AIRCRAFT MATERIALS AND PRODUCTION TECHNOLOGY LABORATORY MANUAL

B.TECH

(II YEAR – II SEM)

(2018-19)

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DEPARTMENT OF AERONAUTICAL ENGINEERING

MALLA REDDY COLLEGE OF ENGINEERING & TECHNOLOGY

(Autonomous Institution – UGC, Govt. of India)

Recognized under 2(f) and 12 (B) of UGC ACT 1956

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Maisammaguda, Dhulapally (Post Via. Hakimpet), Secunderabad – 500100, Telangana State, India

MRCET VISION

To become a model institution in the fields of Engineering, Technology and Management.

To have a perfect synchronization of the ideologies of MRCET with challenging demands of International Pioneering Organizations.

MRCET MISSION

To establish a pedestal for the integral innovation, team spirit, originality and competence in the students, expose them to face the global challenges and become pioneers of Indian vision of modern society.

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To pursue continual improvement of teaching learning process of Undergraduate and Post Graduate programs in Engineering & Management vigorously.

To provide state of art infrastructure and expertise to impart the quality education.

PROGRAM OUTCOMES
(PO's)

Engineering Graduates will be able to:

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design / development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multi disciplinary environments.
12. **Life- long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

DEPARTMENT OF AERONAUTICAL ENGINEERING

VISION

Department of Aeronautical Engineering aims to be indispensable source in Aeronautical Engineering which has a zeal to provide the value driven platform for the students to acquire knowledge and empower themselves to shoulder higher responsibility in building a strong nation.

MISSION

The primary mission of the department is to promote engineering education and research. To strive consistently to provide quality education, keeping in pace with time and technology. Department passions to integrate the intellectual, spiritual, ethical and social development of the students for shaping them into dynamic engineers

QUALITY POLICY STATEMENT

Impart up-to-date knowledge to the students in Aeronautical area to make them quality engineers. Make the students experience the applications on quality equipment and tools. Provide systems, resources and training opportunities to achieve continuous improvement. Maintain global standards in education, training and services.

PROGRAM EDUCATIONAL OBJECTIVES – Aeronautical Engineering

1. **PEO1 (PROFESSIONALISM & CITIZENSHIP):** To create and sustain a community of learning in which students acquire knowledge and learn to apply it professionally with due consideration for ethical, ecological and economic issues.
2. **PEO2 (TECHNICAL ACCOMPLISHMENTS):** To provide knowledge based services to satisfy the needs of society and the industry by providing hands on experience in various technologies in core field.
3. **PEO3 (INVENTION, INNOVATION AND CREATIVITY):** To make the students to design, experiment, analyze, and interpret in the core field with the help of other multi disciplinary concepts wherever applicable.
4. **PEO4 (PROFESSIONAL DEVELOPMENT):** To educate the students to disseminate research findings with good soft skills and become a successful entrepreneur.
5. **PEO5 (HUMAN RESOURCE DEVELOPMENT):** To graduate the students in building national capabilities in technology, education and research

PROGRAM SPECIFIC OUTCOMES – Aeronautical Engineering

1. To mould students to become a professional with all necessary skills, personality and sound knowledge in basic and advance technological areas.
2. To promote understanding of concepts and develop ability in design manufacture and maintenance of aircraft, aerospace vehicles and associated equipment and develop application capability of the concepts sciences to engineering design and processes.
3. Understanding the current scenario in the field of aeronautics and acquire ability to apply knowledge of engineering, science and mathematics to design and conduct experiments in the field of Aeronautical Engineering.
4. To develop leadership skills in our students necessary to shape the social, intellectual, business and technical worlds.

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AIRCRAFT MATERIALS AND PRODUCTION TECHNOLOGY LAB

II Year B.Tech. ANE.-II Semester. T P C

OBJECTIVES 0 3 2

Basic exercises In Lathe , Shaper, Milling ,Slotting ,CNC and Grinding machines ,Welding Equipment Compressing microscopes polishing Disk Grinder as under

LIST OF EXPERIMENTS

1. Plain turning, Taper turning, Facing, Knurling, Thread cutting.
2. Drilling, Boring, Counter boring, counter sinking.
3. Simple exercise on Shaping
4. Simple exercise on planning
5. Plain Milling.
6. Gear Milling (step milling & slot milling)
7. Sheet metal joining by soldering
8. Simple exercises on CNC machines and programme generation.
9. Simple exercises in Gas welding
10. Simple exercises in arc welding
11. Aircraft wood gluing practice.
12. Study of properties of sandwich structures

REFERENCE:

1. Aircraft production techniques ‘keshu S.C, Ganapathy K.K Interline Publishing house Bangalore 1993.

2. Manufacturing Engineering and technology by Kalpakajam-Addison Wesley.

LATHE

INTRODUCTION:

The lathe, probably one of the earliest machine tools, is one of the most versatile and widely used machine tool, so also known as mother machine tool.

An engine lathe is the most basic and simplest form of the lathe. It is called so because in early lathes, power was obtained from engines.

The job to be machined is held and rotated in a lathe chuck; a cutting tool is advanced which is stationary against the rotating job. Since the cutting tool material is harder than the work piece, so metal is easily removed from the job.

Some of the common operations performed on a lathe are facing, turning, drilling, threading, knurling, and boring etc.

NOMICULATEOF SINGLE POINT CUTTING TOOL:

1: Side Cutting Edge Angle:

The angle between side cutting edge and the side of the tool shank is called side cutting edge angle. It is often referred to as the lead angle.

2: End Cutting Edge Angle:

The angle between the end cutting edge and a line perpendicular to the shank of the tool shank is called end cutting edge angle.

3: Side Relief Angle:

The angle between the portion of the side flank immediately below the side cutting edge and a line perpendicular to the base of the tool.

4: End Relief Angle:

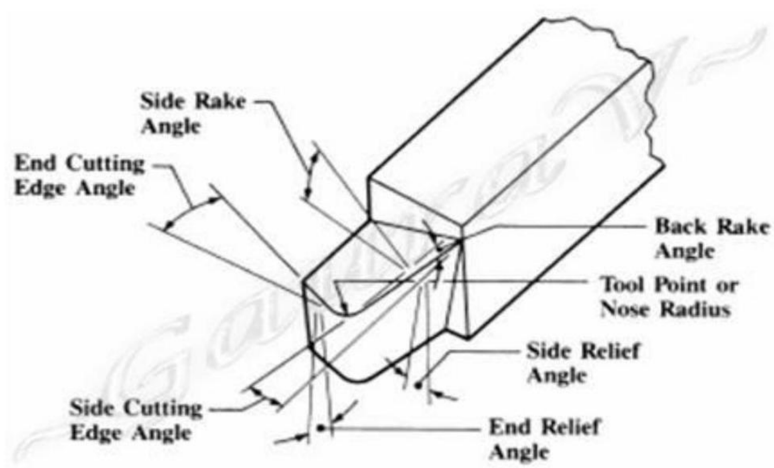
The angle between the end flank and the line perpendicular to the base of the tool is called end relief angle.

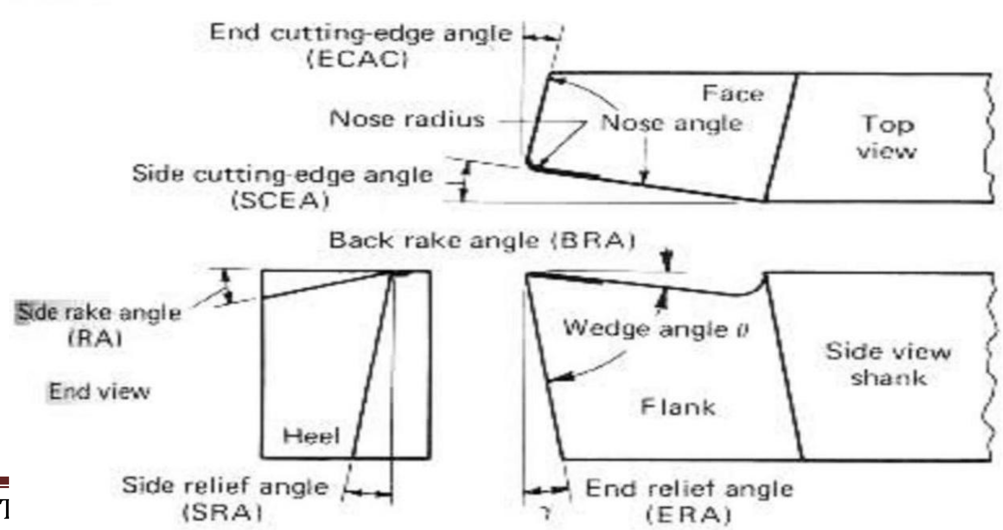
5: Back Rake Angle:

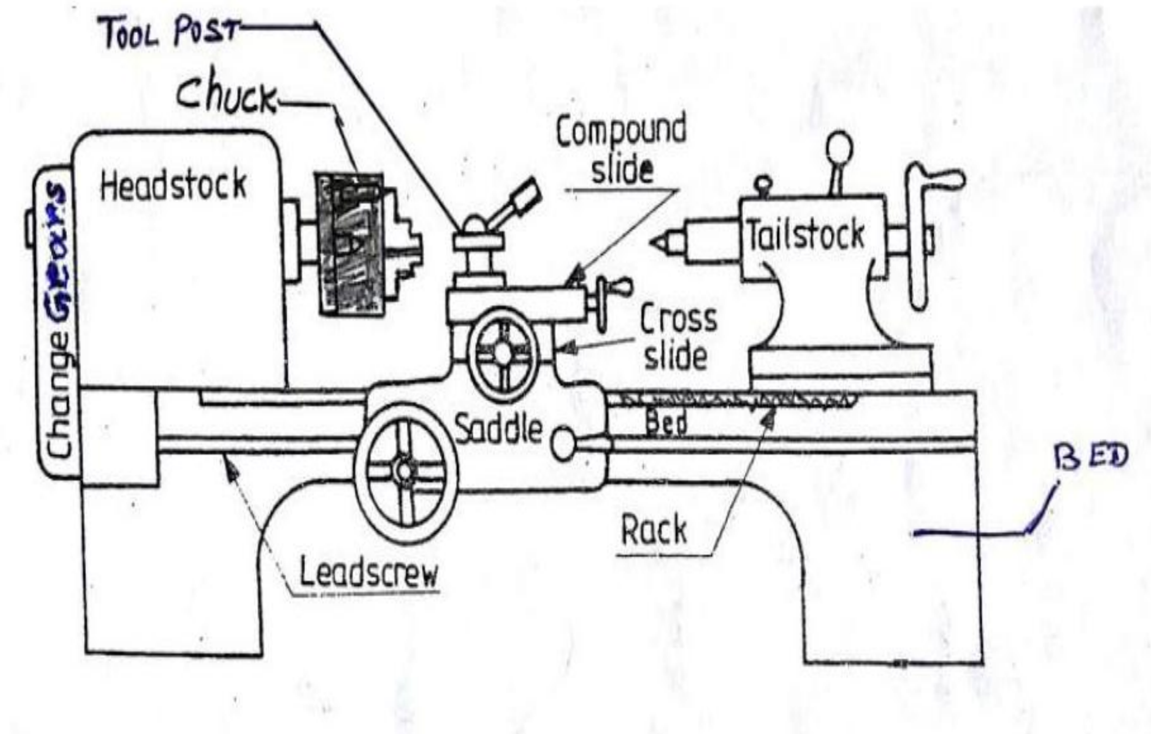
The angle between the face of the tool and line perpendicular to the base of the tool measures on perpendicular plane through the side cutting edge. It is the angle which measures the slope of the face of the tool from the nose, towards the rack. If the slope is downward the nose it is negative back rake.

6: Side Rake Angle:

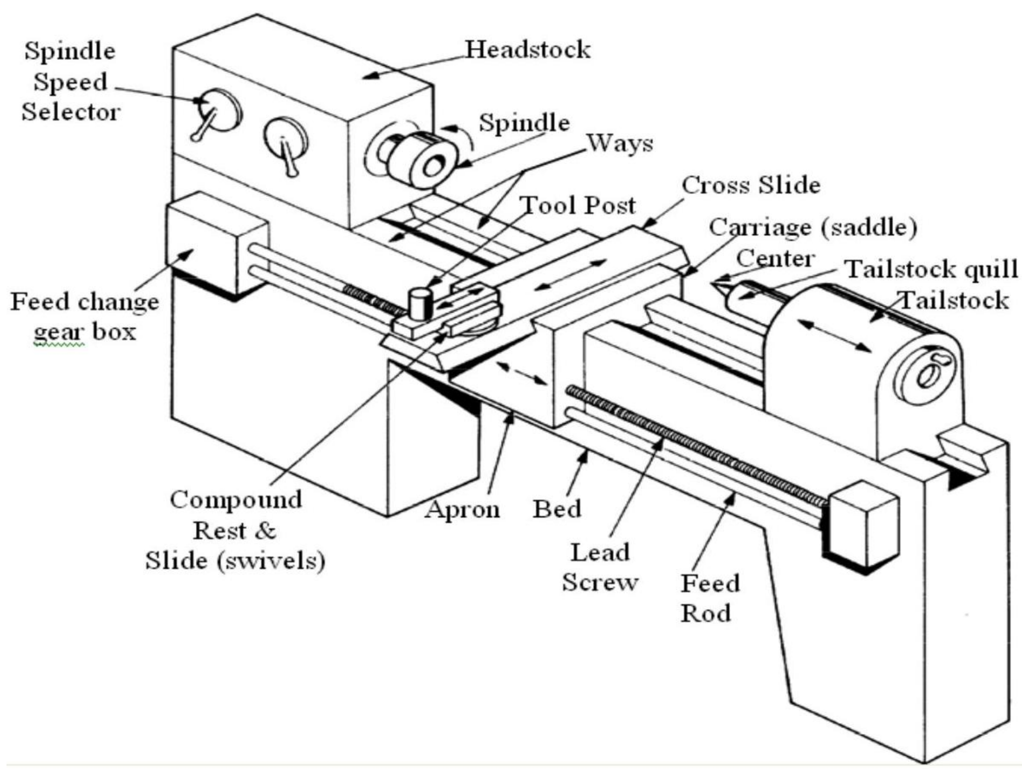
The angle between the face of the tool and a line parallel to the base of the tool measured on plane perpendicular to the base and the side edge. It is the angles that measure the slope of the tool face from the cutting edge, if the slope is towards the cutting edge it is negative side rake angle and if the slope is away from the cutting edge, it is positive side rake angle. If there is no slope the side rake angle is zero.







LATHE MACHINE:



A lathe is a machine tool which rotates the work piece on its axis to perform various operations such as cutting, sanding, knurling, drilling, or deformation with tools that are applied to the work piece 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.

PARTS OF LATHE MACHINE:

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.

TYPES OF OPERATION:

Facing Operation

Facing is the operation of machining the ends of a piece of work to produce a flat surface square with the axis. The operation involves feeding the tool perpendicular to the axis of rotation of the work piece.

A regular turning tool may be used for facing a large work piece. The cutting edge should be set at the same height as the center of the 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.

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.

Step Turning

This 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'.

$$\mathbf{K = (D-d) / L}$$

Where, D = Large diameter of taper in mm

d = small diameter of taper in mm

L = length of tapered part in mm

A taper may be turned by any one of the following methods:

a) Form tool method
b) Tail stock set over method
c) Swiveling the compound rest and
d) Taper turning attachment

Taper turning by swiveling the compound rest:

This method employs the principle of turning taper by rotating the work piece on the lathe axis and feeding the tool at an angle to the axis of rotation of the work piece. The tool mounted on the compound rest is attached to a circular base, graduated in degrees, which may be swiveled and clamped at any desired angle. Once the compound rest is set at the desired half taper angle, rotation of the compound slide screw will cause the tool to be fed at that angle and generate a corresponding taper.

The setting of the compound rest is done by swiveling the rest at the half taper angle. This is calculated by the equation.

$$\tan \alpha = (D-d) / 2L$$

Where α = Half taper angle

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.

Knurling is done at the slowest speed and oil is flowed on the tool and work piece. Knurling is done at the slowest speed and oil is flowed on the tool and work piece to dissipate heat generated during knurling. The feed varies from 1 to 2 mm per revolution.

Chamfering

Chamfering is the operation of beveling the extreme end of a work piece. This is done to remove the burrs, to protect the end of the work piece from being damaged and to have a better look. The operation may be performed after the completion of all operations. It is an essential operation after thread cutting so that the nut may pass freely on the threaded work piece.

METAL CUTTING PARAMETERS

The cutting speed of a tool is the speed at which the metal is removed by the tool from the work piece.

In a lathe, it is the peripheral speed of the work past the cutting tool expressed in meters/minute

(i) Cutting speed (V) = π DN/1000, m/min

Where, D = Diameter of the work in min
N = RPM of the work

(ii) Feed:

The feed of a cutting tool in a Lathe work is the distance the tool advances for each revolution of the work. Feed is expressed in mm/rev.

(iii) Depth of cut:

The depth is the perpendicular distance measured from the machined surface to the uncut surface of the work piece.

Depth of cut = $(d_1\text{-}d_2) / 2$

Where, d_1 = Diameter of the work surface before machining

d_2 = Diameter of the work surface after machining

While using HSS tool for turning mild steel work piece. The following parameters are to be chosen.

(iv) Rough Turning Operation:

Cutting speed (V) = 25m/min,

feed(f) = 0.2 mm/rev,

Depth of cut(t) = 1 mm

(v) Finish turning operation:

Cutting speed (V) = 40m/min,

feed(f) = 0.1 mm/rev,

Depth of cut(t) = 0.2 mm

(vi) Tool geometry:

Back rake angle = 7^0,

End relief angle = 6^0

Side relief angle = 6^0,

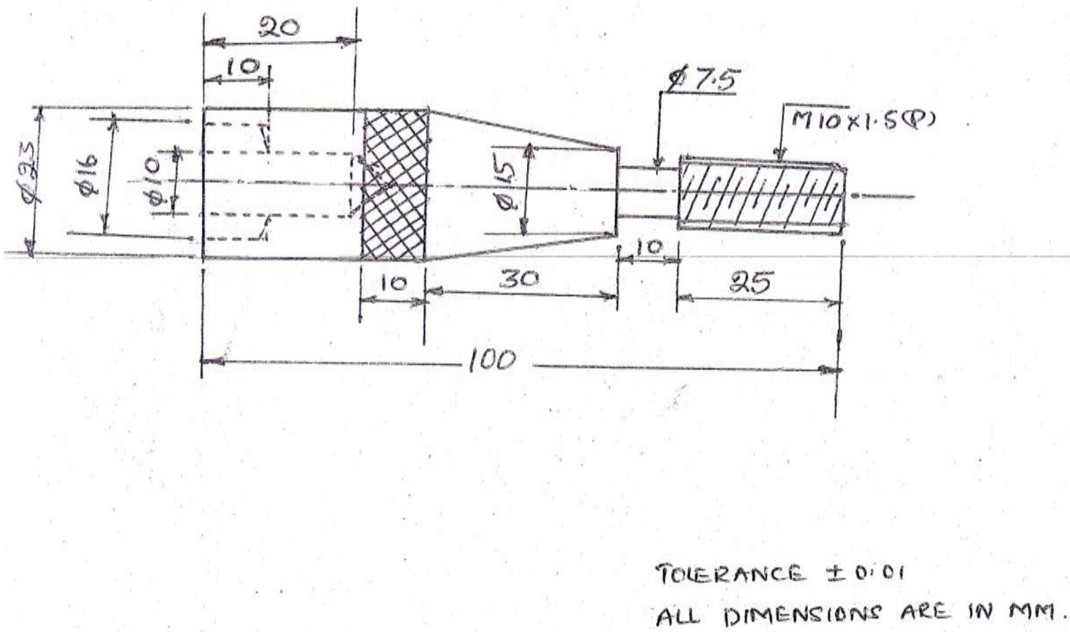
End cutting edge angle = 15^0

Side cutting edge angle = 15^0,

Nose radius = 2 mm

EXPERIMENT - 1

Aim: To perform various lathe operations such as "**Facing, Plain turning, Step turning. Taper turning, under cut, Knurling, Thread cutting** and **chamfering**. "On a given material made of mild steel.



Material required: A mild steel bar of 25mm diameter and 100mm long.

Tools used H.S.S. single point cutting tool, parting tool, V-tool for threading , Knurling tool, Chuck key, tool post key.

Measuring instruments: outside caliper, steel rule, pitch gage etc.

Procedure:

1. Set the work piece on the chuck and tool on the tool post.
2. Operations such as facing& plain turning are performed on a given M.S. bar.

   Then the step & undercut turning is performed using parting tool. (Final cut).

   One after another in the sequence upon the dimensions as shown.
3. Now the compound rest is swiveled by calculated half taper angle and taper is generated on the work piece, by rotating the compound slide screen will cause the tool to be feed at the half taper angle (α).

4. H.S.S. tool is replaced by Knurling tool in tool post. Knurling generation is performed at the slowest speed of the spindle.
5. Knurling must be done at low speed available and apply lubricating oil while knurling.
6. H.S.S. V- Shape thread curing tool fix the tool post and set the work piece on the chuck.
7. The change gears of correct size are calculated and then fitted to the end of the bed between the spindle and the lead screw.
8. The top of the tool nose should be set at the same height as the center of the job.
9. Thread cutting generation is performed at the slowest speed of the spindle.
10. Engage the lead screw lever and start the operation. Apply proper coolant during cutting point.
11. The depth of cut usually varies from 0.05mm to 0.2mm.

Precautions:

1. Operate the machine at specific speed.
2. Do not depth of cut more than 2mm.
3. Apply lubricating oil while all operations
4. Make sure that the work place is neat and clean.

Result :The required operations are successively completed.

VIVA QUESTIONS:

1. What is a lathe?
2. What are the various operations can be performed on a lathe?
3. What are principle parts of the lathe?
4. What are the types of headstock?
5. State the various parts mounted on the carriage?
6. What are the four types of tool post?
7. What is an apron?
8. State any two specification of lathe?
9. List any four types of lathe?

2.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 work piece (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

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.

WORKING PRINCIPLE AND OPERATION OF DRILLING MACHINE

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.

DRILLING OPERATIONS

The following are the most common operations performed on the drilling machine:

1. **Drilling**: it is an operation of producing a circular hole in a work piece by forcing a drill in the work piece.
2. **Boring:** it is an operation of enlarging a hole that has already been drilled. Single point cutting tool is used in boring.

3. **Reaming:** Reaming is done with reamers. It is done to generate the hole of proper size and finish after drilling

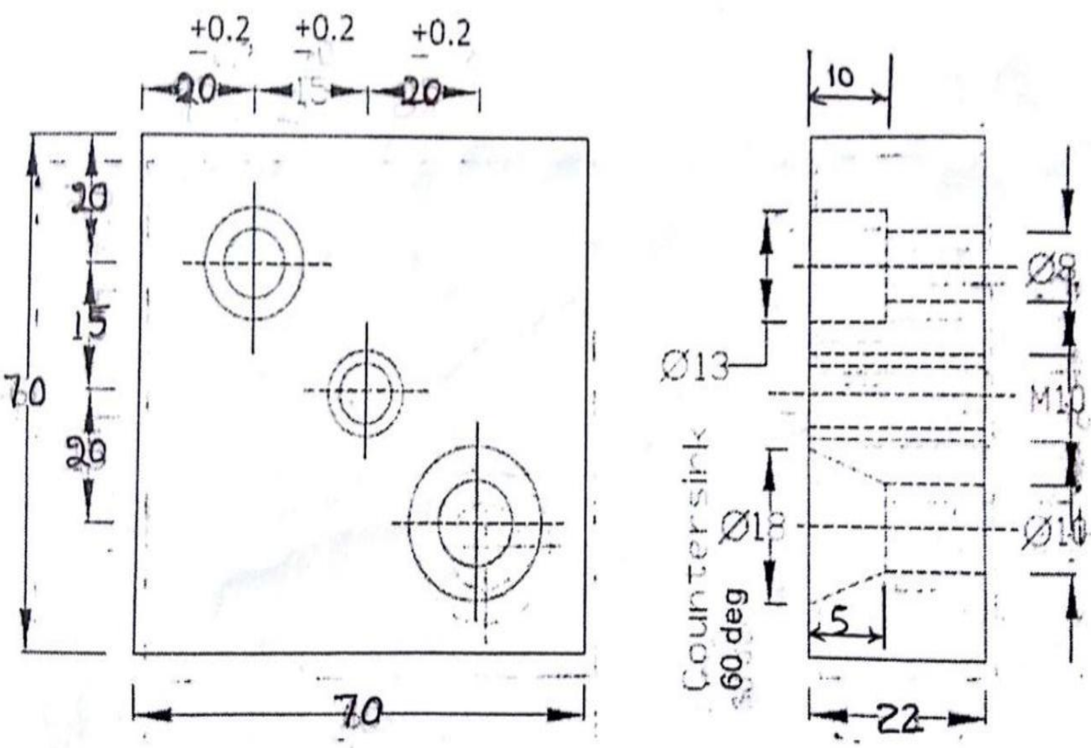
4. **Tapping:** It is an operating of producing internal threads in a hole by means of a tap.

5. **Counter Boring:** It is an operation of enlarging the entry of a drilled hole to accommodate the bolt head etc. Counter boring tool does it.

6. **Spot Facing:** It is an operation done on the drilled hole to provide smooth seat for bolt head.
7. **Counter Sinking:** It is an operation to bevel the top of a drilled hole for making a conical seat. A counter sunk drill is used in this operation

EXPERIMENT – 2

AIM:_To perform Drilling. Reaming, Boring, Counter boring, Counter sinking, and tapping.



TOOLS:Drill bits, Reamer, Boring tool, Counter bore drill bit, Counter sink drill bit, Tap set With wrench, Vernier height gauges, surface plate, Dot punch Hammer. Etc.

MATERIAL: Mild steel flat piece.

PROCEDURE:

1. Before drilling holes, center of holes are located on a work piece by drawing Two lines at right angles to each other using vernier height gauge and surface plate.
2. Punching is done using center punch and ball peen hammer at the located centers.
3. Work piece is firmly fixed in the vice on a drilling machine table and drill bit is firmly fixed by drill chuck.
4. The pilot holes are drilled at the chosen location by starting the drilling at the drilling machines.
5. Drill is replaced by actual size drill and required holes are made in previously drilled pilot holes.

6. The adjustable boring tool held in a boring bar replaces drill bit and the first hole is enlarged to final size.
7. Boring tool is replaced by the reamed and the subsequent sizing and finishing of the reaming a hole is done by performing reaming operation by giving hand feed.
8. Reaming is replaced by the counter bore with pilot to enlarge, to form a square shoulder with the original hole.
9. Counter bore is replaced by the counter sink for given diameter and 90^0 inclined angles to the end of hole and enlarged conically.
10. Tapping is done using hand tap set, by a tap hole.

PRECAUTIONS:

1. The drill bit must be properly fixed,
2. Centers must be correctly marked
3. Slightly lower speeds of the order of 25% less than drilling should be used to counter boring, counter sinking operations.
4. Holes of larger diameter should never be drilled without a pilot hole.
5. Apply proper coolant during drilling operation.

Result: The required operations are successively completed.

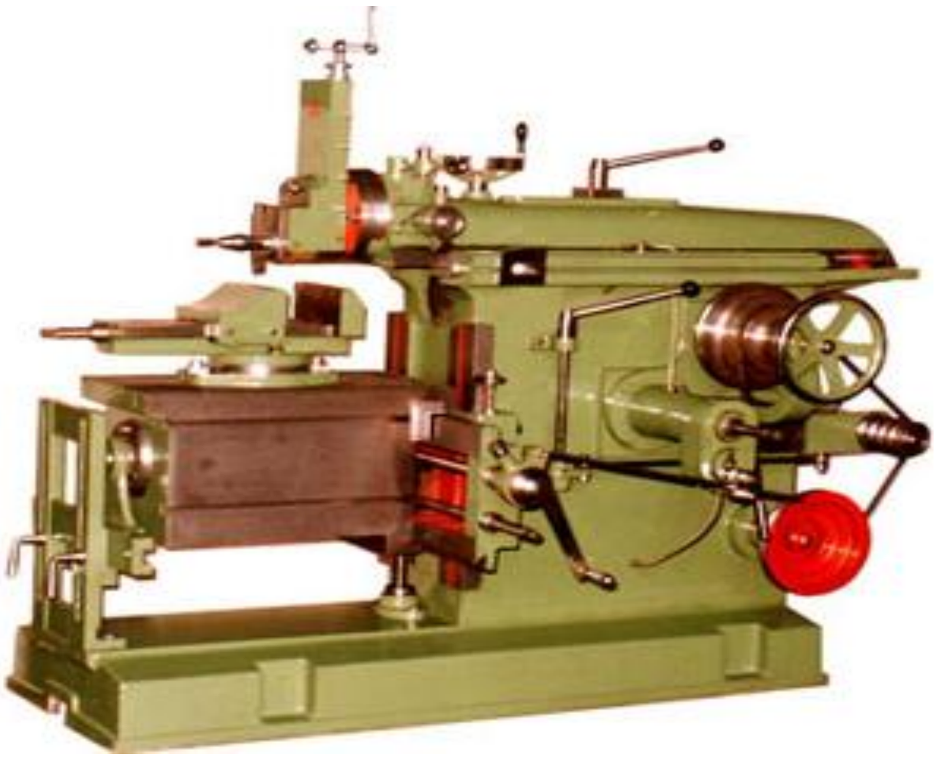
VIVA QUESTIONS:

1. What is ment by drilling?
2. What is gang -drilling machine
3. Mention any four specification of drilling machine?
4. List any four machining operations that can be performed on a drilling machine?
5. What are the different ways to mount the drilling tool?

3. SHAPING

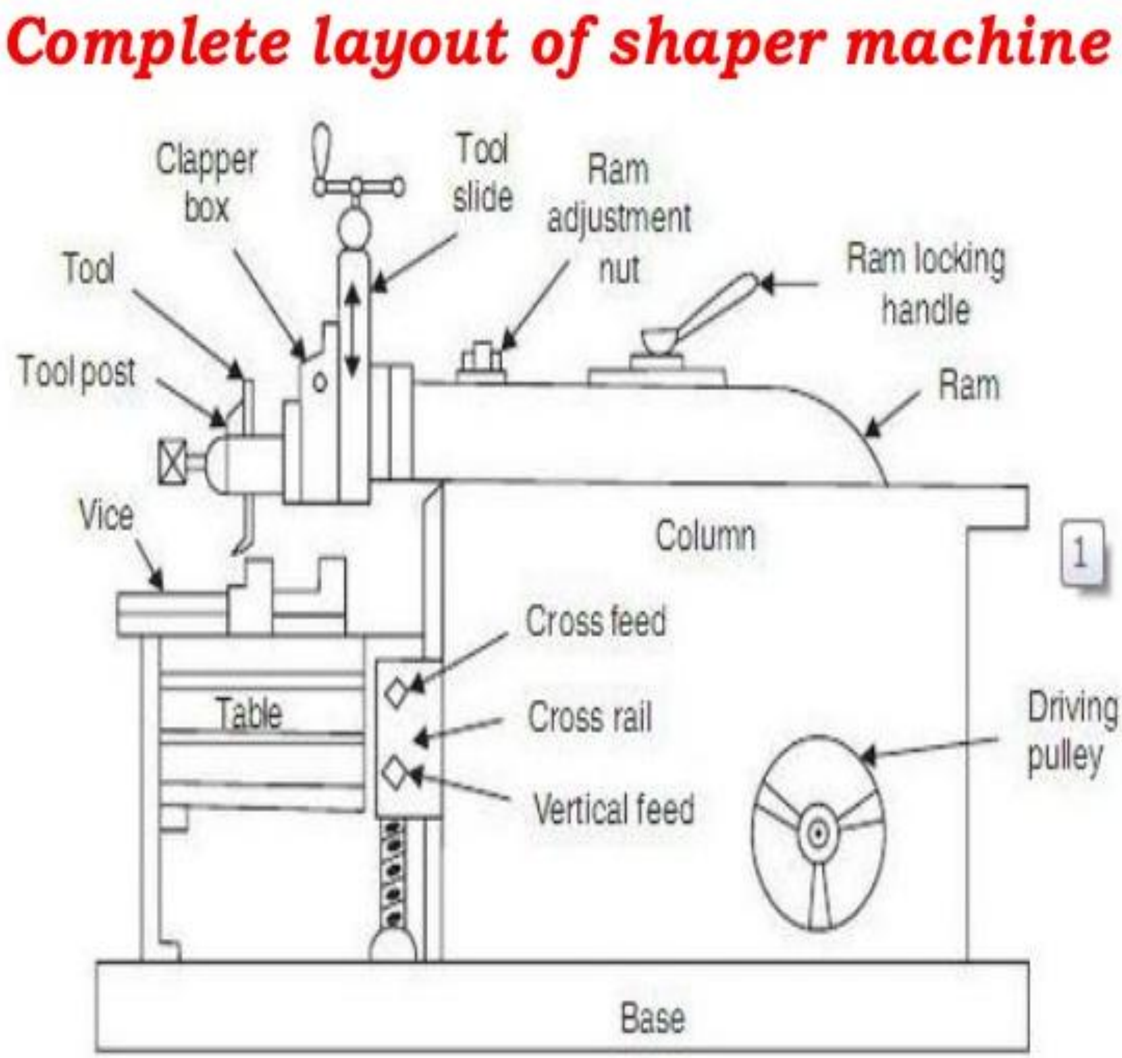
Introduction:

The shaping machine is used for producing flat surfaces. Machining on shaper more economica with easier work setting and cheaper tooling. On a shaper job is fixed on table and the cuing tool reciprocates across the work piece. The tool cuts on forward stroke and the return stroke remain idle. As there is no cutti9ng action in return stroke, we deploy quick return mechanism to reduce cutting time. To produce flat surfaces, channel sections, V- channels and gear teeths.etc.



Types of mechanisms:

1. Crank shaper: In construction the crank shaper employs a crank mechanism to change circular motion of the bull gear to reciprocating motion of the ram. The bull gear receives power either from an individual motor from an over head line shaft if it is a bell drive shaft.
2. Gear type shaper: this type of shaper carries a rack under it is ram which is driven by a spur gear. The pinion (spur gear) machining with the rack is driven by a gear drive. The speed and the direction in which the machine traverse depend on the number of gears in the gear train,
3. Hydraulic type: In these shapers hydraulic pressure is used for driving the ram .it has become very popular and is also more efficient than the both of the above tool.



Parts of the shaper:1. Base. 2. Column 3. Cross slide 4, saddle 5. Table 6. Clapper box 7. Ram 8. Tool head. 9. Feed disc. Elevating screw. Etc..

Driving mechanisms:

1) Crank an slotted lever mechanism
2) whit-worth quick return mechanism
3) Hydraulic shaper mechanism

Shaper operations:

1. Horizontal machining
2. Vertical machining
3. Angular machining
4. Slots, grooves and key ways cutting
5. Cutting gears or splines.

Cutting speed: In a shaper the cutting action is intermittent and is considered only during the forward cutting stroke.

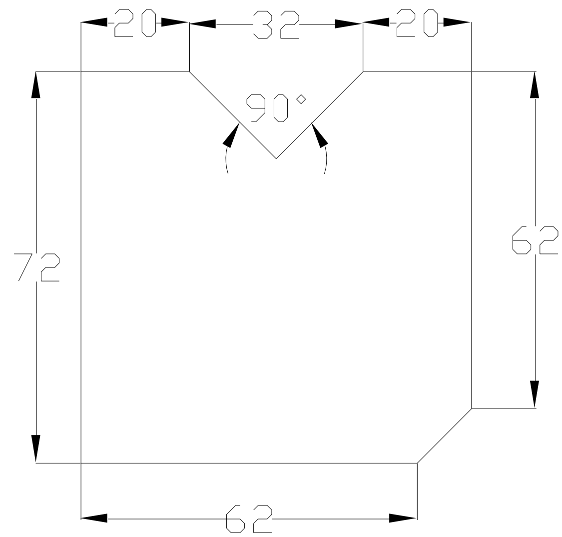
Cutting sped= $\frac{\boldsymbol{length\ of\ cutting\ stroke}}{\boldsymbol{time\ required\ by\ the\ cuting\ \ stroke}}$

Feed: It is the relative movement of the tool or work in a direction perpendicular to the axis of reciprocation of the ram for double stroke. In is expressed in mm. The feed is always given at the end of return stroke when the tool is not cutting the metal.

Depth of cut:_It is the thickness of metal that is removed in one cut. It is the perpendicular distances measured between machined surface and non machined surface of the work piece.

EXPERIMENT –3

AIM: Shaping of square block, V- groove.



All dimensions are in mm

tolerances±0.05mm

Tools: side tool, V- tool, try square, vernier caliper, steel rule

Materiel; m.s. square block

Procedure:

1. The job is fixed on a vice.
2. The tool is fixed on tool post.
3. The stroke of ram is adjusted to required length and machine is switched on.
4. Always during machining the job should be properly fixed with the half of try square and vice to get a right angle surface after machining.
5. After completion of work, the job should be filled help of file.
6. Before fixing the job, V block dimensions are marked on the job with the help of dot punch.
7. The tool head should be rotated at 45^0 to make the V- groove.
8. The feed is given such that the tool moves gradually on either side of the middle line.

9. The tool is moved to get the required groove.

Precautions: 1. The tool should be properly fixed.

2. Proper movement of tool must be entered.
3. Select proper cutting speeds.
4. Don't touch and measure the job during the process of machining.

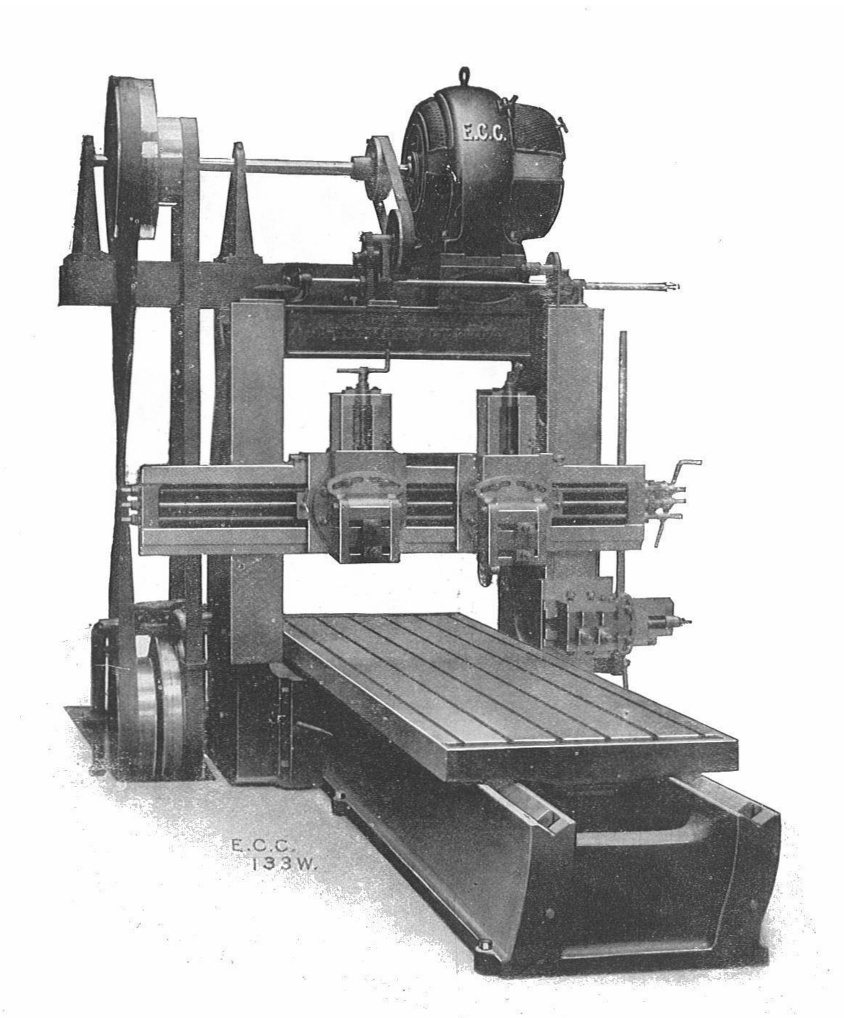
Result: The given square block is machined for plain shaping and done by V groove as for given dimensions.

VIVA QUESTIONS:

1. Mention the applications of gear shaping process?
2. What are the limitations of gear hobbing?
3. What is shaper?
4. List any four important parts of a Shaper?
5. How the feed & depth of cut is given to the shaper?
6. Mention any four-shaper specification?
7. How the planer differs from the shaper?

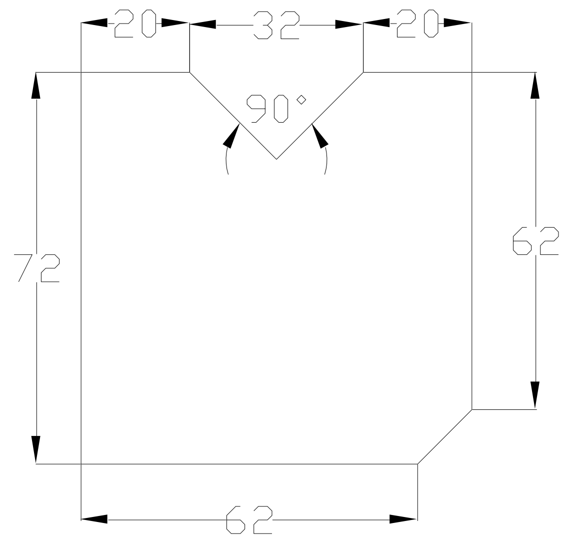
4.PLANER

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



EXPERIMENT –4

AIM: planar square block, with V- groove.



All dimensions are in mm

tolerances±0.05mm

Tools: side tool, V- tool, try square, vernier caliper, steel rule

Materiel; m.s. square block

Procedure:

1 The job is fixed on a vice.
2 The tool is fixed on tool post.
3 The stroke of ram is adjusted to required length and machine is switched on.
4 Always during machining the job should be properly fixed with the half of try square and vice to get a right angle surface after machining.
5 After completion of work, the job should be filled help of file.
6 Before fixing the job, V block dimensions are marked on the job with the help of dot punch.
7 The tool head should be rotated at 45^0 to make the V- groove.
8 The feed is given such that the tool moves gradually on either side of the middle line.
9 The tool is moved to get the required groove.

Precautions: 1. The tool should be properly fixed.

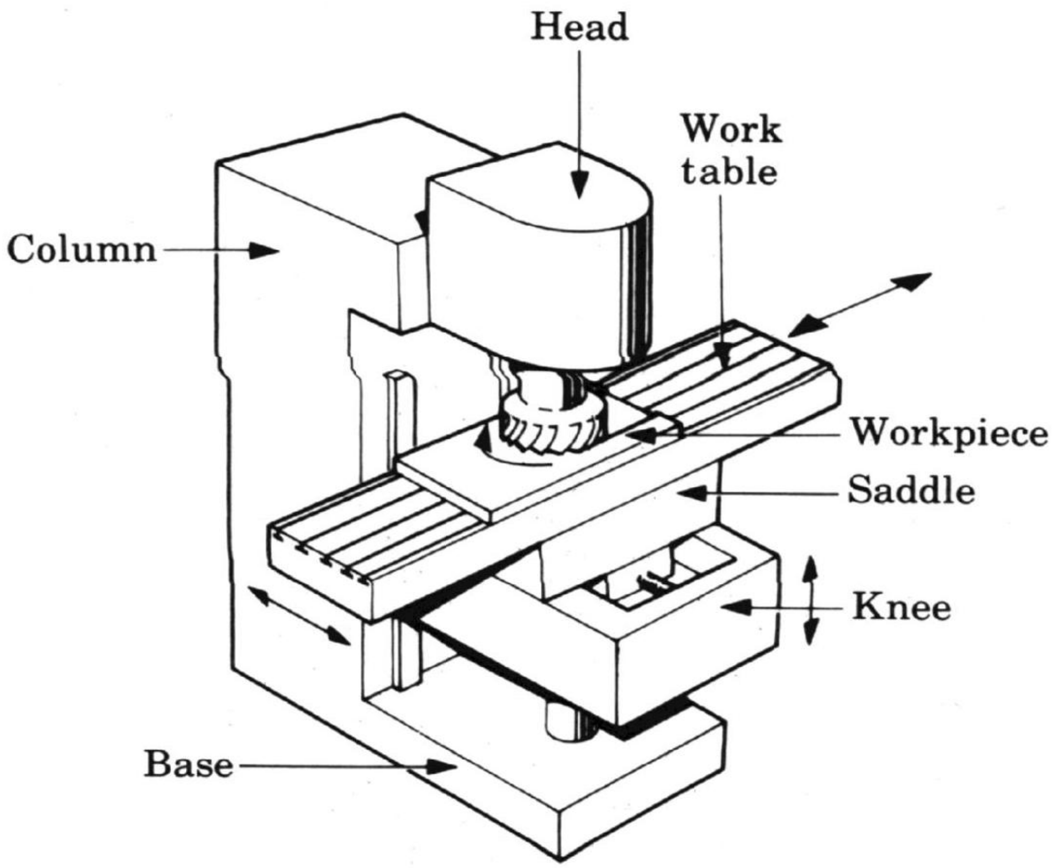
5. Proper movement of tool must be entered.
6. Select proper cutting speeds.
7. Don't touch and measure the job during the process of machining.

Result: The given square block is machined for plainr and done by V groove as for given dimensions.

5. MILLING

Introduction:

Milling is a machining process in which metal is removed by rotating multi-edge cutting tool called “milling cutter”, while the work piece fed against to it. A milling machine is a machine tool that removes metal chips. Work is fed against a rotation multipoint cutter. It removes metal at a very fast rate. The job movement is horizontal, vertical and cross feeding.



Types of milling m/c.: Column and knee type.

1. Horizontal milling. 2. Vertical milling. 3. Universal milling. 4. Omniversal milling.

Parts of milling m/c: - 1._Base. 2. Column. 3. Knee. 4. Saddle. 5. Table. 6. Spindle. 7. Arbor.

8. Elevating screw. 9. Overhanging arm. Etc.

Milling m/c. mechanism: The spindle drive mechanism is incorporated in the column. All modern machines are driven by individual motors housed within the column, and the spindle reeves power from a combination of gears and clutch assembly. Multiple speeds of the spindly may be obtained by altering the gear ratio.

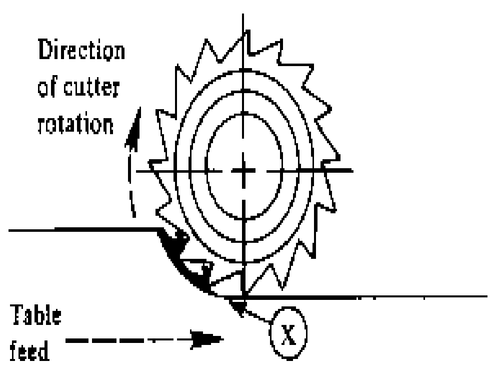
Work holding devices: T- bolts and clamps, V-blocks, Angle plate, Vices, etc.

Cutter holding devices_:Arbors, collets, Adapters, Spring collets, Bolted cutters, Screw on cutters.

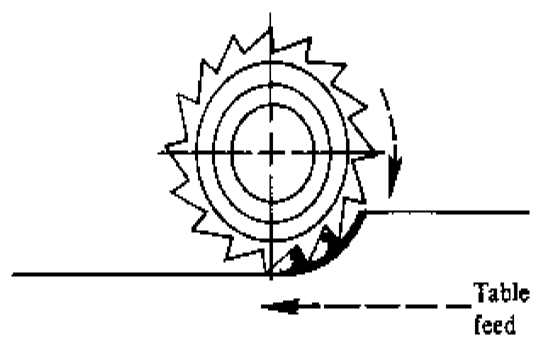
Standard milling cutters:

1. Plain milling cutter.
2. Side milling cutter
3. Angle milling cutter
4. End milling cutters.
5. T- Slot milling cutter.
6. Fly cutter.
7. Formed cutters, (Convex, concave, corner rounding, gear cutter.)
8. Face milling cutter or T max cutter, Saw milling cutter.

Types of milling processes:



UP MILLING



DOWN MILLING

MILLING METHODS

Up milling: The up milling which is also called conventional milling, is the process of removing the metal by a cutter which is rotated against the direction of travel of the work piece.

Down milling: The down milling which is also called climb milling, is the process of removing the metal by a cutter which is rotated in the same the direction of travel of the work piece.

Cutting speed: - The cutting speed of a milling cutter is its peripheral linear speed resulting from rotation. It is expressed in meters per minute. The cutting speed can be derived formula.

$V = \Pi d n / 1000$ minutes per min.

V= the cutting speed in inch per min.

d= the diameter of the cutter in mm.

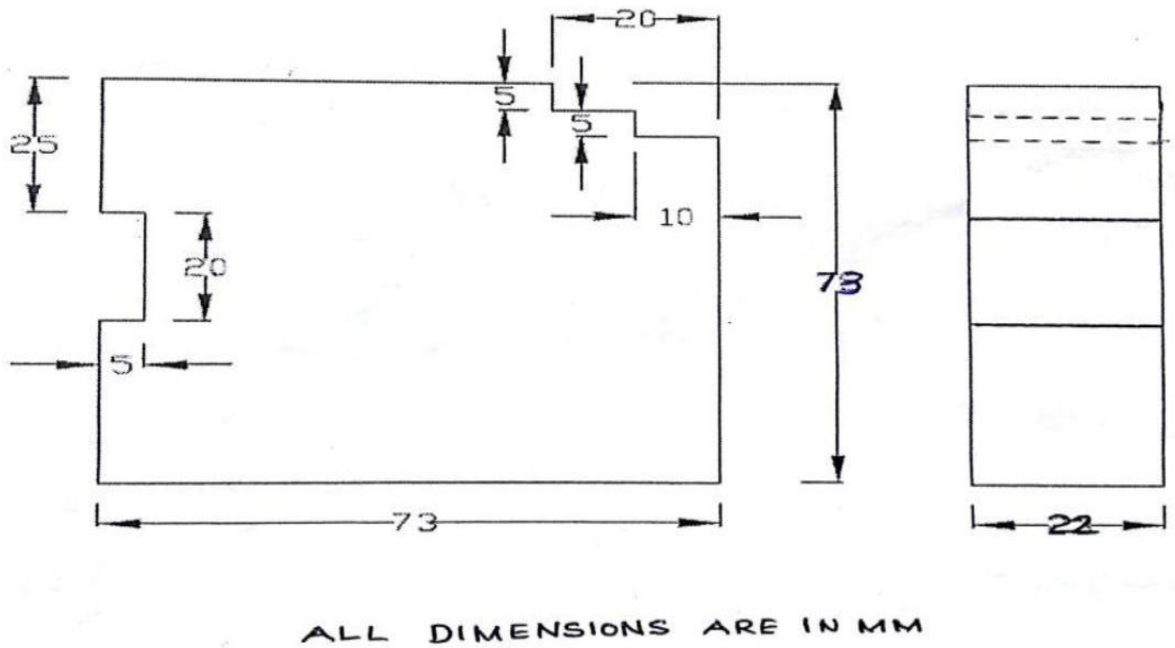
n= the cutter speed in rpm.

Feed: - The feed in a milling machine is defined as the rate with which the work piece Advances under the cutter.

Depth of cut: - The depth of cut in milling is the thickness of the material moved in one pass of the work under the cutter.

EXPERIMENT –5

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



Materials Required: Mild Steel Work Piece.

Machine Required: Milling Machine

Measuring Instruments: Vernier Calipers

Cutting Tools: Plane (Face) Milling Cutter.

Marking Tools:

1. steel rule, scriber
2. Work holding fixtures: work piece supporting fixtures
3. Miscellaneous tools: Hammer, brush, Allen keys

PROCEDURE:

1. The dimensions of the given rod are checked with the steel rule.
2. The given rod 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 on the horizontal milling machine spindle and one end of the rod is face milled, by raising the table so that the end of the rod faces the cutter.
4. The rod is removed from the vice and fitted in the reverse position.
5. The other end of rod is face milled such that, the length of the job is exactly 100 mm.
6. The table is lowered and the rod is removed from the vice and refitted in it such that, the top face of the rod is projected from the vice jaws.
7. The face milling cutter is removed from the spindle and the arbor is mounted in the spindle; followed by fixing the plain milling cutter.
8. The top surface of the job is slab milled; first giving rough cuts followed by a finish cut.
9. 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.
10. 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.
11. 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:

VIVA QUESTIONS:

1. What are the specifications of the milling machine?
2. Mention the various movements of universal milling machine table?
3. State any two comparisons between plain &universal milling machine?
4. What are the cutter holding devices?
5. List the various type of milling attachment?
6. Write any ten nomenclature of plain milling cutter?
7. What are the advantages of milling process?

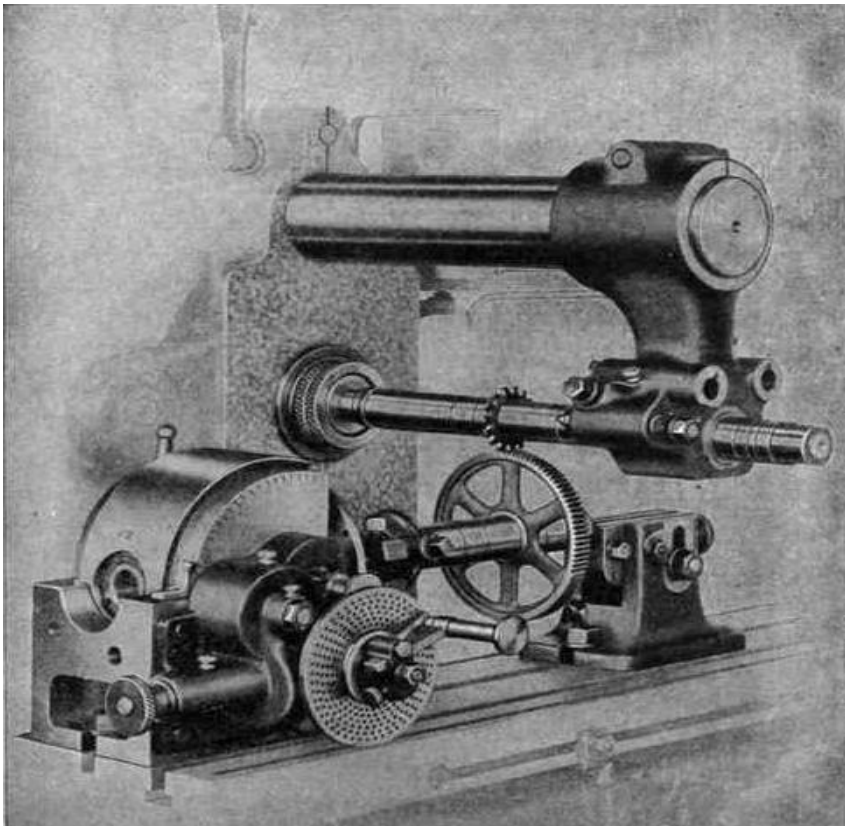
8. what are the down milling processes?
9. List out the various milling operations?
10. What does term indexing mean?
11. What are the three types dividing heads?
12. What is cam milling?
13. What are the different types of thread milling?
14. Gear cutting by single point form tool.
15. List the gear generating process?
16. What is a semi-automatic lathe?
17. What is copying lathe?
18. State the various feed mechanisms used for obtaining automatic feed?
19. List any four holding devices?
20. What are the different operations performed on the lathe?

EXPERIMENT –6

AIM: Study Of Spur Gear Cutting In Milling Machine

Material: Ms Round Dia 40 Mm X 20 Mm Thickness

Tools Require: Gear Tooth Caliper, Gear Cutter, Indexing Head, Indexing Plate, Tail Stock, Mandrel, Spanners



PROCEDURE:

Indexing: It is the process to deviate the periphery or length of a job into required equal or unequal no. of division.

Indexing head: It is the attachment used to perform Indexing purpose.

Types of Indexing: 1. Direct. 2. Indirect. 3. Deferent. 4. Compound. 5. Angular. 6. Linear. 7. Block indexing.

Direct indexing: It is called rapid indexing. It is done on Direct Indexing head and universal Indexing head.

$$\text{Indexing moment} = \frac{\text{No.of holes in indexing plate}}{N}$$

$$\text{I.M} = \frac{32}{16} = 2$$

Indirect indexing: Simple indexing or plain indexing. As the shaft carrying the crank has a single thread worm to which meshes with the worm gear having 40 teeth, 40 turns of the crank are necessary rotate the indexing head spindle through one revolution. Indexing plates with circle of holes patented by the "Brown and Sharpe" company standard index plates.

Plate no. 1: 15, 16, 17, 18, 19, 20.

Plate no. 2: 21, 23, 27, 29, 31, 33.

Plate no. 3: 37, 39, 41, 43, 47, 49.

Example:- N=15.

$$\text{Indexing moment} = \frac{\text{No.of holes in indexing plate}}{N}$$

$$\textbf{I.M} = \frac{\mathbf{40}}{\mathbf{15}} = \frac{\mathbf{8}}{\mathbf{3}} = \mathbf{2}\frac{\mathbf{2}}{\mathbf{3}} \times \frac{\mathbf{5}}{\mathbf{5}} = \frac{\mathbf{10}}{\mathbf{15}}$$

I.M.= 2 complete circle of indexing crank and 10 spaces in 15 hole in a circle plate.

INVOLUTE GEAR CUTTER:

Cutter no.	No. of teeth cut.
	135 to to a rack.
1	55 to 134. Teeth.
2	35 to 54. Teeth.
3	26 to 34. Teeth.
4	21 to 25. Teeth.
5	17 to 20. Teeth.
6	14 to 16. Teeth.
7	12 to 13. Teeth.

GEAR

It is round and teeth on periphery. There are two goops.

1. Spur Teeth: - They are parallel to the axis.
2. Helical Teeth: -They are parallel to the at an angle to the axes. So according to the Right and Left hand axis.

Types of gears:

1. Spur gear. 2. Helical gear. 3. Bevel gear. 4. Hearing gear.

5. Rack& Pinion gear. 6. Worm and worm gear. 7. Internal gear.

Spur gear nomenclature.

Outside circle: It is biggest circle. It is cut on lathe machine.

Pitch circle : It is the imaginary circle. Which separates addendum and dedendum and on this circle. It is most important circle as all the calculations and design of tooth is based on this circle.

Clearance circle: This is circle on which the out side circle of other gears touches.

Root circle: It is circle do train by the milling cutter.

Bore circle: It is circle of bore which is the shaft passes. It is obtain by lathe machine.

Out side diameter: It is the dia of the o.s circle.

Pitch diameter: It is pitch diameter of the pitch circle.

Clearance diameter: It is the dia of the clearance circle.

Root dia: It is the dia at the bottom of the tooth spaces.

Bore diameter: It is the dia of the Bore circle.

Addendum: It is the height from the pitch circle to tip of the tooth.

Dedendum: It is the depth of tooth space below the pitch circle and equals addendum plus clearance.

Clearance: It is the difference between the dedendum of one gear and the addendum of the making gear.

Cordial addendum: This distance from the o.s. circle of the straight line drawn by joining the pitch point on the tooth.

Cordial Dedendum: This is top surface.

Face: It is the part of the tooth surface lying o.s. the pitch surface.(imaginary rollers)

Flank: It is that part of the tooth surface lying inside the pitch surface.

Circular pitch: It is the length of the arc of the pitch circle between similar faces of successive teeth.

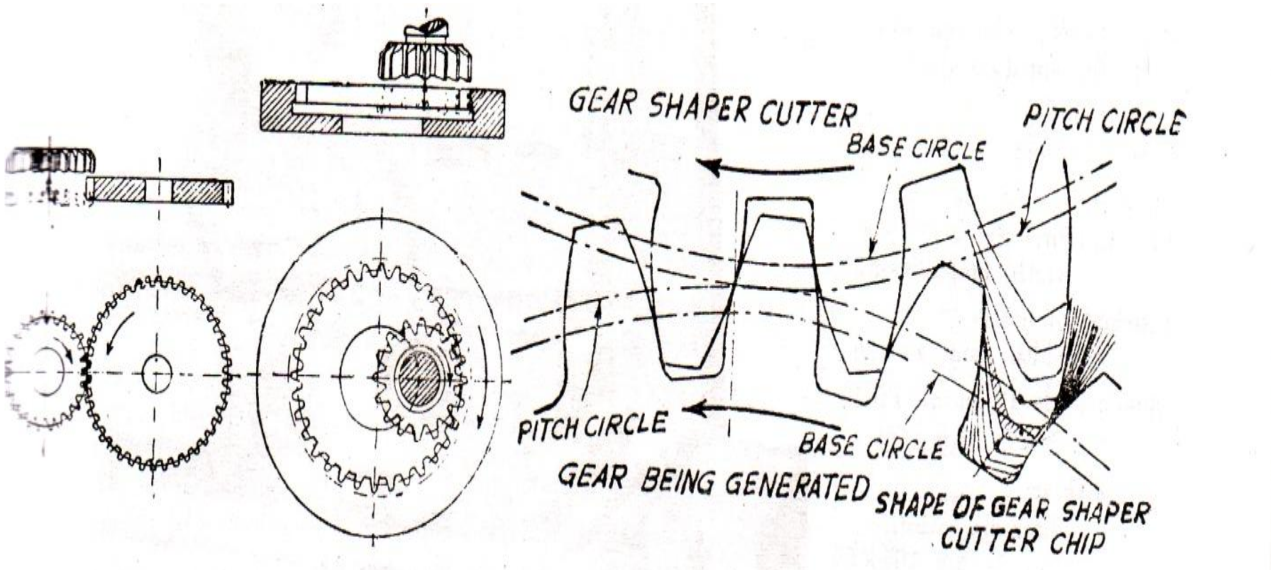
Cordial pitch: It is the distance measured in straight line from tooth along the pitch circle.

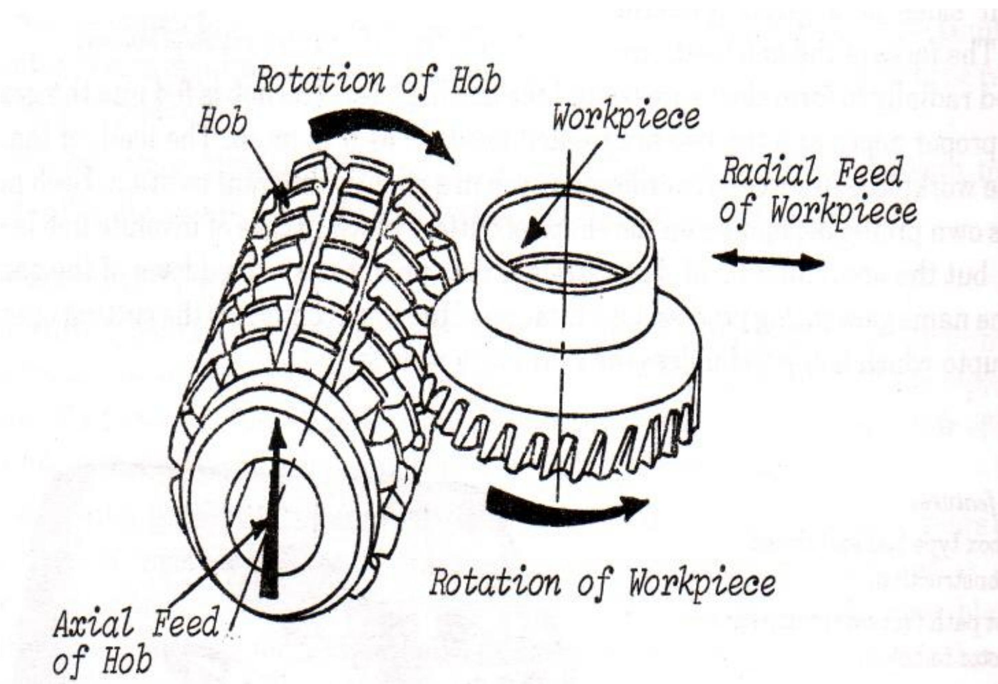
Diameter pitch: It is the number of teeth divided by the pitch diameter.

Depth of pitch: No. of teeth per inch pitch dia.

Module: It is the size of the tooth in mm.

Thickness of tooth: It is the thickness of the tooth measured on the pitch circle. It is the cordial thickness measured in straight line of pitch circle.





SPUR GEAR GENERATION PRINCIPLE

SPUR GEAR FORMULA

1. **Addendum:** lm (module) or ded- clearance.
2. **Dedendum** : Add + Clearance. or 1.25m.

3. **Clearance**: 0.25m.
4. **Working depth**: Add + dend – clearance = l mx 1.25-0.25 =2m.
5. **Total depth**: Add + dend. =2.25.
6. **O.D:** $(n+2)^m$
7. **Pitch diameter** : m x n= mn. or (O.D.- 2add)
8. **Circular pitch**: 2 thickness (π m) π nm
9. **Thickness of pitch** = $\frac{nm}{2} = 1.5708m$
10. **P.D=** O.D. – 2add.
11. .D.P = $\frac{1}{module}$

EXAMPLE: M= 4 T = 45

Indexing $=\frac{40}{m} = \frac{40}{45} = \frac{8}{9} \times \frac{3}{3} = \frac{24}{27}$ 24 space in 27

O.D.= m (n+2) = 4(45 + 2) = 4 x 47 =188mm.

Total Depth:- 2.25 x m = 2.25 x 4 = 9.00 mm.

No. of cutter = 3. Module = 4. N. = 45.

Thickness of tooth:- 1.5708 x 4 = 6.2832.

Chordal thickness =P.D$\times \frac{sin90^{0}}{N}$; (P.D. = O.D. – 2 add), P. D. = 188 – 8 = 180mm.

C.T=180×$\frac{sin90^{0}}{45}$=180×sin2^{0}= 180×0.0349=6.282

Chordal addendum =$\frac{PD}{2}\left(1-\frac{sin90^{0}}{N}\right)+4$ =PD (1- $\frac{0.9994}{2}$)+4= 0.054 + 4 = 4.054mm

Result: The given block was machined as a spur gear successfully.

7. SHEET METAL JOINING BY SOLDERING

Soft soldering is the process of joining metals by the use of filler metal of low melting point (450^0c). The filler metal is an alloy of lead and tin is called solder. The malting point of solder as less then the base metals. Doping up on the proportions of each constituent, its melting point varies from 150^0c to 350^0c. The percentage of lead increases the malting point of soldering

1) Soft solder ----- Lead 37% & tin 63%.
2) Medium solder ----- Lead & tin 50% each.
3) Electrical solder ---- Lead 58% & Tin 42%.
4) Plumber solder ----- Lead 70% & Tin 30%.

EXPERIMENT -7

AIM-: To solder the given G. I. using Black smithy & wire. (Using electric soldering)

Material required:- G.I. sheets & electric wire, kerosene, coal (both wood coal & railway coal), cotton waste, filler material, flux.

Machine required:- Open hearth furnace, hot iron with a wooden handle, electric air blower.

Sequence of operations (Block smithy soldering.

1. Fire the open hearth furnace
2. Soldering iron is placed.
3. A few minutes the electric air blower is switched on the coal starts burning.
4. Clamped firmly the metals to be soldered in a bench vice and apply layer of flow after cleaning.
5. Solder is applied using red hot soldering iron.
6. Remove irregularities with the hot iron.

Electric soldering:-

- Starts the electric solder leave it for heating.
- Remove the insulation for the wire to be soldering.
- Clean & twist then together apply flux.
- Filler material wire rubbed slowly against the heated soldering iron.
- Spread the metal uniformly on wire & make a uniform joint.

Procedure: -

1) Plug in the soldering rod & leave it for the heating.
2) Now, remove the insulation of wires to be soldered.
3) Twist the copper of the wires & then apply flux for copper ends.
4) Lead which is used as filler metal is rubbed slowly against the heated soldering iron rod.
5) Spread the metal uniformly on the wires.
6) Plug out the soldering rod & leave it for cooling.

Result: The wires are joined using electrical soldering successfully

8. COMPUTER NUMERICAL CONTROL (CNC)

XL Turn: - A2 axes CNC slant bed lathe with Fanuc emulated control programming software. The software ware incorporates major functions and facilities used on industrial controls with further option of linking the machine to CAD/ CAM and FMS (Flexible manufacturing System. XL Turn that performs drilling, boring, reaming, grooving, threading, parting, roughing, chamfering, tapping of circular work pieces, using CNC programming .

Introduction: - CNC program is define as a program which contains various codes which have to be followed according to the given dimensioning methodology operating software.

There are two types of diminishing systems.

1) Absolute Dimension system
2) Incremental Dimension system.

Example:- Absolute Dimension system

	X	Y
P1	0	0
P2	20	0
P3	20	20

Incremental Dimension system

	X	Y
P1	0	0
P2	20	0
P3	0	20

P4	70	20	P4	50	0
P5	70	0	P5	0	-20
P6	100	0	P6	30	0
P7	100	40	P7	0	40
P8	70	70	P8	-30	30
P9	0	70	P9	-70	0

-------------------------- -----------------------------------

A standard billet (raw material) can be represented for a diameter of 20mm and length of 70mm in CNC program methodology is given by various types of codes.

Various types of codes

G- codes: They are instructions described in the machine tool movement in a program.

G-Codes simple definition

G00 Rapid traverse
G01 Linear interpolation with feedrate
G02 Circular interpolation (clockwise)
G03 Circular interpolation (counter clockwise)
G2/G3 Helical interpolation
G04 Dwell time in milliseconds
G05 Spline definition
G06 Spline interpolation
G07 Tangential circular interpolation / Helix interpolation / Polygon interpolation / Feedrate interpolation
G08 Ramping function at block transition / Look ahead "off"
G09 No ramping function at block transition / Look ahead "on"
G10 Stop dynamic block preprocessing
G11 Stop interpolation during block preprocessing
G12 Circular interpolation (cw) with radius
G13 Circular interpolation (ccw) with radius
G14 Polar coordinate programming, absolute
G15 Polar coordinate programming, relative
G16 Definition of the pole point of the polar coordinate system
G17 Selection of the X, Y plane
G18 Selection of the Z, X plane
G19 Selection of the Y, Z plane
G20 Selection of a freely definable plane
G21 Parallel axes "on"
G22 Parallel axes "off"
G24 Safe zone programming; lower limit values
G25 Safe zone programming; upper limit values

G26 Safe zone programming "off"
G27 Safe zone programming "on"
G33 Thread cutting with constant pitch
G34 Thread cutting with dynamic pitch
G35 Oscillation configuration
G38 Mirror imaging "on"
G39 Mirror imaging "off"
G40 Path compensations "off"
G41 Path compensation left of the work piece contour
G42 Path compensation right of the work piece contour
G43 Path compensation left of the work piece contour with altered approach
G44 Path compensation right of the work piece contour with altered approach
G50 Scaling
G51 Part rotation; programming in degrees
G52 Part rotation; programming in radians
G53 Zero offset off
G54 Zero offset #1
G55 Zero offset #2
G56 Zero offset #3
G57 Zero offset #4
G58 Zero offset #5
G59 Zero offset #6
G63 Feed / spindle override not active
G66 Feed / spindle override active
G70 Inch format active
G71 Metric format active
G72 Interpolation with precision stop "off"
G73 Interpolation with precision stop "on"
G74 Move to home position
G75 Curvature function activation
G76 Curvature acceleration limit
G78 Normalcy function "on" (rotational axis orientation)
G79 Normalcy function "off"

G80 - G89 for milling applications:

G80 Canned cycle "off"
G81 Drilling to final depth canned cycle
G82 Spot facing with dwell time canned cycle
G83 Deep hole drilling canned cycle
G84 Tapping or Thread cutting with balanced chuck canned cycle
G85 Reaming canned cycle

G86 Boring canned cycle
G87 Reaming with measuring stop canned cycle
G88 Boring with spindle stop canned cycle
G89 Boring with intermediate stop canned cycle

G81 - G88 for cylindrical grinding applications:

G81 Reciprocation without plunge
G82 Incremental face grinding
G83 Incremental plunge grinding
G84 Multi-pass face grinding
G85 Multi-pass diameter grinding
G86 Shoulder grinding
G87 Shoulder grinding with face plunge
G88 Shoulder grinding with diameter plunge
G90 Absolute programming
G91 Incremental programming
G92 Position preset
G93 Constant tool circumference velocity "on" (grinding wheel)
G94 Feed in mm / min (or inch / min)
G95 Feed per revolution (mm / rev or inch / rev)
G96 Constant cutting speed "on"
G97 Constant cutting speed "off"
G98 Positioning axis signal to PLC
G99 Axis offset
G100 Polar transformation "off"
G101 Polar transformation "on"
G102 Cylinder barrel transformation "on"; cartesian coordinate system
G103 Cylinder barrel transformation "on," with real-time-radius compensation (RRC)
G104 Cylinder barrel transformation with center line migration (CLM) and RRC
G105 Polar transformation "on" with polar axis selections
G106 Cylinder barrel transformation "on" polar-/cylinder-coordinates
G107 Cylinder barrel transformation "on" polar-/cylinder-coordinates with RRC
G108 Cylinder barrel transformation polar-/cylinder-coordinates with CLM and RRC
G109 Axis transformation programming of the tool depth
G110 Power control axis selection/channel 1
G111 Power control pre-selection V1, F1, T1/channel 1 (Voltage, Frequency, Time)
G112 Power control pre-selection V2, F2, T2/channel 1
G113 Power control pre-selection V3, F3, T3/channel 1
G114 Power control pre-selection T4/channel 1
G115 Power control pre-selection T5/channel 1
G116 Power control pre-selection T6/pulsing output

G117 Power control pre-selection T7/pulsing output
G120 Axis transformation; orientation changing of the linear interpolation rotary axis
G121 Axis transformation; orientation change in a plane
G125 Electronic gear box; plain teeth
G126 Electronic gear box; helical gearing, axial
G127 Electronic gear box; helical gearing, tangential
G128 Electronic gear box; helical gearing, diagonal
G130 Axis transformation; programming of the type of the orientation change
G131 Axis transformation; programming of the type of the orientation change
G132 Axis transformation; programming of the type of the orientation change
G133 Zero lag thread cutting "on"
G134 Zero lag thread cutting "off"
G140 Axis transformation; orientation designation work piece fixed coordinates
G141 Axis transformation; orientation designation active coordinates
G160 ART activation
G161 ART learning function for velocity factors "on"
G162 ART learning function deactivation
G163 ART learning function for acceleration factors
G164 ART learning function for acceleration changing
G165 Command filter "on"
G166 Command filter "off"
G170 Digital measuring signals; block transfer with hard stop
G171 Digital measuring signals; block transfer without hard stop
G172 Digital measuring signals; block transfer with smooth stop
G175 SERCOS-identification number "write"
G176 SERCOS-identification number "read"
G180 Axis transformation "off"
G181 Axis transformation "on" with not rotated coordinate system
G182 Axis transformation "on" with rotated / displaced coordinate system
G183 Axis transformation; definition of the coordinate system
G184 Axis transformation; programming tool dimensions
G186 Look ahead; corner acceleration; circle tolerance
G188 Activation of the positioning axes
G190 Diameter programming deactivation
G191 Diameter programming "on" and display of the contact point
G192 Diameter programming; only display contact point diameter
G193 Diameter programming; only display contact point actual axes center point
G200 Corner smoothing "off"
G201 Corner smoothing "on" with defined radius
G202 Corner smoothing "on" with defined corner tolerance

G203 Corner smoothing with defined radius up to maximum tolerance
G210 Power control axis selection/Channel 2
G211 Power control pre-selection V1, F1, T1/Channel 2
G212 Power control pre-selection V2, F2, T2/Channel 2
G213 Power control pre-selection V3, F3, T3/Channel 2
G214 Power control pre-selection T4/Channel 2
G215 Power control pre-selection T5/Channel 2
G216 Power control pre-selection T6/pulsing output/Channel 2
G217 Power control pre-selection T7/pulsing output/Channel 2
G220 Angled wheel transformation "off"
G221 Angled wheel transformation "on"
G222 Angled wheel transformation "on" but angled wheel moves before others
G223 Angled wheel transformation "on" but angled wheel moves after others
G265 Distance regulation – axis selection
G270 Turning finishing cycle
G271 Stock removal in turning
G272 Stock removal in facing
G274 Peck finishing cycle
G275 Outer diameter / internal diameter turning cycle
G276 Multiple pass threading cycle
G310 Power control axes selection /channel 3
G311 Power control pre-selection V1, F1, T1/channel 3
G312 Power control pre-selection V2, F2, T2/channel 3
G313 Power control pre-selection V3, F3, T3/channel 3
G314 Power control pre-selection T4/channel 3
G315 Power control pre-selection T5/channel 3
G316 Power control pre-selection T6/pulsing output/Channel 3
G317 Power control pre-selection T7/pulsing output/Channel 3

Note that some of the above G-codes are not standard. Specific control features, such as laser power control, enable those optional codes.

M- Codes: These are called miscellaneous codes.

M00 Unconditional stop
M01 Conditional stop
M02 End of program
M03 Spindle clockwise
M04 Spindle counterclockwise
M05 Spindle stop
M06 Tool change (see Note below)

M19 Spindle orientation
M20 Start oscillation (configured by G35)
M21 End oscillation
M30 End of program
M40 Automatic spindle gear range selection
M41 Spindle gear transmission step 1
M42 Spindle gear transmission step 2
M43 Spindle gear transmission step 3
M44 Spindle gear transmission step 4
M45 Spindle gear transmission step 5
M46 Spindle gear transmission step 6
M70 Spline definition, beginning and end curve 0
M71 Spline definition, beginning tangential, end curve 0
M72 Spline definition, beginning curve 0, end tangential
M73 Spline definition, beginning and end tangential
M80 Delete rest of distance using probe function, from axis measuring input
M81 Drive On application block (resynchronize axis position via PLC signal during the block)
M101-M108 Turn off fast output byte bit 1 (to 8)
M109 Turn off all (8) bits in the fast output byte
M111-M118 Turn on fast output byte bit 1 (to 8)
M121-M128 Pulsate (on/off) fast output byte bit 1 (to 8)
M140 Distance regulation "on" (configured by G265)
M141 Distance regulation "off"
M150 Delete rest of distance using probe function, for a probe input (one of 16, M151-M168)
M151-M158 Digital input byte 1 bit 1 (to bit 8) is the active probe input
M159 PLC cannot define the bit mask for the probe inputs
M160 PLC can define the bit mask for the probe inputs (up to 16)
M161-M168 Digital input byte 2 bit 1 (to bit 8) is the active probe input
M170 Continue the block processing look ahead of the part program (cancel the M171)
M171 Stop the block processing look ahead of the probe input part program segment (like a G10)
M200 Activate the handwheel operation in the automatic mode (to introduce an offset in the program)
M201-M208 Select the axis (by number from 1 to 8) for the handwheel operation
M209 Activate the handwheel operation in the automatic mode, with PLC control of the axis selection
M210 Deactivate the handwheel input while in the automatic mode
M211 Deactivate this handwheel feature and also remove the handwheel offset (if any)
M213 Spindle 2 clockwise
M214 Spindle 2 counterclockwise

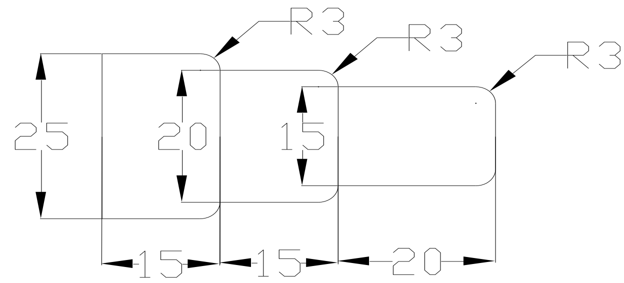
M215 Spindle 2 stop
M280 Switchable spindle/rotary axis, rotary axis on, first combination
M281 Switchable spindle/rotary axis, rotary axis on, second combination
M290 Switchable spindle/rotary axis, spindle enabled, first combination
M291 Switchable spindle/rotary axis, spindle enabled, second combination

Note: Other machine functions, like tool change (usually M06) or coolant control, have their M-code value specified by the PLC application not by the CNC software. Most of the M-code values in above list are configurable.

Other M-codes (up to M699) can be handled by the PLC application based on the particular machine requirements.

EXPERIMENT -8

Aim: To generate a plain & step turning program using CNC software



All dimensions are in mm

Software required: CNC train

Tools required: Single point cutting tool, Align key and spanner

Program:

```
        0       0005
        G21     G28
        G28     U0     WO
        M06     T0202
        M03     S1200
        G00     X26    Z2
        G71     U0.5   W0.5   R1
        G71     P10    Q20    U0.1   W0.1   F60

N10             G01    X0
                G01    Z0
                G01    X10    Z0
                G03    X15    Z-5    R3
                G01    X15    Z-15
                G03    X20    Z-20   R3
                G01    X20    Z-30
N20             G03    X25    Z-35   R3
                G70    P10    Q20    S2000  F40
```

```
G28    U0    W0
M05
M30
```

Result: The required program is executed and the given shape on the work piece is successfully completed.

9 WELDING

Introduction: - Welding is a process of joining metals by heating them to a suitable temperature at which they melt and fuse together.

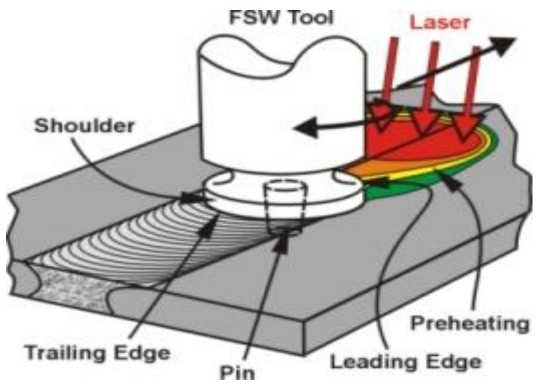
1. Arc Welding: - In arc welding the heat required for joining the metals is obtained from an electric. Transformers or motor generator sets are used as arc welding machines. These machines supply high electric currents at low voltage and an electrode is used to produce the necessary arc. The electrode serves as the filler rod and arc melts the surfaces so that the metals to be joined

Requirements of Arc welding:-

1. Welding machine.
2. Cables or leads.
3. Electrode holders.
4. Cable connectors or lugs.
5. Ground clamp.
6. Chipping hammer.
7. Wire brush.
8. Face shield.
9. Protection clothing.

Fundamental of weld joints:-

1. Butt joint.
2. Lap joint.
3. Corner joint.
4. T- Joint.
5. Edge joint.

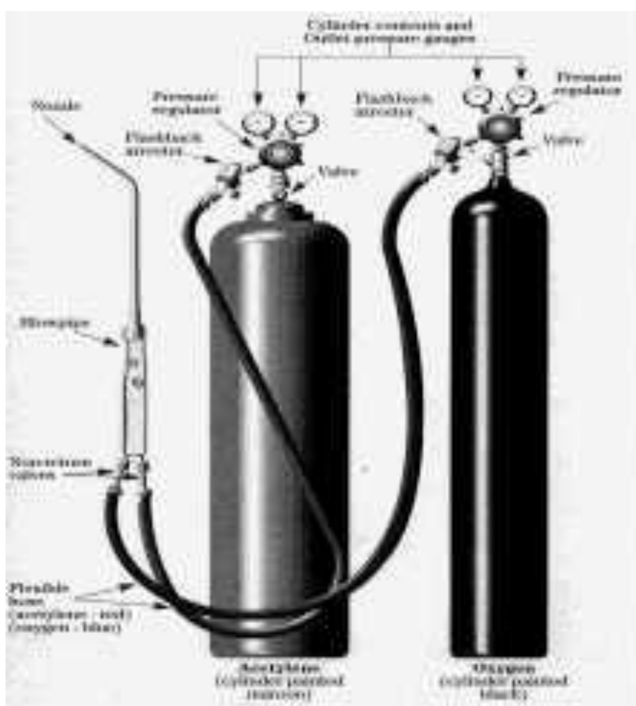


Positions:-

1. Flat and down hand positions.
2. Horizontal positions.
3. Vertical positions.
4. Overhead positions

2. Gas welding:-

Gas welding is a welding in which a combination of gases are used to obtain a concentrated flame hot enough to melt and fuse the ends of the parts to be joined. It is the gas welding process where the parts to be joined are heated with a flame produced by the combination of OXYGEN and ACETYLENE gas.



Note: 1. In oxygen, acetylene welding, the flame must be supplied by a correct balance of oxygen and acetylene so that it is neither oxidizing nor carburizing, since either of these flames would weaken the weld.

2. Oxygen regulators have "Right hand" threads with plain nuts and Acetylene regulators have "Left hand" threads with notched hexagon nuts so that they cannot be confused. The Regulator is closed by unscrewing the regulating screw.

Types of flames: - The correct adjustment of the flame is important for efficient welding.

The neutral flame is widely used for welding steel, stainless steel, cast iron, copper, aluminum, etc. The carburizing produced with an excess of acetylene, is needed for welding lead. The Oxidizing flame with excess of oxygen is used for welding brass.

Technique of welding:-

Select the proper size tip for the job and insert it carefully into the torch.

Open the acetylene cylinder valve slightly, say ¼ to ½ turn.

Open the oxygen cylinder valve slowly, till it is fully open.

Open the acetylene valve on the torch and turn the acetylene regulator screw clockwise, until the gauge reads 0.5 to 1kg /cm^2 of pressure. Then close the valve on the torch.

Open the oxygen valve on the torch to check the flow and close it.

Put-on the welding goggles, gloves and apron.

Welding process:-

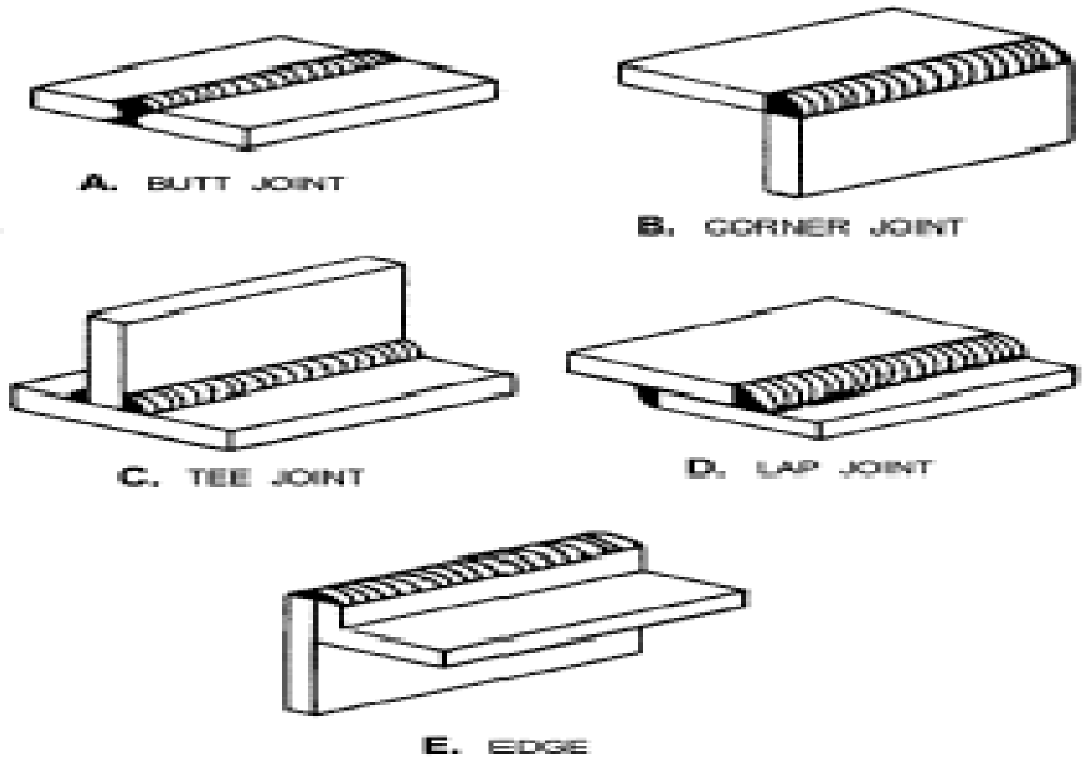
- Prepare the work pieces to be welded and place them in proper position on the welding table.
- Select proper size tip for the job and fix it to the torch.
- Adjust the welding equipment and light the torch.
- Adjust the torch for neutral flame.

General safety:-

- Always welding in a well ventilated place. Fumes given off from welding are unpleasant and in some cases may be injurious, particularly from galvanized or zinc coated parts.
- Do not weld around combustible or inflammable materials, where sparks may cause a fire.
- Never weld containers which have been used for storing gosling, oil or similar materials, without first having them thoroughly cleaned.

EXPERIMENT -9

Aim: To Make Simple Exercises Like Butt, Lap, Corner An Tee Joints In Gas Welding



Materials: MS flats, welding electrodes/filler rods and welding machine

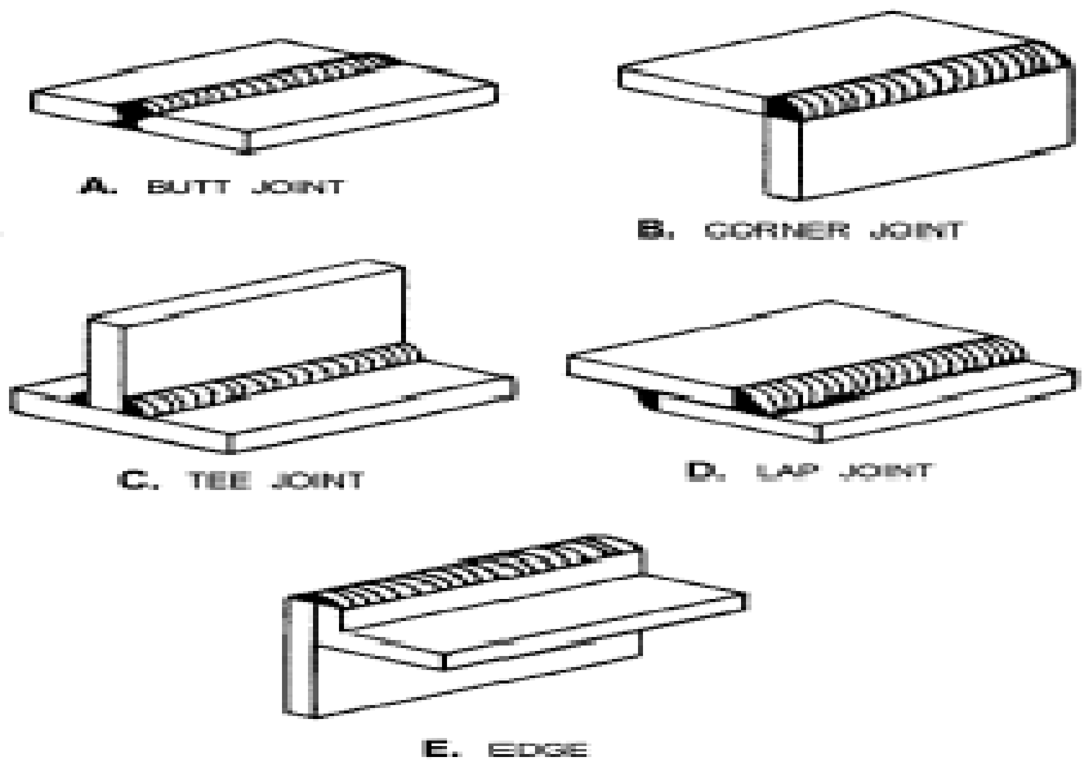
Procedure:

1. The given work pieces are first cleaned and sized accordingly.
2. Keep the materials in a predefined manner to make various joints like lap, butt and T .
3. By using proper techniques finish the welding as in the procedure.

Result: Thus making of simple joints by using gas welding is completed.

EXPERIMENT -10

Aim: To Make Simple Exercises Like Butt, Lap, Corner An Tee Joints In Arc Welding



Materials: MS flats, welding electrodes/filler rods and welding machine

Procedure:

1. The given work pieces are first cleaned and sized accordingly.
2. Keep the materials in a predefined manner to make various joints like lap, butt and T .
3. By using proper techniques finish the welding as in the procedure.

Result: Thus making of simple joints by using Arc welding is completed.

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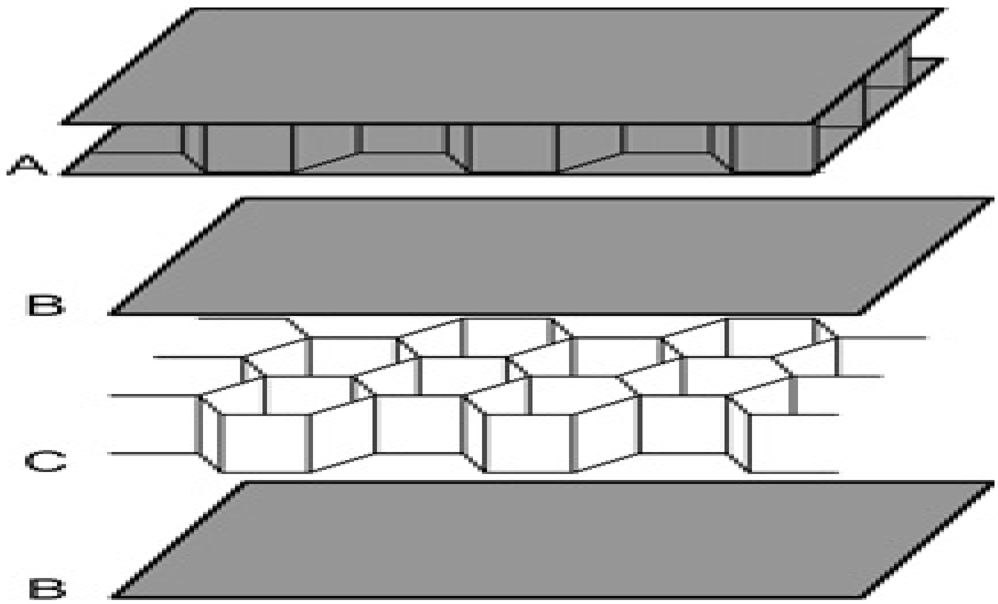
EXPERIMENT -11

Aim: To prepare a bonded structure made up of wood and aluminum with the aid of glue



Work Material: - Wood 75x75x 30mm. and 2 aluminum sheets 75x 75x 6mm.

Theory:-

Bonding is a method of joining bounding material called glue which is to be placed b/m the member to be joined, generally bonding is done b/m the member so that the resultant bonded structure will have hybrid properties ie. The combination of properties of both the materials. Bonded structures are widely used in structures of various a/c components like wing, of fuselage etc as bonded joint b/m aluminum & wood has a strength that to weight ratio compared with the individual materials which is the primary requirement for an a/c.

Procedure:-

1) Take a given wooden piece and san it to the given dimensions.

2) With the help of filing, give the surface finish.

3) Mark the aluminum sheet to 75x75x6mm with the help of scale and scriber, cut it from the main sheet by using cutter

4) With the aid of metal file, give the metals a good edge finish.

5) Finally bond the aluminum sheet & wooden piece with glue.

6) Change it in order to make the bond dry and strong.

Precautions:

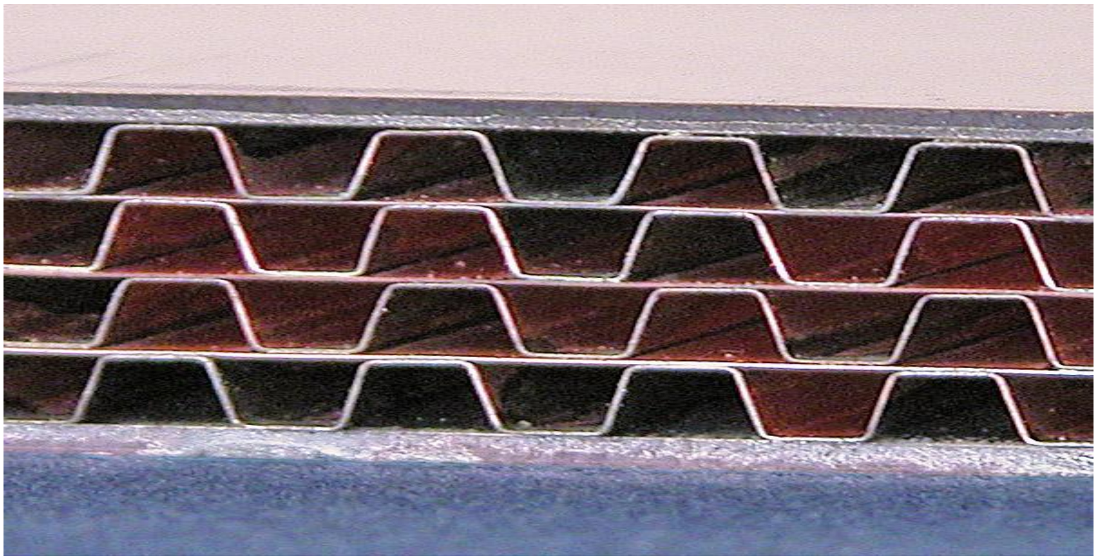
- Mark the dimensions without any parallel errors.
- - Paper case is to be taken while sawing the wooden piece & filing of aluminum sheet.
- -Bonded structure is properly clamped & allowed to dry.

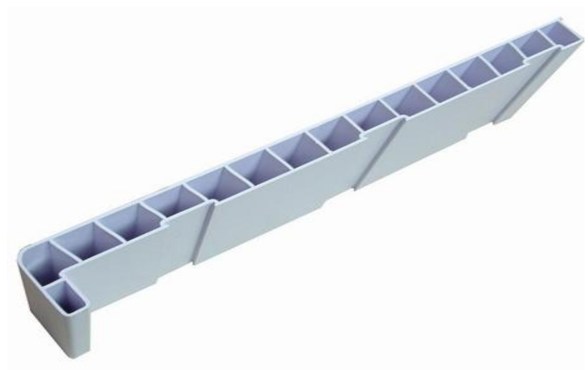
Result: The respective bonded structure is (bond) obtained.

EXPERIMENT -12

Aim: Study of the properties of a sandwich structure

Materials required: Wood 100mm x 10mm x 3 mm, Aluminium100mm x 10mm x 2 mm





Procedure:

1. The given wooden material is made to the standard dimensions as given in the requirement.
2. Then the given aluminum flat are so arranged over the surface of the wood material.
3. This type of structural component is called fletched beam and can have high strength and less weight.
4. These structural members are used in the fabrication of air craft structural members like wings, fuselage etc.

Result: The given materials are fabricated and made as sandwich structures successfully.