 No's

Welding Electrodes:

M.S electrodes 3.1 mm X350 mm

Welding Equipment:

Air cooled transformer

Voltage-80 to 600 V, 3-ϕ supply, Current up to 350Amps

Tools and Accessories required:

1. Rough and smooth files.
2. Protractor
3. Arc welding machine (transformer type)
4. Mild steel electrode and electrode holder
5. Ground clamp
6. Tongs
7. Face shield
8. Apron
9. Chipping hammer.

Sequence of operations:

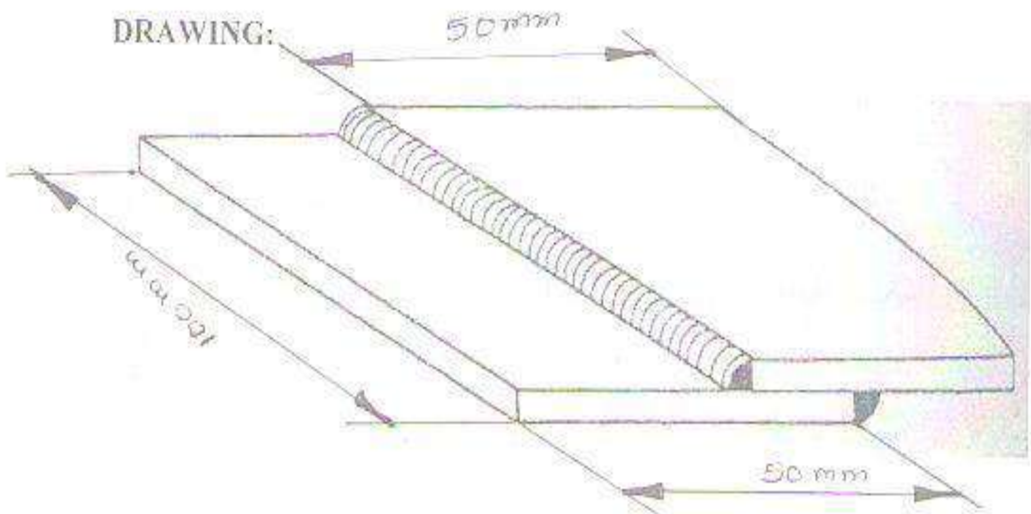
1. Marking
2. Cutting
3. Edge preparation (Removal of rust, scale etc.) by filling
4. Try square leveling
5. Tacking
6. Welding
7. Cooling
8. Chipping
9. Cleaning

Procedure:

1. The given M.S pieces are thoroughly cleaned of rust and scale.
2. The two pieces are positioned on the welding table such that, the two pieces overlapped one over the other as shown in drawing.
3. The electrode is fitted in the electrode holder and the welding current is ser to be a proper value.
4. The ground clamp is fastened to the welding table.

5. Wearing the apron and using the face shield, the arc is struck and the work pieces are tack-welded at both the ends and at the centre of the joint.
6. The alignment of the lap joint is checked and the tack-welded pieces are required.
7. The scale formation on the welds is removed by using the chipping hammer.
   Filling is done to remove any spanner around the weld.

DRAWING:



Result:

The Lap joint is thus made, using the tools and equipment as mentioned.

EXPT NO: 5.2 **BUTT JOINT**

Aim:

To make a Butt joint using the given two M.S pieces by arc welding.

Material Required:

Mild steel plate of size 100X50X5 mm – 2 No's

Welding Electrodes:

M.S electrodes 3.1 mm X350 mm

Welding Equipment:

Air cooled transformer

Voltage-80 to 600 V 3 phase supply, amps up to 350

Tools and Accessories required:

1. Rough and smooth files
2. Protractor
3. Arc welding machine (transformer type)
4. Mild steel electrode and electrode holder
5. Ground clamp
6. Tongs
7. Face shield
8. Apron
9. Chipping hammer

Sequence of operations:

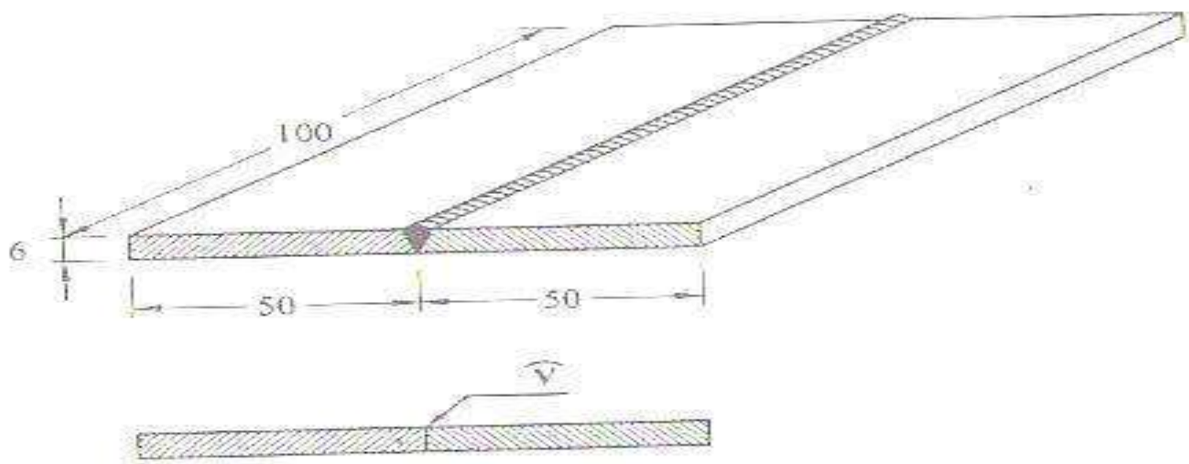
1. Marking
2. Cutting
3. Edge preparation (Removal of rust, scale etc.) by filling
4. Try square leveling
5. Tacking
6. Welding
7. Cooling
8. Chipping
9. Cleaning

Procedure:

1. The given M.S pieces are thoroughly cleaned of rust and scale.
2. One edge of each piece is believed, to an angle of 30^0, leaving nearly ¼ th of the flat thickness, at one end.
3. The two pieces are positioned on the welding table such that, they are separated slightly for better penetration of the weld.
4. The electrode is fitted in the electrode holder and the welding current is ser to be a proper value.
5. The ground clamp is fastened to the welding table.

6. Wearing the apron and using the face shield, the arc is struck and holding the two pieces together; first run of the weld is done to fill the root gap.
7. Second run of the weld is done with proper weaving and with uniform movement. During the process of welding, the electrode is kept at 15^0 to 25^0 from vertical and in the direction of welding.
8. The scale formation on the welds is removed by using the chipping hammer.
9. Filling is done to remove any spanner around the weld.

DRAWING:



Welded Joint Representation

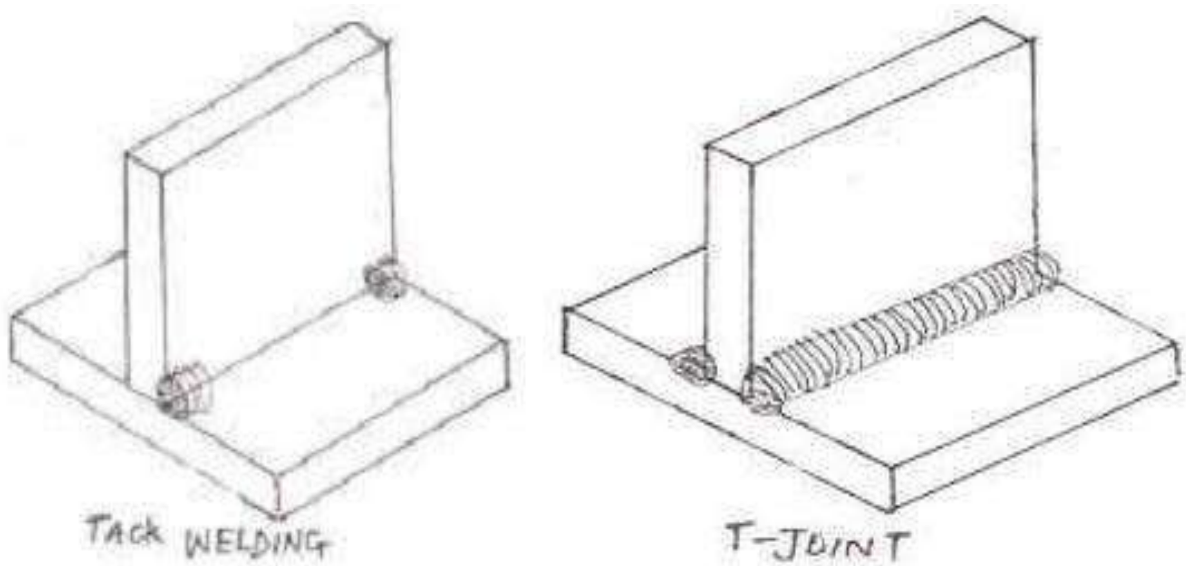
Result:

The single V-butt joint is thus made, using the tools and equipment as mentioned above.

EXPT NO: 5.3 **T JOINT**

AIM: preparation of T-joint as shown in figure using shielded metal arc welding process.

MATERIAL REQUIRED: two mild steel flats of given size.



TOOLS REQUIRED: welding transformer, connecting cables, electrode holder,ground clamp,
electrodes, chipping hammer, welding shield, wire brush etc.

THEORY: Arc welding is a fusion welding process. Arc welding is the process ofjoining two metallic pieces by the application of heat, where heat is obtained from the electricarc.

In this process the two metallic pieces will act as base metal or parent metal. Electrode will act as filler metal. The electrode is coated with flux, which prevents oxidation of parent metal.

T -JOINT: joint are used to weld two plates or sections whose surfaces are at approximately right angles to each other. Plates or surfaces should have good fit up in order to ensure uniform penetration and fusion. Edge preparation of vertical member is come as that of the butt joint.

PROCEDURE:

1. Required edge preparation is made over the given metallic pieces.
2. The work pieces are cleaned properly from rust, grease, oil etc.
3. Place the electrode in the holder and ensure that all connections are givenproperly or not.
4. Assemble the given work pieces as shown in fig. T-JOINT: joint are used toweld two plates or sections whose surfaces are at approximately
5. Switch on the power supply and initiate the arc.
6. first tack welding is done.
7. now full welding is carried after one pass, slag is removed from the weldbed by using chipping hammer and wire brush.
8. then second, third passes will be carried until to get the desired height of weld.

PRECAUTIONS:

1. To protect the welder make use of welding shield, goggles, gloves, apron etc.
2. Maintain uniform arc length to have uniform weld bed.

RESULT:

T-joint is prepared as shown in fig by using by shielded metal arcwelding Process.

WELDING SECTION VIVA QUESTIONS

1. What is meant by welding?
Welding is the process of joining metals or non metals (plastics) together using filler metal or without filler metals/materials

2. What is the name of item coated over a welding rod?
Flux (Flux consists of cellulose, mineral silicates, iron powder, Rutile, Potassium aluminum silicate)

3. What is the purpose of it?
In order to reduce the atmospheric action on molten metal pool

4.What is the name of tool to remove the slag from welded portion?
Chipping hammer

5. Can you tell the approximate temperature while welding Mild steel item?
Above 2000 degree Celsius

6. What is meant by straight line welding?
Welding on a straight line over a metal (only for the study purpose)

7. What is meant by Butt welding?
Butt welding is the process by which metals are joined together to the edges.

8. What is the advantage of 'V' Butt joint?
V butt welding is done to avoid projection over the surface

9. What is the difference between welding and soldering?
Welding is the process of joining the metals together usually the same parent metals, but in the case of soldering the filler material is usually a compound of lead, tin and small amount of zinc. The soldering is done below 400 degree Celsius whereas the welding is done above 800 degree Celsius the joining process in between 400 and 800 degree Celsius is called brazing.

10. What is the approximate voltage for welding in AC welding set?
20 to 80 V

11.What are the accessories used in the welding shop?
Hand gloves, Face shield, apron, goggles

12. Name the main tools used in the welding shop?
Chipping hammer, clamps, tongs, wire brush, grinder, punches measuring tools, etc

13.What type of transformer is used in welding shop?
(Step down or step up)- Step down transformer

14. What are the safety precautions to be followed in welding shop?

15. Tell how to weld a petrol tank to prevent the leak

6.STUDY OF

TIN SMITHY

Tin smithy deals with the production of components in a wide variety of shapes and sizes from a sheet of metal with the aid hand or machines. For example many Engineering and house hold articles such as hoppers, guards covers, boxes and cans, funnels and ducts etc. are made from a flat sheet of metal.

Sheet Metals Used in Metal Work:

A wide variety of metals, in the form of sheet are used in sheet metal workshop. The most commonly used are explained below.

Galvanized Iron (G.I.) Sheet

It is a sheet of soft steel coated with zinc. I sheet is one of the least expensive metals used in sheet metal shop. It is used for making pans, buckets, gutters, tanks, boxes etc. Generally GI products are very suitable for corrosive environment because zinc coating protects the iron form corrosion.

Copper

It has reddish color and is used for water pipes, roofing, gutters and other parts of the building. Copper products are used where thermal resistance is the criterion along with corrosion resistance. But copper is somewhat expensive.

Tin Plate

Tin plate is the iron or steel coated with pure tin. It has bright silvery appearance and is used for containers, dairy equipments, furnace fittings, cans, trays and pans.

Stainless Steel

The 18-8 type steel is used in sheet metal work from the available different type of stainless steel. The products like food containers, dairy equipments and kitchen wares are prepare from 18-8 steel.

Black Iron

It is an uncoated sheet of metal with bluish appearance. The black iron sheet is used for the products, which are having no restrictions on painting after its preparation.

Aluminium

It is an uncoated sheet of metal with bluish appearance. The black iron sheet is used for the products, which are having no restrictions on painting after its preparation.

Tools and Equipments

Most of the tools that are used in fitting are also used in sheet metal work. The additional tools specially used in sheet metal work are described below.

Steel Rule

Steel rule is a simple measuring instrument consisting of a long, thin metal strip with a marked scale of unit divisions. It is an important tool for linear measurement.

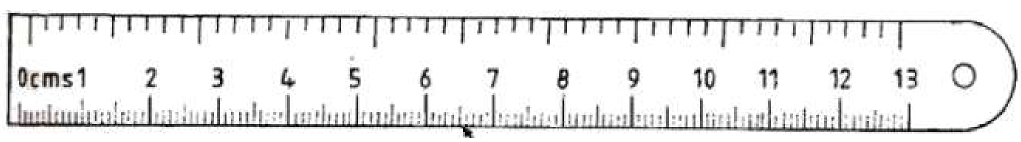


Fig 6.1 Steel Rule

Try Square

It is measuring and marking tool for 900 angle. In practice, it is used for checking the squareness of many types of small works when extreme accuracy is not required. The blade of the Try square is made of hardened steel and the stock of cast Iron or steel. The size of the Try square is specified by the length of the blade.

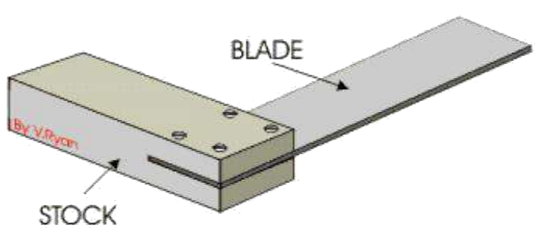


Fig 6.2 Try Square

Compass and Divider

Compass and divider, are used for marking arcs and circles on the planed surfaces of the GI sheet.

Snips:

Snips are hand shears varying in length from 200mm to 600mm. The 250 mm length is the commonly used one.

Types of Snips:

Straight snip

It has a straight blade and is used for cutting along straight lines and for trimming the edges. The straight snip and its usage is shown in figure below:

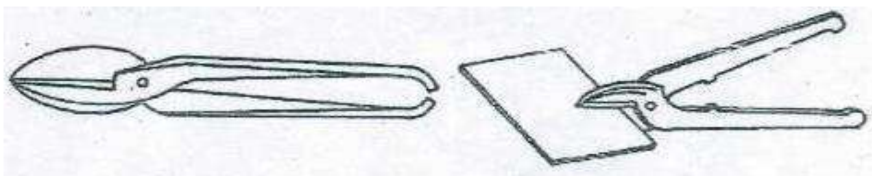


Fig 6.3 Straight Snip

Bent or Curved Snip

It is having curved blade and is used for cutting circles and irregular shapes. It is also used for trimming the cylindrical edges. The curved snip and its usage is shown in figure below:

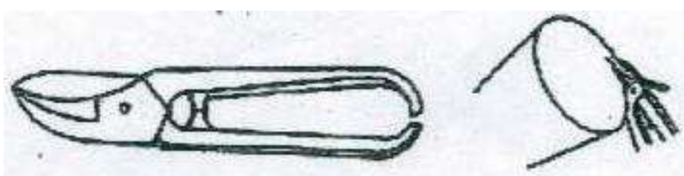


Fig 6.4 Bent or Curved Snip

Double Snip

Double shears are used for cutting thin cylinders, stove pipes and for cutting holes and light gauge metals. The double cut snip is shown in figure below:

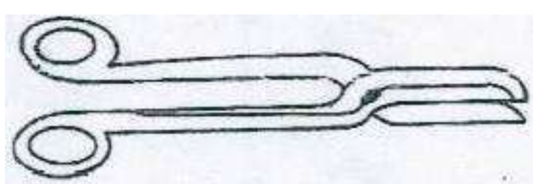


Fig 6.5 Double Snip

Bench Shear

In this type of hand cutting machine, the sheet is cut by shearing action. The force is applied through compound lever. The machine is able to cut the sheet metal upto 2 mm thick.

The bench shear also consists of chopping hole in the chopping blade which can shear a mild steel rod upto 10 mm diameter. The below figure represents the schematic diagram of bench shear.

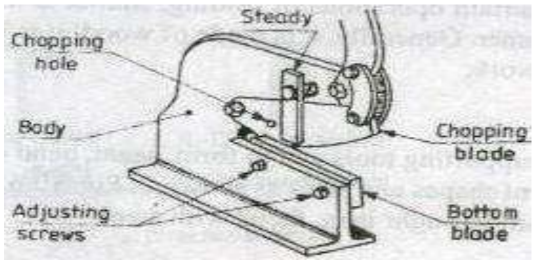


Fig 6.6 Bench Shear

Stakes:

Stakes are supporting tools used in sheet metal work. These are used to form, seam, bend or rivet the sheet metal objects. Stakes are made of wrought iron, faced with steel. Its working face well machined and polished to prevent harmful effect to sheet while doing the hammering process.

Types of Stakes:

Funnel Stake

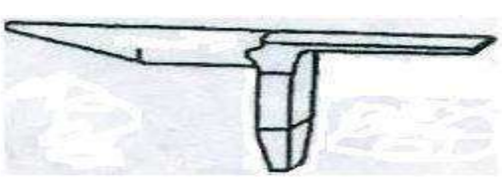
It is used for forming conical shapes and for making wire rings. The below figure shows the line diagram of funnel stake:

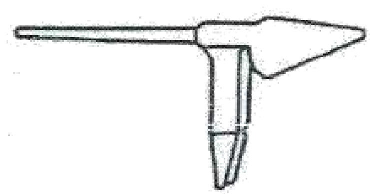
Half Moon Stake

It is used for folding edges of cylindrical shaped articles. The half moon stake is shown in figure below:

Beak Horn Stake

It is used for shaping round, square surfaces, bending edges, and making corners. The beak horn stake is shown in figure below:





It is used for forming or seaming funnels. The below figure represents the blow horn stake:

Conductor Stake

It is used for forming pipes and cylindrical pieces. The conductor stake is shown in figure below:

Hatchet Stake

It has a horizontal sharp straight edge and is used for making straight, sharp bends and folding edges. The schematic representation of hatchet stake is shown in figure below:

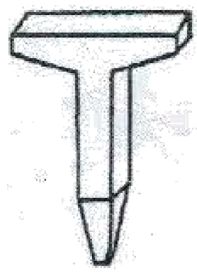


Fig 6.7 Hatchet Stake

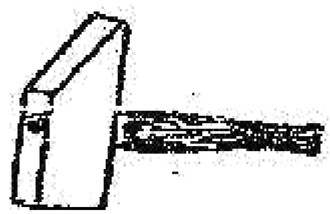


Fig 6.8 Setting Hammer

Hammers and Mallets:

Hammers and mallets are used to apply moderate forces gently in the processes accompanied in tin smithy such as forming and bending.

Types of Hammers and Mallets:

Setting Hammer

It has a square, flat face and its peen is tapered on one side. It is used for setting down the edges for making a double seam. The below figure represents the setting hammer:

Riveting Hammer

It has a square slightly curved face and its peen is tapered. It is used for riveting. The riveting hammer is represented in figure below:

Fig 6.9 Riveting Hammer

Raising Hammer

It is used for making depressions on a flat sheet, and it is particularly adapted for making trays, bowls, and similar objects. The sketch of raising hammer is shown in figure below:

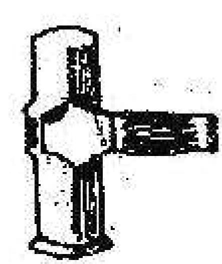


Fig 6.10 Raising Hammer

Mallet:

It is generally made of wood or plastic. It is used whenever slight blows are required. Wooden hammer (mallet) is most commonly used because it does not damage the work surface. The simple mallet used in tin smithy is shown in figure below:

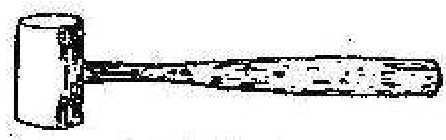


Fig 6.11 Mallet

Miscellaneous Tools:

Hand Groover

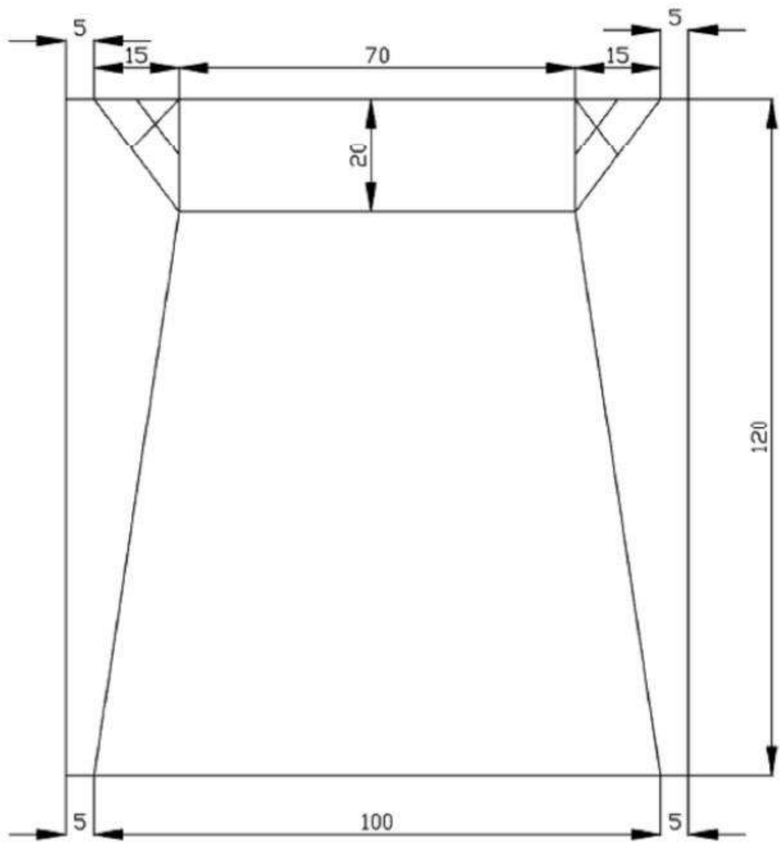
It is used for grooving a seam by a hand. It has a recessed end to fit over the block of seam. The shape of hand groover and usage is shown in figure below.

3. TIN SMITHY

3.1 OPEN SCOOP

AIM: -To make a open scoop, using the given sheet metal.

TOOLS REQUIRED: - steel rule, try-square, divider, scriber, straight snip, mallet, c peen hammer and hatchet stake.



OPEN SCOOP

NOTE:-

1. All dimensions are in mm .
2. Remove the crossed symbol portion.

SEQUENCE OF OPERATIOS:-

1. The size of the given sheet is checked with the steel rule.
2. The layout of the scoop are marked on the given sheet.
3. The layout of the scoop is cut by using the straight snip.
4. The corners of the scoop are hemmed.
5. The edges of the scoop can b e riveted or soldered to ensure stability of the joints.

PRECAUTIONS: -

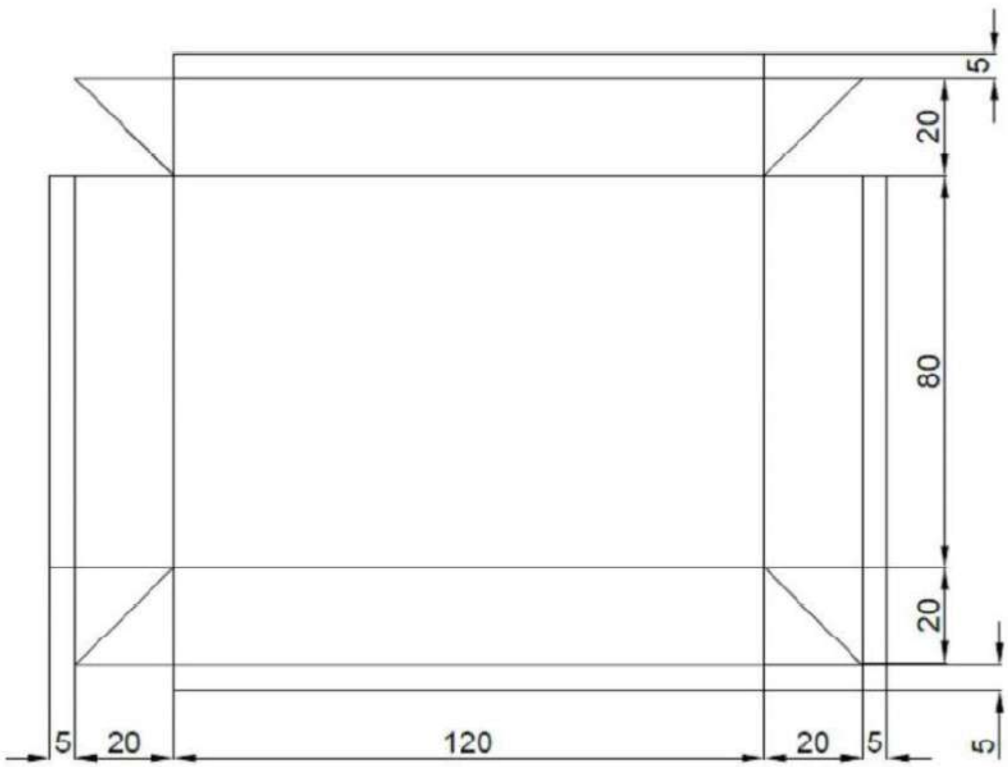
1. Mark the dimensions correctly.
2. Cut the sheet carefully.
3. Remove the chips with brush.

RESULT:-The open scoop is thus made from the given sheet metal.

3.2 RECTANGLE TRAY

AIM:-To make a rectangular tray, using the given sheet metal.

TOOLS:-Steel rule, try-square, divider, scriber, straight snip, mallet, ball - peen hammer and hatchet stake.



RECTANGULAR TRAY

NOTE:-

1. All dimensions are in mm .

SEQUENCE OF OPERATIOS:-

1. The size of the given sheet is checked with the steel rule.
2. The layout of the tray is marked on the given sheet.

3. The layout of the tray is cut by using the straight snip.

4. Single hemming is made on the four sides of the tray.

5. The edges of the scoop can be riveted or soldered to ensure stability of the joints.

PRECAUTIONS: -

1. Mark the dimensions correctly.

2. Cut the sheet carefully.

3. Remove the chips with brush.

RESULT:-The rectangular is thus made, from the given sheet metal.