

MECHANICAL ENGINEERING WORKSHOP MANUAL

MECHANICAL ENGINEERING DEPARTMENT



(ISO 9001:2008 Certified)

MES COLLEGE OF ENGINEERING, KUTTIPPURAM

Mechanical Engineering Workshop Manual

MECHANICAL ENGINEERING DEPARTMENT



Revision	Date	Prepared by			Approved by		
		Name	Designation	Signature	Name	Designation	Signature
Rev1.0					Dr.Rahmathunza. I	Prof. & HoD ME Dept.	

VISION

To develop the Department into a premier destination of international level for advanced learning in Mechanical Engineering and to mould quality engineers to serve the society through creative solutions.

MISSION

- To mould engineers who would be able to apply the basic science and mathematics with confidence in professional activities for the benefit of all.
- To make our graduates experts in practical problem solving with abstract thinking skills.
- To make our students life-long learners capable of building their careers upon a solid foundation of knowledge and competent in communicating technical materials and concepts in individual group situations

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

After 3-4 years of graduation, our students will be able to

- Demonstrate their skills in technical profession and/or higher education by using the acquired knowledge in Mathematics, Science and Engineering fundamentals.
- Analyze the real life problems and propose sustainable design solutions for specific needs through applications of Engineering principles.
- Recognize the ethical responsibility as engineers and judiciously serve their peers, employers & society for the benefit of all.
- Practice life-long learning by continuing up gradation of possessed skills.

PROGRAM SPECIFIC OUTCOMES (PSOs)

At the end of four year programme the students (graduates) will be able to:

- Demonstrate basic knowledge in mathematics, science and engineering.
- Design, manufacture and analyze a Mechanical system using modern engineering software tools and measurement systems.
- Cognize concepts involved in thermal and fluid energy systems.
- Utilize self education to develop lifelong learning to appraise and adapt global and societal contexts to propose Engineering solutions.

PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and

write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

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Course Outcomes (CO's)

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Course Outcomes (COs)

ME 110 MECHANICAL ENGINEERING WORKSHOP(C109)	
C109.1	Able to explain various manufacturing processes and its applications.
C109.2	Able to model using various tools, measuring devices and machines in various workshop sections.

SAFETY PRECAUTIONS
TO BE OBSERVED IN WORK SHOP

1. Always wear tight clothes
2. Never walk barefooted inside the Work Shop. Prefer to use Rubber soled shoes; closed shoe is recommended
3. Never try to operate any machine unless you know how to operate it.
4. Never touch moving parts.
5. Do not use defective tools.
6. Do not touch any live wire.
7. In case of fire, disconnect the electric supply.
8. Those who have long hair should take precaution by dressing them properly.
9. Tools which are not being used should always be kept at their respective places.
10. Never carry an open sharp tool in the pocket.
11. Do not cut work piece by holding it in hand.
12. Never work in a place where there is no sufficient light.
13. Always keep in mind the position of fire extinguishers and first aid box.
14. The job should be properly fitted in the vice.
15. Use always the right tool for the right job.
16. Don't use file or spanner as a hammer.
17. Always try to learn things sincerely from the instructors concerned.
18. Always keep your mind on the job.
19. Make sure that your work is not affecting the work of fellow students in the work shop.
20. Shop floor must be kept clean, free from scarp, oil and grease.

S2

ACCIDENTS AND THEIR CAUSES

An accident is an unplanned incident which can cause damage to property or injury people. It can happen due to anyone of the following reasons

1. Carelessness of the operator.
2. Lack of knowledge of the operator about the machine tool or job.
3. Lack of interest in the work.
4. Excessive confidence of the operator.
5. Operating a faulty machine.
6. Use of improper tools.
7. Running the machines at higher speeds or higher loads than recommended.
8. Improper or loose dress of the operator.
9. Improper lighting and ventilation in the workshop.
10. Lack of discipline among the operators.
11. Keeping objects in improper places, so as to interfere with free movement.

WELDING

INTRODUCTION

Welding is the process of joining similar or dissimilar metals by the application of heat, with or without application of pressure or filler metal. in such a way that the joint is equivalent in composition and characteristics of the metals joined. In the beginning welding was mainly used for repairing all kinds of worn or damaged parts. Now, it is extensively used in manufacturing industry, construction industry (construction of ships, tanks, locomotives and automobiles) and maintenance work, replacing riveting and bolting to a greater extent.

THE VARIOUS WELDING PROCESSES ARE:-

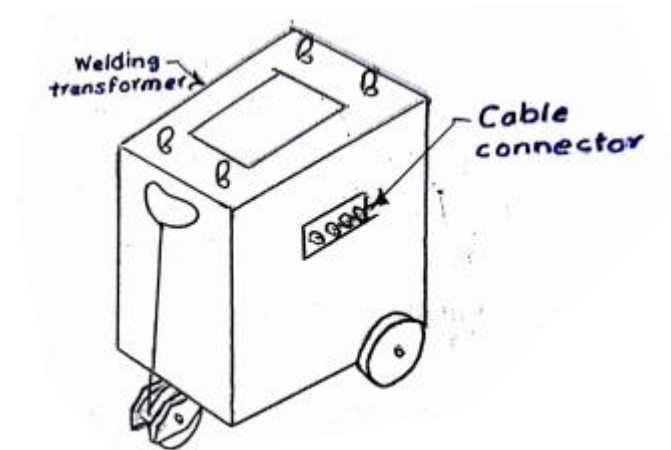
- i. Electric arc welding,
- ii. Gas welding
- iii. Thermit welding
- iv. Resistance welding,
- v. Friction welding.

ARC WELDING: In arc welding, the heat required for joining the metals is obtained from an electric arc. Transformers or motor generator sets are used as arc welding machines. These machines supply high electric currents at low voltages and an electrode is used to produce the necessary arc. The electrode serves as the filler rod and the arc melts the surfaces so that, the metals to be joined are actually fused together.

To supply the current for welding, three types of power sources are available: Transformers, motor generators and rectifiers. Sizes of welding machines are rated according to their approximate amperage capacity at 60% duty cycle, such as 160,200,260,300,400,600 and 600 amperes. This amperage is the rated current output at the working terminal.

EQUIPMENTS AND TOOLS

TRANSFORMERS: The transformer type of welding machine produces A.C current and is considered to be the least expensive. It takes power directly from a power supply line and transforms it to the voltage required for welding. Transformers are available in single phase and three phase in the market.

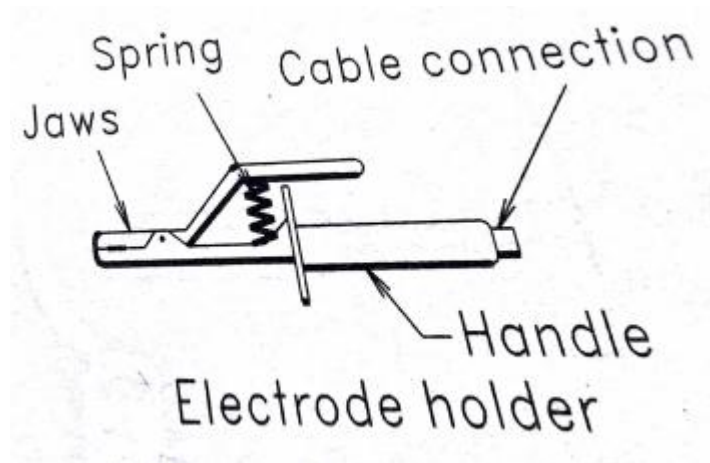


MOTOR GENERATORS: These are D.C generator sets, in which electric motor and alternator are mounted on the same shaft to produce D.C power as per the requirement for welding. These are designed to produce D.C current in either straight or reversed polarity. The polarity selected for welding depends upon the kind of electrode used and the material to be welded.

WELDING CABLES: Two welding cables are required, one from the machine to the electrode holder and the other, from the machine to the ground clamp. Flexible cables are usually preferred because of the ease of using and coiling the cables. Cables are specified by their current carrying capacity, say 300 A, 400 A, etc.

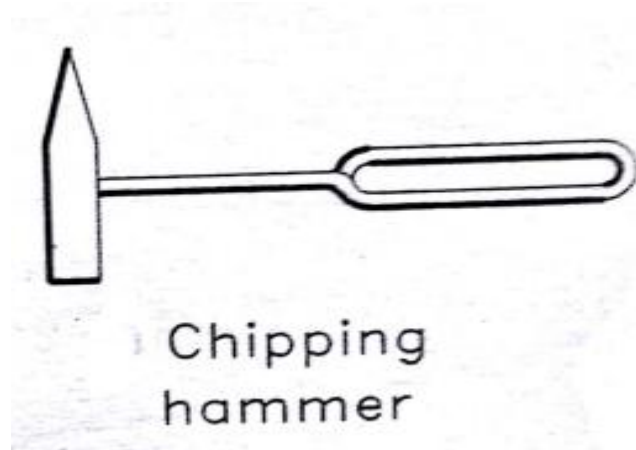
ELECTRODES: Filler rods used in arc welding are called electrodes. These are made of metallic wire called core wire, having approximately the same composition as the metal to be welded. These are coated uniformly with a protective coating called flux. Flux acts as an insulator of electricity. The size of an electrode is measured and designated by the diameter of the core wire in SWG and length, apart from the brand and code names; indicating the purpose for which they are most suitable.

ELECTRODE HOLDER: The electrode holder is connected to the end of the welding cable and holds the electrode. It should be light, strong and easy to handle and should not become hot while in operation. The jaws of the holder are insulated, offering protection from electric shock.



GROUND CLAMP: It is connected to the end of the ground cable and is clamped to the work or welding table to complete the electric circuit . It should be strong and durable and give a low resistance connection.

WIRE BRUSH AND CHIPPING HAMMER: A wire brush is used for cleaning and preparing the work for welding. A chipping hammer is used for removing slag formation on welds.



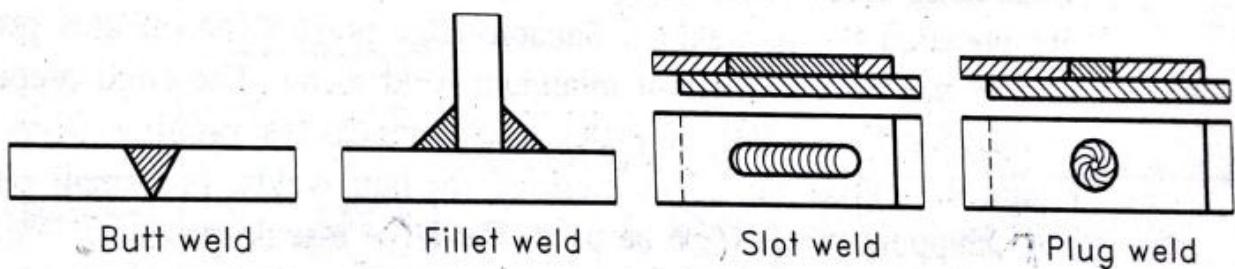
FACE SHIELD: A face shield is used to protect the eyes and face from the rays of the arc and from spatter or flying particles of hot metal. It is available either in hand or helmet type. The hand type is convenient to use wherever the work can be done with one hand. The helmet type is more comfortable to wear and both hands free for the work.



HAND GLOVES: These are used to protect the hands from electrical shock and hot spatters.

WELDED JOINTS

Some common types of welded joints. Wherever possible, it is better to weld, by placing the parts in the flat position. In this, welding is done on top, so that gravity helps pull the molten metal into the joint.



WELDING POSITIONS

There are five recognized positions for welding:

1. Flat or down hand position.
2. Inclined position.
3. Horizontal position.
4. Vertical Position.
5. Over Head Position.

ADVANTAGES OF ARC WELDING

1. Welding process is simple.
2. Equipment is portable and the cost is fairly low.
3. All the engineering metals can be welded because of the availability of a wide variety of electrodes.

DISADVANTAGES OF ARC WELDING

1. Number of electrodes may have to be used while welding long joints. Unless proper care is taken; a defect (slag inclusion or insufficient penetration) may occur at the place where welding is restarted with a fresh electrode.

GAS WELDING: Oxy-acetylene flame is commonly used for gas welding. It consists of the supply of oxygen and acetylene under pressure in cylinders, pressure regulators, a torch, hoses and accessories like goggles and a lighter. The oxygen and acetylene cylinders are connected to the torch through pressure regulators and hoses. The regulator consists of two pressure gauges, one for indicating the pressure within the cylinder and the other shows the pressure of the gas fed into the torch, which may be regulated. The torch mixes the two gases and the flame may be controlled by adjusting the oxygen and acetylene supply.

TYPES OF FLAMES: The correct adjustment of the flame is important for efficient welding. When oxygen and acetylene are supplied to the torch in nearly equal volumes, a neutral flame is produced having a maximum temperature of 3200°C. The neutral flame is widely used for welding steel, stainless steel, cast iron, copper, aluminum, etc. Carburising flame produced with an excess of acetylene, is needed for welding lead. Oxidizing flame with excess of oxygen is used for welding brass and bronze.

Depending upon the thickness of the job, different torch nozzle sizes are used. The pressure of the gases and the flame size vary depending upon the size of the nozzle tip.

GOGGLES: Goggles with colored glasses are used to protect the eyes from glare and flying bits of hot metal . A welding table with a top of fire bricks is recommended for oxy-acetylene welding.



FILLER RODS: For oxy-acetylene gas welding, filler rods are not coated with flux; however they are applied separately. Mild steel welding rods are usually copper coated to prevent rusting. Cast iron rods are square shaped. Brazing rods are made of brass or bronze. They are usually one meter long. Filler rod size increases as the metal thickness to be joined increases. 1.6 mm diameter filler rod is recommended for 18 SWG sheet and 2 to 3 mm diameter for 3mm thick sheet and so on.

TYPES OF JOINTS: The type of joint needed depends upon the nature of material, its thickness and the kind of job. The types of joints used are common to both arc and gas welding. Both ferrous and non-ferrous welding may be carried out in gas welding.

ADVANTAGES OF GAS WELDING

1. It can be used for a wide variety of manufacturing processes and repairs.
2. As the source of heat and filler metal are different, the welder can have control over filler metal deposition rates.

DISADVANTAGES OF GAS WELDING

1. It is not economical to join heavy sections.
2. Flame temperature is less than the temperature of the arc welding.
3. Fluxes used, produce fumes that are irritating in nature.

SAFE PRACTICES

ARC WELDING

1. Check the welding machine to make sure that it is properly grounded and that all leads are properly insulated.
2. Never look at the arc with the naked eye. The arc can burn your eyes severely. Always use a face shield while welding.
3. Prevent welding cables from coming in contact with hot metal, water, oil, or grease. Avoid dragging the cables around sharp corners.
4. Ensure proper insulation of the cables and check for openings.
6. Always wear the safety hand gloves, apron and leather shoes.
6. Always turn-off the machine when leaving the work.
7. Apply eye drops after welding is over for the day, to relieve the strain on the eyes.
8. While welding, stand on dry footing and keep the body insulated from the electrode, any bare parts of the electrode holder and the work

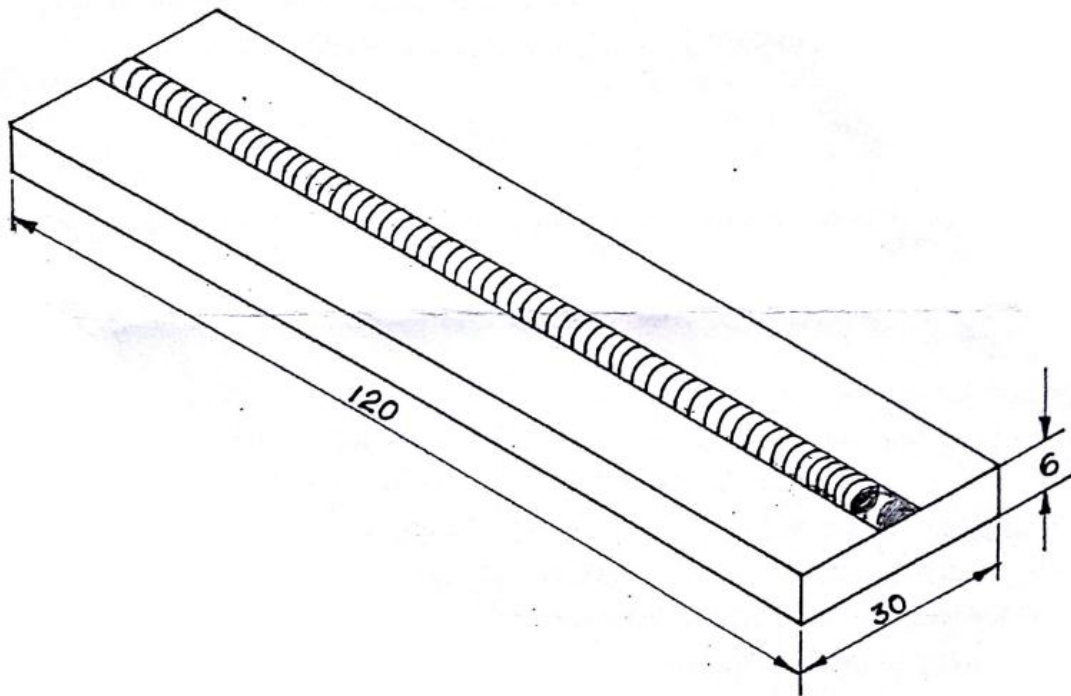
GAS WELDING

1. Always wear welding goggles while doing gas welding.
2. Always use the spark lighter to light the torch and never use a match.
3. Do not allow blow pipe to heat the cylinders, hoses or any other equipment.
4. Do not allow the hose to become excessively warm.
5. Do not remove the spanner used for operating the valve. Always keep it with the cylinders.
6. Secure cylinders in use, against falling, which may knock-off the valve.
7. To test the leakage in a valve or hose, use soap water but not a lighted match.

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MODEL NO:1

STRAIGHT BEADS



Scale 1:1

All dimensions are in mm

MODEL NO: 1**STRAIGHT BEADS**

AIM: - To practice straight beads on the given mild steel flat piece in down hand position by arc welding.

MATERIALS REQUIRED:-

Work piece:-Mild steel flat of size 123 x 30 x 6mm – 1 no.

Electrode: - Mild steel electrode 10SWG (3.2mm) - 1no.

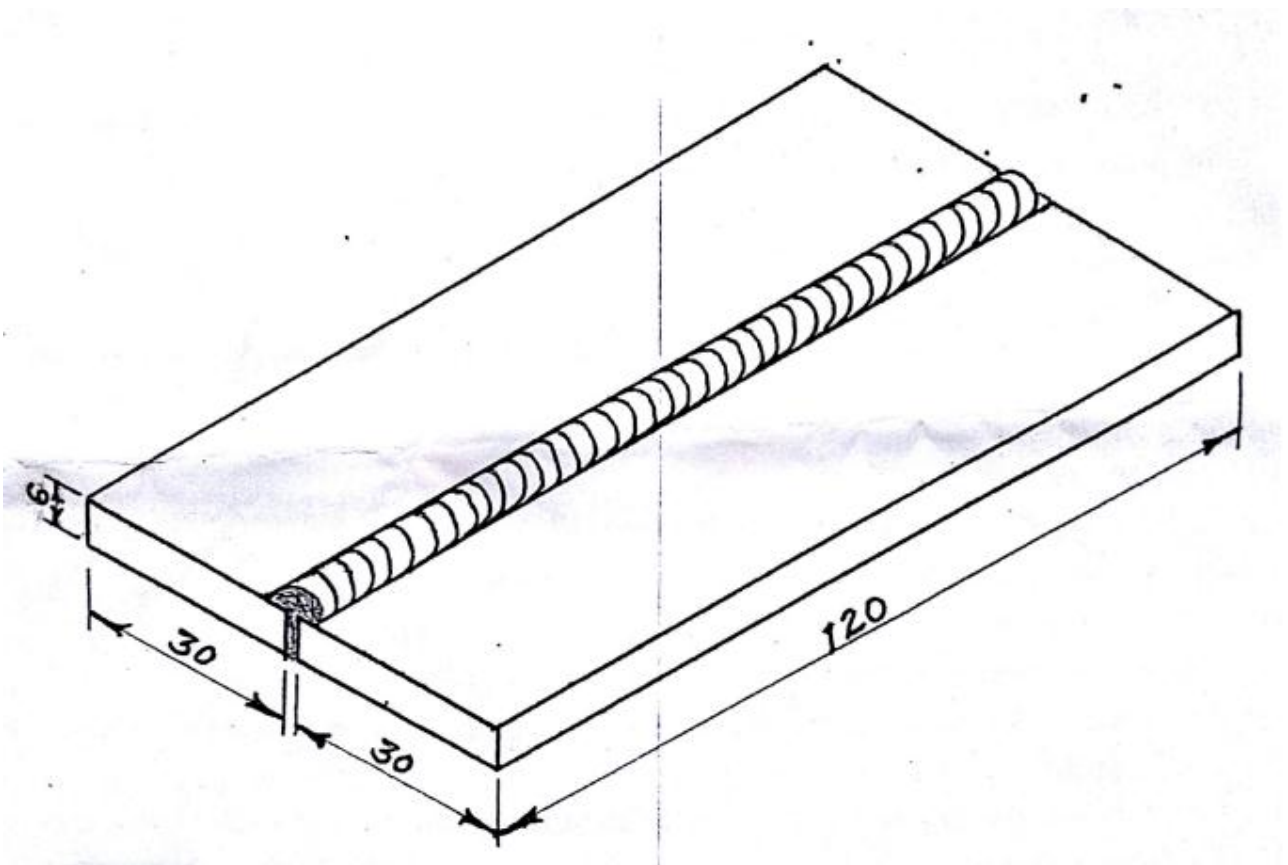
TOOLS REQUIRED:-Steel rule, Try square ,Scriber, Hacksaw ,Bench vice ,Flat file ,face shield ,Tongs, Wire-brush, Chipping hammer, Welding machine and all other arc welding accessories.

LIST OF OPERATIONS:-Measuring, Marking, Fixing, Cutting, Filing, Welding, Deslagging, Cleaning and Inspecting.

PROCEDURE

1. Copy the given drawing in the work record.
2. Cut the work piece as per the drawing.
3. File the work piece to the dimensional accuracy.
4. Kept the work piece on the welding table in the down hand position.
5. Set the ampere of the machine and use protective cloth , select suitable electrode and proper shield.
6. Remove the slag and spatters using the chipping hammer and wire brush.
7. After completion of weld , the weld bead should be inspected.

MODEL NO: 2
BUTT JOINT



Scale 1:1
All dimensions are in mm

MODEL NO: 2
BUTT JOINT

AIM: - To make a butt joint on the given mild steel flat pieces in down hand position by arc welding.

MATERIALS REQUIRED:-

Work piece:-Mild steel flat of size 123 x 30 x 6mm – 2 nos.

Electrode: - Mild steel electrode 10SWG (3.2mm) - 1no.

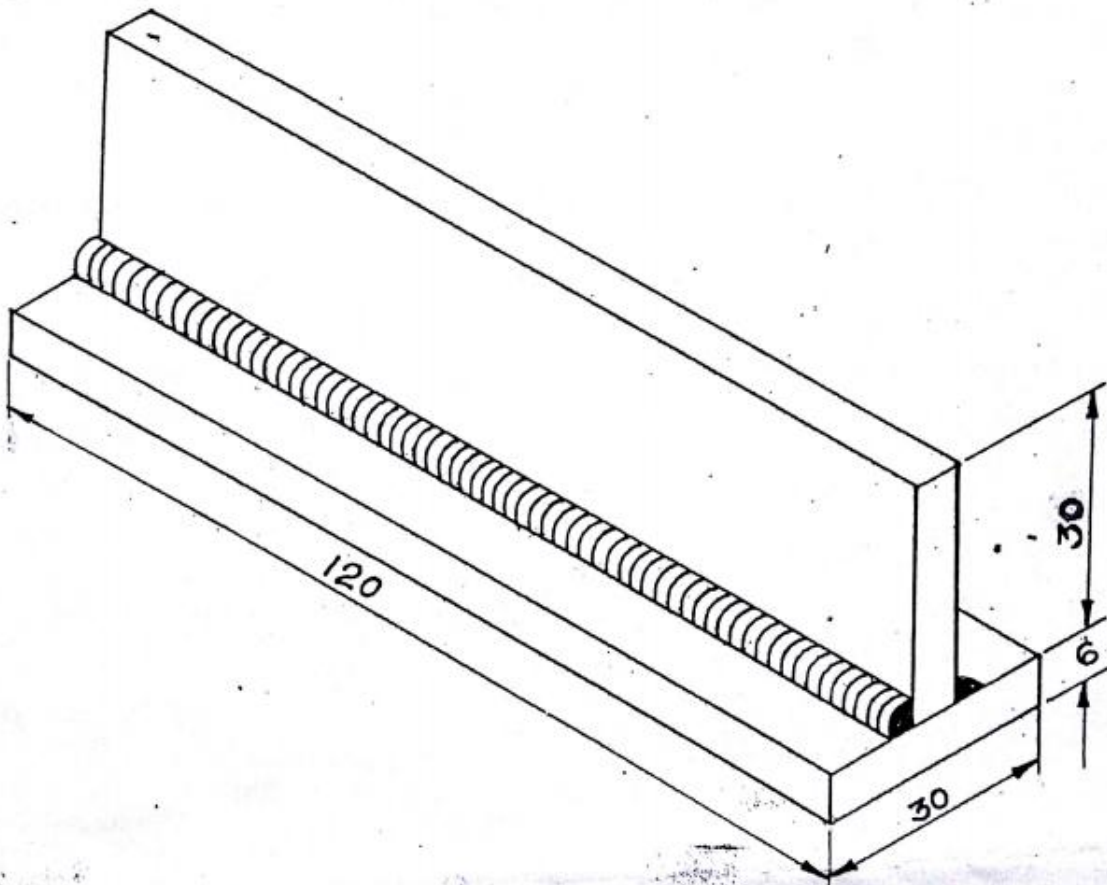
TOOLS REQUIRED:-Steel rule, Try square ,Scriber, Hacksaw ,Bench vice ,Flat file ,face shield ,Tongs, Wire-brush, Chipping hammer, Welding machine and all other arc welding accessories.

LIST OF OPERATIONS:-Measuring, Marking, Fixing, Cutting, Filing, Welding, Deslagging, Cleaning and Inspecting.

PROCEDURE

1. Copy the given drawing in the work record.
2. Cut the work piece as per the drawing.
3. File the work piece to the dimensional accuracy.
4. Kept the work piece on the welding table in the down hand position.
5. Set the ampere of the machine and use protective cloth , select suitable electrode and proper shield.
6. Tack weld the two ends of the work piece and check the alignment.
7. Remove the slag and spatters using the chipping hammer and wire brush.
8. After completion of weld , the weld bead should be inspected.

MODEL NO: 3
FILLET (TEE) JOINT



Scale 1:1
All dimensions are in mm

MODEL NO: 3
FILLET (TEE) JOINT

AIM: - To make a butt joint on the given mild steel flat pieces in down hand position by arc welding.

MATERIALS REQUIRED:-

Work piece:-Mild steel flat of size 123 x 30 x 6mm – 2 nos.

Electrode: - Mild steel electrode 10SWG (3.2mm) - 1no.

TOOLS REQUIRED:-Steel rule, Try square ,Scriber, Hacksaw ,Bench vice ,Flat file ,face shield ,Tongs, Wire-brush, Chipping hammer, Welding machine and all other arc welding accessories.

LIST OF OPERATIONS:-Measuring, Marking, Fixing, Cutting, Filing, Welding, Deslagging, Cleaning and Inspecting.

PROCEDURE

1. Copy the given drawing in the work record.
2. Cut the work piece as per the drawing.
3. File the work piece to the dimensional accuracy.
4. Kept the work piece on the welding table in the down hand position.
5. Set the ampere of the machine and use protective cloth, select suitable electrode and proper shield.
6. Tack welds the two ends of the work piece and checks the alignment.
7. Remove the slag and spatters using the chipping hammer and wire brush.
8. After completion of weld, the weld bead should be inspected.

SHEET METAL

INTRODUCTION

Many engineering and house hold articles such as hoppers, guards, covers, boxes, cans, funnels, ducts, etc., are made from a flat sheet of metal; the process being known as tin smithy or sheet metal work. For this, the development of the article is first drawn on the sheet metal, then cut and folded, to form the required shape of the article.

SHEET METAL MATERIALS

A variety of metals are used in a sheet metal shop such as black iron, galvanized iron, copper, tin, aluminum and stainless steel.

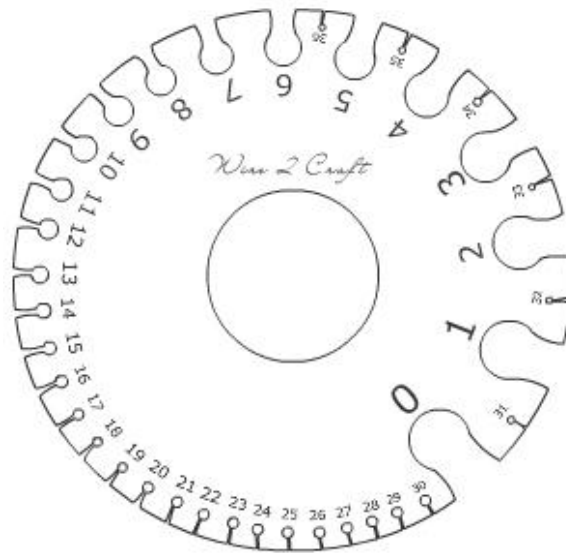
A sheet of soft steel, which is coated with molten zinc, is known as galvanized iron. The zinc coat forms a coating that resists rust, improves the appearance of the metal and permits it to be soldered with greater ease.

HAND TOOLS: The common hand tools used in sheet metal work are, steel rule, wire gauge, dot punch, trammel, scribe, ball-peen hammer, straight-peen hammer, cross-peen hammer, mallet, snips and soldering iron.

TRAMMEL: Sheet metal layout requires marking of arcs and circles. This may be done by using the trammel. The length of the beam decides the maximum size of the arc that can be scribed.

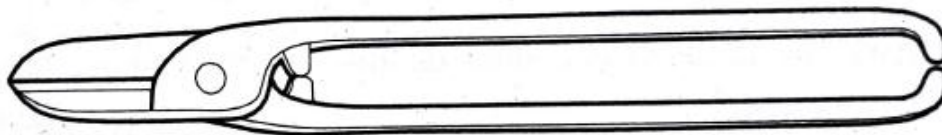
WIRE GAUGE: The thickness of sheet metal is referred in numbers known as standard wire gauge (SWG). The gaps in the circumference of the gauge are used to check the gauge number. Some of the standard wire gauge numbers with corresponding thicknesses are as follows,

Table	
SWG No	Thickness, mm
10	3.20
12	2.60
14	2.30
16	1.60
20	1.00
22	0.70
24	0.65
26	0.45
30	0.30

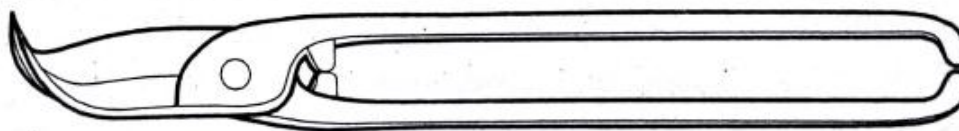


BENCH SHEAR: Sheet metal may be cut by shearing action. In this, the force is applied through a compound lever, making it possible to cut sheet metal up to 4 mm thick. The chopping hole can shear a mild steel rod up to 4 mm diameter.

SNIPS: Snips are hand shears, varying in length from 200 mm to 600 mm, 200 mm and 250 mm being the lengths commonly used. The straight snips is used for cutting along outside curves and straight lines and curved snips or bent snips is for trimming along inside curves.



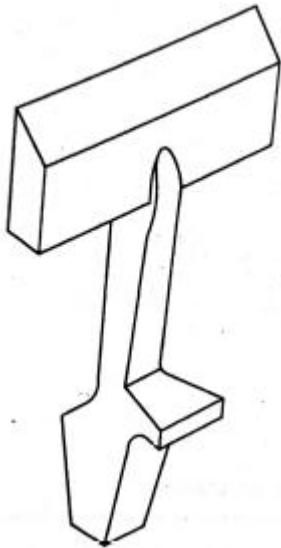
(a) Straight snips



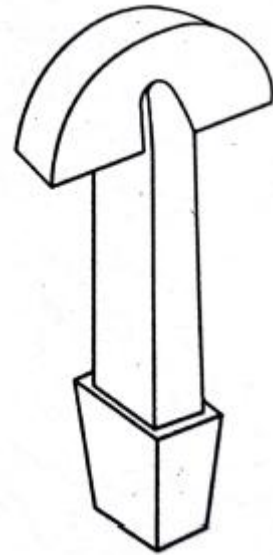
(b) Bent snips

MALLET: It is used for bending and folding work. It is called as soft hammer. Generally, it is made of wood. It is light in weight, covers more area and does not dent the work.

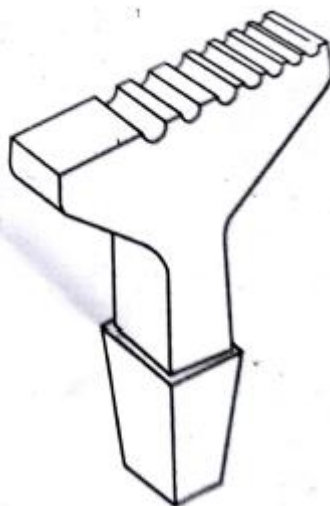
STAKES: Stakes are nothing but anvils, which are used as supporting tools and to form, seam, bend or rivet sheet metal objects. These are available in different shapes and sizes, to suit the requirements of the work. They are made from wrought iron, faced with steel.



HATCHET STAKE



HALF MOON STAKE



CREASING STAKE

SHEET METAL JOINTS:

Various types of joints are used in sheet metal work, to suit the varying requirements. Some commonly used sheet metal joints and folded edges. These are self secured joints, formed by joining together two pieces of sheet metal and using the metal itself to form the joint. These joints are to be used on sheets of less than 1.6 mm thickness. Various forms of seams and hems are associated with sheet metal works; as described below:

A seam is a joint made by fastening two edges together. The following are the types of seams

SINGLE SEAM: It is used to join a bottom to a vertical body.

DOUBLE SEAM: It is similar to single seam, with the main difference that its formed edge is bent upward against the body. The layout process for this seam is similar to that used for a single seam.

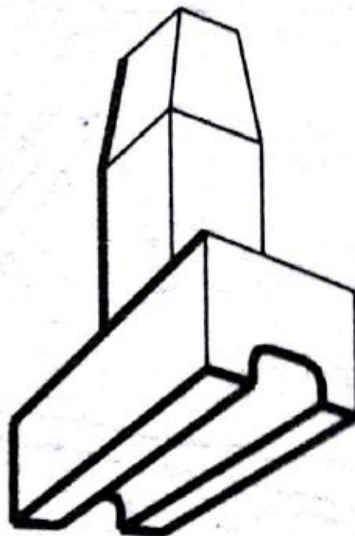
GROOVED SEAM: It is made by hooking two folded edges together and then off-setting the seam. A hem is an edge made by folding. The following are the types of hems.

SINGLE HEM: It is made by folding the edge of the sheet metal, to make it smooth and stiff.

DOUBLE HEM: It is a single hem, with its end bent.

WIRED EDGE: It consists of an edge which has been wrapped around a piece of wire. This edge is used where more strength is needed.

HAND GROOVER: It is used to flatten and shape joints made in sheet metal. The tool has a groove of required width and depth like a die. This groover is placed over the joint and hammered from the top to shape.



RIVETING: Rivets are used to fasten two or more sheets of metal together. It is the common practice to use rivets of the same material as that of the sheets being fastened. Tin men's rivets with flat heads are used on sheet metal work. For successful riveting operation, the selection of proper size and spacing of rivets is essential.

SOLDERING: Soldering is one method of joining two or more pieces of metals by means of fusible alloy, called solder, applied in the molten state-. The melting temperature of the solder should be lower than that of the base metals being joined. For a good job, the metals to be joined must be free from dirt, grease and oxide. Solder is made of tin and lead, usually in equal proportions. It comes either in the form of wire or bar. A soldered joint cannot withstand high temperatures (more than 150° C) and pressures.

SOLDERING IRON: Soldering requires a source of heat. A common method of transmitting heat to the metal surfaces is by using a soldering iron. The working end of this tool is made of copper, which is a good conductor of heat. In electrical soldering; the soldering iron is heated by passing current. But, in the ordinary soldering, the bit is heated by a heating source like furnace, etc

USES OF SOLDERING

Soldering is used to join the following:

1. Electrical components in television, radio, transistor and tape recorders
2. Electronic components like printed circuit boards
3. Automobile parts like radiators and copper pipes
4. Sheet metal works
5. Utensil repairs

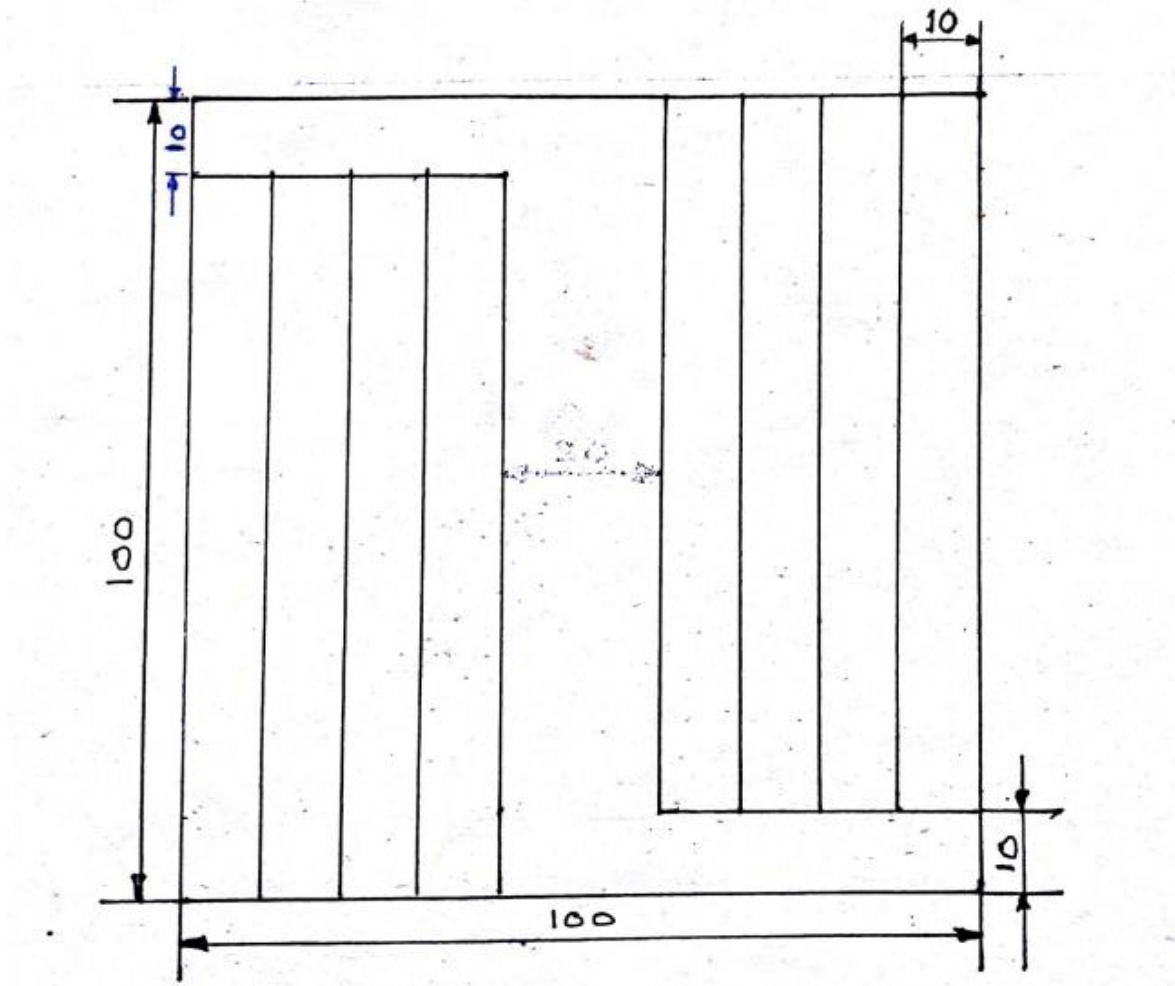
SAFE PRACTICES

GENERAL

1. Use hand leather gloves while handling heavy sheets.
2. Avoid feeling the cut portion by hand while cutting with snips.
3. Do not let sheet metal slip through your hands. Most cuts from sheet metal result from allowing it to slide through the hands.

SNIPS

1. Use snips only for metal that can be cut by force applied by hand.
2. Hand snips should never be used to cut wire. Such practice ruins the cutting edges of the blades.

MODEL NO: 1**MARKING AND CUTTING PRACTICE**

Scale 1:1
All dimensions are in mm

MODEL NO: 1**MARKING AND CUTTING PRACTICE**

AIM: To practice marking and cutting on a given sheet.

MATERIALS REQUIRED: G.I sheet of size 110 X 110mm of 26swg

TOOLS REQUIRED:

- Steel rule
- Mallet
- Scriber
- Straight snips
- Bench shear
- Try square
- Anvil

List of operations:

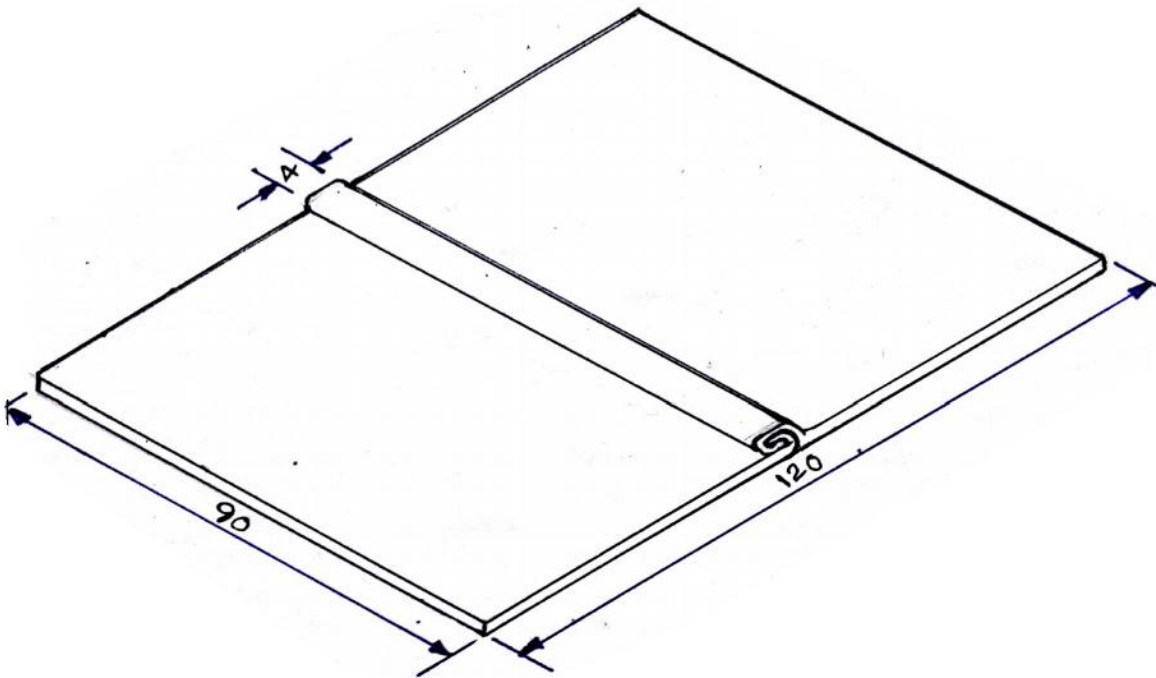
- Laying out and marking
- Cutting
- Finishing

Procedure:

1. Copy the given drawing.
2. Collect the tools and sheet metal.
3. Draw the layout on the work material.
4. Cut the Sheet along the marked out line.
5. Check the edges of sheet for straightness and perpendicularity with the help of try square.
6. Mark the necessary lines to practice straight line cutting.
7. Cut the sheet along the marked lines using straight snips and straighten the sheet by the mallet.
8. Check the dimensions and finish the model

MODEL NO: 2

LOCKED GROOVED JOINT



Scale 1:1
All dimensions are in mm

MODEL NO: 2**LOCKED GROOVED JOINT**

AIM: To make a locked grooved joint as the given dimension.

MATERIALS REQUIRED: GI sheet of size 140 X 100mm of 26 swg.

TOOLS REQUIRED

- Steel rule
- Mallet
- Scriber
- Straight snips
- Bench shear
- Try square
- Anvil
- Hand groover

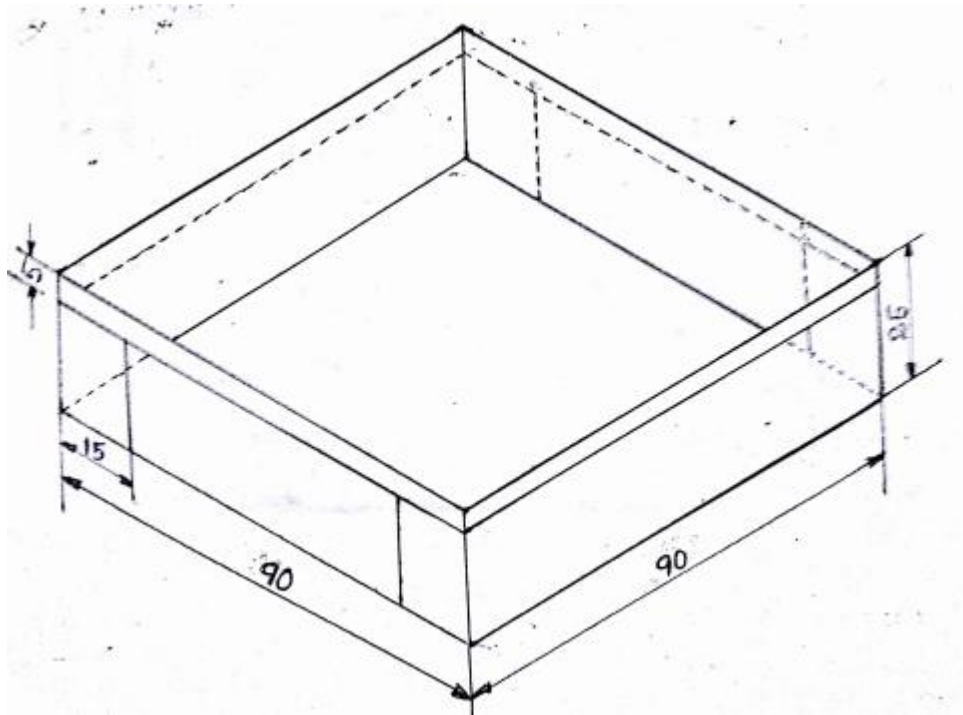
LIST OF OPERATIONS

- Laying out and marking
- Cutting
- Joint making
- Finishing

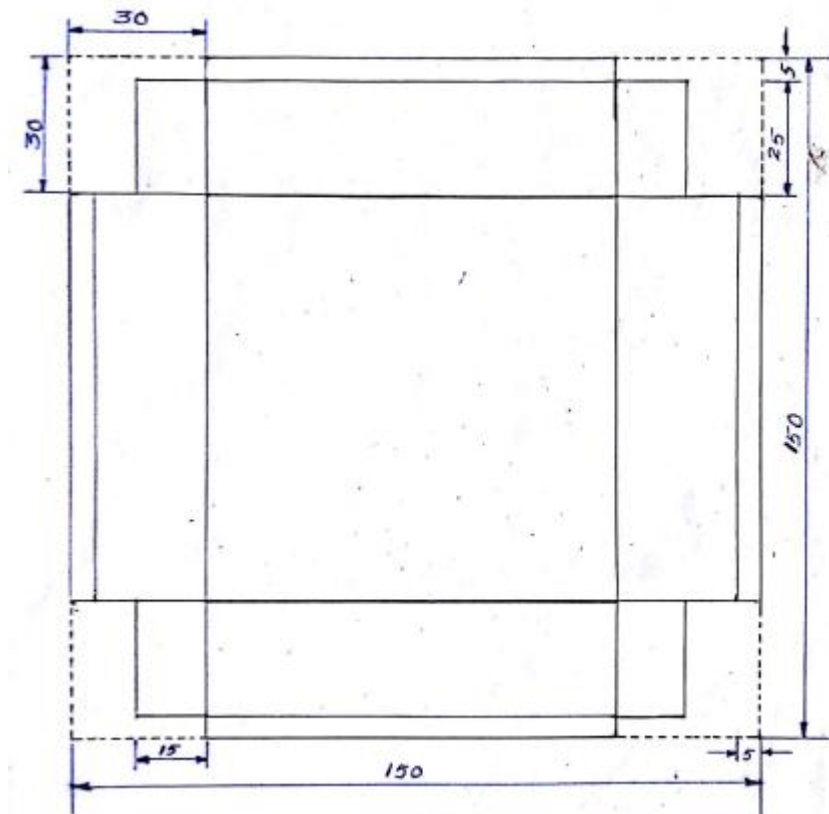
PROCEDURE

1. Copy the given drawing.
2. Collect the tools and sheet metal.
3. Draw the layout on the work material.
4. Cut the Sheet along the marked out line.
5. Check the edges of sheet for straightness and perpendicularity with the help of try square.
6. Mark all the necessary lines to make the required model of size 132 X 90mm.
7. Cut the sheet into two of size 66 X 90mm.
8. Mark the necessary line to form the hook on each, need for bending.
9. The hooks were fold together to form the joint by striking with mallet.
10. Locked the joint with the help of hand groover and finished the model.
11. Finish the model and check all the dimensions.

MODEL NO: 3
SQUARE TRAY



DEVELOPEMENT OF SQUARE TRAY



Scale 1:1
All dimensions are in mm

MODEL NO: 3
SQUARE TRAY

AIM: To make a square tray as per given dimensions.

MATERIALS REQUIRED: G.I sheet of size 150 X 150mm of 26 swg.

TOOLS REQUIRED

- Steel rule
- Mallet
- Scriber
- Straight snips
- Bench shear
- Try square
- Anvil

LIST OF OPERATIONS

- Laying out and marking
- Cutting, Notch cutting
- Bending, Hemming
- Finishing

PROCEDURE

1. Copy the given drawing.
2. Collect the tools and sheet metal.
3. Draw the layout on the work material.
4. Cut the Sheet along the marked out line.
5. Check the edges of sheet for straightness and perpendicularity with the help of try square.
6. Mark all the necessary line to make the required model.
7. Cut the sheet along the lines with straight snips.
8. Do all the bending operations to get the square as vertical sides.
9. Bent all edges to avoid sharp corners and edges for safety.
10. Straighten the four sides and then finish the model.
11. Check all the dimensions and finish.

FITTING

INTRODUCTION

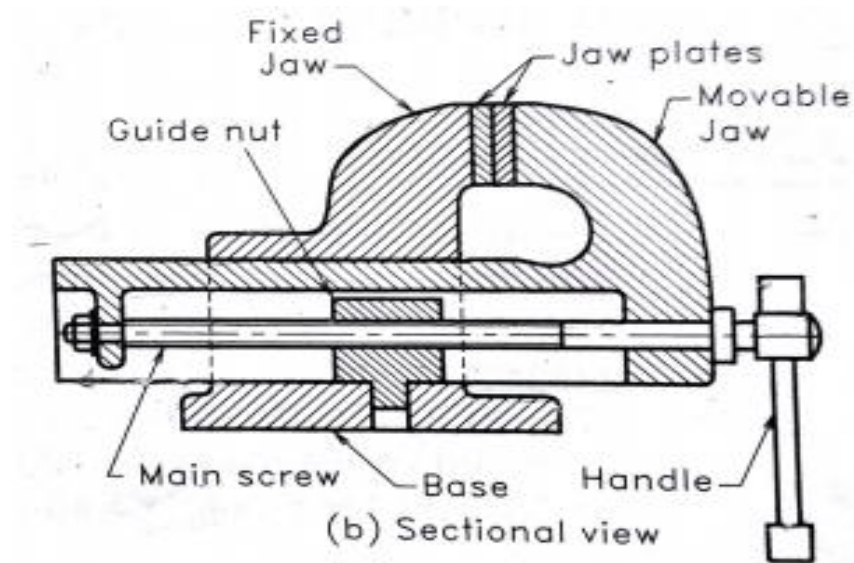
The term, "Bench work" refers to the production of components by hand on the bench, whereas fitting deals with the assembly of mating parts, through removal of metal, to obtain the required fit.

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

FITTING TOOLS

HOLDING TOOLS

BENCH VICE: The bench vice is a work-holding device. It is the most commonly used vice in a fitting shop. It is fixed to the bench with bolts and nuts. The vice body consists of two main parts, fixed jaw and a movable jaws. Jaws are made of hardened steel. 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.



V-BLOCK WITH CLAMP: The V-block is a 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°. V-block with a clamp is used to hold cylindrical work securely.

MARKING AND MEASURING TOOLS

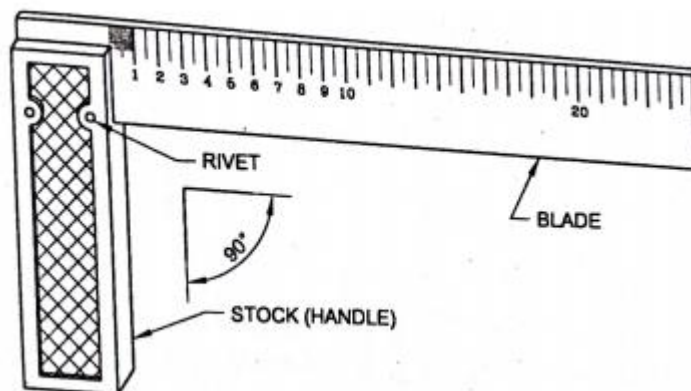
SURFACE PLATE: The surface plate is machined to fine limits and is used for testing the flatness of the work piece. It is also used for marking out small works and is more precise than the marking table. The surface plate is made of cast iron, hardened steel or granite stone. It is specified by length ' width ' height' and grade.

ANGLE PLATE: The angle plate is made of cast iron. It has two surfaces, machined at right angle to each other. Plates and components, which are to be marked out, may be held against the upright face of the angle plate, to facilitate the marking. Slots are provided on the angle plate to clamp the work in position.

UNIVERSAL SCRIBING BLOCK: This is used for scribing lines for layout work and checking parallel surfaces. It may be noted that its spindle can be quickly adjusted to any angle, by an adjusting screw.

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.

TRY-SQUARE: It is used for checking the trueness of an object and also for making. The blade of the try-square is made of hardened steel and the stock of cast iron or steel.



ODD-LEG CALIPER: This is also called 'Jenny Caliper' or 'Hermaphrodite'. This is used for marking parallel lines from a finished edge and also for locating the centre of round bars.

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, bisecting lines.

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.

DOT PUNCH: This is used to lightly indent along the layout lines, to locate centre of holes and to provide a small centre mark for divider point. etc .The angle of the punch is 60° .

CENTRE PUNCH: It is used to mark the location of the holes to be drilled. This is similar to a dot punch .The angle of the punch is 90° .

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. These are specified by the length of the legs.

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. 49 main scale divisions are divided into 50 equal parts in the vernier scale. Hence, one division of vernier scale is $1/50$ mm less than 1mm.This gives a least count of .02mm.

Least count may be defined as the minimum dimension which can be measured by the device. For measuring the size of an object; it is held between its jaws and noting the main scale and vernier scale readings; the size can be determined.

Vernier caliper is generally made of nickel-chromium steel. Its size is specified by the maximum length that can be measured by it.

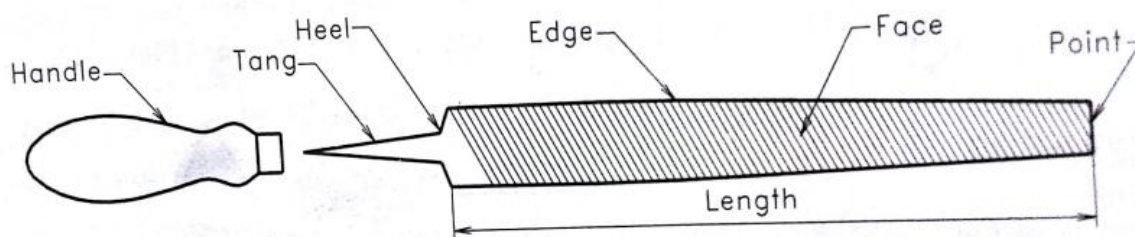
VERNIER HEIGHT GAUGE: The vernier height gauge, clamped with a scribe. It is used for layout work. An off-set scribe is used when it is required to take measurements from the surface, on which the gauge is standing. The accuracy is same as vernier calipers. Its size is specified by the maximum height that can be measured by it. It is made of nickel-chromium steel.

VERNIER DEPTH GAUGE: It is used for precision measurement of blind holes, slots, grooves, etc. The working principle of this instrument is the same as that of the vernier caliper. It is made of nickel-chromium steel. Its size is specified by the maximum depth that can be measured by it.

CUTTING TOOLS

FILE: A file is a hardened piece of steel containing a percentage of carbon or tungsten. Fine teeth are cut on the surface of the teeth in slanting rows. Files are classified according to the following factors:

1. **The cut.**
2. **The shape.**
3. **The length.**



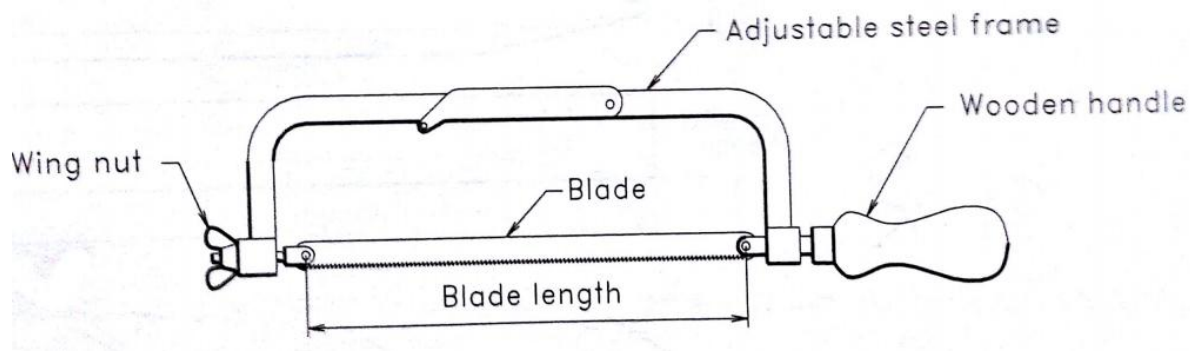
SINGLE CUT FILE: A single cut file will be having parallel teeth at 60 degree inclination to the centre line.

DOUBLE CUT FILE: double cut files have two times cut-teeth; one as 60 degree and the other cut is 80 degree.

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

CHIPPING: Removing the metal with a chisel is called chipping and Is normally used where machining is not possible .While chipping, safety goggles must be put on, to protect eyes from the flying chips.

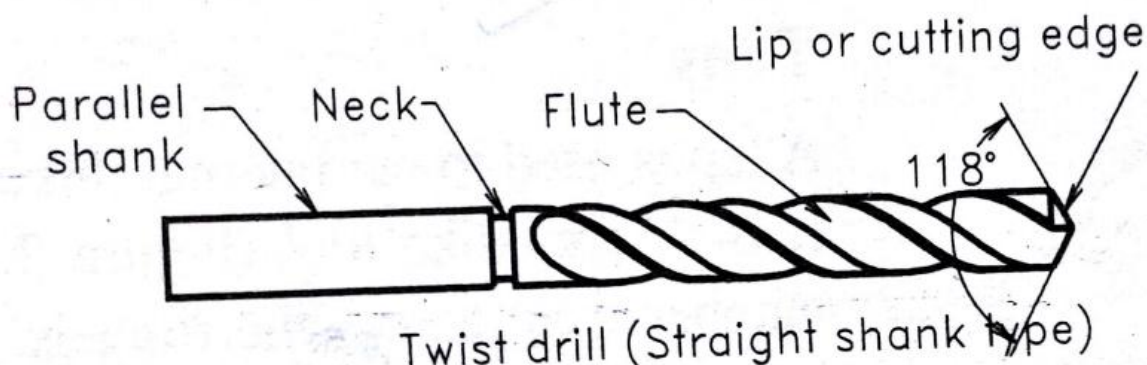
HACKSAW: The hacksaw is used for cutting metal by hand. It consists of a frame, which holds a thin blade, firmly in position. Hacksaw blade is specified by the number of teeth per centimeter. Hacksaw blades have a number of teeth ranging from 5 to 15 per centimeter (cm). Blades having lesser number of 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 types. 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. The size of the blade is measured by the distance between the pin holes.

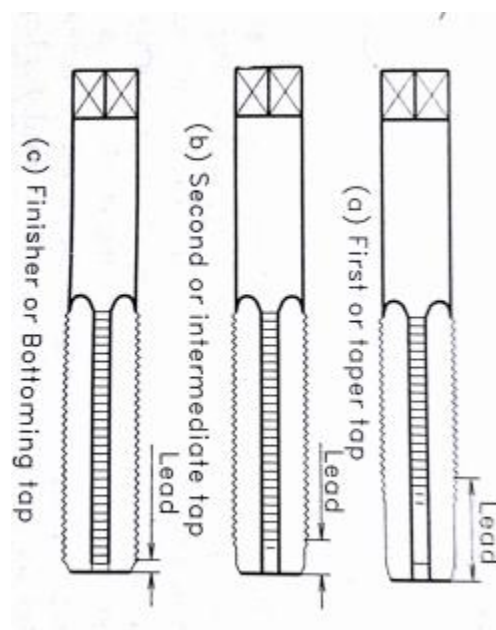
CHISELS: Chisels are used for removing surplus metal or for cutting thin sheets. These tools are made from carbon steel of octagonal or hexagonal section. Chisels are annealed, hardened and tempered to produce a tough shank and a hard cutting edge. The cutting angle of the chisel for general purpose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

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. Cutting angle of the twist drill is 118° .



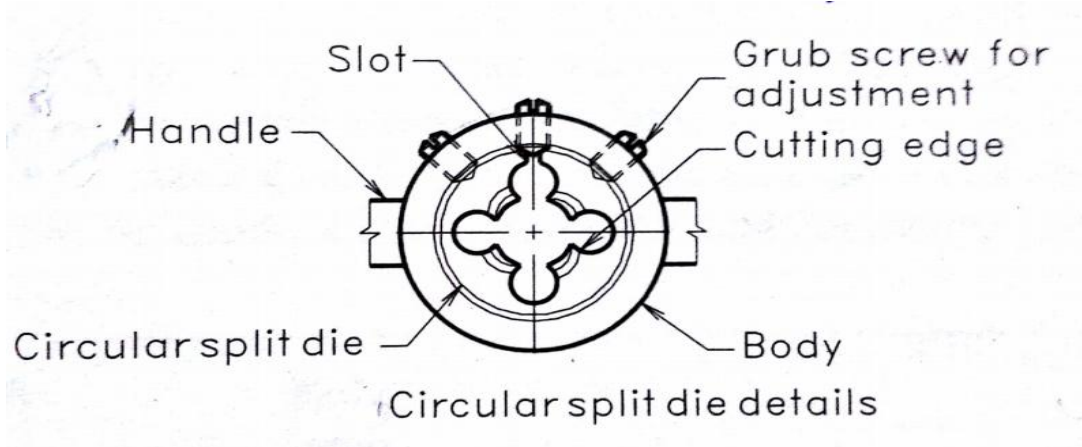
TAPS AND TAP WRENCHES: A tap is a hardened steel tool, used for cutting internal threads in a drilled hole. Hand taps are usually supplied in sets of three for each diameter and thread size. Each set consists of a taper tap, intermediate tap and plug or bottoming tap. Taps are made of high carbon steel or high speed steel.

1. First tap, or rougher - to start threading.
2. Second tap or intermediate - to cut the thread.
3. Bottoming tap or finisher - to finish the thread.



TAPS

DIES: Dies are used to cut external threads on round rods. A die is a round block of hardened steel with a hole having internal threads and flutes across the threads. The die is fitted inside a die holder called *die stock*.

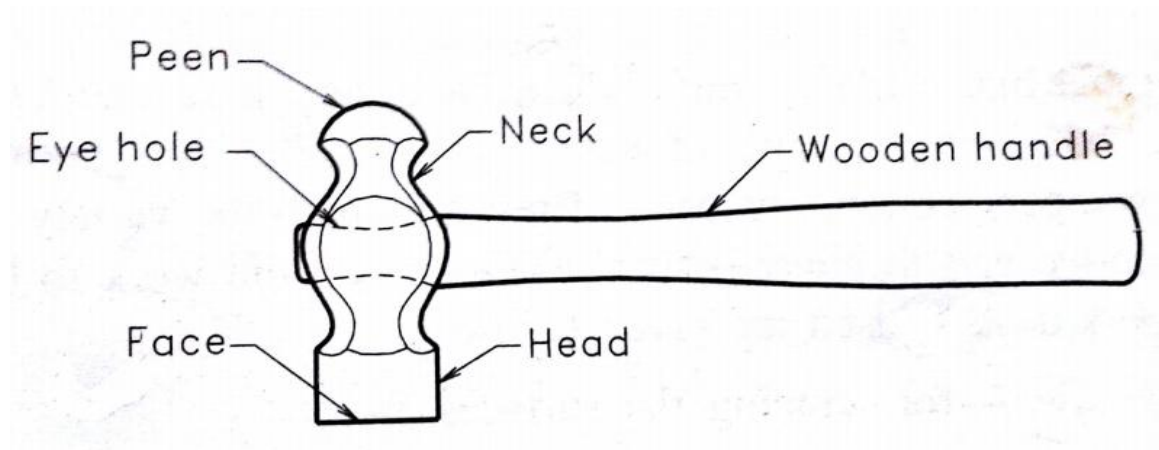


BENCH DRILLING MACHINE: Holes are drilled for fastening parts with rivets, bolts or for producing internal threads. Bench drilling machine is the most versatile machine used in a fitting shop for the purpose. Twist drills, made of tool or high speed steel are used with the drilling machine for drilling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

HAMMERS

Hammers are used to strike on a tool fastener or workpiece. They are made up of steel by forging process. Wooden or bamboo handle is fitted in the elliptical eye hole of the hammer.

BALL-PEEN HAMMER: 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.



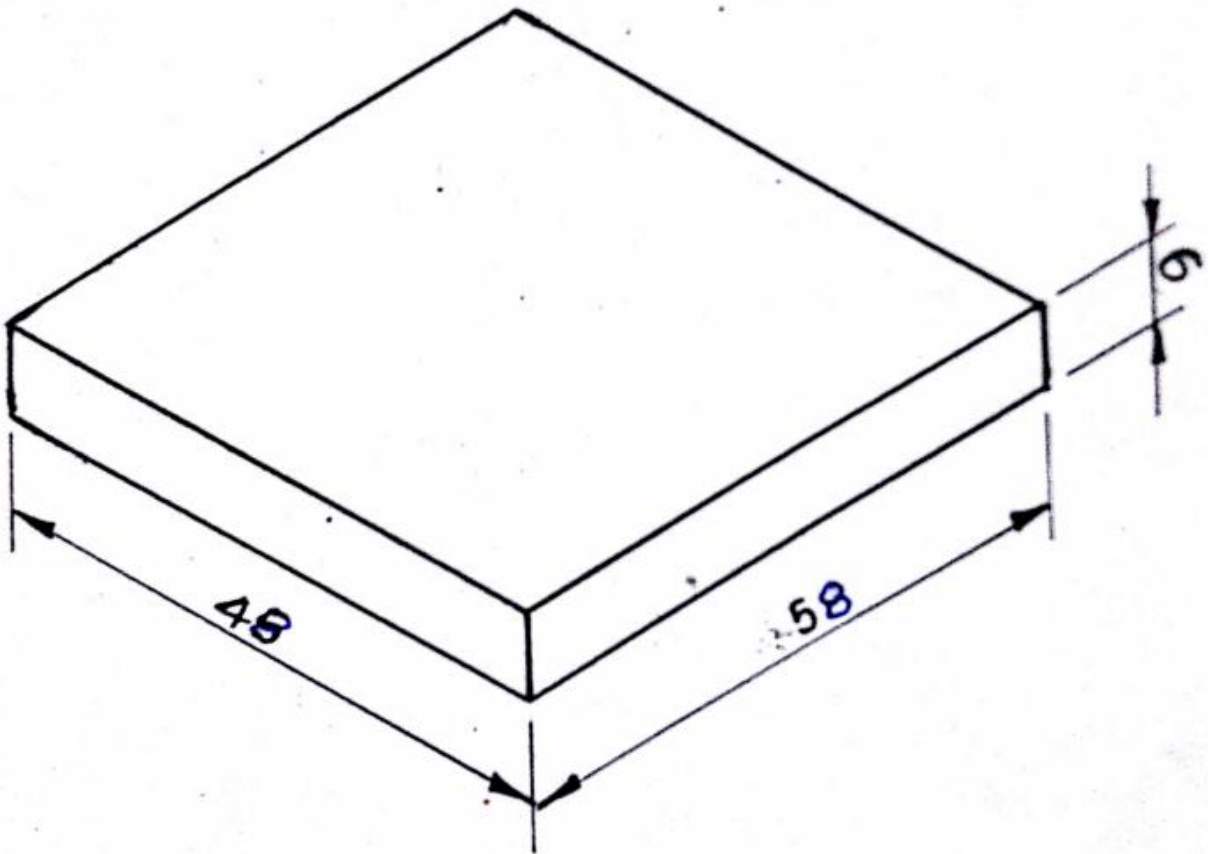
CROSS-PEEN HAMMER: It is similar to ball peen hammer, except the shape of the peen. This is used for chipping, riveting, bending and stretching metals and hammering inside the curves and shoulders.

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.

SPANNERS: A spanner or wrench is a tool for gripping 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

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MODEL NO: 1
FILING PRACTICE



Scale 1:1
All dimensions are in mm

MODEL NO: 1
FILING PRACTICE

AIM: To make square of 45 x 45mm using the given mild steel flat piece by filing.

MATERIALS REQUIRED: Mild steel flat of 50 x 50 x 6mm

TOOLS REQUIRED:

- Steel rule
- Scriber
- Centre punch
- Surface plate
- Vernier height gauge
- Flat file
- Try square

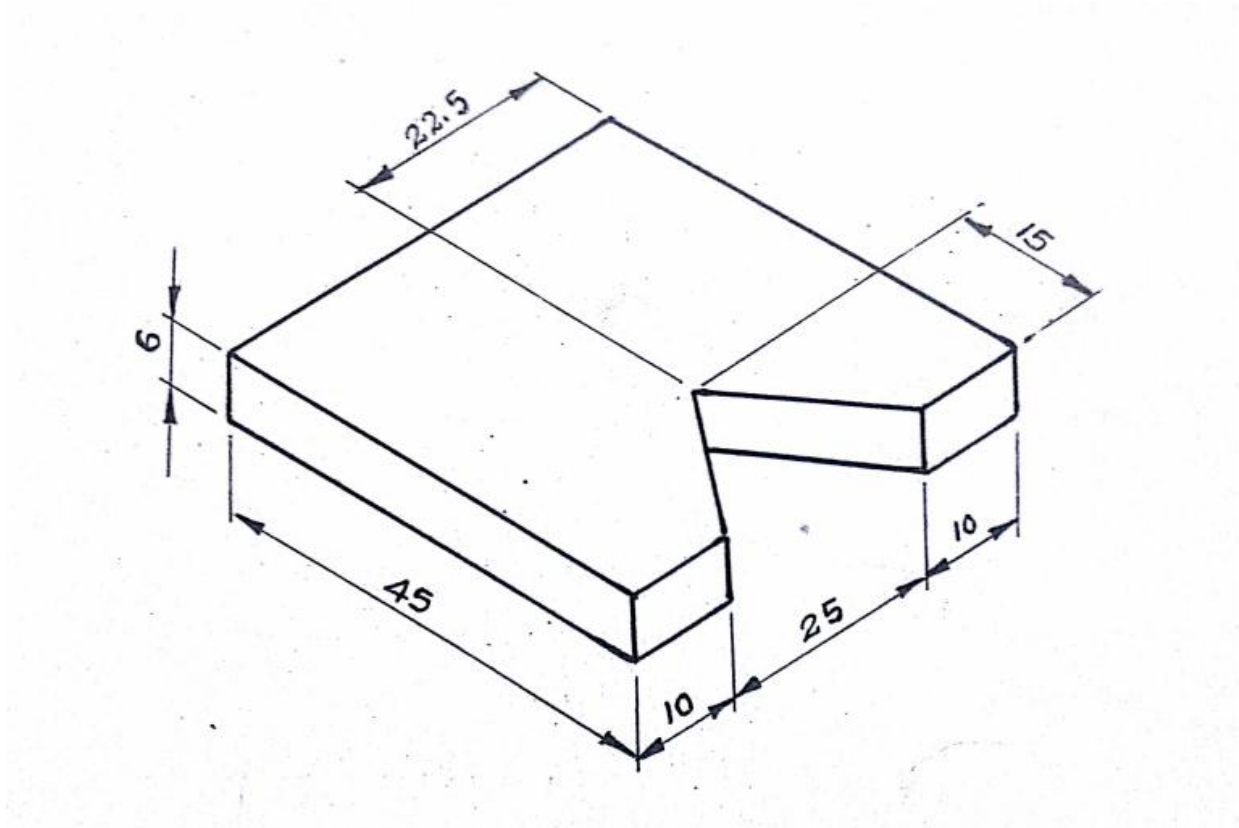
LIST OF OPERATIONS:

- laying out and marking
- punching
- cutting
- rough filing
- smooth filing

PROCEDURE:

1. Copy the given drawing.
2. Collect the tools and work piece.
3. Mark the layout on the work piece then punch the required lines.
4. Cut unwanted material from the work piece.
5. Filed the work piece as per the drawing.
6. Check all the dimensions and then finish the model.

MODEL NO : 2
V-GROOVE



Scale 1:1
All dimensions are in mm

MODEL NO : 2
V-GROOVE

AIM: To make a V-Groove on a given m.s flat as in the dimensions shown in fig.

MATERIALS REQUIRED : Mild steel flat of 50 X 50X 6mm.

TOOLS REQUIRED:

- Steel rule
- Scriber
- Centre punch
- Surface plate
- Vernier height gauge
- Hack saw
- Flat file
- Try square

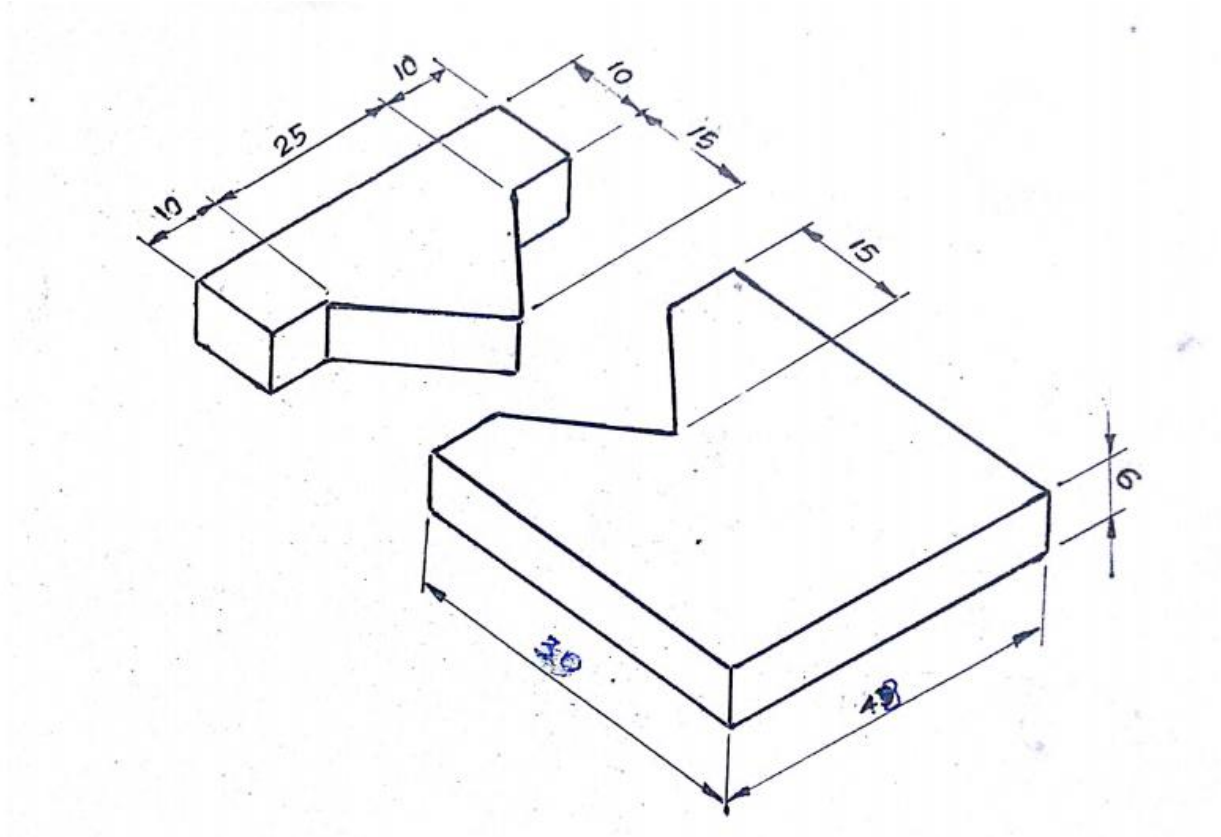
LIST OF OPERATIONS :

- Laying out and marking
- Punching
- Cutting
- Rough filing
- Smooth filing

PROCEDURE :

1. Copy the given drawing.
2. Collect the tools and work piece.
3. Mark the layout on the work piece then punch the required lines.
4. Cut unwanted material from the work piece.
5. After completing the square cut the V-groove .
6. Filed the V-Groove to the exact angle.
7. Check the angles of 'V' and finish the model.

MODEL NO: 3
V-JOINT



Scale 1:1
All dimensions are in mm

MODEL NO: 3**V-JOINT**

AIM: To make a v joint as per the given dimension shown in fig.

MATERIALS REQUIRED: Mild steel flat of 50X50X6mm
30x50X6mm

TOOLS REQUIRED:

- Steel rule.
- Scriber.
- Centre punch.
- Surface plate..
- Vernier height gauge.
- Hack saw.
- Flat file.
- Try square.

LIST OF OPERATIONS:

- Laying out and marking.
- Punching.
- Cutting.
- Rough filing.
- Smooth filing.

PROCEDURE:

- 1 Copy the given drawing.
- 2 Collect the tools and work piece.
- 3 Mark the layout on the work piece then punch the required lines.
- 4 Complete the cutting operation of two pieces.
5. Filed the two pieces together to form the joint.
- 6 Check the joints for dimensional accuracy.

BLACKSMITHY

INTRODUCTION

Blacksmithy or hand forging is an ancient trade. It consists of heating a metal stock till it acquires sufficient plasticity, followed by hand forging involving hammering bending pressing etc., till the desired shape is attained.

Hand forging is the term used when the process is carried out by hand tools. If power operated machines are used for the process, it is known as machine forging. Hooks, links, lifting tackles and agricultural implements are some of the items that are produced by machine forging. The following are the advantages of forging:

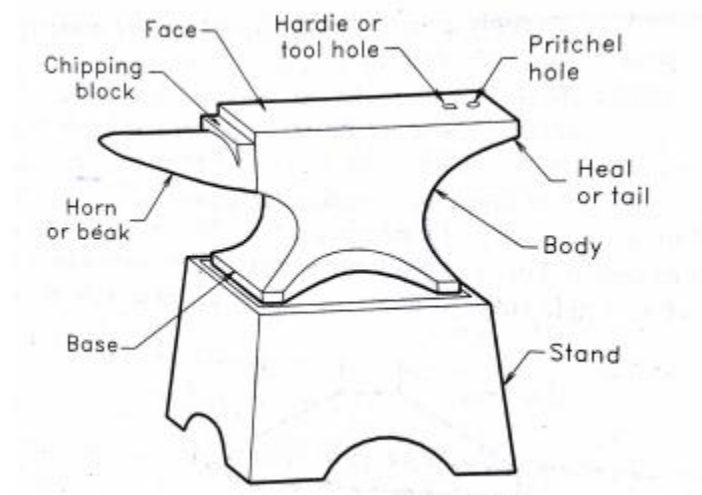
1. Strength and toughness is high.
2. Strength to weight ratio is high.
3. Internal defects are eliminated.
4. Forged parts need less or no machining.

TOOLS AND EQUIPMENTS

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

Metal	Forging temperature, °C
Mild steel	750-1300
Wrought iron	700-1300
Medium carbon steel	750-1850
High carbon and alloy steel	800-1150

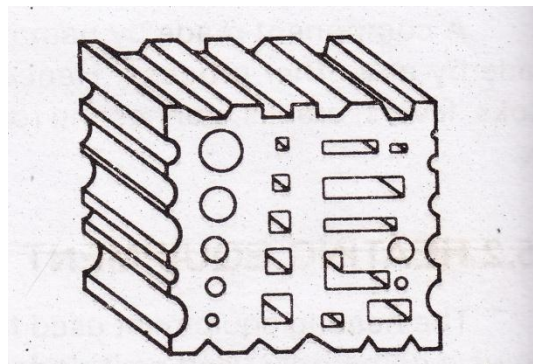
ANVIL: It is a supporting tool used in smithy shop. It is useful for operations such as bending, swaging, etc. Its body is generally made of cast steel, wrought iron or mild steel, with a hardened top layer.



The beak or horn is used for bending metal to round shape of different radii. The portion between the beak and face is called chipping block, which is used as a base for cutting operations, using hot chisels. The square hardy hole is used to hold square shank tools like swages and fullers. A round hole is also provided near the hardy hole, which is used for bending round rods and as a die for hot punching operation.

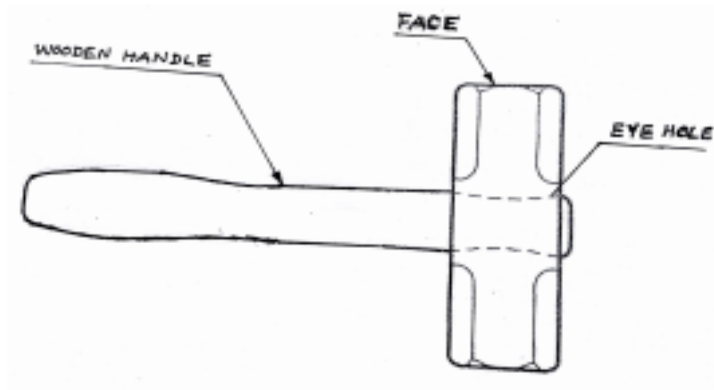
Anvils are made in sizes weighing from 85 kg to 850 kg. An anvil weighing about 75 kg is suitable for general purpose.

SWAGE BLOCK: It is also a supporting tool used in a forge shop. It has a number of slots of different shapes and sizes along its four side faces and through holes of different shapes and sizes, running from its top to bottom faces. This is used as a support while forming (swaging) different shapes, bending and in punching holes. It is generally made of cast iron or steel.

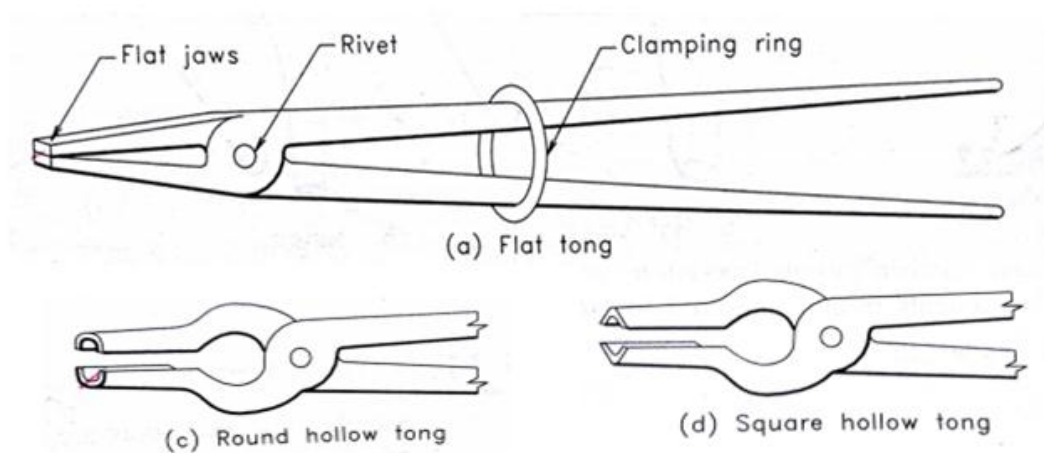


LEG VICE: It is a heavy duty vice, fixed to the work bench at one end of a leg set in a concrete base. It is mainly used for light forging and bending work.

HAMMERS: Hammers of different types and weights are used in smithy. The ball-peen hammer used for light forging works. The sledge hammer which is used for heavy work.



TONGS: It is a holding device. Figure shows the most commonly used shapes in a smithy shop they are made of mild steel. A flat tongs I used for holding works in rectangular section, round tongs used for holding round rod, Square tongs is used for holding square rod.



FORGING OPERATIONS

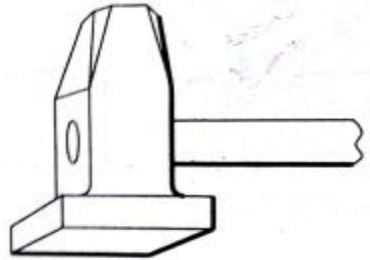
The following are the basic operations that may be performed by hand forging:

DRAWING-DOWN: Drawing is the process of stretching the stock while reducing its cross-section locally. Forging the tapered end of a cold chisel is an example of drawing operation.

UPSETTING: It is a process of increasing the area of cross-section of a metal piece, with corresponding reduction in length. In this, only the portion to be upset is heated to forging temperature and the work is then struck at the end with a hammer.

FULLERING: Fullers are used for necking down a piece of work. Fullers are made of high carbon steel in two parts, called the top and bottom fullers.

FLATTENING: Flatters are the tools that are made with a perfectly flat face. These are used for finishing flat surfaces. A flatter of small size is known as sethammer and is used for finishing near corners and in confined spaces.



FLATTENER

SWAGING: Swages, like fullers are also made of high carbon steel and are made in two parts called the top and bottom swages. These are used to reduce and finish to round, square or hexagonal forms.

BENDING: Bending of bars, flats, etc., is done to produce different types of bent shapes such as angles, ovals, circles, etc. Sharp bends as well as round bends may be made on the anvil.

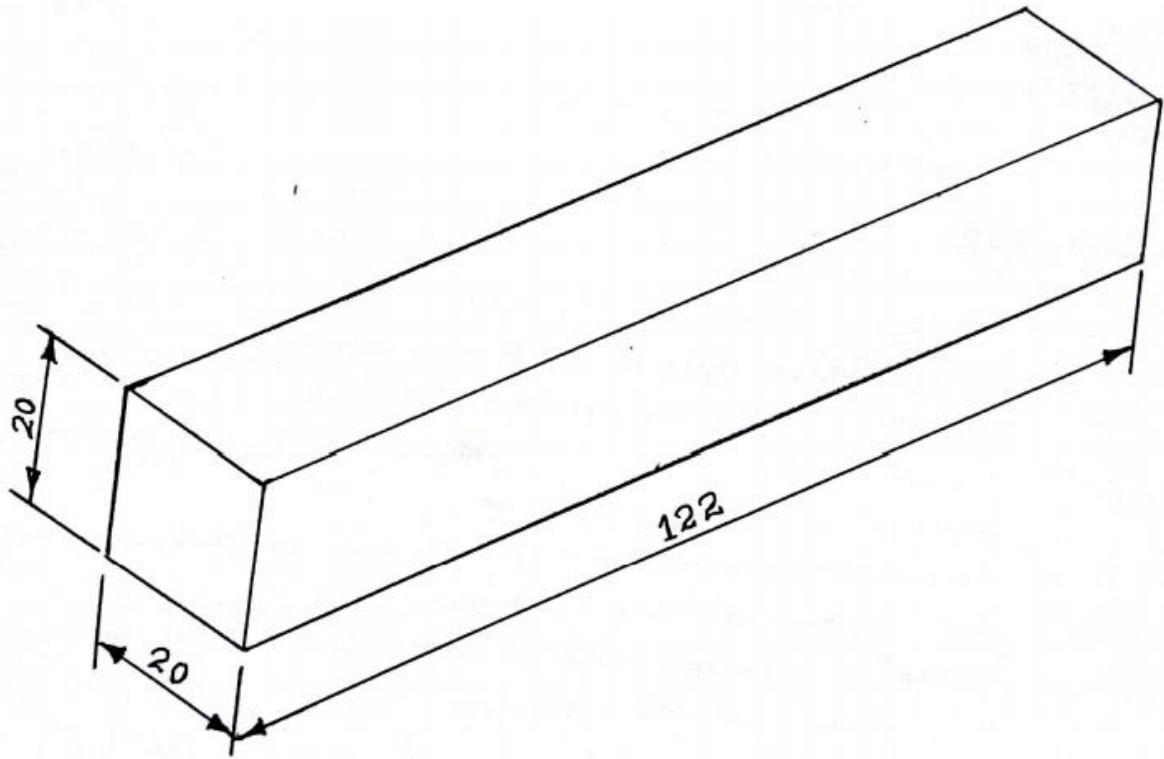
TWISTING: It is also one form of bending. Sometimes, it is done to increase the rigidity of the work piece. Small pieces may be twisted by heating and clamping a pair of tongs on each end of the section to be twisted and applying a turning moment.

CUTTING (HOT AND COLD CHISELS): Chisels are used to cut metals, either in hot or cold state. The cold chisel is similar to fitter's chisel, except that it is longer and has a handle. A hot chisel is used for cutting hot metals and its cutting edge is long and slender. Chisels are made of tool steel, hardened and tempered.

SAFE PRACTICES

1. Hold the hot work downwards close to the ground, while transferring from the hearth to anvil, to minimize danger of burns; resulting from accidental collisions with others.
2. Use correct size and type of tongs to fit the work.
3. Care should be taken in the use of the hammer.
4. Wear face shield when hammering hot metal.
5. Wear gloves when handling hot metal.
6. Wear proper safety shoes.
7. Ensure that hammers are fitted with tight and wedged handles.

MODEL NO:1
SQUARE PRISM



Scale 1:1
All dimensions are in mm

MODEL NO:1
SQUARE PRISM

AIM:

To make a square prism using the given cylindrical M.S rod.

MATERIALS REQUIRED:

Cylindrical M.S rod of dia 25 mm and length 100 mm, and coke for heating.

TOOLS REQUIRED:

- 1- Hammer,
- 2- Tongs,
- 3- Flattener,
- 4- Anvil,
- 5- Forge,
- 6- Brass rule.

LIST OF OPERATIONS:

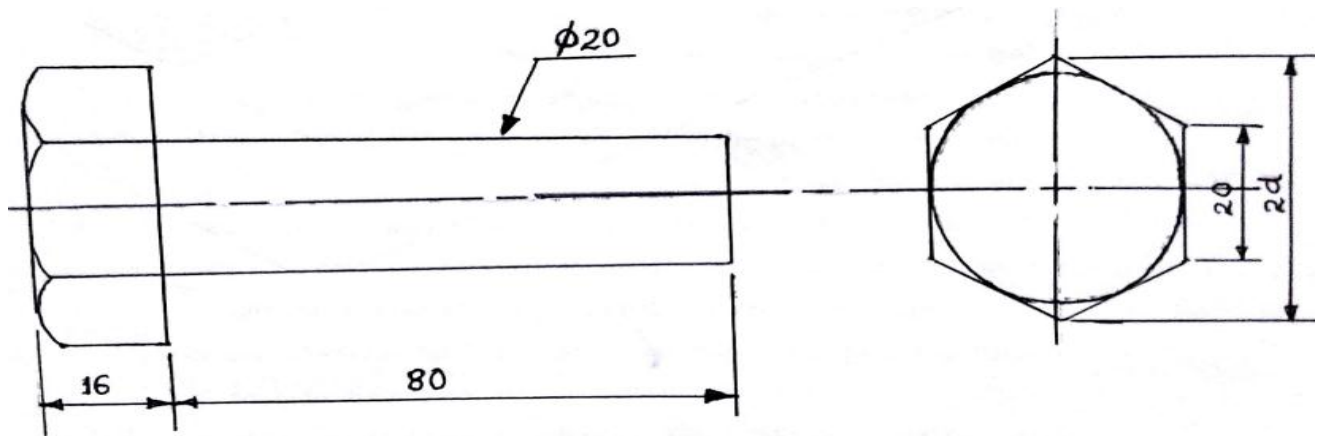
- 1- Heating,
- 2- Hammering to square prism,
- 3- Jumping to reduce length .

PROCEDURE:

- 1- Copy the given drawing.
- 2- Collected the tools and material for the model.
- 3- Heat the given work piece in the hearth to red hot temperature.
- 4- Take the work piece from the hearth and keep it on the anvil in lengthwise and then hammer.
- 5- Turned the work piece to 90 degree after flattening the opposite sides and continued the heating & hammering to get exact shape of square prism.
- 6- To reduce the length of the prism to 122 mm, the jumping operation is performed by keeping the square prism on the anvil in the vertical position.
- 7- Finally flattened the four faces of the prism using the flattener and finished the square prism .
- 8- Then checked the dimensions using steel rule.

MODEL NO:2

HEXAGONAL BOLT



Scale 1:1

All dimensions are in mm

MODEL NO:2

HEXAGONAL BOLT

AIM:

To make a hexagonal bolt using the given cylindrical M.S rod.

MATERIALS REQUIRED:

Cylindrical M.S rod of dia 20 mm and length 100 mm, and coke for heating.

TOOLS REQUIRED:

- 1- Hammer
- 2- Tongs,
- 3- Flattener,
- 4- Anvil,
- 5- Forge,
- 6- Brass rule.

LIST OF OPERATIONS:

- 1- Heating,
- 2- Jumping one end of the work piece to make bolt head,
- 3- Hammering to form hexagonal head .

PROCEDURE:

- 1- Copy the given drawing.
- 2- Collected the tools and material for the model.
- 3- Heat the given work piece in the hearth to red hot temperature.
- 4- Take the heated work piece from the hearth for jumping operation on the heated end to form the bolt head by hammering.
- 5- Repeated this operation to form the end of work piece to the required size of head.
- 6- Then heated the head again and place the unheated end of the work piece in the pritchel hole of the anvil and hammered it suddenly to form the cylindrical head of the bolt.
- 7- Again heated the cylindrical head and keeping the end on the anvil and hammered it to form the hexagonal head. This is repeated to form a regular hexagonal head of the bolt.
- 8- Finished the hexagonal headed bolt and checked the dimensions using brass rule.

FOUNDRY

INTRODUCTION

Foundry practice deals with the process of making castings in moulds formed in either sand or some other material. The process involves the operations of pattern making, sand preparation, moulding melting of metals, pouring in moulds, cooling shake-out, fettling heat treatment, finishing and inspection. Moulding is the process of making moulds.

Moulds are classified as temporary and permanent. Temporary moulds are made of refractory and other binding materials and may be produced either through hand moulding or machine moulding.

MOULDING SAND: Sand is the principal material used in a foundry. The principal ingredients of moulding sands are: Silica sand, (ii) clay and (iii) moisture. Clay imparts the necessary bonding strength to the moulding sand. Moisture when added in correct proportion, provides the bonding action to the clay.

PROPERTIES OF MOULDING SAND: The essential requirement of a good moulding sand is that it should produce sound castings which are free from defects. For producing sound castings, moulding sand or mold should possess the following properties;

POROSITY OR PERMEABILITY: When molten metal is poured into a mould, gases and steam will be formed. The sand mould should have sufficient porosity to allow the gases and steam to pass through it. If they are not removed, casting defects such as blow holes will be formed.

PLASTICITY: It is the property of the moulding sand by virtue of which, it flows to all the corners around the pattern in the mold, when rammed. Only due to this property, the molding sand gets the shape of the pattern in the mold.

COHESIVENESS: It is the property by which the sand particles stick to each other. Coarsegrained sand particles give better cohesiveness than spherical grained sand particles.

ADHESIVENESS: Sticking of the sand particles to another body is known as adhesiveness. The moulding sand sticks to the sides of the cope and drag parts of the moulding box.

PATTERNS: A pattern is the prototype of the desired casting, which when packed in a suitable material, produces a cavity called the mould. This cavity when filled with molten metal, produces the desired casting after solidification.

TYPES OF PATTERNS: Wood or metal patterns are used in foundry practice. Single piece, split, loose piece, multi-piece and cored patterns are some of the common types.

SINGLE PIECE PATTERN: It is the simplest of all the patterns. This has a flat surface on the cope side. This makes possible a straight line parting on the joint between the cope and drag of the mould. It is used for making simple castings.

SPLIT PATTERN: Split patterns are recommended for intricate castings, where removal of the pattern from the mould is difficult. The two halves of the pattern are put together by dowel pins.

LOOSE PIECE PATTERN: When a pattern cannot be withdrawn from the mould due to its complexity, loose pieces are provided to facilitate this. The loose parts or pieces are attached to the main body of the pattern with dowel pins. However, only two moulding boxes are required for making a mould in this case.

CORE BOX: A core box is a pattern, made of either wood or metal, into which sand is packed to form the core. Wood is commonly used for making a core box; but metal boxes are used when cores are to be made in large numbers. Specially prepared core sand is used in making cores.

PATTERN MATERIALS

The following are the materials that are widely used for making patterns:

1. Wood,
2. Metals and alloys,
3. Plastics,
4. Plasters and waxes.

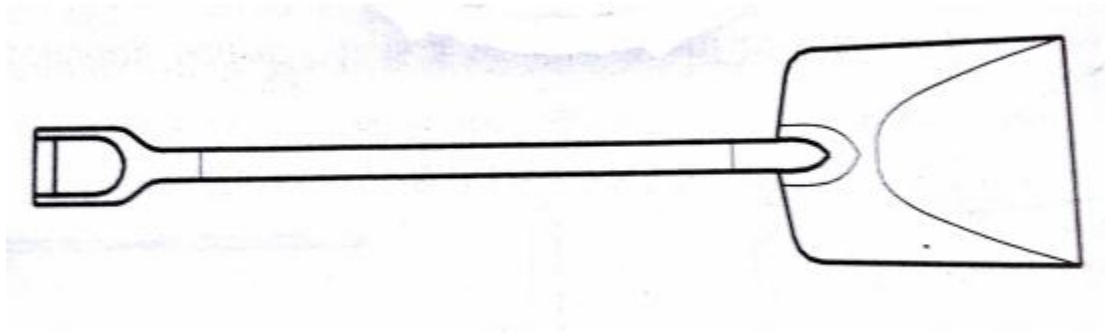
TOOLS AND EQUIPMENT FOR HAND MOULDING

The tools and equipment used for sand moulding process are grouped as mentioned below:-

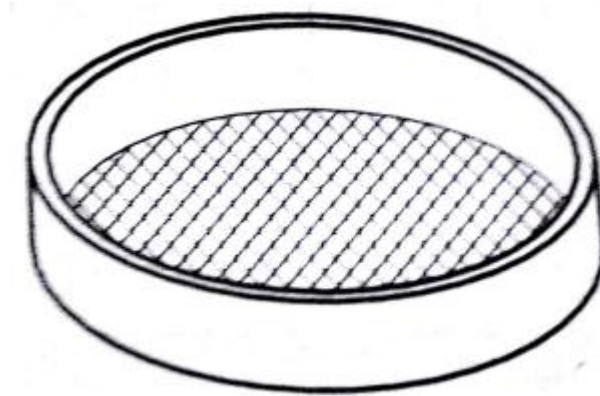
- (a) Sand preparation tools and equipments.
- (b) Moulding flask.
- (c) Moulders tools.

SAND PREPARATION TOOLS AND EQUIPMENTS

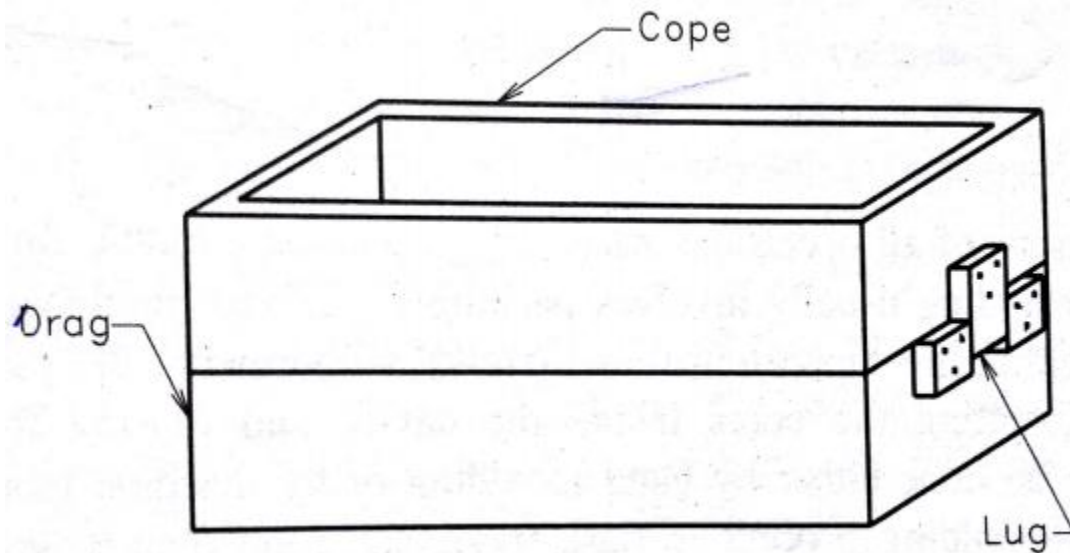
SHOVEL: It is used for mixing and tempering moulding sand and for transferring the sand into the flask. It is made of broad steel blade with a wooden handle.



RIDDLE: Hand riddle consists of a square or circular wooden frame fitted with a screen of standard wire mesh (No. 8) at its bottom. It is used for hand riddling (sieving) of sand to remove coarse sand particles and other foreign material from the foundry sand. It also produces required aeration to the sand. The spacing between two consecutive wires in the sieve determine the fineness of the sand that can be obtained through it.



MOULDING FLASK: It is a box, made of wood or metal, open at both ends. The sand is rammed-in after placing the pattern in the moulding flask. Usually, it is made of two parts. Cope is the top half of the mould, having guides for the aligning pins. Drag is the bottom half of the flask, having aligning pins. Cheek is that part of the flask, which comes in-between the cope and drag. Cheek is used when the pattern is a multi-piece pattern.



RAMMER: It is used for packing or ramming the sand around the pattern. One of its ends, called the peen end, is wedge shaped and is used for packing sand in spaces, pockets and comers, in the early stages of ramming. The other end, called the butt end, has a flat surface and is used for compacting the sand towards the end of molding.

STRIKE EDGE OR STRIKE-OFF BAR: It is a piece of metal or wood with straight edge. It is used to remove the excess sand from the mold after ramming, to provide a level surface.

SPRUE (RUNNER) 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.

RISER PIN: It is a straight wooden pin used to make a hole in the cope, over the mould cavity for the molten metal to rise-in and feed the casting to compensate the shrinkage that may take place during solidification.

TROWEL: It consists of a metal blade fitted into a wooden handle. It is used to smoothen the surface of the mould. It may also be used for repairing the damaged portion of the mould. Trowels are made in many different styles and sizes, each one suitable for a particular job.

SPIKE OR DRAW PIN: It is a pointed steel rod with a loop at the other end. It is used to remove the pattern from the mould. A draw screw, with a threaded end, may also be used for the purpose.

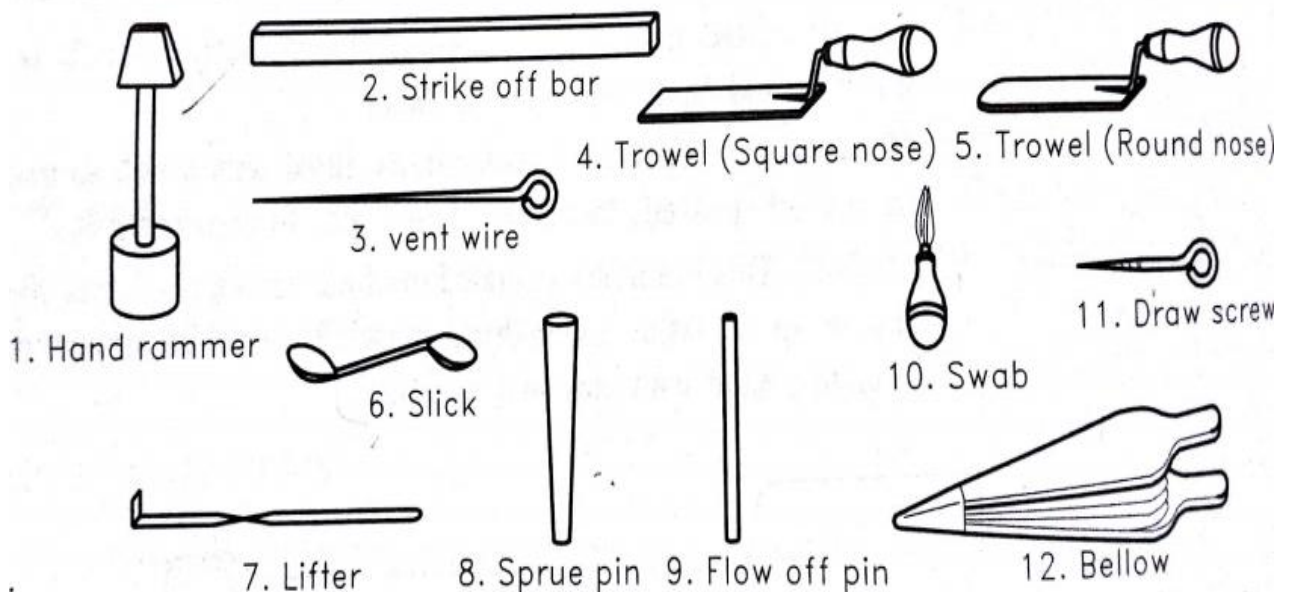
SLICK: It is a small double ended tool having a flat on one end and a spoon on the other. It is used for mending and finishing small surfaces of the mould.

LIFTERS: Lifters are made of thin sections of steel of various widths and lengths, with one end bent at right angles. These are used for cleaning and finishing the bottom and sides of the deep and narrow pockets of the mould.

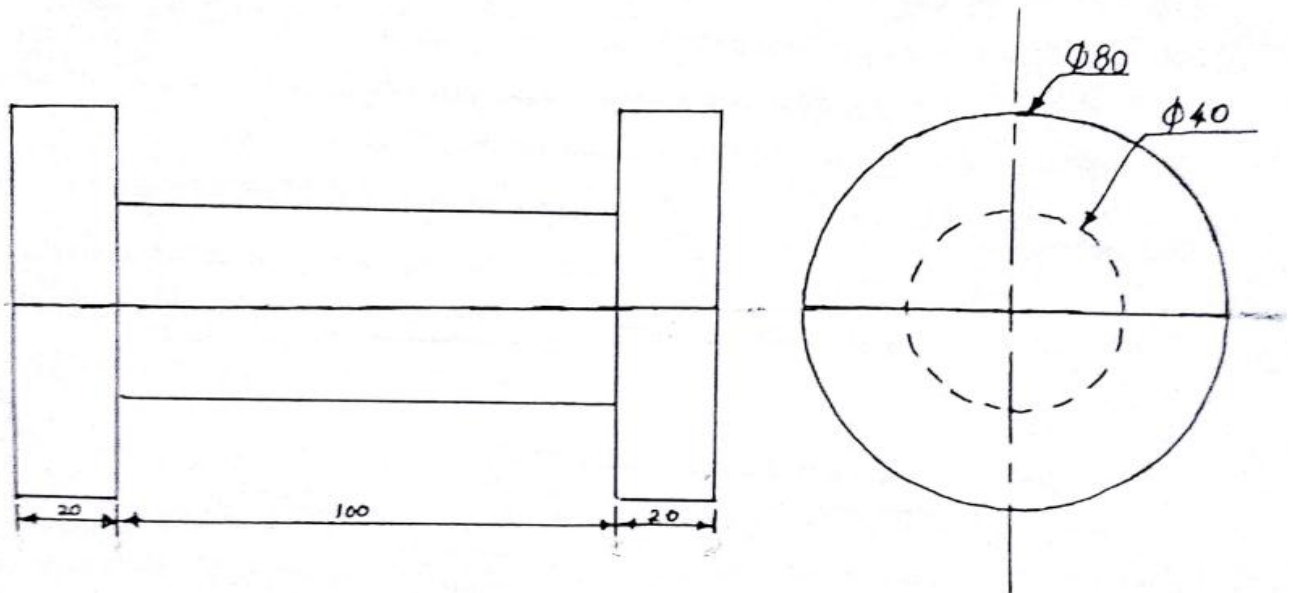
GATE CUTTER: It is a semi-circular piece of tin sheet, used to cut gates in the mould. Gates are meant for easy flow of molten metal into the mould.

BELLOWS: It is a hand tool, used to blow air, to remove the loose sand particles from the mould cavity.

VENT ROD: It is a thin rod used for making vents or holes in the sand mould to allow the escape of mould gases generated during the pouring of molten metal.



MODEL NO:1
BEARING



Scale 1:1
All dimensions are in mm

MODEL NO:1
BEARING

AIM: To make a sand mould using the bearing pattern.

MATERIALS REQUIRED: Moulding sand, parting sand water.

TOOLS REQUIRED: Flask (cope& drag), Shovel, Hand rammer, Round rammer, Strike off -bar, Vent -wire, Trowel, Slick, Lifter, Sprue & Flow off pins (runner& riser), Hand riddle.

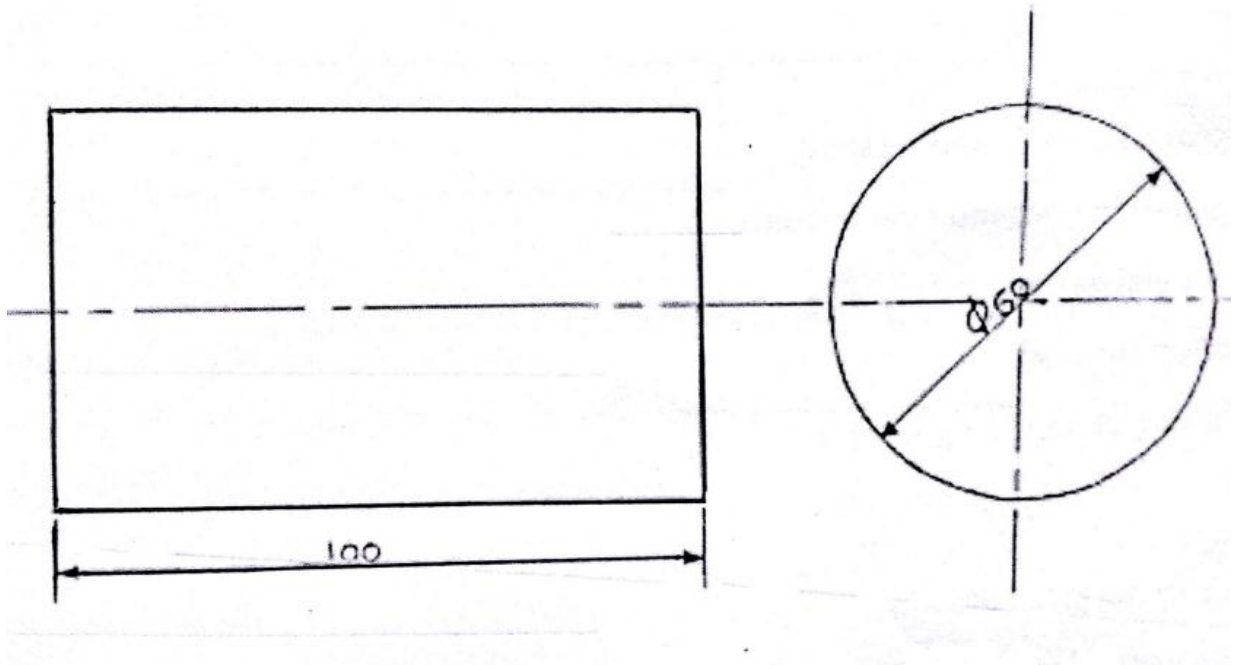
LIST OF OPERATIONS:

- 1- Preparation of moulding sand,
- 2- Compressing of sand over pattern,
- 3- Withdrawal of pattern,
- 4- Gate cutting,
- 5- Finishing of moulding surface.

PROCEDURE:

- 1- Copy the given drawing.
- 2- Collected the tools and materials.
- 3- Prepared the moulding sand and check the quality.
- 4- Placed the drag box keeping upside down and place the pattern.
- 5- Fill the sand, ram by hand rammer and remove excess sand by using strike -of bar.
- 6- Keep the drag box in normal position and finished the surface, also make air vent holes.
- 7- Keep the top half of the pattern above the lower half and sprinkle parting sand.
- 8 - Fix the cope box over the drag box and place the sprue pins and then fill the moulding sand.
- 9 - Remove excess sand, and make air vent holes.
- 10- Remove the sprue pins and detach the cope from drag.
- 11- Cut the gate on the drag box and withdraw the pattern.
- 12- Clean the mould cavity by lifters.

MODEL NO:2
CYLINDER



Scale 1:1
All dimensions are in mm

MODEL NO:2
CYLINDER

AIM: To make a sand mould using the cylinder pattern.

MATERIALS REQUIRED: Moulding sand, parting sand water.

TOOLS REQUIRED: Flask (cope& drag), Shovel, Hand rammer, Round rammer, Strike off -bar, Vent -wire, Trowel, Slick, Lifter, Sprue & Flow off pins (runner& riser), Hand riddle.

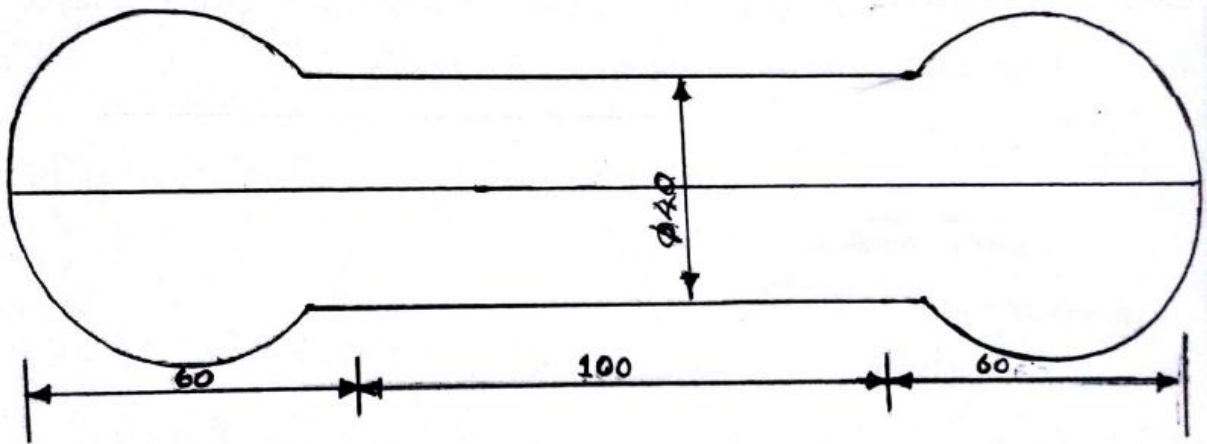
LIST OF OPERATIONS:

- 1- Preparation of moulding sand,
- 2- Compressing of sand over pattern,
- 3- Withdrawal of pattern,
- 4- Gate cutting,
- 5- Finishing of moulding surface.

PROCEDURE:

- 1- Copy the given drawing.
- 2- Collected the tools and materials.
- 3- Prepared the moulding sand and check the quality.
- 4- Placed the drag box keeping upside down and place the pattern.
- 5- Fill the sand, ram by hand rammer and remove excess sand by using strike -of bar.
- 6- Keep the drag box in normal position and finished the surface, also make air vent holes.
- 7- Cut the shape of half portion of the pattern on the drag box.
- 8- Keep the top half of the pattern above the lower half and sprinkle parting sand.
- 9 - Fix the cope box over the drag box and place the sprue pins and then fill the moulding sand.
- 10 - Remove excess sand, and make air vent holes.
- 11- Remove the sprue pins and detach the cope from drag.
- 12- Cut the gate on the drag box and withdraw the pattern.
- 13- Clean the mould cavity by lifters

MODEL NO:3
DUMB-BELL



Scale 1:1
All dimensions are in mm

MODEL NO:3
DUMB-BELL

AIM: To make a sand mould using the bearing pattern.

MATERIALS REQUIRED: Moulding sand, parting sand water.

TOOLS REQUIRED: Flask (cope& drag), Shovel, Hand rammer, Round rammer, Strike off -bar, Vent -wire, Trowel, Slick, Lifter, Sprue & Flow off pins (runner& riser), Hand riddle.

LIST OF OPERATIONS:

- 1- Preparation of moulding sand,
- 2- Compressing of sand over pattern,
- 3- Withdrawal of pattern,
- 4- Gate cutting,
- 5- Finishing of moulding surface.

PROCEDURE:

- 1- Copy the given drawing.
- 2- Collected the tools and materials.
- 3- Prepared the moulding sand and check the quality.
- 4- Placed the drag box keeping upside down and place the pattern.
- 5- Fill the sand, ram by hand rammer and remove excess sand by using strike -of bar.
- 6- Keep the drag box in normal position and finished the surface, also make air vent holes.
- 7- Keep the top half of the pattern above the lower half and sprinkle parting sand.
- 8 - Fix the cope box over the drag box and place the sprue pins and then fill the moulding sand.
- 9 - Remove excess sand, and make air vent holes.
- 10- Remove the sprue pins and detach the cope from drag.
- 11- Cut the gate on the drag box and withdraw the pattern.
- 12- Clean the mould cavity by lifters.

CARPENTRY

INTRODUCTION

Carpentry may be defined as the process of making wooden components. It starts from a marketable form of wood and ends with a finished product. 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.

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

MARKET SIZES OF TIMBER: Timber is sold in the market in various standard shapes and sizes. The following are the common shapes and sizes:

1. **Log** - The trunk of the tree, which is free from branches.
2. **Balk** - The log, sawn to have roughly square cross-section.
3. **Plank** - A sawn timber piece, with more than 275 mm in width, 50 to 150 mm in thickness and 2.5 to 6.5 meters in length.

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. Woods obtained from teak, sal, oak, shisham, beach, ash, mango, neem and babul are known as hard woods.

SEASONING OF WOOD: A newly felled tree contains considerable moisture content. If this is not removed, the timber is likely to warp, shrink, crack or decay. Seasoning is the art of extracting the moisture content under controlled conditions

CHARACTERISTICS OF GOOD TIMBER

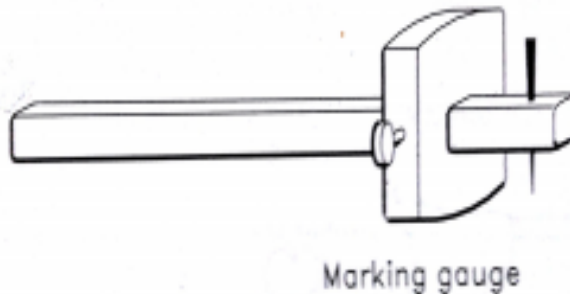
1. It should have minimum moisture content.
2. The grains of wood should be straight and long.
3. It should produce metallic sound on hammering.
4. It should be free from knots or cracks.
5. It should be of uniform in color.
6. It should respond well to the finishing and polishing operations.

CARPENTRY TOOLS

The following are the tools that are made use of in all the wood working operations.

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:

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 project through the stem, about 3 mm and the end is sharp enough to make a very fine line.



MORTISE GAUGE: It consists of two pins. In this, it is possible to adjust the distance between the pins, to draw two parallel lines on the stock.

COMPASS AND DIVIDER: It is used for marking arcs and circles on the planed surfaces of the wood.

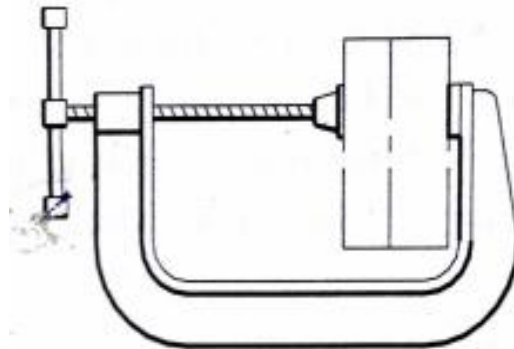
SCRIBER OR MARKING KNIFE: It is used for marking on timber. It is made of steel, having one end pointed and the other end formed into a sharp cutting edge.

BEVEL SQUARE: 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.

HOLDING TOOLS

CARPENTER'S BENCH VICE: It is 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 jaws are lined with hard wooden faces.

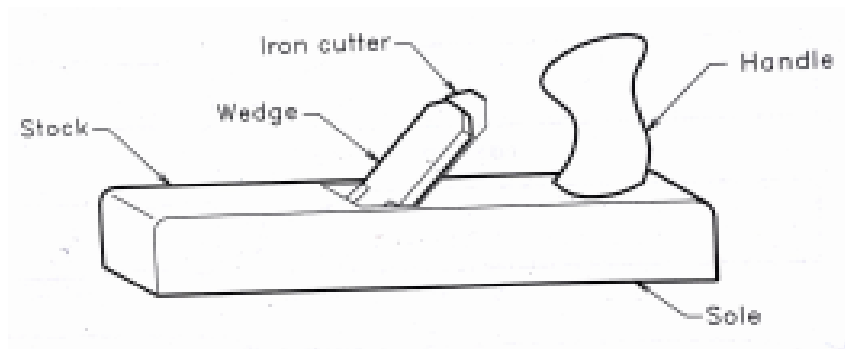
C-CLAMP: The clamp of the shape of letter C or G is used to clamp short pieces together as the bar clamp.



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.

PLANING TOOLS

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 planing.



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.

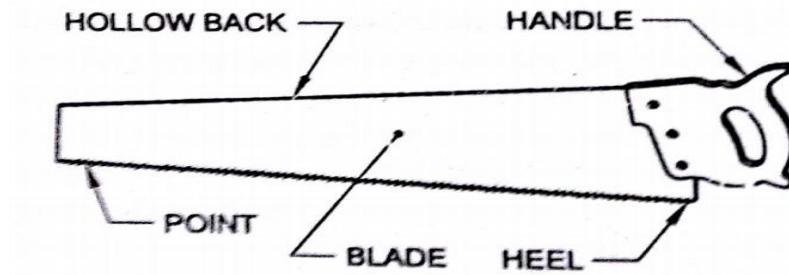
REBATE PLANE: It is used for making a rebate. A rebate is a recess along the edge of a piece of wood, which is generally used for positioning glass in frames and doors.

PLOUGH PLANE: It is used to cut grooves, which are used to fix panels in a door.

CUTTING TOOLS

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.

CROSS-CUT OR HAND SAW: It is used to cut across the grains of the stock. The teeth are so set that the sawkerf will be wider than the blade thickness .

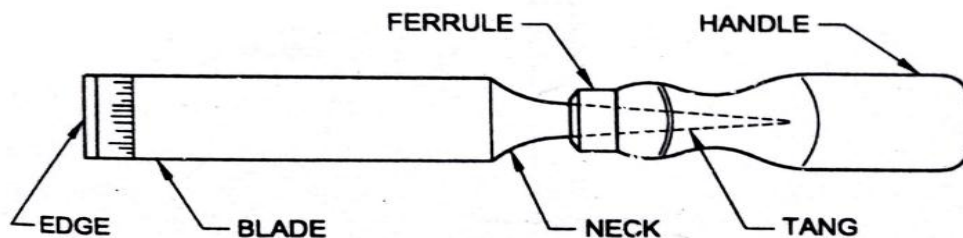


RIP SAW: It is used for cutting the stock along the grains. The cutting edge of this saw makes a steeper angle, i.e., about 60° .

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.

CHISELS

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..



DOVETAIL CHISEL: It has a blade with a beveled back, as shown in . due to which it can enter sharp corners for finishing, as in dovetail joints.

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.

DRILLING AND BORING TOOLS

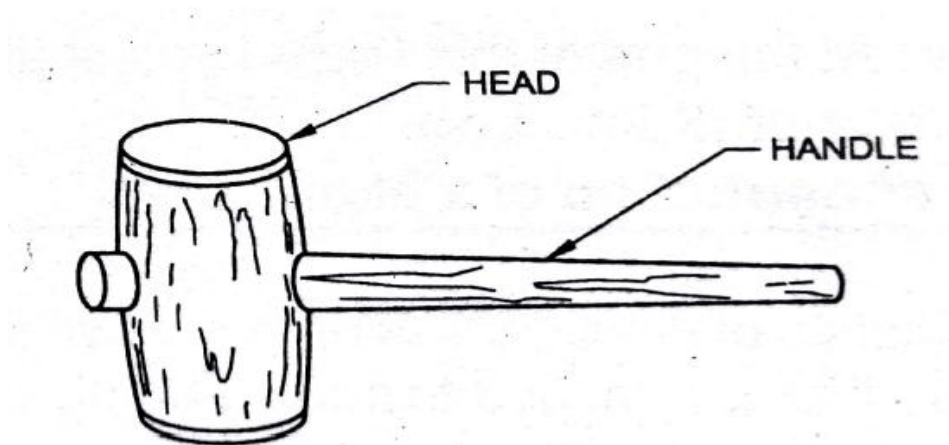
CARPENTER'S BRACE: It is used for rotating auger bits, twist drills, etc., to produce holes in wood. In some designs, braces are made with ratchet device.

AUGER: It is the most common tool used for making holes in wood. During drilling, the lead screw of the bit guides into the wood.

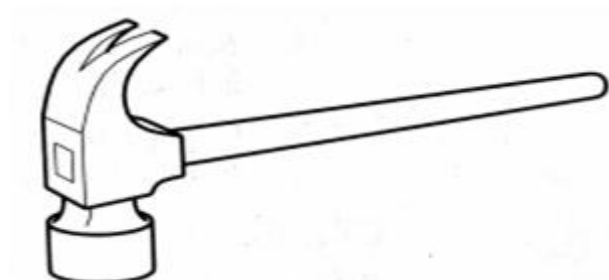
HAND DRILL: Carpenter's brace is used to make relatively large size holes; whereas hand drill is used for drilling small holes.

STRIKING TOOLS

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.



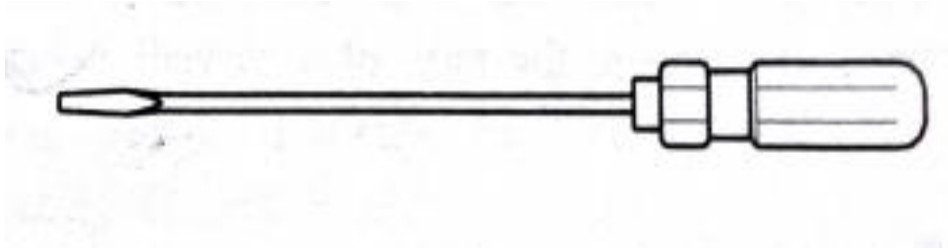
CLAW HAMMER: It has a striking flat face at one end and the claw at the other face is used to drive nails from wood and for other striking purposes.



MISCELLANEOUS TOOLS

PINCER: It is made of two forged steel arms with a hinged joint and is used for pulling-out small nails from wood.

SCREW DRIVER: It is used for driving wood screws into wood or unscrewing them. The length of a screw driver is determined by the length of the blade.



WOOD RASP FILE: It is a finishing tool used to make the wood surface smooth, remove sharp edges, finish fillets and other interior surfaces.

WOOD JOINTS: There are many kinds of joints used to connect wood stock. Each joint has a definite use. The strength of the joint depends upon the amount of contact area.

SAFE PRACTICES

1. Make sure that your hands are not in front of sharp edged tools while you are using them.
2. Use only sharp tools. A dull tool requires excessive pressure, causing the tool to slip.
3. Wooden pieces with nails should never be allowed to remain on the floor.
4. Test the sharpness of the cutting edge on wood or paper, but not on your hand.
5. Never chisel towards any part of the body.
6. Keep the screw driver properly pointed to prevent injury to hands.

CARE AND MAINTENANCE OF TOOLS

CHISELS

1. Do not use chisels where nails are present.
2. Do not use it as a screw driver.

SAWS

1. Do not use a saw with a loose handle.
2. Always use triangular file for sharpening the teeth.
3. Apply grease when not in use.
4. Do not use a saw on metallic substances.

AUGER

1. Do not use it without a handle.
2. Keep it straight while drilling; otherwise, the screw position may get altered.

BRADAWL

1. Keep it well sharpened.
2. Do not use it on metals.

MALLET

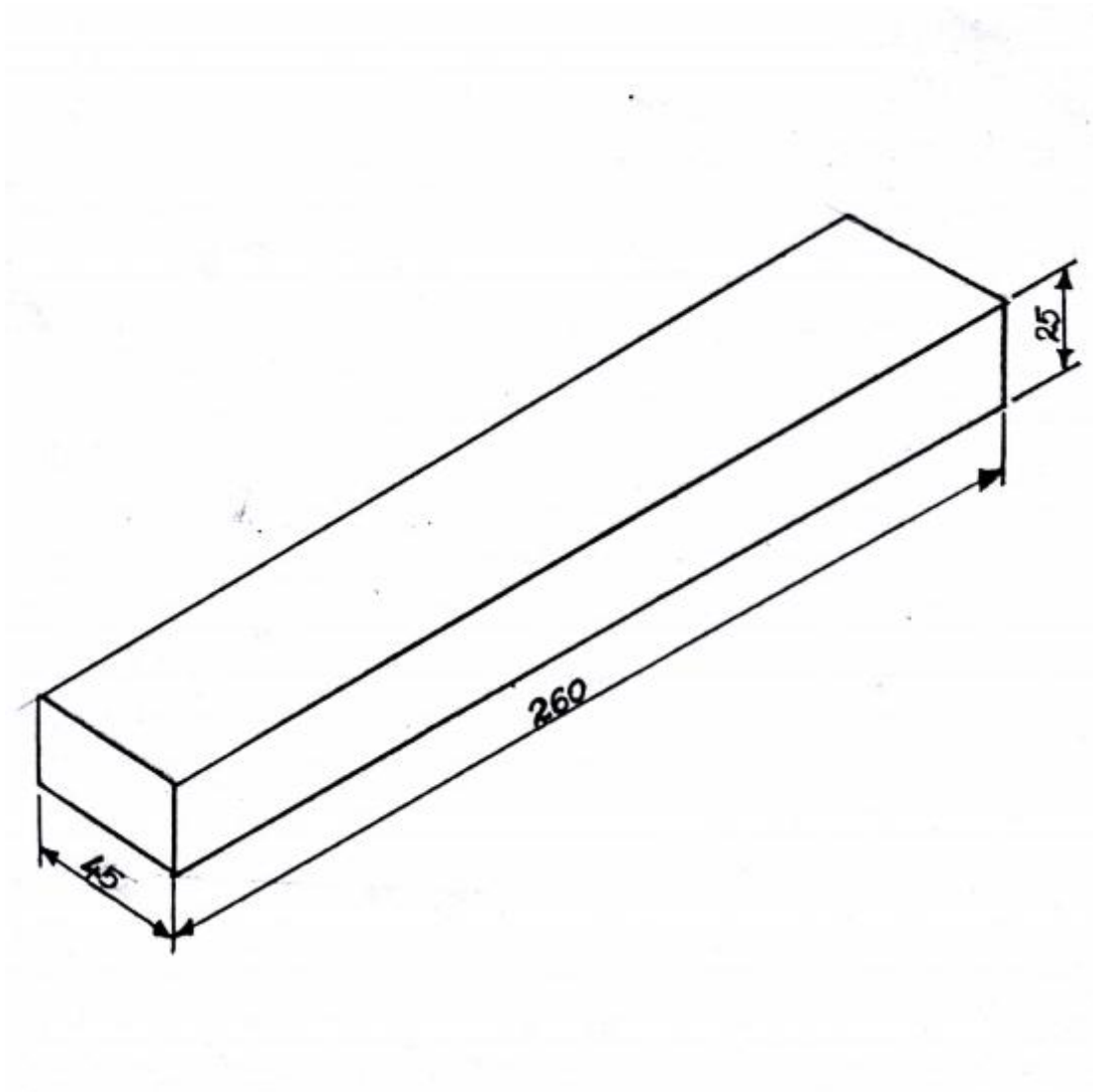
1. Do not use it on hard substances.
2. Do not use it on nails.

PLANE

1. Do not use it at the places, where a nail is driven in the wood.
2. Keep its blade well sharpened.

.....

MODEL NO:1
PLANING PRACTICE



Scale 1:2
All dimensions are in mm

MODEL NO:1
PLANING PRACTICE

AIM:

Planing practice using the given wood piece.

MATERIALS REQUIRED:

Material: Hard wood (Mahagony)

Size: 260x50x30 mm

TOOLS REQUIRED:

- 1-Steel rule,
- 2-Try square,
- 3-Metal jack plane,
- 4- Marking gauge,
- 5- Carpentry Vice,
- 6- Hand saw

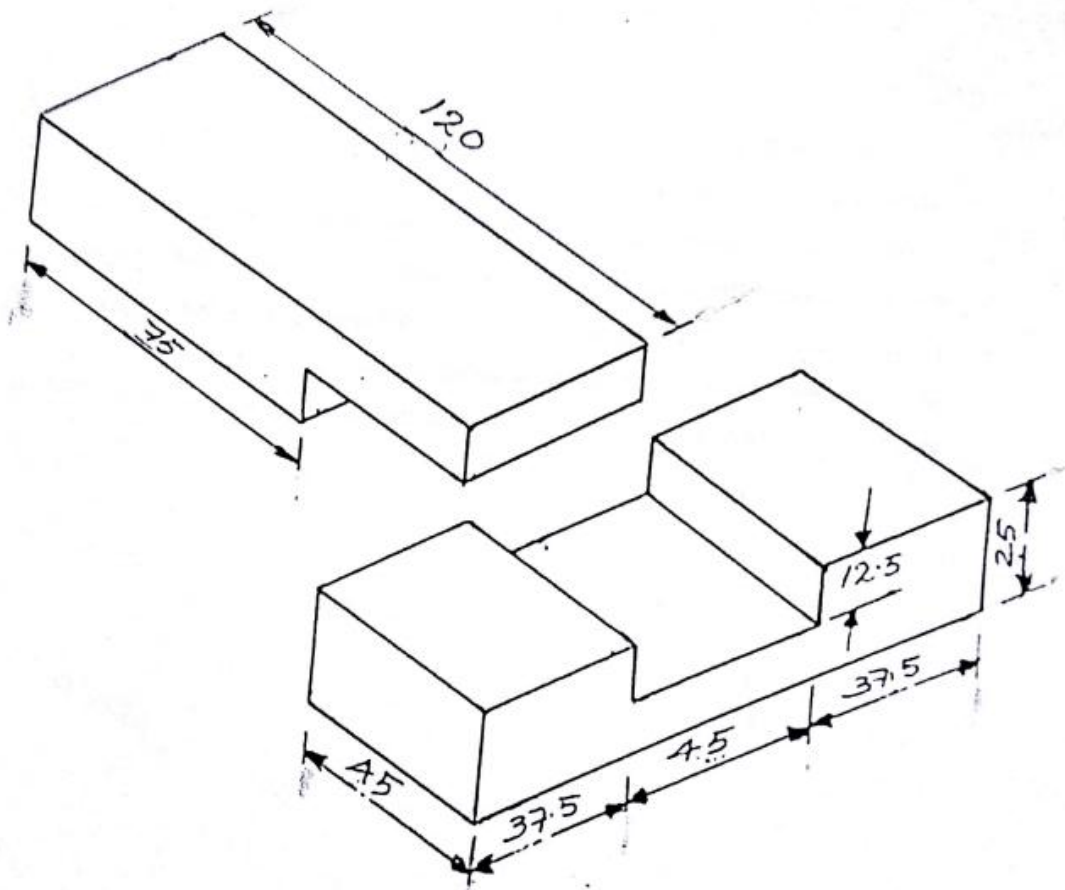
LIST OF OPERATIONS:

- 1- Marking,
- 2-Planing

PROCEDURE:

- 1- Copy the given drawing.
- 2- Collect the tools and wood piece.
- 3- Check the size of the wood piece for its suitability to make the model as per the drawing.
- 4- Plane one side of the wood piece using metal jack plane and check the straightness.
- 5- Plane the adjacent side of the wood piece and checked geometrical accuracy.
- 6- Mark the thickness and width as per drawing using marking gauge.
- 7- Finish the planning operation and check the dimensions as per the drawing.

MODEL NO:2
T-HALVED JOINT



Scale 1:1
All dimensions are in mm

MODEL NO:2

T-HALVED JOINT

AIM:

To make a T-Halved joint using the given wood piece

MATERIALS REQUIRED:

Material: hard wood (Mahagony).

Size: 260x50x30 mm.

TOOLS REQUIRED:

- 1-Steel rule,
- 2-Try square,
- 3-Metal jack plane,
- 4- Marking gauge,
- 5- Carpentry Vice,
- 6- Hand saw,
- 7- Firmer chisel,
- 8-Mallet.

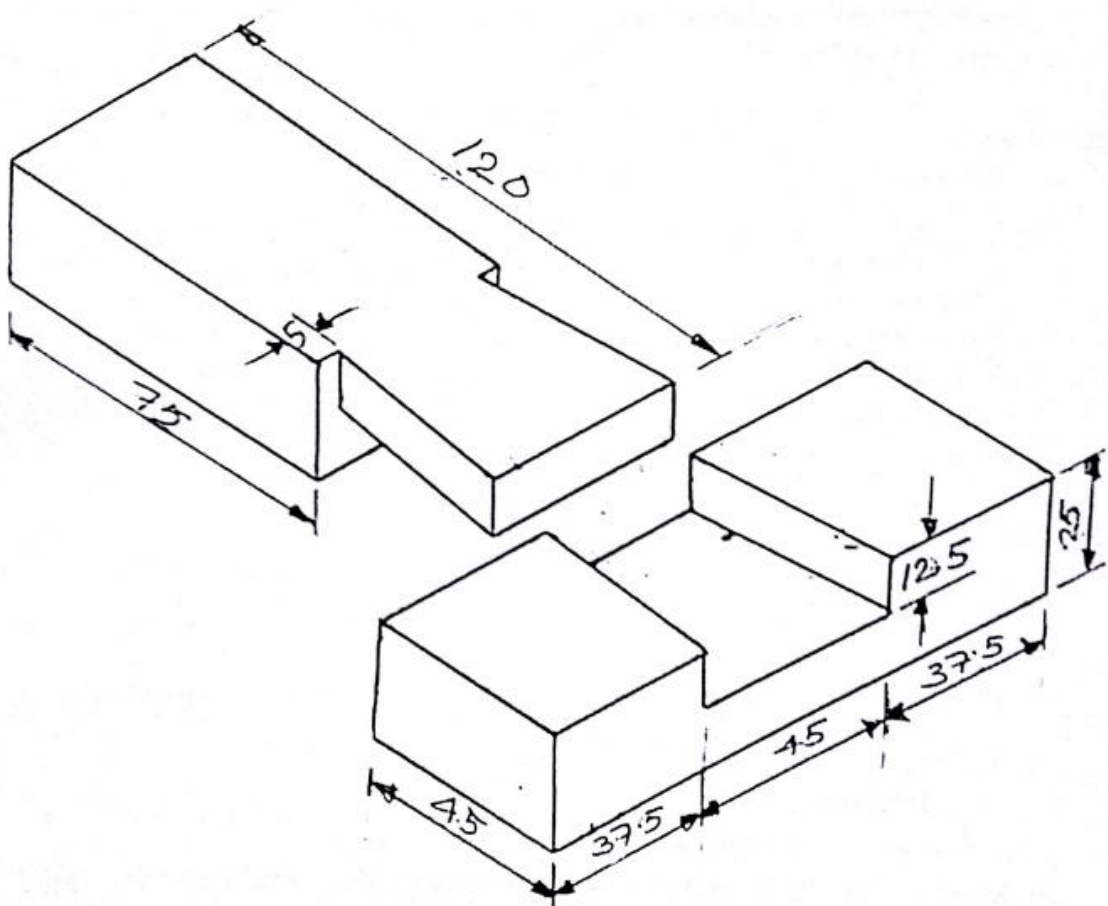
LIST OF OPERATIONS:

- 1- Marking,
- 2-Planing,
- 3- Sawing,
- 4- Chiseling.

PROCEDURE:

- 1- Copy the given drawing.
- 2- Collect the tools and wood piece.
- 3- Check the size of the wood piece for its suitability to make the model as per the drawing.
- 4- Plane one side of the wood piece using metal jack plane and check the straightness.
- 5- Plane the adjacent side of the wood piece and checked geometrical accuracy.
- 6- Mark the thickness and width as per drawing using marking gauge.
- 7- Cut the wood piece in to two halves using hand saw and layout the dimensions of the T-halved joint on each piece.
- 8- Remove the excess wood by saw cutting and chiseling keeping allowance for final chiseling.
- 9- Finish all chiseling operations with the help of firmer chisel on the marked lines.

MODEL NO:3
T-HALVED DOVE TAIL JOINT



Scale 1:1
All dimensions are in mm

MODEL NO:3**T-HALVED DOVE TAIL JOINT****AIM:**

To make a T-Halved Dove tail joint using the given wood piece.

MATERIALS REQUIRED:

Material: Hard wood (Mahagony)

Size: 260x50x30 mm

TOOLS REQUIRED:

- 1-Steel rule,
- 2-Try square,
- 3-Metal jack plane,
- 4- Marking gauge,
- 5- Carpentry Vice,
- 6- Hand saw,
- 7- Firmer chisel,
- 8- Mallet.

LIST OF OPERATIONS:

- 1- Marking,
- 2- Planing,
- 3- Sawing,
- 4- Chiseling.

PROCEDURE:

- 1- Copy the given drawing.
- 2- Collect the tools and wood piece.
- 3- Check the size of the wood piece for its suitability to make the model as per the drawing.
- 4- Plane one side of the wood piece using metal jack plane and check the straightness.
- 5- Plane the adjacent side of the wood piece and checked geometrical accuracy.
- 6- Mark the thickness and width as per drawing using marking gauge.
- 7- Cut the wood piece in to two halves using hand saw and layout the dimensions of the T-halved dove tail joint on each piece.
- 8- Remove the excess wood by saw cutting and chiseling keeping allowance for final chiseling.
- 9- Finish all chiseling operations with the help of firmer chisel on the marked lines.
- 10- Finish the joints by correcting the contact surfaces of the joints and checked all the dimensions.