SecA- Tuesday
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INDIAN INSTITUTE OF TECHNOLOGY (ISM) DHANBAD, JHARKHAND

MECHANICAL ENGINEERING DEPARTMENT

WORKSHOP TECHNOLOGY

MACHINE SHOP - II

NAME OF EXPERIMENT: Machining operation on Milling Machine.

2.1 INTRODUCTION: Milling is the process of machining using rotary cutters to remove material by advancing a cutter into a work piece. This may be done varying direction on one or several axes, cutter head speed, and pressure. Milling covers a wide variety of different operations and machines, on scales from small individual parts to large, heavy-duty gang milling operations. It is one of the most commonly used processes for machining custom parts to precise tolerances.

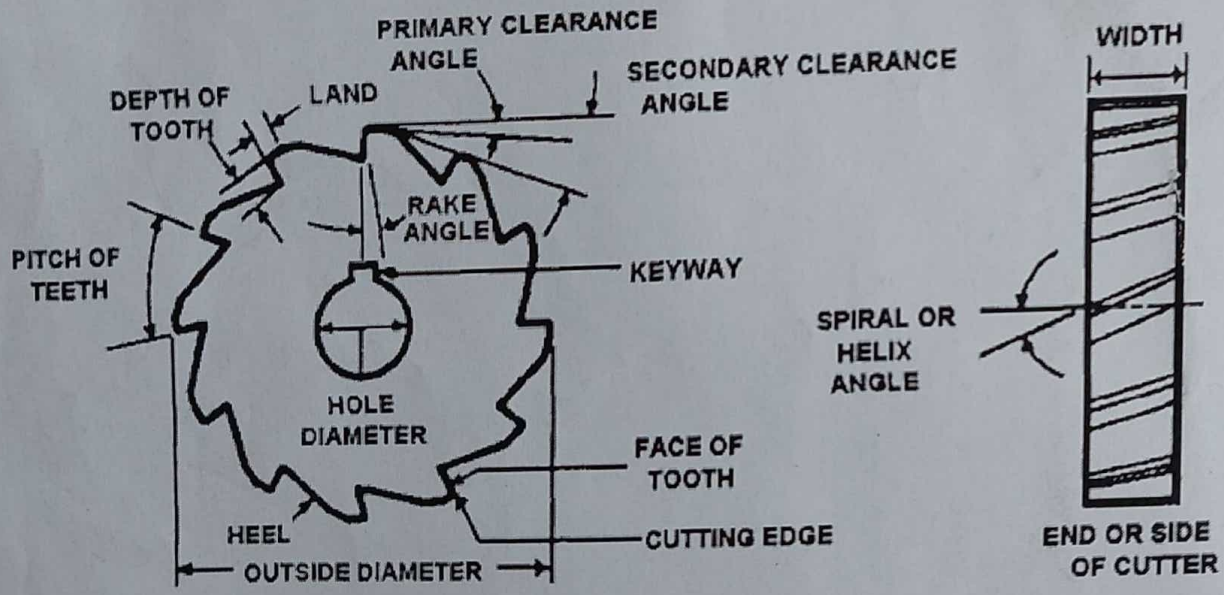
4.6 TOOL MATERIALS

General purpose hand cutting tools are usually made from carbon steel or tool steel. The single point lathe cutting tools are made of high speed steel (HSS).the main alloying elements in 18-4-1 HSS tools are 18 percent tungsten, 4 percent chromium and 1 percent vanadium.5 to 10 percent cobalt is also added to improve the heat resisting properties of the tool.

Carbide tipped tools, are mostly used in production shops.

4.7 TOOL GEOMETRY

A multipoint cutting tool used on milling machine. Figure shows the common milling tools used for different operations. Figure shows the basic angles of a simple side and face cutting tool.



PRINCIPAL PARTS OF A MILLING MACHINE:

A milling machine has Column and Base, Knee, Saddle and Swivel Table, Power Feed Mechanism, Table, Spindle, Over Arm/ Overhanging Arm, Arbor Support, and Ram.

1. Column and base provide supports for the other parts of a milling machine. There is an oil reservoir and pump in the column to lubricate the spindle. The column rests on the base and also it has a coolant reservoir and a pump to provide coolant in machining operations.
2. Knee

   The gearing mechanism is enclosed within a knee. The knee is fastened to the column by dovetail ways. It is supported and adjusted by a vertical positioning screw also known as an elevating screw. The use of the elevating screw is to adjust the knee up and down by raising or lowering the lever with the help of hand or power feed.

3. Saddle and Swivel Table

   The saddle is on the knee and supports the table. Saddle slides on horizontal dovetail on the knee and dovetail are parallel to the axis of the spindle (in horizontal milling m/c). Swivel table is attached to the saddle that swiveled (revolved) horizontally in both directions.

4. Power Feed Mechanism

   The power feed mechanism is in the knee. The power feed mechanism is used to control in longitudinal (left and right), transverse (in and out), and vertical (up and down) feeds. For the desired rate of feed on the machine, the feed selection lever is placed to indicate on the feed selection plates. For some universal knee and column milling machines, feed is obtained by turning the speed selection handle till the required rate of feed is shown on feed dial. Almost in every milling machine, there is a rapid traverse lever which is used when a temporary increase in the speed of the longitudinal, transverse, or vertical feeds is required. This lever is used when the operator is aligning or positioning the work.

5. Table:

   A table is a rectangular casting that is presented on the top of a saddle. The table is used to hold the work or for work holding devices. There are several T-slots to hold work and work holding devices (jigs and fixtures). It can be operated by hand or by power. For moving the table by hand, it engages and turns the longitudinal hand crank. For moving it by power, it engages longitudinal direction feeds control lever.

6. Spindle:

The spindle is used to hold and drive the cutting tools of a milling machine. It is mounted on the bearings and has the support of the column. The spindle is driven by an electric motor via gear trains and gear trains are on the column. The spindle face lies near the table and has an internal taper machined on it. There are two keys at the front face provide a positive drive for cutter holder or arbor.

7. Over Arm/ Overhanging Arm:

Over arm is a horizontal beam and it is on the top face of the column. It may be a single casting and slides on the dovetail way which is on the top face of the column.

8. Arbor Support:

Arbor support is casting with a bearing that supports the outer end of a arbor. It also helps to align the outer end of the arbor with the spindle. Arbor support prevents the springing of the outer end of arbor in cutting operations. Generally, there are two types of arbor supports used in the milling machines. The first one has a small diameter bearing hole of a maximum diameter of 1 inch. The second one has a large diameter bearing hole of up to 23/4 inch.

9. Ram:

The ram is an overhanging arm in a vertical milling machine. The one end of the ram is mounted on the top of the column and the milling head is attached to another.

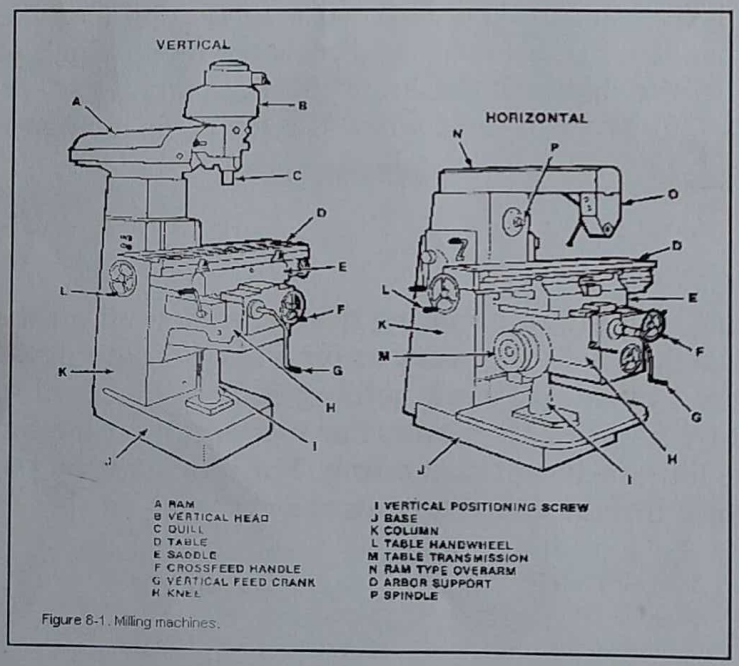
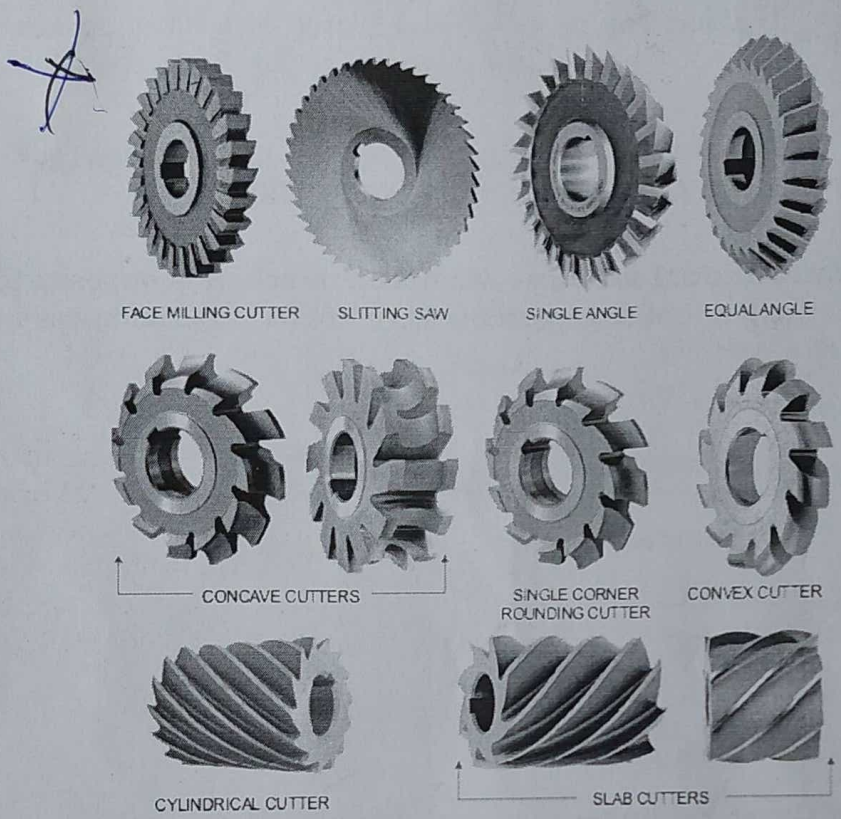


Figure 8-1. Milling machines.

- **COMMON MILLING CUTTER:** 1.End mill. 2. Face mill. 3. Ball cutter 4. Slab mill. 5. Side-and-face cutter. 6. Involutes gear cutter. 7. Fly cutter. 8. Hollow mill.



TYPES OF MILLING MACHINE:

The different types of Milling Machines are as follows.

- Horizontal milling machine.
- Vertical milling machine.
- Column and Knee Type Milling Machine
- Simplex milling machine.
- Duplex milling machine
- Triplex milling machine.
- Fixed Bed Type milling machine.
- Universal Milling Machine.

DIFFERENT TYPE OF MILLING MACHINE OPERATION:

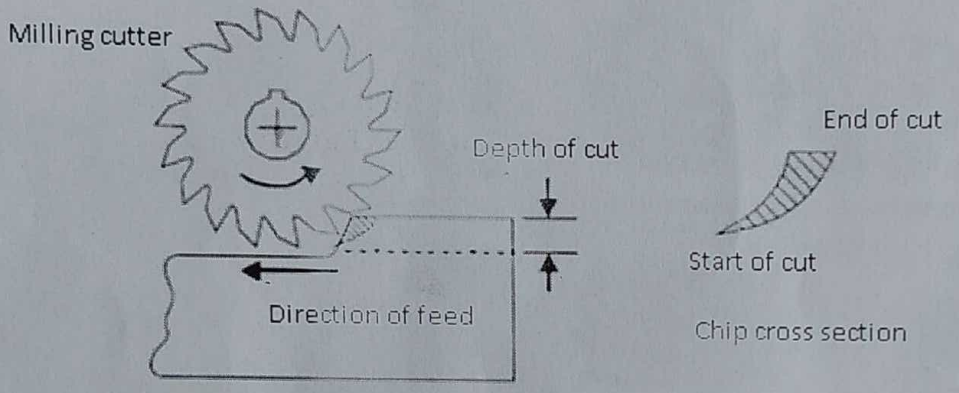
These are the operations we can perform on a Milling Machine:

1. Face Milling Operation
2. Slot or Slab Milling Operation

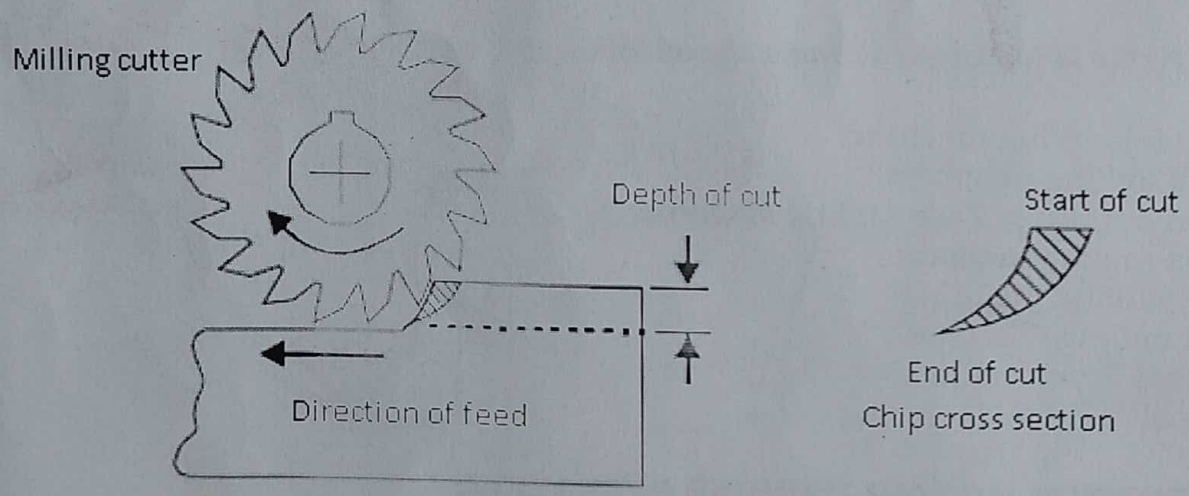
3. End Milling Operation
4. Angular Milling Operation
5. Side and Face Milling Operation
6. Form Milling Operation
7. Slitting Operation
8. Keyway Milling Operation
9. Gear Cutting Operation
10. Profile Milling Operation
11. Helical Milling Operation

DIFFERENCE BETWEEN UP MILLING AND DOWN MILLING OPERATION:

- **Up milling or Conventional milling**—when feed direction is opposite to the cutter rotation at the point of engagement. Here uncut chip thickness increases with cutter rotation.



- **Down milling or Climb milling**—when feed direction is along the direction of cutter rotation at the point of disengagement. Here uncut chip thickness decreases with cutter rotation.



Job No. 1:- Rough Milling of Izod test specimen.

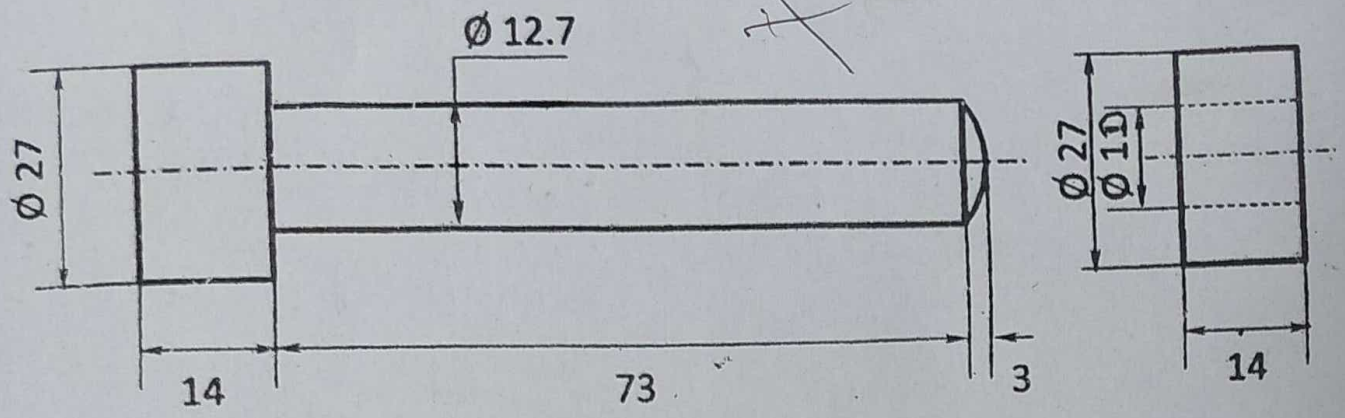
Material Supplied: - Mild Steel rod of 19mm dia. And 152mm long.

Tools used: - Vertical Milling machine, shell end mill cutter, indexing head, Tail stock, outside calipers, foot rule and spanner.

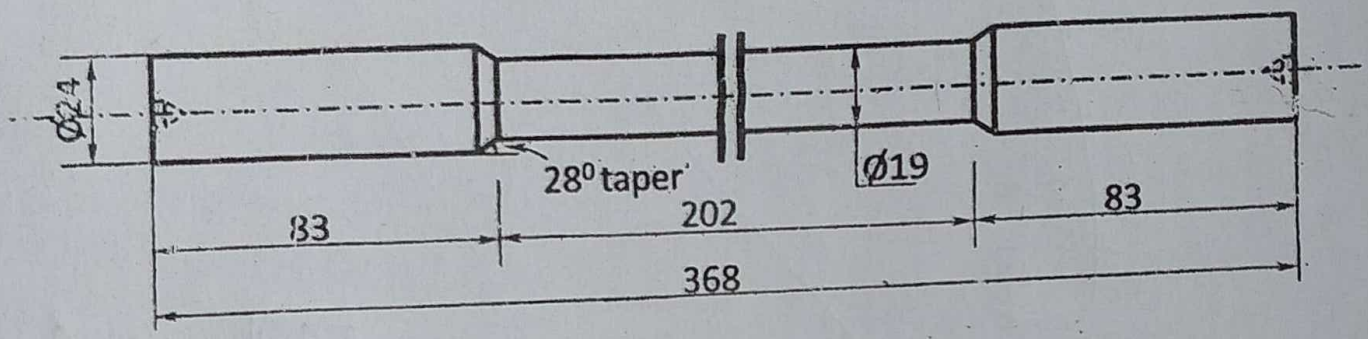
OPERATION

1. Measure the rough stock to be sure that it is of required size. Use the foot rule and outside calipers.
2. Hold the piece between the center of the tail stock and 3 jaw chuck or centre on the indexing head.
3. Set the indexing pin in the index plate initial hole.
4. Find out the direction of motion according to the direction of cutter.
5. Start the machine and by raising the table to bring the work gradually in contact with the cutter.
6. Clear the cutter from the work and raise the table by an amount of 0.125". Use graduated sleeve of the machine (1 division circular scale 0.001").
7. Start the coolant pump. Feed the work at slower rate by uniformly operating the longitudinal slide by hand. Cut from one end till the cutter reaches the other end of the work up to required length.
8. Clear the cutter from the work after the first cut is over. Now, as you have to make a square cross-section, index for the other side i.e. revolve the job through 90°. For this you have to give 10 revolutions to the indexing pin. Finish this side as before.

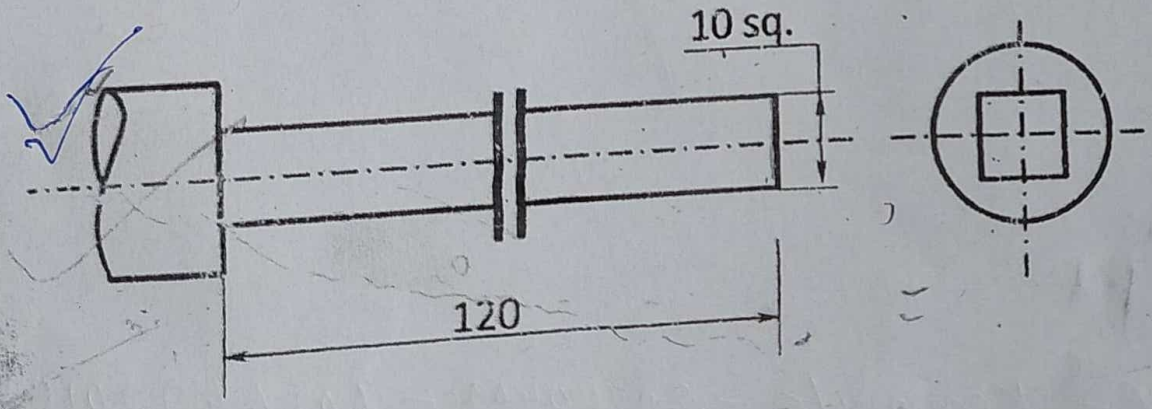
9. Repeat the operation 6, 7 and 8 to complete the other sides of the work. Use the foot rule and the caliper to measure the thickness of the work and finish the job to the required size by taking successive cuts.
10. Remove the work from the machine and file the corners to remove burrs.



JOB NO.1 BLANK FOR NUT AND BOLT



JOB NO.2 ROUGH TURNING OF TENSILE TEST SPECIMEN



JOB NO.3 ROUGH MILLING OF IZOD TEST SPECIMEN

NAME OF EXPERIMENT: Machining operation on Shaper Machine.

INTRODUCTION:

The shaper machine is a reciprocating type of machine basically used for producing the horizontal, vertical or flat surfaces. The shaper holds the single point cutting tool in ram and work piece is fixed in the table.

PRINCIPAL PARTS OF A SHAPER MACHINE:

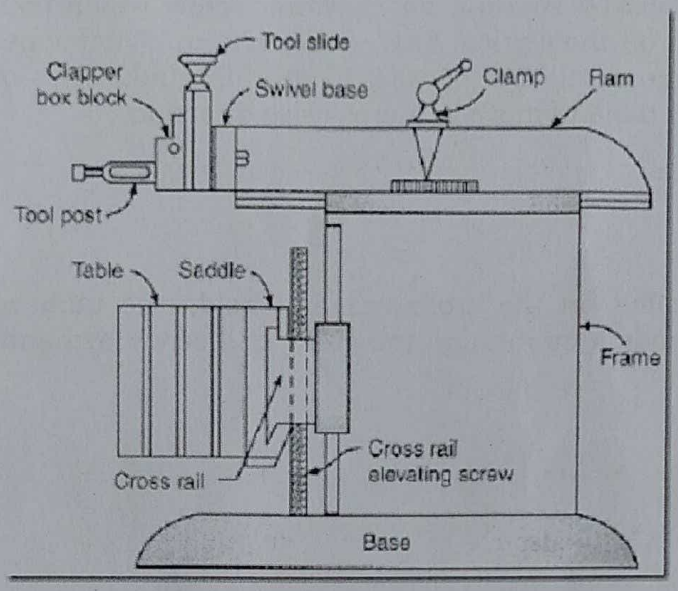


Fig. shows the parts of a standard shaper. The main parts are given as under.

1. Bas 2. Column 3. Cross-rail 4. Saddle 5. Table 6. Ram 7. Tool head 8. Clapper box 9. Apron clamping bolt 10. Down feed hand wheel 11. Swivel base degree graduations 12. Position of stroke adjustment hand wheel 13. Ram block locking handle 14. Driving pulley 15. Feed disc 16. Pawl mechanism 17. Elevating screw. Some of important parts are discussed as under.

Base

It is rigid and heavy cast iron body to resist vibration and takes up high compressive load. It supports all other parts of the machine, which are mounted over it. The base may be rigidly bolted to the floor of the shop or on the bench according to the size of the machine.

Column

The column is a box shaped casting mounted upon the base. It houses the ram-driving mechanism. Two accurately machined guide ways are provided on the top of the column on which the ram reciprocates.

Cross rail

Cross rail of shaper has two parallel guide ways on its top in the vertical plane that is perpendicular to the rail axis. It is mounted on the front vertical guide ways of the column. It consists mechanism for raising and lowering the table to accommodate different sizes of jobs by rotating an elevating screw which causes the cross rail to slide up and down on the vertical face of the column. A horizontal cross feed screw is fitted within the cross rail and parallel to the top guide ways of the cross rail. This screw actuates the table to move in a crosswise direction.

Saddle

The saddle is located on the cross rail and holds the table on its top. Crosswise movement of the saddle by rotation the cross feed screw by hand or power causes the table to move sideways.

Table

The table is a box like casting having T -slots both on the top and sides for clamping the work. It is bolted to the saddle and receives crosswise and vertical movements from the saddle and cross rail.

Ram

It is the reciprocating part of the shaper, which reciprocates on the guideways provided above the column. Ram is connected to the reciprocating mechanism contained within the column.

Tool head

The tool head of a shaper performs the following functions-

(1) It holds the tool rigidly,

(2) It provides vertical and angular feed movement of the tool, and

3) It allows the tool to have an automatic relief during its return stroke.

TYPES OF SHAPER MACHINES:

Following are the different types of shaper machines. 1. Based on the type of driving mechanism. 1. Crank type shaper. 2. Geared type shaper. 3. Hydraulic type shaper. 2. Based on ram travel. 1. Horizontal shaper 2. Vertical shaper. 3. Based on the table design. 1. Standard shaper. 2. Universal shaper. 4. Based on cutting stroke. 1. Push cut type 2. Draw cut type

DIFFERENT TYPE OF SHAPER MACHINE OPERATION:

- Horizontal cutting.
- Vertical cutting.
- Inclined cutting.
- Irregular cutting.

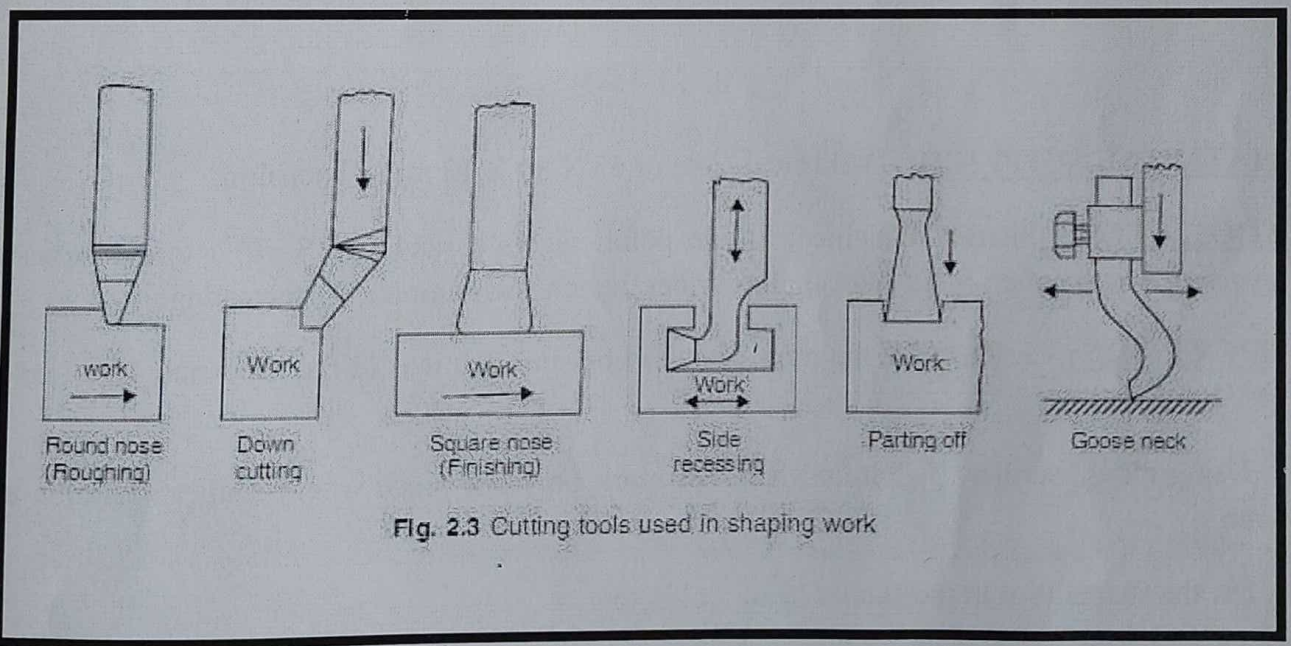
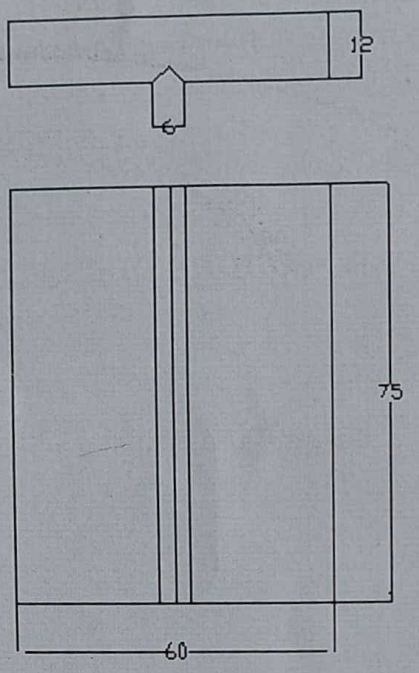


Fig. 2.3 Cutting tools used in shaping work

JOB NO. 2:- Flat surface and 'V' – Grove cutting on shaper machine.



MATERIAL SUPPLIED: - Mild steel plate of 65 X 80 X 12 mm dimension.

TOOL USED:- Shaper machine , single point negative rake H.S.S 'V' tool , Adjustable spanner, Box spanner, Steel rule, chalk, scriber, punch and hammer, surface gauge.

OPERATION: - 1. Measure the rough stock to be sure that it is of required size. Use steel rule or Vernier calliper.

2. Using chalk, scriber, punch and hammer mark on work piece where shaper operation to be done

3. Fix the shaper tool in the shaper head tool holder.

4. Hold the work piece in machine vice which is rest on shaper machine table ad set one face of work piece parallel to the machine table by using of surface gauge and try square.

5. Adjust the stroke length by stroke adjustment hand wheel and table height by Elevating screw.

6. When the machine is switch on, the ram is moves with reciprocating motion. in this condition, the time taken for return stock is less than the time taken for forward stock, this is known as **'Quick return mechanism'** and the tool should be moved down slowly for given 'depth of cut'.

7. At first slowly move the table manually for feed, because of rough surface on the job material.

8. After one complete pass of the surface machining, start auto feed by **'Pawl and Ratchet mechanism'**.

9. When surface finish is totally complete then stop the machine and reset tool position for making 'V' groove.

10. Now switch on the machine and cut the 'V' groove as per the given dimension.

11. Remove the work from the slowly machine and file the corners to remove burrs.