WEST GODAVARI INSTITUTE OF SCIENCE & ENGINEERING

(Approved by AICTE, New Delhi and Affiliated to JNTU, Kakinada)

An ISO 9001-2015 Certified College

AVAPADU, **PRAKASARAOPALEM** – 534 112, W.G.Dist., A.P

MT LAB MANUAL-R20

DEPARTMENT OF MECHANICAL ENGINEERING
III B.TECH I SEMESTER

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

KAKINADA–533003, Andhra Pradesh, India

2022-23

EXPERIMENTS LIST

LAB: MACHINE TOOLS LAB

1. INTRODUCTION OF GENERAL PURPOSE OF MACHINES

- Lathe machine,
- Shaper machine,
- Slotting machine,
- Planning machine,
- Drilling machine,
- Boring machine,
- Milling machine,
- Grinding machine
- Lapping machine
- Honing machine
- Broaching machine

2. LATHE OPERATIONS

- Facing
- Chamfering
- Step turning
- Taper turning
- Plain turning
- Knurling
- Grooving
- Thread cutting

3. DRILLING OPERATIONS

-Drilling -Tapping

4. SHAPING AND PLANNING OPERATIONS

5. SLOTTING OPERATIONS

6. MILLING OPERATIONS

-Vertical milling

7. GRINDING OPERATIONS

- Surface grinding

SAFETY PRECAUTIONS

1. Attention to be paid for clamping the job, tool, tool holders or supporting items.
2. Care should be taken for avoiding accidental contact with revolving cutters.
3. Break the sharp edges in jobs
4. Do not handle chips with bare hands, use brush or hand gloves.
5. Pay attention while selecting tools or blades for the proposed use to avoid accidents.
6. Do not remove chip while machine is running.
7. Ensure proper bucking of m/c slides or pay attention or alertness.
8. Care should be taken while selecting rapid or feed .
9. Follow safety precautions while approach with cutter to avoid tool damage.
10. Use coolants for heat dissipation.
11. Use goggles for sparks, spatters, avoid the watch clearly with bare eyes.
12. Avoid sharp edge tools.
13. Ensure clamping on surface grinding m/c before take a cut.
14. Select proper speed or feed or depth of cut.
15. Aim for easy chip disposal system.

PROBABLE ACCIDENTS

1. Before switching on any machine tool, work piece, tool or tool holder or any supporting assembly like tailstock in lathe to be clamped properly.
2. The chief hazard associated is accidental contact with moving cutter
3. Hazard of sharp edge contact with chips while machining.
4. Selection of no. of teeth or blade size on primer hacksaw machine.
5. Ramming of chips when machine in motion viz. shaping or slotting.
6. Locking of tables and ensure the feed.
7. Switch on the connection selection of lever (rapid/feed).
8. Approach the tool to the work piece while machining at slow pace to avoid cutting tool damage.
9. Flying sparks in welding.
10. Holding of heated parts after machining, welding or spot welding.
11. Magnetic clamping refines starting the surface grinding.
12. Selection of proper depth cut or feeds or any machine.
13. Chip disposal system to the accident free.

1. GENERAL PURPOSE OF MACHINES

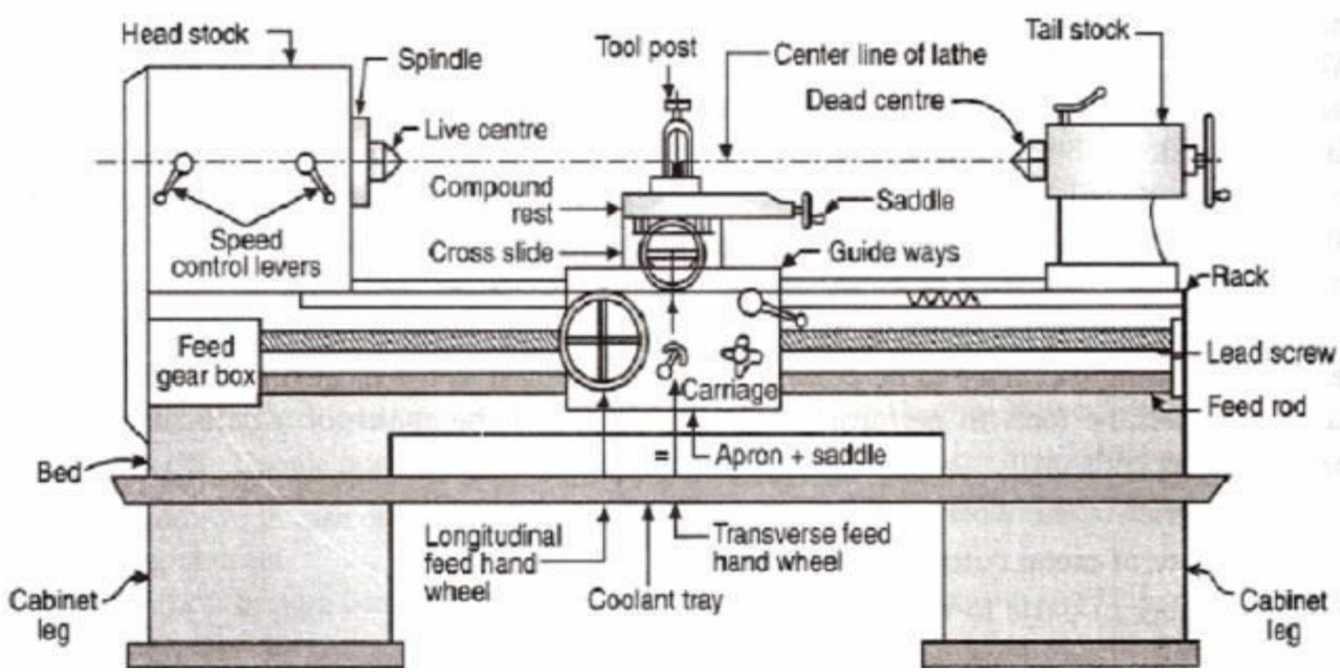
1.GENERAL PURPOSE OF MACHINES

INTRODUCTION

Various machining purpose used these all type of mechanical machining machines are Lathe machine, Shaper machine, Slotting machine, Planning machine, Drilling machine, Boring machine, Milling machine, Grinding machine, Lapping machine Honing machine and Broaching machine

These machines are to producing various operations like namely Facing, Chamfering, Step turning, Taper turning, Plain turning, Knurling, Grooving, Thread cutting, Drilling, Tapping, Precision grinding, Cylindrical grinding, Surface grinding, grinding of tool angles e.t.c.

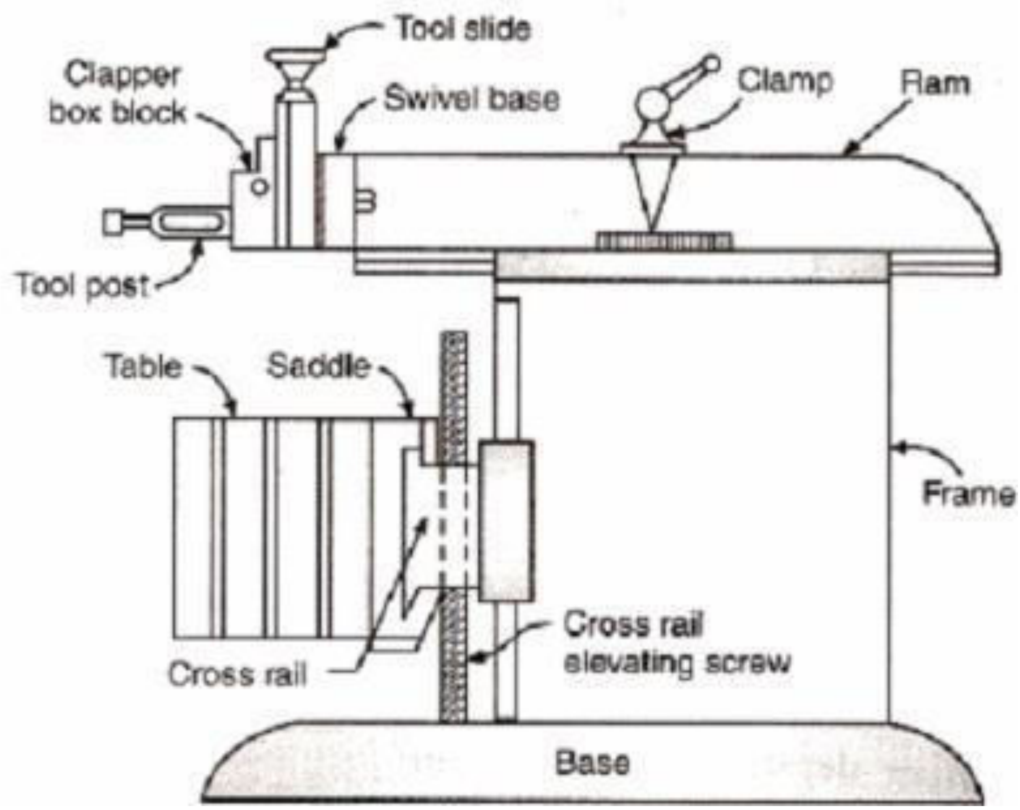
LATHE MACHINE:



A lathe s a machine tool which rotates the workpiece on its axis to perform various operations such as cutting, sanding, knurling, drilling, or deformation with tools that are applied to the workpiece to create an object which has symmetry about an axis of rotation.

Lathes are used in woodturning, metalworking, metal spinning, and glass working. Lathes can be used to shape pottery, the best-known design being the potter's wheel. Most suitably equipped metalworking lathes can also be used to produce most solids of revolution, plane surfaces and screw threads or helices. Ornamental lathes can produce three-dimensional solids of incredible complexity. The material can be held in place by either one or two centers, at least one of which can be moved horizontally to accommodate varying material lengths. Other work holding methods include clamping the work about the axis of rotation using a chuck to a faceplate, using clamps or dogs.

SHAPER MACHINE:



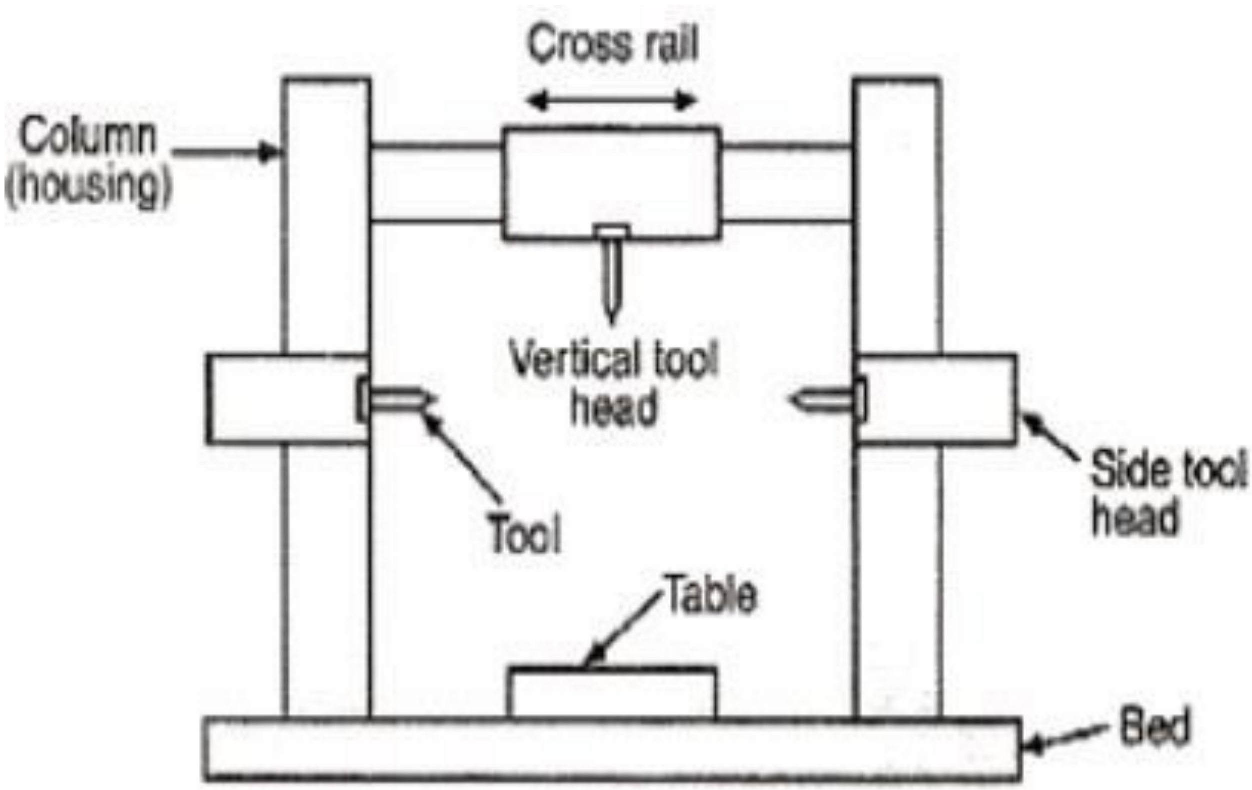
A shaper is a type of machine tool that uses linear relative motion between the workpiece and a single-point cutting tool to machine a linear tool path. Its cut is analogous to that of a lathe, except that it is linear instead of helical. (Adding axes of motion can yield helical tool paths, as also done in helical planning.) A shaper is analogous to a planer, but smaller, and with the cutter riding a ram that moves above a stationary workpiece, rather than the entire workpiece moving beneath the cutter. The ram is moved back and forth typically by a crank inside the column; hydraulically actuated shapers also exist.

A shaper is a type of machine tool that uses linear relative motion between the workpiece and a single-point cutting tool to machine a linear tool path. Its cut is analogous to that of a lathe, except that it is

linear instead of helical. (Adding axes of motion can yield helical tool paths, as also done in helical planning.) A shaper is analogous to a planer, but smaller, and with the cutter riding a ram that moves above a stationary workpiece, rather than the entire workpiece moving beneath the cutter. The ram is moved back and forth typically by a crank inside the column; hydraulically actuated shapers also exist.

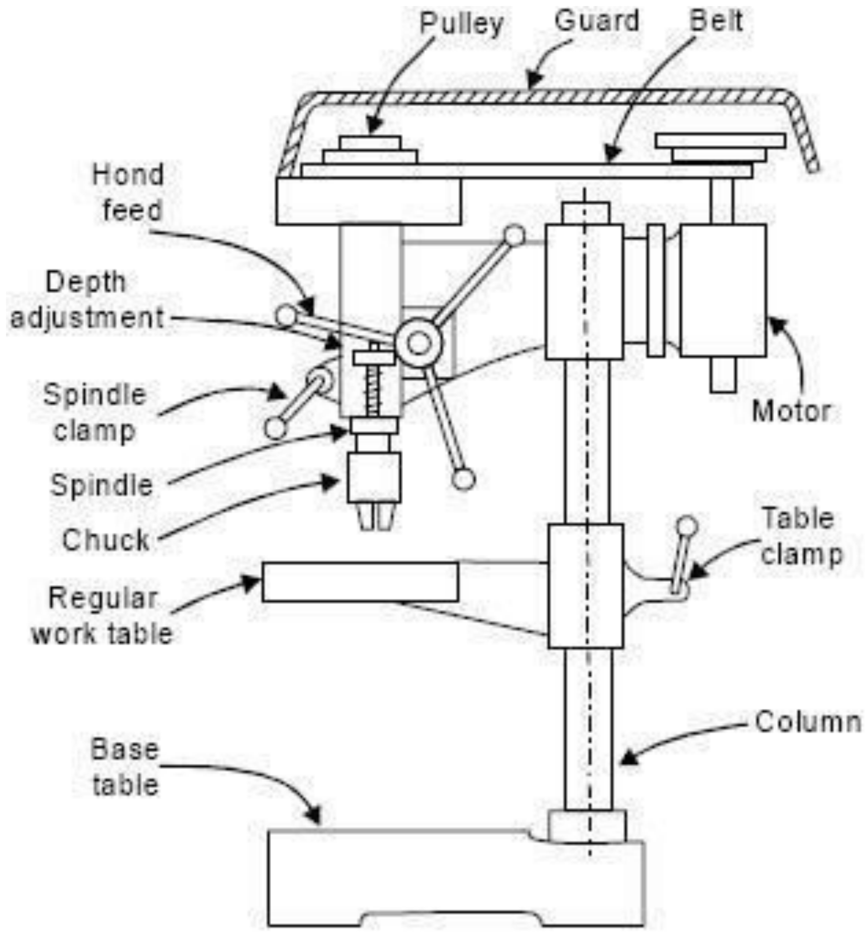
PLANNING MACHINE:

A planer is a type of metalworking machine tool that uses linear relative motion between the workpiece and a single-point cutting tool to machine a linear tool path. Its cut is analogous to that of a lathe, except that it is linear instead of helical. (Adding axes of motion can yield helical tool paths; see "Helical planing" below).



A planer is analogous to a shaper, but larger, and with the entire workpiece moving on a table beneath the cutter, instead of the cutter riding a ram that moves above a stationary workpiece. The table is moved back and forth on the bed beneath the cutting head either by mechanical means, such as a rack and pinion drive or a leadscrew, or by a hydraulic cylinder.

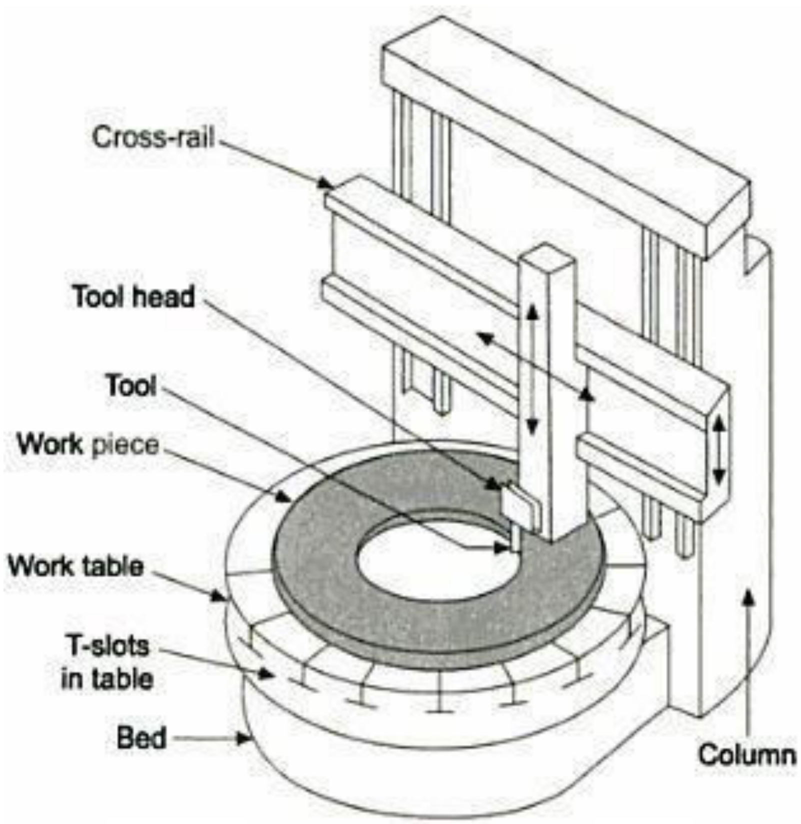
DRILLING MACHINE:



A drill or drill motor is a tool fitted with a cutting tool attachment or driving tool attachment, usually a drill bit or driver bit, used for drilling holes in various materials or fastening various materials together with the use of fasteners. The attachment is gripped by a chuck at one end of the drill and rotated while pressed against the target material. The tip, and sometimes edges, of the cutting tool does the work of cutting into the target material. This may be slicing off thin shavings (twist drills or auger bits), grinding off small particles (oil drilling), crushing and removing pieces of the workpiece (SDS masonry drill), countersinking, counter boring, or other operations.

Drills are commonly used in woodworking, metalworking, construction and do-it-yourself projects. Specially designed drills are also used in medicine, space missions and other applications.

BORING MACHINE:

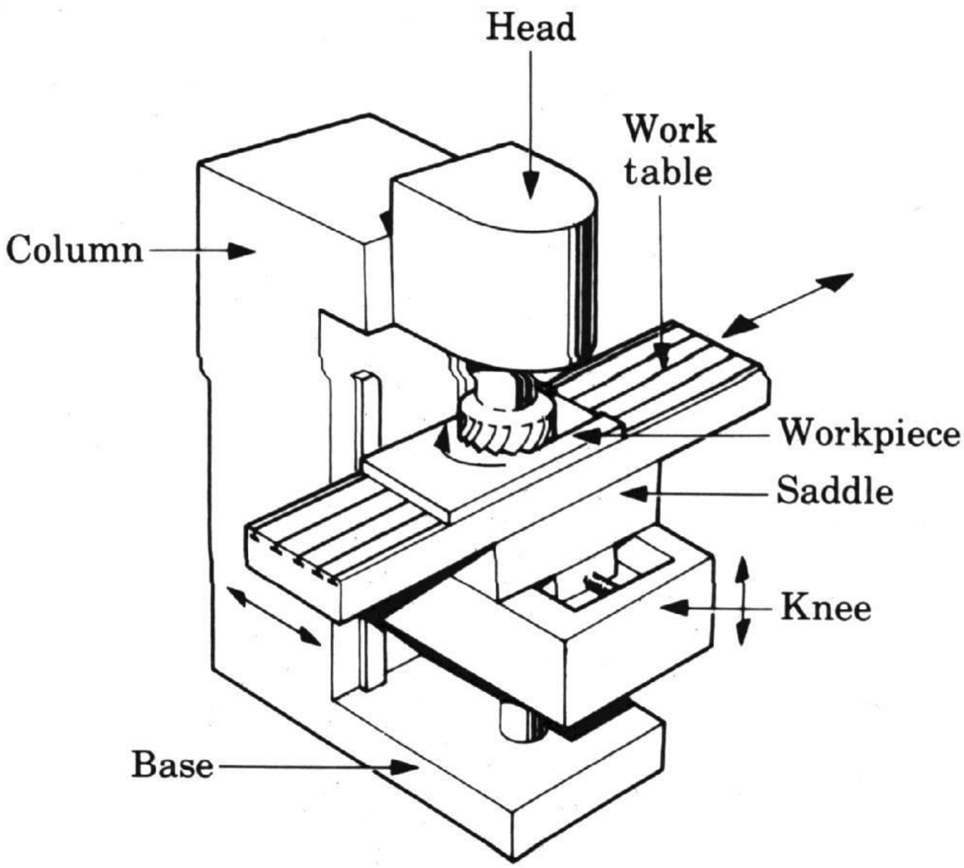


Vertical boring mill

In machining, boring is the process of enlarging a hole that has already been drilled (or cast), by means of a single-point cutting tool (or of a boring head containing several such tools), for example as in boring a cannon barrel. Boring is used to achieve greater accuracy of the diameter of a hole, and can be used to cut a tapered hole.

There are various types of boring. The boring bar may be supported on both ends (which only works if the existing hole is a through hole), or it may be supported at one end. Line boring (line boring, line-boring) implies the former. Backboring (back boring, back-boring) is the process of reaching through an existing hole and then boring on the "back" side of the workpiece (relative to the machine headstock).

MILLING MACHINE:

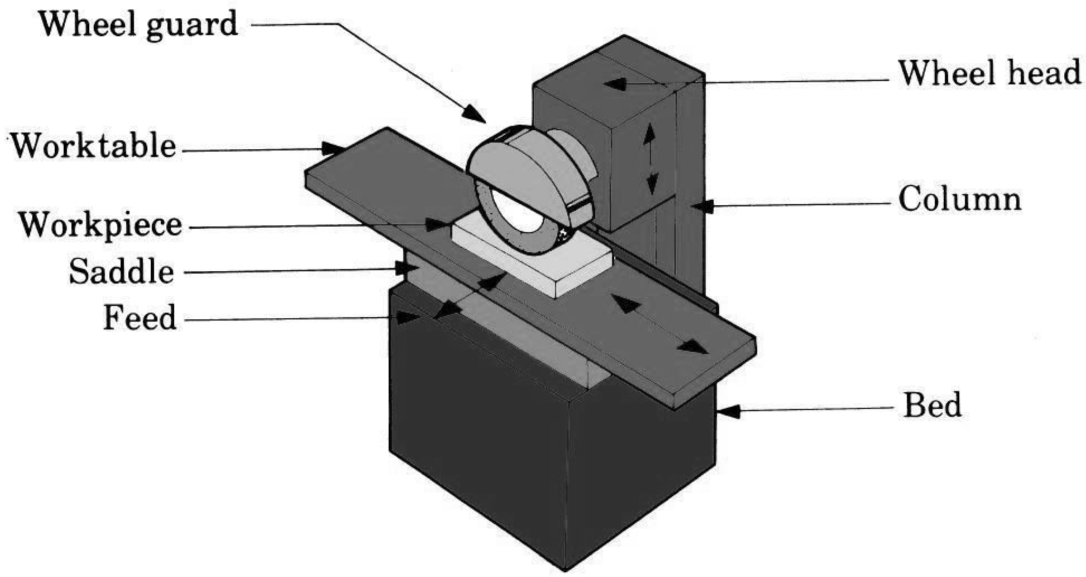


A milling machine (also see synonyms below) is a machine tool used to machine solid materials. Milling machines are often classed in two basic forms, horizontal and vertical, which refers to the orientation of the main spindle. Both types range in size from small, bench-mounted devices to room-sized machines. Unlike a drill press, this holds the workpiece stationary as the drill moves axially to penetrate the

material, milling machines also move the workpiece radially against the rotating milling cutter, which cuts on its sides as well as its tip. Workpiece and cutter movement are precisely controlled to less than 0.001 in (0.025 mm), usually by means of precision ground slides and lead screws or analogous technology. Milling machines may be manually operated, mechanically automated, or digitally automated via computer numerical control (CNC).

Milling machines can perform a vast number of operations, from simple (e.g., slot and keyway cutting, planing, drilling) to complex (e.g., contouring, die sinking). Cutting fluid is often pumped to the cutting site to cool and lubricate the cut and to wash away the resulting swarf.

GRINDING MACHINE:

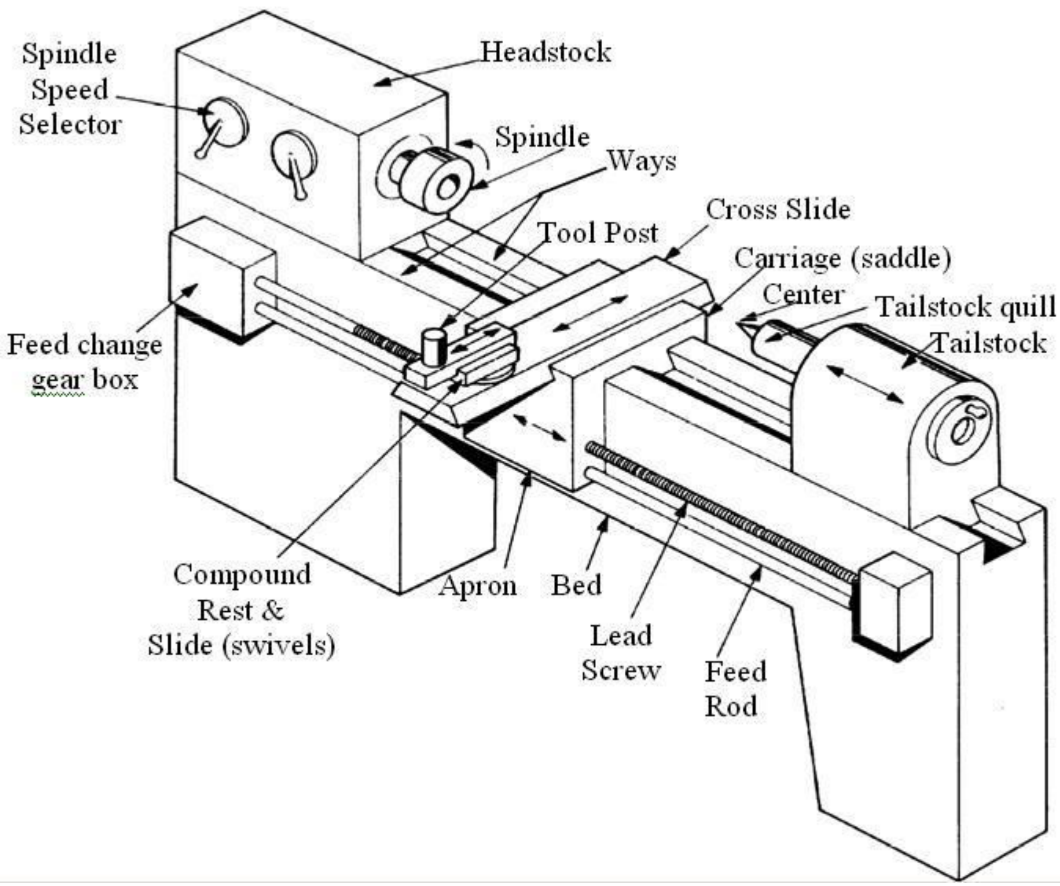


A grinding machine, often shortened to grinder, is a machine tool used for grinding, which is a type of machining using an abrasive wheel as the cutting tool. Each grain of abrasive on the wheel's surface cuts a small chip from the workpiece via shear deformation.

The grinding machine consists of a power driven grinding wheel spinning at the required speed (which is determined by the wheel’s diameter and manufacturer’s rating, usually by a formula) and a bed with a fixture to guide and hold the work-piece. The grinding head can be controlled to travel across a fixed work piece or the workpiece can be moved whilst the grind head stays in a fixed position. Very fine control of the grinding head or tables position is possible using a Vernier calibrated hand wheel, or using the features of numerical controls.

2. LATHE MACHINE

PARTS OF LATHE MACHINE:



LATHE MACHINE PARTS

Bed: Supports all other machine parts.

Carriage: Slides along the machine ways.

Head stock: Power train of system (spindle included).

Tail Stock: Fixes piece at end opposite to the head stock.

Swing: Maximum diameter of the machinable piece.

Lead screw: **C**ontrols the feed per revolution with a great deal of precision.

2.1. STEP TURING AND TAPER TURNING ON A LATHE

1. AIM: To perform lathe operations, step turning and taper turning on a given work piece made of Mild steel.

2. MATERIAL REQUIRED:

A mild steel bar of 30 mm diameter and 100 mm length.

3. TOOLS AND EQUIPMENT USED:

H.S.S. single point cuttingtool,
Parting tool,
Chuck key,
Tool post key,
Outside caliper,
Steel rule.

4. THEORY:

Facing Operation

Facing is the operation of machining the ends of a piece of work to produce a flat surface square with the axis. A regular turning tool may be used for facing a large work piece. The tool is brought into work piece from around the center for the desired depth of cut and then is fed outward, generally by hand perpendicular to the axis of rotation of the work piece.

Rough Turning Operation

Rough turning is the operation of removal of excess material from the work piece in a minimum time by applying high rate of feed and heavy depth of cut. The depth of cut for roughing operations in machining the work ranges from 2 to 5 mm and the rate of feed is from 0.3 to 1.5 mm per revolution of the work.

Step Turning

Is the operation of making different diameters of desired length. The diameters and lengths are measured by means of outside caliper and steel rule respectively.

Taper Turning

A taper may be defined as a uniform increase or decrease in diameter of a piece of work measured along its length. In a lathe, taper turning means to produce a conical surface by gradual reduction in diameter from a cylindrical work piece. The amount of taper in a work piece is usually specified by the ratio of the difference in diameters of the taper to its length. This is termed as the conicity designated by the letter ‘K’.

$$\alpha = \tan^{-1} [(D-d) /2L]$$

Where, α = Half taper angle
D = Large diameter of taper in mm

d = small diameter of taper in mm
L = length of tapered part in mm

Finish Turning Operation

It requires high cutting speed, small feed, and a very small depth of cut to generate a smooth surface. The depth of cut ranges from 0.5 to 1 mm and feed from 0.1 to 0.3 mm per revolution of the work piece.

PROCEDURE:

1. The work piece and HSS single point cutting tool are securely held in the chuck and tool post respectively.

2. Operations such as facing, rough turning and finish turning are performed on a given mild steel bar one after the other in sequence up to the dimensions shown. Then the step turning is performed using parting tool.

3. Then the compound rest is swiveled by calculated half taper angle and taper is generated on the work piece. Rotation of the compound slide screw will cause the tool to be fed at the half-taper angle.

4. The work piece is removed from the chuck and refixed with the unfinished part outside the chuck. This part is also rough turned, finish turned and facing is done for correct length.

5. Finally, the chamfering is done at the end of the work piece.

PRECAUTIONS:

1. Operate the machine at optimal speeds

2. Do not take depth of cut more than 2 mm.

3. Care should be taken to obtain the required accuracy.

RESULT: Lathe operations, step turning and taper turning are performed on a given work material for obtaining the dimensions given in the drawing.

2.2. THREAD CUTTING AND KNURLING

1. **AIM:** To perform lathe operations, Thread cutting and Knurling on a given work piece made of Mild steel.

2. **MATERIAL REQUIRED:**
   Mild steel bar of 30 mm diameter and 100 mm length

3. **TOOLS AND EQUIPMENT**

   H.S.S. single point cutting tool,

   Grooving tool,

   Threading tool

   Thread gauge,

   Outside caliper,

   Chuck key,

   Tool post key,

   Steel rule.

4. THEORY:

THREAD CUTTING :

The principle of thread cutting is to produce a helical groove on a cylindrical or conical surface by feeding the tool longitudinally when the job is revolved between centers or by a chuck. The longitudinal feed should be equal to the pitch of the thread to be cut per revolution of the work piece. The lead screw of the lathe, through which the saddle receives its traversing motion, has a definite pitch. A definite ratio between the longitudinal feed and rotation of the head stock spindle should therefore be found out so thatthe relative speeds of rotation of the work and the lead screw will result in the cutting of a screw of thedesired pitch.This is affected by change gears arranged between the spindle and the lead screw or by the change gear mechanism or feed box used in a modern lathe.

In a thread cutting operation, the first step is to remove the excess material from the work piece to make its diameter equal to the major diameter of the screw thread. Change gears of correct size are then fitted to the end of the bed between the spindle and the lead screw.

The shape or form of the thread depends on the shape of the cutting tool to be used. In a metric thread, the included angle of the cutting edge should be ground exactly 60^0. Several cuts are necessary before the full depth of thread is reached arising from this comes the necessity to "pick-up" the thread which is accomplished by using a chasing dial or thread indicator.

KNURLING:

Knurling is the process of embossing a diamond shaped pattern of the surface of a work piece. The purpose of knurling is to provide an effective gripping surface on a work piece to proven it from slipping when operated by hand. Knurling is performed by a special knurling tool which consists of a set of hardened steel rollers in a holder with the teeth cut on their surface in a definite pattern. The tool is held rigidly on the tool post and the rollers are pressed against the revolving surface of work piece to squeeze the metal against the multiple cutting edges, producing depressions in a regular pattern on the surface of the work piece.

PROCEDURE:

1. The work piece and HSS single point cutting tool are fixed in chuck and tool post respectively.
2. Operations such as facing, rough turning finish turning and step turning are performed on the given mild steel bar one after the other in sequence up to the dimensions shown.
3. Single point cutting tool is replaced by a grooving tool and grooving operation is performed at half of the normal spindle speed.
4. The grooving tool is replaced by a threading tool. Right hand and left hand metric threads are cut on the work piece up to the required length at $1/4^{th}$ of the normal speed of the spindle.
5. The thread cutting tool is replaced by the knurling tool and knurling operation is performed at the slowest speed of the spindle.
6. The knurling tool replaced by a single point cutting tool again and finally chamfering is done at right end of the work piece at normal spindle speed.

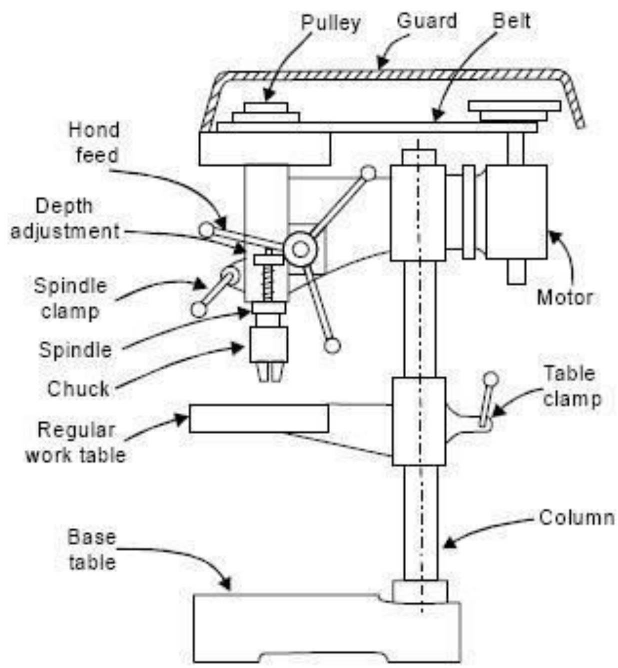
PRECAUTIONS:

1. Low spindle speeds should be used for accurate threads in thread cutting operation.
2. Ensure correct engage and dis-engage of half-nut.
3. Plenty of oil should be flowed on the work and tool during thread cutting.

RESULT: Lathe operations, thread cutting and knurling are performed on a given work material for obtaining metric threads as given in the drawing.

3. DRILLING MACHINE

DRILLING MACHINE:



Drilling machine is a machine tool designed for drilling holes in metallic and non metallic materials. The cutting tool is a multi-point cutting tool, known as drill.

PRINCIPAL PARTS OF THE DRILLING MACHINE

1. Head: Head contains the electric motor, v pulleys and v belt which transmit rotary motion to the drill spindle at a no. of speeds.

2. Spindle: spindle is made up of alloy steel. It rotates as well as moves up and down in a sleeve.

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

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

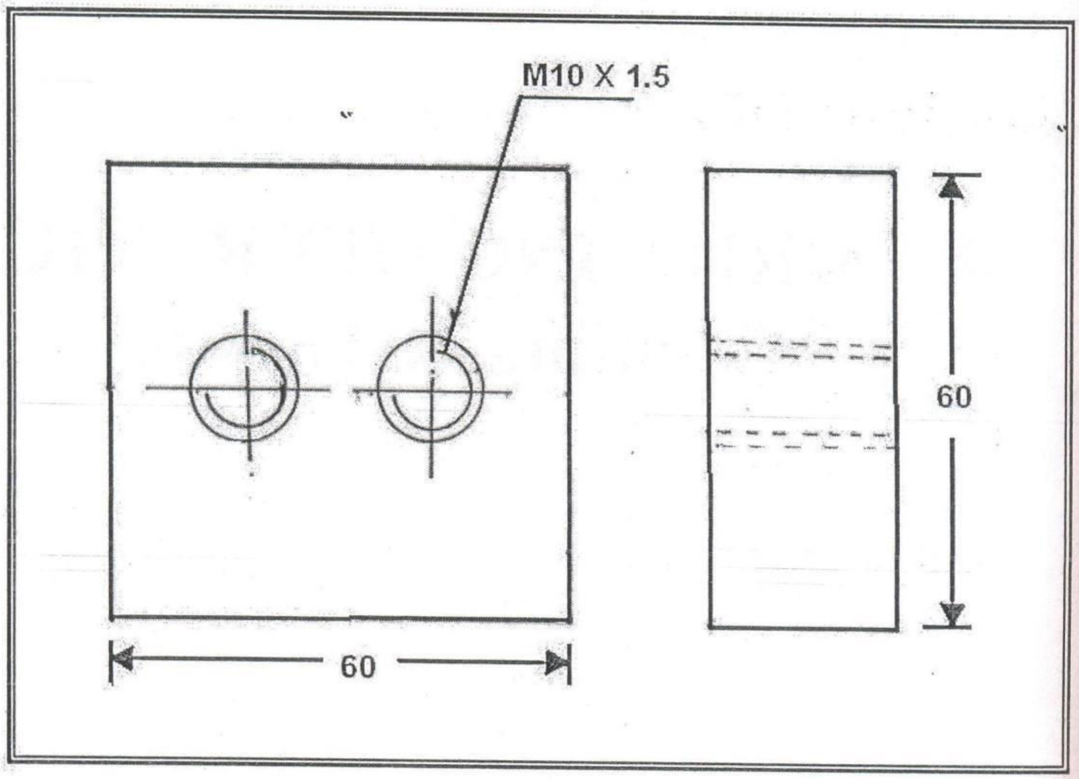
5. Base: It supports the column, which, in turn, supports the table, head etc.

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

EXPERIMENT DIAGRAM:

DRILLING AND TAPING OPERATION

Drill and tap to size M10 X 1.5 pitch two holes as per the sketch given below



All Dimensions are in "mm"

DRILLING AND TAPPING ON A DRILLING MACHINE

1. **AIM:** To perform drilling and tapping operations on the given work piece.
2. **MATERIALS REQUIRED:** mild steel specimen, coolant (oil and water mixture), lubricant oil, nut and bolt.
3. **TOOLS AND EQUIPMENT USED:**

Drilling machine,
Dot punch,
Scriber,
Vernier calipers,
Button pattern stock,
Drill bits,
Hand taps,
Tap wrench,
Bench vice,
V-Block

4. **THEORY:**

Drilling machine is used to produce holes in the work piece the end cutting tool used for drilling holes in the work piece is called the 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.

Tapping is an operation used to produce internal threads in a hole by means of a tap set. A tap may be compared with a screw which has teeth formed on it by cutting flutes parallel to the axis and then has been harden so that it will cut metals. The flutes cut on the channels to carry the chips formed by cutting action.

5. PROCEDURE:

1. The given work piece is first fitted to get required length, breadth and thickness wet chalk is applied on four sides and with the scriber lines are drawn to get center hole at required location.
2. The centers are punched with a Punch and hammer.
3. The work piece is fixed firmly in the vice of the Drilling Machine
4. 3/8” drill bit is fixed firmly in the chuck and drilling is performed giving uniform depths.
5. The drill bit is removed from the drill chuck and is replaced by a reamer.
6. The reaming operation is performed on the hole which has been previously drilled.
7. The work is removed from the vice for performing tapping operation.
8. The job is fixed firmly in a bench vice.
9. Tap is fixed in the tap wrench.
10. First, second and final taps are by hand pressure applied on the taps to obtain internal thread.

6. PRECAUTIONS:

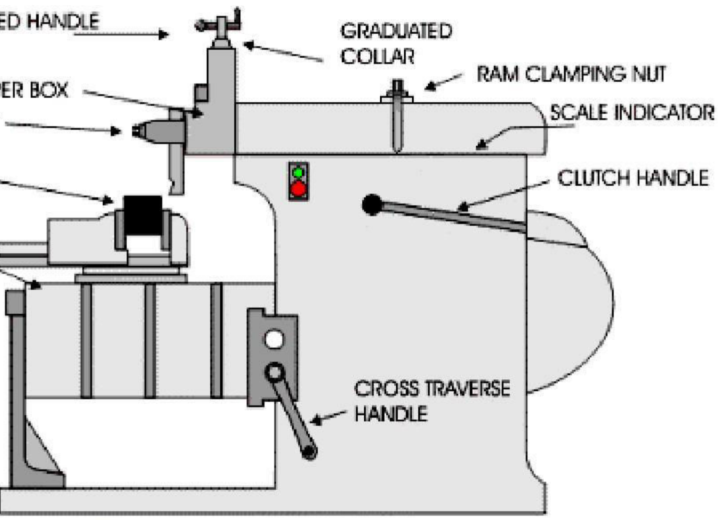
1. While performing drilling and tapping operations lubricant should be used to minimize friction.
2. Tapping should be done very slowly.
3. Care should be taken that the job is fixed properly.

7. RESULT:

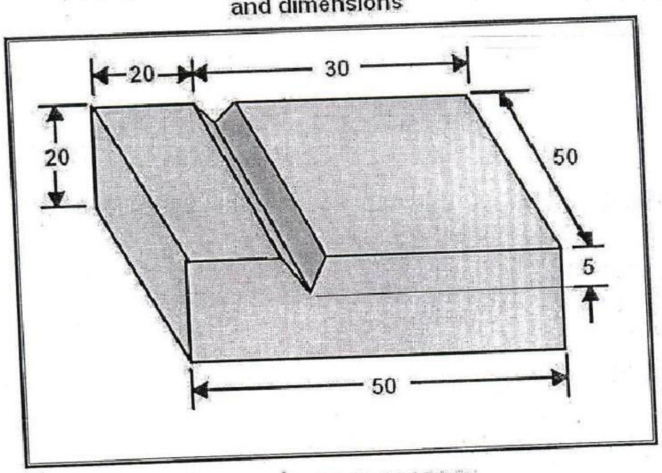
Drilling and Tapping operations are performed on the given work piece as per given dimensions.

4. SHAPER MACHINE

PARTS OF SHAPER MACHINE:



Machine V Groove of 45 for the given specimen and dimensions



SHAPING OPERATION

All dimensions are in "mm"

5. SHAPING AND PLANNING

1. AIM: To perform the Shaping and Planning operations to produce flat surface on the given work piece.

2. MATERIALS REQUIRED: Mild steel / Cast iron / Cast Aluminum.

3. MACHINE REQUIRED: Shaping machine

4. MEASURING INSTRUMENTS:

Vernier calipers,

Vernier height gauge,

Dial indicator,

Required steel ball.

5. CUTTING TOOLS

H.S.S tool bit,
V tool,

Plain tool,
Grooving tool.

6. SEQUENCE OF OPERATIONS:

1. Measuring of specimen.
2. Fixing of specimen in the machine vice of the shaping machine
3. Giving the correct depth and automatic feed for the slot is to be made.
4. Check the slot with the Vernier calipers & precision measurement by slip gauges at the end.

7. THEORY

The shaper also called shaping machine, is a reciprocating type of machine tool in which the ram moves the cutting tool backward and forward in a straight line to generate the flat surface. The flat surface may be horizontal, inclined or vertical.

Principal Parts Of A Shaper

i. Base: It is a heavy and robust cast iron body which acts as a support for all other parts of the machine which are mounted over it.

ii. Column (body): it is a box type iron body mounted upon the base. It acts as housing for the operating mechanism of the machine, electrical, cross rail and ram. On the top it is having two guide ways open which the ram reciprocates.

iii. 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 travel of the table.

iv. Table: it is made of cast iron and used for holding the work piece. T slots are provided on its top and sides for securing the work on to it. It slides along the cross rail to provide feed to the work.

v. Ram: It reciprocates on the guide ways provided above the column. It carries the tool head and mechanism for adjusting the stroke length.

vi. Tool Head: It is attached to the front portion of the ram and is used to hold the tool rigidly. It also provides the vertical and angular movement to the tool for cutting.

Working principle and operation of a Shaper:

In a shaper, a single point cutting tool reciprocates over the stationary work piece. The work piece is rigidly held in a vice or clamped directly on the table. The tool is held in the tool head mounted on the ram of the machine. When the ram moves forward, cutting of material takes place. So, it is called cutting stroke. When the ram moves backward, no cutting of material takes place so called idle stroke. The time taken during the return stroke is less as compared to forward stroke and this is obtained by quick return mechanism. The depth of cut is adjusted by moving the tool downward towards the work piece.

Principle of Quick return motion:
(Crank and Slotted level type)

In the extreme position, the slotted lever AL occupies the positions AL_1, and AL_2 and the cutting tool is at the end of the stroke. The forward or cutting stroke occurs when the crank rotates from the position

CB_1 to CB_2 (or through an angle) in the clockwise direction. The return stroke occurs when the crank rotates from the position CB_1 to CB_2 (or through an angle) in the clockwise direction. Since the crank rotates at a uniform speed, so

$$\frac{\text{Time of cutting stroke}}{\text{Time of cutting stroke}} = \beta/\alpha = \alpha / (360^0 - \beta) \text{ or } (360^0 - \alpha) / \alpha$$

Travel of tool or length of stroke = R_1R_2 = L1L2 = 2AI X CB/AC

It can easily be seen that the angle β is more than α. Since the crank rotates with uniform angular speed, therefore from equation (1), it can be concluded that the return stroke is completed with in shorter time. Thus, it is a quick return motion mechanism.

8. PROCEDURE:

1. The given work piece is fitted to the vice and the cutting tool bit height is adjusted.
2. Ram stroke is adjusted according to the length if the job.
3. The motor is switched on and the planning operation is done on the surfaces of the work piece.
4. 1 to 3mm depth of the cut is applied for each pass of total surface.
5. Repeat step-3 up to required dimensions are obtained on the job.

9. PRECAUTIONS:

1. The level of the work piece should be properly adjusted.
2. Maintain uniform feed for manual feeding.
3. Feeding of the work should not be given during cutting stroke.
4. The shaping machine must be stopped before setting up or removing the work piece
5. All the chips should be removed from the cutter.

10. RESULTS: Planning and Shaping operation is done on the given work piece to required dimension using Shaper.

5. SLOTTING MACHINE

6. SLOTTING

1. AIM: To make a slot on the given work piece.

2. MATERIALS REQUIRED: mild steel, aluminum.

3. MACHINE REQUIRED: slotting machine

4. MEASURING INSTRUMENTS:

Vernier calipers slip gauges.

5. CUTTING TOOLS: H.S.S.Tool bit of the required slot size.

6. SEQUENCE OF OPERATIONS:

- Fix the specimen in the three-jaw chuck of the slotting machine
- By giving the required feed and depth of cut, the required slot is being made progressively

7. THEORY:

Introduction: The slotting machine is a reciprocating machine tool in which, the ram holding the tool reciprocates in a vertical axis and the cutting action of the tool is only during the downward stroke.

Construction: The slotter can be considered as a vertical shaper and its main parts are**:**

1. Base, column and table
2. Ram and tool head assembly
3. Saddle and cross slide
4. Ram drive mechanism and feed mechanism.

The base of the slotting machine is rigidly built to take up all the cutting forces. The front face of the vertical column has guide ways for Tool the reciprocating ram. The ram supports the tool head to which the tool is attached. The workpiece is mounted on the table which can be given longitudinal, cross and rotary feed motion.

The slotting machine is used for cutting grooves, keys and slotes of various shapes making regular and irregular surfaces both internal and external cutting internal and external gears and profiles The slotter machine can be used on any type of work where vertical tool movement is considered essential and advantageous.

The different types of slotting machines are:

1. **Punch slotter**: a heavy duty rigid machine designed for removing large amount of metal from large forgings or castings

2. **Tool room slotter**: a heavy machine which is designed to operate at high speeds. This machine takes light cuts and gives accurate finishing.

3. **Production slotter**: a heavy duty slotter consisting of heavy cast base and heavy frame, and is generally made in two parts.

8. PROCEDURE:

1. A work piece turned to the required diameter and length is taken.
2. 25mm hole is drilled and the hole is bored to the exact dimension.
3. Drilled work piece is fixed on slotting machine.
4. The work piece is fitted to the vice on the work table.
5. The work table and the cutting tool bit are moved and adjusted to the work piece.
6. The Slotting is switched on.
7. The feed is given to the work table.
8. 1 to 2mm depth of the cut is applied for each pass.
9. Repeat the depth of cut to get required dimensions are obtained on the job.
10. Dimensions are checked with Vernier Calliper for accuracy.

PRECAUTIONS:

1. Choose proper feed and depth of cut.

2. Feed should be controlled to avoid any damage to the cutting tool

3. Lock the index table before starting the operation.

4. Care has to be taken so as to maintain the right feed of the material.

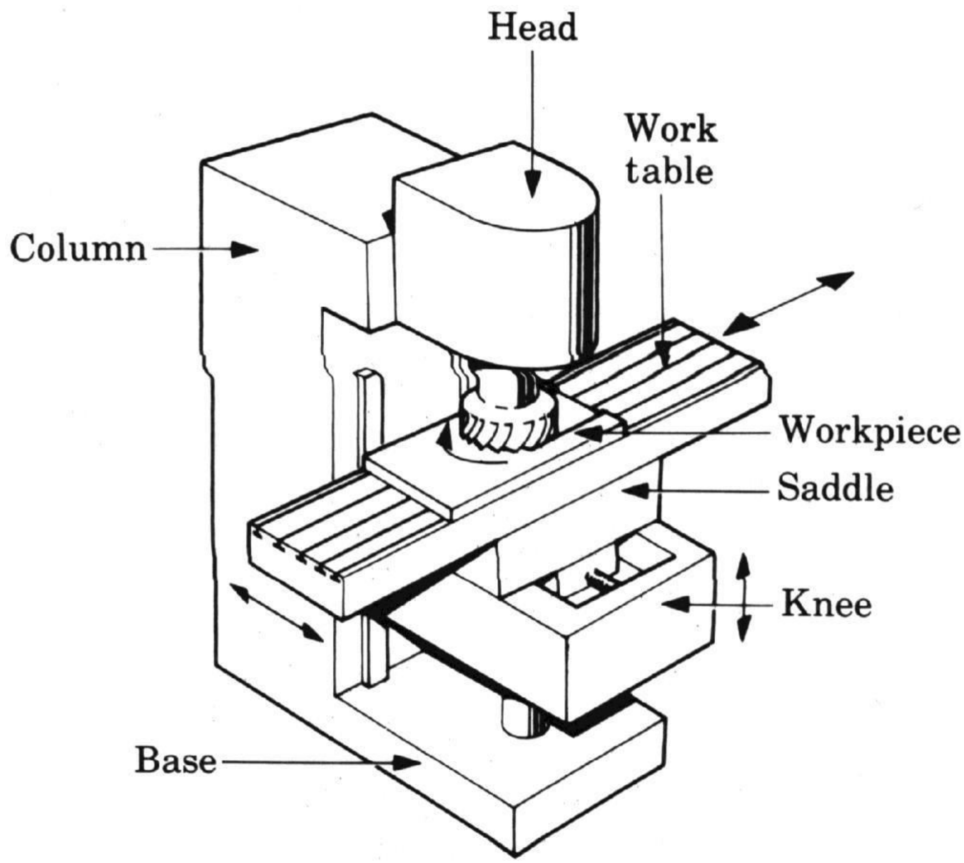
5. Work-wheel interface zone is to be flooded with coolant

6. Dressing of grinding wheel to be done before commencement of cutting action, intermittent dressing also to be done if wheel is loaded.

RESULTS: A Slot of required dimensions on the given work piece was obtained.

7.MILLING MACHINE

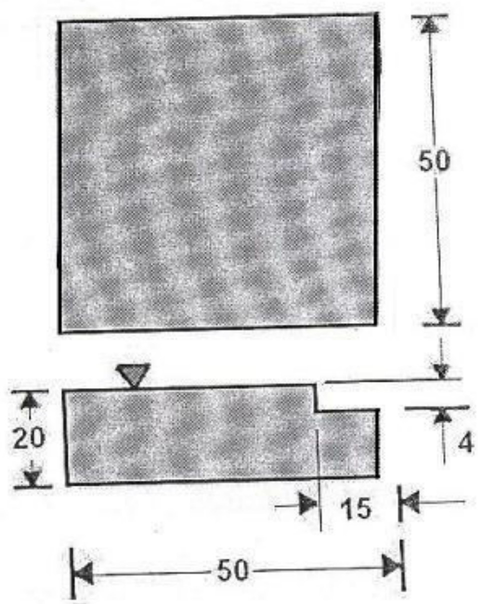
PARTS OF MILLING MACHINE:



EXPERIMENT DIAGRAM:

MILLING OPERATION

Milling the given specimen as per drawing given below



All dimensions are in "mm"

7. PLANE MILLING OPERATION

1. AIM: To perform plane milling operation on the given specimen (mild steel) & get to its correct dimensions.

2. MATERIALS REQUIRED: mild steel specimen.

3. MACHINE REQUIRED: milling machine

4. MEASURING INSTRUMENTS:

Vernier calipers

5. CUTTING TOOLS: Plane (face) milling cutter.

6. MARKING TOOLS: steel rule, scriber

a. Work holding fixtures: work piece supporting fixtures
b. Miscellaneous tools: Hammer, brush, Allen keys

7. SEQUENCE OF OPERATIONS:SE

i. Measuring of specimen
ii. Fixing of specimen in the milling m/c.
iii. Giving the correct depth and automatic feed cut the specimen
iv. Check the specimen with Vernier caliper at the end.

8. THEORY:

Milling machine is a machine tool in which metal is removed by means of a revolving cutter with many teeth (multipoint), each tooth having a cutting edge which removes the metal from the work piece. The work may be fed to the cutter, longitudinally, transversely or vertically, the cutter is set to a certain depth of cut by raising the table. This machine is very much suitable in tool room work due to its variety of operations, better surface finish and accuracy.

Specification: The milling machine is specified by its table working surface, its longitudinal, cross and vertical transverse, knee movement in degrees, range and number of spindle speeds, available power of the machine and machine type.

***.**

9. PRINCIPAL PARTS OF A MILLING MACHINE

Base: It is the foundation of the machine upon which all other parts are mounted. It is generally made of grey cast iron to absorb shock and vibration. Sometime it also serves as a reservoir for cutting fluid.

Column: It is the main supporting frame mounted vertically on one side of the base. The motor and other driving mechanisms are contained in it. It supports and guides the knee in its vertical travel. It carries the jack for elevating the knee.

Knee: The Knee projects from the column and slides up and down on its face. It supports the saddle and table. It is partially supported by the elevating screw which adjusts its height. It carries the table feed mechanism and controls to feed in longitudinal, cross, vertical, and rotation etc. by hand power or machine power.

Saddle: The saddle supports and carries the table and is adjustable transversely on ways on top of the knee. It is provided with graduation for exact movement and can be operated by hand or power.

Table: The table rests on ways on the saddle and travels longitudinally in a horizontal plane. It supports the work pieces fixtures etc.

10. PROCEDURE:

1. The dimensions of the given work piece are checked with the steel rule.

2. The given work piece is fixed in the vice provided on the machine table such a, one end of it is projected outside the jaws of the vice.

3. A face milling cutter is mounted in to the milling machine spindle and the table is raised so that the end of the work piece faces the cutter.

4. One end of the work piece is face milled first to obtain parallelism to both the faces of the work piece.

5. The work piece is removed from the vice and fitted in the reverse position.

6. The other end of work piece is face milled such that, the length of the job is exactly 100 mm.

7. The table is lowered and the work piece is removed from the vice and refitted in it such that, the top face of the work piece is projected from the vice jaws.

8. The face milling cutter is removed from the spindle and the arbor is mounted in the spindle; followed by fixing the plain milling cutter.

9. The top surface of the job is slab milled first giving rough cuts followed by a finish cut.

10. The job is removed from the vice and refitted in it such that, the face opposite to the above, comes to the top and projects above the vice jaws.

11. The top surface of the job is milled in stages; giving finish cuts towards the end such that, the height of the job is exactly 40 mm.

12. The burrs if any along the edges are removed with the help of the flat file.

PRECAUTIONS:

1. The milling machine must be stopped before setting up or removing a work piece, cutter or other accessory

2. Never stop the feeding of job when the cutting operation is going on, otherwise the tool will cut deeper at the point where feed is stopped.

3. All the chips should be removed from the cutter. A wiping cloth should be placed on the cutter to protect the hands.
The cutter should be rotated in the clockwise direction only for right handed tools.

4. The work piece and cutter should be kept as cool as possible (i.e. coolant should be used where necessary to minimize heat absorption).

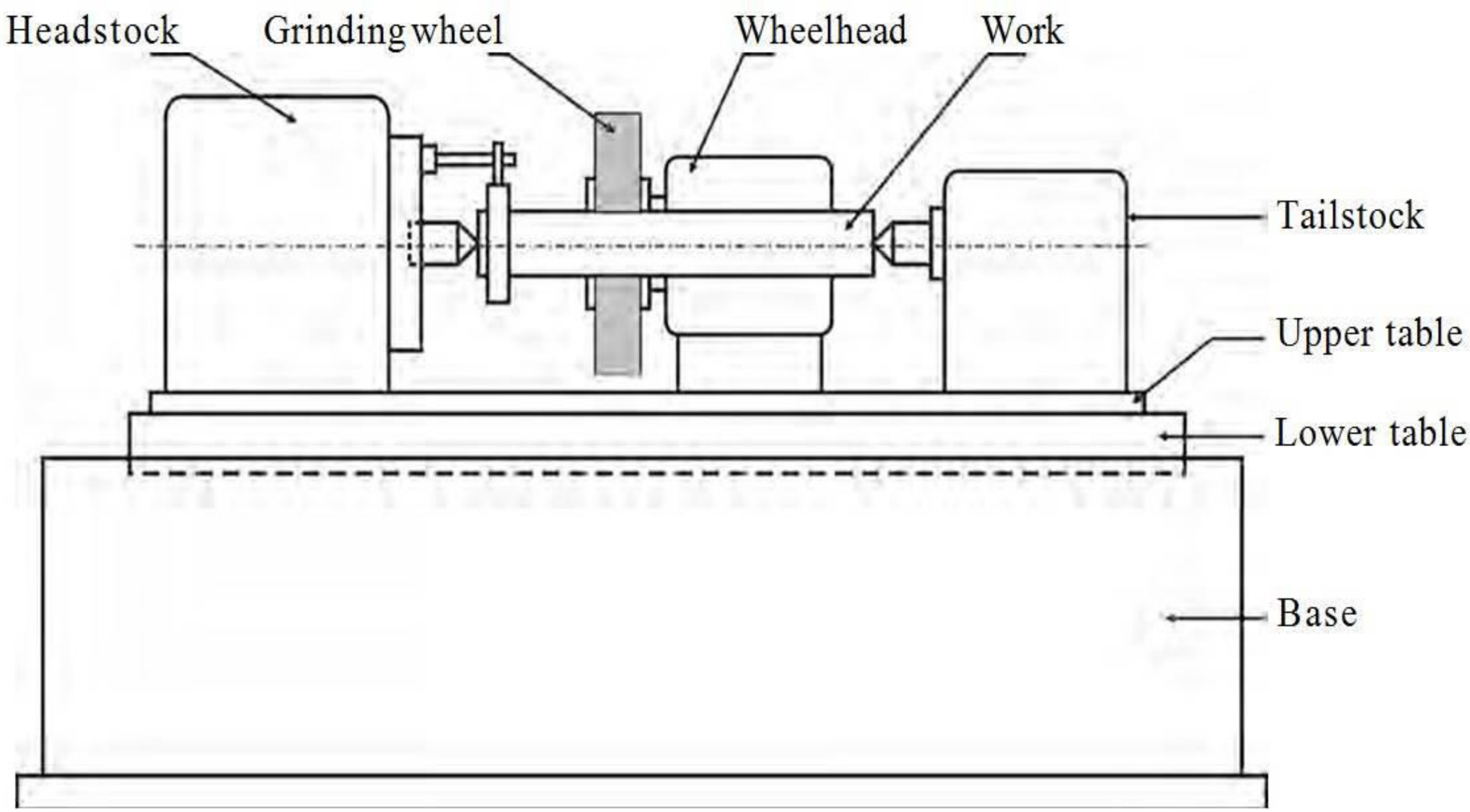
5. The table surface should be protected with a wiping cloth.

6. Tool must be mounted as close to the machine spindle as possible.

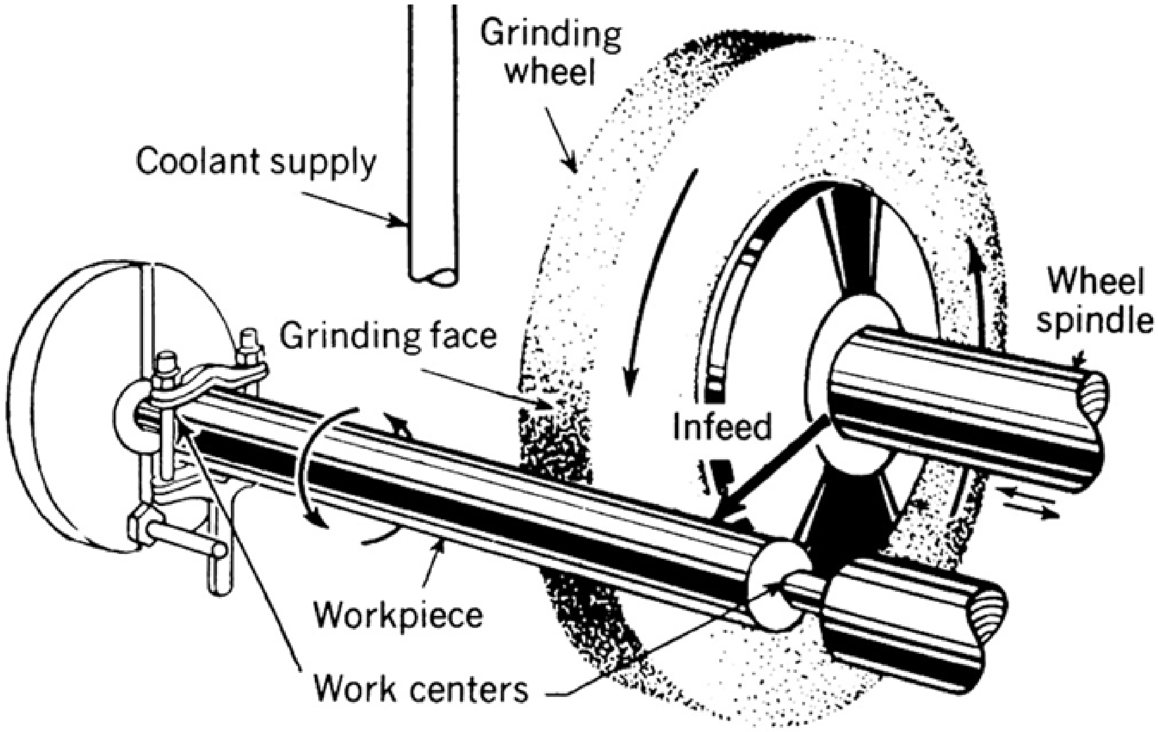
RESULT: The rectangular block of 50 x 40 x 100 mm, is thus obtained, by following the stages

Of milling operations described above.

8. PRECISION SURFACE GRINDING MACHINE



Cylindrical Grinding Machine


Grinding wheel
Coolant supply
Wheel spindle
Grinding face
Infeed
Workpiece
Work centers

CYLINDRICAL SURFACE GRINDING

1. AIM: To perform surface grinding operation on the given work piece.

2. MATERIALS REQUIRED: mild steel specimen.

3. MACHINE REQUIRED: surface grinding machine

4. MEASURING INSTRUMENTS:

Vernier calipers,

Micrometer.

5. CUTTING TOOLS: Diamond point dressing block

6. WORK HOLDING FIXTURES: Magnetic chuck

7. MISCELLANEOUS TOOLS:

Wire brush (for cleaning the formed chips),

Lubricant (coolant),

8. SEQUENCE OF OPERATIONS:

- Measuring of specimen using Vernier caliper, screw gauge micro meter
- Fix the work piece on to specimen & lock the magnetic chuck
- Move the specimen close to the moving grinding wheel so that it touches the specimen.
- Perform the surface grinding operation.
- Check the final dimension using Vernier caliper, screw gauge micro- meter.

9. THEORY:

Finish Grinding: Grinding is a metal cutting operation performed by means of a rotating abrasive wheel that acts as a cutting tool. This is used to finish work pieces which must show a high surface quality, accuracy of shape and dimension. Mostly grinding is the finishing operation because it removes comparatively little metal, usually 0.25 to50.5 mm in most operations and the accuracy in dimensions is in the order of 0.00025 mm.

10. PROCEDURE:

1. Work piece is mounted in the chuck and the length is supported with tailstock, so that the line along face of grinding wheel coincides with the edge of work piece.
2. Depth of cut is given by moving the diamond grinding wheel into the work piece.

3. The work piece rotates in the chuck and the feed is given by moving grinding wheel into the work piece.
4. And the material is removed by passing the grinding wheel through the length of the work piece to produce cylindrical surface and to get required size of work piece.

11. PRECAUTIONS:

1. Coolant usage is compulsory as the speeds employed are very high and continuous application of coolant is necessary for ductile materials like-steel etc.
2. Care has to be taken so as to maintain the right feed of the material.
3. Work-wheel interface zone is to be flooded with coolant
4. Dressing of grinding wheel to be done before commencement of cutting action.

RESULT: Cylindrical surface grinding operation is performed on the given work piece.

9. GRINDING OF TOOL ANGLES

9. GRINDING OF TOOL ANGLES

1. **AIM:** To grind a Lathe tool bit to the required angles on grinding machine.
2. **MATERIALS REQUIRED**: H.S.S.Lathe tool bit.
3. **MACHINE REQUIRED:** Hand grinding machine
4. **MEASURING INSTRUMENTS:** Bevel Protractor for measuring angles.
5. **CUTTING TOOLS:** Higher quality fine grit diamond grinding wheel
6. **THEORY:**

Re-sharpening lathe tool bit is a good idea than purchasing a new lathe tool bit as it is very expensive.

There is a cutting edge on the end of the tool bit called the front cutting edge. There is also a cutting edge on the side of the tool. Between these cutting edges is a rounded section of cutting edge called the nose.

Side Cutting Edge	The side cutting edge does most of the cutting. As the tool bit moves along the work piece the side cutting edge removes most of the material.
Front Cutting Edge	The front cutting edge cuts when the tool is advanced into the work.
Nose	The nose is a critical part of the cutting edge, because it produces the surface finish of the work piece.
Side Rake	The side rake produces the side cutting edge that cuts into the work piece.
Side Relief	Side relief provides clearance for the side cutting edge. Without side relief, the side of the tool bit would hit the work piece and not allow the cutting edge to penetrate the work piece.
Back Rake	The back rake produces the front cutting edge that cuts into the work piece.
Front Relief	Front relieve provides clearance for the front cutting edge. Without front relief, the front of the tool bit would hit the work piece and not allow the cutting edge to penetrate the work piece.

How to Grind Tool Bits

Use a bench grinder to sharpen your tool bits. Even an inexpensive bench grinder can do a good job grinding lathe tool bits. In some cases, you might want to purchase a higher quality fine grit wheel. Keep a small cup of water near your grinder. Grinding generates heat, which can cause two problems. The tool bit will become too hot to hold. Overheating can also affect the heat treatment of the tool bit, leaving the cutting edge soft. Use a protractor to measure the angles. They are not super-critical, but you should try to stay within one degree of the recommendations.

SEQUENCE OF OPERATIONS:

Grind the Front Relief

The first step in creating a tool bit is to grind the front relief. For most work, a relief angle of 10° works well. While you are grinding the front relief, you are also creating the front cutting edge angle. Make this angle about 10° also, so that the corner formed by the front cutting edge and the side cutting edge is less than 90°.

Grind the Left Side Relief

Form the left side relief next. Again, create about a 10° angle. You don't need to form a side cutting angle. The side cutting edge can be parallel to the side of the tool blank.

Grind the Top Rake

The top of the tool bit is ground at an angle that combines the back rake and the side rake. The side rake is most important, because the side cutting edge does most of the work. For cutting steel and aluminum, the side rake should be about 12° and the back rake should be about 8°. For cutting brass, the rake angles should be much less, or even 0°.

Round the Nose

A small nose radius allows you to turn into tight corners. A large nose radius produces better surface finishes. Create a nose radius that is appropriate for the tool bit you are creating.

Relief and Rake Angles for Cutting Common Metals

Material	Side Relief	Front Relief	Side Rake	Back Rake
Aluminum	12°	8°	15°	35°
Brass	10°	8°	5° to -4°	0°
Bronze	10°	8°	5° to -4°	0°
Cast iron	10°	8°	12°	5°
Copper	12°	10°	20°	16°
Machine Steel	10° to 12°	8°	12° to 18°	8° to 15°
Tool Steel	10°	8°	12°	8°
Stainless Steel	10°	8°	15° to 20°	8°

7. PROCEDURE:

1. Use a bench grinder to sharpen your tool bits with a high quality fine grit wheel and keep a small cup of water near your grinder.

2. Step one grind the tool bit front relief angle with a angle of 10° and also by creating the front cutting edge angle with a angle of 10°.

3. Step two grind the left side relief angle with a angle of 10°.

4. Step three grind the top rake angle by grinding the side rake angle to 12° and the back rake angle to 8°.

5. Grind the tool bit to a appropriate nose radius.

8. PRECAUTIONS:

1. Use hand gloves and goggles while grinding.

2. Use proper coolant while grinding.

3. Check the tool bit angle periodically while grinding.

4. Handle the machine, tool bit and hand carefully.

9. RESULT:

H.S.S. Lathe Tool bit is grinded to the required angles given the table.