5104-ARUNAI ENGINEERING COLLEGE

TIRUVANNAMALAI

DEPARTMENT OF MECHANICAL ENGINEERING

ME8381-COMPUTER AIDED MACHINE DRAWING

LABORATORY MANUAL

ME8381-Machine drawing manual

LABARATORY CLASSES - INSTRUCTIONS TO STUDENTS

1. Students must attend the lab classes with ID cards and in the prescribed uniform.
2. Boys-shirts tucked in and wearing closed leather shoes. Girls' students with cut shoes, overcoat, and plait incite the coat. Girls' students should not wear loose garments.
3. Students must check if the components, instruments and machinery are in working condition before setting up the experiment.
4. Power supply to the experimental set up/ equipment/ machine must be switched on only after the faculty checks and gives approval for doing the experiment. Students must start to the experiment. Students must start doing the experiments only after getting permissions from the faculty.
5. Any damage to any of the equipment/instrument/machine caused due to carelessness, the cost will be fully recovered from the individual (or) group of students.
6. Students may contact the lab in charge immediately for any unexpected incidents and emergency.
7. The apparatus used for the experiments must be cleaned and returned to the technicians, safely without any damage.
8. Make sure, while leaving the lab after the stipulated time, that all the power connections are switched off.
9. **EVALUATIONS:**
    - All students should go through the lab manual for the experiment to be carried out for that day and come fully prepared to complete the experiment within the prescribed periods. Student should complete the lab record work within the prescribed periods.
    - Students must be fully aware of the core competencies to be gained by doing experiment/exercise/programs.
    - Students should complete the lab record work within the prescribed periods.
    - The following aspects will be assessed during every exercise, in every lab class and marks will be awarded accordingly:
    - **Preparedness, conducting experiment, observation, calculation, results, record presentation, basic understanding and answering for viva questions.**
    - In case of repetition/redo, 25% of marks to be reduced for the respective component.

NOTE 1

- **Preparation** means coming to the lab classes with neatly drawn circuit diagram /experimental setup /written programs /flowchart, tabular columns, formula, model graphs etc in the observation notebook and must know the step by step procedure to conduct the experiment.
- **Conducting experiment** means making connection, preparing the experimental setup without any mistakes at the time of reporting to the faculty.
- **Observation** means taking correct readings in the proper order and tabulating the readings in the tabular columns.
- **Calculation** means calculating the required parameters using the approximate formula and readings.
- **Result** means correct value of the required parameters and getting the correct shape of the characteristics at the time of reporting of the faculty.
- **Viva voice** means answering all the questions given in the manual pertaining to the experiments.
- **Full marks will be awarded if the students performs well in each case of the above component**

NOTE 2

- Incompletion or repeat of experiments means not getting the correct value of the required parameters and not getting the correct shape of the characteristics of the first attempt. In such cases, it will be marked as **"IC" in the red ink** in the status column of the mark allocation table given at the end of every experiment. The students are expected to repeat the incomplete the experiment before coming to the next lab. Otherwise the marks for IC component will be reduced to **zero.**

NOTE 3

- Absenteeism due to genuine reasons will be considered for doing the **missed experiments.**
- In case of power failure, extra classes will be arranged for doing those experiments only and assessment of all other components preparedness; viva voice etc. will be completed in the regular class itself.

NOTE 4

- The end semester practical internal assessment marks will be based on the average of all the experiments.

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Completed date:

Average Mark:

Staff - in - charge

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Completed date:

Average Mark: **Staff - in – charge**

Ex.No: 1 CODE OF PRACTICE FOR ENGINEERING DRAWING

Date:

Aim:

To study the code for engineering drawing

i) ABBREVATIONS

Term	*Abbreviation*	*Term*	*Abbreviation*
Across corners	A/C	Maunfacture	MFG
Across flats	A/F	Material	MATL
Approved	APPD	Maximum	max.
Approximate	APPROX	Metre	m
Assembly	ASSY	Mechanical	MECH
Auxiliary	AUX	Millimetre	mm
Bearing	BRG	Minimum	min.
Centimetre	Cm	Nominal	NOM
Centres	CRS	Not to scale	NTS
Centre line	CL	Number	No.
Centre to centre	C/L	Opposite	OPP
Chamfered	CHMED	Outside diameter	OD
Checked	CHD	Pitch circle	PC
Cheese head	CH HD	Pitch circle diameter	PCD
Circular pitch	CP	Quantity	QTY
Circumference	OCE	Radius	R
Continued	CONTD	Radius in a note	RAD
Counterbore	C BORE	Reference	REF
Countersunk	CSK	Required	REQD
Cylinder	CYL	Right hand	RH
Diameter	DIA	Round	RD
Diametral pitch	DP	Screw	SCR
Dimension	DIM	Serial number	Sl. No.
Drawing	DRG	Specification	SPEC
Equi-spaced	EQUI-SP	Sphere/Spherical	SPHERE
External	EXT	Spot face	SF
Figure	FIG.	Square	SQ
General	GNL	Standard	STD
Ground level	GL	Symmetrical	SYM
Ground	GND	Thick	THK
Hexagonal	HEX	Thread	THD
Inspection	INSP	Through	THRU
Inside diameter	ID	Tolerance	TOL
Internal	INT	Typical	TYP
Left hand	LH	Undercut	U/C
Machine	M/C	Weight	WT

ii) STANDARD CODES

Sl.NO	IS-CODE	DESCRIPTION
1	IS:9609-1983	Lettering on Technical Drawing
2	IS:10711-1983	Size of drawing sheets
3	IS:10713-1983	Scales for use on technical drawing
4	IS:10714-1983	General Principles of Presentation
5	IS:10715-1983	Presentation of threaded parts on technical drawing
6	IS:10716-1983	Rules for presentation of springs
7	IS:10717-1983	Conventional representation of gears on technical drawing
8	IS:11663-1986	Conventional representation of common features
9	IS:11664-1986	Folding of drawing prints
10	IS:11665-1986	Technical drawing – Title blocks
11	IS:11669-1986	General principles of dimension on technical drawing
12	IS:11670-1986	Abbreviation"s for use in Technical Drawing

RESULT:

Thus the code and symbols of practice for Engineering drawing were studied.

Ex.No: 2 **STUDY OF WELDING SYMBOLS**

Date:

Aim:

To study the welding symbols.

INTRODUCTION

Welding is a process of fastening the metal parts together permanently by the application of heat (fusion welds) or pressure (pressure or forge welding) or both (resistance welding). Both ferrous (steel, cast iron) and Non-ferrous metals (like brass copper and alloy) can be joined by welding.

The welding is cheaper, stronger, easier and faster than riveting.

The various types of welding process are

a. Gas welding
b. Arc welding
   i. Metal Arc Welding (MAW)
   ii. Gas metal Arc Welding (GMAW)
   iii. Submerged Arc Welding (SAW)
   iv. Tungsten Inert Gas Welding (TIG)
   v. Metal Inert Gas Welding (MIG)
c. Forge Welding
d. Resistance Welding
e. Thermit Welding
f. High Energy Welding

The welded joints are broadly classified into

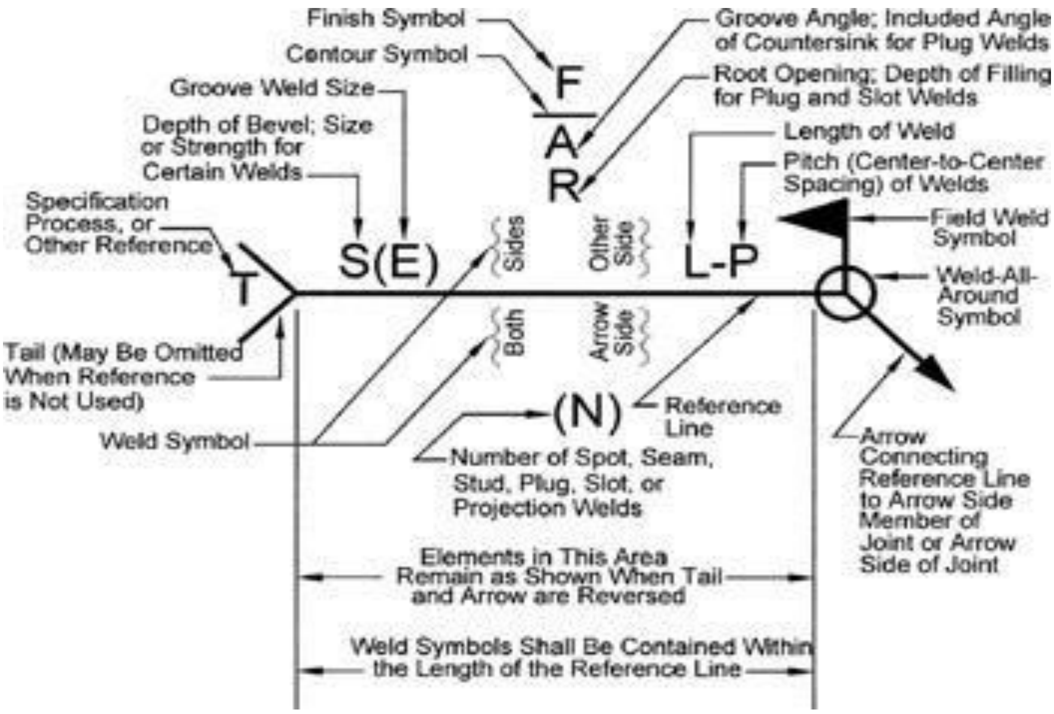
a. Butt joint b. Lap joint c. Corner or Fillet joint d. Tee joint e. Edge joint

SYMBOLIC REPRESENTATION OF WELD

The standard welding symbol is given below.

Arrow Line and reference Line

The position of the arrow line with respect to the weld is of no special significance. The side of the joint on which the arrow line is drawn is called “arrow side”. The side of the joint remote to the arrow line is called “other side”. The reference line has significance on the weld side. If the weld symbol is placed BELOW the reference line, the welding should be done in the “ARROW SIDE”. If the weld symbol is placed ABOVE the reference line, the welding should be done in the “OTHER SIDE”. If the weld symbol is placed both ABOVE and BELOW the reference line, the welding should be done in both the “ARROW AND OTHER SIDES”.



Basic Weld Symbol

The basic symbols recommended by Bureau of Indian Standards (BIS) for specifies the type

Sl. No.	Type of weld	Symbol
1.	Fillet joint	
2.	Square butt joint	
3	Single V- butt joint	
4	Double V- butt joint	
5	Single U – butt joint	
6	Single bevel butt joint	

of weld are shown in the fig1.

Basic weld symbols. FIG1.

1.1.3 Size of weld

The size of the weld is height of the isosceles triangle in the case of fillet welds. In other cases, the size will be the minimum distance from the surface of the paert of the bottom of penetration.

Finish and contour symbol

The contour symbols are

a. Flat (flush)
b. Convex
c. Concave

Finishing welds other than cleaning shall be indicated by finish symbols.

Chipping – C, Grinding – G, Machining – M

SI No.	Particulars	Weld Symbol
1	Flush contour	—
2	Convex contour	⌒
3	Concave contour	⌣
4	Grinding finish	G
5	Machining finish	M
6	Chipping finish	C

Welded and unwelded length

Length of weld means it is the length to be welded once, after that pitch equal to unwelded length is not welded and this process is continued for the whole length of the side.

Weld all round

If the weld should be made all round the joint, a circle should be placed at the point connecting the arrow and the reference line.

Site weld

When some of the welds (the welded structures) are required to be made on site during erection. They should be designed by a filled in circle at the point connecting the arrow and the reference line.

RESULT:

Thus the welding symbols were studied.

Ex.No: 3 **STUDY OF RIVETED JOINTS**

Date:

Aim:

To study the riveted joints.

3. APPLICATIONS OF RIVETED JOINTS

A riveted joint is a permanent type of fastener used to join the metal plates or rolled steel sections together. Riveted joints are extensively used in structural works such as bridges and roof trusses and in the construction of pressure vessels such as storage tanks, boilers, etc. Although welded joints are best suited to several of these applications than the riveted joints, however, riveted joints are ideal in cases where the joints will be subjected to pronounced vibrating loads. Riveted joints are also used when a non-metallic plate and a metallic plate are to be connected together. They are also used when the joints are not expected to be heated while joining as in welding, which may cause warping and tempering of the finished surfaces of the joints.

The disadvantage of riveted joints are: (i) more metal is removed while making of the holes, which weakens the working cross sections along the line of the rivet holes, and (ii) weight of the rivets increases the weight of the riveted members.

DIFFERENCES BETWEEN A BOLT AND A RIVET

As a fastener, a riveted resembles a bolt, but differs from it in the shape and the application as well. Although the shape of a rivet is similar to that of a bolt, unlike the bolts, it is used as a permanent fastener to withstand shear forces acting perpendicular to its axis, whereas a bolt is used as a temporary fastener to withstand axial tensile forces.

RIVET

A rivet is a round rod made either from mild steel or non-ferrous materials such as, copper, aluminium, etc., with a head is, and formed at one end during its manufacture and its tail end being slightly tapered. The length of the shank of the rivet must be sufficient enough to accommodate the connection plates and provide enough material for forming a head at its shank end. In general, the shank of the rivet will be equal to sum of the thickness of the connecting plates plus 1.5 to 1.7 times the diameter of the rivet.

If, l = length of the shank of the rivet

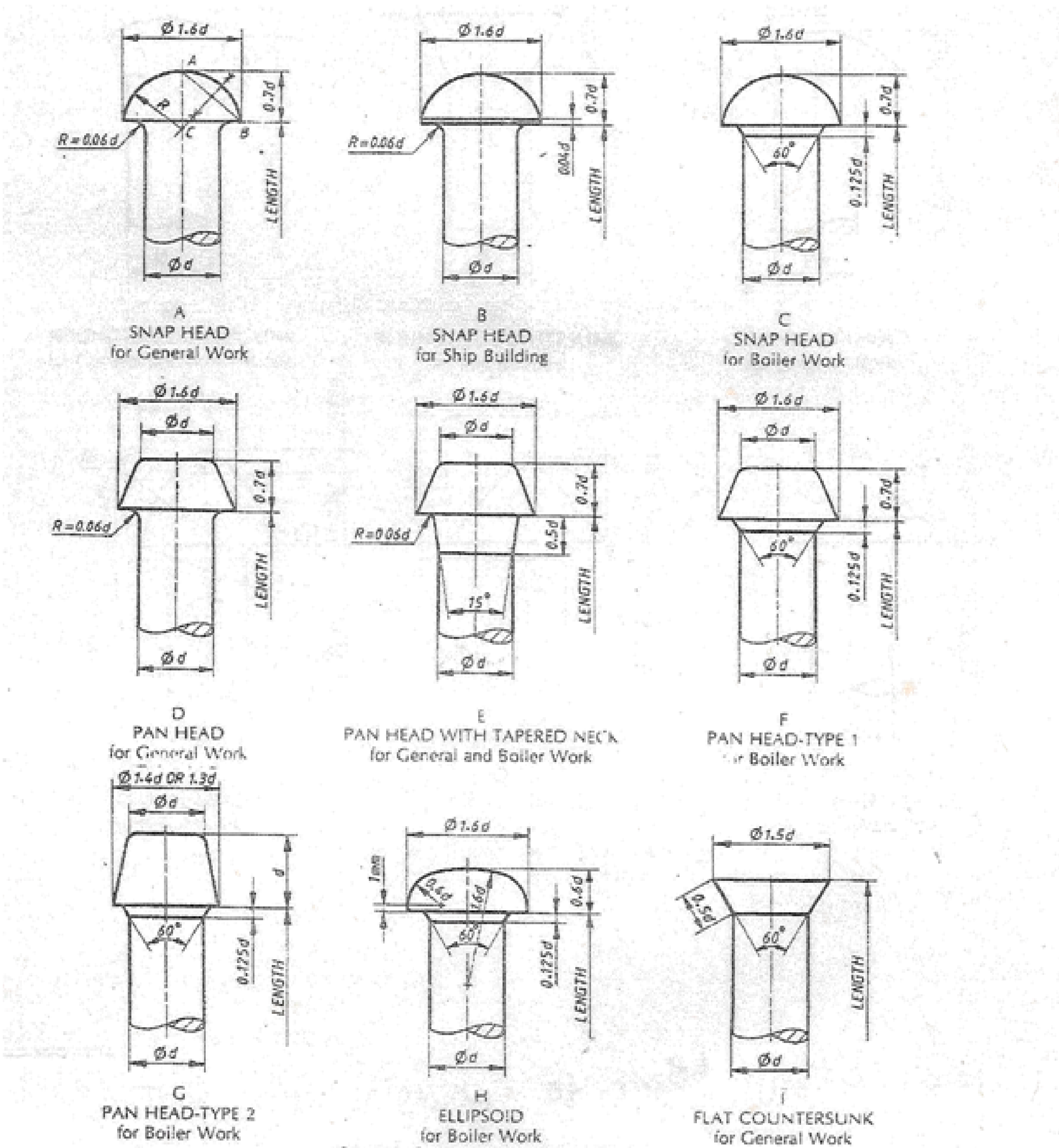
d = diameter of rivet

t = thickness of each of the connecting plates

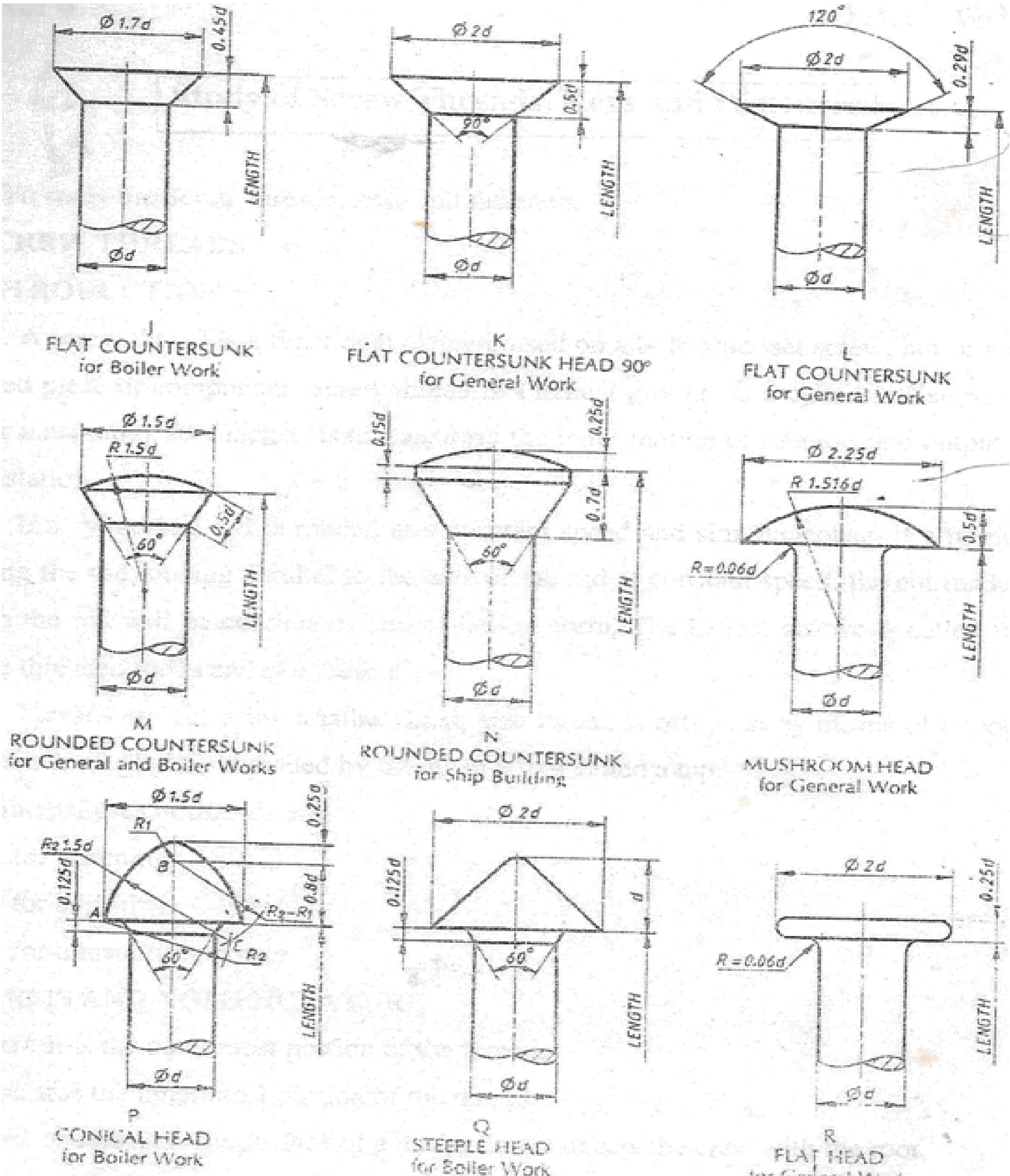
then, $l = \Sigma t + (1.5 \text{ to } 1.7)d$

FORMS AND PROPORTIONS OF RIVET HEADS

Various types of rivet heads for the use in general engineering work and boiler work as recommended by the Bureau of Indian Standards. The different proportions of these rivet heads are given in terms of the nominal diameter d of the rivet. The rivet head to be used for general purposes for diameter below 12 mm are specified in the Indian Standard code IS:2155-1962 and for diameters between 12 and 48 mm are specified in the Indian Standard code IS:1929-1961. The rivet heads to be used for boiler work are specified in the Indian Standard code IS: 1928-1961. The rivet heads to be used for ship building are specified in the Indian Standard code IS: 4732-1968.



Forms and Proportions of Rivet Heads



Forms and Proportions of Rivet Heads
(Continued from Previous Page)

RESULT:

Thus the study of riveted joints was studied successfully.

Ex.No: 4 STUDY OF SCREW THREADS, KEYS AND FASTENERS

Date:

Aim:

To study the Screw Threads, Keys and fasteners

SCREW THREADS

INTRODUCTION

A screw thread is a functional element used on bolt, stud, set screw, nut or any other threaded piece or component. Screw thread is a helical groove on a cylinder surface (outer side or inner side). Its function is to transform the input motion of rotation into output motion of translation.

If a cylindrical rod is rotated at a constant speed simultaneously if a pointed tool touching the rod moving parallel to the axis of the rod at constant speed, the cut made by tool on the rod will be continuous and of helical form. The helical groove is called “thread” and the threaded rod is called a “screw”.

Threads are cut using a lathe. Small size thread is often cut by means of a tool called die. A small size hole is threaded by means of a tool called a tap.

The principal uses of threads are,

1. For fastening
2. For adjusting
3. For transmitting power

TERMS AND NOMENCLATURE

1. Crest: It is outer most portion of the thread.

2. Root: It is the inner most portion of the thread.

3. Flank or side: It is the surface of a thread that connects the crest with the root.

4. Angle of the thread: It is the angle included between the sides of two adjacent Threads measured on an axial plane.

5. Depth of the thread: It is the distance between the crest and the root measured at Right angle to the axis. It is equal to half the difference between the outer diameter and the core diameter.

6. Major diameter or outside diameter: It is the diameter of the imaginary coaxial cylinder, which would bind the crests of an external or internal thread.

7. Minor or core or root diameter: It is the diameter of the imaginary coaxial cylinder, This would bind the roots of an external thread or of an internal thread.

8. Pitch diameter: It is the diameter of the imaginary coaxial cylinder that can be Passed so as to cut the thread, that the width of the cut thread will be equal to the Width of the groove.

9. Pitch: It is the axial distance between a point on one thread and the corresponding Point on the next thread. It may be indicated as the distance from crest or from root of two adjacent threads.

10. Lead: It is the distance measured parallel to the axis from a point on a thread to

The corresponding point on the same thread for one complete revolution. In other words, it is axial distance a screw advances in one revolution.

When all the threads on a member are built on a single helix it is termed as "single start thread". It has only one starting point. For a single start thread, the lead and pitch are same.

If a quick acting thread is needed, the lead must be large. If a single start is cut with large pitch, the thread depth will also be more, so the amount of material removed is more and the thread will be weakened. To avoid this multiple threads are used when a quick advance is required in a screw pair. Two or more threads are cut side by side around the cylinder on an equal number of parallel helices. It is termed as "Multi start thread".

Lead = number of starts x pitch

A common example for multi start thread is the thread on a fountain pen cap.

11. External thread: It is the thread on the outside surface of a member such as bolt, Studs or screw.

12. Internal thread: It is the thread on the inside surface of a member such as nut or Threaded hole.

13. Right hand thread: Right hand thread if turned clockwise direction advances into a Threaded hole. It abbreviated as RH.

14. Left hand thread: Left hand thread if turned anticlockwise direction advances into a threaded hole. It abbreviated as LH.

DIFFERENT THREAD PROFILES

Threads are standardized to permit to interchangeability of bolts and nuts of the same nominal diameter. The profile of a screw thread is based on its use. The two main kinds are „V" and square with various modifications. When the thread has a „V" cross-section it is called a „V" thread and when it has square cross section it is called a square thread.

DIFFERENCE BETWEEN „V" AND SQUARE THREADS

„V" THREADS	SQUARE THREADS
1. V - threads have inclined flanks making an angle between them.	1. The flanks of square threads are perpendicular to thread axis and parallel to each other.
2. V – threads have a larger contact area providing more frictional resistance to motion. So they are more suitable for fastening.	2. Square threads offer less friction to relative motion. The normal force between the threads acts parallel to the axis with zero radial components. So they are suitable for power transmission.
3. V – threads are stronger than the square threads.	3. Square threads have only half the resisting the power, resting the shearing action.

4. V – threads are cheap because they can be cut easily by a die or on machines. 5. Examples for V – threads are the thread used in bolts, nuts and studs.	4. Square threads are costly. 5. Examples for square threads are lead screw of a lathe, screw jack etc.,

V- THREADS

British standard whit worth thread (BSW)

This thread was introduced by Sir Joseph whit worth, and was standardized as British standard thread. It has a thread angle of 55 degree and is rounded equally at crest and roots.

British Association threads (B.A Threads)

The angle between flanks is 47.5 degree. These threads are to supplement BSW and have fine pitches. They are used on screws for precision work.

American standard threads (or) sellers thread

The thread angle is 60 degree and both the crests and roots are kept flat. The sellers thread has been in use in USA and Canada.

Unified screw threads

The countries UK, U.S.A and Canada came to an arrangement for a common screw thread system with the included angle of 60 degree and designated as unified screw thread in the year 1949. The thread on the bolt is rounded off at the crest and root and the thread in the nut is rounded off at the root but the crest is left flat.

This thread is very important in the motor and aeroplane industries and in chemical engineering. Unified thread can be either coarse (UNC) or fine (UNF) and unified national extra fine (UEF).

ISO Metric Thread

This is Indian standard thread for ISO (International Standard Organization). The included angle is 60 degree and the crests are flat and roots are round.

Metric threads are grouped into diameter pitch combination differentiated by the pitch applied to specific diameters. There are coarse, constant, fine pitch series available.

ISO metric threads are defined by nominal size (Basic major diameter) and pitch both expressed in millimeters. For example, a 10mm diameter, 1.25 pitches is expressed as M10x1.25.

SQUARE THREADS

Basic square thread

The sides of these threads are normal to the axis and parallel to each other. The depth and the thickness of the thread are equal to half pitch. A square thread is designated by the letter SQ followed by nominal diameter pitch. For example a square thread of nominal diameter 30mm and pitch 6mm is designated as SQ 30 X 6.

Acme Thread

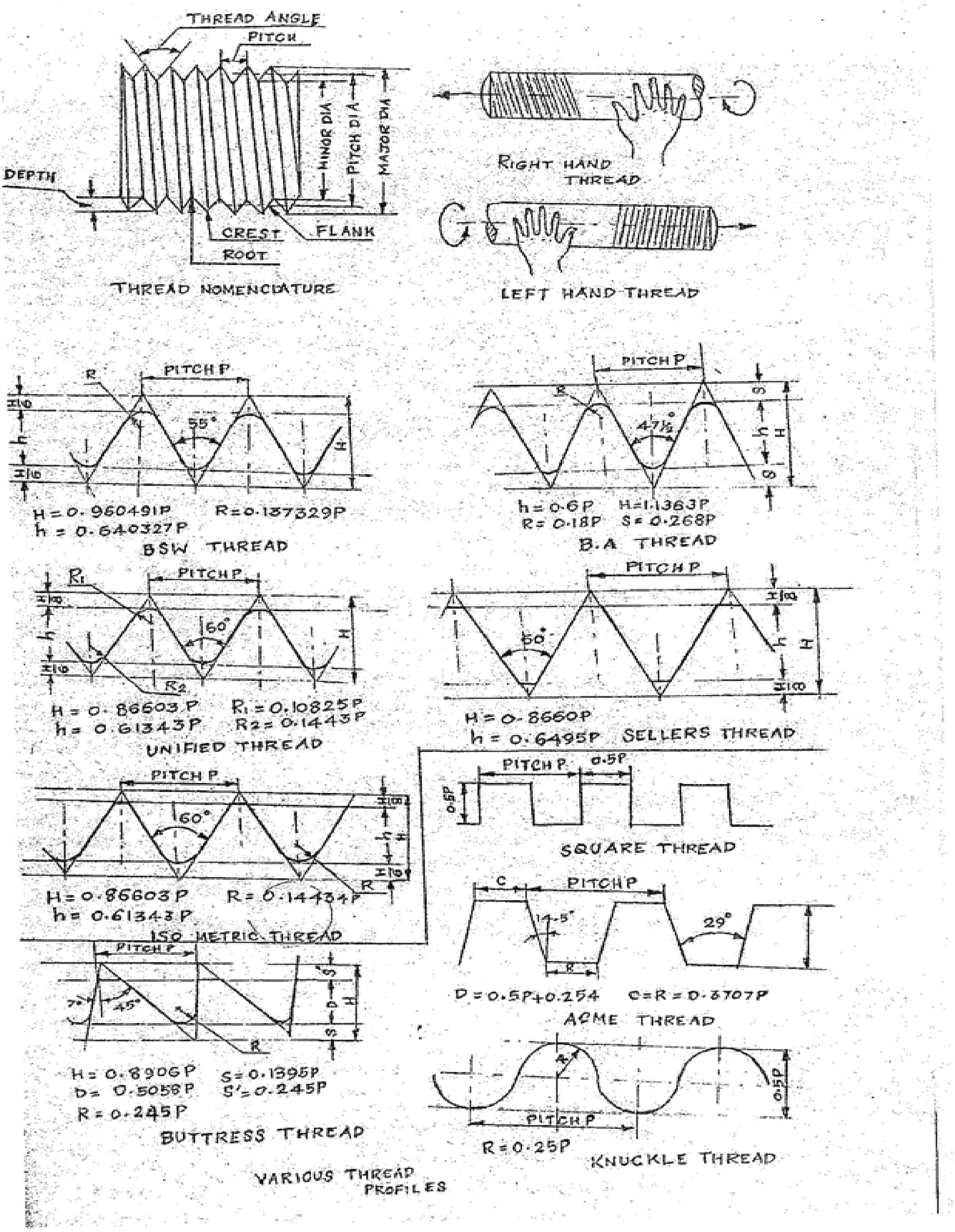
It is a modified from of square thread. It is easier to cut and is much stronger than square thread. It has a 29 degree thread angle. This inclined sides of the thread facilitate quick and early engagement and disengagement. It is used for power screws like lead screw of lathe, jackscrews, bench vices and valve operating screws.

Buttress Thread

The profile of this thread is a combination of square and V- threads. It combines the low frictional of square and ability to transmit power of square thread and the strength of V – thread. It is used to transmit load in uni-direction. These threads are used in screw press, vices.

Knuckle Thread

It is also a modification of square thread. The sharp corners of square thread are rounded off. This thread is used where heavy wear rough use is expected. The thread can be rolled or cast easily. It is used in railway carriage coupling screws, light bulbs and sockets, bottle caps etc and also objects made of brittle materials as glass, plastic, porcelains etc.



KEYS

Introduction:

A machine runs by the power supplied to it by a prime mover such as motor, engine etc;. This power is transmitted from prime mover to the machine through a coupler which couples shaft of the prime mover and the machine. Within the machine the power from the main shaft is transmitted to the other elements such as gears, pulleys and belts. These elements have to be mounted on these shafts and there should not be any relative motion between the machine element and shaft for effective power transmission. The most commonly employed method to connect a shaft and a machine parts is to drive a small piece of metal s known as KEY. To drive a key axial grooves are cut both in the shaft end the part mounted on it. The groove in the shaft is called the “KEYWAY”.

CLASSIFICATION OF KEYS:

Keys are classified into three types

1. Taper keys
2. Parallel (or) feather keys
3. Special purpose keys

COMPARISION BETWEEN TAPER KEY AND PARALLEL KEY:

TAPER KEY	PARALLEL KEY
1. It is of rectangular cross section having uniform width and tapering thickness.	1. It is of rectangular cross section having uniform width and tapering thickness.
2. These are used to transmit only the turning moment between the shaft and hub without any relative axial motion between them.	2. These are used to transmit moment between the shaft and hub with the provision to allow a small sliding axial motion.
3. examples for taper keys are i. Taper sunk key ii. Hollow saddle key flat saddle iii. Gib head key	3. examples for parallel keys are i. Parallel sunk key ii. Peg key iii. Single head key iv. Double head key

Special purpose keys are used for specific application (ex) Woodruff key, pin key.

Keys can also be classified as

1. Heavy duty keys sunk keys
2. Light duty keys saddle keys, pin (or) round keys.

Taper keys:

A sunk taper key is of rectangular or square cross section of uniform width having its bottom surface straight and top surface tapered. So in the shaft flat key seat is made and in the hub tepered key is made to accommodate the key.

If D is the diameter of the shaft in mm

W = Width of the key

T = thickness of the key

W = 0.25D+2mm

T = 0.66W

Standard taper = 1:100

Saddle key:

Saddle keys are of two types

a. Hollow saddle key
b. Flat saddle key

Hollow saddle key:

A hollow saddle key is of uniform width and varying thickness having its upper side flat and the bottom side curved (hollow) so as it sit on a shaft. The key way is cut only in the hub and the key holds the shaft by friction only.

Width of the key =0.25D+2mm

Nominal thickness =0.33W

Standard taper =1:100

Flat saddle key:

A flat saddle key is smaller is similar to a hollow saddle key except that its bottom side is flat. The keys sits over the flat surface formed on the flat shaft, and fits into the keys way in the hub.

Width of the key =0.25D+2mm

Nominal thickness =0.33W

Standard taper =1:100

2.3.3. Gib head key:

When a tapered sunk key is used it can be removed by striking at its exposed thin end. If this end is not reachable, a head is called “GIB” is provided with the sunk taper key at its thicker end it is called GIB-HEAD key. To remove the key, a wedge is forced vertically in the gap between the key and the hub.

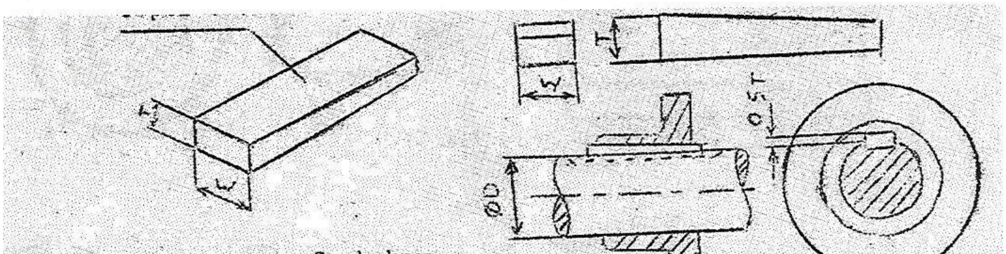
Width of the key W =0.25D+2mm

Nominal thickness T =0.33W

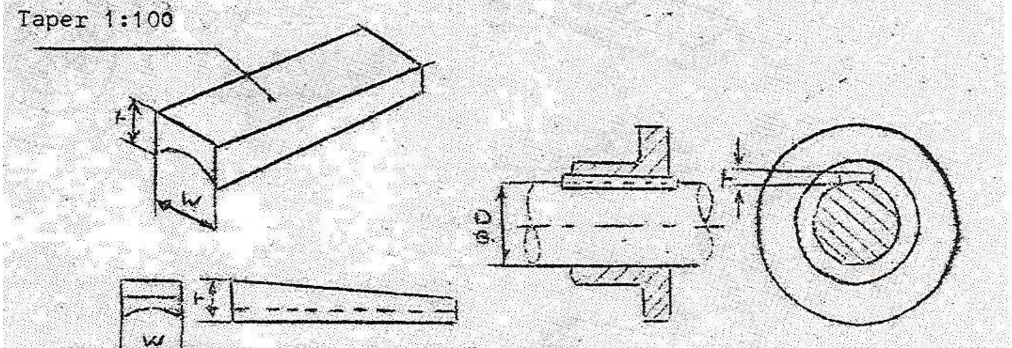
Height of gib head h = 1.75T

Width of the gib head b = 1.5T

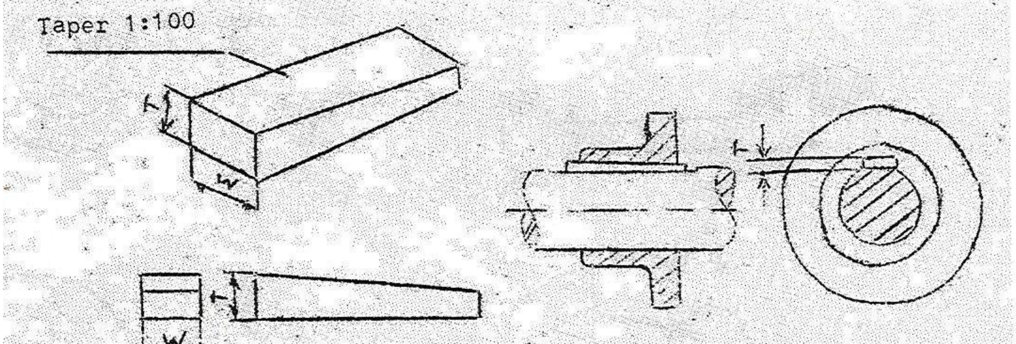
Standard taper =1:100



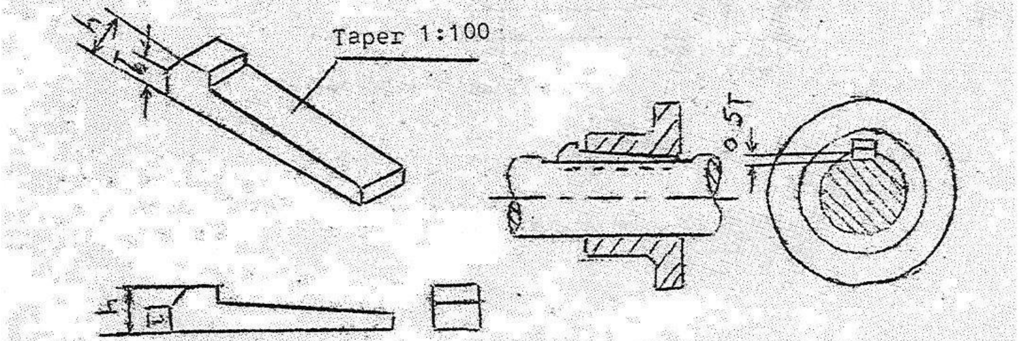
Taper Sunk key



Hollow Saddle key



Flat Saddle key



Gib Head key

THREADED FASTENERS

INTRODUCTION

Threaded fasteners are temporary fasteners, which hold the parts together through the medium of a screw thread. These are used in pairs for their action (for example, a nut and a bolt). They have the advantage over permanent fasteners of allowing assembly of parts when required.

A wide variety of threaded fasteners are in use. Some of them are standardized and others are made for special use.

COMMON TYPE OF THREADED FASTENERS

The five types of threaded fasteners in common use are

- ✓ Bolt
- ✓ Stud
- ✓ Cap screw
- ✓ Machine screw
- ✓ Setscrew

All these with external threaded and used in combination with another having corresponding internal threads (eg) a nut or a tapped hole.

BOLTS

A bolt is a metal having a head at one end and a threaded portion to a definite length on other end. The head is formed by forging or machining. The bolt is admitted through holes in the parts, which are to be fastened. The projected thread end of the bolt admits a corresponding nut from the other side. Tightening the bolt by turning gives necessary clamping grip to hold the parts together.

Bolts and nuts of various shapes are used for different purpose but the hexagonal head and square head are very common. Although, the square shape provides better spanner grip than the hexagon, but needs one fourth of a turn to bring it into the same position for inserting spanner again, whereas a hexagon need only one sixth of a turn and hence provided.

The sharp corners on the external flat end faces of bolt heads and nuts are chamfered conically at 30^{o} to ensure safety of the user. To facilitate early insertion of the nut over the bolt, the threaded holes in the nut are countersunk. Three dimensions are usually sufficient for simplified representation of a bolt

The bolt shank diameter (d)

The bolt length (l)

The length of a threaded portion of the shank (b)

EMPIRICAL PORTIONS OF HEXAGON AND SQUARE HEAD BOLT & NUT

DETAIL PROPORTION:

Nominal diameter	d=size of bolt or nut,mm
Width across flats	s=1.5d+3mm
Width across corners	e=2d
Thickness of bolt head	k=0.8d
Thickness of nut	n=0.9d
Root diameter	d1=d-(2*depth of thread)
Length of the bolt	l=as specified

Thread length b=2d+6mm (for l<150mm)

=2d+12mm (for l>150mm)

Chamfer of bolt end Z=depth of thread*45(degree) (or) =0.1d

Chamfer angle of bolt head & nut 30 (degree)

DRAWING OF HEXAGONAL NUT AND BOLT STEP: 1

Draw the shank of the bolt equal to the given diameter (d) and length (l).The thickness of the bolt head equals to 0.8d and the thickness of nut equal to 0.9d are marked. Measure the width across corners equal to 2d and complete the three faces of the bolt head and nut in these lines.

The right hand view of the bolt and nut assembly is drawn as follows with any point on the axis as centre and radius equal to draw a thin circle. A hexagon is inscribed inside this circle. The chamfer circle is drawn as a thick circle inside the hexagon touching all its sides.

STEP: 2

The chamfer arcs in three face view of bolt head and nut are drawn as follows.

From the point O1, drawn an arc (more than semi circle) radius equal to half of the across flats width. It cuts the bolt axis at c2. From c2, again draw an arc equal to half of the across flat width. This arc cuts the bolt axis at c3. These two arcs are intersecting at c4 and c5.

From c3, draw the chamfer arc in the centre face, radius equal to across flats width. This arc cuts the edges of the other two faces. From c4 and c5, draw the other two chamfer arcs.

STEP: 3

The chamfer lines on the side faces of the three face views of the bolt head and nut are drawn through the points p and q inclined at 30^{O} to the flat faces of the bolt. The end of the bolt is chamfered 0.1d*45^{O} .

The threaded portion of the shank is indicated, by drawing two thin lines at a distance equal to d1=0.9d.the root circle in the right view is represented by a thin three-fourth of a circle of diameter 0.9d.

STEP: 4

The two face view of the bolt head and nut is as follows. The width of the bolt head in this view is equal to the across flats width. Draw an arc radius equal to half of the across flats width from the point O1. Two arcs with radius equal to across flats width from the corners.These two arcs cut the first arc at two points 02 and 03. From 02 and 03 the chamfer arcs are drawn.

Drawing of Square Head Bolt And Nut:

STEP: 1

Draw the shank of the bolt equal to the given diameter d and the length of the bolt. The thickness of the bolt head is equal to 0.8d and the thickness of the nut is equal to 0.9d are marked.

The right hand view of the bolt and nut assembly is drawn as follows. With any point 01 on the axis as centre and diameter equal to 1.5d+3mm draw a chamfer circle with its sides inclined at 45degree to the axis. Project the corners 1 and 2 to get to get point"s p.

STEP: 2

From the point 01 draw an arc radius equal to half of the across corners width. From the corners, draw two arcs radius equal to half of the across corners width. These two arcs cut the first arc at two points 02 and 03. From 02 and 03 the chamfer arcs are drawn.

STEP: 3

The chamfer line is drawn at 30degree to the flat face of the bolt head and nut. The threaded portion on the shank of the bolt is indicated by drawing two thin line spaced at a distance equal to the root diameter d1=0.9d. The root circle in the right view is represented by a thin three-fourth of a circle with center 01 and diameter 0.9. The end of the bolt is chamfered to 0.1d*45degree.

Special Types of Bolts:

In practice various types of bolts than the hexagon and square head bolts are used in where the bolt head cannot be held by the spanner when the nut is turned on or off the bolt. The rotation of the bolt prevented by a stop pin or a snug or a square neck provided below the head.

Cylindrical or Cheese Headed Bolt:

The head of this type of bolt is of cup shape and the rotation of the bolt head is prevented by a stop pin. The stop pin may be driven into the shank with its axis perpendicular to the axis of the bolt. The stop pin may also be driven into the head adjacent to the shank with its axis parallel to the axis of the bolt. These types of bolt heads are used in the big ends of the connecting rods, eccentrics, cross heads etc...

Cup Or Round Headed Bolt:

Two types of cup head bolts are available. In one type, a snug is provided which prevents the rotation of bolt head. The other type, a square neck is provided which will fit into the square hole provided in the bearing surface and thus prevents the rotation of the bolt head.

Counter Sunk Head Bolt:

The counter sunk head bolts are used when the bolt head must not project and foul with surfaces. The counter sunk bolt is provided with a stop pin of square cross section integral with the head. The other type of counter sunk bolt is provided with the square neck below the head. This type of bolt is also called as “coach bolt”.

I-Head Bolt:

The head of this bolt is like letter „i". These bolts are used in bearing housing and in glands packing. These bolts are used in setting work on machine tool tables. The i head of the bolt can slide, to the required position through the i slots cut on the m/c table.

Eye Bolt:

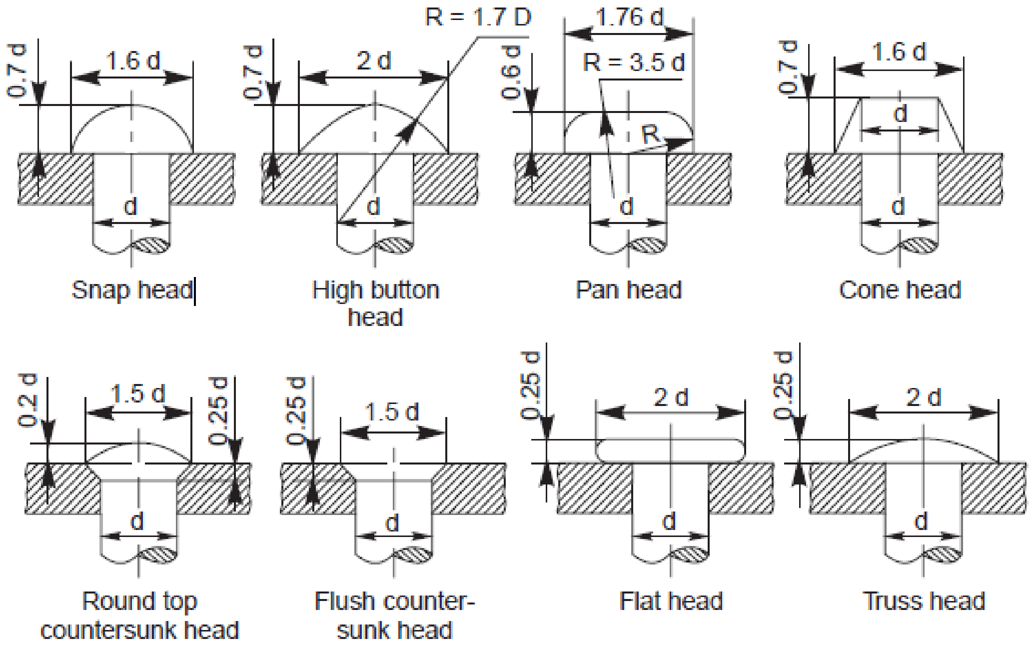
The head of the bolt is in the form of circular form of rectangular cross section. It is generally used in the inspection covers, lids etc..., Which have to be opened and closed frequently.

Lifting Eye Bolt:

The lifting eye bolt, having a circular ring of circular cross section as head. A flat circular portion, integral with a head is also provided. This type of bolt is used for lifting a heavy machine such as motors, pumps, turbine, electrical generators etc., This bolt is screwed in a threaded hole provided for this purpose , on the top of the machine directly above the centre of gravity so that while lifting the machine does not change from its usual working position.

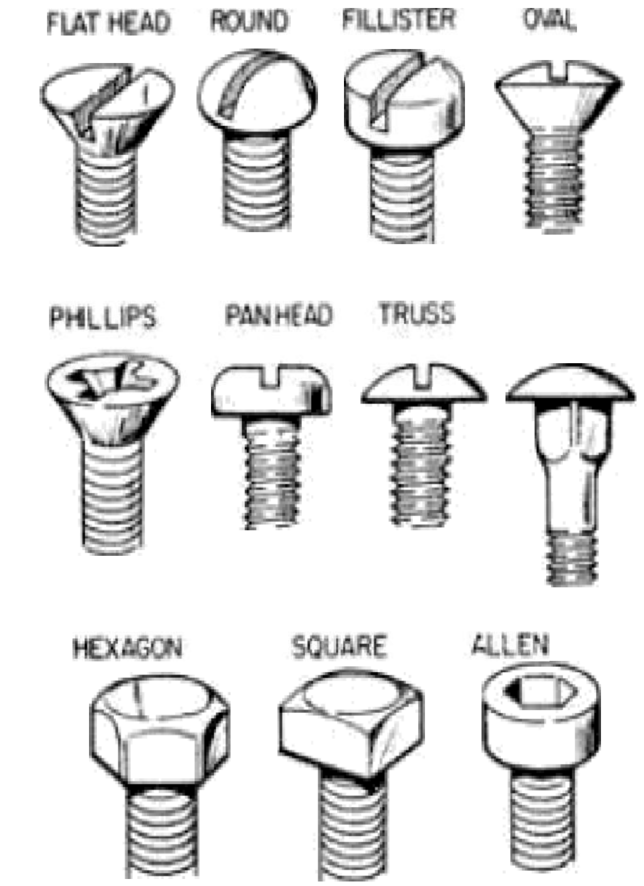
Hook Bolt:

The hook bolt has its head comprising of a square neck and projection. The shank of the bolt passes through a hole in one of the fastening pieces and the other piece comes under the bolt head and is supported by it.



Different types of Rivet Heads Fig

POPULAR MACHINE SCREWS AND BOLTS



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12	32	7/32	.2160	13	.185
					.201
1/4"	28	1/4"	.2500	3	.213
5/16"	18	5/16"	.3125	F	.257
5/16"	24	5/16"	.3125	1	.272
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Machine Screws
Fully threaded screws with a

Self Drilling SMS
A n'oto +t1wwahu ++lf

Hex Bolts
Born a+tn a bezfq<<lal zeaa
or tapped hole. Abbreviated HHMB or HXBT.

Carriage Bolts
tulip akn a nrrxx h taur«Jad
section underneath.

Lag Bolts
A›at wr 1\ a vraxs lfir++J no
Abbreviated Lag.

Socket Screws
Socket screws, also known as Allen Head, are fastened with a
h••#I -#

Set Screws
Machine screws with no head for screwing all the way into
h•x|eo

Eye Bolts
A bolt with a circular ring on the head end. Used for attaching a rope or chain.

Eya tags
Similar to an eye bolt but with wood threads instead of machine thread

J-Bolts
1#W€MwmdM a&VO@WMB#
bolt

U-Bolts
to pipe or other round surfaces. Also available with a

Shoulder Bolts
In r hnkwwoimed,o
create a pivot point.

Elevator Bolts
aovweynr enn Th yheve^
large, flat head

NUTS

A nut is a device having internal threads used in combination with a bolt or stud, having external threads to fasten parts together. It is screwed on the threaded end of the bolt or stud and the head of the bolt is drawn closer to hold and tighten the parts to be joined.

Nuts are usually made in form of hexagonal or square prism, however various other types of nuts are also used for the specified purposes, which are suitable for a particular type of work. These special types of nuts are described here.

SLOTTED NUT OR RING NUT

On the cylindrical surface of the nut number of slots parallel to the axis are cut. The nut is operated by a spanner. These are used in large screws for small pitches where adjustment by a spanner is convenient.

KNURLED NUT

It is cylindrical nut with knurled curved surface. The nut is used when finger tightness and quick turning on or off is desired as in the case of terminals of electric apparatus.

WING NUT:

This type of nut is used for light duty only. It is used wherever the nut is required to be frequently turning on or off. The nut is operated by thumb and finger i.e., without the use of a spanner. The main objection for using this type of locking is that the hole drilled in the bolt reduces its strength considerably. The other equally important objection is that after continuous use owing to the stretch of the bolt the split pin may not rest on the top face of the nut which may reduce the locking effect.

SPLIT PIN LOCKING USING SLOTTED NUT:

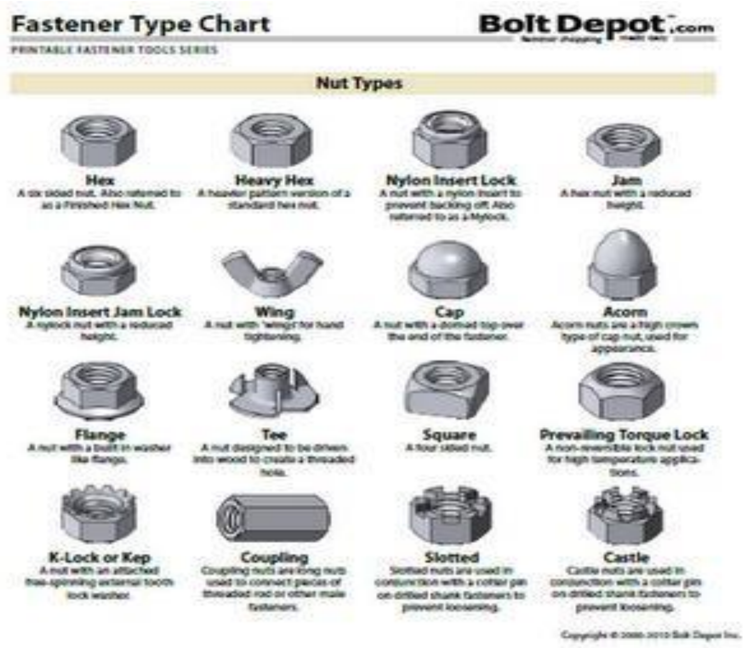
In this method a slotted nut is used instead of the ordinary nut. The slotted nut has slots cut through the opposite parallel hexagonal faces. When the bolt is fully tightened, one set of slots on the opposite faces will come in line with the hole in the bolt. The split pin is inserted through the slots in the nut and the hole in the bolt and then open ends of the split pin are opened.

SPLIT PIN LOCKING USING CASTLE NUT:

In the slotted nuts, the number of effective threads is reduced due to the slot which reduces the strength of the nut considerably. Therefore instead of cutting the slots within the effective depth, they are cut in the extra cylindrical projection provided at the top of the nut. This type of nut is called castle nut. The castle nuts are used on the wheel shafts of automobiles. In the reassembly of the slotted or castle nut, the slots may not come in the alignment with the hole in the bolt. In such cases, the nut is removed from the bolt and its lower face is filled until it can be screwed tightly so that one set of slots come in alignment with the hole in the bolt.

SET SCREW LOCKING USING GROOVED NUT:

A hexagonal nut provided with a cylindrical grooved collar at its lower end is called ring or grooved nut. The end of the bolt hole is counter bored to receive the cylindrical lower grooved portion of the nut. Locking of the nut is done by a setscrew screwed through the nearest face of the work piece. The projection dog-end of the set-screw enters the groove in the cylindrical portion of the nut and prevents the slacking of the



nut. This method of locking is possible if the bolt hole is close to the nearest vertical edge as in the case of marine engine connecting rods. When the bolt hole is not close to the vertical edge of the work piece, this nut is used in conjunction with separate collar. The dowel pin screwed in the bearing surface prevents the rotation of the collar.

SCREW PIN LOCKING:

A nut may be locked by screw pin, screwed in the bearing surface adjoining the nut touching one of the lateral faces of the nuts. This type of locking is employed when the nut is expected without any adjustment for a long time. In this method of locking first the nut is screwed on and then a screw pin is screwed into a threaded hole in the bearing surface adjoining to one lateral vertical faces of the nut.

LOCKING BY A LOCK PLATE:

This type of locking is employed in the heavy engineering work, as in the case of connecting rod, wheel shafts etc. the plate is grooved in such a way that the grooves in the plate receive the hexagonal corners of the nut at every 30˚ rotation. The plate is fixed to the bearing surface by a tap bolt screwed into it.

LOCKING BY A TAP WASHER:

A tap washer provided with a rectangular projection is called tab washer. This method of locking of nut or bolt head is suitable when the nut or bolt head is tightened and the tab and the projection portion of the washer itself are bent against the vertical edge of the work piece and one of the lateral faces of the nut or bolt head.

STUD OR STUD BOLT:

Stud is a round bar threaded on both its ends. An undesirable feature of a tab bolt fastening is the tendency to damage the threads in the holes when the bolts are frequently removed and replaced, especially when the screwed holes are in the iron and aluminum alloys, this disadvantage are overcome by the use of stud bolts.It has threads on both ends so that one of the pieces, being held together, must be threaded to replace the head. The stud bolt is screwed tightly into the threaded part by a special locknut device, until it jams. The studs become an assembly guide by means of which the other part, which is drilled but not threaded, is easily placed in position. A nut screwed on the other end of the stud bolt holds the two parts together. The end of the square neck, at the center, facilitates gripping of stud while screwing or unscrewing.

SET SCREWS

Setscrews are used as semi permanent fasteners to hold a collar, sleeve, pulley or on a shaft against rotational or translation forces. In contrast to most fastening device, the setscrew is essentially a compression device. Forces developed by the screw point during tightening produce a strong clamping action that resists relative motion between assembled parts. The basic problem in setscrew selection is in finding the best combination of setscrew form, size, and point style providing the required holding power. Set screws are categorized by their form and the desired point style. Selection of specific, form or point is influenced by functional by functional, as well as other considerations.

The conventional approach to setscrew selection is usually based on a rule of thumb that the setscrew and key are used together; the screw diameter should be equal to the width of the key.

CAP SCREW

Cap screws are similar to bolts in that they have a head on one threads on the other. But they widely in the method of holding two parts together. The bolt keeps two parts between the head and the nut, and the cap-screw is threaded in one of the parts, thus clamping another part between the head threaded part. The cap screws are manufactured in several styles of head. The point of all cap screw is flat surface and to a depth equal of the threaded on it.

MACHINE SCREWS

These are similar in function and operation to cap screws, but are usually smaller in diameter. Materials: for general engineering purpose, nuts and screws are made of mild steel (MS). However, copper and its alloys, aluminum alloys, etc are also alloys, etc are also used for also used for special purpose in their manufacture.

FOUNDATION BOLTS

For securing heavy machines to concrete foundations, special types of bolts known as foundation bolts are used. Positions of bolt holes are marked either from a temple or from a template or from the machine itself, and holes bored out in the floor, sufficiently large enough to allow the bolt to be suspended freely in positions while the cement concrete is poured around to fill up the space. When the cement concretes sets the bolt will be firmly secured in the ground.

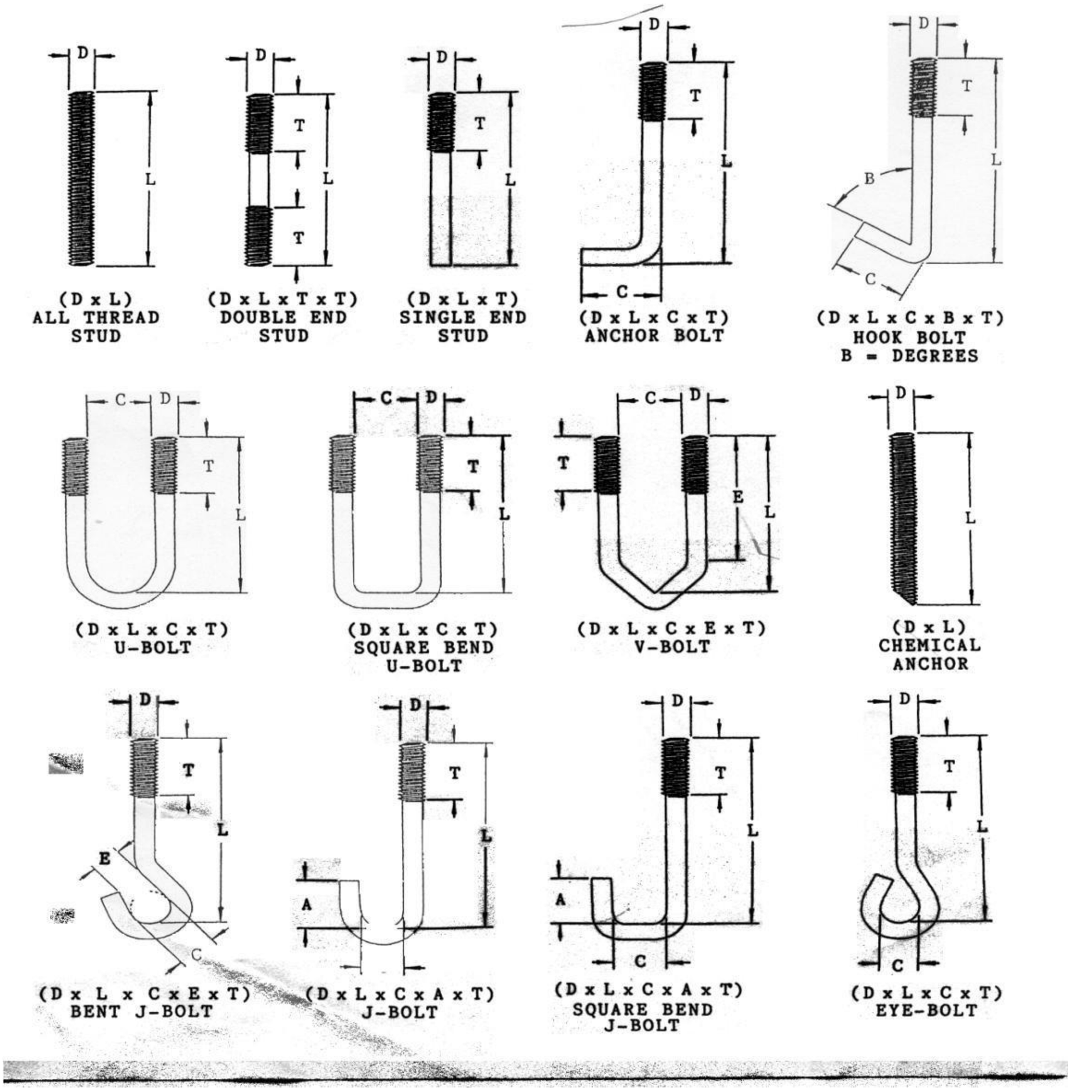


Fig. Foundation Bolts

RESULTS:

Thus the studies of Screw threads, keys and fasteners were studied.

Ex.No: 5 **STUDY OF DRAFTING SOFTWARE (AUTOCAD)**

Date:

Aim:

To study the AUTOCAD Software.

Sl.No	Command	Description
1.	OPEN	Opens an existing drawing file
2.	ARC	Creates an arc
3.	ARRAY	Creates multiple copies of objects in a pattern
4.	BHATCH	Fills an enclosed area or selected objects with a hatch pattern
5.	BLOCK	Creates a block definition from objects you select
6.	BREAK	Erase parts of object or splits an object in two
7.	CHAMFER	Bevels the edges of object
8.	CHANGE	Changes the properties of existing objects
9.	CIRCLE	Creates a circle
10.	COLOR	Defines color for new objects
11.	COPY	Duplicates objects
12.	DIVIDE	Places evenly spaced point objects or blocks along the length or perimeter of an object
13.	DONUT	Draws filled circles and rings
14.	ELLIPSE	Creates an ellipse or an elliptical arc
15.	ERASE	Removes objects from a drawing
16.	HATCH	Fills a specified boundary with a pattern
17.	HATCHEDIT	Modifies an existing hatch object
18.	EXTEND	Extends an object to meet another object
19.	INSERT	Places a named block or drawing into the current drawing
20.	LAYER	Manages layers and layer properties
21.	LINE	Creates straight line segments
22.	LINETYPE	Creates, loads, and set line types
23.	OFFSET	Creates concentric circles, parallel lines, and parallel curves
24.	FILLET	Rounds and fillets the edges of objects
25.	MIRROR	Creates a mirror image copy of objects
26.	MOVE	Displaces objects a specified distance in a specified direction
27.	MSLIDE	Creates a slide file of the current view port in model space, or of all view ports in paper space.

28.	LTSCALE	Sets the line type scale factor
29.	PAN	Moves the drawing display in the current view port
30.	OOPS	Restores erased objects
31.	PLINE	Creates two-dimensional polylines
32.	POINT	Creates a point object
33.	POLYGON	Creates an equilateral closed polyline
34.	PROPERTIES	Controls properties of existing objects
35.	MTEXT	Multiline text
36.	ORTHO	Constrains cursor movement
37.	OSNAP	Sets object snap modes
38.	REDRAW	Refreshes the display in the current view port
39.	REGEN	Regenerates the drawing and refreshes the current view port
40.	ROTATE	Rotate
41.	SCALE	Enlarges or reduces selected objects equally in the X,Y, and Z directions
42.	SCRIPT	Executes a sequence of commands from a script
43.	SKETCH	Creates a series of freehand line segments
44.	SPLINE	Creates a quadratic or cubic spine (NURBS) curve
45.	TEXT	Displays text on screen as it is entered
46.	UNDO	Reverse the effect of commands
47.	ZOOM	Increases or decreases the apparent size of objects in the current view port
48.	AREA	Calculates the area and perimeter of objects or of defined areas
49.	LTSCALE	Sets the line type scale factor
50.	BACKGROUND	Sets up the background for your scene
51.	BASE	Sets the insertion base point for the current drawing
52.	BLIPMODE	Controls the displays of marker blips
53.	BLOCKICON	Generates preview images for blocks created with release 14 or earlier
54.	CHPROP	Changes the color, layer, line type, scale factor, line weight, thickness, and plot style of an object
55.	CLOSE	Closes the current drawing
56.	DBLIST	Lists database information for each object in the drawing
57.	DDEDIT	Edits text and attribute definitions
58.	DDPTYPE	Specifies the display mode and size of point objects

59.	DELAY	Provides a timed pause within a script
60.	DIM AND DIM	Accesses dimensioning mode
61.	DIMALIGNED	Creates an aligned linear dimension
62.	DIMANGULAR	Creates an angular dimension
63.	DIMBASELINE	Creates a linear, angular, or ordinate dimension from the baseline of the pervious dimension or a selected dimension
64.	DIMDIAMETER	Creates diameter dimensions for circles and arcs
65.	DIMEDIT	Edit dimensions
66.	DIMLINEAR	Creates linear dimension
67.	DIMORDINATE	Creates ordinate point dimensions
68.	DIMOVERRIDE	Overrides dimension system variables
69.	DIMRADIUS	Creates ordinate point dimensions
70.	DIMSTYLE	Creates and modifies dimension styles
71.	DIST	Measures the distance and angle between two points
72.	DWGPROPS	Sets and displays the properties of the current drawing
73.	FILL	Controls the filling of multi-lines, traces, solids, all hatches and wide polylines
74.	FILTER	Creates reusable filters to select objects based on properties
75.	ID	Displays the coordinate values of a location
76.	LIST	Displays database information for selected objects
77.	MASSPROP	Calculate and displays the mass properties of regions or solids
78.	MENU	Loads a menu file
79.	MENULOAD	Loads partial menu files
80.	MENUUNLOAD	Unloads partial menu files
81.	OPTIONS	Customizes the AutoCAD settings
82.	PLAN	Displays the plan view of a user coordinate system
83.	PLOT	Plots a drawing to a plotting device of file
84.	SHADEMODE	Shades the objects in the current view port
85.	SNAP	Restricts cursor movement to specified intervals
86.	SPELL	Checks spelling in a drawing
87.	VLISP	Displays the Visual LISP interactive development environment(IDE)

RESULTS:

Thus the AutoCAD software was studied.

Ex.No: 6 BASIC 2D DRAWING – Auto CAD

Date:

Aim:

1. To understand drawing standards
2. Draw basic sketches and constraint them using Geometrical and Dimensional constraints

Procedure:

1. Open Auto CAD; Draw the Shape given in the Fig.1.
2. Add relations and Smart dimensions and make sure that the Sketch is Fully constraint
3. Change the dimensions according to Fig.1
4. Repeat the same for Fig.2 to Fig.6

Commands used:

Line, Circle, Arc, Fillet, Trim, Smart Dimension, Relations, Show, View

Result:

The basic sketches were drawn using CATIA as shown in Figures and the required parameters were added to modify the dimensions at later stage if necessary.

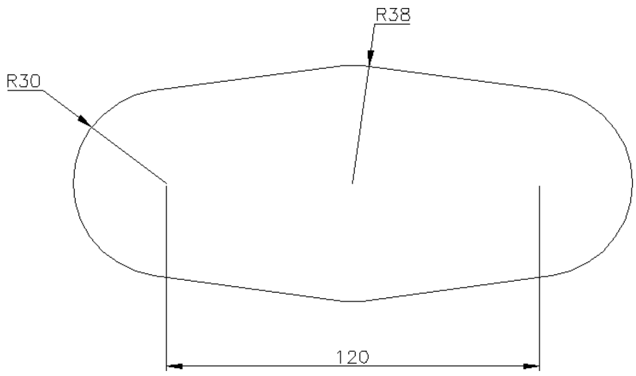


Fig.1

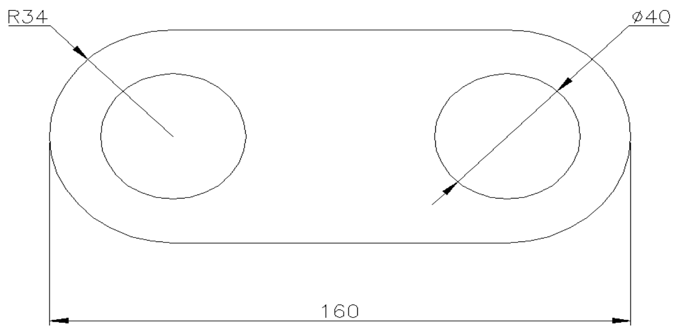


Fig.2

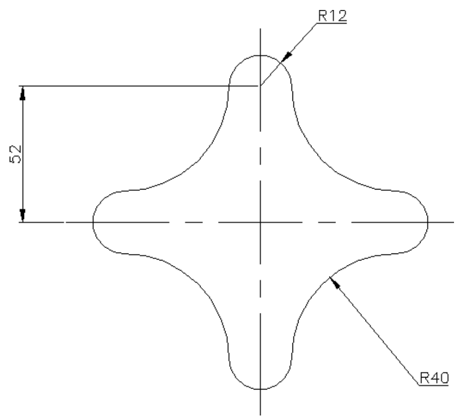


Fig.3

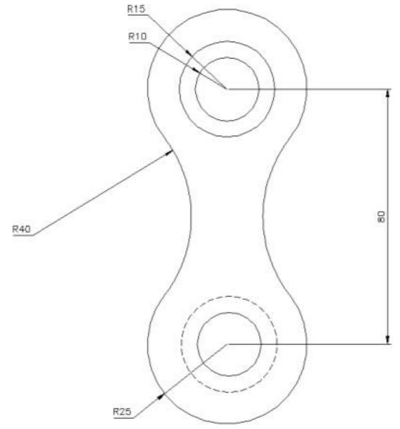


Fig.4

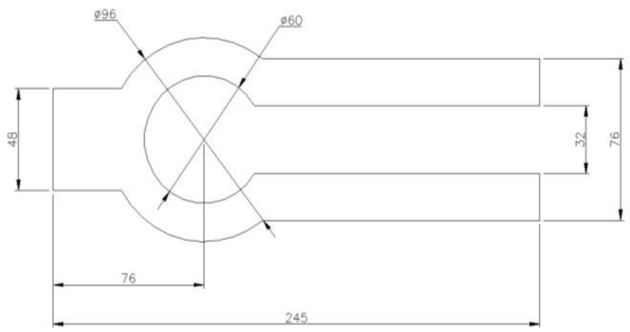


Fig.5

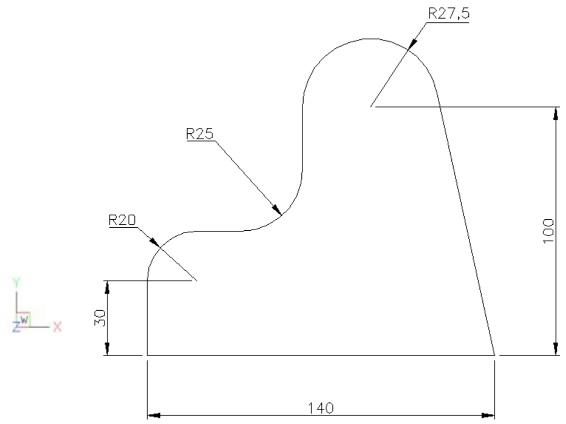


Fig.6

Ex.No: 7 ASSEMBLY OF SLEEVE AND COTTER JOINT

Date:

Aim:

1. To create 3D models of **Sleeve and Cotter Joint** parts using Auto CAD/CATIA.
2. To Create the Assembly of Sleeve and Cotter Joint using Auto CAD/CATIA.
3. To understand the type of fits and tolerances used in Assembly.

Procedure:

1. The modeling concepts – Solid modeling, Surface modeling were trailed in Auto CAD/CATIA by creating 3D model of Sleeve and cotter Joint-connecting rod, sleeve, cotter.
2. The options available in each Feature command are tried to understand the capabilities of each command
3. Design Methods: Bottom-up Design, Top down Design are discussed
4. Assembly of Sleeve and Cotter Joint was created using Bottom-up design approach

Commands used:

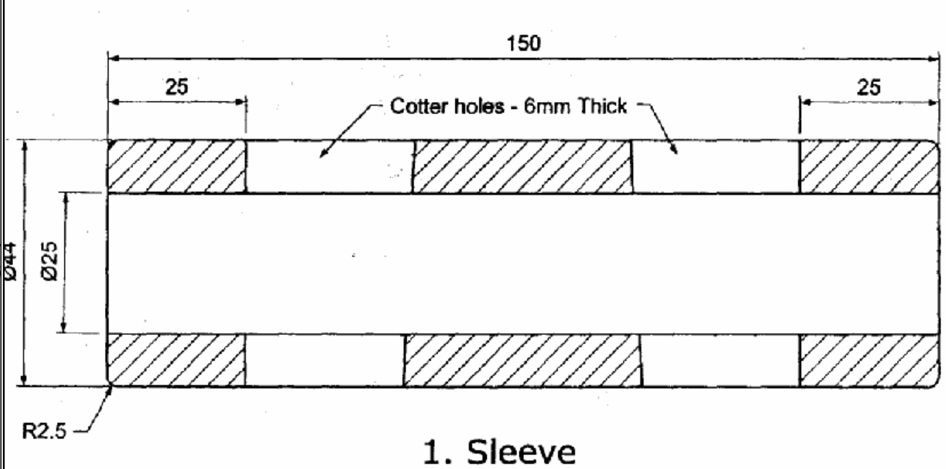
Sketcher Commands: Line, Circle, Arc, Fillet, Trim, Smart Dimension, Relations, Show, and View

Features Commands: Extrude (pad) and Cut, Revolve (shaft), Sweep, and Loft, Fillet/Round, Chamfer, and Draft, Hole - Simple and Hole Wizard, Hole Series, Scale, Shell, Rib, Dome, Freeform, Shape, Deform, Indent, Flex, Pattern and Mirror, Curves, Fastening Features

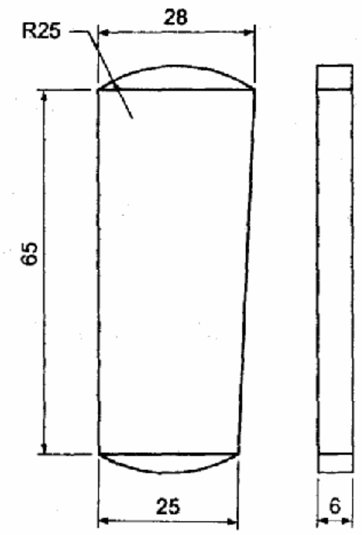
Assembly Commands: Insert, Component, Existing Part/Assembly
Mating Commands: Angle, Coincident, Concentric, Distance, Parallel, Perpendicular, Tangent

Result:

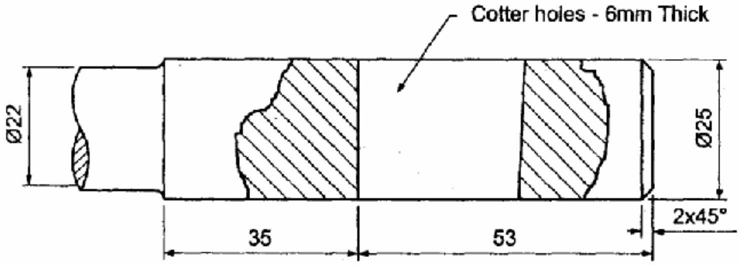
The 3D models of Sleeve and Cotter Joint parts are created using Auto CAD/CATIA. The type of fits and tolerances used in Assembly are studied.



1. Sleeve



3. Cotter



2. Connecting Rod

Bill Of Materials			
Sl no	Description	Material	Qty
1	Sleeve	MS	1
2	Connecting rod	MS	2
3	Cotter	Steel	2

All dimensions are in mm

Ex.No:8 ASSEMBLY OF SOCKET AND SPIGOT JOINT

Date:

Aim:

1. To create 3D models of **Socket & spigot Joint** parts using Auto CAD/CATIA.
2. To Create the Assembly of Socket & spigot joint using Auto CAD/CATIA.

Procedure:

1. The drawings of socket, spigot, and cotter are studied.
2. 3D models of socket, spigot, cotter are created using Auto CAD/CATIA.
3. The Assembly of socket and spigot joint was created as per the drawing specification.

Commands used:

Sketcher Commands: Line, Circle, Arc, Fillet, Trim, Smart Dimension, Relations, Show, and View

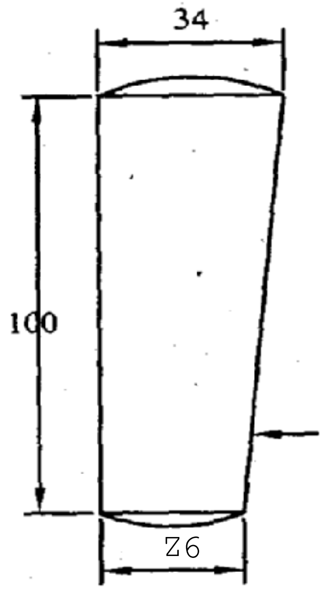
Features Commands: Extrude (Pad) and Cut, Revolve (Shaft), Fillet/Round, Chamfer, Hole - Simple, Pattern Fastening Features

Assembly Commands: Insert, Component, Existing Part/Assembly

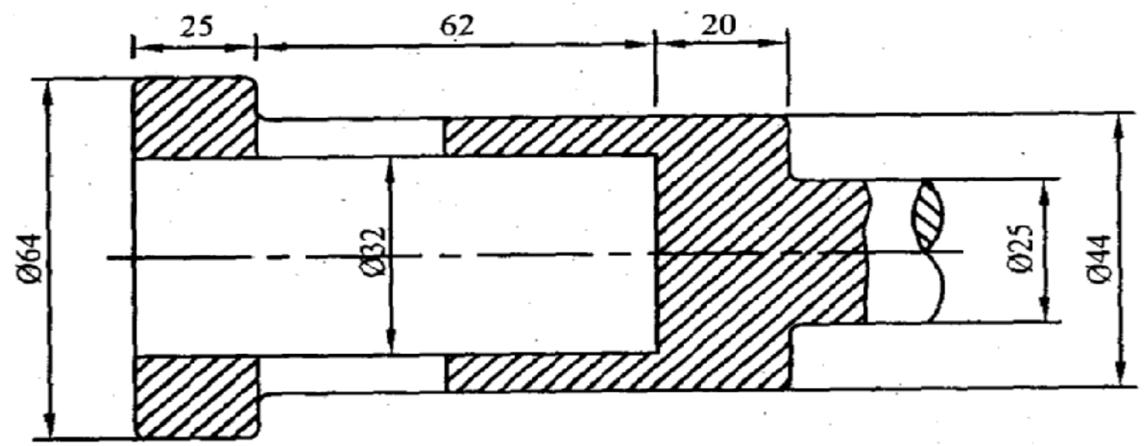
Mating Commands: Coincident, Concentric, Distance

Result:

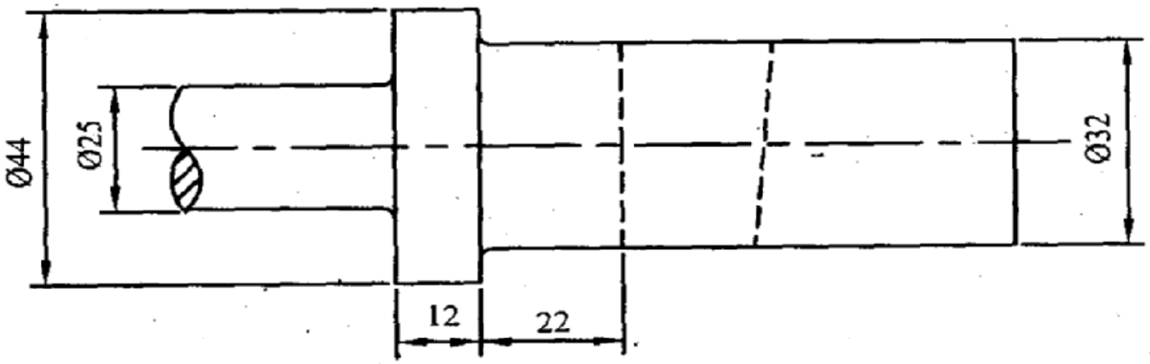
The 3D models of **Socket and spigot joint** parts (socket, spigot, cotter) are created using Auto CAD/CATIA.



Cotter



Socket



Spigot (Rod)

Detailed Drawing of Socket and Spigot Joint

SCALE: 1:1

All dimensions are in mm

Ex.No:9 ASSEMBLY OF GIB & COTTER JOINT

Date:

Aim:

1. To create 3D models of **GIB & COTTER JOINT** parts using Auto CAD/CATIA.
2. To Create the Assembly of Gib & Cotter Joint using Auto CAD/CATIA.
3. To understand the type of fits and tolerances used in Assembly.

Procedure:

1. The drawings of **Gibb & Cotter** parts (Gibb & Cotter, Fork, Square rod) are studied.
2. 3D models of all the parts are created using CATIA.
3. The Assembly of Gibb & Cotter was created as per the drawing specification.

Commands used:

Sketcher Commands: Line, Circle, Arc, Fillet, Trim, Smart Dimension, Relations, Show, and View.

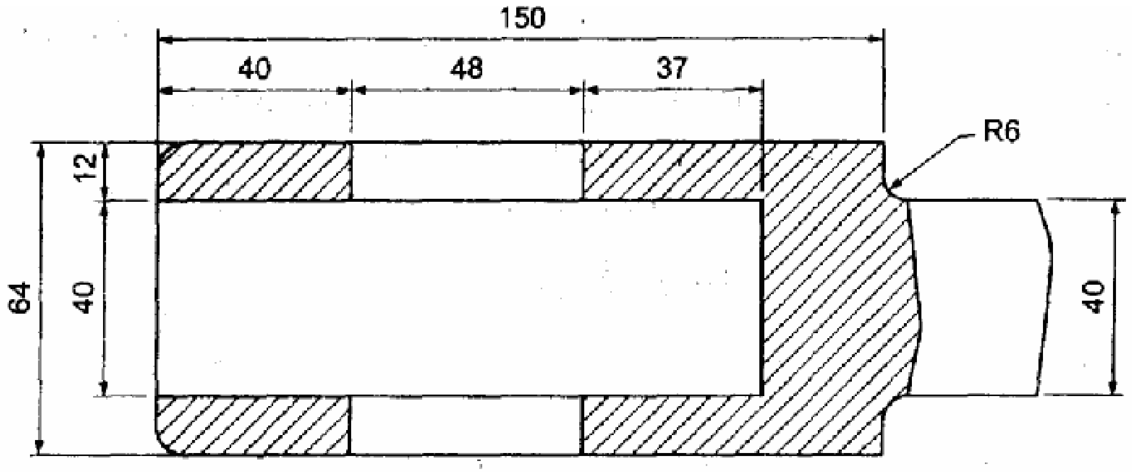
Features Commands: Extrude (Pad) and Cut, Revolve (Shaft), Fillet/Round, Chamfer, Hole - Simple, Pattern, Fastening Features.

Assembly Commands: Insert, Component, Existing Part/Assembly.

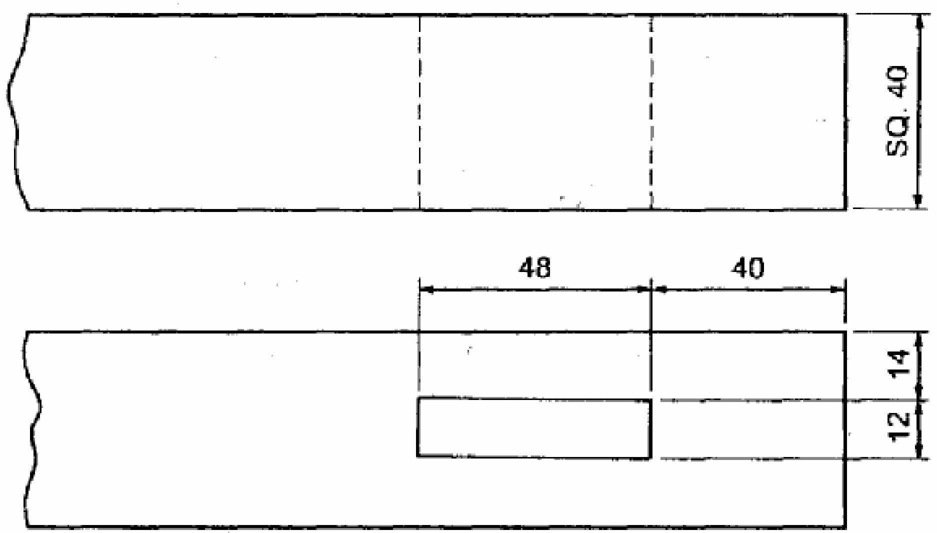
Mating Commands: Coincident, Concentric, Distance.

Result:

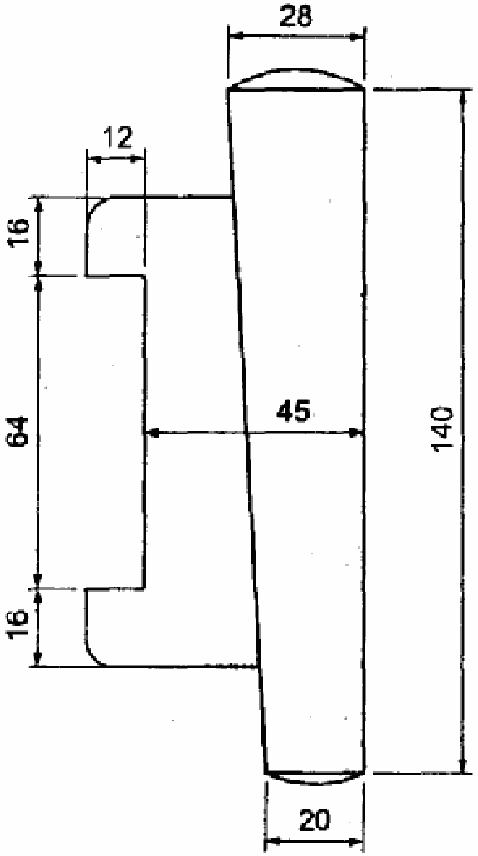
The 3D models of **Gibb & Cotter** parts (Gibb & Cotter, Fork, Square rod) are created using CATIA. The type of fits and tolerances used in Assembly are studied.



1. Fork



2. Square Rod



3. Gib & Cotter

Bill Of Materials			
Sl no	Description	Material	Qty
1	Fork	MS	1
2	Square rod	MS	1
3	Gib & Cotter	Steel	1 each

ALL DIMENSIONS ARE IN “mm”

Ex.No:10 ASSEMBLY OF SHAFT COUPLING

Date:

Aim:

1. To create 3D models of **Flanged Coupling** parts using Auto CAD/CATIA.
2. To Create the Assembly of Flanged Coupling using Auto CAD/CATIA.

Procedure:

1. The drawings of Flanges, Shaft, Taper key, Hexagonal Bolt and Nut are studied.
2. 3D models of Flanges, Shaft, Taper key, Hexagonal Bolt and Nut are created using Auto CAD/CATIA.
3. The Assembly of Flanged Coupling was created as per the drawing specification.

Commands used:

Sketcher Commands: Line, Circle, Arc, Fillet, Trim, Smart Dimension, Relations, Show, and View

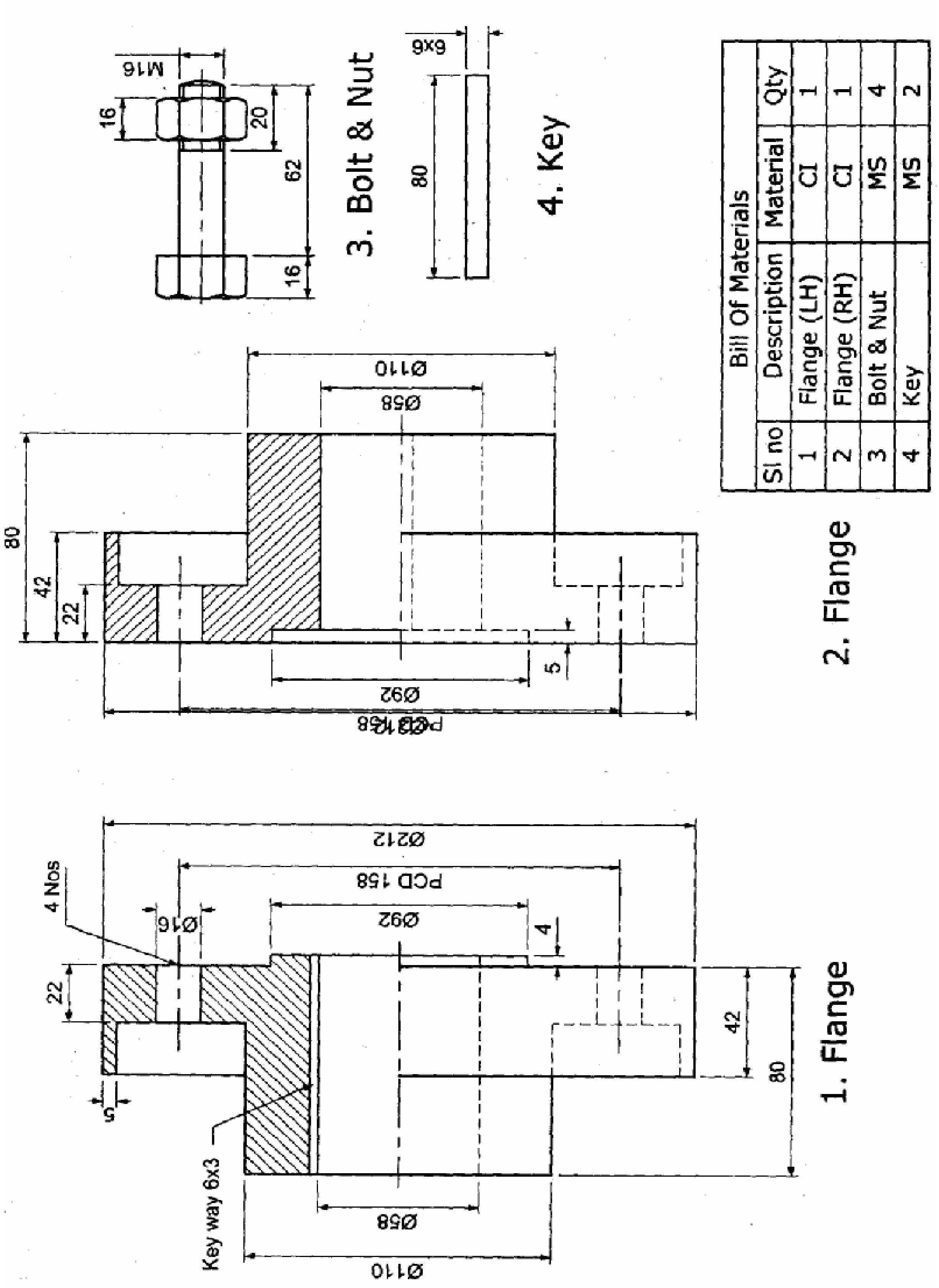
Features Commands: Extrude (Pad) and Cut, Revolve (Shaft), Fillet/Round, Chamfer, Hole - Simple, Pattern Fastening Features

Assembly Commands: Insert, Component, Existing Part/Assembly

Mating Commands: Coincident, Concentric, Distance

Result:

The 3D models of **Flanged Coupling** parts (Flanges, Shaft, Taper key, Hexagonal Bolt and Nut) are created using Auto CAD/CATIA.



Bill Of Materials			
Sl no	Description	Material	Qty
1	Flange (LH)	CI	1
2	Flange (RH)	CI	1
3	Bolt & Nut	MS	4
4	Key	MS	2

All Dimensions are in "mm"

Ex.No: 11 ASSEMBLY OF SIMPLE ECCENTRIC

Date:

Aim:

1. To create 3D models of **SIMPLE ECCENTRIC** parts using Auto CAD/CATIA.
2. To Create the Assembly of Simple Eccentric using Auto CAD/CATIA.
3. To understand the type of fits and tolerances used in Assembly.

Procedure:

1. The drawings of **Simple Eccentric** parts (straps, sheave, shim, cheese headed bolt, M12 nut, M12 lock nut) are studied.
2. 3D models of all the parts are created using Auto CAD/CATIA.
3. The Assembly of Simple Eccentric was created as per the drawing specification.

Commands used:

Sketcher Commands: Line, Circle, Arc, Fillet, Trim, Smart Dimension, Relations, Show, and View.

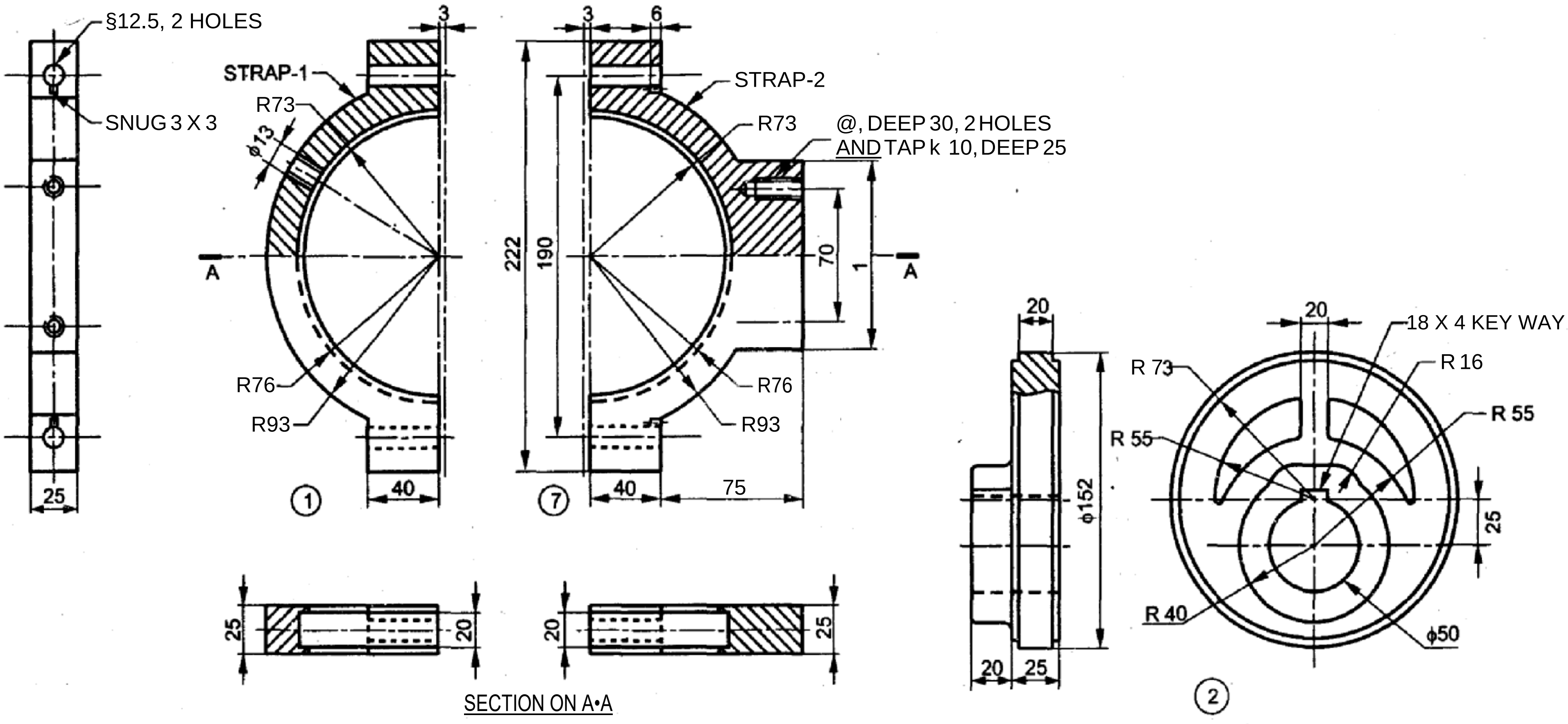
Features Commands: Extrude (pad) and Cut, Revolve (shaft), Fillet/Round, Chamfer, Hole - Simple, Pattern, Fastening Features.

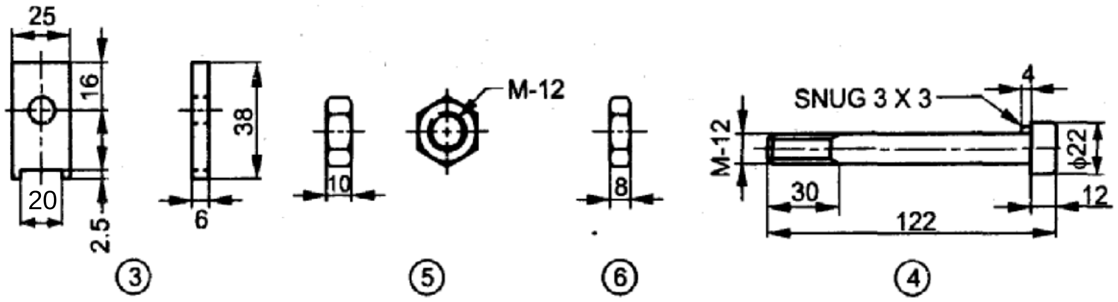
Assembly Commands: Insert, Component, Existing Part/Assembly.

Mating Commands: Coincident, Concentric, Distance.

Result:

The 3D models of **Simple Eccentric** parts (straps, sheave, shim, cheese headed bolt, M12 nut, M12 lock nut) are created using Auto CAD/CATIA. The type of fits and tolerances used in Assembly are studied.





ITEM NO.	DESCRIPTION	MATERIAL	NO. OFF
6	M-12 LOCK NUT	MILD STEEL	2
5	M-12 NUT	MILD STEEL	2
4	CHEESE HEADED BOLT	MILO STEEL	2
3	SHIM	BRASS	2
2	SHEAVE	CAST STEEL	1
1 & 7	STRAPS	CAST IRON	1

Ex.No:12 ASSEMBLY OF KNUCKLE JOINT

Date:

Aim:

1. To create 3D models of **Knuckle Joint** parts using Auto CAD/CATIA.
2. To Create the Assembly of Knuckle Joint using Auto CAD/CATIA.
3. To understand the type of fits and tolerances used in Assembly.

Procedure:

1. The modeling concepts – Solid modeling, Surface modeling were trailed in Auto CAD/CATIA by creating 3D model of Knuckle Joint Parts – Fork, Eye, Pin, Collar, Taper pin
2. The options available in each Feature command are tried to understand the capabilities of each command
3. Design Methods: Bottom-up Design, Top down Design are discussed
4. Assembly of Knuckle Joint was created using Bottom-up design approach

Commands used:

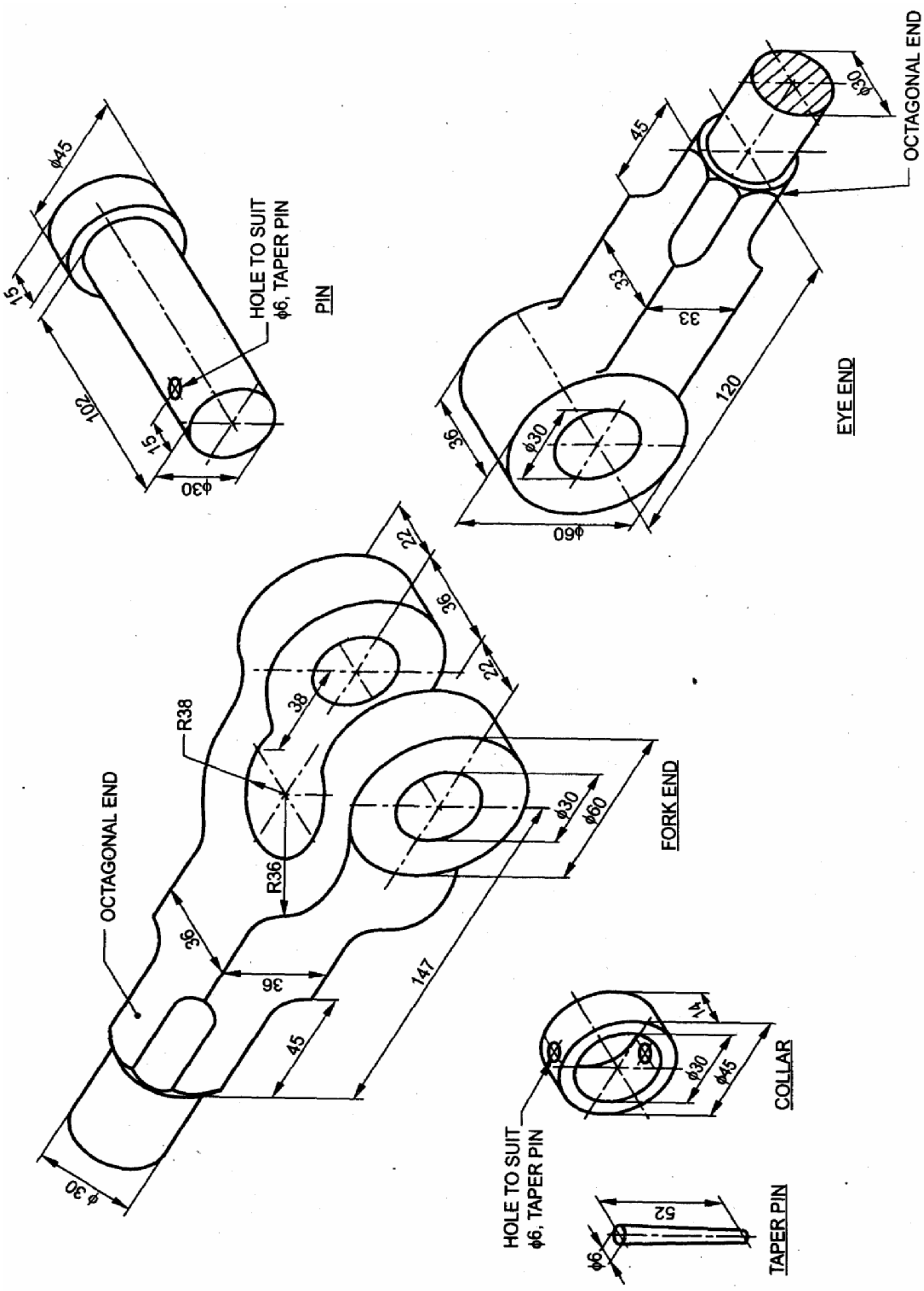
Sketcher Commands: Line, Circle, Arc, Fillet, Trim, Smart Dimension, Relations, Show, and View

Features Commands: Extrude (pad) and Cut, Revolve (shaft), Sweep, and Loft, Fillet/Round, Chamfer, and Draft, Hole - Simple and Hole Wizard, Hole Series, Scale, Shell, Rib, Dome, Freeform, Shape, Deform, Indent, Flex, Pattern and Mirror, Curves, Fastening Features

Assembly Commands: Insert, Component, Existing Part/Assembly
Mating Commands: Angle, Coincident, Concentric, Distance, Parallel, Perpendicular, Tangent

Result:

The 3D models of **Knuckle Joint** parts are created using Auto CAD/CATIA. The type of fits and tolerances used in Assembly are studied.



DETAILS OF KNUCKLE JOINT

ALL DIMENSIONS IN MM.

Ex.No: 13 ASSEMBLY OF PLUMMER BLOCK

Date:

Aim:

1. To create 3D models of **PLUMMER BLOCK** parts using Auto CAD/CATIA
2. To Create the Assembly of **Plummer block** using Auto CAD/CATIA

Procedure:

1. The drawings of Body, Cap, Bearing top & Bottom half, Nuts and shaft are studied
2. 3D models of Body, Cap, Bearing top & Bottom half Nuts and shaft are created using Auto CAD/CATIA.
3. The Assembly of Plummer block was created as per the drawing specification

Commands used:

Sketcher Commands: Line, Circle, Arc, Fillet, Trim, Smart Dimension, Relations, Show, and View

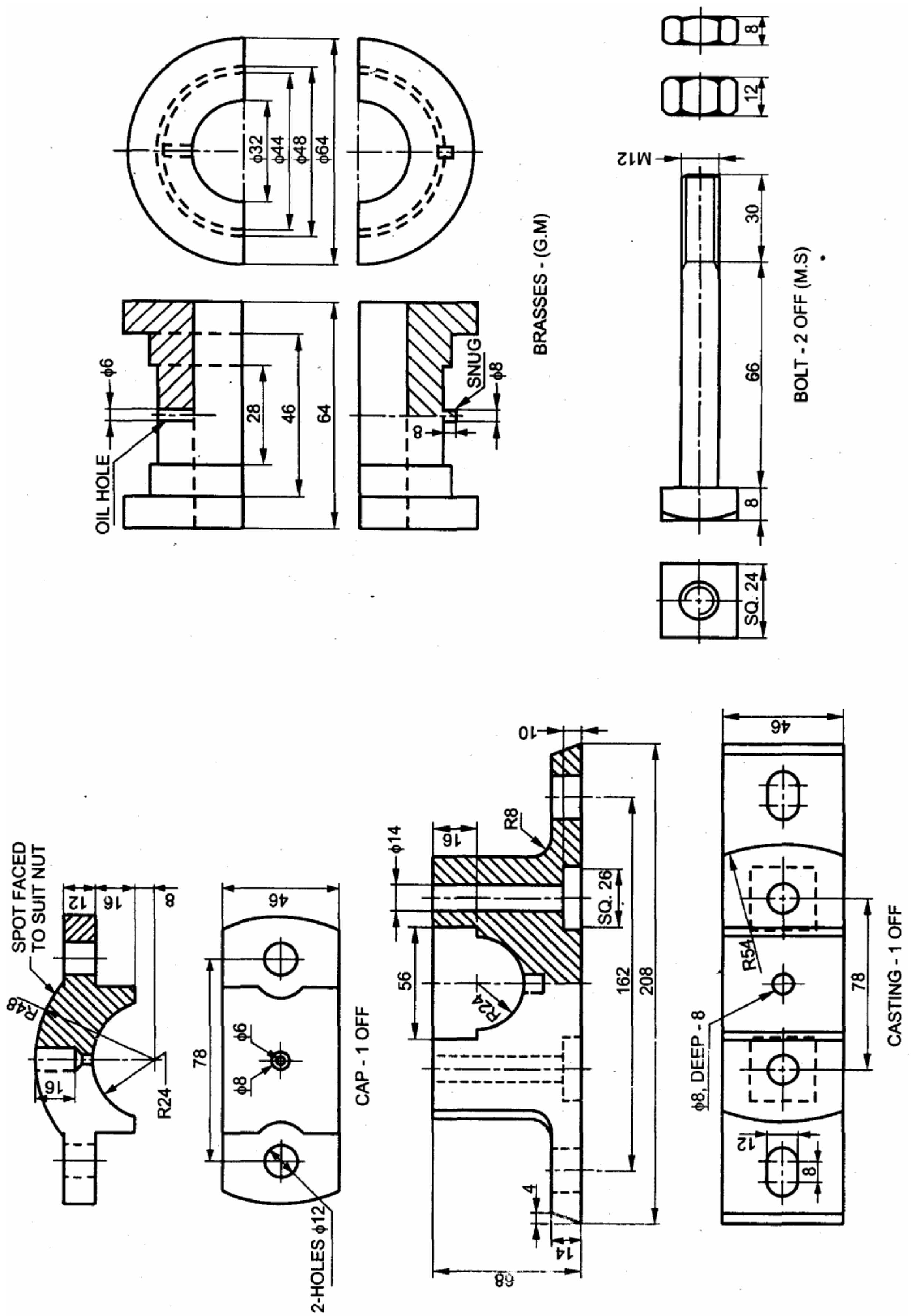
Features Commands: Extrude (pad) and Cut, Revolve (shaft), Fillet/Round, Chamfer, Hole - Simple, Pattern, Fastening Features

Assembly Commands: Insert, Component, Existing Part/Assembly

Mating Commands: Coincident, Concentric, Distance

Result:

The 3D models of **Plummer block** parts (Body, Cap, Bearing top & Bottom half, Nuts and shaft) are created using Auto CAD/CATIA.



All Dimensions are in "mm"

Ex.No: 14 ASSEMBLY OF SCREW JACK

Date:

Aim:

1. To create 3D models of **SCREW JACK** parts using Auto CAD/CATIA.
2. To Create the Assembly of **Screw Jack** using Auto CAD/CATIA.

Procedure:

1. The drawings of Body, Nut, Screw Spindle, Cup, Washer Special, CSK Screw, and Tommy Bar are studied.
2. 3D models of Body, Nut, Screw Spindle, Cup, Washer Special, CSK Screw, and Tommy Bar are created using Auto CAD/CATIA.
3. The Assembly of Screw Jack was created as per the drawing specification.

Commands used:

Sketcher Commands: Line, Circle, Arc, Fillet, Trim, Smart Dimension, Relations, Show, and View

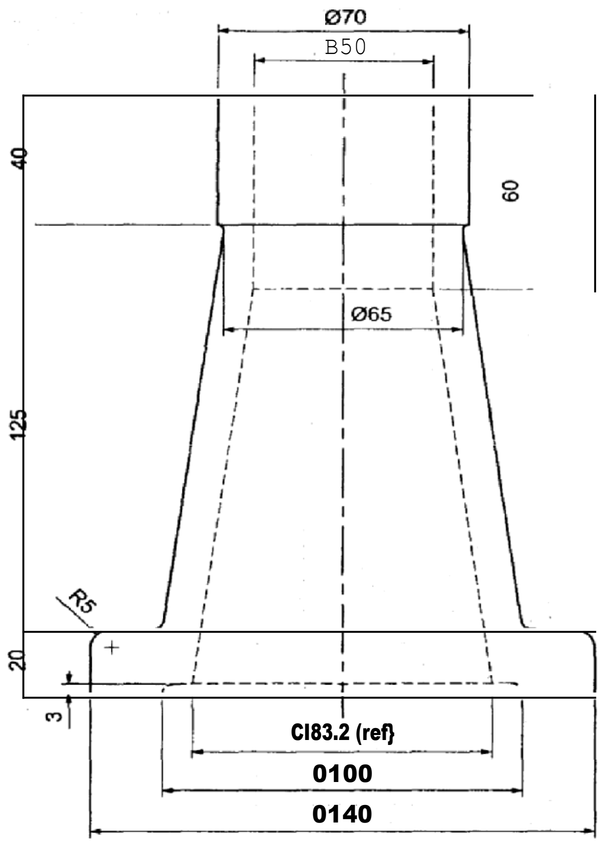
Features Commands: Extrude (pad) and Cut, Revolve (shaft), Fillet/Round, Chamfer, Hole - Simple, Pattern, Fastening Features

Assembly Commands: Insert, Component, Existing Part/Assembly

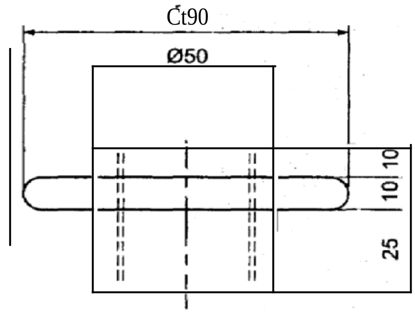
Mating Commands: Coincident, Concentric, Distance

Result:

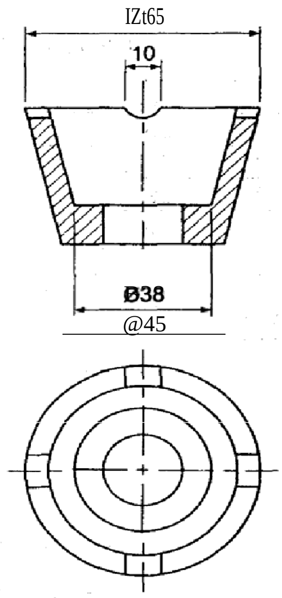
The 3D models of **Screw Jack** parts (Casting, Nut, Cup, Tommy bar, Setscrew, Screw, washer) are created using Auto CAD/CATIA.



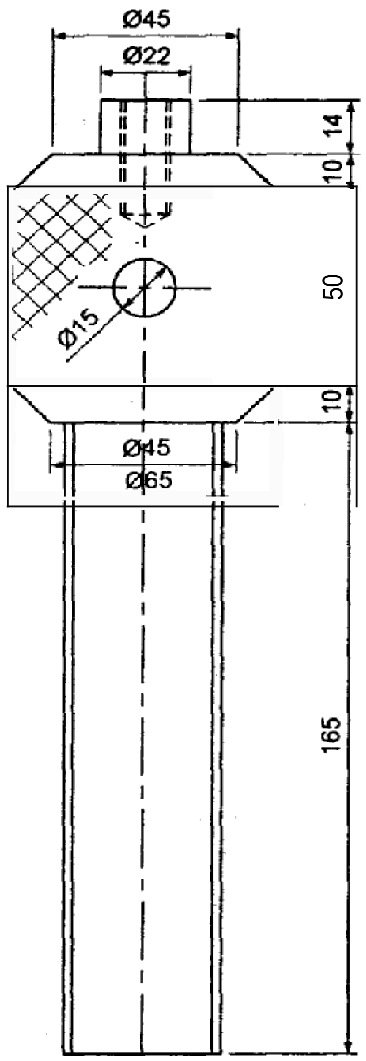
1. Casting



2. Nut



3. Cup



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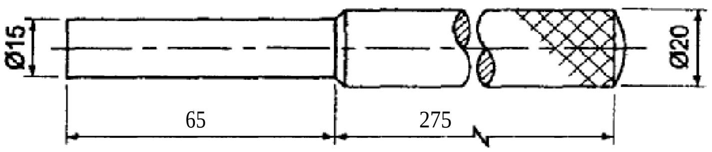
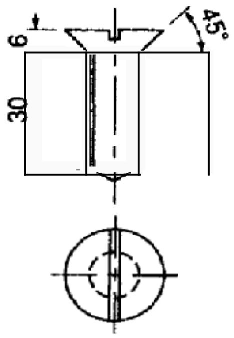
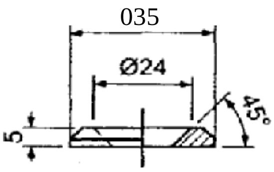
4. Ecrew



5. Tommy bar



6. Set Screw



7. Washer

Bill Of Materials			
SI no	Descriptlon	Naterial	9ty
1	Casting	CI	1
2	Nut	MW	1
3	Cup	f1S	1
4	Screw	f•tS	1
5	Tommy bar	f•15	1
6	Set Screw	MS	1
7	Washer	MS	1

Ex.No: 15 ASSEMBLY OF LATHE TAILSTOCK

Date:

Aim:

1. To create 3D models of **Lathe Tailstock** parts using Auto CAD/CATIA.
2. To Create the Assembly of Lathe Tailstock using Auto CAD/CATIA.
3. To understand the type of fits and tolerances used in Assembly.

Procedure:

1. The drawings of Body, Feather, Barrel, Screw Spindle, Flange, Screw, Feather key, Hand wheel, Washer M12 -M16- M22, Hex Nut M12 - M16- M22, Stud, Handle, Clamping plate, Sq. Head bolt and Centre are studied.
2. 3D models of all the parts are created using Auto CAD/CATIA.
3. The Assembly of Lathe Tailstock was created as per the drawing specification.

Commands used:

Sketcher Commands: Line, Circle, Arc, Fillet, Trim, Smart Dimension, Relations, Show, and View.

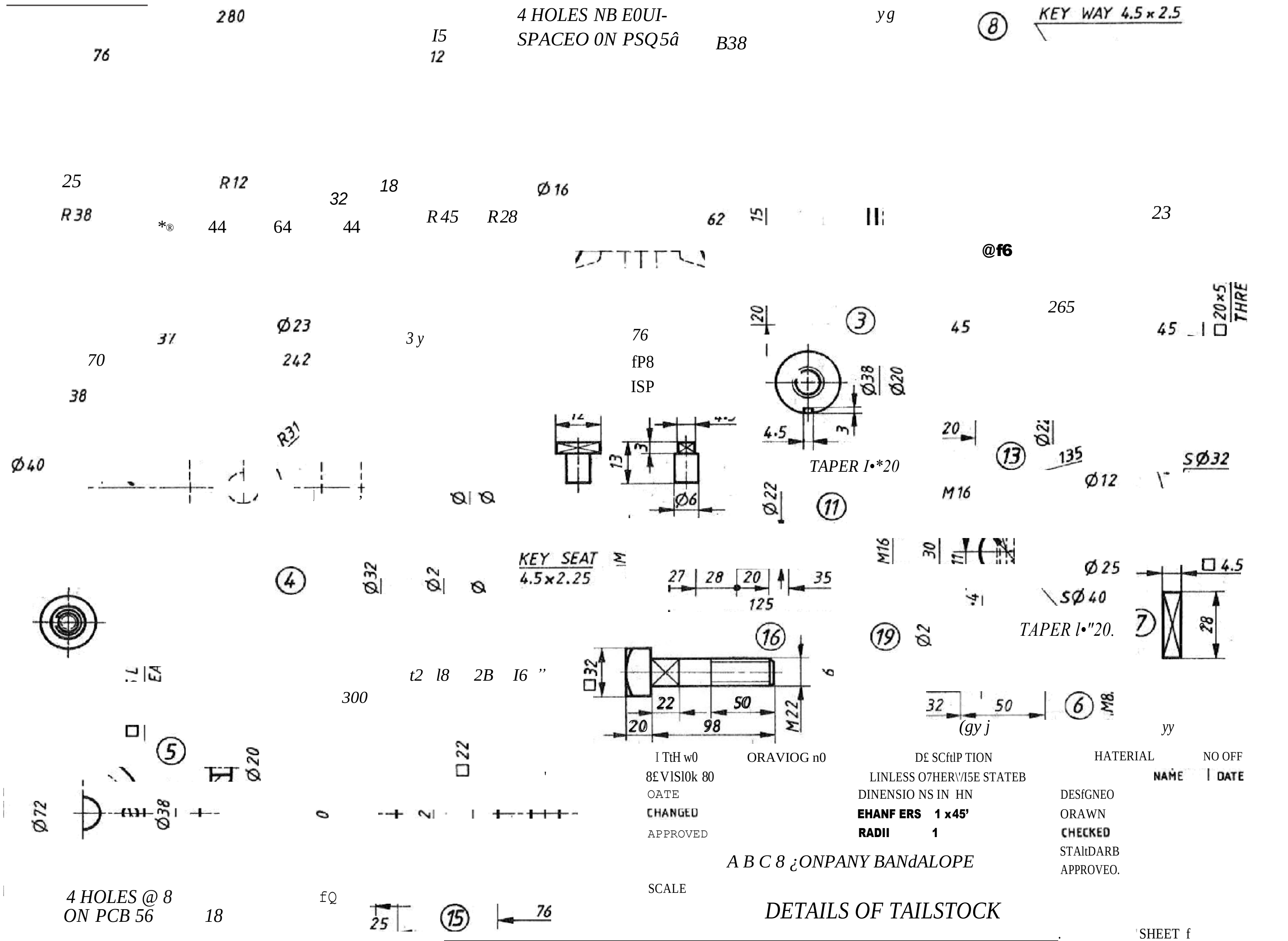
Features Commands: Extrude (pad) and Cut, Revolve (shaft), Fillet/Round, Chamfer, Hole - Simple, Pattern, Fastening Features.

Assembly Commands: Insert, Component, Existing Part/Assembly.

Mating Commands: Coincident, Concentric, Distance.

Result:

The 3D models of **Lathe Tailstock** parts (Body, Feather, Barrel, Screw Spindle, Flange, Screw, Feather key, Hand wheel, Washer M12 -M16- M22, Hex Nut M12 - M16- M22, Stud, Handle, Clamping plate, Sq. Head bolt and Centre) are created using Auto CAD/CATIA. The type of fits and tolerances used in Assembly are studied.



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SCALE

DETAILS OF TAILSTOCK

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Ex.No: 16 ASSEMBLY OF UNIVERSAL JOINT

Date:

Aim:

1. To create 3D models of **UNIVERSAL JOINT** parts using Auto CAD/CATIA.
2. To Create the Assembly of Universal Joint using Auto CAD/CATIA.
3. To understand the type of fits and tolerances used in Assembly.

Procedure:

1. The drawings of Fork, Shaft, Centre, Parallel key, Pin, Collar and Taper pin are studied.
2. 3D models of all the parts are created using Auto CAD/CATIA.
3. The Assembly of Universal Joint was created as per the drawing specification.

Commands used:

Sketcher Commands: Line, Circle, Arc, Fillet, Trim, Smart Dimension, Relations, Show, and View.

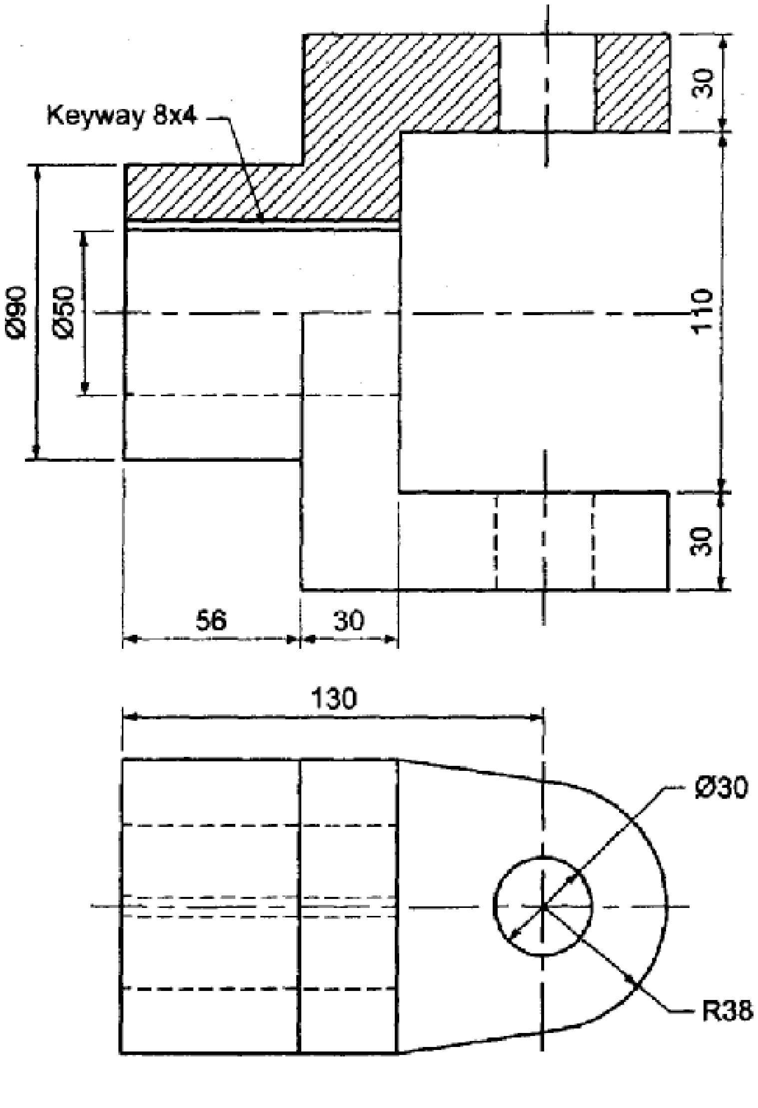
Features Commands: Extrude (pad) and Cut, Revolve (shaft), Fillet/Round, Chamfer, Hole - Simple, Pattern, Fastening Features.

Assembly Commands: Insert, Component, Existing Part/Assembly.

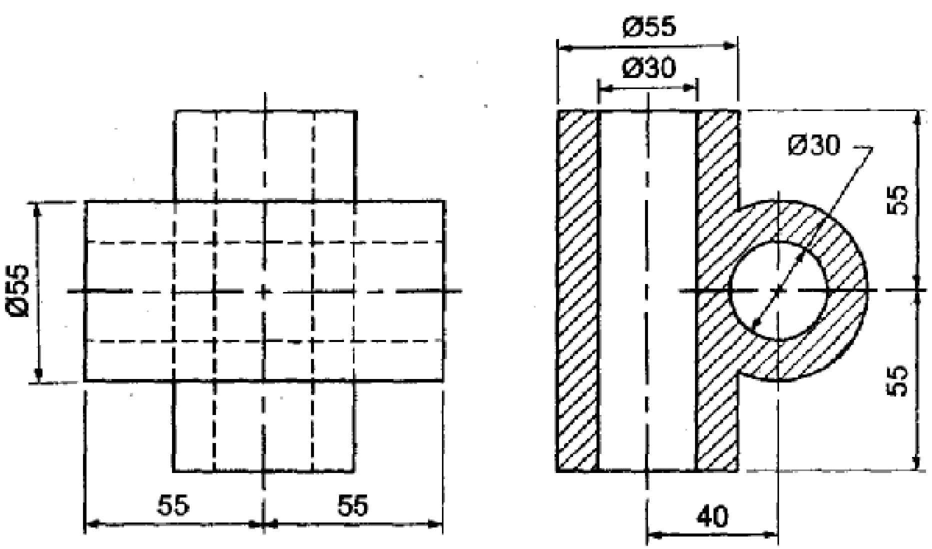
Mating Commands: Coincident, Concentric, Distance.

Result:

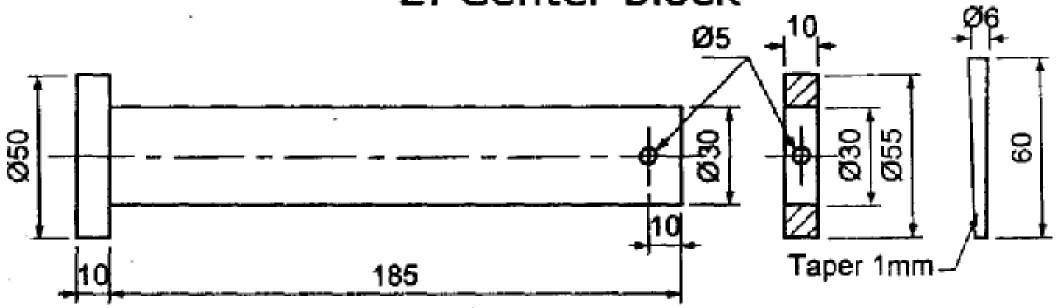
The 3D models of **Universal Joint** parts (Fork, Centre block, Pin & Collar and Key) are created using Auto CAD/CATIA. The type of fits and tolerances used in Assembly are studied.



1. Fork



2. Center block



3. Pin & Collar

Bill Of Materials			
Sl no	Description	Material	Qty
1	Fork	C.I	2
2	Center Block	C.I	1
3	Pin & Collar	M.S	2
4	Key	M.S	2

All Dimensions are in "mm"

Ex.No: 17 ASSEMBLY OF MACHINE VICE

Date:

Aim:

1. To create 3D models of **MACHINE VICE** parts using Auto CAD/CATIA.
2. To Create the Assembly of Machine Vice using Auto CAD/CATIA.
3. To understand the type of fits and tolerances used in Assembly.

Procedure:

1. The drawings of Body, Movable jaw, Jaw Grip, Screw M6, Screw Rod, Washer, Nut, Lock Nut and Clamping plate are studied.
2. 3D models of all the parts are created using Auto CAD/CATIA.
3. The Assembly of Machine Vice was created as per the drawing specification.

Commands used:

Sketcher Commands: Line, Circle, Arc, Fillet, Trim, Smart Dimension, Relations, Show, and View.

Features Commands: Extrude (pad) and Cut, Revolve (shaft), Fillet/Round, Chamfer, Hole - Simple, Pattern, Fastening Features.

Assembly Commands: Insert, Component, Existing Part/Assembly.

Mating Commands: Coincident, Concentric, Distance.

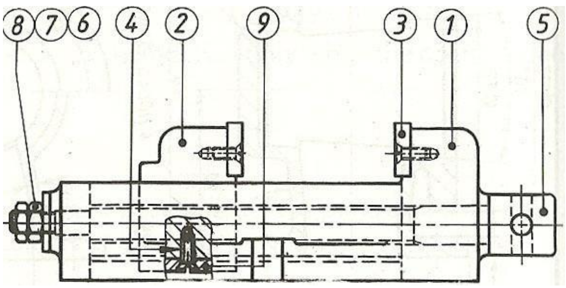
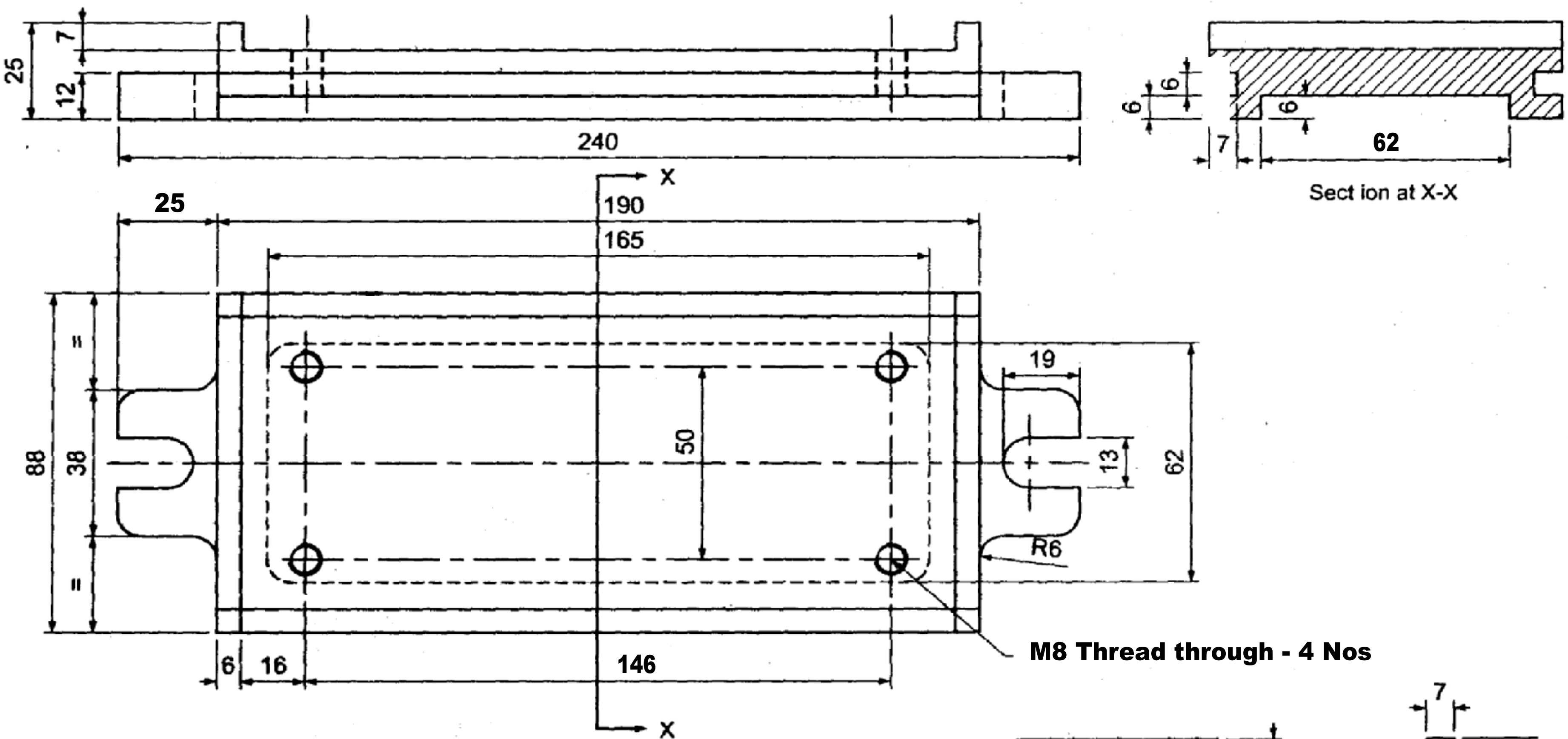


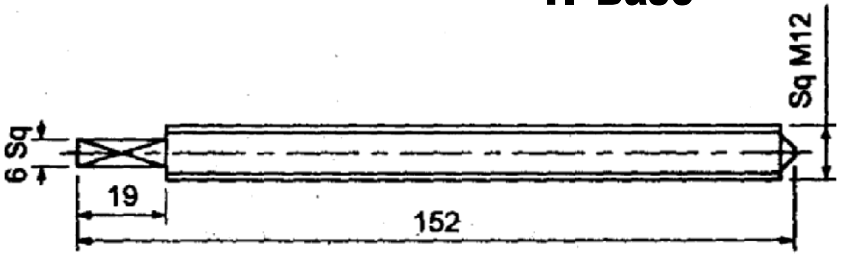
Fig.16

Result:

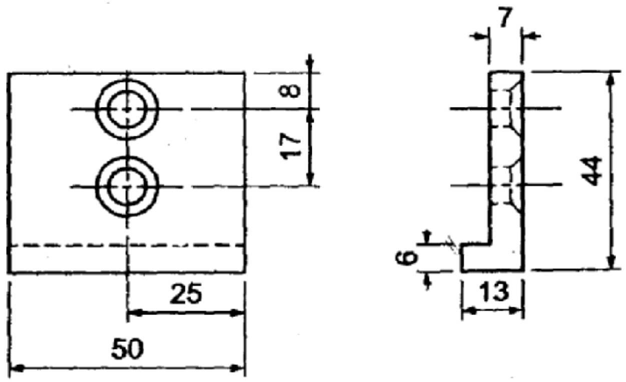
The 3D models of **Machine Vice** parts (Body, Movable jaw, Jaw Grip, Screw M6, Screw Rod, Washer, Nut, Lock Nut and Clamping plate) are created using Auto CAD/CATIA. The type of fits and tolerances used in Assembly are studied.



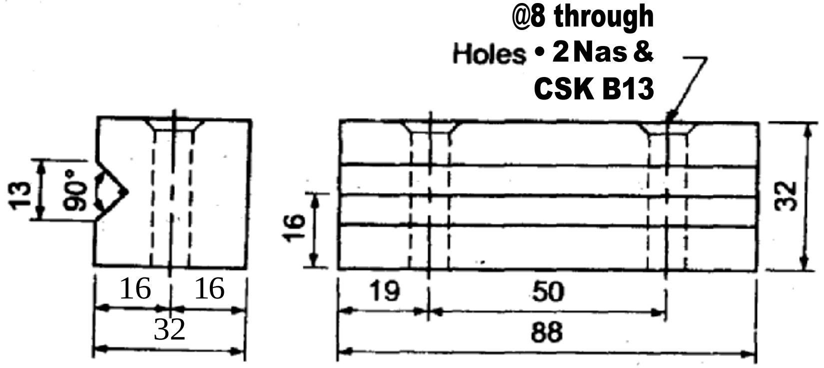
1. Base



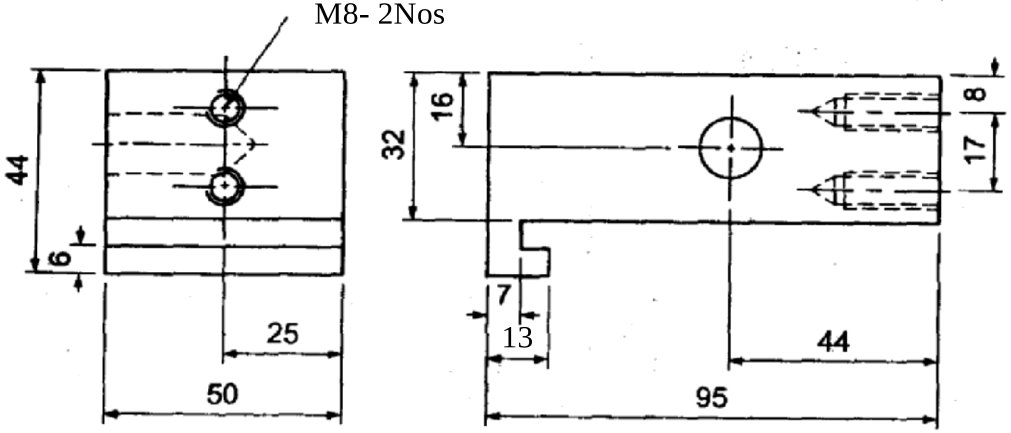
2. Screw



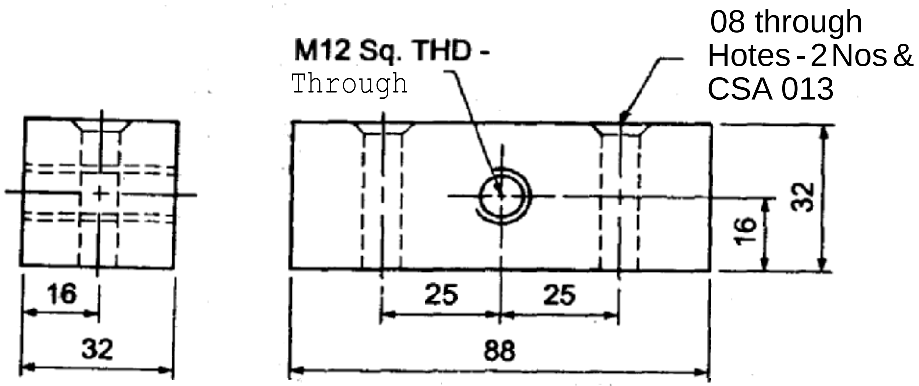
3. End Plate



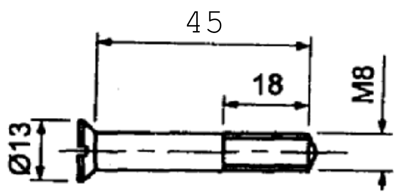
4. Fixed Jaw



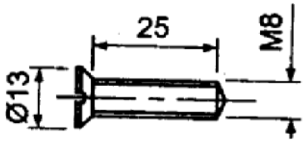
5. Sliding law



6. Block



7. Head screw type 1



8. Head screw type 2

Bill Of Materials			
Sl no	Description	Material	Qty
1	Base	CI	1
2	Screw	MS	1
3	End Plate	MS	1
4	Fixed 3aw	CI	1
5	Sliding law	CI	1
6	Block	CI	1
7	Head screw Type1	MS	4
8	Head screw Type2	MS	2

Ex.No: 18 ASSEMBLY OF CONNECTING ROD

Date:

Aim:

1. To create 3D models of **Connecting Rod** parts using Auto CAD/CATIA.
2. To Create the Assembly of Connecting Rod using Auto CAD/CATIA.
3. To understand the type of fits and tolerances used in Assembly.

Procedure:

1. The drawings of Connecting Rod, Bush, Stud, Pin, Bearing Brasses, Distance Piece, Cover, Washer, Nut, and Split pin are studied.
2. 3D models of all the parts are created using Auto CAD/CATIA.
3. The Assembly of Connecting Rod was created as per the drawing specification.

Commands used:

Sketcher Commands: Line, Circle, Arc, Fillet, Trim, Smart Dimension, Relations, Show, and View.

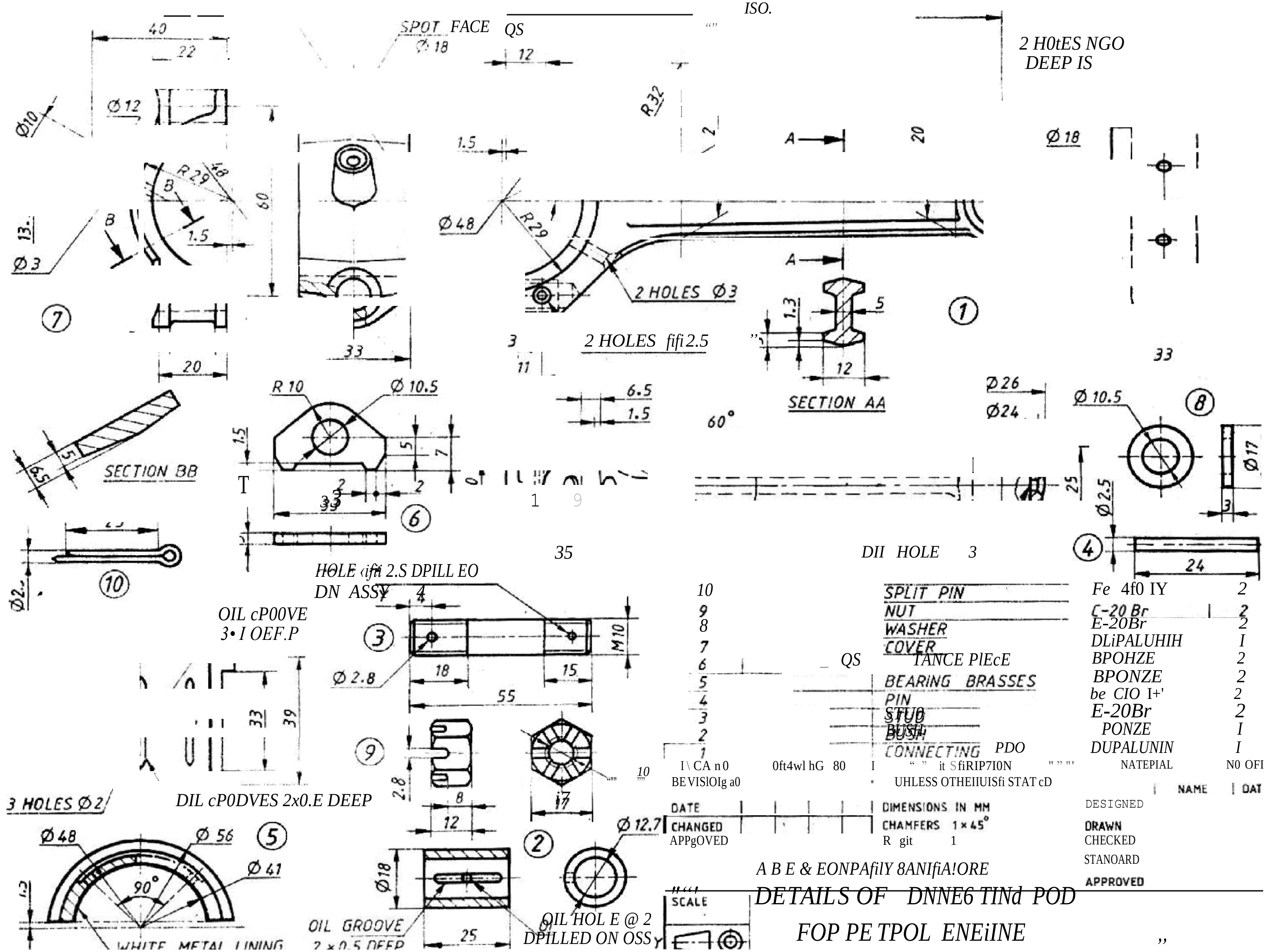
Features Commands: Extrude (pad) and Cut, Revolve (shaft), Fillet/Round, Chamfer, Hole - Simple, Pattern, Fastening Features.

Assembly Commands: Insert, Component, Existing Part/Assembly.

Mating Commands: Coincident, Concentric, Distance.

Result:

The 3D models of Connecting Rod parts (Connecting Rod, Bush, Stud, Pin, Bearing Brasses, Distance Piece, Cover, Washer, Nut, and Split pin) are created using Auto CAD/CATIA. The type of fits and tolerances used in Assembly are studied.


SPOT FACE Ø18
2 HOLES Ø3
2 HOLES Ø2.5
SECTION AA
SECTION BB
R 10
Ø 10.5
Ø 2.8
M10
3 HOLES Ø2
Ø 48
Ø 56
Ø 41
90°
WHITE METAL LINING
OIL GROOVE
Ø 12.7
SPLIT PIN
NUT
WASHER
COVER
BEARING BRASSES
PIN
STUD
BUSH
CONNECTING
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CHANGED
DIMENSIONS IN MM
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DRAWN
APPROVED
DETAILS OF