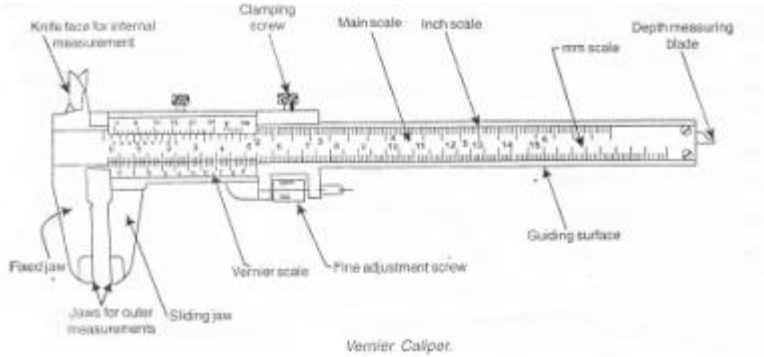
EXPRIMENT NO – 1

TITLE: - To study different types of measuring tools used in metrology and determine least count of vernier caliper and micrometer.

OBJECTIVE: - To study different measuring instruments, their working principle & least count determination of vernier caliper & micrometer.

APPRATUS USED: - Vernier caliper, micrometer, vernier height gauge & steel rule.

VERNIER CALIPER :-



Vernier Caliper.

PRECAUTION :- 1.Take care with taking reading.

2. Slide the vernier scale only when locking nut is loose.

3. Tight the locking nut when taking the reading.

4. Clean the instrument regularly.

THEORY: - It is a precision instrument used for measuring length , diameters and depth. It can be used for measuring external & internal dimensions. It consists of a graduated bar of rectangular section. It has two jaws, one is movable with a small vernier head & the other one is fixed. A fine adjustment nut is also attached to the head. The dimension is measured by the jaws which is indicated on the graduated bar & is measured by the main scale reading & by the vernier scale reading.

PROCEDURE :- 1.Loose the locking nut.

2. Clamp the job between the jaws and lock the tight nut.

3. Note the reading in the main scale.

4. Note the reading of vernier scale of meshing point.

Reading :- dimension= Main scale reading + (vernier scale reading × least count).

LEAST COUNT :- Least count is minimum reading that an instrument can measure.

Vernier caliper with 0.02mm least count.

Main scale length = 49mm

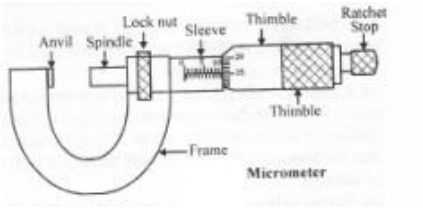
Division on vernier scales = 50mm

1 division of vernier scale = 49/50 = 0.98mm

1 small division on main scale = 1mm

So difference between the one small division of main scale and one division of vernier scale is = 1- 0.98 = 0.02mm .

MICROMETER:-



THEORY :- It is used to measure diameter or thickness of any job. It consist a hook type frame. A hard anvil is fixed on one end. On the other end a spindle moves back & forth with another anvil fixed to its end. There is a graduation on sleeve surrounding the spindle called main scale. The vernier is provided on the thimble that is around the spindle. The adjustment of the gap between the two jaws can be done by rotating the thimble. Ratchet is provided to apply pressure on the side of spindle. To lock any required position the lock nut is also provided.

PRECAUTION :- 1. Maintain the tool clean from dust, oil.

2. Use the ratchet stop to take accurate reading.

PROCEDURE :- 1. Hold the job in between the anvil and spindle and tight with ratchet stop.

2. Press the lock nut.

3. Take the reading on main scale.

4. Take the vernier scale reading on thimble.

READING :- Dimension= main scale + vernier scale reading × least count.

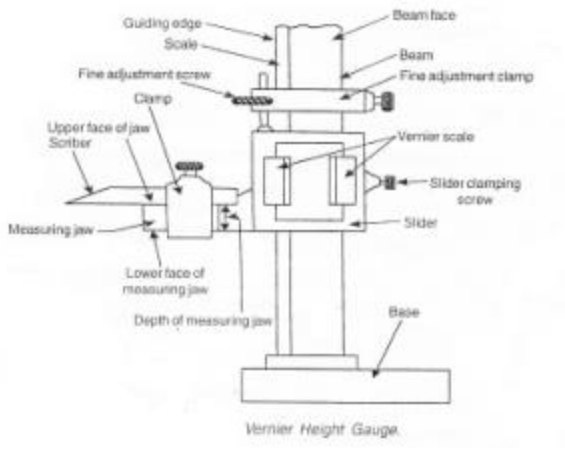
LEAST COUNT:- In one complete turn of the thimble distance covered on main scale = 0.5mm = pitch

Division on vernier scale (on thimble) = 50

Pitch = 0.5 mm

Least count = pitch/ division on vernier scale = 0.5/50 = 0.01mm

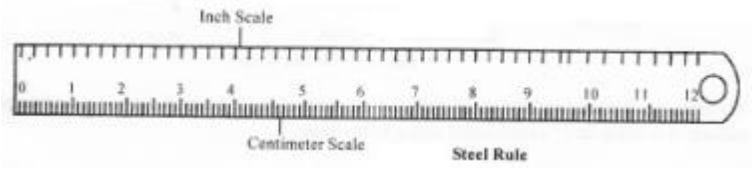
VERNIER HEIGHT GAUGE :- It is used for measuring the height of the parts or scribing the lines at height or for marking purposes. It consists of a vertical bar mounted on a heavy base. Asliding head with the pointer is carried on the vertical rectangular bar. The bar & the head are graduated. The scale on the bar is called main scale & on the head is called vernier scale. It is always used by placing it on the surface plate. The base is made up of cast iron & beam of stainless steel. It works on the same principle as vernier caliper



Vernier Height Gauge

SEEL RULE :- it is made up of stain less steel and is marked with scales. In this scale there is graduation also both in inches and centimeter which are further divided into smaller division.

PRECAUTIONS:- 1. The edges of steel rule should be protected from rough handling.



Steel Rule

LEAST COUNT :- 0.5mm

CONCLUSION: - We have successfully study the various measuring tools and the least count of

vernier caliper = 0.02 mm &
micrometer =0.01mm.

EXPRIMENT NO -- 2

TITLE :- To prepare a job in fitting shop including facing ,marking and filing.

OBJECTIVE :- To get a knowledge about use of fitting tools .

TOOL USED :- Try square ,scriber ,hand hacksaw and file (flat ,bastard).

PRECAUTION :- 1. Use proper tool at proper place.

2. Do not tight the fitting bench vice in excess.

3. Never move the fingers on filing surface otherwise file will start slipping.

PROCEDURE :- 1. At first cut the rough square of 50×50×10mm from mild steel flat.

2. Suppose one side is ideal and all sides are to be made at 90° each other by filing use try square to check right angle of the surfaces

3. And prepare a square of required size 48mm.

4. Mark the center of the work piece at the surface.

5. Drill an hole with10mm dia.

RESULT/DISCUSSION :-

EXPRIMENT NO --3

TITLE :- To prepare butt joint using manual metal arc welding set.

OBJECTIVE :- To study about metal welding & make a job of butt joint with two mild steel flat piece.

APPARATUS USED :- Wire brush ,chipping hammer ,tongs ,hand gloves ,welding screen ,welding set and electrode rod.

MATERIAL USED :- Mild steel flat.

ELECTRODE USED:- Flux coated mild steel electrode of size $3.15 \times 350mm$, current 35-350 ampere.

THEORY :- Welding is a local fusion process by which two pieces are combined with or without help of pressure & with or without use of filler rod. Heat is generated by heating the work piece with an electrons arc set up between a flux-coated electrode & the work piece.

PRECAUTION :- 1. Inspect the equipment before welding.

2. Make sure, that the floor on which you stand, is dry.

3. The welding should be done in a properly ventilated area.

4. Set the current and voltage properly.

PROCEDURE :- 1. Procure two flat pieces of mild steel having the required dimension.

2. Perform edge preparation by file.

3. Set the machine for welding operation.

4. Select the correct electrode size and hold in it the holder.

5. Clean the welding area.

6. Put the two pieces on table.

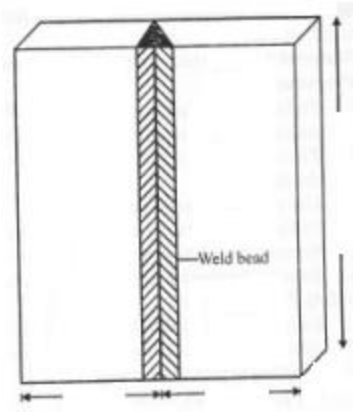
7. Make tuck on the both ends of the joints.

8. Start welding from one side to the other end of work piece.

9. Allow the joint to cool.

10. Remove slag covering by chipping hammer.

11. Finish the welding by brush.



RESULT/DISCUSSION:- we have studied about the working of metal arc welding & prepared the butt joint using this.

EXPRIMENT NO :-4

TITLE :- To prepare a job on lathe involving facing, outside turning, taper turning & step turning.

OBJECTIVE :- To do facing, turning, step turning, taper turning operation on a work piece on lathe.

TOOLS USED :- Lathe, turning tool, tool post key, L N key, vernier caliper, spanner & work piece of mild steel.

RAW MATERIAL:-MS Rod $\phi 32 \times 115$mm.

SAFETY PRECAUTIONS :- 1. Fix and tight the job and tool properly.

2. Lathe should be properly grounded.

3. Top tip should be center of job.

4. Use safety goggles while machining.

5. Use proper speed, feed and depth of cut for machining.

6. Handle hot chips carefully.

7. After use, clean the machine and hand tools.

THEORY: - Cutting tool moves slowly (feed) over the revolving job at high speed and remove unwanted material and produce manually cylindrical jobs.

PROCEDURE :- 1. Hold the job on three jaw chuck of lathe from one end.

2. Face the end of the job for a length of 110mm i.e, total length by facing tool.

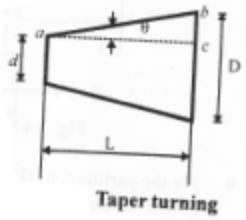
3. Turning tool is set at the right angle of the job. The tool is moved along the length of
. bed through the main hand wheel of lathe apron. Turning tool turn theØ30mm×110mm
. take depth of cut= 1mm.

4. By turning tool, step turning in done on the job of Ø26×20mm.

5. For taper turning the required angle is calculated out as explained in the theory. The . compound rest / slide set at the desired angle.

tan Θ = D- d/2l

Step turning is similar to outside turning having a step.



Taper turning

RESULT : - Job made and self inspected as per drawing.

EXPRIMENT NO :-5

AIM :- To prepare horizontal surface on a shaper.

OBJECTIVE:- To use shaper effectively for the desired job.

TOOLS USED :- Shaper machine, single point HSS cutting tool, vernier caliper, machine vice , spanner etc

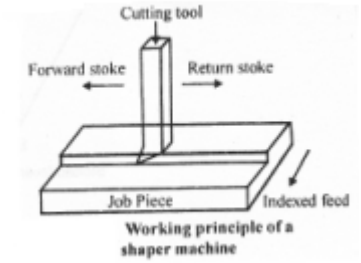
MATERIAL USED:- M.S block (50×50×50)

PRECAUTIONS:-

1. Tight the job & cutting tool nicely
2. Adjust length of stroke & position of stroke according to the job length.
3. Do not use blunt cutting tool.
4. Keep away from the moving ram and flying hot iron chips.
5. Thoroughly clean the machine and tools before leaving the work place.

PROCEDURE:-

1. Mark the job as per drawing.
2. Clamp the job in machine vice,level it with the help of marking block& properly tight the job.
3. Adjust length of stroke & position of stroke according to the job length.
4. Produce horizontal surface by moving the cutting tool over jobs.
5. Repeated cut can be given to achieve the required dimensions.
6. Inspect the job and clean the machine along with tools.



Working principle of a shaper machine

RESULT:- A job has been produced as per drawing.

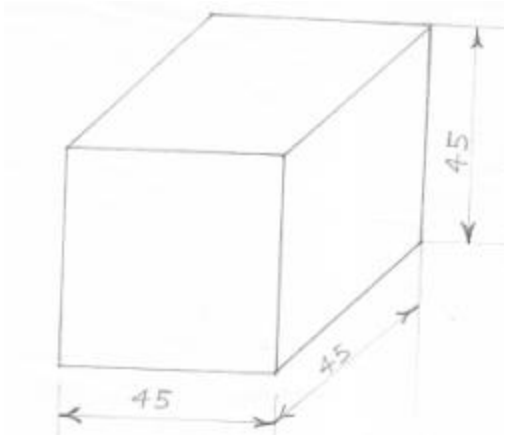
EXEPRIMENT NO :-6

AIM: - To prepare a job involving side and face milling on a milling machine.

OBJECTIVE: - To use the milling operations to prepare the job as per requirement.

TOOLS USED: - Milling machine, side& face milling cutter, machine vice, vernier caliper, and spanner.

MATERIAL USED: - Mild steel block (45×45×45)



PRECAUTIONS: - 1. Make sure that the cutter and arbor are secure.

2. Keep hands away from the work while machine.

3. Do not strike over the milling cutter.

4. Use a brush and not the hands to remove chips.

5. Use of coolants prolongs cutter life and produce a smooth surface finish.

PROCEDURE: - 1. Fix the (mild steel) block in the machine vice on the milling.

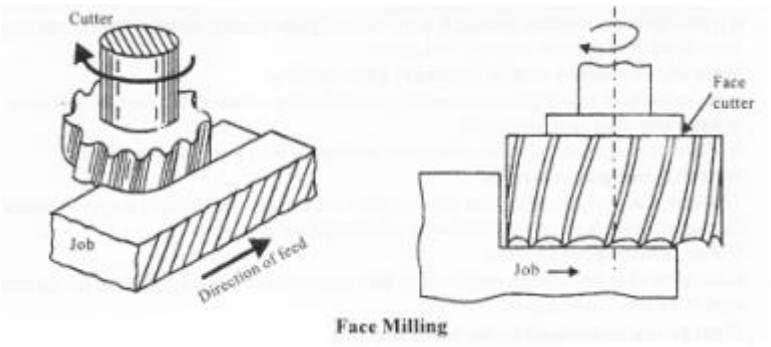
2. Fix the side & face milling cutter as per the operation in the arbor of the milling.

3. Select the proper speed of the spindle for mild steel work piece.

4. Select the references and place the work piece near the cutter.

5. Select the proper depth of cut for the respective cutting operation according to requirement.

6. Give feed to the work piece and hence the operation is repeated as per requirement of job.



Face Milling

RESULT :- A job has been produced as per drawing.

EXEPRIMENT NO :-7

TITLE:- To study different types of machine tools used in machine shop (Lathe, Shaper, milling & Drilling)

Objective:- The objective of this experiment is to study about the parts, working principle and different types of operations to be performed by different machine tools in the workshop.

Tools used:- Machine tools:-

1. Lathe
2. Shaper
3. Milling
4. Drilling

Theory:-

LATHE

A lathe is probably one of the earliest, versatile & widely used machine tool so it is also known as mother of all machine tools.

Working principle:-

The job to be machined is held and rotated in lathe chuck. A cutting tool is advanced which is stationary against the rotating job. Since the cutting tool material is harder than the work piece so removal of metal takes place.

Main parts of lathe:-

The main parts of lathe are:-

1. Bed

2. Head stock
3. Carriage
4. Column
5. Feed mechanism

Bed is the base of lathe.

Head stock is permanently fastened on the inner ways at the left side of bed.

Tail stock is situated at the right hand end of the bed and is mounted on the inner guide ways. It can be moved toward or apart from the operator.

Carriage controls and supports the cutting tool. It has five major parts:-

1. Saddle
2. Cross slide
3. compound rest
4. Tool post
5. Apron

Saddle is an H shaped casting mounted on the top of the lathe ways so slides along the ways between head stock and tail stock.

Cross slide is mounted on the saddle.

Compound rest is mounted on the top of the cross slide.

Tool post is mounted above the compound rest.

Apron is fastened in the saddle and contains the feed mechanism.

Feed mechanism is the tool movement relative to the work.

Lathe feed are of three types

1. Longitudinal feed
2. Cross feed
3. Angular feed

Types of lathe:-

Lathe is of many types. Some of them are:-

1. Speed lathe
2. Bench lathe
3. Engine lathe
4. Special purpose lathe

Lathe operations:-

1.Centering 2. Facing 3. Plain turning 4. Step turning 5. Taper turning 6. Centre drilling 7. Boring 8. Threading 9. Knurling etc.

Precautions :-

1. Use brush to clean chips.
2. While working on lathe use goggles.
3. Choose proper depth of cut.

SHAPER

Working principle:-

It is a machine tool in which the ram moves the cutting tool backward and forward in a straight line to generate flat surfaces. Flat surfaces may be horizontal or vertical.

Main parts of shaper:-

The main parts of shaper are:-

1. Base 2. Column 3. Cross tail 4. Table 5. Ram 6. Tool post

Base supports all other parts of the machine.

Column is mounted on the base. It also operates the mechanism of the machine.

Cross rail is heavy cast iron construction attached to column.

Table is used for holding the work piece.

Ram is placed above the column. It carries the tool head and mechanism for adjusting the stroke length.

Tool head is attached to the front portion of the ram and is used to hold the tool rigidly.

Shaper operations:-

Shaper is used for making:-

1. Horizontal surface 2. Vertical surface 3. Regular surface 4. Slots 5. Keyways

Precautions:-

2. Use brush to clean the chip.
3. Use goggles while working.
4. Never remove chips while ram is in motion.

MILLING

Working principle:-

It is a machine tool in which metal is removed by means of a revolving cutter with many teeth. Each tooth has a cutting edge which removes the metal from the work piece. The feed to the cutter may be longitudinally, transversely or vertically. The cutter is set to a certain depth of cut by raising the table.

Main parts of milling:-

The following are the main parts of the milling machine:-

1.Base 2. Column 3. Knee 4. Saddle 5. Table 6. Over arm 7. Spindle 8. Arbor

Base is the foundation of machine upon which all other parts are mounted.

Column is the main supporting frame mounted vertically on one side of base. It supports and guides knee in its vertical travel.

Knee projects from column and slides up & down on its face. It supports the saddle and table.

Saddle supports and carries the table and travels longitudinally in a horizontal plane.

Over arm is mounted on and guide by the top of column.

Spindle is mounted on the upper part of the column.

Arbor is the extension of the spindle on which all the various cutters are mounted.

Milling operations:-

1.Face milling 2. Side milling 3. T-spot milling 4. Gear milling 5. Angular milling 6. Keyways 7. Grooves

Precautions:-

1. Use brush to clean chips.
2. Use goggles while working.

DRILLING

Working principle:-

Drilling machine is used to produce hole in the work piece. The end cutting tool used is called drill. The drill is placed in the chuck and when the machine is on the drill rotates. The linear motion is given to the drill towards the work piece, which is called feed. In order to remove the chips from the hole, drill is taken out from the hole. So the combination of rotary and linear motion produces the hole in the work piece.

Main parts of drilling:-

1.Head 2. Spindle 3. Drill chuck 4. Adjustable table 5. Base 6. Column

Head contains the electric motor.

Spindle is made up of alloy steel. It rotates as well as moves up & down in a sleeve.

Drill chuck is held at the end of the drill spindle and in turn it holds the drill bit.

Adjustable table is supported on the column of the drilling machine and can be moved vertically and horizontally. It also carries slots for bolt clamping.

Base supports the column which in turn supports the table, head etc.

Column is a vertical round or box section which rests on the base and supports the head and table.

Drilling operations:-

1.Drilling 2. Boring 3. Reaming 4. Tapping 5. Counter sinking 6. Counter boring

Precautions:-

Always use a correct size drill.

Keep your fingers away from drill.

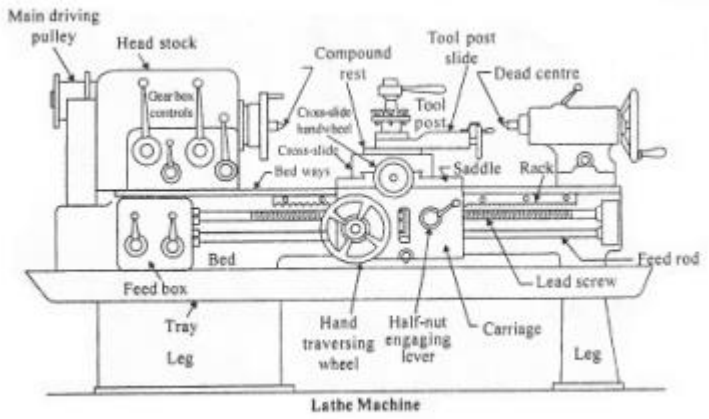
Use correct drill geometry.

Don't wear loose clothing.

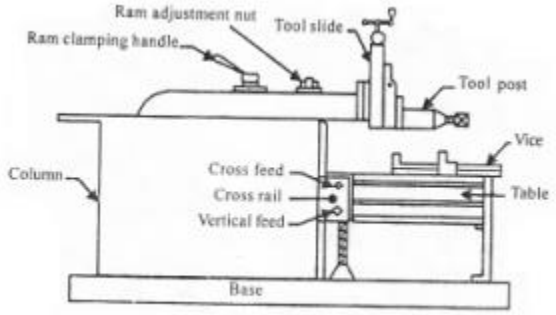
Always use protective eye shields.

Conclusion:-

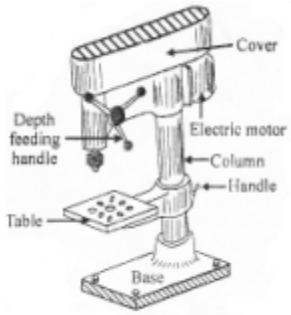
We have successfully studied various machine tools in machine shop.



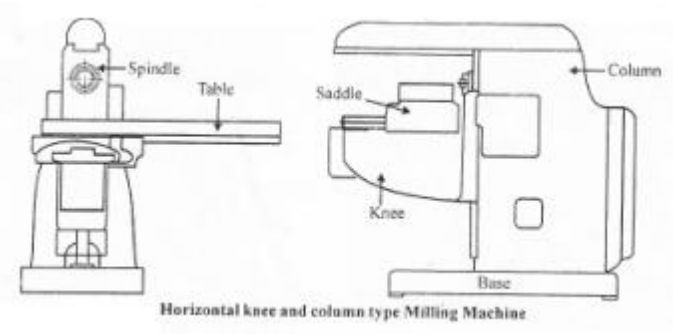
Lathe Machine



Principal parts of Shaper



Drilling Machine



Horizontal knee and column type Milling Machine

EXPERIMENT NO:-8

AIM: - To prepare lay out of a metal sheet by marking and prepare rectangular tray.

MATERIAL REQUIRED: - G.I. (galvanized iron) sheet.

TOOL REQUIRED:- Scale, scriber, snip, sheet metal table, try square, mallet, bench vice, Ball peen hammer.

THEORY: -

When the complete surface of a solid is opened out & laid on a plane, the surface of the solid is said to have been developed. Every line on the development is the true length of the corresponding line on the surface. Surfaces are normally developed with the inside face up.

The knowledge of the development of surface is frequently required in the design & manufacturing of an object. Practical applications of development occur in sheet metal work, pattern making etc.

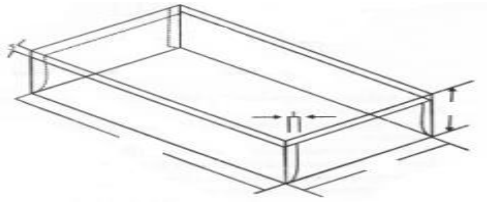
Notching is used to cut away a portion of the metal to prevent overlapping on seams & edges.

SAFETY PRECAUTIONS: -

1. Perform the operations as per required sequence given in procedure.
2. Protect hands from sharp corners of edges of the sheet.
3. Don't allow any scratch mark to come on the sheet surface.

PROCEDURE: -

1. Sheet of required size is cut and smoothened by using mallet.
2. Layout of the tray is drawn on the sheet as per pattern using the scriber.
3. Four corners are cut as per marking using straight snip.
4. Edges are folded to make the beading on all four sides.
5. Bending of all four sides are done at right angles opposite the beading and bend corners using mallet.
6. Then the tray is finished.



EXPERIMENT NO:-9

TITLE: - To prepare cross lap joint in carpentry shop.

OBJECTIVE: -

The objective of the experiment is to make a cross lap joint of accurate dimensioning of the given wood pieces with the proper use of various tools being used in the carpentry shop.

THEORY: -

Cross lap joints are very frequently used to connect two wooden pieces, which are required to

cross each other & at the same time remain in the same plane so that an even surface is obtained at the joint. When the intersecting members cross each other at their centre, it is known as cross lap joint.The study done of the carpentry tools will help in choosing the desired tools for the work to be done efficiently & easily.

TOOL USED: -

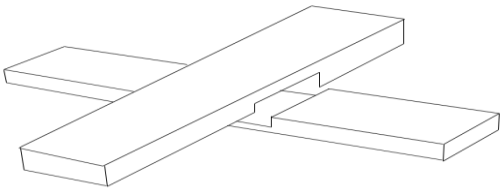
Rip saw, planer, firmer chisel mallet, try square, rasp, scale & marking gauge.

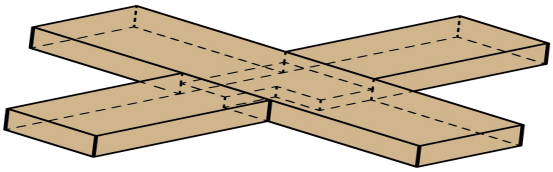
SAFETY PRECAUTIONS: -

1. Start the cross lap cutting from both the sides.
2. While cutting the groove hold the block in vice properly so that saw teeth does not touch the vice.
3. Don't tight the work pieces in vice too much.

PROCEDURE: -

1. Two wooden pieces of required size are to be cut.
2. The pieces are squared using jack plane and rasp.
3. Length, width and height for lap joint are marked on both the pieces.
4. One piece is clamped in vice and unwanted material is removed as per marking, using saw, firmer chisel and hummer and the piece is finished using rasp file.
5. The process is repeated on the second piece.
6. The piece should be fitted with normal hand pressure.





RESULT/DISCSSION: -

The carpentry job has been prepared successfully.

EXPERIMENT NO:-10

TITLE: To Study various types of carpentry tools.

OBJECTIVE:

The object is to get knowledge of the various tools being used in the carpentry shop. This will make to know which tool should be used for a specific process.

THEORY:

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:-

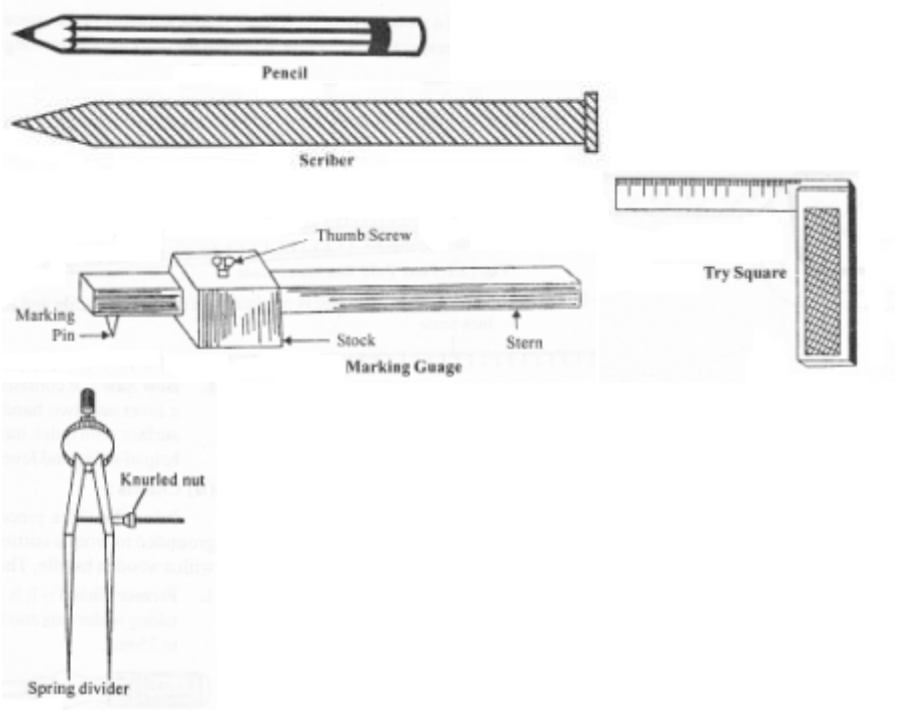
1. Measuring tools
2. Marking tools
3. Cutting tools
4. Planning tools
5. Drilling & Boring tools
6. Holding devices
7. Striking tools
8. Sharpening tools

These can be discussed as:-

1. **Measuring tools**:-
   - **a) Steel Rule**: It is made up of stainless steel & is marked with scales of graduation both inches & centimetres. Inches & centimetres are further divided into smaller divisions.
   - **b) Inch tape**: It is made up of flexible thin strip. It is folded around a centre pin attached with a small handle.

2. **Marking tools**:-
   - **a) Pencil**: A 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 & tear. It is made up of carbon steel. It is used for measuring & marking the points & lines on the wooden stock before processing.
   - **c) Marking Gauge**: It is used to draw parallel lines. The movable portion of the gauge is adjusted to suitable position & is tightened on the stem. The piece which slides is called as Stock & a scribing pin is fixed on the stem. One face of the stock remains in contact with the job while marking. By the help of the thumb screw we can tighten the stock anywhere on the stem.
   - **d) Try Square**: It is used to draw lines at right angles, parallel or the trueness of the planed surfaces. It is made up of a steel blade with heavy base.
   - **e) Compass or Dividers**: These are used for dividing equal number of parts & for drawing arcs & circles. It consists of 2 legs with a spring on the top of the legs. A

screw is also attached for adjustment. These are also used to transfer any dimensions.



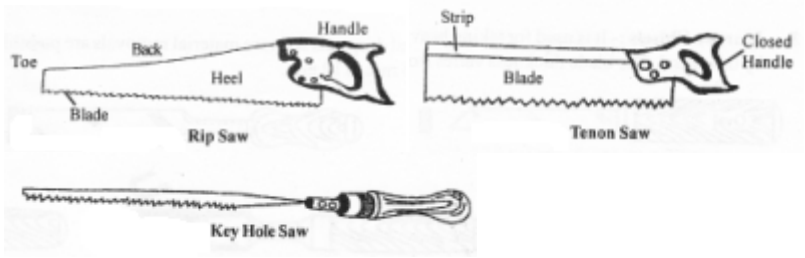
3. **<u>Cutting tools</u>**:-

A) Saws: A saw is a multi tooth tool made up of a thin sheet attached with a wooden handle. Its teeth are ground & sharpened to achieve smooth cutting. The front portion of the saw is called Toe & back portion is called Heel.

a) Rip Saw: It is a saw of blade length 30-75 cm & blade width 120-150 mm near the handle & 60-70 mm at the toe. Cutting is done along the wood grains & nearly entire length of the saw blade is used for cutting.

b) Tenon Saw or Back Saw: It is a thin saw made of parallel blade having blade length 20-40 cm & blade width 60-100 mm. It is supported by back of wrought iron or brass, hence, it is called Back Saw. It is primarily used for short cuts so the blade is provided with a reinforcing strip or back at the top so the blade is prevented from bending during operation.

c) Keyhole Saw or Pad Saw: It is used for cutting thick internal curves where it is impossible to use other saws. Its blade width is very small. It is also used to create the keyholes.



B) Chisels: It is a flat thick piece of steel whose one edge is grounded to form a cutting edge & other is provided with a wooden handle.

a) Firmer Chisel: It is a general purpose chisel. The cross section of the blade is rectangular in shape & the wider portion shows the width & the smaller side is the thickness. Blade width varies from 5-35 mm.

b) Mortise Chisel: It has a wider blade thickness than other chisels of same size so it is more strong than the other same size chisels. The blade thickness varies from 5-12 mm. It is used for taking heavy & deep cuts.

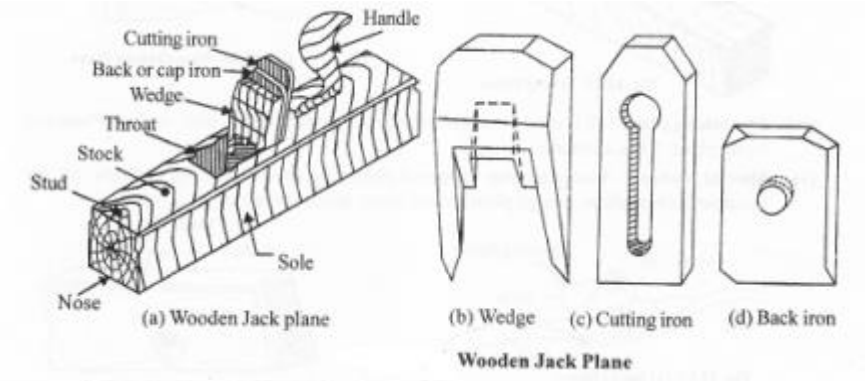
4. **<u>Planning tools</u>**: Planning tools are used for the smoothening purposes, preparing proper sizes.

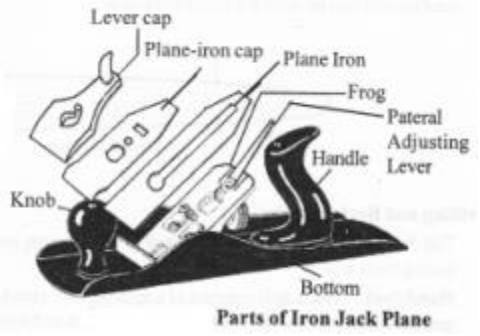
A) Planes: Planes are used to maintain the job smooth & of proper size.

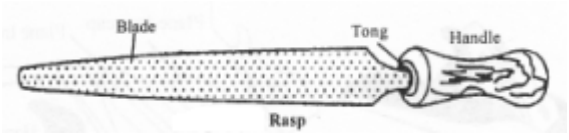
a) Wooden Jack Plane: Its length is 20"-30" & used for general purpose. It consists of a wooden body called Stock & bottom face is called as Sole. The blade remains at an angle of 45 º with respect to the Sole. The projection of the blade from the Sole is controlled by a tapered wooden Wedge.

b) Iron Jack Plane: This plane is used for better surface finish. It is made of cast iron with a wooden handle at the back & a wooden knob at the front so that it can be held by both the hands during the operation.

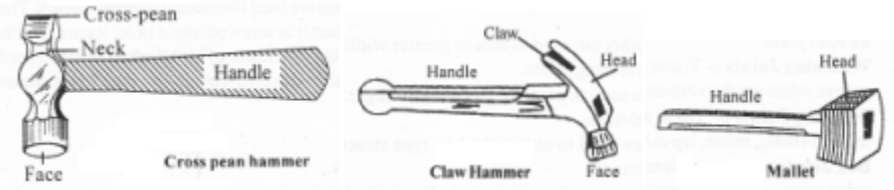
B) Rasp: It is a finishing tool used to make the wood surface smooth, remove sharp edges, finishing fillet & other interior surfaces. Sharp cutting teeth are provided on its surface for this purpose. It can be used for wood work only.



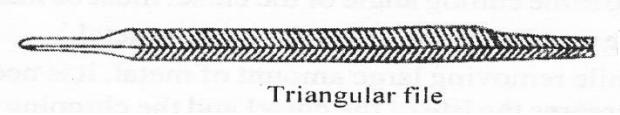




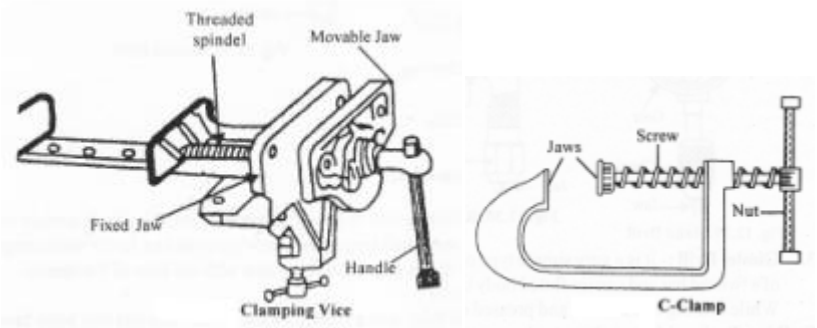
5. **<u>Striking tools</u>**: These are used to force the nails or chisels into the wood.
   a) **Cross Pean Hammer**: It has a cast steel body & a wooden handle. Body has two parts- Face & Pean. The pean is in the form of a narrow-round edge ridge placed at right angles to the axis of the handle.
   b) **Claw Hammer**: It is used for striking as well as for pulling the nails from the wood. It is made of cast steel.
   c) **Mallet**: It is used to strike the chisels that have wooden handles. It is made up of a hard wood & is round or rectangular in shape.

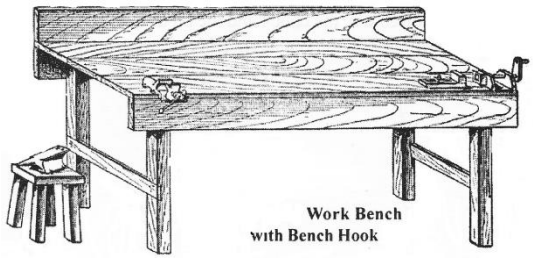


6. **<u>Sharpening Tools</u>**:
   a) **Water Stone**
   b) **Triangular File**
   c) **Grinding wheel of Grinder**



7. **<u>Holding Devices</u>**:
   a) **Work Bench**: Size of the table is 6'X3'. Two to Four carpenter's vice are fixed at the four corners of the table. This table acts as a base for all the carpentry operations.
   b) **Bench Hook**: It is a simple type of working tool used for supporting the wood while working on it. It is used on work bench. Sawing & planning are mostly done on it.
   c) **Clamping Vice**: It is used for sawing, joining or cutting more than one strip of the wood at the same time. It's one end is fixed on the table while other is kept movable. It is made of cast steel & jaws are lined with hard wood.





Work Bench
with Bench Hook