WORKSHOP

DEPARTMENT OF MECHANICAL ENGINEERING

LAB MANUAL

OF

Machine Shop -2

INDIAN INSTITUTE OF TECHNOLOGY (INDIAN SCHOOL OF MINES), DHANBAD

OBJECTIVES

The objectives of machine shop-2 laboratory are

- ✓ To study milling machine and shaper machine operations.
- ✓ To prepare Izod test specimen using milling machine.
- ✓ To make a plain surface and V groove using shaper machine.

OUTCOMES

The expected outcome of machine shop- 2 that the students should have

- ✓ A practical hand on experience of milling and shaper machine.
- ✓ Understand the basic mechanism of milling machine and shaper machine.
- ✓ Learn to perform machining operation on the milling and shaping machine.

Tutorial Assignments

- ✓ To make an Izod test specimen.
- ✓ To make plain surface and 'V' groove.

Milling:

Milling is the operation of removing a layer of material from the surface of work piece or producing a slot in the component using a rotating multipoint cutting tool called as milling cutter.

Basic functions and purposes of using milling machines:

The basic function of milling machines is to produce flat surfaces in any orientation as well as surfaces of revolution, helical surfaces and contoured surfaces of various configurations. Such functions are accomplished by slowly feeding the work piece into the equispaced multiedge circular cutting tool rotating at moderately high speed.

Working Principle:

The workpiece is holding on the worktable of the machine. The table movement controls the feed of workpiece against the rotating cutter. The cutter is mounted on a spindle or arbor and revolves at high speed. Except for rotation the cutter has no other motion. As the workpiece advances, the cutter teeth remove the metal from the surface of workpiece and the desired shape is produced.

Different parts of a vertical milling machine:

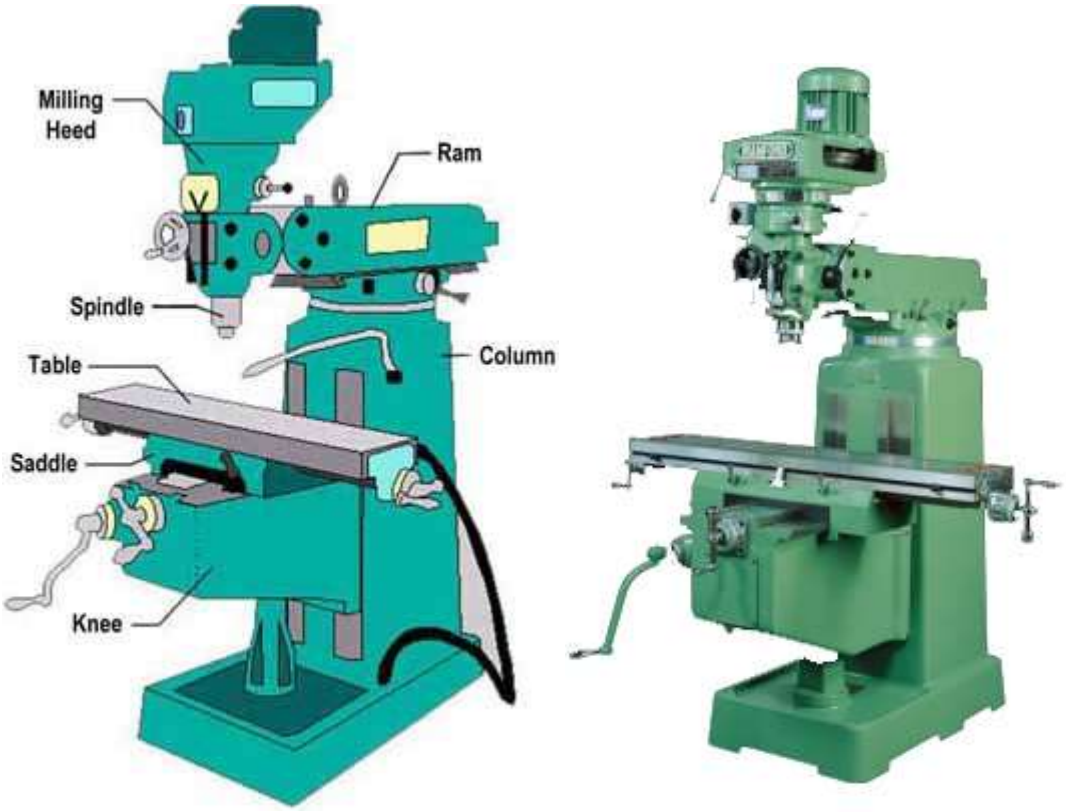


Fig. 1 different parts of a vertical milling machine

Base: It gives support and rigidity to the machine and also acts as a reservoir for the cutting fluids.

Column: The column is the main supporting frame mounted vertically on the base. The column is box shaped, heavily ribbed inside and houses all the driving mechanisms for the spindle and table feed.

Knee: The knee is a rigid casting mounted on the front face of the column. The knee moves vertically along the guide ways and this movement enables to adjust the distance between the cutter and the job mounted on the table. The adjustment is obtained manually or automatically by operating the elevating screw provided below the knee.

Saddle: The saddle rests on the knee and constitutes the intermediate part between the knee and the table. The saddle moves transversely, i.e., crosswise (in or out) on guide ways provided on the knee.

Table: The table rests on guide ways in the saddle and provides support to the work. The table is made of cast iron, its top surface is accurately machined and carries T-slots which accommodate the clamping bolt for fixing the work. The worktable and hence the job fitted on it is given motions in three directions:

a). Vertical (up and down) movement provided by raising or lowering the knee.

b). Cross (in or out) or transverse motion provided by moving the saddle relative to knee.

c). Longitudinal (back and forth) motion provided by hand wheel fitted on the side of feed screw.

In addition to the above motions, the table of a universal milling machine can be swiveled 45° to either side of the centre line and thus fed at an angle to the spindle.

Purpose of using milling machine:

- Flat surface in vertical, horizontal and inclined planes
- Making slots of various sections
- Cutting teeth in piece or batch production of spur gears, straight toothed bevel gears, worm wheels, sprockets, clutches etc.
- Producing some features like grooves, flutes, gushing and profiles in various cutting tools, e.g., drills, taps, reamers, hobs, gear shaping cutters etc.

Classification of milling machines:

According to the orientation of the spindle(s)

Plain horizontal knee type
Vertical spindle type
Universal head milling machine

Broad classifications of milling cutters

Milling cutters are mainly classified as,

- End milling cutter
- Peripheral milling cutter

Indexing:

The operation of rotating the job through the required angle between two successive cuts is called as indexing.

Methods of indexing:

(i) Direct indexing (ii) Simple indexing (iii) Angular indexing (iv) Compound indexing

(v) Differential indexing

Simple indexing:

In simple indexing if N no. of divisions are to be made on the circumference of the job then required crank rotations = $\frac{40}{N}$.

Example: If 6 divisions are to be made on the job then find the crank rotation required.

Given: N=6

Therefore crank rotation (CR) = $\frac{40}{6} = 6\frac{4}{6} = 6\frac{2}{3} = 6\frac{2\times5}{3\times5} = 6\frac{10}{15}$.

Hence the crank rotation required after every cut is 6 complete rolution and 10 holes in a 15 holes circle.

Shaping machine: 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 workpiece is fixed in the table

Working Principle of Shaping machines: Shaper machine works on the quick return mechanism. It is used to shape the metal or make flat surfaces, making grooves and slots. It cuts the metal in one stroke in back motion or in froth motion and the remaining one is useless. The working of shaper machine can be described as follow.

1. First the job is fixed to the machine table.
2. The single point cutting tool is mounted on the tool post situated on the ram.
3. Now the motor start by manually which create reciprocating motion of ram by quick return mechanism.
4. When the ram is in reciprocating motion, the tool rubs the work piece, which removes unwanted material from it. It cuts the metal in forward stroke.
5. While return strokes the clapper provide the clearance between tool and work piece, which make sure no cutting in return stroke. If the tool cuts material in both in forward and return stroke it give poor surface finish and also cause for tool wear.
   Today we have discussed about shaper machine parts and working. If you have any query regarding this article ask by commenting. If you like this article, don't forget to share it on social networks. Subscribe our website for more informative articles. Thanks for reading it.

Parts of Shaper Machine:

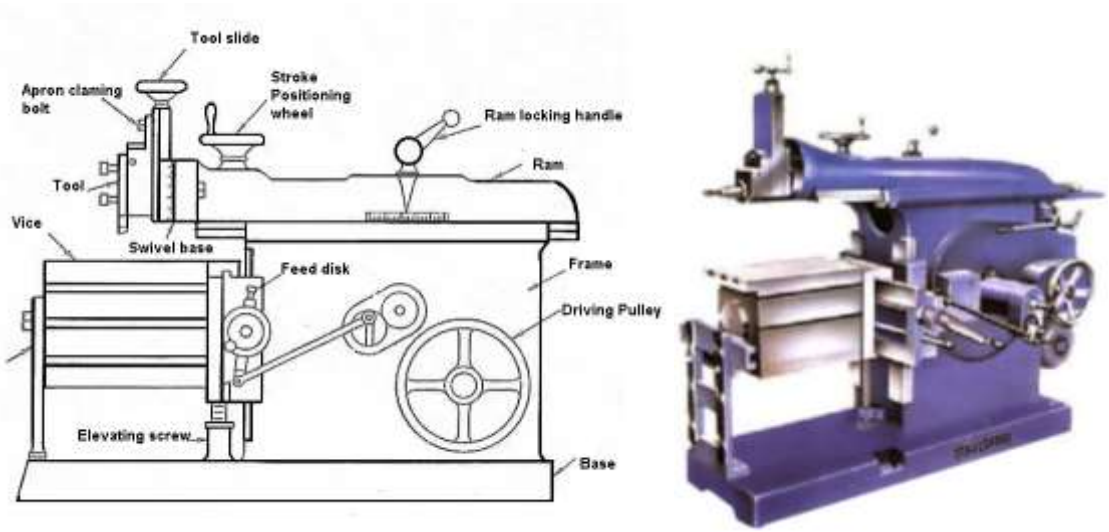


Fig. 2 different parts of a shaping machine

The following are the main parts of shaper machine:

1. Base: It is the main body of the machine. It consist all element of machine. It works as pillar for other parts. Base is made by cast iron which can take all compressive loads.

2. Ram: It is the main part of the shaper machine. It holds the tool and provides the reciprocating motion to it. It is made by cast iron and move over ways on column. It is attached by the rocker arm which provide it motion in crank driven machine and if the machine is hydraulic driven it is attached by hydraulic housing.

3. Tool head: It is situated at the front of the ram. Its main function is to hold the cutting tool. The tool can be adjusted on it by some of clamps.

4. Table: It is the metal body attached over the frame. Its main function is to hold the work piece and vice over it. It has two T slots which used to clamp vice and work piece over it.

5. Clapper box: It carries the tool holder. The main function of clapper box is to provide clearance for tool in return stock. It prevents the cutting edge dragging the work piece while return stock and prevent tool wear.

6. Column: Column is attached to the base. It provides the housing for the crank slider mechanism. The slide ways are attached upper section of column which provide path for ram motion.

7. Cross ways: It consist vertical and horizontal table sideways which allow the motion of table. It is attach with some cross movement mechanism.

8. Stroke adjuster: It is attached below the table. It is used to control the stroke length which further controls the ram movement.

9. Table supports: These are attached front side of the table and used to support the weight of table during working.

Classification of shaping machines:

Following are the different types of shaper machines.

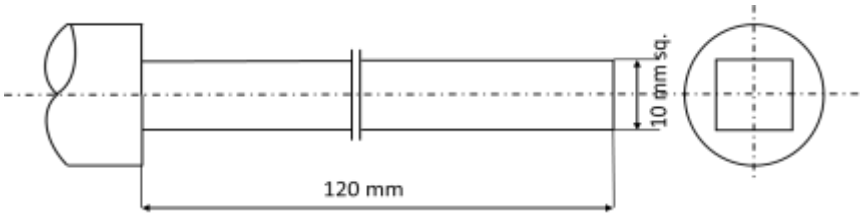
1. **Based on the type of driving mechanism.**
   1. Crank type shaper.
   2. Geared type shaper.
   3. Hydraulic type shaper.
2. **Based on ram travel.**
   1. Horizontal shaper
   2. Vertical shaper.
3. **Based on the table design.**
   1. Standard shaper.
   2. Universal shaper.
4. **Based on cutting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

Job No. 01: 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:**

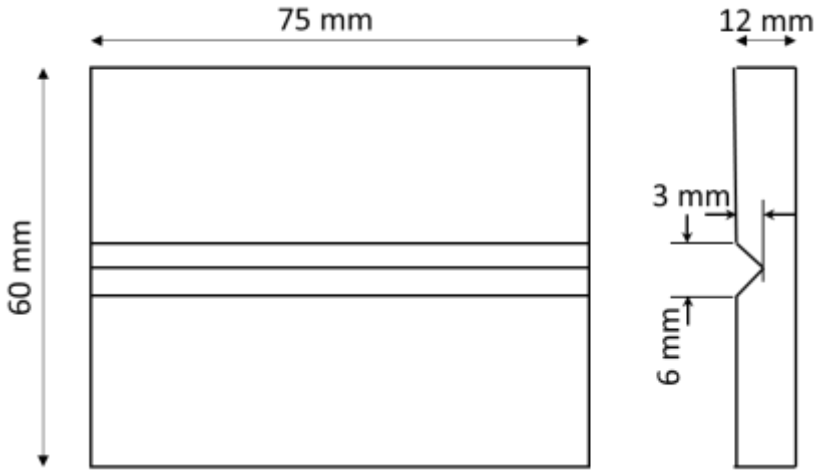
1. Measure the rough stock to be sure that it is of required size. Use the foot rule and outside calipers.
2. Hold the piece between the center of the tail stock and 3 jaw chuck or centre on the indexing head.
3. Set the indexing pin in the index plate initial hole.
4. Find out the direction of motion 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 90^0. 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. 3 ROUGH MILLING OF IZOD TEST SPECIMEN

Job No. 02: To make plain surface and 'V' groove.

- ***Materials Supplied:*** M.S. plate 75x60x12.5 (All dimensions are in mm)
- ***Tools used:*** Shaper, V Tool, Vernier Calliper, Vice, Scribber and Surface Gauge**.**
- **Operation:**
    1. Check the supplied material to ensure that material fulfils specified dimensions.
    2. Fix the material on a vice fixed on the table of shaper.
    3. Use scriber and surface gauge to check the proper location of job.
    4. Fix the tool on the tool head.
    5. Adjust the depth of cut using tool feed handle
    6. Take a cut and move the table manually using handle for table traverse.
    7. After taking the first cut check the dimension using Vernier calliper.
    8. Find the centre of the job (half of the width).
    9. Adjust the tool & make a v groove 3 mm deep.
    10. Check the dimensions.
    11. Remove the job from vice.



JOB NO 2: MAKING OF FLAT SURFACE AND 'V' GROOVE ON SHAPER MACHINE