MANUFACTURING PRACTICES

MEW 2101

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Manufacturing Practices

Carpentry Shop

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LIST OF PRACTICALS

SAFETY FIRST

1. While working keep your mind & eyes on the job & do not indulge in talking.
2. Smart (no loose) clothing.
3. Use lab/ workshop coat.
4. Use proper (no open) shoes in workshop premises
5. Remove wrist watch, ring, bracelets etc.
6. Use hand glove for hot/ sharp objects, paints etc.
7. Keep the work area clean, dry, free from scrap, oil spillage etc.
8. Never operate any machine unless you know how to operate it.
9. In case of any fire, the electric supply should be disconnected
10. Must always know the position and operation of Fire Extinguisher & First Aid box in the shop.
11. In case of an accident, immediately inform the instructor

INTRODUCTION:

In carpentry workshop, wooden pieces of commercial sizes are given specific shape and size as per the requirements. The processes involved in carpentry shop are making a layout, marking, sawing, plaining, chiseling, jointing etc.

In this shop we shall study about the raw material and tools used in carpentry shop. Various material used are wood, nut, screw, nut & bolt, glue, paint etc. The tools used are for marking, cutting, planning, chiseling, striking tools etc.

BASIC THEORY

Various Types of Timber and Boards

Common wood are generally classified according to their degree of hardness or softness.

i. **Hardwood-** Hard wood has closed structure, heavy in weight, dark in colour and is difficult to work on it, annular rings are not distinct. It has good tensile strength.

ii. **Soft Wood-** Hard wood has less weight, less durable and is easy to work out. Soft wood catches fire easily as compared to hardwood, annular rings are quite distinct.

iii. **Plywood-** It consists of more than three layers. Middle layer is called core which is thick and not of good quality. The top and bottom are called as face ply's which is glued on the core at top and bottom. The grains of adjacent layers are kept perpendicular to each other which prevent plywood from warpage.

Types of plywood – Ply Board, Commercial Board, Chip Board, Soft Board.

Advantage of Plywood

i. Lighter in weight and easy to work.

ii. Can be used for interior work, decorating the furniture as well.

iii. It is also available in bigger sizes.

iv. Possesses better strength than solid wood of same thickness.

Defects in Timber

Common defects occurring in the wood can be divided into following three categories.

i. Natural defects which are caused in the tree due to abnormality in the growth.

ii. Defects are also caused during seasoning operation.

iii. Some defects are also due to termites or insects.

Natural defects :

Wood being a product from nature is subjected of natural defects, some of them are explained below:

a. **Shakes:** Shakes are caused due to the disease of the tree like separation of wood grains, sometimes burning of tissues and shrinkage of interior parts. This causes radial or circular rupture in tissues and creates cavities, which are called shakes. These are of three types

   (i) **Heart and star shakes:** These defects are in the heart wood of older tree, especially. Hemlock heart shakes can be evidenced by a small point cavity at the center of the wood.

   (ii) **Wind shakes or Cup shakes:** The separation of annual rings is called wind shake or cup shake. These defects are common in lines.

   (iii) **Radial Shakes:** These are the radial splits extending from bark towards the center. The cracks over the cross section of the log are wider at the bark and narrow down near the center.

b. **Knots:** Knot represents irregularity in the body of a tree which interrupt the smooth growth. The fibers of the tree are turned from their normal shape and grow around the knot at that point of a tree where a link is being formed. Knots are of two types:

   (i) **Dead knots**: When the separation of branches takes place before the tree is cut, the knot thus formed are called leaf knot. This knot is not held firmly and wood having leaf knot is not recommended for engineering purposes.

   (ii) **Live knots**: If the separation occurs after falling of a tree the knot thus formed is called live knot. A wood having live knot can be used for engineering purposes. According to the shapes knot can be classified.

Seasoning of Wood

The process of removing moisture from freshly cut down trees is known as seasoning In these trees the percentage of moisture is very high. The wood containing high percentage of moisture may cause a number of problems, such as shrinkage, warpage, distortion etc. To reduce these problems, seasoning is done. After seasoning the percentage of moisture is reduced to about 10-20%.

Types of Seasoning

(i) **Air Seasoning:** In this method, the timber balks are stacked in a shed such that they are not directly exposed to sun and rain but a free circulation of air takes place through them. The timber balks are allowed to remain in that condition for a long times. The balks should be periodically turned upside down which accelerates the rate of drying. Due to the circulation of free air through the stack, the excess moisture evaporates and the wood gets seasoned.

This is the commonly used method which takes much time but proper seasoning can be easily done with a little care.

(ii) **Water Seasoning**: In this method, timber balks are immersed in flowing water for a fortnight. The flowing stream of water removes the sap. The timber is then taken out and air seasoning is done as usual. This method takes less time but the strength of wood is reduced.

(iii) **Artificial or Kiln Seasoning:** This is a quick process of seasoning. In this method the timber balks are stacked over large trolleys which are then driven into hot chambers or kilns. Hot air or dry steam is pushed into the chamber under controlled temperature conditions. The moisture content is reduced because of the evaporation and the timber gets seasoned.

PATTERN MAKING

Pattern is a mirror image of the casting. When it is used with suitable moulding material, it forms a cavity called as mould. When this cavity is filled with molten metal and after solidification we get the desired casting. Some allowances are provided in the pattern.

Pattern Allowances

i. Shrinkage allowance – Most of the metal have tendency to contract during solidification of metal. The amount of shrinkage differs from metal to metal. The factors which affect the shrinkage are temperature while pouring the metal, material of the mould, specification of the casting, method of moulding, casting material.

ii. Machining Allowance – Partial or full machining may be required by casting. In drawing the portion to be machined is identified and in these portions machining allowance is provided, apart from the shrinkage allowance

iii. Draft allowances – It is provided for easy withdrawal of the pattern. Pattern is given slight taper on all vertical surfaces. This taper is draft allowance. This is provided on the internal and external surfaces

iv. Distortion allowances – There are certain casting in which the cooling rate of metal is not uniform throughout due to complicated shape. This results in distortion of the casting. To minimize its effect, distortion in opposite direction is given in the pattern.

Uses of Pattern

i. To form a cavity of proper shape and size in the mould material so that required casting is obtained by molten metal

ii. Providing seating surface for the cores that is used for making the cavity. This resting surfaces are called core prints

iii. To form several locating points that are used for reference and checking dimensions of casting and measurements during machining

iv. Reduces casting defects

v. Minimizes the cost of castings

Types of Pattern

i. Solid or single piece pattern

ii. Two piece or split pattern

iii. Multiple pattern

iv. Match plate pattern

v. Gated pattern

vi. Cope & drag pattern

vii. Pattern with loose pieces

Pattern colors

i. Red machining surface

ii. Black un-machined surface

iii. Yellow core prints

iv. Red strip on yellow base seat for loose pieces

v. Without color parting surface

Core prints

In a casting if we want to have hole then this is done by core. This core is placed on the impressions made in the sand. These projections are called core prints

CARPENTRY TOOLS

The efficiency of the workman depends upon the tools used in the workshop. Good quality tools always make the work easy. In the carpentry shop the tools are classified as under:

Measuring Tools

(a) **Four fold box wood rule:** It is generally 2 feet long and is folded from three places. It is marked with inch scale.

(b) **Steel rule:** It is made up of stainless steel and is marked with both inches and cm scale.

(c) **Inch tape:** It is made up of flexible thin steel strip. It is folded around a center pin attached with a small handle. It is graduated with both inches and cm scale.

Marking Tools

(a) **Pencil:** Lead pencil is generally used for marking purposes.

(b) **Scriber:** Scriber has a sharp conical edge used to mark on even hard surfaces. The front edge is hardened so as to resist wear and tear. It is made up of carbon steel.

(c) **Marking gauge:** It is used to draw parallel lines. The movable portion of the gauge is adjusted to suitable position and is tightened on to stem.

(d) **Try square:** It is used to draw parallel lines at right angles, parallel or to check the trueness of plane surfaces. It is made up of a steel blade with heavy base.

(e) **Bevel square:** It consists of wooden handle fitted with an adjustable handle blade. The blade can be rotated by 180º w.r.t. handle. It is used for marking various angles.

(f) **Compass/Dividers:** These are used for dividing equal number of parts and for drawing arcs and circles. It consists of two legs with a spring on the top of the legs. A screw is also attached at the center of the legs for adjustment.

Cutting Tools

Saw:

A saw is a multi tooth tool made up of thin sheet attached with a wooden handle. Its teeth are ground and sharpened to achieve smooth cutting. Different types of saw are:

(i) **Rip Saw:** It is hand saw from 30 cm to 75 cm long, containing one to one and half teeth per cm. It should not be called a hand saw but a rip saw only.

(ii) **Tenon Saw:** It derives its name from the tenon form of joint It is a thin saw ranging from 20 cm to 40 cm in length, and is supported by back of wrough iron or brass; hence it is also called a back saw. It contains about 4 teeth per cm.

(iii) **Coping Saw:** It is used for cutting quick or sharp curves either internal or external.

(iv) **Compass Saw:** It is a short narrow saw, tapering towards the point, used for cutting sweeps and large interior curves by hand sometimes termed as a table saw.

(v) **Keyhole or Pad Saw:** It is used for cutting thick internal curves where it is not possible to use other saws.

(vi) **Cross-cut Saw:** It is a saw provided with two handles, one at each end used for cutting heavy timber across the grains.

(vii) **Bow Saw:** It consists of a wooden frame, a bar, a string, lever and two handles. It is used to produce curved surfaces with quick turns. The blade is tightened with the help of string and lever.

Setting of saw teeth: The teeth of saw are bend in opposite direction alternatively. It is used as saw teeth setting. It is made to form a clearance between two cutting edges so that the saw may work without any restriction.

Chipping Tools

Chisel : Three types of chisels are commonly used in carpentry shop

(i) **Firmer Chisels:** It is a general chisel used to finish inside grooves. It has various sizes of cutting edge depending upon the work to be done. Width varies from 5 mm to 35 mm.

(ii) **Mortise Chisel :** It is used to make mortises. Mortise chisel is used for heavy cuts. The blade thickness varies from 5 mm to 12 mm.

(iii) **Gauge Chisel :** It is used to finish curved holes. Gauge chisels are of two types i.e. inside and outside.

Planning Tools

Planning tools are used for smoothening purposes. Preparing proper sizes and for forming curved wooden strips. Many types of planes are used in carpentry shop

(a) **Jack plane:** Jack plane is 10"-14" long. Heavy and is used for rough cutting.

(b) **Trying plane**: Trying plane is 18" long and used for general purpose planning of wood. It is applied after jack plane.

(c) **Smoothing plane:** Smoothing plane is used for finishing work. It is small in size generally 9" long.

(d) **Rebate plane:** Rebate planes are used for preparing household goods and furniture.

(e) **Moulding plane**

(f) **Plough plane :** Plough plane is used for making grooves

(g) **Spoke shave:** Spoke shave is used for shaving corners.

Files

(i) **Rasp cut file :** It is also known as a rasp file. It is a finishing tool used to make the wood surface smooth, remove sharp edge. Finishing fillers and other interior surfaces. Sharp cutting teeth are provided on its surface for this purpose. This file is used in wood work only.

Striking Tools:

Striking tools are used to force the nails or chisels into the wood. Main striking tools are:-

(i) **Cross Peen Hammer:** It has a cast steel body and a wooden handle. Body has two parts face and peen. In cross peen hammer, the peen is in the form of a narrow, round edge ridge placed at right angle to the axis of the handle.

(ii) **Claw Hammer:** It is used for striking as well as for pulling the nails from the wood. The material of the wood is cast steel, one end is made striking and the second is claw face.

(iii) **Mallet:** It is used to strike the chisels which have wooden handles. It is made up of a hard wood and is round or rectangular in shape.

Sharpening Tool:

Water Stone: It is a rectangular piece of stone generally kept in a wooden base. It is used to re-sharpen the chisels, bits, plane blades and other tools, while sharpening water is sprinkled on the stone.

FURTHER LINKS

- ✓ For more details refer the books listed in the Lab course handouts

- ✓ Discussion forum with instructors and/or teacher

PRECAUTIONS AND DO'S & DON'TS

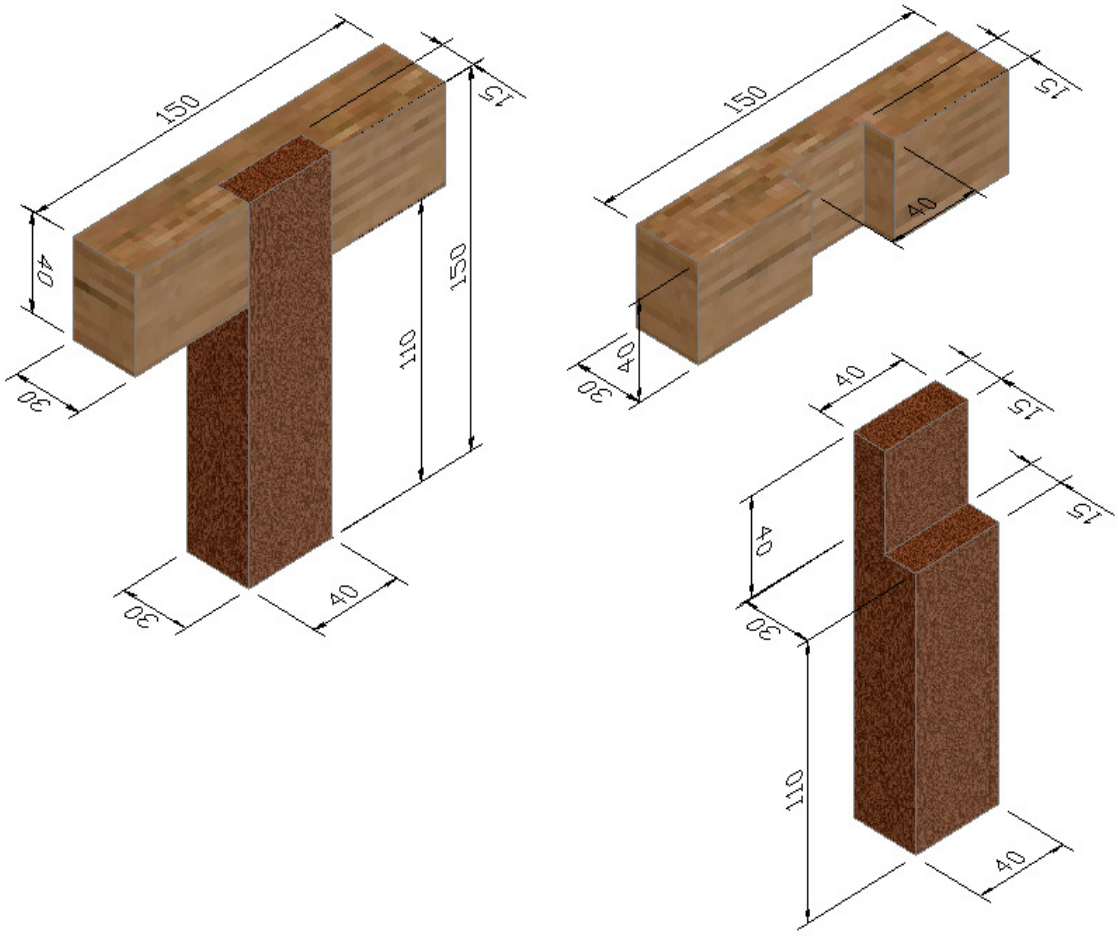
While working in carpentry shop following precautions shall be observed

1. The tools being used should be well sharpened.
2. Safety guard provide on the machines should be in proper position & well secured.
3. While working on a band saw it should be ensured that the guides are properly adjusted.
4. Feed the stock directly by moving hand & don't press from sides
5. Cutting should start only after the saw attains the full Speed.
6. Turning tools should be held firmly.
7. Use goggles while turning & sawing
8. Never feed the stock faster than its capacity.
9. Hold the job firmly with clamping devices while working at the machines.
10. Always keep the tools at proper position when not in use.

Job No. 1

1. **Objective:** To Prepare a "T–LAP JOINT" as per sketch.
2. **Tools Used:** Steel rule, pencil, try square, marking gauge, rip saw and tenon saw, jack plane, smooth plane, firmer chisel, mallet and ball pean hammer
3. **Material Used:** Wooden piece of "RED MARINDI", Nails and fevicol.
4. **Drawing:** See Diagrams
5. **Procedure :**
   - i. Take a wooden piece slightly more than given dimension.
   - ii. Fix the job piece in carpentry vice and do planning on width side with the help of jack plane and smoothing with the smooth plane. Check flatness and straightness of the work piece with the help of try square.
   - iii. Repeat step 1 & 2 on adjacent side to make it right angle (i.e. 90^0).
   - iv. Mark one side (i.e. 30 mm or 40 mm) of the work piece and remove extra material accordingly with the help of marking gauge, jack plane and smoothing plane.
   - v. Mark other side (30 mm or 40 mm) on the job piece and remove extra material.
   - vi. Make two pieces each 150 mm in length with the help of pencil, try square and rip saw.
   - vii. Mark on the both job piece as per given dimensions with the help of pencil, try square and marking gauge.
   - viii. Remove extra material and produce recess on one work piece at one end and middle of the other job work as per given sketch with the help of rip saw, tenon saw, firmer chisel and mallet.
   - ix. Fit the job pieces in the shape of "T-LAP JOINT"

T-LAP JOINT

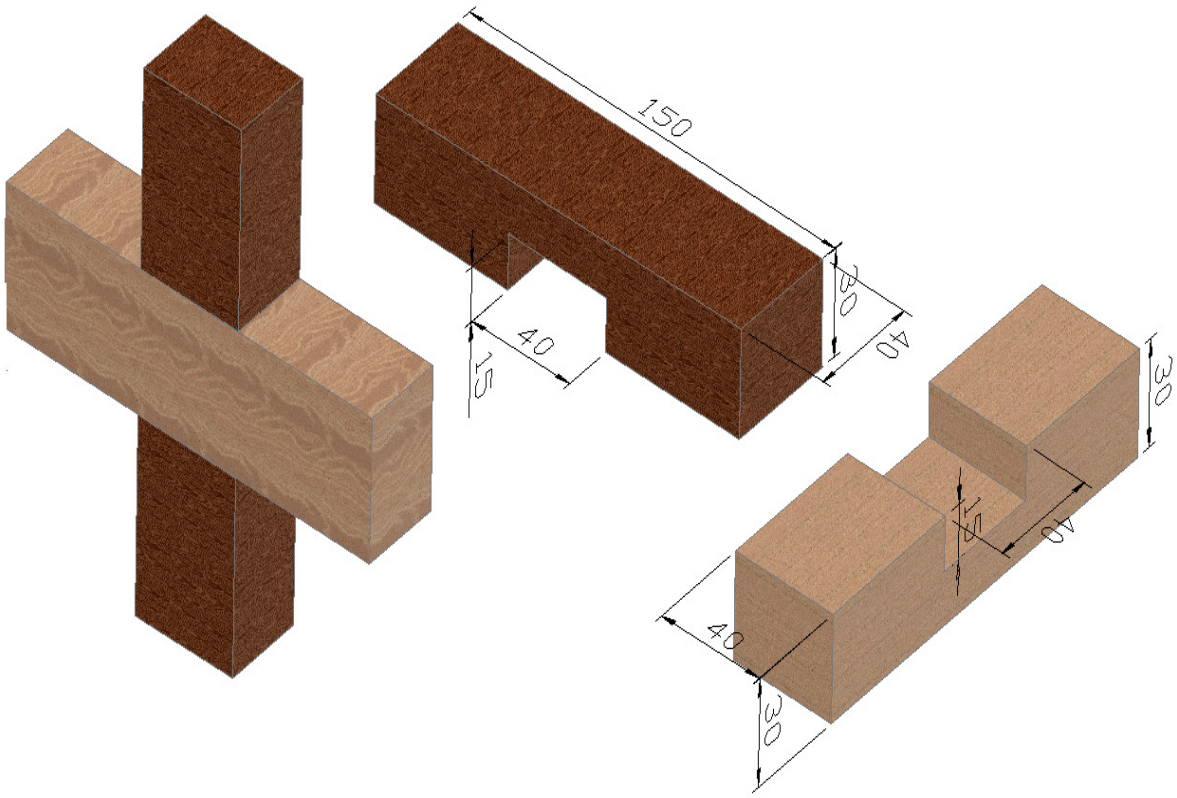


ALL DIMENSIONS ARE IN mm.

Job No. 2

1. **Objective:** To prepare a "Cross Lap Joint" as per given sketch.
2. **Tools Used:** Steel rule, pencil, try square, marking gauge, rip saw and tenon saw, jack plane, smooth plane, firmer chisel, mallet and ball pean hammer
3. **Material Used:** Wooden piece of "RED MARINDI"
4. **Drawing:** See Diagrams
5. **Procedure :**
   - i. Take a wooden piece slightly more than given dimension.
   - ii. Fix the job piece in carpentry vice and do planning on width side with the help of jack plane and smoothing with the smooth plane. Check flatness and straightness of the work piece with the help of try square.
   - iii. Repeat step 1 & 2 on adjacent side to make it right angle (i.e. 90^0).
   - iv. Mark one side (i.e. 30 mm or 40 mm) of the work piece and remove extra material accordingly with the help of marking gauge, jack plane and smoothing plane.
   - v. Mark other side (30 mm or 40 mm) on the job piece and remove extra material.
   - vi. Make two pieces each 150 mm in length with the help of pencil, try square and rip saw.
   - vii. Mark on the both job piece as per given dimensions with the help of pencil, try square and marking gauge.
   - viii. Remove extra material and produce recess on the middle of the both work piece as per given diagram with the help of Rip saw, firmer chisel and mallet.
   - ix. Fit the job pieces in the shape of "CROSS LAP JOINT"

CROSS LAP JOINT



ALL DIMENSIONS ARE IN mm.

Job No. 3

1. **Objectives:** To prepare Mortise and Tenon Joint
2. **Tools Used:** Steel rule, pencil, try square, measuring tape, mortise & marking gauge, rip saw and tenon saw, firmer chisel, mallet, ball peen hammer and clamping vice
3. **Materials Used:** Wood piece of require dimension
4. **Drawing:** See Diagrams
5. **Procedure:**

   i. Procure mortise and Tenon members of required dimension.

   ii. Square the piece to the suitable dimension and mark their faces.

   iii. Mark the length of the Tenon, and square a line all around its end at the point, which is the shoulder. Also mark the width of the Tenon member on the mortise at the point where they are jointed.

   iv. Using a mortise gauge, mark the thickness of the tenon. Also, mark width of the mortises groove on the mortises member (for the face of the members that are to be flushed).

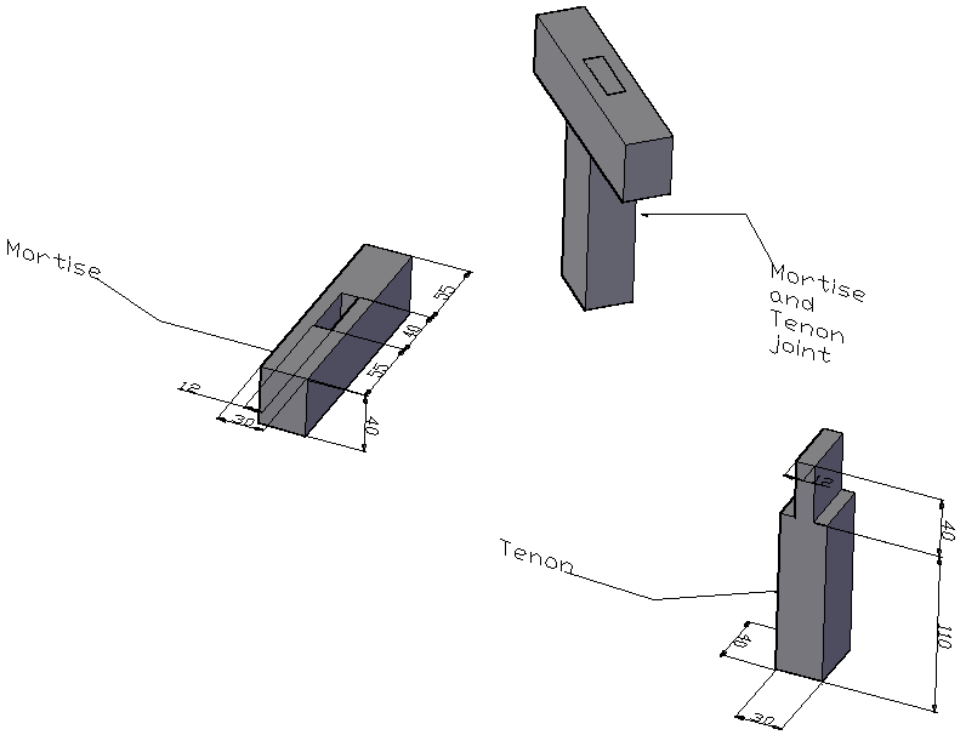
   v. In order to avoid tearing of mortises while chiseling. Layout an additional check cut at both Tenon and mortises members.

   vi. Saw off the thin pieces of wood along the layout lines already marked, by using Tenon saw or rip saw.

   vii. Then trim off any unevenness with a sharp chisel.

   viii. When working on a plane it should be ensured that the blades are sharp and the cut is light. Use a push block for all face planning, especially on the short pieces of stock.

MORTISE & TENON JOINT



ALL DIMENSIONS ARE IN mm.

Job No. 4

1. **Objective:** To make wooden pattern for C.I. bracket.
2. **Tools used :** Try square, steel rule, marking gauge, smoothing plane, flat file, dividers, Hand saw, sand paper (soft wood)
3. **Material :** Partal wood 140 mm × 75 mm × 35 mm
4. **Drawing :** See diagram
5. **Procedure :**
   - i. Prepare the layout for C.I. bracket as per drawing.
   - ii. Take all the allowances and core prints of the job.
   - iii. Mark out the job as per the patterns layout.
   - iv. Cut with handsaw and plane with the jack plane as per marking done as per layout.
   - v. Finish the C.I. bracket with the help of rasp file as per dimensions.
   - vi. Check all the dimensions as per drawing.
   - vii. Finally use sand paper to give smooth finish to C.I. bracket pattern.

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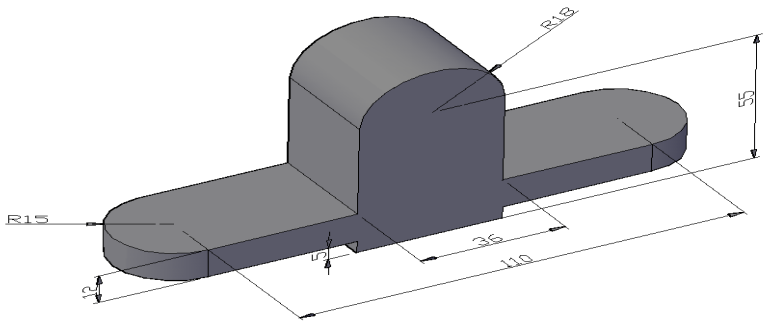


ALL DIMENSIONS ARE IN mm.

Job No. 5

1. **Objective:** To make V Block Pattern to be used in foundry shop.
2. **Tools used :** Try square, steel rule, marking gauge, smoothing plane, flat file, dividers, Hand saw, sand paper (soft wood)
3. **Material :** Partal wood 100 mm × 55 mm × 55 mm
4. **Drawing :** See diagram
5. **Procedure :**

   i. Prepare the layout of V block pattern as per drawing.

   ii. Take all the allowances and core prints on the job.

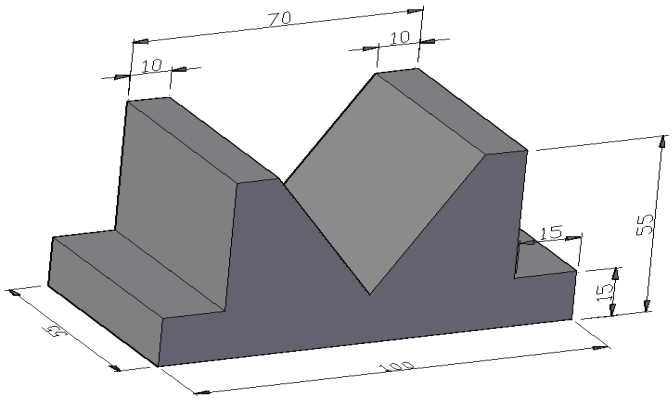
   iii. Mark out the job as per the patterns layout.

   iv. Cut with handsaw and plane with the jack plane as per marking done as per layout.

   v. Finish the V block pattern with the help of rasp file as per dimensions.

   vi. Check the dimensions as per drawing.

   vii. Finally use sand paper to give smooth finish to V Block pattern.

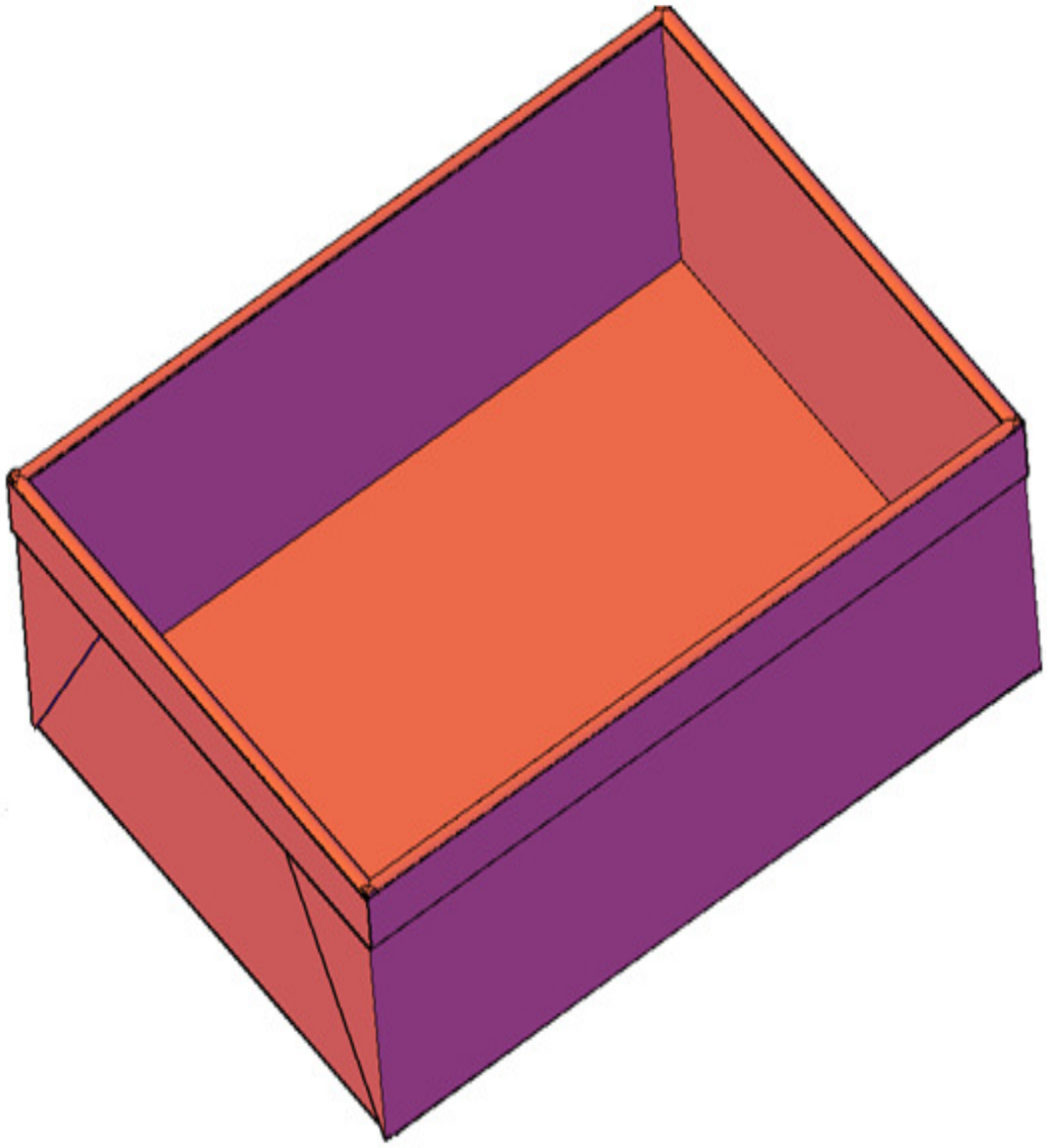


ALL DIMENSIONS ARE IN mm.

Job No-6

1. **Objective:** To Prepare Square/Rectangular Box as per sketch.
2. **Tools Used:** Steel ruler, Try square, Measuring tape, Smoothing plane, Mortise and marking gauge, Rip and Tenon saw, Pencil, Mallet, Ball Peen hammer, Clamping vice, Mortise, Gauge, and firmer chisel
3. **Material Used:** Wooden piece of "RED MARINDI", Nails and adhesive.
4. **Drawing:** See Diagrams
5. **Procedure:**

i. Take a wooden piece slightly more than given dimension.
ii. Fix the job piece in carpentry vice and do planning on width side with the help of jack plane and smoothing with the smooth plane. Check flatness and straightness of the work piece with the help of try square.
iii. Repeat step 1 & 2 on adjacent side to make it right angle (i.e. 90^0).
iv. Mark one side (i.e. 20 mm or 45 mm) of the work piece and remove extra material accordingly with the help of marking gauge, jack plane and smoothing plane.
v. Mark other side (20 mm or 45 mm) on the job piece and remove extra material.
vi. Make one pieces 375 mm in length with the help of pencil, try square and rip saw.
vii. Mark on the both job piece as per given dimensions with the help of pencil, try square and marking gauge.
viii. Ply board Cut with Ripsaw and plane with the jack plane as per marking done as per layout.
ix. Cut the four work piece as per given diagram with the help of Rip saw, firmer chisel, mallet.
x. Fit the job pieces in the shape of "Box" with the help of nails & adhesive.



Manufacturing Practices

Electrical Shop

INDEX

SAFETY PRECAUTIONS

ELECTRICAL & ELECTRONICS SHOP

1. Always wear a rubber sole closed shoe, while performing experiments.
2. Wooden board should be kept under the feet while working on live supply.
3. Connect the circuit as given in the circuit diagram.
4. Don't switch on the supply without getting the circuit checked in series.
5. Don't touch the bare joints or terminals.
6. Follow the procedure given it the manual strictly to avoid any accident.
7. Never touch any bare conductor.
8. During repairing electrical appliances should be disconnected from power supply.
9. Never disconnect a plug point by pulling the flexible wires.
10. In case of electric fire, power supply main switch be disconnected immediately.
11. Never use water to extinguish fire. Use sand or CTC fire extinguisher.
12. Proper earth must be provided.
13. Before replacing burnt fuse, main switch should be put off.
14. Never give supply to any point unless you known that nobody is working on line.
16. Electrical appliances should be insulated properly.

ELECTRICAL ENGINEERING SHOP

INTRODUCTION:

ELECTRICAL: Electrical is an essential need of our daily life. It is widely used for domestic as well as industrial purposes. So it is necessary for the engineering students work. In electrical shop knowledge is given about the electricity filed and its application also electrical instruments, domestic & industrial wiring, electrical goods used, symbol & precaution to be kept in mind. Electrical is used in the electronics filed of manipulating electrical current & voltage using passive & active components that are connected together to create circuits. It also includes a simple load resistor that converts a current to a voltage to computer central-processing units (CPU) that contain more than a million transistors. The following indices & documents provide a basic reference for understanding electric components, circuit & application.

TOOLS:

1. **TEST PEN OR LINE TESTER:**

Test pen has the following function:-

ii) To check the supply.

iii) Loosing or tightening small screws.

It is a very common tool used in electrical shop. A small bulb is fitted inside a transparent handle. When checking the supply the blade is touched to the point & the finger tip is placed on the backside of the handle. If the bulb glues, it shows that electrical current is flowing through the wire.

2. **COMBINATION PLIER:** It is made of steel. It is the combination of cutter & holder. It is used fir holding, twisting & cutting of wire.

3. **SCREW DRIVER:** Screw driver consist of the following parts: - (1) handle (2) blade. Handle is made up of plastic or wood blade is made of steel. The top of the blade is flattened screw driver is used to loosen or tighten the screw.

4. **POCKER:** Pocker is a sharp edge, tool used to make holes in wood. Holes are made for nails or screws.
5. **WIRE CUTTER OR NIPPER:** It is made of steel and has cutter. It is used for cutting of wires.

6. **LONG NOSE PLIER:** Nose pliers is made of steel. They have a cutter for cutting thin wires. It is used for holding, twisting and cutting wire. Preparing looks and jointing of wires.

7. **BALL PEEN HAMMER:** It is made of mild steel having ball on top and face at bottom, provided with wooden handle. It is used to break the brick, riveting, grooving purpose and fixing the nails.

8. **CROSS PEEN HAMMER:** It is made of mild steel having cross shape on top and face at bottom with wooden handle. It is used for fixing clip and nails and making gitties hole in wall.

9. **HACKSAW:** It is made of frame, blade and handle. The blade is fixed in the frame. It is used for cutting conduit pipe, G.I. pipes and other small metallic materials.

10. **STANDARD WIRE GAUGE:** It is a thin circular or straight plate having number of slots representing gauge numbers on its circumference. It is used to find the gauge of wire.

11. **HAND DRILL MACHINE:** It is made of wooden handle. It has gear, chuck and jaw. It is made of cast iron and steel. It is used for making holes in wooden and metallic objects with twist drill bit.

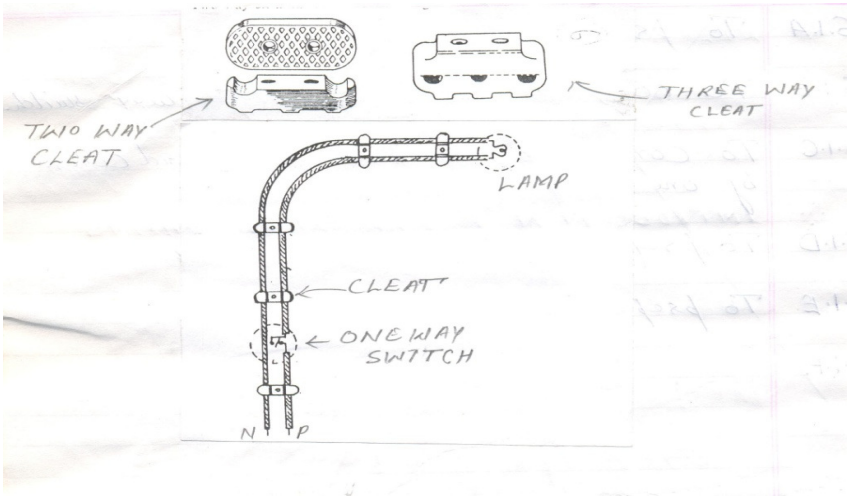
12. **ELECTRIC SOLDERING IRON:** It consist of a oval copper bit fixed to an iron rod. It is heated by an electric element. It is used for soldering wires to small joints.

INTRODUCTION TO ELECTRICAL WIRING

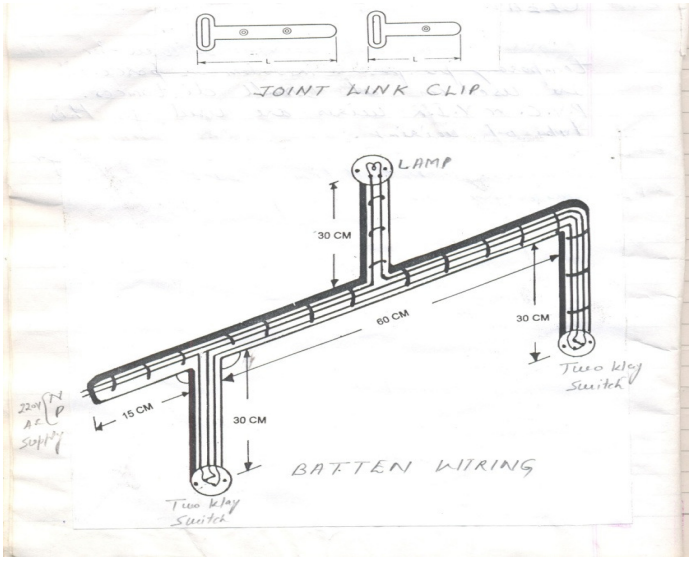
TYPES OF WIRING

1. **Cleat Wiring:** Cleat wiring is used for temporary purposes. Wood or porcelain is used at small distances. PVC or VIR wires are used for this type of wiring.

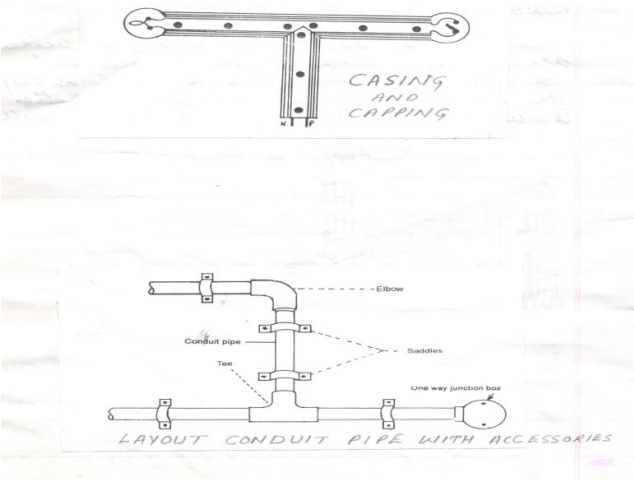
   This system is suitable for temporary installation such as marriage and other functions.



2. **TRS or CTS or Batten Wiring:** In batten wiring, the wires are covered with tough rubber and are fixed on wooden batten. Joint clips are used to hold wires. Wooden batten is used on gutties inserted in the walls.



3. **Casing and Capping Wiring:** In old days it was the most used type of wiring. Wire are placed in the grooves provided on the casing. It is covered with a strip known as capping, caring is fixed on the walls with the help of gutties and scress.



4. **Conduit Wiring:** In this system, wires are enclosed in conduit pipe to give the wires mechanical protection. Fire risks are also avoided in this system of wiring. This system is applied in two ways:

   (h) Surface conduit wiring: In this system the pipes are fixed over the surface of walls and are visible. Surface conduit wiring is easy to install but is less safe to mechanical injuries as compared to concealed conduit wiring.

   (ii) Concealed Conduit/Underground Wiring: In concealed conduit wiring the conduit pipes are buried inside the walls. Grooves are made as per the circuit of the wiring on the wall with the help of chisel. Pipes, bends and junction box are placed in the grooves and then covered with cement.

TYPES OF FUSES

1 KIT-KAT /REWIRABLE TYPE FUSE-

2 HRC FUSE- High rupturing capacity fuses can be rated to safely interrupt up to 300,000 amperes at 600 V AC. Special current-limiting fuses are applied ahead of some molded-case breakers to protect the breakers in low-voltage power circuits with high short-circuit levels

3 GLASS TYPE FUSE- Glass fuses are used to protect electrical systems of all types from damage due to overload. Glass fuses have a temperature sensitive metal strip inside that melts when a power surge or overload occurs, breaking the circuit and stopping current flow. A blown or shorted out fuse protects the equipment it is connected to from damage and helps prevent electrical fires. Glass fuses are used in our homes, cars and many appliances.

ILLUMINATION

CFL-Compact fluorescent lamp (CFL), also known as a compact fluorescent light or energy saving light (or less commonly as a compact fluorescent tube), is a type of fluorescent lamp. Many CFLs are designed to replace an incandescent lamp and can fit into most existing light fixtures formerly used for incandescent

Mercury Vapour lamp-A mercury-Vapour lamp is a gas discharge lamp that uses mercury in an excited state to produce light. The arc discharge is generally confined to a small fused quartz arc tube mounted within a larger borosilicate glass bulb. The outer bulb may be clear or coated with a phosphor; in either case, the outer bulb provides thermal insulation, protection from ultraviolet radiation, and a convenient mounting for the fused quartz arc tube. Mercury vapor lamps (and their relatives) are often used because they are relatively efficient. Phosphor coated bulbs offer better

color rendition than either high- or low-pressure sodium vapor lamps. Mercury vapor lamps also offer a very long lifetime, as well as intense lighting for several special purpose applications

Sodium Vapour Lamp-Sodium vapor lamp is a gas discharge lamp that uses sodium in an excited state to produce light. There are two varieties of such lamps: low pressure and high pressure. Because sodium vapor lamps cause less light pollution than mercury-vapor lamps, many cities that have large astronomical observatories employ them.

Fluorescent Tube- fluorescent lamp or fluorescent tube is a gas-discharge lamp that uses electricity to excite mercury vapor. The excited mercury atoms produce short-wave ultraviolet light that then causes a phosphor to fluoresce, producing visible light. A fluorescent lamp converts electrical power into useful light more efficiently than an incandescent lamp. Lower energy cost typically offsets the higher initial cost of the lamp. The lamp fixture is more costly because it requires a ballast to regulate the current through the lamp.

Filament lamp- The incandescent light bulb, incandescent lamp or incandescent light **globe** makes light by heating a metal filament wire to a high temperature until it glows. The hot filament is protected from air by a glass bulb that is filled with inert gas or evacuated. In a halogen lamp, a chemical process that returns metal to the filament prevents its evaporation

SWITCH GEAR

1) DPIC-DPIC known as Double Pole Iron Clad Switch. It is used for controlling single phase 2 wire circuits. This is normally used in domestic wiring

2) TPIC- TPIC is known as Triple Pole Iron Clad Switch. This switch is used to 3 phase power with 4 wire system. It is used mainly in Industry Installation.

3) ELCB- An earth leakage circuit breaker (ELCB) may be a residual-current device, although an older type of voltage-operated earth leakage circuit breaker exists

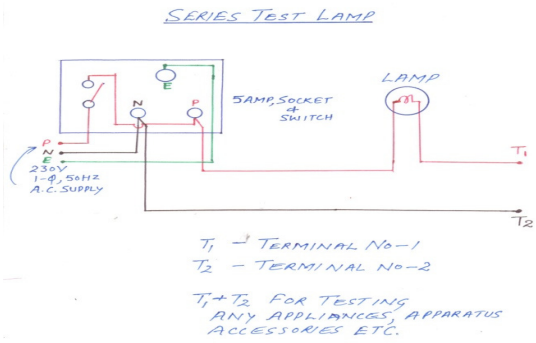
APPARATUS

1) Clamp Meter- Current clamp or **Current probe** is an electrical device having two jaws which open to allow clamping around an electrical conductor. This allows properties of the electric current in the conductor to be measured, without having to make physical contact with it, or to disconnect it for insertion through the probe. Current clamps are usually used to read the magnitude of a

sinusoidal current (as invariably used in alternating current (AC) power distribution systems), but in conjunction with more advanced instrumentation the phase and waveform are available.

2 Multimeter-A multimeter or a multitester, also known as a VOM (Volt-Ohm meter), is an electronic measuring instrument that combines several measurement functions in one unit. A typical multimeter may include features such as the ability to measure voltage, current and resistance. Multimeters may use analog or digital circuits—analog multimeters (AMM) and digital multimeters

3 Series Test Lamp- It is used for Testing for electrical appliance, apparatus, accessories etc



4. Coil Winding Machine(Manual)- It is only used for preparing the inductor and motor winding coil

Job No : 01

OBJECTIVE: To connect one lamp & control by one way switch.

TOOL USED: Knife, combination plier, screw driver, poker, line tester, wire stripper, hacksaw & ball /cross peen hammer.

MATERIAL USED:

SR. NO	MATERIAL	QUANTITY
1	PVC copper wire 1mm square	1.5mt
2	Casing & capping 1”	1.5ft
3	Wooden board 4”x 4”	01 No
4	Bakelite sheet 4”x 4”	01 No
5	One way switch	01 No
6	Batten holder	01 No
7	Wooden round block	01 No
8	Batten nail	As per requirement
9	Bulb 60 watt	01No
10	Screws	As per requirement

CIRCUIT DIAGRAM:

PRECAUTIONS

1. Connection must be tight & right as per circuit dig.
2. Live conductor should be go through switch.
3. After removed the insulation from wires, wire conductors should be twisted using pliers.
4. Always Job check in series, do not connect with the direct supply.
5. For safety, MCB/ fuse should be used in the circuit as per rating.
6. Tools should be insulated.

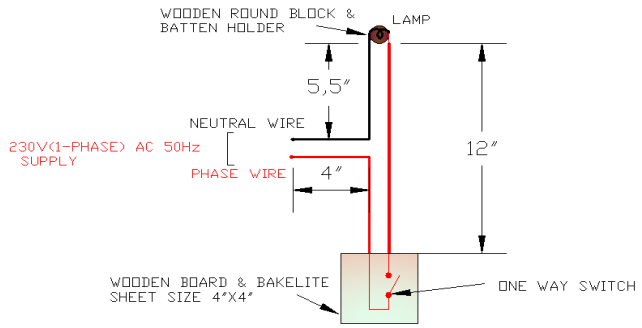
7. Earthing must be provided.

PROCEDURE

1. Take the casing (as per requirement), wooden box, round block & fixed on the wiring board with the help of batten nails & screws with the help of screw driver & hammer as per dimension.
2. Now as per circuit dig. Wires installed. Firstly neutral wire connects with the batten holder (no. one terminal). Secondly phase wire connected through one way switch with batten holder(no. two terminal).
3. Bakelite sheet with switch & batten holder fixed on wooden box & round block with screw & than capping fitted on casing. Lamp is fixed with batten holder.

Resultant- Job is checked with the series test lamp, if lamp glowing dim it means circuit is ok & then job connected with direct supply, lamp glow in full condition.

ONE LAMP CONTROL BY ONE SWITCH



JOB 01(PVC CASING & CAPPING WIRING SYSTEM)

JOB NO: 2

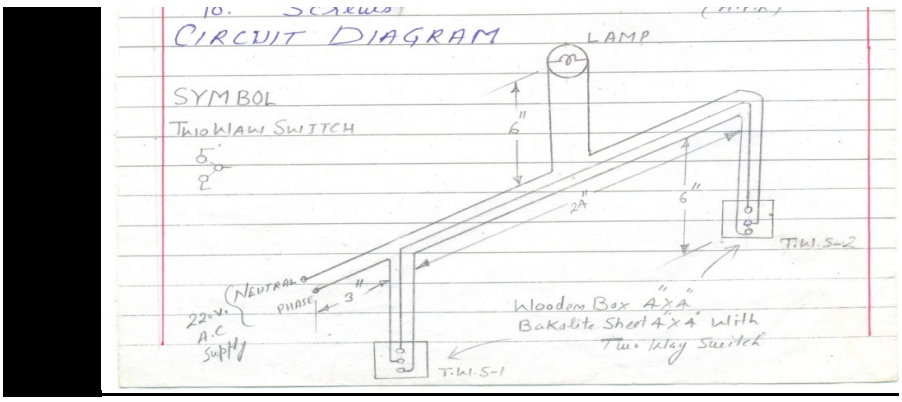
OBJECTIVE:. To prepare a circuit for Stair Case Wiring

TOOL USED: Knife, combination pliers, screw driver, poker, line tester, wire stripper, hacksaw & ball /cross pean hammer.

MATERIAL USED(Casing and Capping Wiring System)

SR. NO	MATERIAL	QUANTITY
1	PVC copper wire 1mm square	2.5mt
2	Casing & capping 1”	2.5ft
3	Wooden board 4”x 4”	02 No
4	Bakelite sheet 4”x 4”	02 No
5	Two way switch	02 No
6	Batten holder	01 No
7	Wooden round block	01 No
8	Batten nail	As per requirement
9	Bulb 60 watt	01 No
10	Screws	As per requirement

CIRCUIT DIAGRAM:



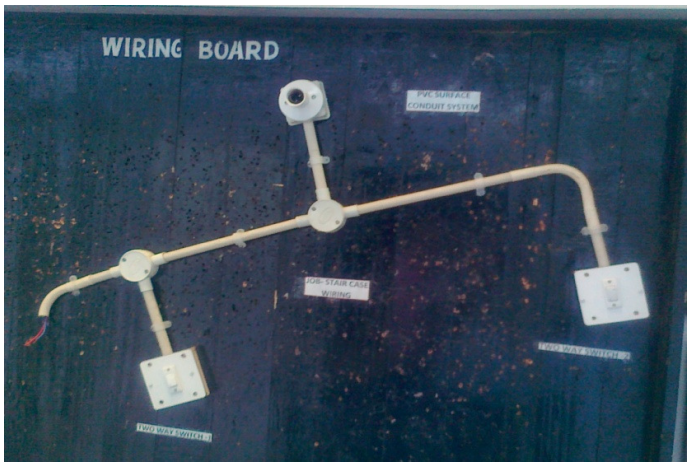
PVC SURFACE CONDUIT SYSTEM

MATERIAL USED:

SR. NO	MATERIAL	QUANTITY
1	PVC copper wire 1mm square	As per requirement
2	PVC Conduit Pipe3/4 inch	As per requirement
3	Wooden board 4"x 4"	02 No
4	Bakelite sheet 4"x 4"	02 No
5	Two way switch	02 No
6	Batten holder	01 No
7	Wooden round block/PVC square box	01 No
8	Saddles	As per requirement
9	Bulb 60 watt	01No
10	Screws	As per requirement
11	PVC Bend ¾ inch	02
12	3 way junction box	02

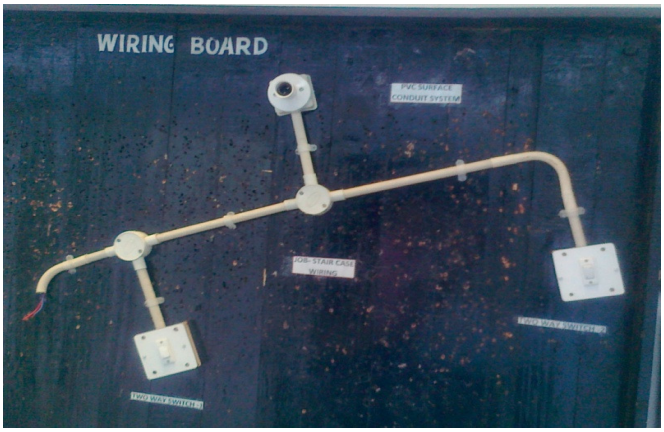
PROCEDURE (For Casing and Capping Wiring System)

1. Take the casing (as per requirement), wooden blocks, wooden round blocks, fixed on the wiring board with batten nails and wooden screws with the help of screw driver and hammer as per dimension.
2. Neutral wire connects with the lamp (Terminal no 1) now phase wire (Red) connects with the central terminal of Two way switches fix on the bakelite sheets. Now install the wires as per circuit diagram. Now neutral wires connect with the batten holder terminal. Phase wire connect with the central terminal of two way switch number one. Now upper terminal of two ways switch number 1 & 2 connect to each other with the help of red wire. Lower terminal of two way switch number one & two connect to each other with help of RED wire. Now central terminal of two way switch number 2 & other terminal of lamp connect to each other with the help of RED wire. Fix the bakelite sheets and batten holder on wooden boxes and wooden round block square box.



PROCEDURE

Cut the PVC conduit pipe3/4 inch as per dimension. Now PVC pipe, end,3 way junction box wooden round block/PVC square box ,wooden boxes mounted on the wiring board with the help of saddles & screws. Two way switches fix on the bakelite sheets. Now install the wires as per circuit diagram. Now neutral wires connect with the batten holder terminal. Phase wire connect with the central terminal of two way switch number one. Now upper terminal of two ways switch number 1 & 2 connect to each other with the help of red wire. Lower terminal of two way switch number one & two connect to each other with help of RED wire. Now central terminal of two way switch number 2 & other terminal of lamp connect to each other with the help of RED wire. Fix the bakelite sheets and batten holder on wooden boxes and wooden round block/ PVC square box.



PRECAUTIONS:

1. Connection must be tight & right as per circuit dig.
2. Live conductor should be going through switch.
3. After removed the insulation from wires, wire conductors should be twisted with the help of plier.
4. Always check in series, do not connect with the direct supply.
5. For safety, should be used MCB/ fuse in the circuit as per rating.
6. Tools should be insulated.
7. Earth must be provided.

PROCEDURE:-

1. Take the casing (as per requirement), wooden blocks, wooden round blocks, fixed on the wiring board with batten nails and wooden screws with the help of screw driver and hammer as per dimension.
2. Now as per circuit diagram wires installed. Firstly, no. 2 terminal of batten holder (lamp -1) & no.1 terminal of batten holder (lamp-2) connected to each other with help of wires.
3. Neutral wire connected with the no -1 terminal of lamp-1
4. Phase wire connected through one way switch with batten holder (second terminal) of lamp 2
5. Batten holders & bakelite fixed one round block & wooden block with screws. Capping is fitted on casing two lamps fixed on battle holders.

Resultant: - Test with the series test lamp T1 and T2 connect with the neutral & phase wire (the supply should be in off position. Press Two Way switch if lamp glowing dim it means circuit open and connect with direct supply.

JOB NO. 3

Objective: To test and Connect the Fluorescent Tube 40 Watt

Tools used: Combination plier, screw driver, pocker, line tester, wire stripper, hammer, series test lamp.

Material used:

Sr. no	Material	Qty.
1.	PVC copper wire 1 square mm	As per Requirement
2.	One way switch	01
3.	Capacitor 4μF	01
4.	Tube Holder	02
5.	Tube Rod 40W	01
6.	Choke 40 W	01
7.	Tube Starter	01
8.	Insulation Tape Roll	As per Requirement

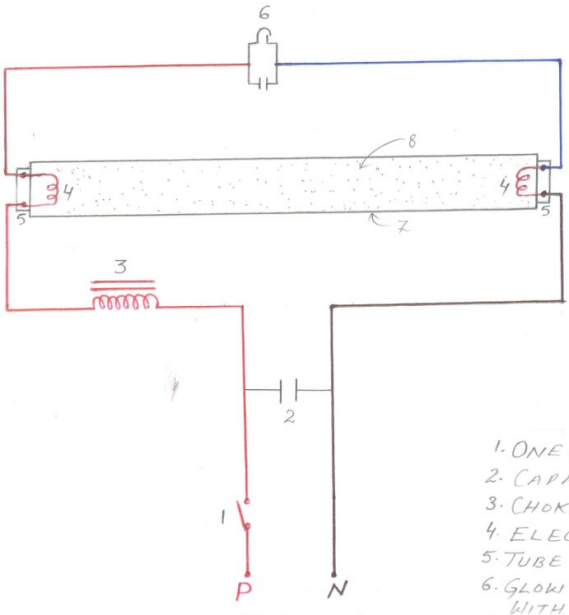
Theory: The fluorescent lamp is a low pressure mercury vapour lamp. Due to low pressure, the lamp is in the form of long tube, coated inside with phosphor. The tube contains a small amount of mercury and small quantity of argon gas at pressure of 2.5 mm of mercury. When the temperature increases, the mercury changes into vapour form which it takes over the conduction of current. At each end of the tube electron are of spiral form made of tungsten and coated with electron emitting material. A choke is connected in series with the tube filament. It provide a voltage impulse for starting the lamp and act as ballast later on when the lamp is running. The filament is connected to a starter which is small cathode glow lamp with metal at electrodes.

Precautions:

1. The connections must be tight and right as per circuit diagram.
2. Choke is always connected in series with electrode.
3. Test the Choke, starter before assembling
4. Starter should be connected in between two electrode

JOB NO. 3

FLUORESCENT TUBE
(Electrical Wiring Circuit Diagram)



230 VOLT, 1-ϕ
50 HZ, A.C
SUPPLY

1. ONE WAY SWITCH
2. CAPACITOR
3. CHOKE/BALLAST
4. ELECTRODES
5. TUBE HOLDERS
6. GLOW TYPE STARTER WITH STARTER HOLDER
P. PHASE
N. NEUTRAL
7. TUBE ROD
8. MERCURY VAPOUR

TESTING OF CHOKE- T1 and T2 of the series test lamp connect with both terminals of choke, if the lamp glowing dim it means that choke is ok. If the lamp glowing full it means that choke is not ok.

TESTING OF TUBE STARTER- T1 and T2 of the series test lamp connected with both terminal of the starter, if the lamp blinking, it means tube starter is ok. If lamp not blinking it means tube starter is not ok.

PROCEDURE-

1 Tube Holder, Starter Holder and choke mounted on wooden board.

2 Connect all the accessories with the wire as per electrical wiring circuit diagram. Phase wire connects with the holder terminal through switch and choke. Neutral wire connects with the other side holder terminal. The starter connects in between both holders terminals. The capacitor connects across the supply.

TESTING- Now test with Series Test lamp T1 and T2 connect in between both lamp holder terminals. If lamp glowing dim it means wiring circuit diagram is ok. If lamp glows fully or not glowing it means fault occur in circuit diagram. Electrical circuit found ok, now Fluorescent tube fix with both holders and close the switch the fluorescent tube is glowing

Manufacturing Practices

Machine Shop

INDEX

SAFETY FIRST

1. Alert & Attentive - Mind & eyes on the job.
2. Smart (no loose) clothing.
3. Use lab coat/ workshop apron
4. Use proper (no open) shoes in workshop premises
5. Remove wrist watch, ring, bracelets etc.
6. Protect the eyes with goggle or screen while working with hot objects or in bright work area
7. Use hand glove for hot/ sharp objects, paints etc.
8. Avoid breathing of fumes emanating from welding, soldering or other such processes.
9. Shop should be properly lit & well ventilated.
10. Keep the work area clean, dry, free from scrap, hot items, oil spillage etc.
11. Never operate any machine unless you know how to operate it.
12. In case of any fire, the electric supply should be disconnected
13. Must always know the position and operation of Fire Extinguisher & First Aid box in the shop.
14. In case of an accident immediately inform the instructor

INTRODUCTION

Machine shop is the area where machining operations are performed. Machining is a manufacturing process in which the raw material is processed by removing unwanted material with the help of machines. Different machine used in machine shop are:

1. Lathe machine
2. Shaper
3. Milling machine
4. Planning machine
5. Drilling machine
6. Grinding machine
7. Threading machine

DESCRIPTION of MACHINE TOOLS

1. LATHE

A lathe is a powered mechanical device in which the work is held and rotated against a suitable cutting tool for producing cylindrical forms in the metal, wood or any other machineable material.

Type of Lathe

- Precision lathe
- Tool room lathe
- Capstan and turret lathe
- Automatic lathe
- Speed lathe
- Engine lathe
- Bench lathe
- Power Hacksaw machine
- Special purpose lathe

Various Parts of Lathe

a) **Bed :**

It is the base or foundation of lathe. It is a casting made in one piece. It holds and support all other parts of lathe.

b) **Head Stock :**

It is a permanently fastened on the inner ways at the left hand end of the bed. It supports spindle and driving arrangements. Lathe receives its power through head stock.

c) **Tailstock :**

It is the counter part of head stock. It is located at the right end of the bed. It is used for supporting the work when turning on centers or when a long component is to be held in a chuck.

d) **Carriage :**

It is located between headstock and tailstock. It can slide along bed guide ways and can be locked at any position by tightening the carriage lock screws. It consist of following parts

i. **Apron**: It is fastened to saddle. It contains gears and clutches for transmitting motion from feed rod and hand wheel to the carriage. Also split nut which engages with the lead screw during threading. The Clutch mechanism is used for transmitting motion from feed rod whereas the split nut along with the lead screw moves the carriage during thread cutting.

ii. **Saddle**: It is made up of H shaped casting. It aids saddle to slide on bed guide ways by operating hand wheels.

iii. **Compound rest**: It supports the tool post and cutting tool in its various positions. It may be swiveled on the cross-slide to any angle in the horizontal plane.

iv. **Cross-slide**: It is provided with a female dovetail on one side and assembled on top of saddle having a male dovetail.

v. **Tool post**: It is used to hold various tool holders and tools. Three types of tool post commonly used are

- Ring and rocker tool post.
- Square head tool post.
- Quick change tool post

e) Legs :

These are supports which carry the entire load of the machine. Legs are casted and are fixed on foundation by grouting. The left leg acts as a housing for the motor, the pulleys and the counter shaft at the same time the right leg acts as a housing for the coolant tank, pump and the connecting parts.

Specification of Lathe:

The size of the lathe is specified by one of the following ways:

- Length of the bed.
- Distance between centers
- Diameter of the work which can be turned between the ways
- Swing over carriage

Lathe machine accessories & attachment

- ✓ Live Centre / dead center or revolving center.
- ✓ Job or dog carrier
- ✓ Mandrel
- ✓ Collet chuck
- ✓ Drill chuck
- ✓ Steady rest
- ✓ Face plate
- ✓ Angle plate
- ✓ Three jaw chuck or four jaw chuck

2. SHAPER

Shaper is a versatile machine which is primarily intended for producing flat surfaces. The surfaces may be horizontal, vertical or inclined. This machine involves the use of single point tool held in a properly designed tool box mounted on a reciprocating ram.

Classification of Shapers:

i. According to the ram driving mechanism
   - Crank shaper
   - Geared shaper
   - Hydraulic shaper

ii. According to position and travel of ram
   - Horizontal shaper
   - Vertical shaper

iii. According to direction of cutting stroke
   - Push cut shaper
   - Draw cut shaper

iv. According to design of table
   - Plain shaper
   - Universal shaper

3. *MILLING MACHINE*

It is a machine tool in which metal is removed by means of a revolving cutter with many teeth. Each tooth has an edge which removes metal.

Type of Milling Machine

i. Column & knee type milling
   - Horizontal milling machine
   - Vertical milling machine
   - Universal milling machine.

ii. Planer milling machine

iii. Fixed bed type

iv. Special purpose milling machine.

Parts of Milling Machine

i. Base: It is a heavy casting on which column and other parts are mounted.

ii. Column: There are guide ways on the front face of the column on which knee slides.
iii. Knee: It supports the saddle table, work piece and other clamping device.
iv. Saddle: It is mounted on the knee and can be moved by a hand wheel.
v. Table: It is mounted on the saddle and can be moved by hand or automatic power feed.
vi. Arbor: It holds and drives different types of milling cutters.
vii. Spindle: It gets power from gears; belt drive to drive the motor. It has the power to add or remove milling cutter on the arbor.

4. Drilling Machines

Drilling is operation to produce cylindrical holes existing hole with an end cutting tool Called twist drill, with two cutting edges. Two motion i.e. rotary and linear are given to drill simultaneously to cut off chips.

Classification of drills

The drill are classified as Flat Drill, Straight fluted Drill, Twist Drill, Oil hole Drill, Centre Drill

There are three types of drilling machines:

i. **Bench drilling machine**: It is used for drilling, reaming, counter sinking and counter boring etc.
ii. **Hand drilling machine**: It is used for making small holes. It is pressed from the handle with left hand while crank is rotated with right hand.
iii. **Portable drilling machine**: It is compact and small in size; it can be brought near to the work place for drilling medium size holes.
iv. **Radial drilling machine**: It is used for drilling large size holes, and can be moved in different directions.

5. OTHER TOOLS IN MACHINE SHOP

a. Measuring Tools

i. Steel Rule
ii. Vernier Caliper (L.C.-0.02mm)

iii. Out Side Micro Meter (L.C.- 0.01mm)
iv. In side caliper / out side caliper
v. Threading gauge
vi. Vernier height gauge
vii. Dial indicator
viii. Surface gauge
ix. Radius gauge
x. Feeler gauge
xi. Surface plate

b. Cutting tools

i. Single point cutting tool
ii. Internal / external threading tool
iii. Parting off tool
iv. Boring tool
v. Knurling tool
vi. Round split die / spring die
vii. Tap set
viii. Twist drill
ix. Taper shank drill
x. Smooth file
xi. Grinder Dresser

c. Miscellaneous tools

i. Double ended spanner
ii. Ring spanner
iii. Allen key set
iv. 'L' shape socket wrench

FURTHER LINKS

- ✓ For more details refer the books listed in the Lab course handouts
- ✓ Discussion forum with instructors and/or teacher

PRECAUTIONS AND DO'S & DON'TS

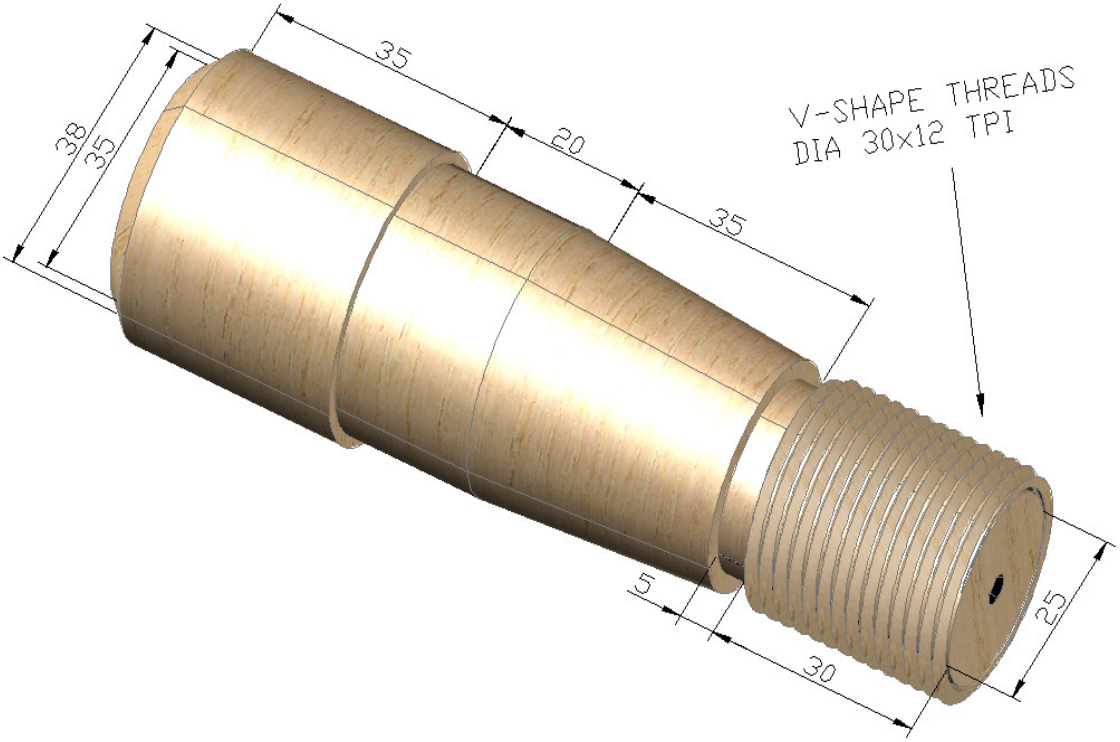
In machine shop following precautions shall be observed while working

1. Wear safety goggles to protect your eyes against any flying chips or dust.
2. Keep your hands away from the moving cutter or work piece.
3. Cover the pulleys & belts with safety guards while working.
4. Never let your clothes & hand come in contact with the revolving chuck, pulleys, belts, etc.
5. Work piece should be held tightly between the live & dead centers.
6. Don't touch the chips while the same are being generated by the machine because these are extremely hot.
7. Be sure that cutting tool is tightly held in tool post.
8. Do not touch the tool tip during grinding of the tool.
9. Don't give excessive feed to the cutting tool. it damages the tool tip & may even cause accident.
10. Always clean machine before use.

Job No. 1- To perform different Jobs on Lathe Machine

1. **Objective:** To prepare the job as per the given specifications provided for different operations on lathe machine
2. **List of Operations:** Cutting, facing, center drilling, plain turning, taper turning, necking, knurling, threading, chamfering, filing etc.
3. **Machine Tools:** Lathe Machine (Specification H.P. =0.75 H.P. overall length 1600-2000 mm, Swing Dia =455-575 mm.
4. **List of tools:** Engineering. Steel Rule 6", Outside caliper, Vernier calipers, Flat smooth file, Single point cutting tool, Knurling tool, Center drill, Drill chuck ½", Spanner set, Parting off or necking tool, Thread gauge, Threading tool, Parting tool, Lathe Dog carrier, Revolving Centre etc.
5. **Materials Used:** Mild steel bar (32 mm dia.)
6. **Drawing:** See diagram
7. **Procedure:**
   i. Understand the job drawing thoroughly and plan the job.
   ii. Cut off a 130mm long piece from 32 mm dia. Bar.
   iii. Hold the work piece in the Lathe chuck and perform facing and center drill operations. Repeat the same on the other side also.
   iv. Hold the job in between live and dead centers with Lathe dog or Lathe carrier.
   v. Perform plain turning with single point cutting tool and maintain dimensions as:-
      - Dia 30 mm and length 90 mm
      - Dia 28mm and length 35mm
   vi. Perform necking or grooving by using recessing tool (Dia 15mm and length 5mm)
   vii. Perform taper turning by swiveling the compound rest at an angle = 4°
   viii. Now start threading by setting levers as per requirement.(BSW 12 TPI)
   ix. Finish by filing, take off the job from m/c and do oiling in the whole job for the protection from the rust.

Different operations on Lathe Machine

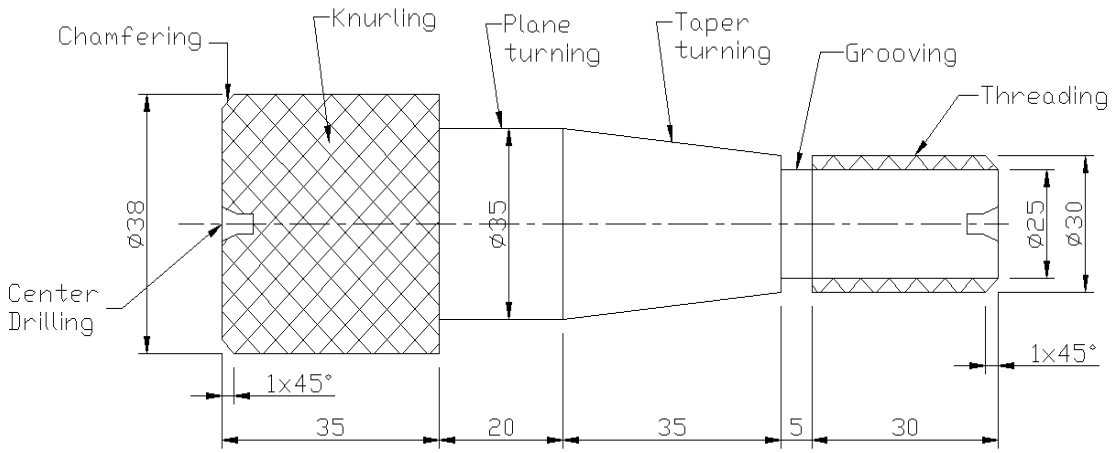


Swiveling angle = Half of the taper angle = 4°

All Dimensions are in mm

Tolerance = ± 0.5mm

Different operations on Lathe Machine



Swiveling angle = Half of the taper angle = 4°

All Dimensions are in mm

Tolerance = ± 0.5mm

Manufacturing Practices

Fitting Shop

INDEX

SAFETY FIRST

1. While working keep your mind & eyes on the job & do not indulge in talking.
2. Smart (no loose) clothing.
3. Use lab/ workshop coat
4. Use proper (no open) shoes in workshop premises
5. Remove wrist watch, ring, bracelets etc.
6. Protect the eyes with goggle or screen while working with hot objects/ in bright area
7. Use hand glove for hot/ sharp objects, paints etc.
8. Avoid breathing of fumes emanating from welding, soldering or other such processes.
9. Shop should be properly lit & well ventilated.
10. Keep the work area clean, dry, free from scrap, hot items, oil spillage etc.
11. Never operate any machine unless you know how to operate it.
12. In case of any fire, the electric supply should be disconnected
13. Must always know the location and operation of Fire Extinguisher & First Aid box in the shop.
14. In case of an accident immediately inform the instructor

INTRODUCTION

Fitting jobs involves the removal of excess / unwanted material from blanks with the help of hand tools so that they could be assembled as specified in drawing. It is done for the assembly practice by mating surfaces/edges of components leading to assembly.

In this chapter we shall study about metals its properties & classification and tools required to work with metals. The tools are for marking, cutting, chiseling, striking, drilling, threading tools etc.

BASIC THEORY

PROPERTIES OF METALS

1. **Lustre**: Lustre is the ability of a metal surface to reflect light rays.
2. **Colour**: Colour is the property of a metal to show specific surface appearance.
3. **Plasticity**: This is the property of metal where it can be converted in to required shape and size by application of heat or pressure or both.
4. **Elasticity**: It is the property of metal by which it return back to its original shape and size after removal of external force / pressure.
5. **Malleability:** By this property metal can be drawn in the form of a thinner sheet without failure.
6. **Toughness:** Due to this property metal can withstand bending without failure.
7. **Ductility:** By this property metal can be drawn in the form of wires without failure.

CLASSIFICATION OF METALS

Metals are classified into two categories- Ferrous and Non Ferrous Metals.

1. **Ferrous Metals** – In ferrous metals iron acts as base (highest percentage) metal. Some other materials like carbon, sulphur, nickel, etc are also mixed into ferrous metals to change the properties. They are magnetic in nature. Some ferrous metals are discussed as under.
    a) **Steel** – Steel is a mixture of iron, carbon and other elements.
        i. **Plain Carbon Steel**: is a mixture of iron, carbon with negligible percentage of Si, P, Mn etc. elements.
            - Low Carbon Steel – Carbon content 0.05 to 0.30%.
            - Medium Carbon Steel - Carbon content 0.30 to 0.80%.

- High Carbon Steel - Carbon content 0.80 to 1.50%.

ii. **Alloy Steel** – Alloy steel is made by adding some percentage of alloying elements like nickel, phosphorous, silicon, chromium, molybdenum in the plain carbon steel to give strength, hardness, resistance to corrosion properties.

- Tool Steel – is alloy steel used for making cutting tools, mainly designated as HSS(High Speed Steel) with 18% tungsten, 4% chromium, 1% vanadium and 0.7% carbon.
- Invar steel – is an alloy steel with 36% Nickel leading to zero coefficient of thermal expansion used for making precision instruments.
- Spring Steel – alloy steel used for making springs.

b) **Cast Iron** – also referred, as iron is a ferrous metal containing more than 2% of carbon. It is hard and brittle material, used in machine beds, heavy parts of machines.

c) **Wrought Iron** – It is almost pure iron containing 99.9% of iron. It is ductile and soft.

2. **Non Ferrous Metals** - The metals which has base metal other than iron are known as non ferrous metals, copper, aluminum, brass, bronze, tin, lead are common non ferrous metals.

a) **Copper:** Reddish brown color, soft, ductile, high electrical and thermal conductivity.

b) **Brass:** Alloy of copper and zinc, soft and ductile.

c) **Bronze:** Alloy of tin and copper, corrosion & wear resistance material.

d) **Aluminum:** Soft metal, white in color, light in weight, good electrical conductivity.

e) **Gun metal:** Alloy of copper, tin and zinc, used in making casting.

FITTING SHOP TOOLS

Fitting shop tools are classified as under:

Clamping Tools

Clamping tools are used for holding the job firmly during various fitting operations.

i). **Bench vice:** It is a common tool for holding the jobs. It consists of cast iron body and iron jaws .The jaws are opened up to required width, job is placed in the jaws and is fully tightened with handle.

ii). **Leg vice:** It is stronger then bench vice and used for heavy work.

iii). **Hand vice:** It is used to grip very small objects.

iv). **Pin vice:** Pin vice is used to hold wire or small diameter rods.

v). **Pipe vice:** It is used to hold pipes. It grips the pipe at four places and is fixed on bench or can be grouted.

Measuring and Marking Tools

i). **Try Square:** It is used for checking square ness of two surfaces. It consists of a blade made up of steel, which is attached to base at 90°.

ii). **Bevel Protector:** It consists of a steel dial divided into 360° divisions, used for measuring angles.

iii). **Combination Set** – Multipurpose instrument can be used as a protector, a level, a meter, a center square and a Try square.

iv). **Centre Square** – It is used to find the centre of the round jobs, Angle of punching end is 90°.

v). **Scriber and Surface Gauge** – It is used for marking of lines parallel to a surface. Scriber mounted on a vertical bar is called surface gauge.

vi). **Dot Punch** – It is used for marking dotted lines. Angle of punching end is 60°.

vii). **Centre Punch** – It is like a dot punch used to mark the centre of hole before drilling. Angle of punch end is 90°.

viii). **Surface Plate** – Surface plate is used for testing the flatness, trueness of surfaces; its upper face is machined to form a very smooth surface.

ix). **Angle Plate** – It consists of cast iron in which two ribs of metal are standing at right angle to each other, used for holding and supporting the jobs.

x). **'V' Block** – It is used for supporting as well as marking of round and square jobs.

xi). **Steel Rules** – It is made up of stainless steel and marked in inches or millimeters, available in various sizes ½ ft to 3 ft.

xii). **Vernier Caliper** – It is a precision instrument used for measuring lengths and diameters. Minimum dimension that can be expressed on Vernier caliper is known as least count, which is usually 0.001 or 0.02 mm.

xiii). **Micrometer** – It is used for measuring diameters or thickness of any Job. The graduation on micrometers is available in inches or in millimeters.

xiv). **Dial Indicator** – A round gauge in which a pointer moves over a graduated scale. The movement is magnified through links. It is used to check the run out or ovality of Jobs.

xv). **Dividers** – Dividers have two legs having sharp feet. It is used for marking arcs, dividing a line or transferring the dimensions.

xvi). **Calipers:** it is generally used to measure the inside or outside diameters. There are four types of calipers.

a) Outside calipers
b) Inside calipers
c) Spring calipers
d) Odd leg calipers

xvii) **Gauges**

a) **Depth Gauge**: It is used to measure the depth of a hole. The beam is graduated in inches or millimeters.
b) **Feelers Gauge**: It is used to check the gap between two mating parts. It consists of a number of metal leaves of different thickness marked on the leaves.
c) **Radius Gauge**: It is used to check the radius of outer and inner surfaces. Every leave has different radius.
d) **Vertical Height Gauge**: It is used to measure the height of work pieces.
e) **Thread Gauge**: It is used to check the pitch of the threads. It consists of a number of leaves, pitch of the threads marked on each leaves.
f) **Wire Gauge**: It is used to check the diameter of wires and thickness of sheets.

Cutting Tools

These tools are used to remove the materials

1. **Hacksaw** – It is used for cutting of flats, rods etc. The blade of hacksaw is made up of high carbon steel and frame is made from mild steel. The blade is placed inside the frame and is tightened with the help of a flange nut. The teeth of hacksaw blades are generally forward cut. There are two types of hacksaw frames, fixed frames and adjustable frame. The material to be cut with hacksaw is clamped in a vice. Cutting point should be close to the clamping vice. Long pieces should be clamped at more than one points. The hacksaw

should be moved perfectly straight and horizontal. Cutting stroke should be in the forward direction

2. **Files** – It is used to remove material by rubbing it on the metal. Classification of files.
   i) **Size** – The length of file vary from 4 inch to 14 inch.
   ii) **Shape** – The shapes available are flat, square, round, half-round, triangular etc.
   iii) **Cuts** – Single and Double Cut.
   iv) **Grade** –

   Rough - 20 teeth per inch

   Bastard - 30 teeth per inch

   Second Cut - 40 teeth per inch

   Smooth – 50-60 teeth per inch

   Dead Smooth - 100 teeth per inch

   Rough and bastard files are used for rough cutting; smooth and dead smooth files are used for finishing work. Files should be used in perfect horizontal position. Pressure should be applied on the forward stroke only. Work is held in a vice.
3. **Chisels** – They are used for chipping away the material from the work piece. Commonly used forms of chisels are flat, cross cut, half round, and diamond point chisels. Flat chisel is used for chipping a large surface. Crosscut chisel is used for grooving. Half round chisel is used to cut oil-grooves. Diamond point chisel is used for chipping plates.

Striking Tools

Hammers are the only tools used for striking in fitting shop like chipping, fitting, punching etc. Main types of hammer

- Ball peen hammer
- Straight peen hammer
- Cross peen hammer

Miscellaneous Tools

i. **Drill Bit**– It is used for making round holes. Twist drill is most commonly used for making holes.

ii. **Reamer** – It is used to finish the drilled hole to accurate size.

iii. **Taps** – It is used for making internal threads. The tap holder holds tap, normally it comes in a set of three i.e. Taper tap, Intermediate tap, Plug tap.

iv. **Die** – It is used for cutting external threads. It is held in a diestock, the handle is rotated by hand and job is held firmly in a vice.

Drilling Machines

There are three types of drilling machines:

i. **Bench drilling machine**: It is used for drilling, reaming, counter sinking and counter boring etc.

ii. **Hand drilling machine**: It is used for making small holes. It is pressed from the handle with left hand while crank is rotated with right hand.

iii. **Portable drilling machine**: It is compact and small in size; it can be brought near to the work place for drilling medium size holes.

iv. **Radial drilling machine**: It is used for drilling large size holes, and can be moved in different directions.

Screw Threads

i. **British standard Whitworth threads (BSW):** The thread is generally used on bolts and nuts 'V' shape having an angle of 55º.

ii. **Metric threads:** 'V' shape having an angle of 60º.

iii. **Square threads:** Shape of thread is square used on screw jacks.

iv. **Acme threads:** These threads are stronger than square threads having an angle of 29º, they are used on lead screw shaft of lathe.

BENCH WORKING PROCESSES

1. **Marking** – Measurement is performed on the job by measuring instrument and scriber does marking.
2. **Chipping** – Material is removed with the help of chisels.
3. **Sawing** – This operation is required to cut the metal in different sizes and shapes by hacksaw.
4. **Filing** – This operation is performed with the help of files, pressure should be exerted in the forward stroke and backward stroke is ideal.
5. **Scrapping** – This is done for reducing more accurate finish that obtained by filing.
6. **Drilling** – This is done to produce holes with the help of drills. It is done on a drilling machine and job is held in a machine vice. Drill.bit is fixed on the drilling machine,
7. **Tapping** – This is done to cut the internal threads with the help of tap and tap holder.
8. **Dieing** – This is done to cut the external threads with the help of die and die holder.

FURTHER LINKS

- ✓ For more details refer the books listed in the Lab course handouts
- ✓ Discussion forum with instructors and/or teacher

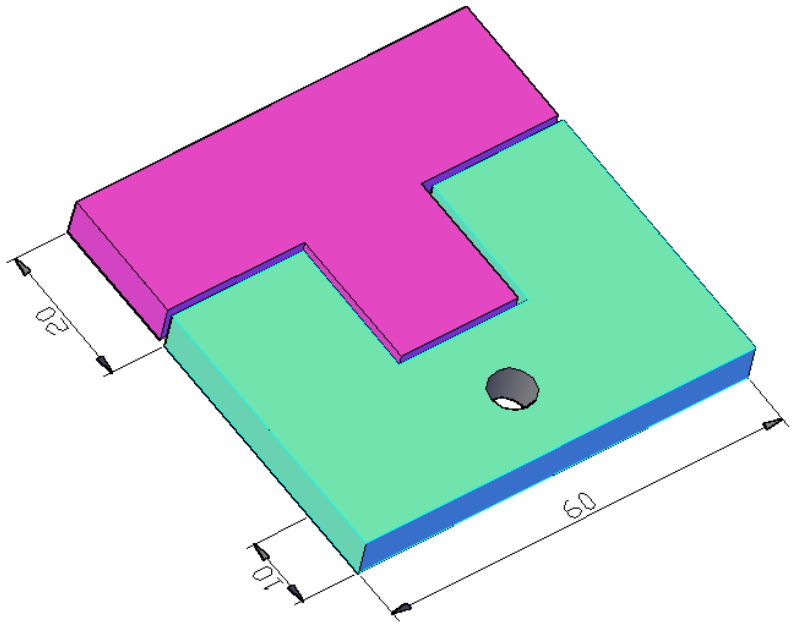
PRECAUTIONS

While working in Fitting shop following precautions shall be observed

1. Never touch moving parts, belts or rotating tools etc.
2. Keep your hands away from the drilling machine
3. Always move the hacksaw in perfect straight and horizontal direction.
4. Never tilt the hacksaw blade while sawing.
5. Grip should be fixed in proper direction and tightened sufficiently
6. The teeth should be protected from excessive wearing.
7. Use water as a coolant while sawing.
8. Hold the chisel firmly while chipping.
9. Drill the holes centralizing on pop marks, give gradual feed.
10. Check the dimensions carefully from time to time with try square and Vernier clipper.
11. Tap should be held perpendicular and rotated every half turn forward and reverse quarter turn backward

Job No. 1

To Make Right Angle Fitting Job



All dimensions in mm
Material : M.S. Flat 62×6 mm
Tolerances ± 0.5 mm

1. **Objective:** Exercise involving marking, cutting, chipping, filing, drilling, tapping and fitting operations on a M.S. flat.

2. **Tools and equipment:** Bench vice, hacksaw. files. scriber, steel rule, try square, hammer, chisel flat, surface plate, angle plate, surface gauge, drills, taps, Vernier caliper, centre punch, drilling machine.

3. **Materials required:** Mild steel flat 62 x 6 mm.

4. **Drawing:** See Diagrams

5. **Procedure:**

Ex I: To make Rectangular job 60 x 40 mm.

i. Mark the M.S flat 62 x 6 x 42 mm (two pieces), clamp it in a bench vice and cut the metal with hacksaw,.

ii. File the two adjacent sides at right angle, check with try square.

iii. Mark the other two sides to dimension 60 x 40 mm with surface gauge on a surface plate supporting it by angle plate

iv. Cut extra metal and file to accurate 60 x 40 mm rectangular piece. Finish the surface with smooth file keeping tolerance ± 0.5 mm; check the dimension with vernier caliper.

v. Finish the other piece also by same procedure.

Ex II: To make a part 1

i. Mark parallel lines at 20 mm distance on a finished rectangular piece of 60 x 40 mm as shown in diagram.

ii. Cut with hacksaw outer side of marked lines to remove 20 mm square pieces on both sides.

iii. File the cut 'T' to bring it to accurate dimensions, check all angles at 90^0 with try square.

Ex III: To make a part 2

i. Mark parallel lines at 20 mm distance on another finished rectangular piece 60 x 40 mm.

ii. Punch mark at equal distance, drill 3.5 mm hole, Cut with hacksaw inside line of marking and chip out 20mm piece with a chisel as shown in diagram

iii. File the cut out portion to bring it to accurate dimensions, check angles with try square.

Ex IV: Fitting of part 1 into part 2

i. Fit the Part 1 into Part 2 after filing to accurate dimension of fitting clearance 0.1 mm.

ii. Check for squareness of the fitting male & female parts.

iii. Finish the job with a smooth file.

Ex V: To make internal threads

i. Mark the point with centre punch, drill hole (6.8 mm for 8 x 1.25 mm) by electric drilling machine for tapping as shown in diagram.

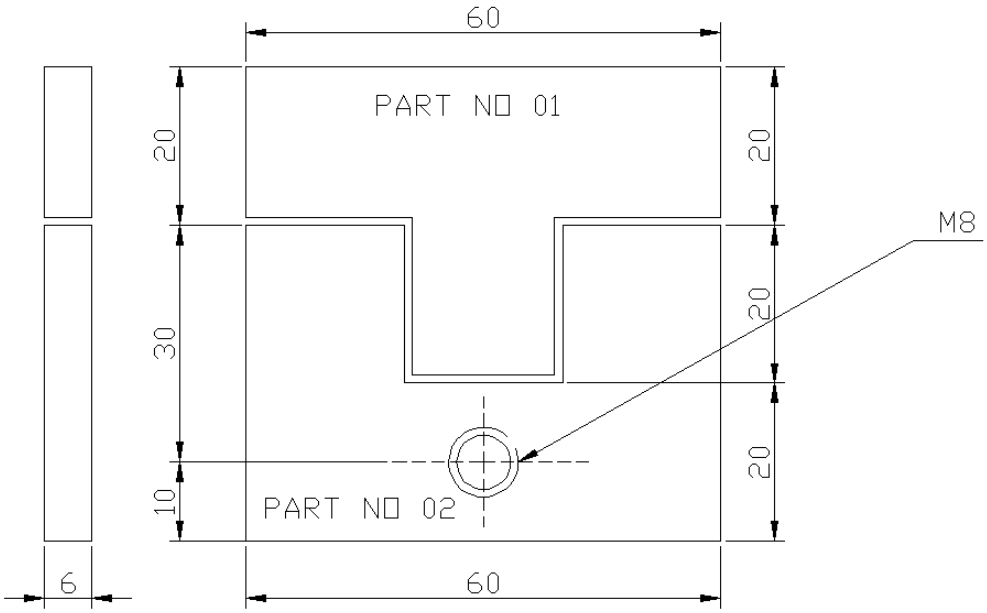
ii. Fix the taper tap in a tap holder, Clamp the job in a bench vice, Insert taper tap in a drilled hole, hold it perpendicular and rotate clock wise to start threading.

iii. Apply little lubricating oil on cutting operation, on each half turn forward, turn the tap backward by quarter turn, to break the cutting chips.

iv. Repeat the threading operation with intermediate and finally with bottoming tap.

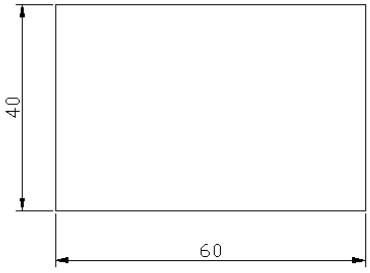
v. Remove the burrs with a file.

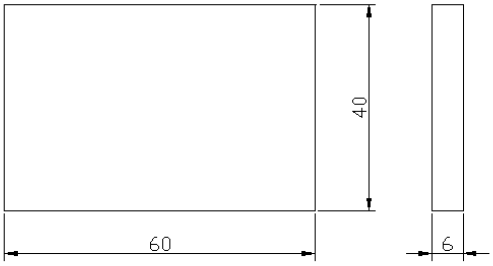
TO MAKE A RIGHT ANGLE FITTING JOB



- ALL DIMENSIONS ARE IN mm
- MATERIAL MILD STEEL FLAT 62*6mm
- TOLERANCES ±0.5mm

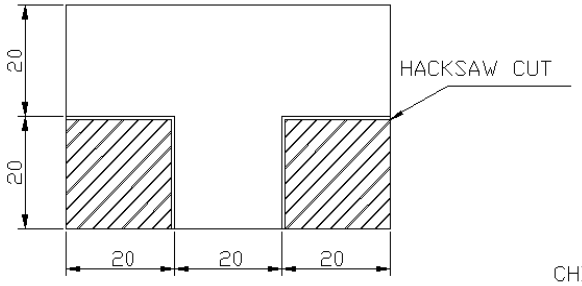
EX: 1

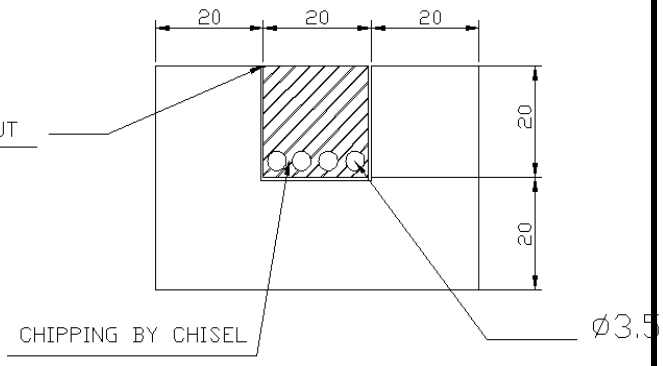




EX: 2

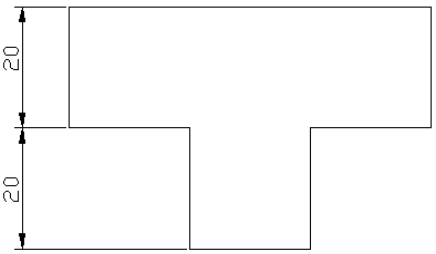
EX: 3

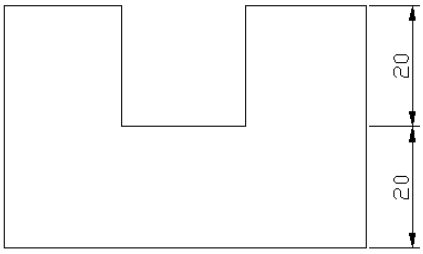




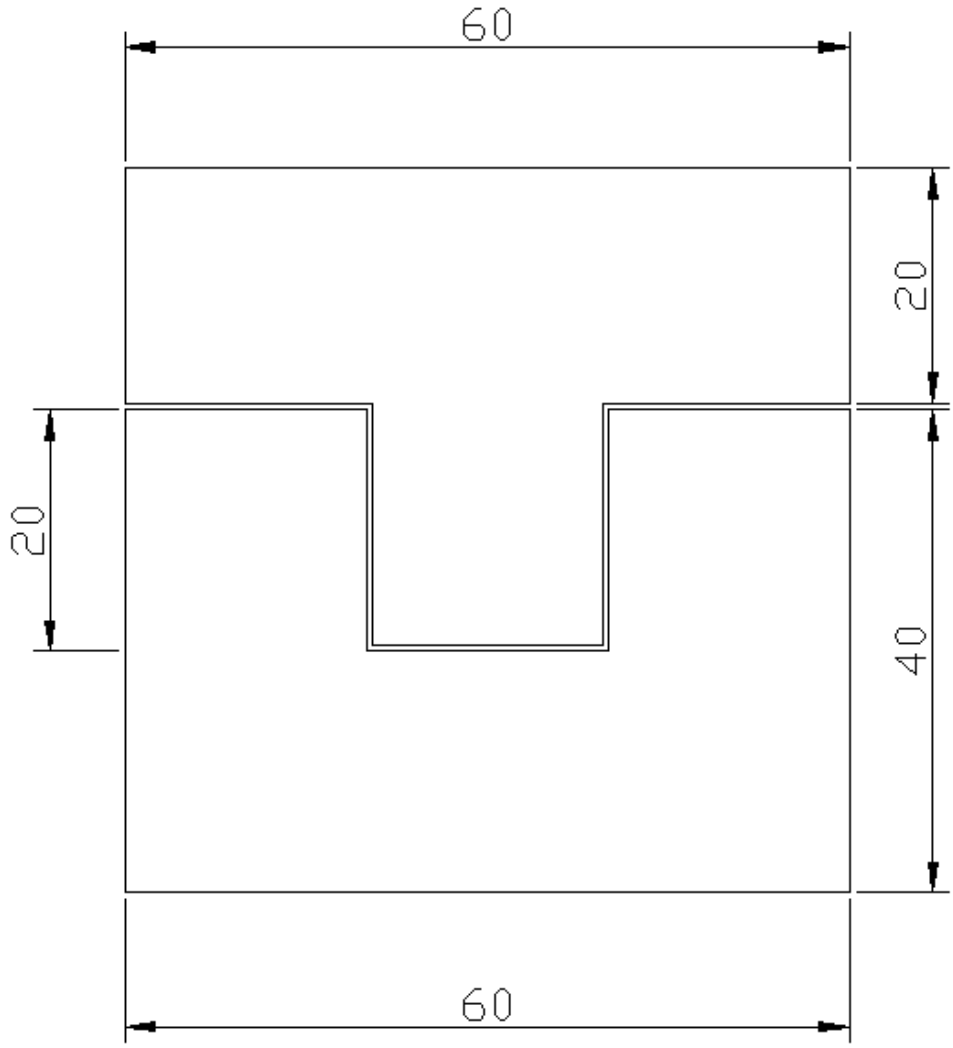
PART: 1

PART: 2

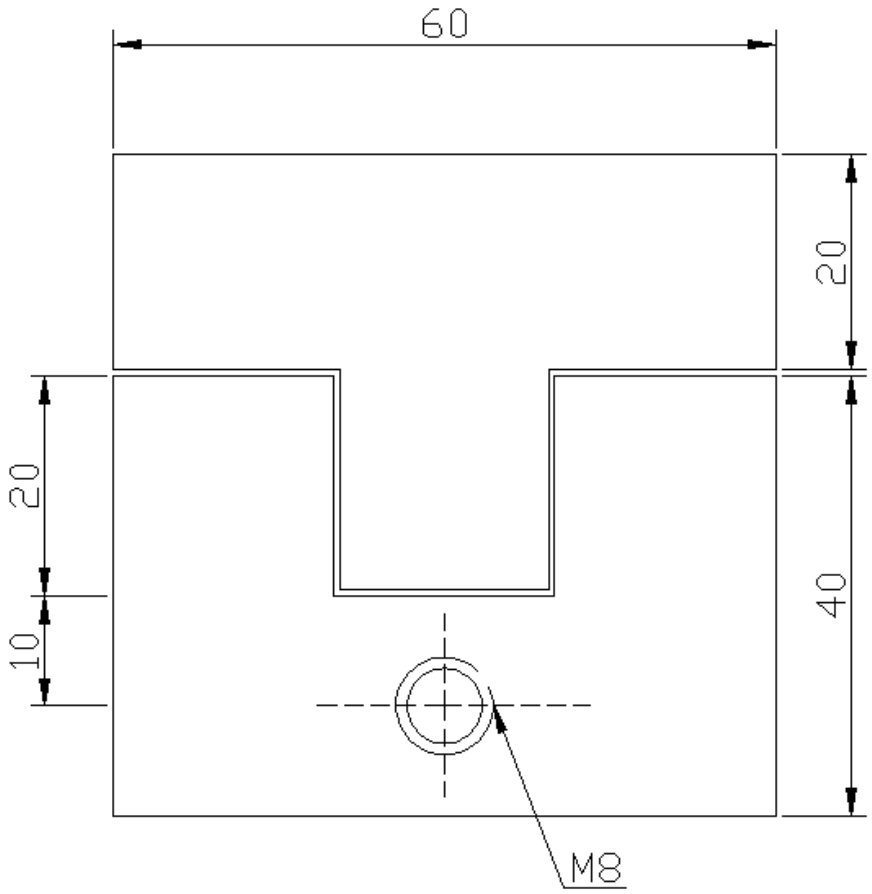




EX: 4



EX: 5

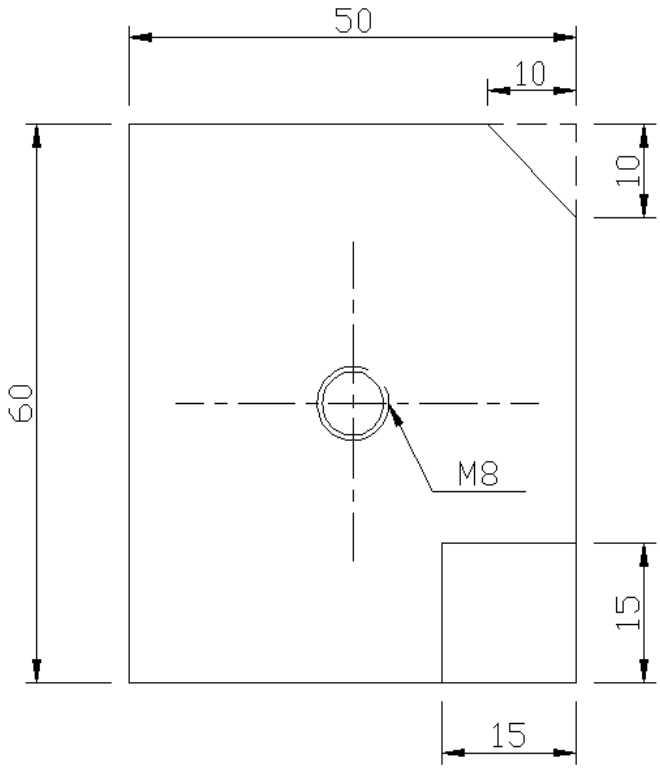


Job No. 2

To Make A Square Fitting Job

1. **Objective:** To carry out different types of fitting operations like checking, marking, punching, cutting, filing etc. on a job of size 50*60 mm MS flat
2. **Tools & Equipment:** File, hacksaw, bench vice, twist drill, drilling machine, surface plate, angle plate, marking gauge, Vernier clippers, try square
3. **Material Required:** Mild steel flat 50*62*6 mm
4. **Drawing:** See diagram
5. **Procedure:**
   i. Check the tools and equipments required. Ensure that the required tools are in good working condition.
   ii. Do marking on the MS flat using scale and cut the piece with the help of hacksaw.
   iii. Do filing operation on the job piece with proper method of filing and make two sides at a right angle.
   iv. Do marking operation with the marking tools and make a chamfer cut 10*10 mm and square cut of 15*15 mm by using hacksaw.
   v. Do drilling operation with the pillar electric drilling machine and do the tapping operation.
   vi. Do finishing operation with smooth file.

TO MAKE A SQUARE FITTING JOB



All Dimensions are in mm

Material : M.S. Flat 62 x 6 mm

Tolerance: ±0.5 mm

Manufacturing Practices

Welding Shop

INDEX

SAFETY FIRST

1. Alert & Attentive - Mind & eyes on the job.
2. Smart (no loose) clothing.
3. Use proper (no open) shoes in workshop premises
4. Use lab coat/ workshop apron
5. Remove wrist watch, ring, bracelets etc.
6. Protect the eyes with goggle or screen while working with hot objects or in bright work area
7. Use hand glove for hot/ sharp objects, paints etc.
8. Avoid breathing of fumes emanating from welding, soldering or other such processes.
9. Shop should be properly lit & well ventilated.
10. Keep the work area clean, dry, free from scrap, hot items, oil spillage etc.
11. Never operate any machine unless you know how to operate it.
12. In case of any fire, the electric supply should be disconnected
13. Must always know the position and operation of Fire Extinguisher & First Aid box in the shop.
14. In case of an accident immediately inform the instructor

INTRODUCTION

Welding is the process of joining two metal pieces with the help of heat or pressure. It is widely used in engineering field. Many types of welding processes has been developed depending upon their applications.

BASIC THEORY

Various Types of Welding

(a) **Forge Welding:** This welding is done by the black-smiths. In this two pieces of similar metal are heated up to the plastic stage in the furnace. Then it is hammered so that a homogeneous mixture is formed at the joint. The surface to be joined should be cleaned and made free of any foreign particle, this is done by brushing.

(b) **Gas Welding:** Gas welding is the process in which a gas flame is used to raise the temperature of the metals to be joined. The metals are heated up the melting. The metal flows and on cooling it solidifies. A filler metal may be added to the flowing molten to fill up cavity made during the end preparation. Many combinations of gases are used in gas welding. But the most common of these is oxygen and acetylene.

(c) **Arc Welding:** The welding in which the electric arc is produced to give heat for the purpose of joining two surfaces is called electric arc welding.

Principle: Power supply is given to electrode and the work piece. A suitable gap is kept between the work and electrode. A high current is passed through the circuit. An arc is produced around the area to be welded. The electric energy is converted into heat energy, producing a temperature of 3000ºC to 4000ºC.

(d) **Resistance Welding:** Resistance welding is a group of welding processes wherein coalescence is produced by the heat obtained from resistance of the work piece to the flow of electric current in a circuit of which is the work piece is a part and by the application of pressure. No filler metal is needed.

Fundamentals of Electric Resistance Welding

The two factors or variables mainly responsible for resistance welding are

(i) The generation of Heat at the place where two pieces are to be joined.

(ii) The application of pressure at the place where a weld joint is to be formed.

(e) **Thermit Welding:** It is used on those places where there is no availability of electric supply or gas. It is a compact unit and can be moved easily up to the site. It consists of a conical shape vessel with a brick lining inside. Mixture of powdered aluminum and iron oxide is placed inside the vessel. This mixture is heated by the surface up to molten stage, due to the reaction the Aluminum is converted in Aluminium oxide.

(f) **Other welding:** Spot welding, seam welding, TIG, MIG welding

Welding Joints

1. **Butt Joint:** In this type of joint, the edges are welded in the same plane with each other. V or U shape is given to the edges to make the joints strong.
2. **Lap Joint:** This type of joint is used in joining two overlapping plates so that the corner of each plate is joined with the surface of other plate. Common types of lap joints are single lap, double lap or offset lap joint.
3. **T-Joint:** When two surfaces are to be welded at right angles, the joint is called T-Joint. The angle between the surfaces is kept 90º.
4. **Corner Joint:** In this joint the edges of two sheets are joined and their surfaces are kept at right angle to each other. Such joints are made in frames, steel boxes etc.
5. **Plug Joint:** Plug Joints are used in holes instead of rivets and bolts.

WELDING EQUIPMENTS

Various equipments used for Arc welding are as under:

1. **Motor Generator Set:** In this a generator is driven by a suitable AC motor. The average voltage of the generator is 25 volt. The current ranges from 25 to 100 amperes, the voltage in the generator is variable. The voltage can be set to the desired value with the help of rheostat.
2. **Diesel Engine Generator Set:** In this set, the drive is given by a diesel engine. Rest of the system is same as in case of A.C. motor generator. Diesel engine generator sets are used in the areas where electricity is not available.
3. **Transformer rectifier set:** It allows the current to flow through it only in one direction, because it has a one way valve or solid rectifier installed on the electrode

side of the secondary coil. The set can supply straight polarity and reverse polarity power supply. The rectifiers are of two types:

(i) Silicon diode

(ii) Selenium plate

4. **Welding Transformer Set:** It is used to step down the voltage supply. It consists of a primary and secondary circuit. The input is given to primary winding. By electromagnetic induction the current flows through the secondary coil. The output can be controlled as per requirement.
5. **Cables or Leads**: Copper or Aluminium wire with heavy insulation, holder, connectors, ground clamps
6. **Face Shield:** To protect face and eyes from dangerous infrared/ ultraviolet rays
7. **Other accessories:** Chipping hammer, wire brush, closed shoe, apron etc.

Welding Electrodes

Electrode Type

Electrodes are of two types:

i Coated electrodes

ii. Bare electrodes

Coated electrodes are generally applied in arc welding processes. A metallic core is coated with some suitable material. The material used for core is mild steel, nickel steel, chromium molybdenum steel etc. One end of the coated core is kept bare for holding and flow of current.

Bare electrodes when used alone produce the welding of poor quality. These are cheaper than coated electrodes. These are generally used in modern welding process like MIG welding.

Electrode Size

Electrodes are commonly made in lengths 250 mm, 300 mm, 350 mm, 450 mm and the diameters are 1.6 mm, 2 mm, 2.5 mm, 3.2 mm, 4 mm, 7 mm, 8 mm and 9 mm.

Functions of Coatings

i. To prevent oxidation of electrode.

ii. Forms slag with metal impurities.

iii. It stabilizes the arc.

iv. Increases deposition of molten metal.

v. Controls depth of penetration.

vi. Controls the cooling rate.

vii. Adds alloy elements to the joint.

Specifications of electrodes:

An electrode is specified by six digits with profile letter M. These six digits indicate the following matter:

M: It indicates that it is suitable for metal arc welding.

First Digit: First digit may be from 1 to 8, which indicate the type of coating on the electrode.

Second Digit: It denotes the welding position for which electrode is manufactured. It varies from 1 to 6.

Third Digit: It denotes the current to be used for an electrode. It is taken from 0 to 7.

Fourth Digit: Fourth digit is from 1 to 8. Each digit represents the tensile strength of welded joint.

Fifth Digit: It carries any number from 1 to 5. This digit denotes a specific elongation in percentage of the metal deposited.

Sixth Digit: It carries any number from 1 to 5 denotes impact strength of the joint.

WELDING DEFECTS

S.No.	Defects	Reasons
1.	Low penetration of metals into each other	(a) Incorrect current (b) Fast speed or welding
2.	Cracks in welded metal	(a) Wrong selection of electrode (b) Metal contains too much carbon
3.	Poor appearance	(a) Faulty electrodes (b) Irregular welding (c) Wrong arc length (d) Overheating due to high current

4.	Inclusions	(a) Dirty base metals (b) Higher sulphur content in metals to be welded (c) Improper removal of slag
5.	Poor Fusion	(a) Wrong current setting (b) Wrong clearance between the electrode and work piece (c) Fast speed of welding
6.	Blow Holes	(a) Wrong arc length (b) Old electrode (c) Impurities in base metal
7.	Warping	(a) Uneven heating (b) Over heating due to high current (c) Thin cross-section of metals (d) Slow speed of welding
8.	Scattering of welding	(a) High current (b) Long arc (c) Faulty electrodes

FURTHER LINKS

- ✓ For more details refer the books listed in the Lab course handouts
- ✓ Discussion forum with instructors and/or teacher

PRECAUTIONS AND DO'S & DON'TS

In welding shop following precautions shall be observed while working

i. **Protection of eyes and face**

Never look at a welding arc without a shield as the ultraviolet rays and infra-red rays emitted from the arc can harm the eyes as well as skin of the face. Replace the spattered glasses with clear cover glasses.

ii. **Protection of body from radiations**

Always wear flexible gauntlet gloves and a leather apron when welding in order to save the rest of the body from weld metal spatter & sparks, and ultra violet rays & infra red light emitted by the arc. Shoes worn by the welder should be high topped. Street shoes will not prevent globules of molten metal from dropping into the shoes.

iii. **Use specified current and electrodes for arc welding**

Always use welding current and electrodes for the particular application of metal and its size as specified by the supplier of the equipment.

iv. **Handling the work piece**

Never touch the hot objects with hands. Always use a pair of tongs for this purpose.

v. **Safety during chipping**

While chipping the slag off the welded layer remember that it can be very hot. Start the chipping when the pieces are at lower temperature. Chip only with appropriate chipping hammer and in such a ways that the chips flow away from the persons.

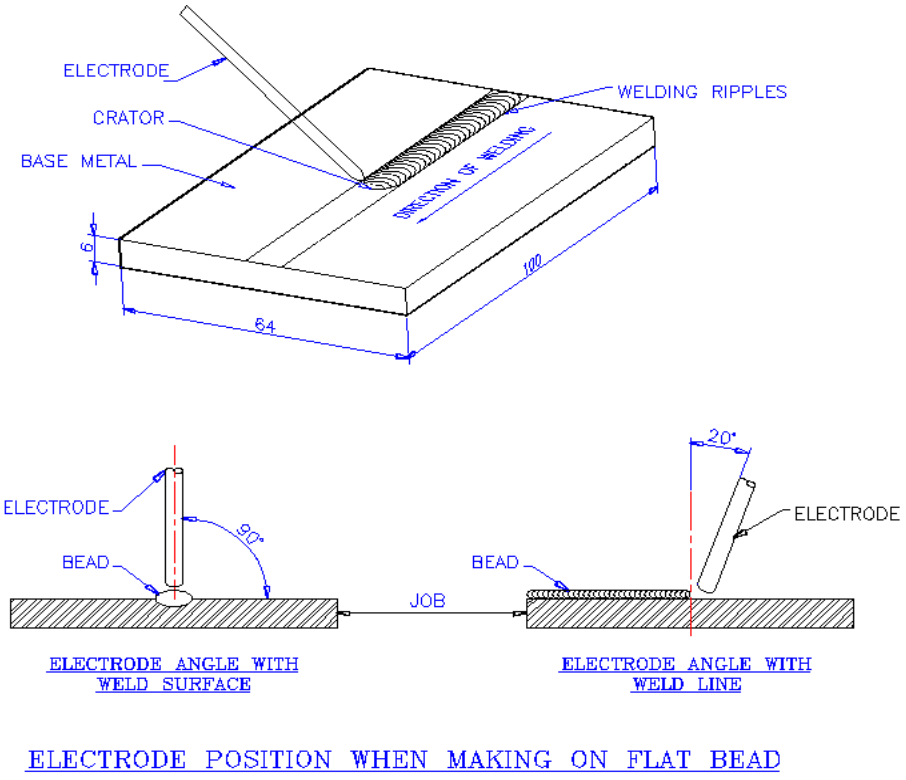
vi. **Miscellaneous**.

Any eye drops containing sylphs acetamide (Locula 20%) can also be used.

Job No. 1

1. **Objective:** Beading practice with arc welding
2. **Tools & Equipment:** Arc welding machine with all the accessories, try square, hacksaw, steel rule, hammer, chisel, pair of tongs, chipping hammer, face shield etc.
3. **Material Used:** MS-Flat of size 100*64*6 mm – one piece
4. **Electrode:** M.S Electrode 3.15 mm dia [SWG 10], length 350 mm.
5. **Drawing:** See diagram
6. **Procedure:**
   i. Marking and cutting the MS Flat
   ii. Start the welding transformer machine, and then set the current to approx. 100 amps.
   iii. Hold the Electrode at an angle as shown in diagram. Keeping the flat position & then complete the welding layer.
   iv. Clean with a chipping hammer and wire brush.

Beading practice with Arc welding

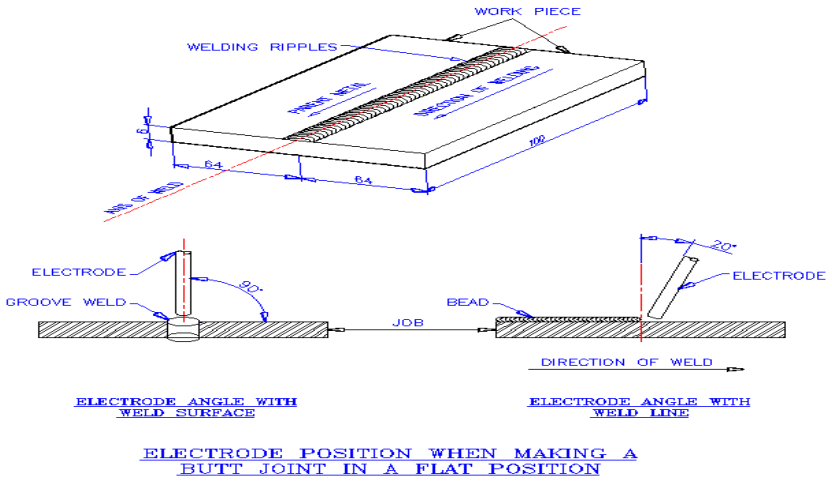


ELECTRODE POSITION WHEN MAKING ON FLAT BEAD

Job No. 2

1. **Objective:** To make a butt joint by arc welding.
2. **Tools & Equipment:** Arc welding machine with all the accessories, electrode holder, earth clamp, try square, hacksaw, steel rule, hammer, chisel, pair of tongs, chipping hammer, face shield etc.
3. **Material Used:** MS Flat of size 100*64*6 mm – two pieces
4. **Electrode:** MS Electrode 3.15 mm dia [SWG 10] length 350 mm
5. **Drawing:** See diagram
6. **Procedure:**
   i. Marking and cutting the MS Flat
   ii. Start the welding transformer machine, and then set the current to approx. 100 amps.
   iii. Tack both the sides of joints. Keeping the flat position of the job, complete the layer.
   iv. Clean with a chipping hammer and a wire brush and then check the welding layer.

Butt joint by Arc Welding



ELECTRODE POSITION WHEN MAKING A BUTT JOINT IN A FLAT POSITION

Manufacturing Practices

Sheet Metal Shop

INDEX

SAFETY FIRST

1. While working keep your mind & eyes on the job & do not indulge in talking.
2. Smart (no loose) clothing.
3. Use lab/ workshop coat
4. Use proper (no open) shoes in workshop premises
5. Remove wrist watch, ring, bracelets etc.
6. Protect the eyes with goggle or screen while working with hot objects/ in bright area
7. Use hand glove for hot/ sharp objects, paints etc.
8. Avoid breathing of fumes emanating from welding, soldering or other such processes.
9. Shop should be properly lit & well ventilated.
10. Keep the work area clean, dry, free from scrap, hot items, oil spillage etc.
11. Never operate any machine unless you know how to operate it.
12. In case of any fire, the electric supply should be disconnected
13. Must always know the location and operation of Fire Extinguisher & First Aid box in the shop.
14. In case of an accident immediately inform the instructor

INTRODUCTION

Sheet metal working covers the use of thin metallic sheets with hand tools and sheet metal machines. Many important engineering articles made up of sheet metal find their application in air-conditioning ducts, aircraft industry, agriculture implements, decorative articles and household goods. For effectively working in sheet metal one should have knowledge of hand tools, sheet metal machines, properties of metals and thorough knowledge of projective geometry i.e. development of surfaces.

BASIC THEORY

Types of Sheet Metal

1. **Ferrous Sheets**
   - i) *Mild Steel sheets* – These are black iron sheets, susceptible to rust and corrosion, mostly used in water tanks and fabrication works.
   - ii) *Galvanized Iron (GI Sheet)* – It is soft steel sheet coated with zinc, which is corrosion resistance due to zinc coating, used for making air-conditioning ducts, roofs, boxes, buckets, coolers etc.
   - iii) *Stainless steel sheets* – It is an alloy of high-grade steel with chromium, nickel, phosphorous and manganese. It is used in household goods, food-processing plants etc.
   - iv) *Tin Plate* – steel coated with tin is called tin steel. It is used for making food containers.
2. **Non-ferrous sheets**
   - i) *Aluminum Sheets* – It is two and half times lighter than iron but lacks in tensile strength. Small percentage of other elements like copper, manganese and silicon is added to make it suitable for production in aircraft industry and other industrial goods. It is also called aluminum alloy sheets.
   - ii) *Copper and Brass sheets* – These are non-ferrous sheets used in electrical industry and various other industrial and household articles.

Measurement of thickness of sheets

Thickness of sheet is generally measured by gauge number, which is obtained by actually measuring the sheet thickness with a sheet gauge or wire gauge. Each slot in the standard wire gauge is numbered, a number, which represents gauge number such as 20 SWG (Standard Wire Gauge). The more the SWG number, lesser is the thickness of sheet.

TOOLS USED IN SHEET METAL

Marking Tools

i. **Steel Rule:** Available in different sizes, it could be steel foot rule, folding rule or tape rule.

ii. **Steel Square:** It is L-shaped piece of hardened steel, used to make square corners, checking and making right angles.

iii. **Scriber:** It is a steel wire with one end sharp and hardened to mark lines on metallic sheet.

iv. **Divider:** It is used to scribe arcs and circles on metallic sheets.

v. **Trammel points:** It is used for drawing large circles and arcs

vi. **Punches:**

(a) Prick Punch: Used for making indentation marks for locating center position for dividers, it has a taper angle of 30º.

(b) Centre Punch: Used for marking the location of points and centering hole to be drilled. it has a taper angle of 90º.

Cutting Tools

i. Straight Snips: It is used to cut 22 SWG or lighter sheets along a straight line. Its blades are straight,

ii. Bent snip: It is used to cut discs and round articles from sheets. Blades are curved back from the cutting edges.

iii. Hollow Punch: Hollow punch is used to cut circular holes on thin sheets.

iv. Chisels: This is used for cutting sheets, rivets and bolts.

Striking Tools

Hammers: Hammers are used for bending of sheets, smothering of sheets, locking of joints and riveting work.

i. Ball peen hammer : General purpose, face is slightly curved, and head is round.
ii. Square face hammer : It has square flat face, used for flattening of seams
iii. Raising hammer : It is used to form flat surface of sheet into curved surface.
iv. Riveting hammer : Face is square slightly curved with beveled edges.
v. Mallet : Made of good quality of wood used whenever light force is required.

Supporting Tools

Stakes – Stakes are used to support sheets in bending, seaming, forming, riveting, punching etc. Some commonly used stakes are:

(a) Hand stake: It is handy with flat face, two straight edges one concave edge, other convex edge, used for pressing the inner sides of straight joint.
(b) Half Round stake: It is used for pressing round seam joint on inner side.
(c) Taper stake: It is used for rounding of tapering jobs such as conical jobs.
(d) Grooving stake: It is made up of forged steel, used for grooves of different sizes.
(e) Horse stake: There are two square holes for holding two stakes at a time for carrying out different operations.

Sheet Metal Working Machines

1. **Rolling & Bending Machine:** This machine is used to form cylindrically shaped articles;. The machine consists of three rollers that can be adjusted for different radii.
2. **Sheet Bending Machine:** This is used for bending and folding the edges of sheet metal.
3. **Swaging Machine:** It is used to provide different types of swages to give strength to thin sheets.
4. **Lever shearing machine:** It is used for sheet cutting, round bar shearing mostly used in sheet metal shop.
5. **Universal Cutting machine:** It is used for cutting sheet into desired shape & size. Machine has two circular tools used for circle cutting.
6. **Grooving machine:** It is used to make grooves; depth of groove can be adjusted.

Sheet Metal Joints

1. **Lap Joint** – It can be prepared by means of soldering or riveting.
2. **Seam Joint** – When two or more sheets are folded and fastened together is called seam joint. There are two types of seam joints.
   i) Single Seam Joint
   ii) Double Seam Joint
3. **Groove Seam Joint** – In this joint two single edges are hooked together and flattened with a small mallet to make them tight, seam is then grooved with a hammer and a hand groover.
4. **Wired Edge** – It is one of the methods of strengthening the thin metal by turning over the edge on a wire in it.
5. **Hinged Joint** – It is used for easy movement of opening or closing doors, window etc.
6. **Cap Joint** – It provides another useful form of locked seam joint.
7. **Hem Joint-** This is turning over the edge of the sheet to give the strengthening on the edge of the sheet.

SHEET METAL OPERATIONS

1. **Measuring and Marking –** Sizes are marked on large sheet to cut into small pieces.
2. **Development of Surface (Laying Out) –** Operation of scribing the development of surface of the component on the sheet together with the added allowance for overlapping, bending, hammering etc.
3. **Cutting and shearing –** The term shearing stands for cutting of sheet metal by two parallel cutting edges moving in opposite direction.
4. **Hand Forming –** It stands for shaping, bending of sheet metal in three dimensions in order to give the desired shape and size of final product.
5. **Nibbling –** It is a process of continuous cutting along a contour which may be of straight or irregular profile.
6. **Piercing and Blanking –** Piercing is basically a hole punching operation while blanking is an operation of cutting out a blank.

7. **Edge Forming or Wiring –** Edges of sheet metal products are folded to provide stiffness to the products and to ensure safety of hand due to sharp edges.
8. **Joint Making –** Sheet metal parts can be joined by folded joints, riveting, welding, brazing, soldering, self-tapping screws, screwed fastening, and by adhesives.
9. **Bending –S**heet metal is bent at different angles to shape it to required form.
10. **Circle Cutting –** It is an operation of cutting circular blanks or curved contours with the help of circular cutting machines.
11. **Hollowing –** It is the process whereby a flat sheet metal is beaten up into spherical shape by placing the metal upon a sand bag or hollowing block, beating with hollowing hammer, starting from boundaries towards center.
12. **Raising –** It is the process of hammering the metal from outside to form a hollow article, working around from center towards edge.
13. **Turned over Edge –** It is the method of strengthening the thin metal at edge. The edges are turned with some radius.
14. **Swaging –** This is also a method of strengthening thin sheet metal by making impressions in the bodies. It is done by machine or by hand.

SOLDERING

Soldering is a process of joining two metals by using low temperature below 400° C by metal alloy called solder (alloy of lead + tin)

Process: Surface to be joined are cleaned and placed on each other, flux is applied to prevent oxidation. Zinc chloride is commonly used as a flux. Soldering iron is heated either electrically or by some external heat. Then hot end is dipped into the flux and solder is pressed against the surfaces to be joined. Melted solder forms the joint.

Applications: Soldering is widely used in electronic, radio and television work for joining wires etc.

Advantages: Cost is low, equipment is very simple and cheap, provides positive electrical connection and properties of base metal are not affected.

Disadvantages: Joints formed are weak.

BRAZING

The process of joining two metal surfaces by heating and adding a non-ferrous alloy Brazing Spelter (Copper + Zinc) with melting point above 400° C is known as Brazing.

Process: Surface to be joined are cleaned and placed in joining position. Flux Borax is sprinkled between the joining pieces. The heat is given to the surface and the filler metal. The molten filler metal flows to the surface to be joined.

Brazing Methods:

i. Gas Torched Brazing: In this process oxygen – acetylene torch is used.

ii. Furnace Brazing: The surfaces to be joined are placed in a furnace already hot.

iii. Dip Brazing: The surfaces to be joined are dipped in molten filler metal.

iv. Electrical Brazing: In electrical brazing heat is produced by resistance or induction method.

Applications: Brazing is used for electrical items, radiators, heat exchangers, pipes fitting, and tool tips.

Advantages: It is useful for joining dissimilar metals, less skilled is required, cost of operation is less, good finish is obtained, and thin section can be easily joined.

Disadvantages: Low strength, not applicable for hardened steel and aluminum alloys.

DEVELOPMENT OF SURFACES OF OBJECTS

A layout of the complete surfaces of a three dimensional object on a plane is called the development of pattern. Development is the term frequently used in sheet metal work where it means the unfolding or unrolling of a detail into a flat sheet called pattern.

Practically, the development consists of drawing the successive surfaces of the object in its true shape and size with common edges joined together.

Methods of pattern development

There are three methods by which surface of solids may be geometrically developed.

(i) **Radial Line Method**: - a radial line method is used for those objects such as cones and pyramids, the sides of which converge to an apex.

(ii) **Parallel Line Method**: - This method can be applied for development of pattern for elbows, T-pipes intersection of pipes of equal diameter, cylindrical articles.

(iii) **Triangulation Method**: - This method is universally applied to solve a large number of developments, problems. This system consists in drawing an elevation and plan of the object to be developed, dividing the surface of the plan into a suitable number of triangles, finding the true lengths of the triangle sides and building a pattern triangles in their correct relation to the triangles already shown in the plan.

Theory for Development of Surface of a Cone by Radial Line Method

Procedure:

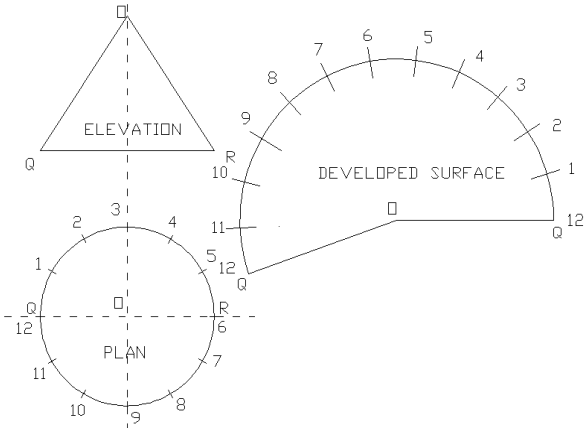
i. Draw the elevation OQR and plan of the cone.

ii. With OR equal to slant height as a radius describe a long arc QQ.

iii. Divide the plan of the cone into any number of equal parts (say 12) as points 1, 2, 3 … 12.

iv. From Q mark of along arc QQ 12 equal parts, each equal to one of the division of the circle in the plan.

v. Join the 12th point to the center point O. OQQ will be the required development of the cone.



FURTHER LINKS

- ✓ For more details refer the books listed in the Lab course handouts
- ✓ Discussion forum with instructors and/or teacher

PRECAUTIONS AND DO'S & DON'TS

In sheet metal shop we work with sharp tools/ job following precautions shall be observed while working in sheet metal shop

1. Be careful when working on sharp edges to avoid injury.
2. Do not use any tools whose edges are blunt or out of order.
3. Never touch moving parts, belts, rotating tools etc.
4. Appropriate cutting tools and machines must be used for cutting tin sheets.
5. Do not cut metal heavier than the capacity of snips or shears.
6. Do not place the hot soldering iron on any wooden surface; keep it on its stand.
7. Save your hands while working on sheet bending or sheet rolling machines.
8. While using a chisel for chipping wear goggles.
9. Do not hold small work in your hand while working with screw drivers or chisels.
10. Extra allowance must be provided in the sheets while cutting so that furnished product is of correct size.

Job No. 1

1. **Objective:** To make a funnel using G.I Sheet as per dimensions provided.
2. **Tools & Equipment:** Steel rule, compass, pencil, eraser straight snip, bent snip, mallet, hammer files, stakes, spring divider, bench vice, pliers, scriber soldering iron, solder, flux.
3. **Materials used**: Galvanized iron sheet 28 SWG.
4. **Drawing:** See Diagrams
5. **Procedure:**

Ex I: Body of Funnel

i. Draw the pattern of body of funnel on a drawing sheet as per dimension by Radial line method as shown in diagram
ii. Mark the allowance for flange and lock seam joint.
iii. Cut the pattern from drawing sheet with sharp blade
iv. Keep the cut out pattern on G.I sheet and mark all around with scriber without moving the pattern.
v. Cut the sheet on the marked line with a suitable snip,
vi. Remove the burrs with a smooth file.
vii. Make closed folds on both ends for lock seam joint
viii. Fold the sheet to the shape of body of funnel on funnel stake and lock the seam joint
ix. Flange out top edge of body of funnel as per diagram.

Ex II: Bottom piece of Funnel

i. Draw the pattern for bottom of funnel by triangulation method on drawing sheet.
ii. Mark the allowance for soft soldering Lap joint.
iii. Cut the pattern from drawing sheet.
iv. Keep the cut out pattern on G.I sheet and mark all around with a scriber without moving the pattern.
v. Cut the sheet on the marked line with suitable snip
vi. Remove burrs with a smooth file.
vii. Form the sheet to required shape.
viii. Soft solder the over lap joint.

ix. Join the bottom piece to the body of funnel by soft soldering.

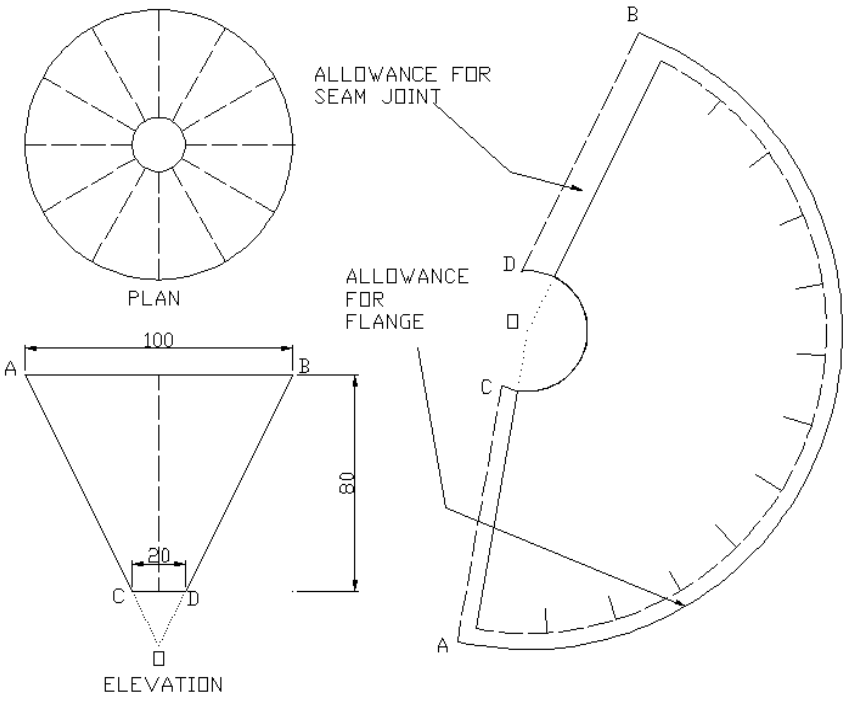
Development of Round Funnel (Frustrum of a Cone)

Procedure:

A round equally tapering body having top and base parallel is Frustums of a right cone. Draw the elevation and plan of Frustums of the cone as shown in figure. Produce the edge line AC & BD to an apex marked O. Divide the outer circle of the plan in equal number of parts (i.e. 12).

For the development mark a point O in a suitable position and with radius OA from the elevation describe arc of indefinite length. Take one of the spacing of the outer circle of the plan and divide the arc into twelve equal parts. Draw another arc of O as centre taking radius equal to OD. Join OB and OA. ABCD is the required development of frustums of a cone.

For the development mark a point O in a suitable position and with radius OA from the elevation describe arc of indefinite length. Take one of the spacing of the



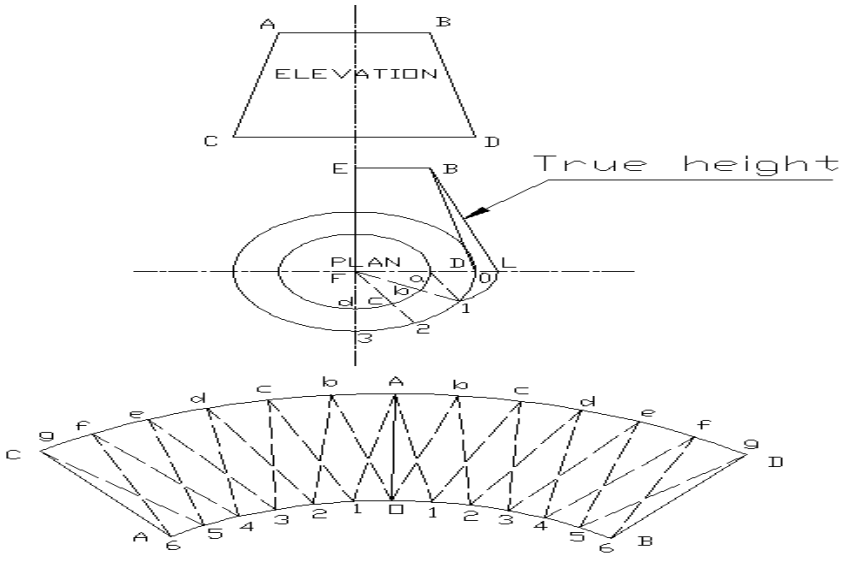
Development of a long equal taper Article (bottom of Funnel)

Procedure:

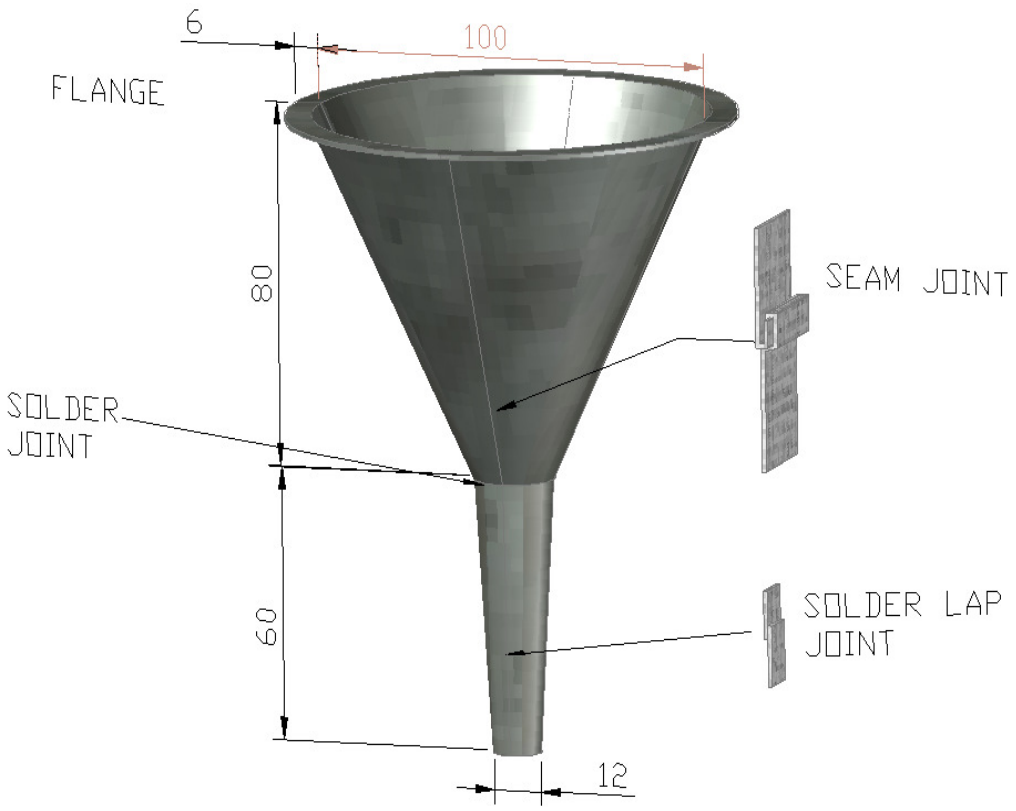
Draw the elevation ABCD and plan of the round equal tapering body. Divide the outer Circle in the plan to number of equal Parts 0,1,2,3 … and a, b, c, d ….. Find the true length BL taking a1 (aL) as base and vertical height aB at right angles.

To set out the development draw any line OA equal to slant height BD. A as a centre taking radius equal to any one of the division of the outer Circle, draw an arc on either side of A. Now O as a centre and take radius equal to any one of the divisions of small circle, draw arcs on either side of O. now A as a centre, taking radius equal to true height BL, cut previous arcs either sides of O. Now, O as a centre taking the same true height radius cut previous arcs in either side of A. Now again from the new formed points (1, 1 b, b) again form the points (2, 2 c, c) by repeating the same method. Continue this up to six parts on either side of the central line OA. Join the last points g6 on both sides. ABCD is the required pattern of round taper article. Take allowance on either side for lock seam joint

Development of long equal Taper article



TO MAKE A FUNNEL

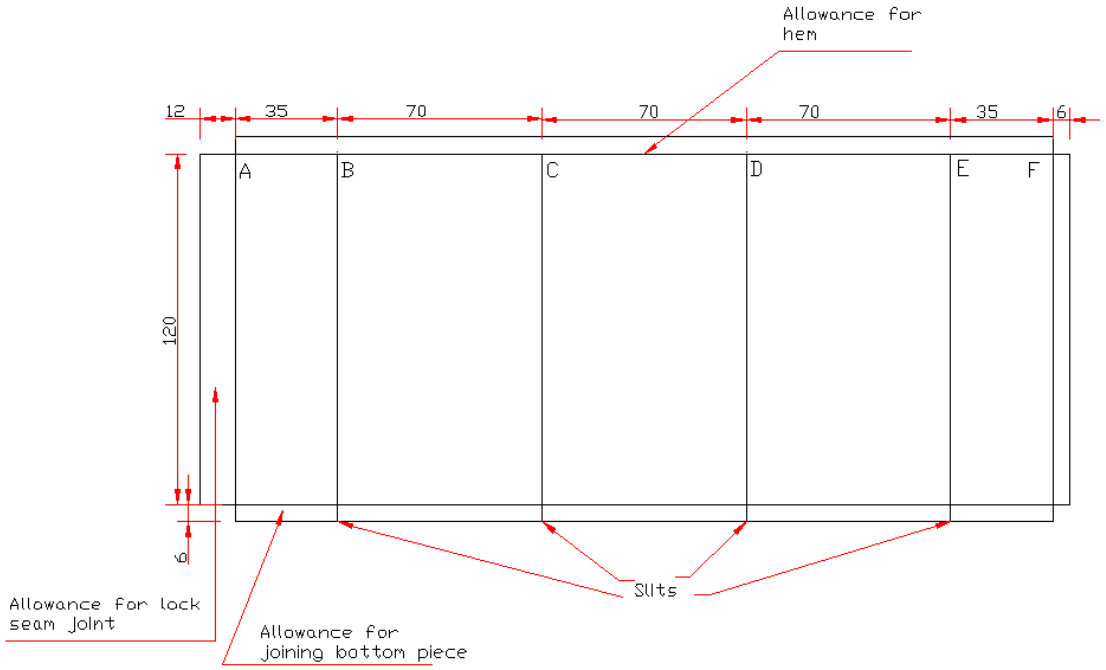


All dimensions are in mm
Material : G.I. Sheet 28 SWG

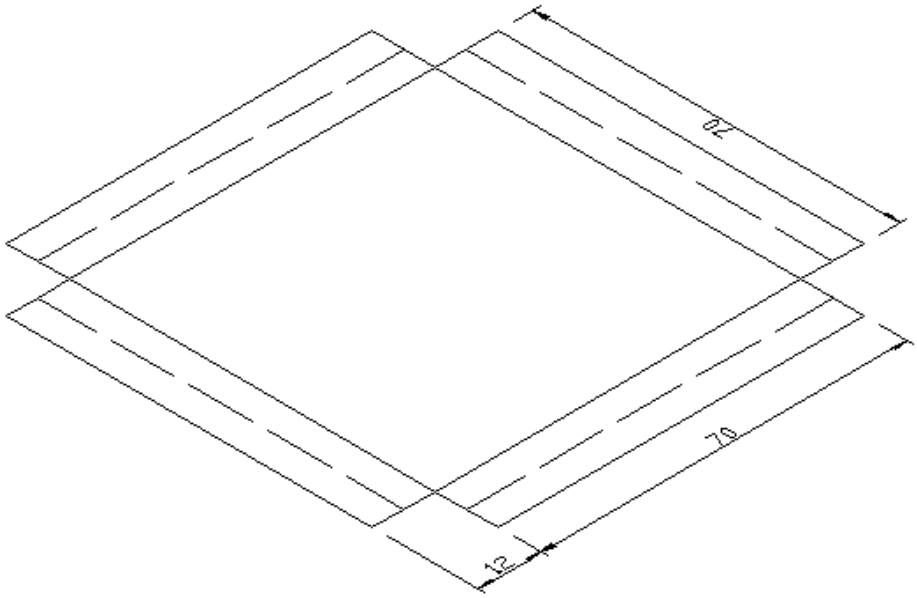
Job No. 2

1. **Objective:** To make a Square box using G.I Sheet as per the dimension
2. **Tools & Equipment:** Straight snip, steel rule, scriber, Mallet, Hammer, Stakes, pliers, soldering iron, solder, flux, bench vice, file, spring divider.
3. **Materials used:** Galvanized iron sheet 28 SWG.
4. **Drawing:** See Diagrams
5. **Procedure:**
   - i. Draw a lay out as shown in development on drawing sheet.
   - ii. Cut the pattern to shape along the line using a suitable snip.
   - iii. Mark on the G.I Sheet as per the pattern and cut to required shape.
   - iv. Make the hem edge using mallet and stake.
   - v. Make closed folds on both ends for lock seam joint
   - vi. Make square folds on lines marked A, B, C, D, E, & F
   - vii. Make lock seam joint after joining both the ends.
   - viii. Make a bottom piece from G.I Sheet taking required allowance for double lock seam joints as shown in diagram.
   - ix. Join the bottom piece with square box by double lock seam joint using stakes and mallet.
   - x. Do the soft soldering operation on the corners of double lock seam joints.
   - xi. File all the sharp corners with file.

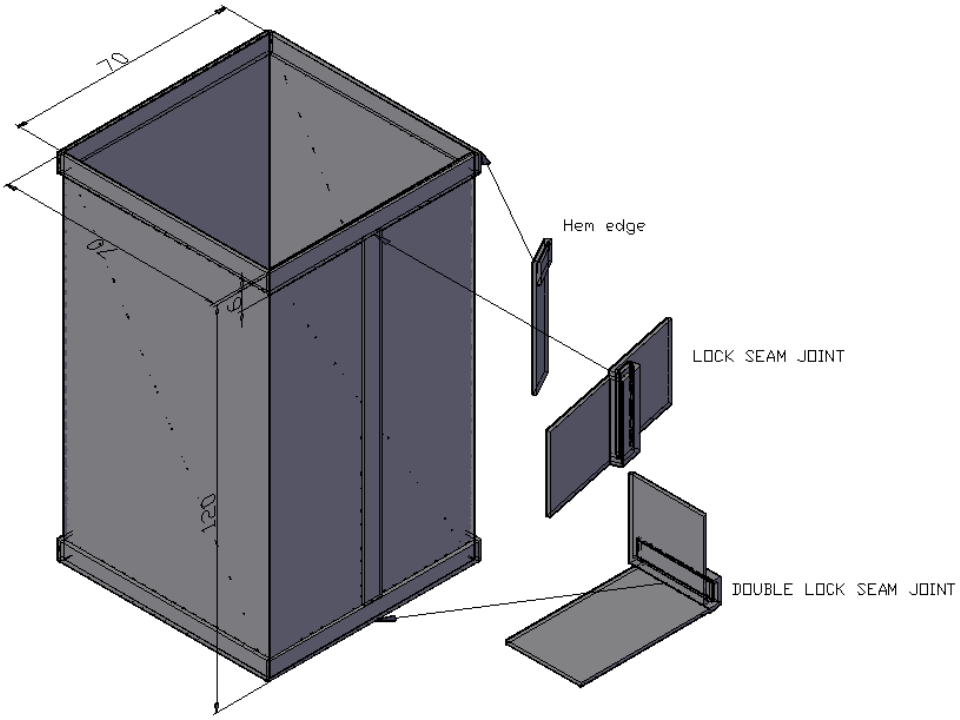
Development for square box



Bottom



To make a square box



All Dimensions are in mm.

Material: G.I Sheet 28 SWG.

Job No. 3

1. **Objective**: To make a rectangular tray.
2. **Tools and materials:** Steel rule, Scriber, Divider, Mallet, Stakes, Try square, snip straight (Tin cutter) Bench shear, file flat smooth, Nylon hammer, Tin sheet piece.
3. **Materials used:** Galvanized iron sheet 28 SWG.
4. **Drawing:** See Diagrams
5. **Procedure:**

i. For developing the surfaces (lying out) draw plan, front view and end view of the required open rectangular box as shown is diagram.

ii. Extend all the lines and cut these lines according to the height of the tray (i.e. 30 mm).

iii. Addition strips of stocks are given along the edges for single hem allowance (6 mm).

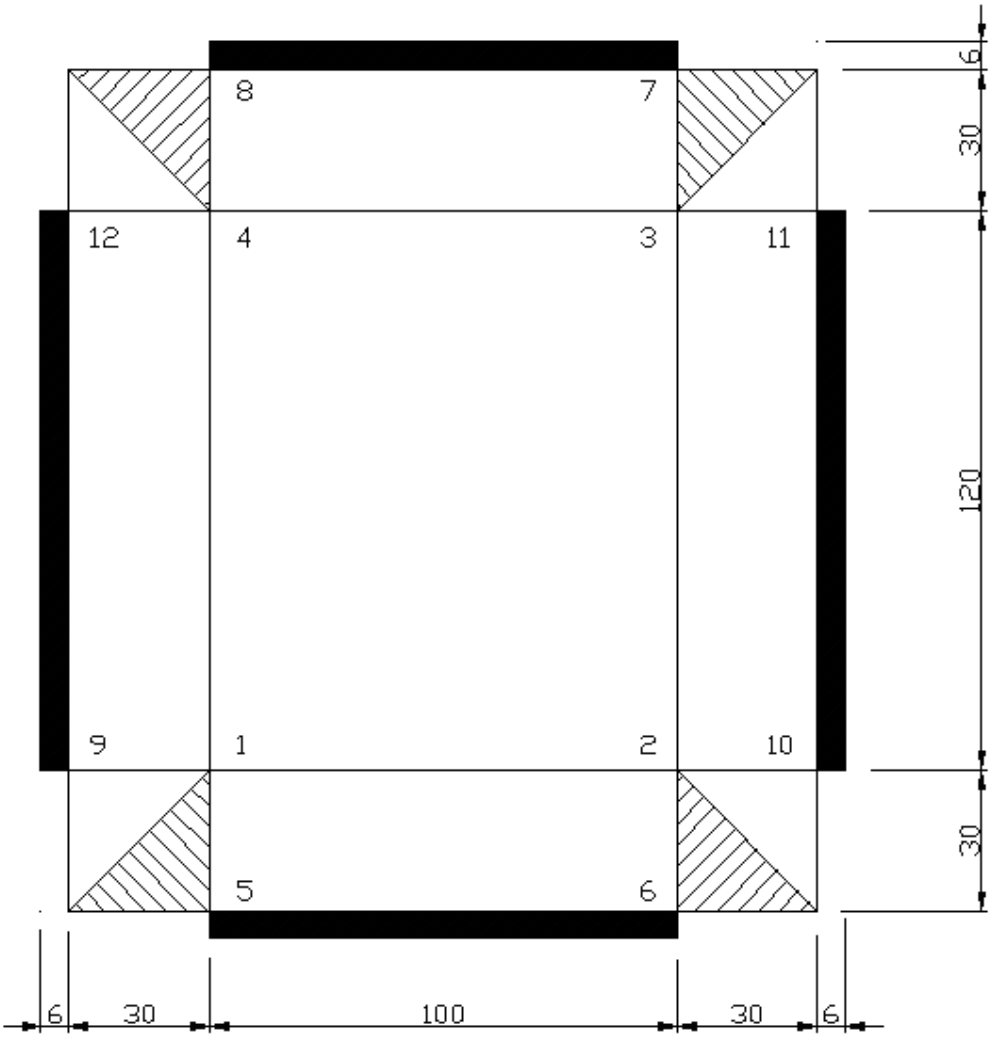
iv. All the four corner triangles are cut as shown in diagram for joint making.

v. Perform the operation of cuttings, shearing edges, hand forming, edge forming, joint making and bending in to rectangular tray by using above mentioned sheet metal tools by.

   a. Square folding along 12, 23, 34, 41 lines.
   b. Square folding of 15, 26, 37, 48, 2-10, 3-11, 19, 4-12,
   c. Square fold for Hem 56, 78, 10, 11, 9-12.

vi. File the sharp edges with a smooth flat file.

Development of Surfaces (Tray)

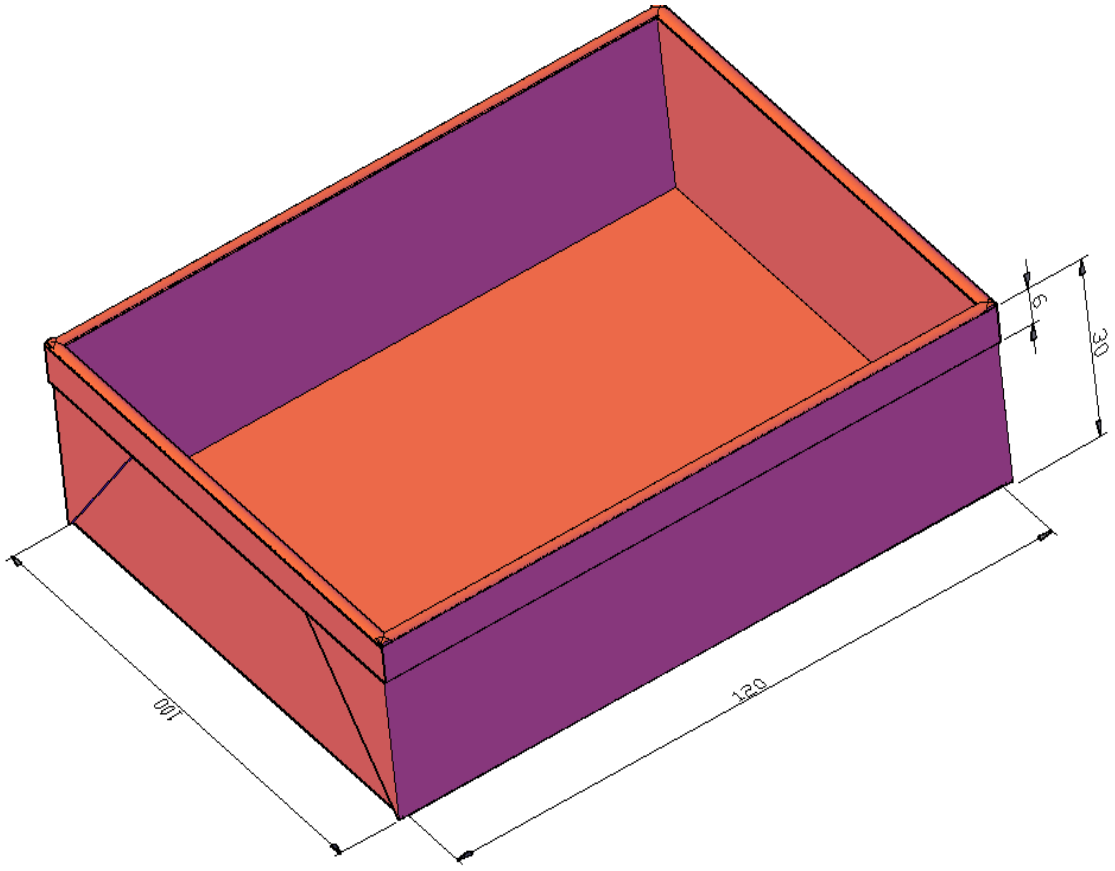


Black portion is to be bend (hem edge).

Hatched portion is to be cut out.

All Dimensions are in mm

To make a Rectangular Tray.



MATERIAL: GI SHEET 28 SWG

ALL DIMENSIONS ARE IN mm.

Job No. 4

1. **Objective:** To make a Book Rake Stand
2. **Tools & Equipment:** Steel Rule, Scriber, Divider, Centre Punch, Chisel, hammer, stakes, Try squre, Leaver, Shearing machine
3. **Material used:** Mild Steel sheet 18 SWG 18×14 cms
4. **Drawing:** See diagram.
5. **Procedure:**

   i. Mark and shear a piece of 18×14 cms M. S sheet with the help of lever shearing machine, check for Squareness with try square.

   ii. Mark two corner edges at diagonals of 20 cm and at base mark a line 50 mm from the edge with scriber and steel rule

   iii. Mark lines on all the three sides of 40 cm distance with scriber and an arc of 30 cm with divider as shown in diagram

   iv. Shear the 20 cm diagonal edges and cut the inner marking piece with the help of chisel hammer

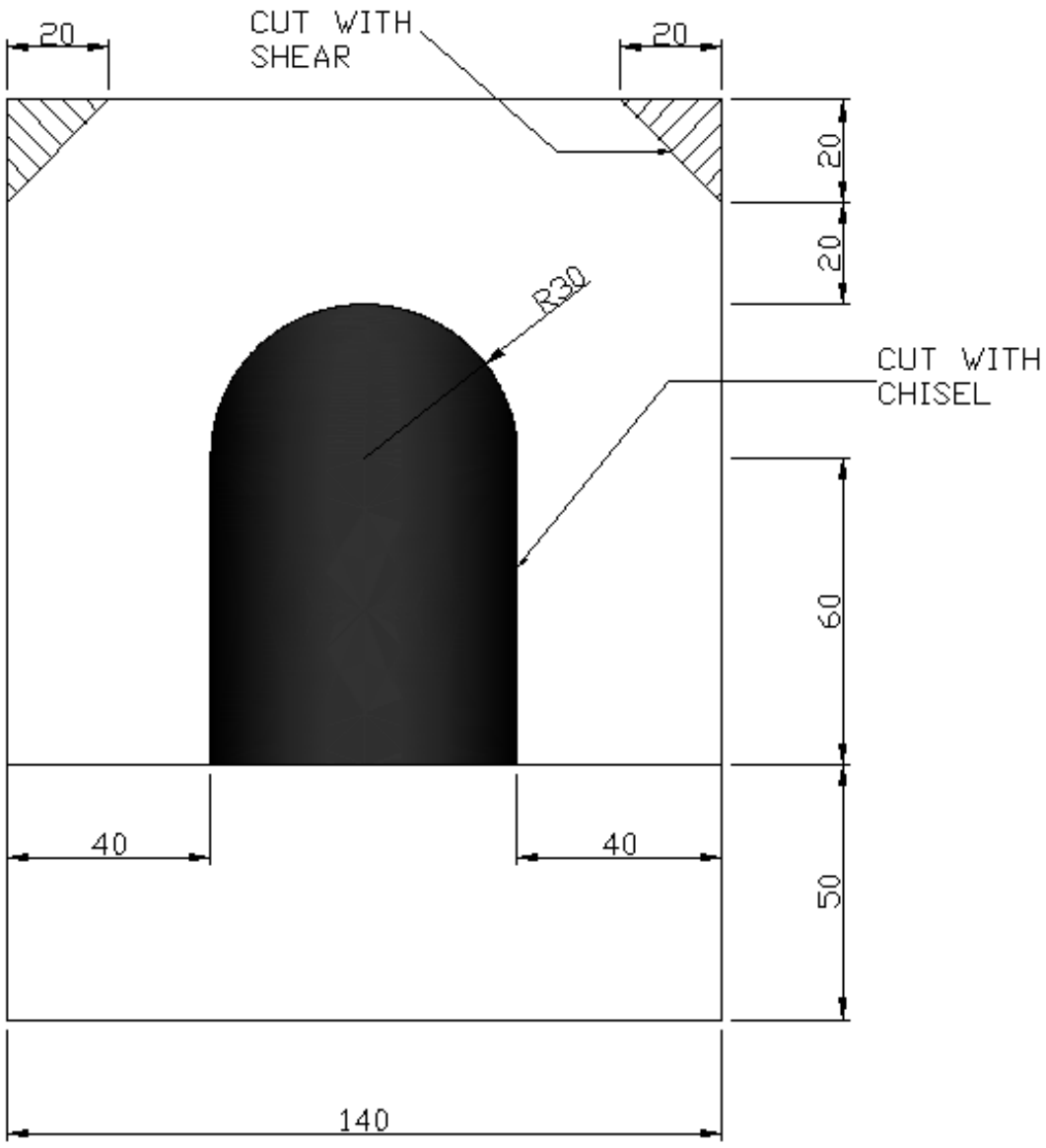
   v. Clamp the sheet in bench vice and bend the inner cut out portion by hammer at 90º

   vi. File the inner cut and portion and the blanking with half round and steel file

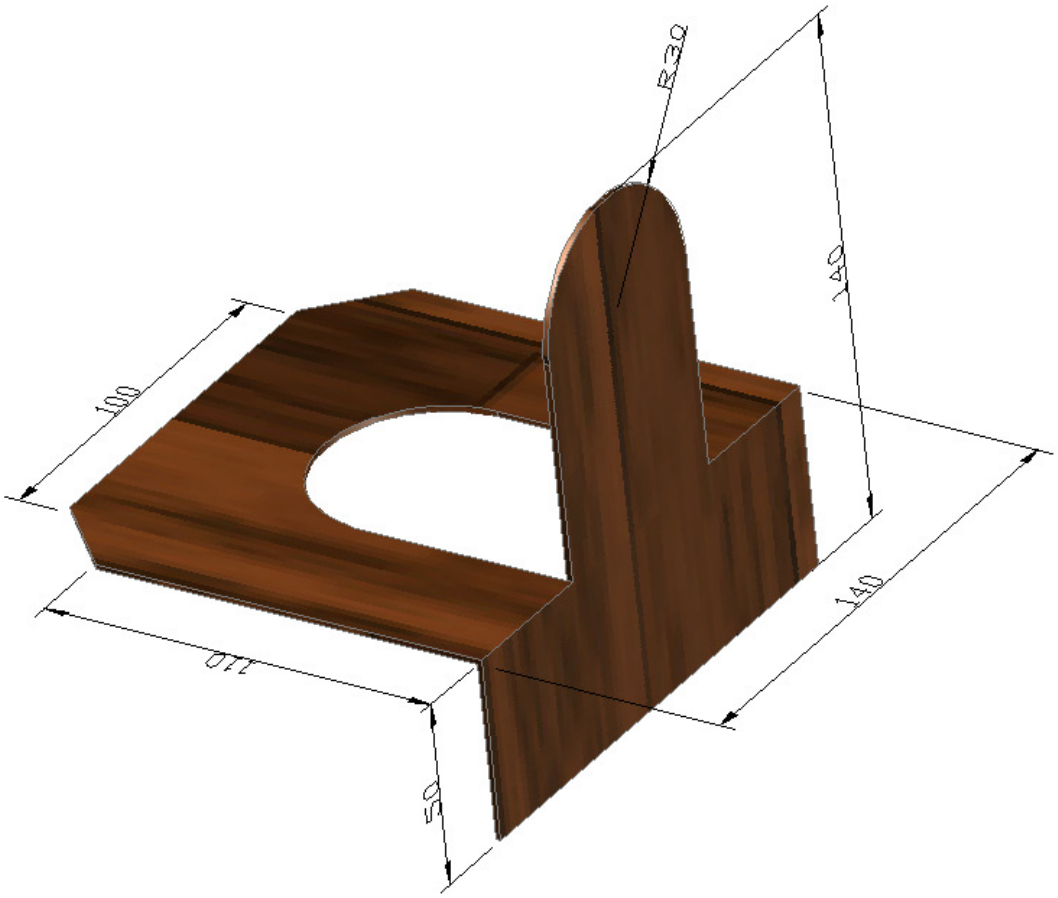
   vii. Bend the 50 cm mark portion to opposite side at 90º as shown in diagram

   viii. Finish the job from sharp edges with a smooth file

DEVELOPMENT OF BOOK RACK STAND



BOOK RACK STAND



ALL DIMENSIONS ARE IN MM

MATERIAL: - MS SHEET 18 SWG

Job No. 5

1. **Objective:** To make a Dust Pan using G.I Sheet as per dimensions provided.
2. **Tools & Equipment:** Steel rule, compass, pencil, eraser straight snip, bent snip, mallet, hammer files, stakes, spring divider, bench vice, pliers, scriber soldering iron, solder, flux.
3. **Materials used**: Galvanized iron sheet 28 SWG.
4. **Drawing:** See Diagrams
5. **Procedure:**
   i. Draw a lay out as shown in development on drawing sheet.
   ii. Cut the pattern to shape along the line using a suitable snip.
   iii. Mark on the G.I Sheet as per the pattern and cut to required shape.
   iv. Make the hem edge using mallet and stake.
   v. Make closed folds on both ends for lock seam joint
   vi. Make square folds on lines marked A, B, C, D, E, & F
   vii. Make lock seam joint after joining both the ends.
   viii. Make a bottom piece from G.I Sheet taking required allowance for double lock seam joints as shown in diagram.
   ix. Join the bottom piece with square box by double lock seam joint using stakes and mallet.
   x. Do the soft soldering operation on the corners of double lock seam joints.
   File all the sharp corners

July 19, 1932. R. W. TYSICK 1,868,297

DUSTPAN

Filed Aug. 11, 1930

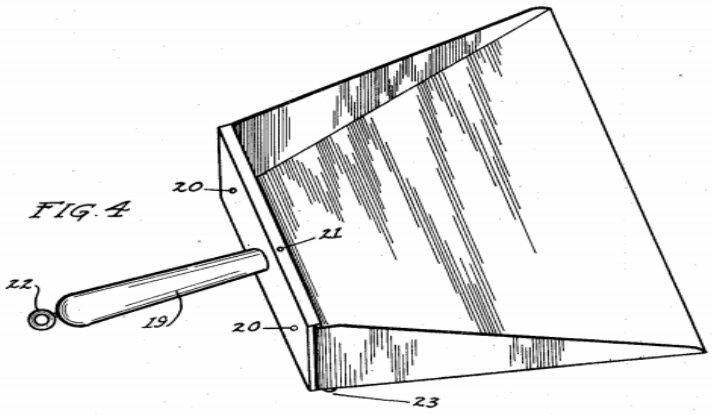


FIG. 4

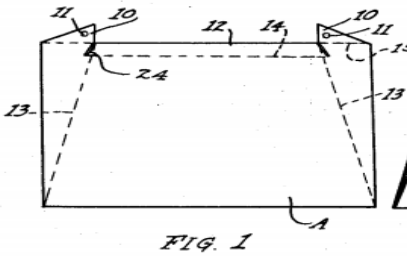


FIG. 1

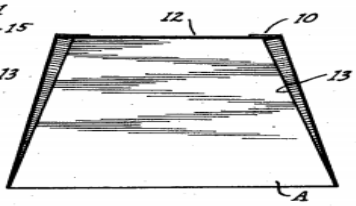


FIG. 2

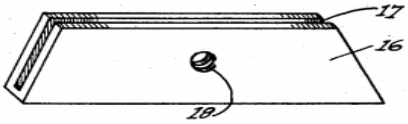


FIG. 3

INVENTOR :-
Robert W. Tysick
BY- J. T. Rickard
ATTORNEY.

Manufacturing Practices

Computer Hardware Shop

LIST OF PRACTICALS

EXPERIMENT: 1

AIM: To describe various components of computer hardware.

PURPOSE: Assembling and Disassembling of PC to get knowledge about the computer hardware.

REQUIREMENTS: Few tools required for assembling and disassembling of PC.

1. A screwdriver.
2. A flathead screwdriver.
3. Needle nose pliers, for one particular motherboard mounting screw and in case we drop something in a hard to reach place.
4. A 5mm socket wrench, which is the size needed for the motherboard mounting posts that came with the Antec KS-282 case.
5. A flashlight can sometimes come in handy when we're trying to make out something on an item we've already installed, but I doubt we'll really need it.
6. Alcohol 99% pure or Acetone, if we'll be removing the pre-applied thermal compound from the CPU cooler to use the Arctic Silver 3 instead. If so then we'll also need a clean, expired credit card (for scraping), a brand new toothbrush (for scrubbing) and lint free cloths (for wiping and rubbing) to remove the pre-applied thermal compound.

DESCRIPTION:

Hardware refers to the physical elements of a computer also referred to as the machinery or the equipment of the computer. Examples of hardware in a computer are the keyboard, the monitor, the mouse and the processing unit. However, most of a computer's hardware cannot be seen; in other words, it is not an external element of the computer, but rather an internal one, surrounded by the computer's casing. A computer's hardware is comprised of many different parts, but perhaps the most important of these is the motherboard. The motherboard is made up of even more parts that power and control the computer.

In contrast to software, hardware is a physical entity, while software is a non-physical entity. Hardware and software are interconnected, without software, the hardware of a computer would have no function. However, without the creation of hardware to perform tasks directed by software via the central processing unit (box), software would be useless.

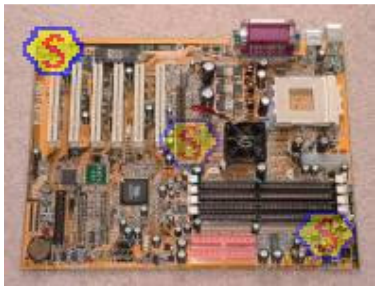
a. MotherBoard

The Computer Case and Power Supply

The Antec KS-282 case. The computer case frequently ships in its own box, as shown here. Inside the case it is the power cord that attaches to the power supply and a small, brown card box that contains parts used to mount the motherboard inside the case.


The Motherboard

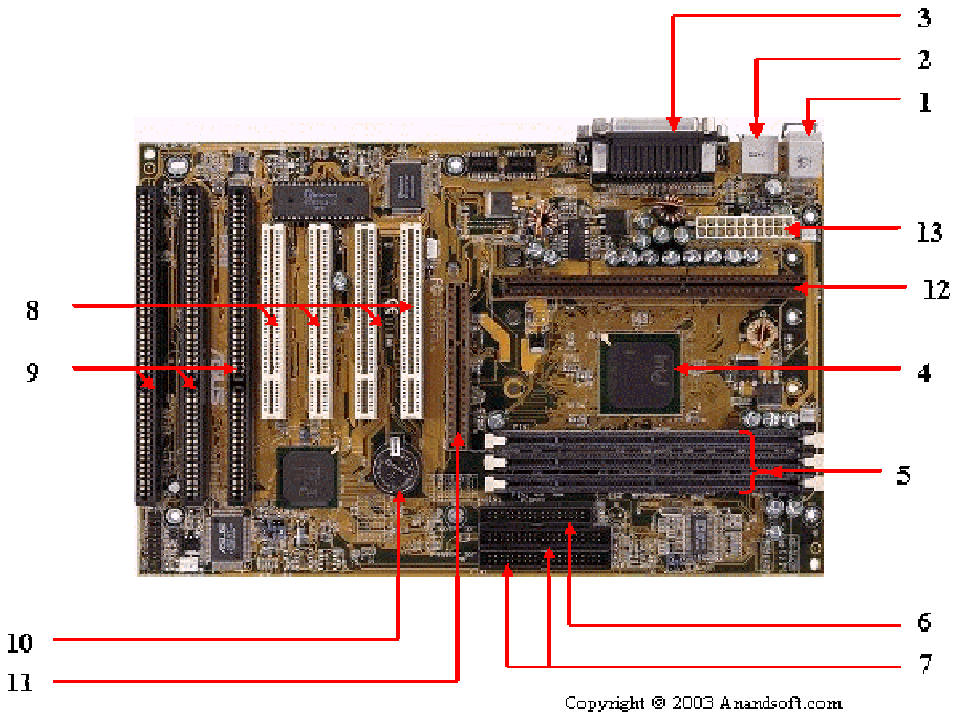
The ABIT KR7A retail box includes one IDE cable suitable for up to an Ultra ATA/133 hard drive and the ribbon cable for the floppy drive. The CD includes the motherboard chipset drivers and utilities, such as a Hardware Doctor which shows the temperatures of the processor and system.

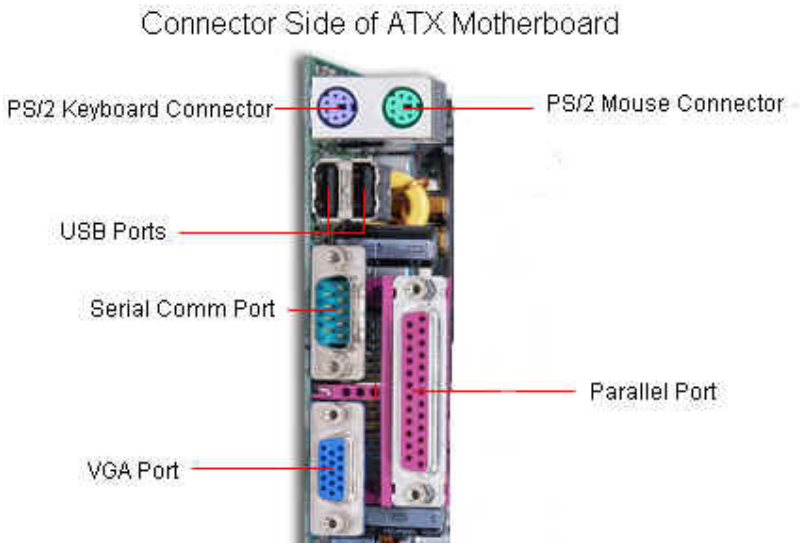


There are primarily two types of motherboards, AT motherboard, and ATX motherboard. AT motherboards are older, and not commonly used now a days. The AT and ATX motherboards differ in the form factor. Full AT is 12" wide x 13.8" deep, and Baby AT is 8.57" wide x 13.04" deep. Full-ATX is 12" wide x 9.6" deep and Mini-ATX is 11.2" wide x 8.2" deep. Other major differences include power supply connector, and keyboard connector. AT has 5-pin large keyboard connector, where as ATX has 6-pin mini connector. Similarly, AT has single row two connectors +/-5V, and +/-

12V, whereas ATX motherboard has double row single connector providing +/-5V, +/-12V, and +3.3V.

A typical ATX PC motherboard with constituent components is given below:



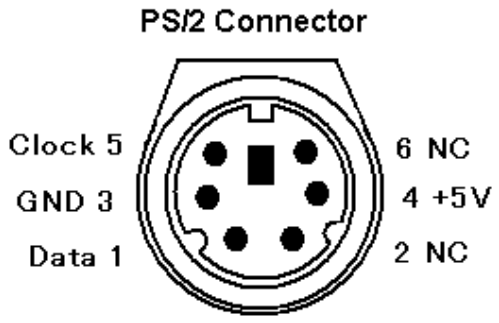


The important constituent components of an ATX Motherboard are given below:

Mouse & keyboard

1. USB
2. Parallel port
3. CPU Chip
4. RAM slots
5. Floppy controller
6. IDE controller
7. PCI slot
8. ISA slot
9. CMOS Battery
10. AGP slot
11. CPU slot
12. Power supply plug in

1. Mouse & keyboard: Keyboard Connectors are basically of two types. All PCs have a Key board port connected directly to the motherboard. The oldest, but still quite common type, is a special DIN, and most PCs until recently retained this style connector. The AT-style keyboard connector is quickly disappearing, being replaced by the smaller mini DIN PS/2-style keyboard connector.



We can use an AT-style keyboard with a PS/2-style socket (or the other way around) by using a converter. Although the AT connector is unique in PCs, the PS/2-style mini-DIN is also used in more modern PCs for the mouse. Fortunately , most PCs that use the mini-DIN for both the keyboard and mouse clearly mark each mini-DIN socket as to its correct use. Some keyboards have

a USB connection, but these are fairly rare compared to the PS/2 connection keyboards.

2.USB(Universal serialbus):

USB is the General-purpose connection for PC. We can find USB versions of many different devices, such as mice, keyboards, scanners, cameras, and even printers. a USB connector's distinctive rectangular shape makes it easily recognizable.

USB has a number of features that makes it particularly popular on PCs. First, USB devices are hot swappable. We can insert or remove them without restarting the system.

3. Parallel port: Most printers use a special connector called a parallel port. Parallel port carry data on more than one wire, as opposed to the serial port, which uses only one wire. Parallel ports use a 25-pin female DB connector. Parallel ports are directly supported by the motherboard through a direct connection or through a dangle.

4. CPU Chip : The *central processing unit,* also called the *microprocessor* performs all the calculations that take place inside a pc. CPUs come in Variety of shapes and sizes. Modern CPUs generate a lot of heat and thus require a cooling fan or heat sink. The cooling device (such as a cooling fan) is removable, although some CPU manufactures sell the CPU with a fan permanently attached.

5. RAM slots: Random-Access Memory (RAM) stores programs and data currently being used by the CPU. RAM is measured in units called bytes. RAM has been packaged in many different ways. The most current package is called a 168-pin DIMM (Dual Inline Memory module).

6. Floppy controller: The floppy drive connects to the computer via a 34-pin *ribbon cable,* which in turn connects to the motherboard. A *floppy controller* is one that is used to control the floppy drive.

7. IDE controller: Industry standards define two common types of hard drives: EIDE and SCSI. Majority of the PCs use EIDE drives. SCSI drives show up in high end PCs such as network servers or graphical workstations. The EIDE drive connects to the hard drive via a 2-inch-wide, 40-pin ribbon cable, which in turn connects to the motherboard. *IDE controller* is responsible for controlling the hard drive.

8. PCI slot: Intel introduced the *Peripheral component interconnect* bus protocol. The PCI bus is used to connect I/O devices (such as NIC or RAID controllers) to the main logic of the computer. PCI bus has replaced the ISA bus.

9. ISA slot: (Industry Standard Architecture) It is the standard architecture of the Expansion bus. Motherboard may contain some slots to connect ISA compatible cards.

10. CMOS Battery: To provide CMOS with the power when the computer is turned off all motherboards comes with a battery. These batteries mount on the motherboard in one of three ways: the obsolete external battery, the most common onboard battery, and built-in battery.

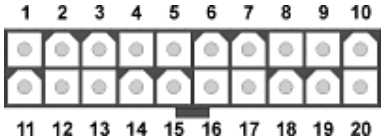
11. AGP slot: If we have a modern motherboard, we will almost certainly notice a single connector that looks like a PCI slot, but is slightly shorter and usually brown. We also probably have a video card inserted into this slot. This is an *Advanced Graphics Port (AGP)* slot

12. CPU slot: To install the CPU, just slide it straight down into the slot. Special notches in the slot make it impossible to install them incorrectly. So remember if it does not go easily, it is probably not correct. Be sure to plug in the CPU fan's power.

13. Power supply plug in:

The Power supply, as its name implies, provides the necessary electrical power to make the pc operate. the power supply takes standard 110-V AC power and converts into +/-12-Volt, +/-5-Volt, and 3.3-Volt DC power.

The power supply connector has 20-pins, and the connector can go in only one direction.



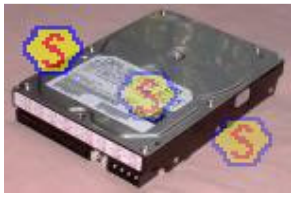
The Processor, CPU Cooler and Thermal Compound

The AMD Athlon XP 1800+ processor. This is the "sweet spot" speed at the time. The AMD Athlon XP 2200+ was just out, but not worth the extra bucks. Typical OEM packaging is like this. Bubble wrap surrounding the processor enclosed an antistatic bag. The processor is inserted into a small foam square to protect the prongs.

It's important that the CPU Cooler provide enough cooling capacity for the processor, but it's also a consideration as to how much noise it makes. The CPU Cooler is perhaps the primary noise factor component.

The Hard Drive

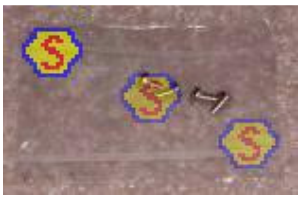
The hard drive is the IBM Deskstar 120GXP 80GB hard drive, OEM version. It's an amazingly quiet and fast hard drive. The OEM version does not include mounting brackets It also does not include mounting screws, which are needed, and can be obtained from Radio shock.

The CD-ROM

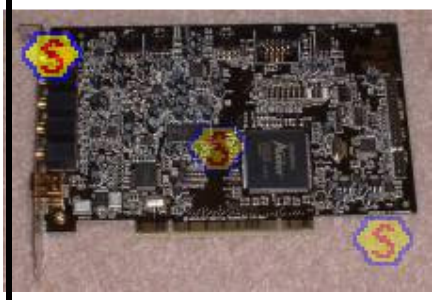
The speed of the CD-ROM drive is not that big a concern, but with a Lite-On drive we can be sure we're getting what we paid for.
Here are front and rear shots of the CD-ROM, plus a picture of the mounting screws for the CD-ROM. Since this is the retail box version of the CD-ROM, it comes with the mounting screws.





The Sound Card and Speakers

The Creative Sound Blaster Audigy can be purchased as either the gamer version or MP3+ version. The hardware is the same in both cases, but the included software bundle is different. The Creative Sound Blaster Audigy line throws in FireWire support along with the sound. Quite a little bonus, that is. The card provides so many connections that a second PCI slot cover, but not the PCI slot itself, is required to use them all. The second PCI slot cover provides a single connection and it's for a joystick.



The Creative Cambridge SoundWorks PCWorks speaker system includes two satellite speakers and a sub-woofer. The sound quality is amazingly good. The speakers come with a handy volume control .

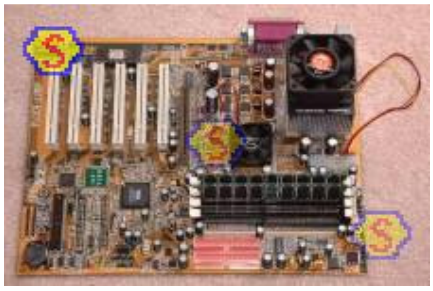
The Modem

Nowadays we should make sure that the modem we purchase supports the V.92 and V.44 standards, as the Zoom V.92 PCI Faxmodem does. These standards offer a number of improvements, including support for faster data transfer.

Computer Assembly - How To Assemble A PC:

Install the Motherboard into the Computer Case

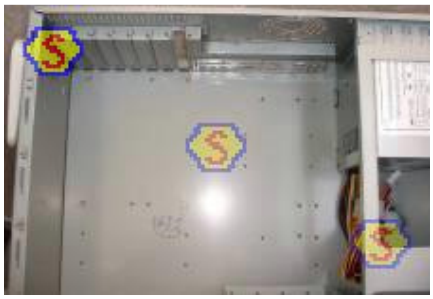
The motherboard is ready to be installed in the computer case. At this point, the processor, CPU cooler and memory modules have been installed onto the motherboard so it looks like this.



Remove the right-hand panel from the computer case and lay the computer case on its side. The motherboard will lay flat inside the case, resting on brass-colored mounting posts.

This shot is taken looking straight down into the case at the position in which the motherboard is to be installed. The orientation of the motherboard when it is inside the case is the same as the picture of the motherboard above. It's easy to see in the enlargement of the picture below that the case

comes with four brass-colored mountings posts already installed. There are holes in the case for additional mounting posts, but not all of them are appropriate for all motherboards.



The motherboard is ready to be affixed to the case. This is done using parts that came with the computer case, shown in the picture below. What's needed are some, but not all, of the brass-colored mounting posts shown in the upper-left of this picture, as well as some, but not all, of the mounting post screws shown in the lower-right of this picture. At this point, pair up screws that fit easily into a corresponding mounting post, including the four mounting posts pre-installed inside the case.

The motherboard is affixed to the case by inserting mounting post screws through holes in the motherboard and into the mounting posts. The first step is to determine in which case holes the mounting posts should be installed. The ABIT KR7A-133 motherboard has 9 holes for using with mounting posts. Place the motherboard down into the case, aligning four of the holes in the motherboard with the four pre-installed mounting posts. All four pre-installed mounting posts align with motherboard holes in the ABIT KR7A-133. In addition, 4 of the remaining 5 holes in the motherboard have a corresponding case hole for a mounting post, so 4 additional mountings posts can be installed. The 4 additional mountings posts should be carefully tightened (not overly

tightened) into place using a 5mm socket wrench. After installing the additional mounting posts, the interior looks like this.

Now rest the motherboard down inside the case on the mounting posts. Insert the screws through the holes in the motherboard and into the mounting post, getting each screw started but not at all tight - just far enough in the mounting post so the screw does not fall out. The motherboard hole in which it is most difficult to get a screw started is the one in the upper right of the board near the CPU cooler.Use needle-nose pliers to lower the screw down to the hole between the CPU cooler and power supply frame. Once all 8 have been started, all 8 can be tighted into place one at a time, again starting with the one in the upper-right corner.

DISASSEMBLY:

Step 1: Unplugging

The first thing we do is unplug every cable that's plugged in to computer. That includes the following cables:

- Power
- USB
- Fire wire etc…

Step 2: Outer Shell/Casing

Now that the computer is fully unplugged, move the PC to a clean work space, preferably a carpet. The carpet is better than tile, because screws and other small parts will roll around

Step 3: Outer Shell/Casing (cont.)

In the last step remove both side panels. In this step, remove the front and top panels.

Step 4: System Fan

Now that the case is off, remove the internal components.

Step 5: CPU Fan

Now that the system fan is out, we can remove the CPU fan.

Step 6: Power Supply

The power supply manages all the power for the machine.

Step 7: Hard Drive & Portable Hard Drive Slot

In order to remove the hard drive, we must remove the portable hard drive slot first.

Step 8: Expansion Cards

Expansion cards are like small upgrades to the computer.

CONCLUSION: With this experiment students gain the knowledge of assembling and disassembling of PC, which enhance knowledge of PC hardware.

EXPERIMENT: 2

AIM: Types of Processors (Computer Processors (CPUs) Dual, Triple and Quad Core take over single CPUs).

PURPOSE: To study various types of processors.

Description:

Every PC has a Central Processing Unit (CPU) this acts as the brain of the system. It connects to the Motherboard and works alongside the other components processing many instructions at the same time between the different hardware and memory systems.

Advancements in CPU technology now mean systems typically come with Dual Core, Triple core or Quad Core processors (on one single chip) instead of the traditional one core per chip. Now the total number of Cores can slot into a socket as before and a single heat sink and fan can keep everything to the right temperature.

Current Intel or AMD CPU Prices using our feed pages

Intel and AMD are the two companies who dominate the PC Processor market. Both have been around for decades and have become the main Chip suppliers for the home and business markets.

There is little difference between using both makes and have run many stable and fast systems using both makes. The AMD processors do tend to run hotter than the Intel versions, but with a suitable fan this is easily kept under control.

Intel products are more expensive typically £20 more than the AMD equivalent. If we are looking to upgrade just the CPU of the system then we need to check what type of socket the Motherboard uses and then check if there is a speed limit on the processor. If not then we need to check if we can buy a new processor for the existing Motherboard.

There are only TWO types of processors. These are:

1. Intel

2. AMD

And of course there are some different processors that do different things, even though they are the same brand name. A Macintosh processor is different from a Windows processor, because the Macintosh processor (my opinion) is more powerful. There are also different processors for different for different types of technology. A PDA would have 64-bit processor, but they are under Intel. The United States is the only country that makes processors, both Intel and AMD. **The specific types of processors are:**

Intel: (These are the current ones that most people have) 1. Pentium Pro 2. Pentium II 3. Celeron (Pentium Based But More Powerful) 4. Pentium II Xeon 5. Pentium III 6. Pentium II and III Xeon 7. Celeron (New Generation, Pentium III Based) 8. Pentium 4 (Most common) 9. Pentium M 10. Intel Core 11. Dual Core Xeon LV 12. Intel Pentium Dual Core 13. Intel Core 2 14. Pentium Duo 15. Pentium Dual Core 16. Core 2 Quad 16. (Newest) Intel Pentuim 2 Dual Core Processor

Amd: (The Current One's) 1. AMD Athlon 2. AMD Athlon 64 3. AMD Athlon X2 4. AMD Athlon Xp 5. AMD Duron 6. AMD Sempron 7. AMD Turion 8. AMD Opteron 9. AMD Phenom 1.

EXPERIMENT: 3

AIM: Explain CPU Sockets

Description:

- Socket 1 - 80486
- Socket 2 - 80486
- Socket 3 - 80486 (3.3V and 5V) and Compatibles
  Socket 4 - Intel Pentium 60/66 MHz
- Socket 5 - Intel Pentium 75-133 MHz, AMD K5
- Socket 6 - 80486
- Socket 7 – Intel Pentium, Pentium MMX; AMD K6
- Super Socket 7 – AMD K6-2, AMD K6-III
- Socket 8 – Intel Pentium Pro
- Socket 370 – Intel Pentium III, Celeron; Cyrix III; VIA C3
- Socket 423 – Intel Pentium 4
- Socket 463 – (also known as Socket NexGen) – NexGen Nx586
- Socket 478 – Intel Pentium 4, Celeron, Pentium 4 Extreme Edition
- Socket 479 – Intel Pentium M, Celeron M, Core Due & Core Solo
- Socket 486 - 80486
- Socket 563 – AMD low Power Mobile Athlon XP-M
- Socket 603 – Intel Xeon
- Socket 604 – Intel Xeon
- Socket 754 – AMD Athlon 64, Sempron, Turion 64
- Socket 771 – (also known as LGA 771) Intel Xeon
- Socket 775 – (also known as Socket T) Intel Pentium 4, D, Celeron, Core 2 Due, Core 2 Extreme
- Socket 939 – AMD Athlon 64 FX, Athlon 64 X2 Opteron 100-series
- Socket 940 – AMD multi Processor system
- Socket 1155- Intel i3
- Socket 1156- Intel i5

EXPERIMENT: 4

AIM: Describe SMPS and its functionality

DESCRIPTION:

Every electrical or electronic device needs power for work and the computer is not exception to it. Computers, too, have a particularly designed power supply component known as Switch Mode Power Supply (SMPS). SMPS converts raw input power to controlled voltage and current for the operation of various components of the computer. SMPS uses switches for high efficiency. The primary function of SMPS is to convert the alternating current (AC) power available in homes into direct current (DC) required for a computer system. In desktop computers, a metal box found in the corner of the CPU case supplies power to various components in the CPU box. The power supply converts 115-230 volt AC into DC that is required for computer components to work.

The terms such as voltage, AC, DC, etc., are closely associated with the power supply or SMPS.

Voltage is an electric potential difference between two points and is measured in volts.

AC stands for alternating current. It is an electric current whose magnitude and direction vary cyclically.

DC stands for direct current. It is considered as the constant flow of electrons in a single direction from low to high potential. Computers use DC power. Because of the advantage of alternating current over direct current in transforming and transmission, electric power distribution today is nearly everywhere alternating current.

The SMPS or power supply of a computer comes in different form factor styles. The form factor refers to the physical dimensions of a component. The form factor of the power supply must match with the form factor of the computer case into which the SMPS is inserted. There are various

industry standard form factors available. Some of the commonly used form factors with their characteristics are given below:

- LPX
- ATX
- SFX

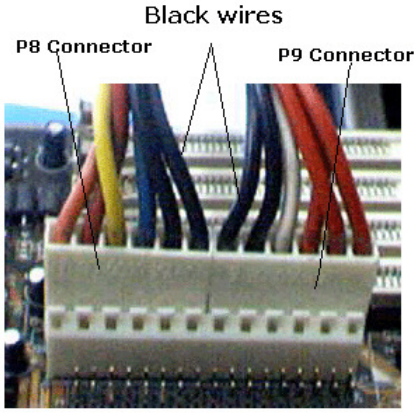
The LPX form factor style power supply has exactly the same motherboard and disk drive connectors as the previous standard power supply form factors. LPX form factor power supply differs in its reduced size that allows building much smaller and consumer oriented PCs. Due to their small size, they can be put into almost every type of computer cases.

The ATX form factor is developed by Intel in 1995. ATX is similar to LPX in physical dimensions. The difference between the two is that the power pass through-outlet for the monitor has been removed from ATX. Another difference is that in ATX, the cooling fan is mounted along the inner side of the power supply. With this kind of arrangement, the fan draws air in from the back of the chassis and blows it inside across the motherboard.

The SFX form factor style power supply is 100 mm wide, 125 mm deep, and 63.5 mm in height. It includes a 60 mm power supply fan for cooling. The main SFX motherboard connector is in the same shape and size as the ATX connector. The one difference here is that the SFX power supply specification does not support the -5V compatibility voltage and, therefore, should not be used with motherboards that have ISA slots.

Each SMPS or power supply on a computer contains a connector that connects to the motherboard, which supplies power to the system processor, memory, and all add-on cards connected to slots such as ISA, PCI, AGP, etc.

Industry standard PC, XT, AT, and LPX motherboards use the same type of main power supply connectors. They use two main power connectors: P8 and P9. Each of the P8 and P9 connectors has 6 pins that connect power supply to the motherboard.



AT Power Connector

ATX main power connector is used to connect to the power connectors on the ATX, SFX, and in all ATX based motherboards. ATX main power connector is a 20-pin connector with a square hole for pin #1 and round holes for the other 19 pins.

ATX Motherboard Main Power Connector

ATX auxiliary power connector is a 6-pin connector. Intel designed this to fulfill the additional power requirement of motherboards, e.g., a motherboard that requires 18A of +3.3v or 24A of +5v power. A higher level of power is required when power supply system is using 250 watt to 300 watt supplies.

ATX12V power connector provides localized power to the CPU, while the AUX connector provides additional power mainly to the AGP card.

The computer components and circuits such as motherboard, adapter cards, and disk drive logic board use +3.3v or +5v, and the disk drive motors and cooling fans require +12v power. The components that require voltage level other than this are powered through onboard voltage regulators. These voltage regulators are built into the motherboard.

Power Good Signal: The power supply not only converts AC to DC but also ensures that the system does not run unless the power supplied is proper. Power supply conducts an internal check before the

computer starts. If the check is successful, it sends a signal called Power Good to the motherboard. The Power Good signal is present in the system. When the AC voltage dips and the power supply is unable to provide outputs, the Power Good signal is withdrawn and the system is reset. The Power Good signal is a +5v active high signal, which is supplied to the motherboard after the internal checks have been successfully performed. The processor timer chip present on the motherboard that controls the reset line receives the Power Good signal. After receiving the signal, it releases the reset line, and the CPU starts executing the code present at FFFF:0000 memory address (ROM BIOS).

Power supply transmits power not only to the motherboard but also to the floppy disk drive, hard disk drive, and CD/DVD drive and other devices. A four-wire connector is attached at the back of each drive. The four wires provide +5v, +12v power, along with two grounds, to the various drives that use them. The connectors are available in two different sizes. The large size connector known as Molex is used on most internal drives, including hard disk, CD/DVD, Zip drives, and the older 5.25″ floppy disk drives. The smaller size power connector, called as Berg, is used for the newer style of 3.5″ floppies.

Power Connectors

Molex

Berg

Serial-ATA (SATA) power connector is used to provide power to SATA hard disk drives.

Serial-ATA (SATA)

The number of power connectors on the power supply varies with the type of power supply. If the power supply is large, the connectors are more in number so that more devices can be attached to it. Power supplies have many other specifications and features to protect computers. A good power supply should have very low current leakage, i.e., less than 500 microamps, to ground.

While adding add-on cards or other components on a computer, a technician should make sure that the power supply is not overloaded. Most of the time the power supply is overloaded by filling up the expansion slots and adding more hard disk or CD-ROM drives. Today's processors may also have high current requirement for the +5v or +3.3v supplies. Therefore, when selecting an SMPS for a computer, technicians should have future system upgrades in mind.

In case of a defect or problem with power supply, it is not recommended that an inexperienced user open a power supply for repairing. The power supply has dangerously high voltage. Even after unplugging, power supplies can retain dangerous voltage and must be discharged (like a monitor) before servicing it. These internal repairs are not recommended unless the technician is specially trained to repair such components.

EXPERIMENT: 5

AIM: Give details of different Ports.

PURPOSE: To study various types of ports

Description:

- VGA (Video Graphic Adaptor)
- LPT (Local Printer Terminal)
- COM (Serial Port)
- USB (Universal Serial Port)
- LAN (RJ 45)
- MIDI (Musical Instrument Digital Interface)
- PS2 (Personal System 2)

SERIAL PORT

Considered to be one of the most basic external connections to a computer, the **serial port** has been an integral part of most computers for more than 20 years. Although many of the newer systems have done away with the serial port completely in favor of USB connections, most modems still use the serial port, as do some printers, PDAs and digital cameras. Few computers have more than two serial ports.

Parallel Ports

If we have a printer connected to the computer, there is a good chance that it uses the parallel port. While USB is becoming increasingly popular, the parallel port is still a commonly used interface for printers. Parallel ports can be used to connect a host of popular computer peripherals:

Printers

Scanners CD burners

EXPERIMENT: 6

AIM: Introduction to Advanced Wireless Technologies

PURPOSE: Familiarity with Latest Web Technologies like Bluetooth, WiFi and Ir

DESCRIPTION:

What is Bluetooth?

Bluetooth is a very simple type of wireless networking that can allow up to eight devices to be connected together in a mini-network.

It is very short range in operation, and so is considered to be for 'personal' networking. With a range typically under 30ft, this allows enough distance to perhaps communicate across the office, but not any further. This short range is also its major security feature - anyone wishing to eavesdrop on the Bluetooth communications would not only need special equipment but would also need to be quite close to us.

It is a moderately slow type of networking, but it can transfer data sufficiently fast enough for most typical applications.

Bluetooth is hoped to be a very low cost type of networking, and, as it becomes more widespread, the cost of adding Bluetooth to devices should drop down to perhaps no more than an extra $5-10 on the selling price.

Bluetooth is designed to be compatible across a range of very different operating systems and devices, including things that we would not normally think of as being 'computer' type items - for example, some types of headset. Bluetooth networking can enable the headset to connect with other devices such as the phone, the MP3 player, the computer, or the PDA.

A Bluetooth enabled headset would mean that we can leave the cellphone in the pocket or briefcase, but still receive incoming phone calls. If the cellphone supports voice recognition for dialing out, we can even place calls as well as receive them, while never needing to reach for the phone. The safety benefits of this, if we're driving, are obvious.

It is probably better from a health point of view to have a very low powered headset close to the head than it is to have a phone that might be generating 100 or even 300 times as much radio energy close to the head.

Bluetooth can also help different devices to communicate with each other. For example, we might have a phone, a PDA, and a computer. If all three devices have Bluetooth capabilities, then (with the

appropriate software on each device) we can probably share contact information between all three devices quickly and conveniently. And we can look up a phone number on PDA (or laptop) and then place a call direct from the laptop or PDA, without needing to touch the cellphone.

Bluetooth is not a magical solution giving universal connectivity between devices. Each device also needs to have the appropriate software as well as the basic Bluetooth communication capability, and so sometimes the promise and theory of what could be possible is not fully matched by the reality.

For best compatibility, devices should support the Bluetooth 1.1 standard. A new standard - 1.2, was formalized in early November 2003 and this will quickly become the dominant standard.

Bluetooth has been slow to become accepted in the market, but now is starting to become increasingly prevalent. Prices are falling and increasing numbers of devices are offering Bluetooth connectivity. Over one million Bluetooth devices are now being sold every week (although mainly outside the US).

Bluetooth Range

These have range comparable to that of Wi-Fi, ie, 100 m or 330 ft.

With Bluetooth, short range is actually a benefit, because it reduces the chance of interference between the Bluetooth devices and those belonging to other people nearby.

Devices that Use Bluetooth

A limited, but growing number of devices use Bluetooth at present. Devices that are starting to have Bluetooth connectivity built in include:

- Digital cameras and camcorders
- Printers
- Scanners
- Cell Phones
- PDAs
- Laptops
- Keyboards and Mice
- Headsets
- In-car hands free kits
- GPS navigation receivers
- Home appliances (microwaves, washers, driers, refrigerators)

In addition, add on Bluetooth adapters are available for computers (eg with a USB interface) and for PDAs (eg SD cards).

How it works?

Bluetooth is a high-speed, low-power microwave wireless link technology, designed to connect phones, laptops, PDAs and other portable equipment together with little or no work by the user. Unlike infra-red, Bluetooth does not require line-of-sight positioning of connected units. The technology uses modifications of existing wireless LAN techniques but is most notable for its small size and low cost. When one Bluetooth product comes within range of another, (this can be set to between 10cm and 100m) they automatically exchange address and capability details. They can then establish a 1 megabit/s link with security and error correction, to use as required. The protocols will handle both voice and data, with very flexible network topography. This technology achieves its goal by embedding tiny, inexpensive, short-range transceivers into the electronic devices that are available today and supports data speeds of up to 721 Kbps.

Each device has a unique 48-bit address from the IEEE 802 standard. Connections can be point-to-point or multipoint. The maximum range is 10 meters but can be extended to 100 meters by increasing the power. Bluetooth devices are protected from radio interference by changing their frequencies arbitrarily upto a maximum of 1600 times a second, a technique known as frequency hopping. They also use three different but complimentary error correction schemes. Built-in encryption and verification is provided.

Bluetooth guarantees security at the bit level. Authentication is controlled by the user by using a 128 bit key. Radio signals can be coded with 8 bits or upto 128 bits. The Bluetooth radio transmissions will conform to the safety standards required by the countries where the technology will be used with respect to the affects of radio transmissions on the human body. Emissions from Bluetooth enabled devices will be no greater than emissions from industry-standard cordless phones. The Bluetooth module will not interfere or cause harm to public or private telecommunications network.

Which is better - Bluetooth or Wi-Fi

Wi-Fi is primarily used as an alternate to traditional cable based networks. It has a longer range than Bluetooth, and supports faster data transfer speeds, and so it might seem better than Bluetooth.

But, in reality, Bluetooth and Wi-Fi have different purposes. Bluetooth is intended for limited data transfer between many different types of devices, Wi-Fi is more focussed on faster data transfer between computers on a network.

One of the distinctive elements of Bluetooth is that is uses very much less power than Wi-Fi. devices (such as are in PDAs, phones, headsets, etc) transmit a very low power signal (1 mW) and only transmit intermittently when in standby mode, saving even more power. Wi-Fi, on the other hand, consumes a great deal of power, and so for any type of portable battery operated device, Bluetooth will allow for substantially more battery life than would Wi-Fi.

If we simply want to swap data between different devices in the office and elsewhere on a casual and occasional basis, then - assuming that the software and Bluetooth hardware is available - Bluetooth is probably a better choice for us. If we need more range, and higher bandwidth; perhaps if we want to connect computers into the office LAN, then Wi-Fi is a better choice.

Wi-Fi

Wi-Fi is a wireless standard for connecting electronic devices. A Wi-Fi enabled device such as a personal computer, video game console, smartphone , and digital audio player can connect to the Internet when within range of a wireless network connected to the Internet. A single access point (or hotspot) has a range of about 20 meters (65 feet) indoors, Wi-Fi has a greater range outdoors .

"Wi-Fi" is a trademark of the Wi-Fi Alliance and the term was originally created as a simpler name for the "IEEE 802.11" standard.

Wi-Fi certification

'Wi-Fi' is not a technical term. However, the Alliance has generally enforced its use to describe only a narrow range of connectivity technologies including wireless local area network (WLAN) based on the IEEE 802.11 standards, device to device connectivity [such as Wi-Fi Peer to Peer AKA Wi-Fi Direct], and a range of technologies that support PAN, LAN and even WAN connections. Wi-Fi certified and compliant devices are installed in many personal computers, video game consoles, MP3 players, smartphones , printers, digital cameras, and laptop computers. Wi-Fi technology builds on IEEE 802.11 standards. The IEEE develops and publishes some of these standards, but does not test equipment for compliance with them.

The name Wi-Fi

The term Wi-Fi suggests Wireless Fidelity, resembling the long-established audio-equipment classification term high fidelity (in use since the 1930) or Hi-Fi (used since 1950)

One can also connect Wi-Fi devices in ad-hoc mode for client-to-client connections without a router.

.Applications

- Internet access
- City-wide Wi-Fi
- Campus-wide Wi-Fi
- Direct computer-to-computer communications

Future directions

As of 2010 Wi-Fi technology has spread widely within business and industrial sites. In business environments, just like other environments, increasing the number of Wi-Fi access points provides network redundancy, support for fast roaming and increased overall network-capacity by using more channels or by defining smaller cells. Wi-Fi enables wireless voice-applications (Vo WLAN or WVOIP). Over the years, Wi-Fi implementations have moved toward "thin" access points, with more of the network intelligence

Advantages and limitations

Advantages

- Wi-Fi allows the deployment of local area networks (LANs) without wires for client devices, typically reducing the costs of network deployment and expansion. As of 2010 manufacturers are building wireless network adapters into most laptops.
- The price of chipsets for Wi-Fi continues to drop, making it an economical networking option included in even more devices.
- Different competitive brands of access points and client network-interfaces can inter-operate at a basic level of service.
- The current version of Wi-Fi Protected Access encryption (WPA2) as of 2010 is widely considered secure, provided users employ a strong passphrase.

- Power saving mechanisms (WMM Power Save) improve battery operation.

Limitations

- **Mobility**

The very limited practical range of Wi-Fi essentially confines mobile use to such applications as inventory-taking machines in warehouses or in retail spaces, barcode-reading devices at check-out stands, or receiving/shipping stations.

- **Data security risks**

The most common wireless encryption-standard, Wired Equivalent Privacy (WEP), has been shown to be easily breakable even when correctly configured.

- **Population**

Many 2.4 GHz 802.11b and 802.11g access-points default to the same channel on initial startup, contributing to congestion on certain channels.

- **Channel pollution**

Wi-Fi pollution, or an excessive number of access points in the area, especially on the neighbouring channel, can prevent access and interfere with other devices' use of other access points, caused by overlapping channels in the 802.11g/b spectrum, as well as with decreased signal-to-noise ratio (SNR) between access points. This can become a problem in high-density areas, such as large apartment complexes or office buildings with many Wi-Fi access points.

- **Piggybacking**

Piggybacking refers to access to a wireless Internet connection by bringing one's own computer within the range of another's wireless connection, and using that service without the subscriber's explicit permission or knowledge.

EXPERIMENT: 7

AIM: Introduction to components of a Laptop

PURPOSE: Familiarity with all the parts of the Laptop.

DESCRIPTION:

Following are the components of the Laptop:

SYSTEM BOARD or MOTHERBOARD

The system board is the main logic board in any laptop. All internal components are connected to the system board. This is one of the most expensive parts in a laptop.

A system board also known as motherboard or main board is the main circuit board in any laptop. Unlike desktop PC system boards, laptop system boards come in thousands of different shapes and sizes. All parts inside a laptop are connected to the system board, either directly via a connector mounted on the system board or through a cable.

In a typical laptop the following ports and components are permanently attached to the system board and cannot be easily removed and replaced without soldering:

1. Hard drive (HDD) connector.
2. CD/DVD drive connector.
3. Memory (RAM) slots.
4. Battery connector.

5. Keyboard connector.

6. Audio (headphone and microphone) jacks.

7. Volume control wheel.

8. USB ports.

9. Ethernet (RJ45 or network) port.

10. IEEE 1394 (Fire Wire) ports.

11. Video chip and some other components and ports.

System board, processor (CPU) and LCD screen are the most expensive parts in any laptop. In some cases, when one of these three parts fails, it's cheaper to buy a brand new laptop than replace the failed part. But each case is different so do the research.

The system board is mounted inside the laptop base assembly. In order to remove or replace the motherboard, we'll have to disassemble the whole laptop.

MEMORY or RAM

A laptop memory also know as RAM (Random-access memory) is a temporary data storage. It's a volatile type of memory. When we turn off the laptop, all the information stored in a RAM module is lost. A type of memory used in laptop computers called **SO-DIMM** (Small Outline Dual In-line

Memory Module).More memory we have installed – better the performance of the laptop.

Here are three most common memory types found in laptop computers:

1. SDRAM SO-DIMM memory has 144pins.

2. DDR SO-DIMM memory has 200 pins.

3. DDR2 SO-DIMM memory has 200 pins.

HARD DRIVE

The hard drive is the main storage of information in a laptop. All system files, personal files are

stored inside the hard drive.

Most modern laptops use 2.5″ hard drives. Older laptops use IDE hard drives; newer laptops use SATA hard drives. SATA and IDE drives are not interchangeable, they have absolutely different connectors. If the laptop came with an IDE hard drive we cannot replace it with a SATA drive. The

connectors on the drive will not match connector on the motherboard.SATA hard drives has faster data transfer rate then IDE drivers. SATA – 150MB/s and IDE – 100/133MB/s.

Laptop hard drives spin at different speeds and most common are 4200RPM, 5400RPM, 7200RPM. The RPM number indicates how fast the hard drive platters spin. Hard drives with high RPM number are quicker than hard drives with low RPM number because they can access data faster.

SATA connectors on a laptop hard drive are similar to SATA connectors on a desktop hard drive. We can connect a SATA laptop hard drive to a desktop computer using same SATA cables.

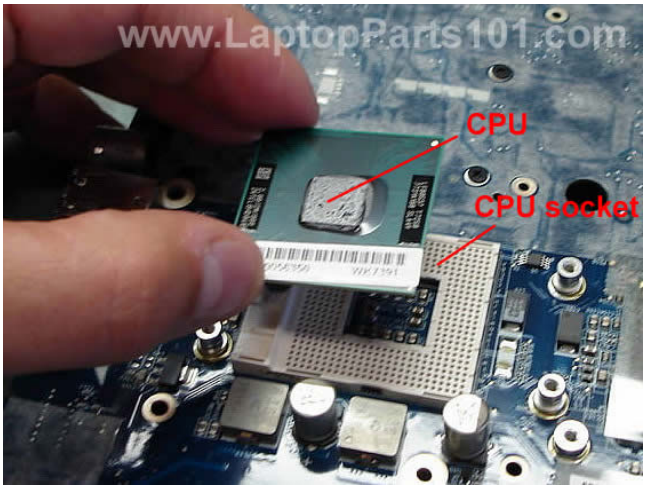
WHERE HARD DRIVE IS LOCATED IN A LAPTOP.

On most laptops the hard drive can be accessed from the bottom.

PROCESSOR or CPU

The processor is the brain of the laptop. Faster CPU means faster data processing.

A processor also known as CPU (Central Processing Unit) is the brain of a laptop computer. The processor is one of the main components in a laptop. Laptop processors are made mainly by Intel and AMD. The processor connects directly to the system board via a processor socket aka CPU socket as it shown on the picture below.



KEYBOARD

The keyboard is the main input device. Find out how the keyboard is connected to the motherboard and how it can be removed or replaced.

In laptops, a keyboard is the main input device. It is interface between a user and a laptop. In most laptops the keyboard is connected directly to the motherboard via a flat ribbon cable.

CD/DVD OPTICAL DRIVE

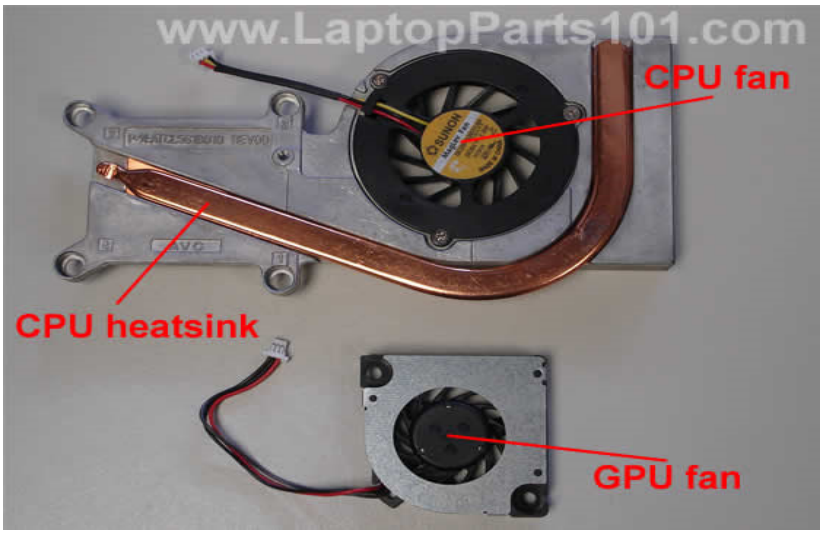
The CD/DVD drive allows we to read/write data from/to a CD or DVD disc.

Most modern laptops are equipped with a CD/DVD-RW drive also known as an optical disc drive which allows it to read and write data from or to a CD/DVD disc. All laptop CD/DVD drives are shaped the same but they all have different face plates also know as front bezels. On the picture above we can see three different laptop CD/DVD drives with different face plates/front bezels.

When we are replacing a failed CD/DVD drive, we have to make sure that the face plate from the old drive will fit the new drive.

COOLING FAN

The cooling fan is a part of the cooling module in a laptop. The fan helps to cool down the processor when the laptop is turned on.



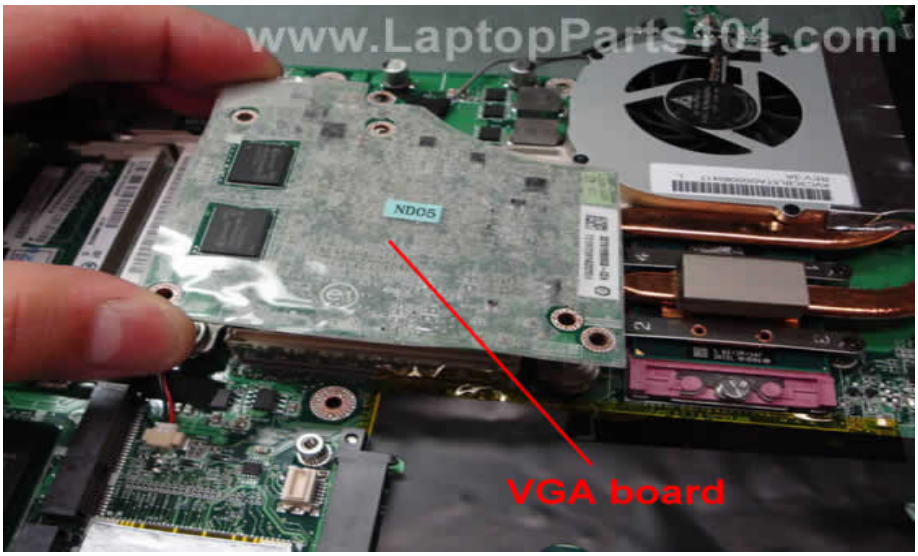
A CPU cooling fan is a dedicated fan which cools down the heatsink and eventually the CPU (Processor). Usually the CPU cooling fan comes as a part of the heatsink assembly – a metal part drawing heat from the CPU chip. In addition to the CPU cooling fan, some laptops have a dedicated GPU (graphics processing unit) fan which cools down the GPU chip.

The CPU and GPU cooling fans connect directly to the motherboard via a cable running from the fan. When CPU and GPU chips get hotter, the cooling fan spins faster.

VIDEO CARD or GRAPHICS CARD

In most modern laptops the video card is integrated into the system board. If the video card fails we have to replace the whole motherboard.

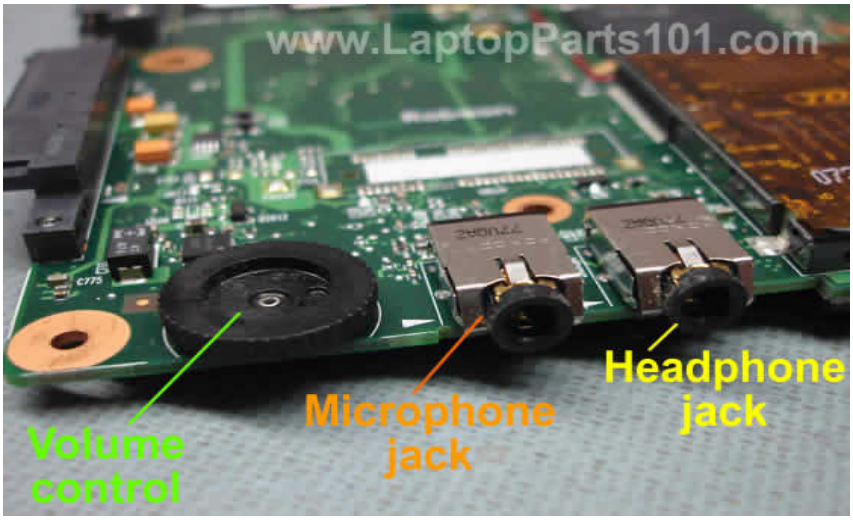
In some laptops the video card is a discrete module and can be removed or replaced separately from the motherboard.



A graphics card also known as a video card or VGA board is a laptop component responsible for creating images on a laptop screen. In most low-mid range laptops the graphics card is integrated into the motherboard. In other words, it's a part of the motherboard. If that's the case, the graphics card is not removable or upgradeable.

AUDIO BOARD or SOUND BOARD

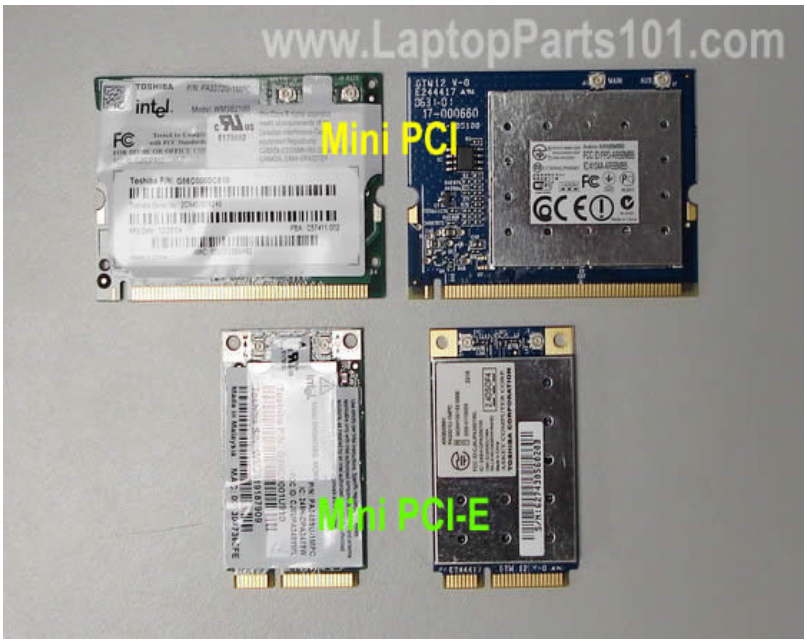
In most laptops the audio board is a part of the motherboard. If that's the case, all audio board input/output components such as volume control, microphone jack and headphone jack are soldered directory to the motherboard.



In most laptops the audio board also know as sound board is integrated into the motherboard. In other words, it's a part of the motherboard and cannot be removed or replaced separately.

WIRELESS NETWORK CARD

The internal wireless card helps to connect to the Internet without running a cable. Learn about different types of internal wireless cards and how they are connected to the motherboard.



Laptop internal wireless network cards also known as WLAN card or Wi-Fi card come in different shapes and sizes. On the picture above we see two most common internal wireless card types found

in laptops. The wireless card plugs into the Mini PCI or Mini PCI-E slot on the motherboard. Most internal cards have two small connectors for wireless antenna cables, some newer Mini PCI-E cards have three connectors and require three antenna cables.

CMOS BATTERY or RTC BATTERY

The CMOS battery provides power to the CMOS chip when the laptop is turned off or disconnected from the wall outlet. Any laptop computer has a CMOS battery also known as RTC battery. The CMOS battery connects directly to the laptop system board and helps to retain important BIOS settings such as system time, date, BIOS configuration while the laptop is turned off or even when the main battery is removed. The CMOS battery is rechargeable and it's getting charged when the laptop is plugged into the mains.

LCD SCREEN

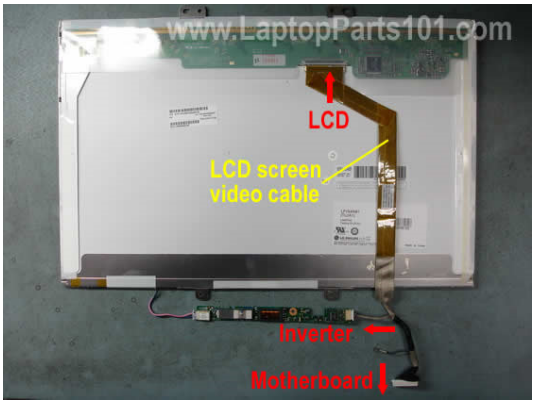
The LCD screen is one of the most expensive parts in a laptop computer. The LCD screen mounts inside the display panel.If we accidentally cracked the screen, it has to be replaced. We cannot repair a cracked screen.

A laptop screen also known as LCD screen displays an image generated by the laptop video card. The LCD screen receives data signal from the video card through the LCD cable.

Laptop screens come in many different sizes and resolutions. In order to find the LCD screen size (in inches), we'll have to measure the screen between the two diagonal corners.

SCREEN CABLE or VIDEO CABLE

The video cable connects the Laptop screen to motherboard. The video cable carries data signal for the LCD screen and power for the inverter board.



A laptop LCD cable also known as video cable, display cable or screen cable. This cable transfers data signal from the motherboard and video card to the LCD screen. The cable has three ends with three connectors. One end plugs into the connector on the back of the LCD screen, the second end plugs into the inverter board, the third end plugs into the connector on the motherboard or video card.The top part of the cable runs inside the laptop display panel between the LCD screen and display cover.

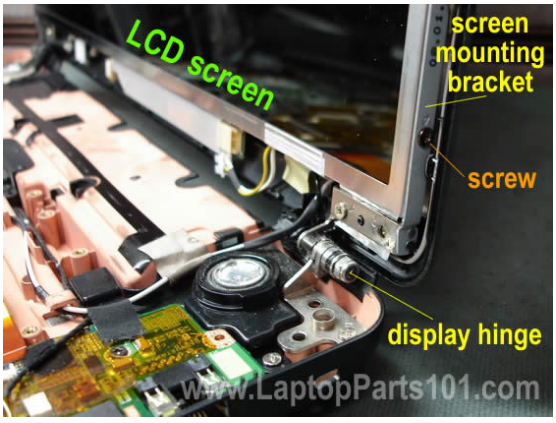
WEB CAMERA

Many modern laptops come with a web camera built into the display panel. The web camera is not a part of the LCD screen. The web camera is located on a separate board and can be replaced separately from the LCD.

Most newer laptops come with a build-in web camera also known as webcam. The web camera is located on the top of the display panel. Some people think the web camera is a part of the LCD screen but it's not. The web camera is a separate module which is mounted inside the display panel above the LCD screen.

DISPLAY HINGES or SCREEN HINGES

The display hinges connect two main parts of any laptop – the display panel and base assembly.



Display hinges connect two halves of a laptop – the display panel and base assembly. All regular laptops have two hinges located on the left and right sides of the display panel. Tablet PCs have one hinge-swivel located in the middle of the display. The display hinges are not repairable. If the hinge is broken or too loose to keep the display in an open position, we have to replace it with a new one.

AC/DC POWER ADAPTER

The AC/DC power adapter converts high voltage AC power from the mains to low voltage DC power required by the laptop.

AC/DC power adapter as known as power supply or power brick converts the high voltage AC power from a wall outlet into the low voltage DC power needed for the laptop. The AC/DC adapter provides power for the laptop and charges the battery. It's very important to use the right adapter for the laptop.

MAIN BATTERY

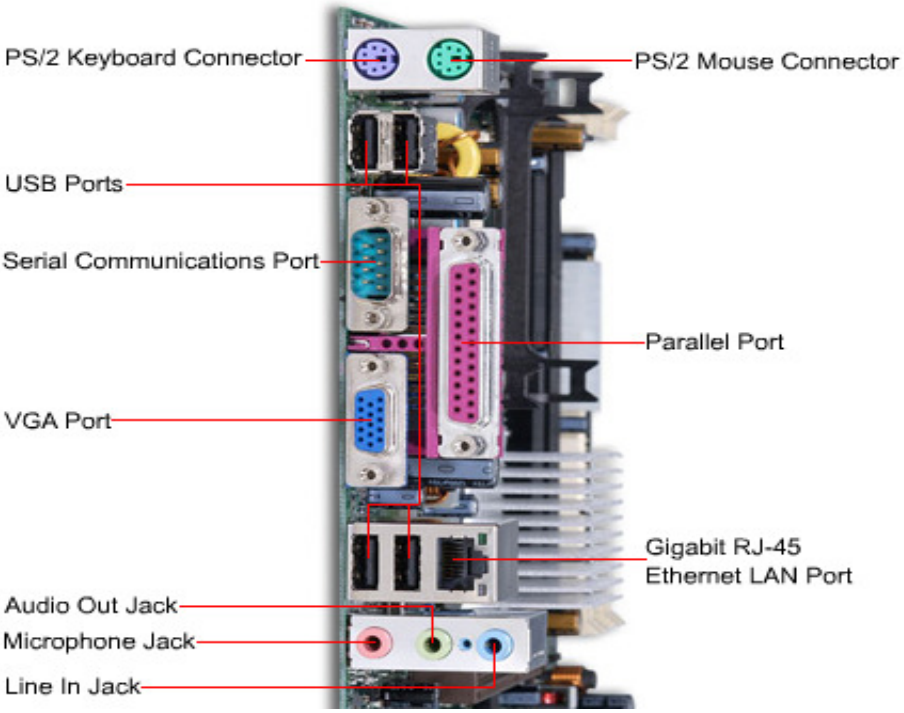
The battery is a secondary source of power for a laptop. The battery gets charged while the laptop is plugged into the mains and keeps the laptop running when it's unplugged from the mains.

Any laptop computer has a battery pack which provides power to the laptop while it's not connected to the wall-plug through AC/DC power adapter. The laptop battery life depends upon many

conditions and circumstances: screen brightness, intensity of running programs, the temperature of the working environment, etc. Some of these settings could be changed only through the manufacturer's power management software. In most laptops the main battery connects directly to the system board.

USB Ports

Connecting a USB device to a computer is simple -- we find the USB connector on the back of the machine and plug the USB connector into it.



EXPERIMENT NO: 8

AIM: Introduction to computer networks

PURPOSE: Familiarity with all the components of the computer network.

DESCRIPTION: A **computer network** or **data network** is a telecommunications network that allows computers to exchange data. The physical connection between networked computing devices is established using either cable media or wireless media. The best-known computer network is the Internet.

Network devices that originate, route and terminate the data are called network nodes. Nodes can include hosts such as servers and personal computers, as well as networking hardware. Two devices are said to be networked when a process in one device is able to exchange information with a process in another device.

Computer networks support applications such as access to the World Wide Web, shared use of application and storage servers, printers, and fax machines, and use of email and instant messaging applications. The remainder of this article discusses local area network technologies and classifies them according to the following characteristics: the physical media used to transmit signals, the communications protocols used to organize network traffic, along with the network's size, its topology and its organizational intent.

Communication media

The communication media used to connect devices to form a computer network include electrical cable (HomePNA, power line communication, G.hn), optical fiber (fiber-optic communication), and radio waves (wireless networking). In the OSI model, these are defined at layers 1 and 2 — the physical layer and the data link layer.

A widely-adopted family of communication media used in local area network (LAN) technology is collectively known as Ethernet. The media and protocol standards that enable communication between networked devices over Ethernet is defined by IEEE 802. Ethernet encompasses both wired and wireless LAN technologies. Wired LAN devices transmit signals over cable media. Wireless LAN devices use radio waves or infrared signals as a transmission medium.

Wired technologies

The order of the following wired technologies is, roughly, from slowest to fastest transmission speed.

- *Twisted pair wire* is the most widely used medium for all telecommunication. Twisted-pair cabling consist of copper wires that are twisted into pairs. Ordinary telephone wires consist of two insulated copper wires twisted into pairs. Computer network cabling (wired Ethernet as defined by IEEE 802.3) consists of 4 pairs of copper cabling that can be utilized for both voice and data transmission. The use of two wires twisted together helps to reduce crosstalk and electromagnetic induction. The transmission speed ranges from 2 million bits per second to 10 billion bits per second. Twisted pair cabling comes in two forms: unshielded twisted pair (UTP) and shielded twisted-pair (STP). Each form comes in several category ratings, designed for use in various scenarios.
- *Coaxial cable* is widely used for cable television systems, office buildings, and other work-sites for local area networks. The cables consist of copper or aluminum wire surrounded by an insulating layer (typically a flexible material with a high dielectric constant), which itself is surrounded by a conductive layer. The insulation helps minimize interference and distortion. Transmission speed ranges from 200 million bits per second to more than 500 million bits per second.
- ITU-T G.hn technology uses existing home wiring (coaxial cable, phone lines and power lines) to create a high-speed (up to 1 Gigabit/s) local area network.
- An optical fiber is a glass fiber. It uses pulses of light to transmit data. Some advantages of optical fibers over metal wires are less transmission loss, immunity from electromagnetic radiation, and very fast transmission speeds of up to trillions of bits per second. One can use different colors of lights to increase the number of messages being sent over a fiber optic cable.

Wireless technologies

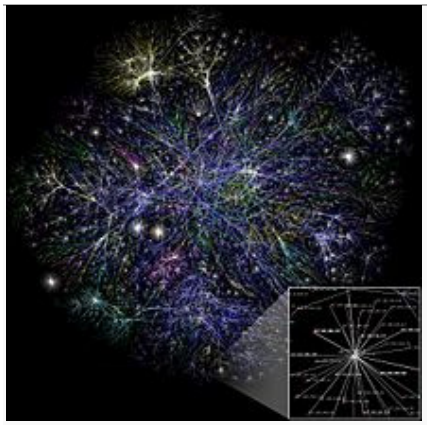
Main article: Wireless network

- *Terrestrial microwave* – Terrestrial microwave communication uses Earth-based transmitters and receivers resembling satellite dishes. Terrestrial microwaves are in the low-gigahertz range,

which limits all communications to line-of-sight. Relay stations are spaced approximately 48 km (30 mi) apart.

- Communications satellites – Satellites communicate via microwave radio waves, which are not deflected by the Earth's atmosphere. The satellites are stationed in space, typically in geosynchronous orbit 35,400 km (22,000 mi) above the equator. These Earth-orbiting systems are capable of receiving and relaying voice, data, and TV signals.
- Cellular and PCS systems use several radio communications technologies. The systems divide the region covered into multiple geographic areas. Each area has a low-power transmitter or radio relay antenna device to relay calls from one area to the next area.
- Radio and spread spectrum technologies – Wireless local area networks use a high-frequency radio technology similar to digital cellular and a low-frequency radio technology. Wireless LANs use spread spectrum technology to enable communication between multiple devices in a limited area. IEEE 802.11 defines a common flavor of open-standards wireless radio-wave technology known as Wifi.
- Infrared communication can transmit signals for small distances, typically no more than 10 meters. In most cases, line-of-sight propagation is used, which limits the physical positioning of communicating devices.
- A global area network (GAN) is a network used for supporting mobile across an arbitrary number of wireless LANs, satellite coverage areas, etc. The key challenge in mobile communications is handing off user communications from one local coverage area to the next. In IEEE Project 802, this involves a succession of terrestrial wireless LANs.

Communications protocols



Internet map: The Internet is a global system of interconnected computer networks that use the standard Internet Protocol Suite (TCP/IP) to serve billions of users worldwide.

A communications protocol is a set of rules for exchanging information over a network. In a protocol stack (also see the OSI model), each protocol leverages the services of the protocol below it. An important example of a protocol stack is HTTP running over TCP over IP over IEEE 802.11. (TCP and IP are members of the Internet Protocol Suite. IEEE 802.11 is a member of the Ethernet protocol suite.) This stack is used between the wireless router and the home user's personal computer when the user is surfing the web.

Communication protocols have various characteristics. They may be connection-oriented or connectionless, they may use circuit mode or packet switching, and they may use hierarchical addressing or flat addressing.

There are many communication protocols, a few of which are described below.

Ethernet

Ethernet is a family of protocols used in LANs, described by a set of standards together called IEEE 802 published by the Institute of Electrical and Electronics Engineers. It has a flat addressing scheme. It operates mostly at levels 1 and 2 of the OSI model. For home users today, the most well-known member of this protocol family is IEEE 802.11, otherwise known as Wireless LAN (WLAN). The complete IEEE 802 protocol suite provides a diverse set of networking capabilities. For

example, MAC bridging (IEEE 802.1D) deals with the routing of Ethernet packets using a Spanning Tree Protocol, IEEE 802.1Q describes VLANs, and IEEE 802.1X defines a port-based Network Access Control protocol, which forms the basis for the authentication mechanisms used in VLANs (but it is also found in WLANs) – it is what the home user sees when the user has to enter a "wireless access key".

Internet Protocol Suite

The Internet Protocol Suite, also called TCP/IP, is the foundation of all modern internetworking. It offers connection-less as well as connection-oriented services over an inherently unreliable network traversed by datagram transmission at the Internet protocol (IP) level. At its core, the protocol suite defines the addressing, identification, and routing specifications for Internet Protocol Version 4 (IPv4) and for IPv6, the next generation of the protocol with a much enlarged addressing capability.

SONET/SDH

Synchronous optical networking (SONET) and Synchronous Digital Hierarchy (SDH) are standardized multiplexing protocols that transfer multiple digital bit streams over optical fiber using lasers. They were originally designed to transport circuit mode communications from a variety of different sources, primarily to support real-time, uncompressed, circuit-switched voice encoded inPCM (Pulse-Code Modulation) format. However, due to its protocol neutrality and transport-oriented features, SONET/SDH also was the obvious choice for transporting Asynchronous Transfer Mode (ATM) frames.

Asynchronous Transfer Mode

Asynchronous Transfer Mode (ATM) is a switching technique for telecommunication networks. It uses asynchronous time-division multiplexing and encodes data into small, fixed-sized cells. This differs from other protocols such as the Internet Protocol Suite or Ethernet that use variable sized packets or frames. ATM has similarity with both circuit and packet switched networking. This makes it a good choice for a network that must handle both traditional high-throughput data traffic, and real-time, low-latency content such as voice and video. ATM uses a connection-oriented model in which a virtual circuit must be established between two endpoints before the actual data exchange begins.

While the role of ATM is diminishing in favor of next-generation networks, it still plays a role in the last mile, which is the connection between an Internet service provider and the home user. For an interesting write-up of the technologies involved, including the deep stacking of communications protocols used, see.

Scale

Computer network types by spatial scope

- Near field (NFC)
- Body (BAN)
- Personal (PAN)
- Near-me (NAN)
- Local (LAN)
  - Home (HAN)
  - Storage (SAN)
- Campus (CAN)
- Backbone
- Metropolitan (MAN)
- Wide (WAN)
- Cloud (IAN)
- Internet
- Interplanetary Internet
- Intergalactic Computer Network

A network can be characterized by its physical capacity or its organizational purpose. Use of the network, including user authorization and access rights, differ accordingly.

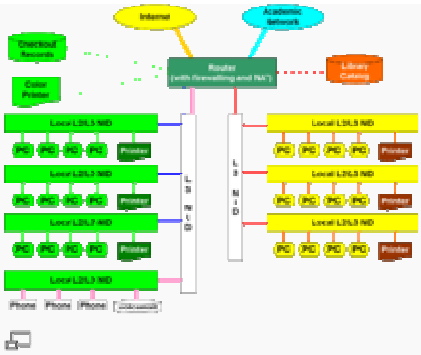
Personal area network

A personal area network (PAN) is a computer network used for communication among computer and different information technological devices close to one person. Some examples of devices that are used in a PAN are personal computers, printers, fax machines, telephones, PDAs, scanners, and even video game consoles. A PAN may include wired and wireless devices. The reach of a PAN typically extends to 10 meters.A wired PAN is usually constructed with USB and Firewire

connections while technologies such as Bluetooth and infrared communication typically form a wireless PAN.

Local area network

A local area network (LAN) is a network that connects computers and devices in a limited geographical area such as a home, school, office building, or closely positioned group of buildings. Each computer or device on the network is a node. Wired LANs are most likely based on Ethernet technology. Newer standards such as ITU-T G.hn also provide a way to create a wired LAN using existing wiring, such as coaxial cables, telephone lines, and power lines.



Typical library network, in a branching tree topology with controlled access to resources

A LAN is depicted in the accompanying diagram. All interconnected devices use the network layer (layer 3) to handle multiple subnets (represented by different colors). Those inside the library have 10/100 Mbit/s Ethernet connections to the user device and a Gigabit Ethernet connection to the central router. They could be called *Layer 3 switches*, because they only have Ethernet interfaces and support the Internet Protocol. It might be more correct to call them access routers, where the router at the top is a distribution router that connects to the Internet and to the academic networks' customer access routers.

The defining characteristics of a LAN, in contrast to a wide area network (WAN), include higher data transfer rates, limited geographic range, and lack of reliance on leased lines to provide connectivity. Current Ethernet or other IEEE 802.3 LAN technologies operate at data transfer rates up to 10 Gbit/s. The IEEE investigates the standardization of 40 and 100 Gbit/s rates.A LAN can be connected to a WAN using a router.

Home area network

A home area network (HAN) is a residential LAN which is used for communication between digital devices typically deployed in the home, usually a small number of personal computers and accessories, such as printers and mobile computing devices. An important function is the sharing of Internet access, often a broadband service through a cable TV or digital subscriber line (DSL) provider.

Storage area network

A storage area network (SAN) is a dedicated network that provides access to consolidated, block level data storage. SANs are primarily used to make storage devices, such as disk arrays, tape libraries, and optical jukeboxes, accessible to servers so that the devices appear like locally attached devices to the operating system. A SAN typically has its own network of storage devices that are generally not accessible through the local area network by other devices. The cost and complexity of SANs dropped in the early 2000s to levels allowing wider adoption across both enterprise and small to medium sized business environments.

Campus area network

A campus area network (CAN) is made up of an interconnection of LANs within a limited geographical area. The networking equipment (switches, routers) and transmission media (optical fiber, copper plant, Cat5 cabling, etc.) are almost entirely owned by the campus tenant / owner (an enterprise, university, government, etc.).

For example, a university campus network is likely to link a variety of campus buildings to connect academic colleges or departments, the library, and student residence halls.

Backbone network

A backbone network is part of a computer network infrastructure that provides a path for the exchange of information between different LANs or subnetworks. A backbone can tie together diverse networks within the same building, across different buildings, or over a wide area.

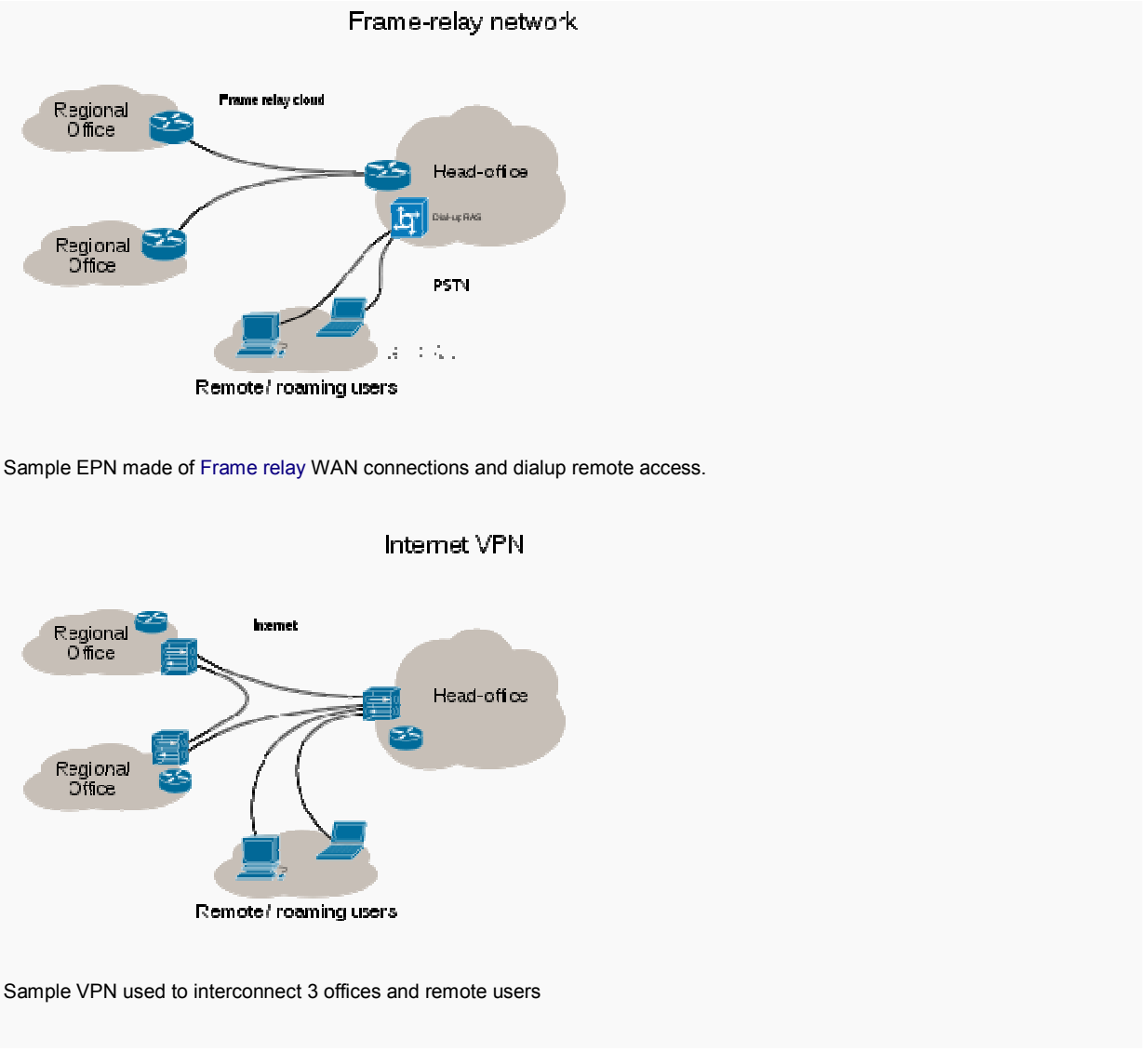
For example, a large company might implement a backbone network to connect departments that are located around the world. The equipment that ties together the departmental networks constitutes the network backbone. When designing a network backbone,network performance and network

congestion are critical factors to take into account. Normally, the backbone network's capacity is greater than that of the individual networks connected to it.

Another example of a backbone network is the Internet backbone, which is the set of wide area networks (WANs) and core routers that tie together all networks connected to the Internet.

Metropolitan area network

A Metropolitan area network (MAN) is a large computer network that usually spans a city or a large campus.



Sample EPN made of Frame relay WAN connections and dialup remote access.

Sample VPN used to interconnect 3 offices and remote users

Wide area network

A wide area network (WAN) is a computer network that covers a large geographic area such as a city, country, or spans even intercontinental distances. A WAN uses a communications channel that combines many types of media such as telephone lines, cables, and air waves. A WAN often makes use of transmission facilities provided by common carriers, such as telephone companies. WAN technologies generally function at the lower three layers of the OSI reference model: the physical layer, the data link layer, and the network layer.

Enterprise private network

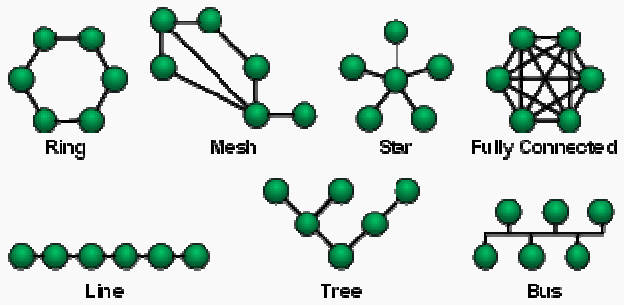
An enterprise private network is a network built by a single organization to interconnect its office locations (e.g., production sites, head offices, remote offices, shops) in order to share computer resources.

Virtual private network

A virtual private network (VPN) is a computer network in which some of the links between nodes are carried by open connections or virtual circuits in some larger network (e.g., the Internet) instead of by physical wires. The data link layer protocols of the virtual network are said to be tunneled through the larger network when this is the case. One common application is secure communications through the public Internet, but a VPN need not have explicit security features, such as authentication or content encryption. VPNs, for example, can be used to separate the traffic of different user communities over an underlying network with strong security features.

VPN may have best-effort performance, or may have a defined service level agreement (SLA) between the VPN customer and the VPN service provider. Generally, a VPN has a topology more complex than point-to-point.

Network topology



Network Topologies examples

Network topology is the layout or organizational hierarchy of interconnected nodes of a computer network.

Common layouts

Common layout are:

- A bus network: all nodes are connected to a common medium along this medium. This was the layout used in the original Ethernet, called 10BASE5 and 10BASE2.
- A star network: all nodes are connected to a special central node. This is the typical layout found in a Wireless LAN, where each wireless client connects to the central Wireless access point.
- A ring network: each node is connected to its left and right neighbour node, such that all nodes are connected and that each node can reach each other node by traversing nodes left- or rightwards. The Fiber Distributed Data Interface (FDDI) made use of such a topology.
- A mesh network: each node is connected to an arbitrary number of neighbours in such a way that there is at least one traversal from any node to any other.
- A fully connected network: each node is connected to every other node in the network.

Note that the physical layout of the nodes in a network may not necessarily reflect the network topology. As an example, with FDDI, the network topology is a ring (actually two counter-rotating

rings), but the physical topology is a star, because all neighboring connections are routed via a central physical location.

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state transition diagrams are often used to model queuing performance in a circuit-switched network. These diagrams allow the network planner to analyze how the network will perform in each state, ensuring that the network will be optimally designed.

Network security

Network security consists of the provisions and policies adopted by the network administrator to prevent and monitor unauthorized access, misuse, modification, or denial of the computer network and its network-accessible resources. Network security is the authorization of access to data in a network, which is controlled by the network administrator. Users are assigned an ID and password that allows them access to information and programs within their authority. Network security is used on a variety of computer networks, both public and private, to secure daily transactions and communications among businesses, government agencies and individuals.

Network resilience

Network resilience is "the ability to provide and maintain an acceptable level of service in the face of faults and challenges to normal operation.