GOVERNMENT COLLEGE OF ENGINEERING, KALAHANDI, BHAWANIPATNA

ENGINEERING WORKSHOP LAB MANUAL

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CONTENTS

SQUARE PAPER WEIGHT

Experiment Number-01

Aim of The Experiment: To prepare a square paper weight by using hand tools.

Raw Materials Required:

i. M.S (Mild Steel) Flat of – (50×50×10) mm.
ii. M.S Rod of – (50×6) mm.

Tools Required:

i. Steel Rule
ii. Hack Saw
iii. Flat File
iv. Scriber
v. Vernier Height Gauge
vi. Try-Square
vii. Center Punch
viii. Bench Vice
ix. Centre Punch
x. Power Hack Saw
xi. Drilling Machine

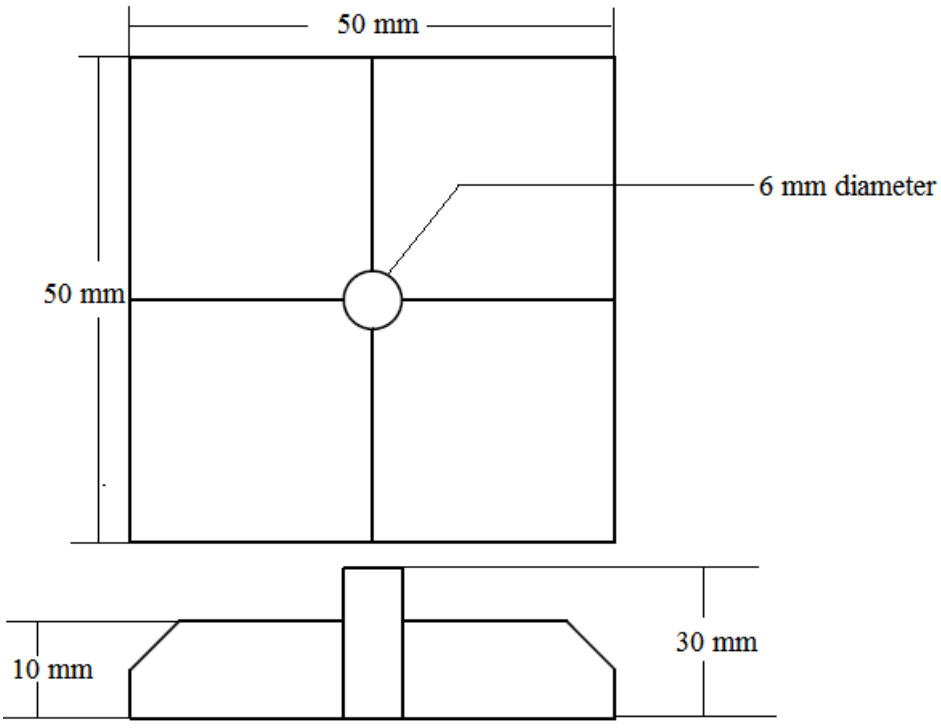

Figure 1: Square Paper Weight

Procedure:

- Cut M.S square of (50×50×5) cross-section from a M.S flat by using power hacksaw.
- Fix the workpiece in the bench vice tightly.
- Filed the workpiece and after filing check the edges and surface of the workpiece with a Try-square to achieve perfect right angles.
- Draw lines on the front surface and side surfaces of the square block, which is 5mm away from the edges by using vernier height gauge.
- Create dotted marks on these lines by using a center punch, for clear visibility of these lines.
- Then use the square file to make chamfers (inclined surface at an angle of 45^0).
- Drill a hole of 6mm diameter at the center position of the square by using a parallel drilling machine.
- Cut a rod of 6mm diameter and 50mm by using hack saw.
- Pressed that rod on the hole produced at the center of the square block.
- Lastly apply a layer of paint on it, to avoid rusting.

Precautions:

- Tighten the job properly in the bench vice.
- The perpendicularity of face end edges is checked perfectly by using try square.
- Finishing is given by using only with smooth files.
- Marking is done without parallax error.

Conclusion:

The paper weight was prepared successfully and safely.

BUTT WELD JOINT

Experiment Number-02

Aim of The Experiment: To prepare a butt joint.

Raw Materials Required:

i. Two M.S flat of length 58mm, width 48mm and thickness 5mm.

Tools Required:

i. File
ii. Hammer
iii. Scriber
iv. Chipping hammer
v. 3.15mm mild steel electrode
vi. Steel rule
vii. Try square
viii. Welding machine

Theory:

Welding is a process of joining two or more pieces of the same or dissimilar materials to achieve complete coalescence. Welding is the only method of developing monolithic structure. It joins different metals/alloys, with or without the application of pressure and with or without the use of filler metal. The fusion of metal takes place by means of heat. The heat may be generated either from combustion of gases, electric arc, electric resistance or by chemical reaction. Welding provides a permanent joint but it normally affects the metallurgy of the components. It is therefore usually accompanied by post weld heat treatment for most of the critical components. The welding is widely used as a fabrication and repairing process in industries. Some of the typical applications of welding include the fabrication of ships, pressure vessels, automobile bodies, off-shore platform, bridges, welded pipes, sealing of nuclear fuel and explosives, etc. A large number of metals/alloys which are similar or dissimilar can be joined by welding. Welding permits considerable freedom in design.

Figure 2: Arc Welding Machine

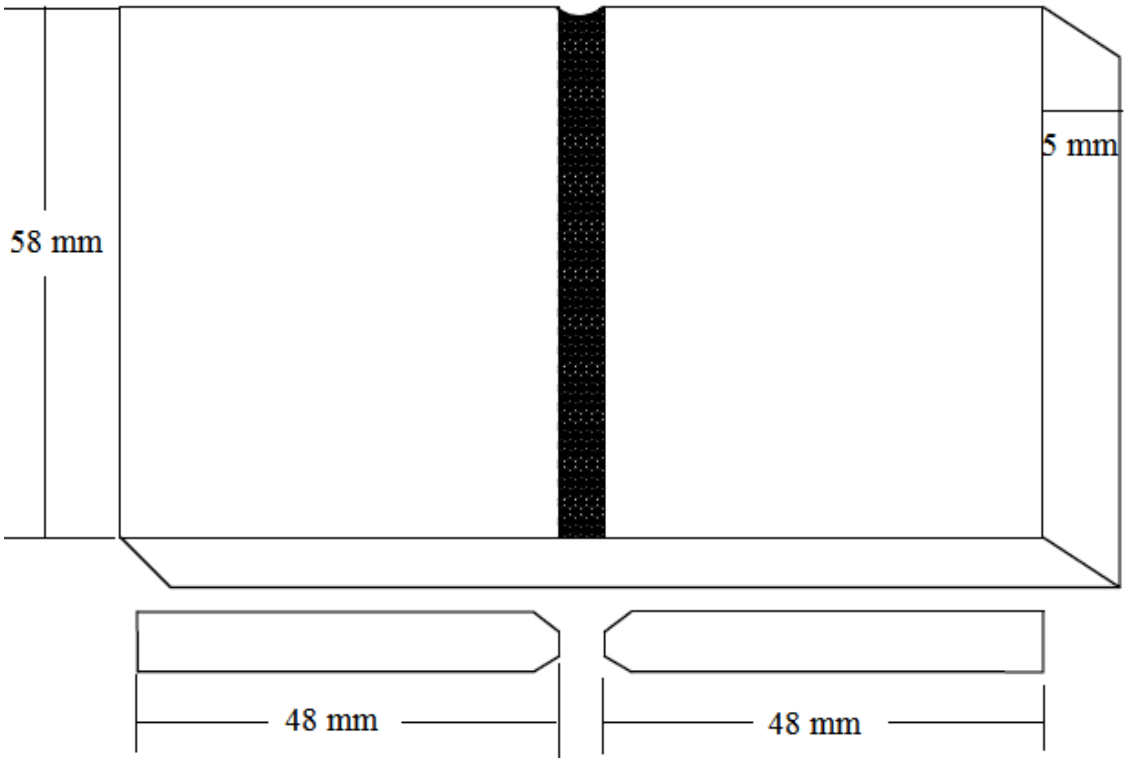

Figure 3: Butt Joint

Procedure:

- Cut the raw part of required size from a M.S flat.
- Measure the dimension of the plates by using steel rule.
- Filed the plates and checked edges by a try-square to obtain perfect right angles between edges.
- Mark flat plate on one side with help of chalk.
- Draw a reference line on the marked side of the plate using scriber.
- Follow the same steps to prepare the second flat plate.
- Filed the edges which are to be joined, so a V-shape will be appeared in the joint section.
- Filed the plates in such a way that the thickness was reduced to 2mm from 5mm.
- Connect both the plates with their V-shaped edges.
- Move the electrode over the workpiece surface that was connected to an oil cooled AC transformer welding machine to produce the weld.
- Lastly filed the joint area to make them shiny.

Precautions:

- Use gloves when performing weld to avoid burning.
- Use shield to protect yourself from radiation.
- Maintain the gap between electrode and workpiece to increase strength of weld.

Conclusion:

The butt joint was prepared successfully and safely.

STEPPED CYLINDRICAL TURNING

Experiment Number-03

Aim of The Experiment: To prepare a stepped cylindrical turning job.

Raw Materials Required:

i. Mild steel rod of 25 mm diameter and 100 mm long.

Tools Required:

i. Vernier calipers
ii. Steel rule
iii. Spanner
iv. Chuck spanner
v. H.S.S. single point cutting tool
vi. Lathe machine

Specification of Lathe Machine:

i. Length of bed 1390 mm
ii. Width of bed 200 mm
iii. Height of centers 165 mm
iv. Admit between centers 700 mm
v. Lead screw pitch 4TPI
vi. Power of the motor is 1 H.P.

Theory:

Lathe removes undesired material from a rotating work piece in the form of chips with the help of a tool which is traversed across the work and can be fed deep in work. The tool material should be harder than the work piece and the later help securely and rigidly on the machine. The tool may be given linear motion in any direction. A lathe is used principally to produce cylindrical surfaces and plane surfaces, at right angles to the axis of rotation. A lathe (shown in fig. 4) basically consists of a bed to provide support, a head stock, a cross side to traverse the tool, a tool post mounted on the cross slide. The spindle is driven by a motor through a gear box to obtain a range of speeds. The carriage moves over the bed guide ways parallel to the work piece and the cross slide provides the transverse motion. A feed shaft and lead screw are also provided to power the carriage and for cutting the threads respectively.

Figure 4: Lathe Machine

Parts of Lathe Machine:

The Lathe machine consists following parts.

1. **Bed:** It is the main body of the machine. All main components are bolted on it. It is usually made by cast iron due to its high compressive strength and high lubrication quality. It is made by casting process and bolted on floor space.
2. **Tool Post:** It is bolted on the carriage. It is used to hold the tool at correct position. Tool holder mounted on it.
3. **Chuck:** Chuck is used to hold the workspace. It is bolted on the spindle which rotates the chuck and work piece. It is four jaw and three jaw according to the requirement of machine.
4. **Head Stock:** Head stock is the main body parts which are placed at left side of bed. It is serving as holding device for the gear chain, spindle, driving pulley etc. It is also made by cast iron.
5. **Tail Stock:** Tail stock situated on bed. It is placed at right hand side of the bed. The main function of tail stock to support the job when required. It is also used to perform drilling operation.
6. **Lead Screw:** Lead screw is situated at the bottom side of bed which is used to move the carriage automatically during thread cutting.
7. **Carriage:** It is situated between the head stock and tail stock. It is used to hold and move the tool post on the bed vertically and horizontally. It slides on the guide ways. Carriage is made by cast iron.
8. **Spindle:** It is the main part of lathe which holds and rotates the chuck.

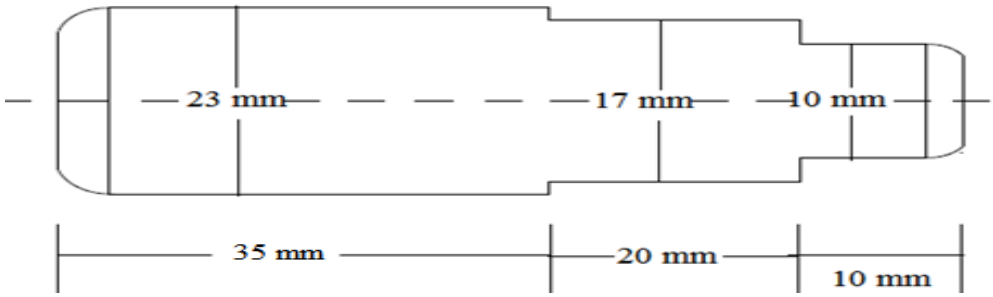

Figure 5: Stepped cylindrical turning job.

Procedure:

- Fix the work piece is in a 3-jaw chuck with sufficient overhang.
- Adjust the machine to run the job to a required cutting speed.
- Fix the cutting tool in the tool post and performed centering operation so that the axis of the job coincides with the lathe axis.
- Give the feed and depth of cut to the cutting tool.
- Perform facing operation from the center of the job towards outwards or from the circumference towards the center.
- Perform plain turning operation until the diameter of the work piece reduces to 23 mm.
- Check the dimensions by using vernier calipers.
- Perform chamfering on the 23mm diameter surface.
- Reverse the work piece in the chuck and performed facing operation to reduce the length of work piece to the required dimensions.
- Again perform plain turning operation until the diameter of the work piece reduced to 17 mm.

Precautions:

- The work piece should be held rigidly in the chuck before operating the machine.
- Tool should be properly ground, fixed at correct height and properly secured, and work also be firmly secured.
- Before operating the machine see whether the job and tool is firmly secured in devices or not.
- Optimum machining conditions should be maintained.
- Chips should not be allowed to wound around a revolving job and cleared as often as possible.
- Apply cutting fluids to the tool and work piece properly.

Conclusion: The stepped cylindrical turning job was prepared successfully and safely.

THREAD CUTTING

Experiment Number-04

Aim of The Experiment: To perform thread cutting operation on a given work piece by using lathe machine.

Material Required:

Mild Steel rod of 30 mm diameter and 150 mm long.

Tools Required:

i. Vernier calipers
ii. Steel rule
iii. Spanner
iv. Chuck spanner
v. H.S.S. single point cutting tool, parting tool and V- cutting tool.
vi. Lathe Machine

Specification of Lathe Machine:

Length of bed 1390 mm
Width of bed 200 mm
Height of centers 165 mm
Admit between centers 700 mm
Lead screw pitch 4TPI
Power of the motor is 1 hp.

Theory:

Lathe removes undesired material from a rotating work piece in the form of chips with the help of a tool which is traversed across the work and can be fed deep in work. The tool material should be harder than the work piece and the later help securely and rigidly on the machine. The tool may be given linear motion in any direction. A lathe is used principally to produce cylindrical surfaces and plane surfaces, at right angles to the axis of rotation. It can also produce tapers and bellows etc. A lathe basically consists of a bed to provide support, a head stock, a cross side to traverse the tool, a tool post mounted on the cross slide. The spindle is driven by a motor through a gear box to obtain a range of speeds. The carriage moves over the bed guide ways parallel to the work piece and the cross slide provides the transverse motion. A feed shaft and lead screw are also provided to power the carriage and for cutting the threads respectively.

Figure 6: Lathe Machine

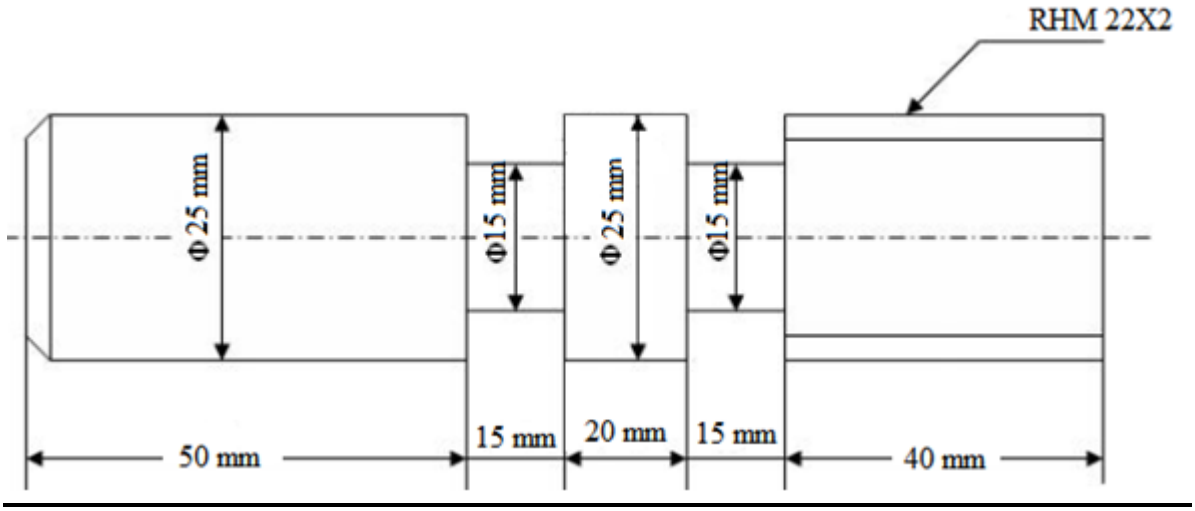

Figure 7: Thread cutting operation

Procedure:

- Fix the work piece in a 4– jaw chuck with sufficient overhang.
- Fix the cutting tool in the tool post and performed centering operation so that the axis of the job coincides with the lathe axis.
- Perform facing operation by giving longitudinal depth of cut and cross feed.
- Perform plain turning operation was until the diameter of the work piece reduced to 25mm.
- Perform chamfering operation according to the given dimensions.
- Then reverse the work piece was in the chuck and performs plain turning operation again according to the given dimensions.

- Use V-cutting tool and parting off tool to perform grooving operation on the specimen to the required dimensions.
- Reduce the speed of the spindle by engaging back gear and transmit power through the lead screw by using Tumbler feed reversing mechanism.
- And calculate the change gears for the required pitch to be made on the work piece.
- Perform thread cutting operation (right hand threading) according to the given dimensions using half nut mechanism and continues it until required depth of cut is obtained.

Precautions:

- Before starting the spindle by power, lathe spindle should be revolved by one revolution by hand to make it sure that no fouling is there.
- Tool should be properly ground, fixed at correct height and properly secured, and work also be firmly secured.
- Chips should not be allowed to wind around a revolving job and cleared as often as possible.
- Before operating threading operation, V-tool should be properly ground to the required helix angle.
- Apply cutting fluids to the tool and work piece property.
- No attempt should be made to clean the revolving job with cotton waste.
- On hearing unusual noise, machine should be stopped.

Conclusion:

The tread cutting operation was successfully completed on the given specimen.

MILLING

Experiment Number-05

Aim of the experiment: To perform face milling operation on a cube block by using milling machine.

Raw Materials Required:

Cast iron block of (50×50×50 mm)

Tools and Equipments Required:

i. Base pan hammer.
ii. Brush
iii. Vernier height gauge
iv. Vernier caliper
v. Spirit level
vi. Double ended spanner
vii. Milling Machine

Theory:

Milling machine is a machine tool that removes materials as the work is feed against the rotating multipoint cutter. The cutter rotated at a high speed and because of multiple cutting edges it removes material at very faster rate. The machine can hold one or more number of cutters at a time. This is why the milling machine finds its application in the production work. The mechanism of milling machine is composed of spindle drive mechanism and power feed mechanism. The spindle drive mechanism is incorporated in the column. The power is transmitted from the feed gear box. Telescopic shaft and universal joints are necessary to allow vertical movements. The main limitation of the milling machine is, it can't produce sharp corners.

Parts of Milling Machine:

1. **Base:** It is the foundation part of a milling machine. All other parts are jointed on it. It carries the entire load so it should have high compressive strength so it is made by cast iron. It also works as reservoir of cutting fluid.
2. **Column:** Column is another foundation part of milling machine. It is mountain vertically on the base. It supports the knee, table etc. Work as housing for the all the

other driving member. It is a hollow member which contains driving gears and sometimes motor for spindle and the table.

3. **Knee:** Knee is the first moving part of milling machine. If is mounted on the column and moves along the slide ways situated over the column. It is made by cast iron and moves vertically on slide ways. It moves up and down on sideways which change the distance between tool and workpiece It is driven by mechanically or hydraulically.
4. **Saddle:** It is placed between table and the knee and work as intermediate part between them. It can moves transversally to the column face. It slides over the guide ways provided situated on the knee which is perpendicular to the column face. The main function of it is to provide motion in horizontal direction to work piece. It is also made by cast iron.
5. **Table:** Table is situated over the knee. It is the part of machine which holds the work piece while machining. It is made by cast iron and have T slot cut over it. The work piece clamp over it by using clamping bolts. The one end of clamping bolt fix into this slot and other is fix to work piece which hold the work piece. It can provide three degree of freedom to work piece.
6. **Spindle:** Spindle is the main part of the machine which hold tool at right place in vertical milling machine and hold arbor in horizontal milling machine. It is a moving part which is in rotary motion. It is motor driven and drives the tool. It has a slot on the front end of it. The cutting tool fix in that slot.
7. **Ram:** Ram is work as overhanging arm in vertical milling machine. One end of the arm is attached to the column and other end to the milling head.

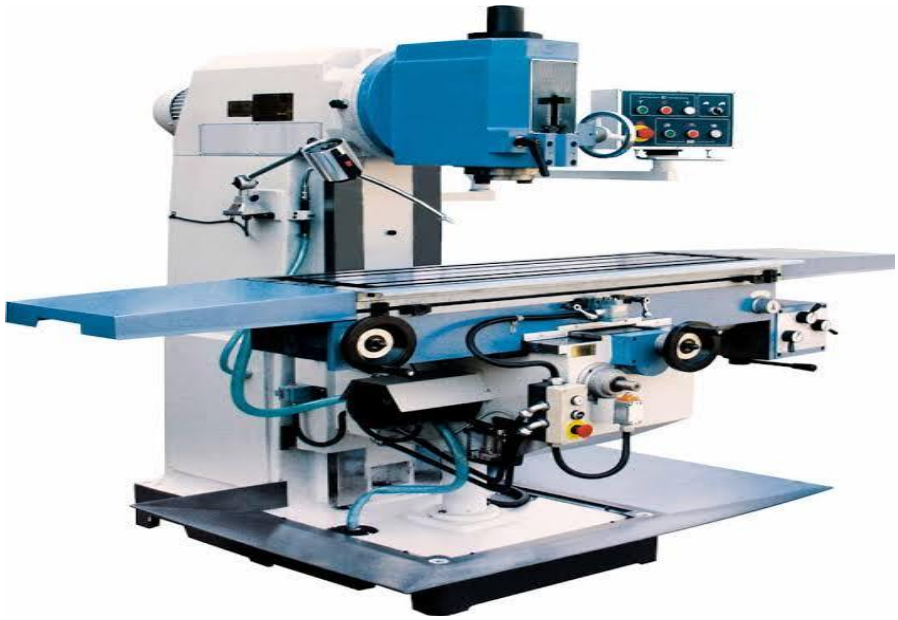

Figure 8: Milling Machine

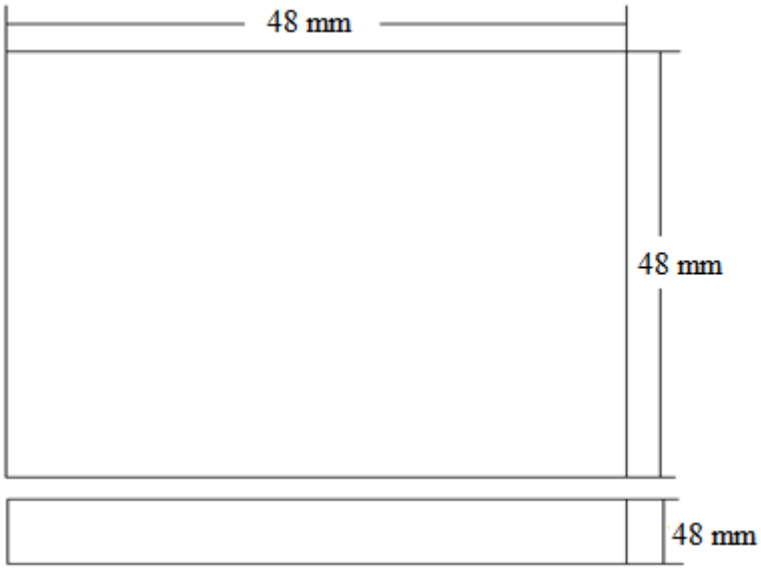

Figure 8: Layout of the job

Procedure:

- Use vernier height gauge to draw lines on the job surface to make it square.
- Fix the block in the milling machine.
- Set the feed, spindle speed and depth of cut.
- Mill the surface of the block until the height of the job reduced to 48 mm.
- After getting required dimensional product, clean the surface of the block by using brush.

Precautions:

- The job should be properly cleaned.
- Tool should be properly fixed in the tool head.
- Do not touch the block, tool head, and any other component of the machine, when the machine is working.
- Proper attention should be given to the machine.

Conclusion:

The job was prepared successfully and safely.

SHAPING

Experiment Number-06

Aim of The Experiment: To produce a channel in the cubic block by using shaping machine.

Raw Material Required:

Cast iron block of (50×50×50 mm)

Tools and Equipments Required:

i. Base pan hammer.
ii. Brush and ball pen hammer
iii. Vernier height gauge and Vernier caliper
iv. Spirit level
v. Double ended spanner
vi. V-block
vii. Shaping Machine

Specification of The Machine:

i. Length of ram stroke : 457 mm
ii. Length of ram : 914 mm
iii. Max/min. distance from table to ram 406 x 89
iv. Max. Vertical travel of tool slide 152 mm
v. Max. Swivel of tool head 60 degrees L & R
vi. Power of the motor is 2 H.P.

Theory:

In case of shaper; the job is rigidly held in a suitable device like a vice or clamped directly on the machine table. The tool is held in the tool post mounted on the ram of the machine. This ram reciprocates to and fro and in doing so makes the tool to cut the material in the forward stroke. No cutting of material takes place during the return stroke of the ram. Hence it is termed as idle stroke. However in case of a draw cut shaper the cutting takes place in the return stroke and the forward stroke is an idle stroke. The job is given an index feed in a direction normal to the line of action of the cutting tool.

Parts of the machine:

1) **Base:** It is a heavy and robust cast iron body which as a support for all the other parts of the machine which are mounted over it.
2) **Column:** It is a box type cast-iron body mounted on the base acts as housing for the operating mechanism of the machine. It also acts as a support for other parts of the machine such as cross rail and ram etc.
3) **Cross rail:** It is a heavy cast iron construction attached to the column at its front on the vertical guide ways. It carries two mechanisms: one for elevating the table and the other for cross traversing of the table.
4) **Table:** It is made of cast iron and has a box type construction. It holds and supports the work during the operation and slides along the cross rail to provide feed to the work.
5) **Ram:** It is also an iron casting, semi circular in shape and provides with a ribbed construction inside for rigidity and strength. It carries the tool head and travels in dovetail guide ways to provide a straight line motion to the tool.
6) **Tool head:** It is a device in which is held the tool. It can slide up and down can be swung to a desired angle to set the tool at a desired position for the operation.
7) **Vice:** It is job holding device and is mounted on the table. It holds and supports the work during the operation.

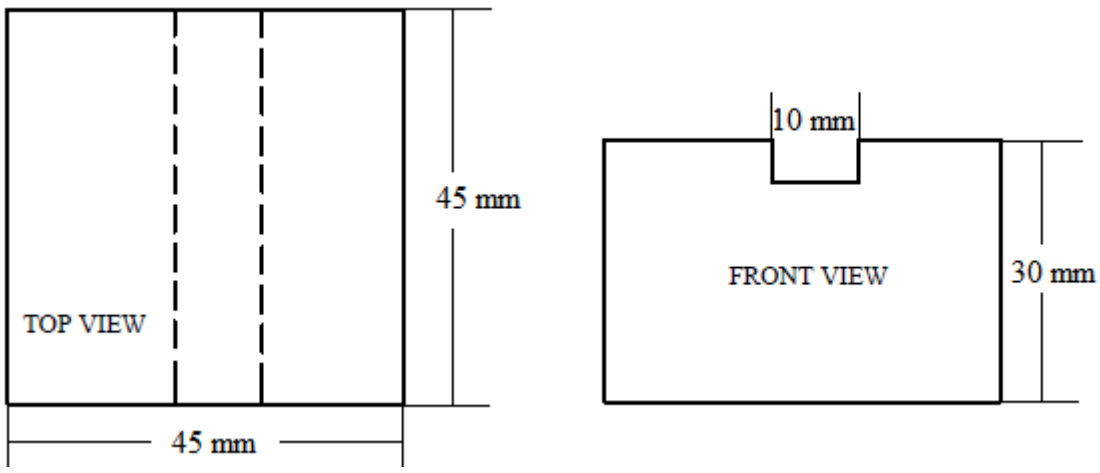

Figure 9: Block diagram of the job to be done

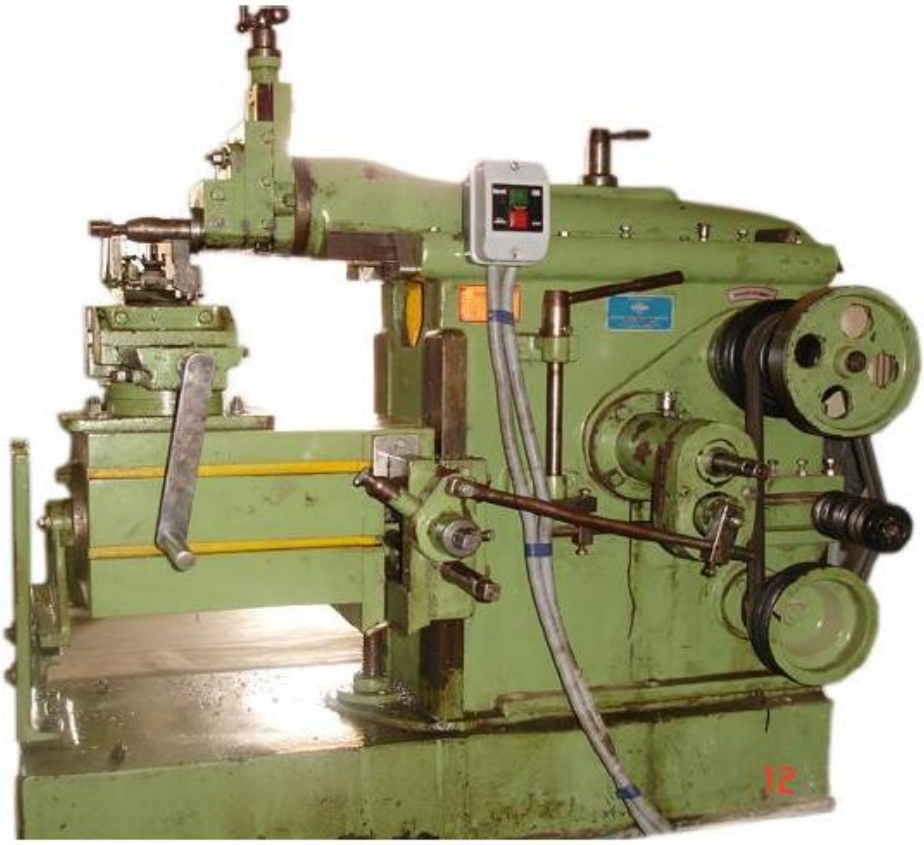

Figure 10: Shaper Machine

Procedure:

- First smooth the two ends of the work piece by filing and applying chalk on its surface.
- Place the work piece on the V-block and mark centre on the end face using surface gauge, scriber and Vernier height gauge.
- Mark square on the end face according to the required dimensions.
- Make permanent indentation on the job surface by using dot punch.
- Fixed the tool in the tool post such that the tool movement should be exactly perpendicular to the table.
- Set the work piece in the vice such that the tool is just above the work piece.
- Adjust the length of the stroke.
- Make sure that line of action of stroke should be parallel to the surface of the work piece.
- Give depth of cut by moving the tool and feed is given to the work piece during return stroke of the ram.
- Continue the process, until the required dimensions are to be obtained.

- Repeat the process for all the four sides.
- Finally make a channel on one side according to the given dimensions.

Conclusion:

The job was prepared successfully and safely.