

DRONACHARYA

GROUP OF INSTITUTIONS

LABORATORY MANUAL

COMPUTER AIDED MACHINE DRAWING LAB - I

SUBJECT CODE: BME-353

B.TECH. (ME) SEMESTER - III

Academic Session: 2023-24, Odd Semester

**Dronacharya Group of Institutions
Plot No. 27, Knowledge Park-3, Greater Noida, Uttar Pradesh 201308**

Affiliated to

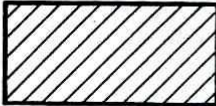
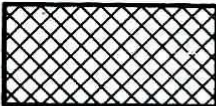
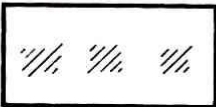
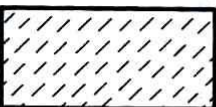
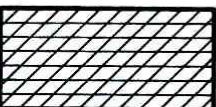
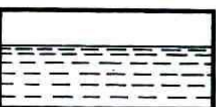
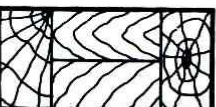
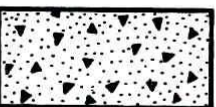
**Dr. A P J Abdul Kalam Technical University
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List of Experiments mapped with COs

S. No.	Aim of the Experiment	COs
1.	Study and exercises on machine drawing conventions.	
	a. Conventional representation of materials.	CO1
	b. Conventional representation of machine components.	CO1
	c. Conventional representation sectional views.	CO1
	d. Conventional representation of limits, Fits and tolerances-form and positional tolerances and machining symbols.	CO1
	e. Surface roughness and its Indications	CO1
2.	Temporary Fasteners: Assembly of Nut and Bolt	CO2
3.	Permanent Fasteners: Riveted Joints for Plates	CO2
4.	Assembly of Sleeve and Cotter Joint	CO2
5.	Assembly of Flange Coupling	CO4
6.	Assembly of Screw Jack	CO5

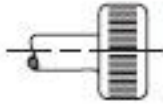
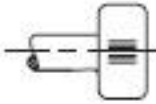
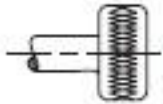
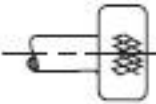

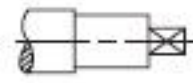


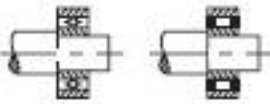
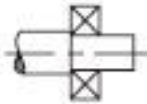






1. CONVENTIONAL REPRESENTATION OF MATERIALS

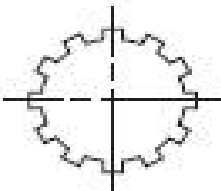
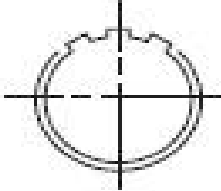
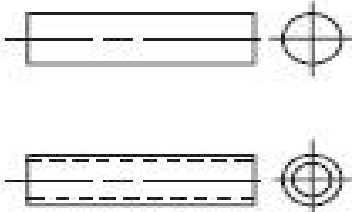
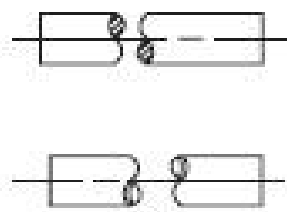
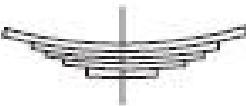
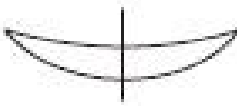
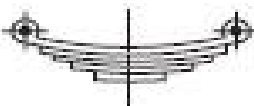
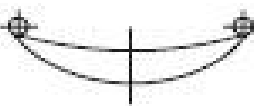
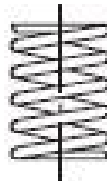
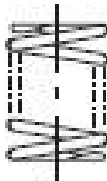




As a variety of materials are used for machine components in engineering applications, it is preferable to have different conventions of section lining to differentiate between various materials. The recommended conventions in use are shown in Fig.

TYPE	CONVENTION	MATERIALS
METALS		STEEL, CAST IRON, COPPER AND ITS ALLOYS, ALUMINIUM AND ITS ALLOYS, ETC
		LEAD, ZINC, TIN, WHITE-METAL, ETC
GLASS		GLASS
PACKING AND INSULATING MATERIALS		PORCELAIN, STONEWARE, MARBLE, SLATE, ETC
		ASBESTOS, FIBRE, FELT, SYNTHETIC RESIN PRODUCTS, PAPER, CORK, LINOLEUM, RUBBER, LEATHER, WAX, INSULATING & FILLING MATERIALS
LIQUIDS		WATER, OIL, PETROL, KEROSENE, ETC
WOOD		WOOD, PLYWOOD, ETC
CONCRETE		


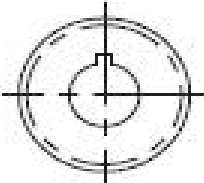
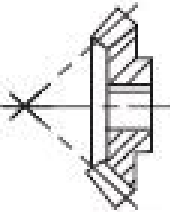
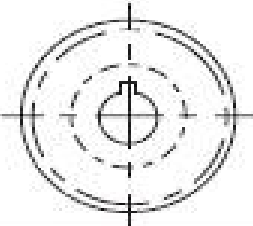
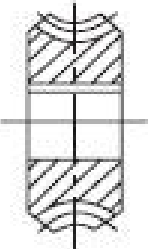
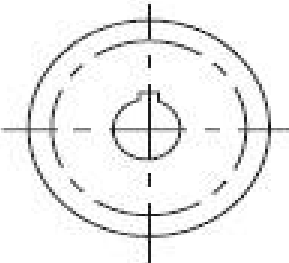

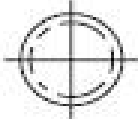
2. CONVENTIONAL REPRESENTATION OF MACHINE COMPONENTS

When the drawing of a component in its true projection involves a lot of time, its convention may be used to represent the actual component. Images shows typical examples of conventional representation of various machine components used in engineering drawing.

Title	Subject	Convention
Straight knurling		
Diamond knurling		
Square on shaft		
Holes on circular pitch		
Bearings		
External screw threads (Detail)		
Internal screw threads (Detail)		
Screw threads (Assembly)		

Title	Subject		Convention
Splined shafts			
Interrupted views			
Semi-elliptic leaf spring			
Semi-elliptic leaf spring with eyes			
	Subject	Convention	Diagrammatic Representation
Cylindrical compression spring			
Cylindrical tension spring			

(b)

Title	Convention	
Spur gear		
Bevel gear		
Worm wheel		
Worm		

3. CONVENTIONAL REPRESENTATION SECTIONAL VIEWS

When an object becomes more complex, as in the case of an automobile engine block, a clearer presentation of the interior can be made by sketching the object as it would look if it were cut apart. In that way, the many hidden lines on the sketch are eliminated.

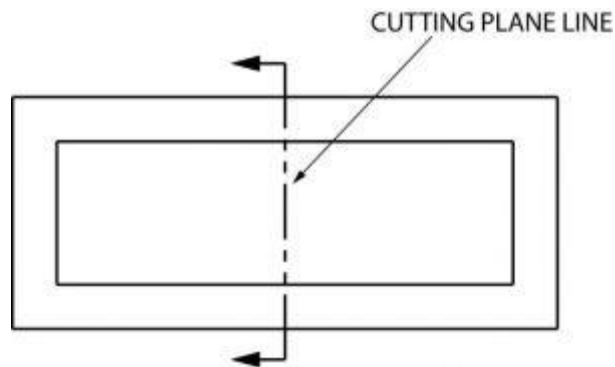
The process of sketching the internal configuration of an object by showing it cut apart is known as sectioning. Sectioning is used frequently on a wide variety of Industrial drawings. The following are the representation of sectional views.

Cutting Plane

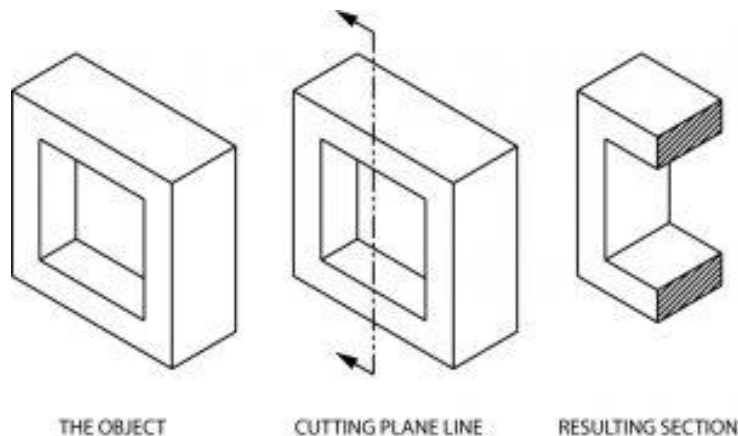
A surface cut by the saw in the drawing above is a cutting plane. Actually, it is an imaginary cutting plane taken through the object, since the object is imagined as being cut through at a desired location.

Cutting Plane Line

A cutting plane is represented on a drawing by a cutting plane line. This is a heavy long-short-short-long kind of line terminated with arrows. The arrows in show the direction of view.



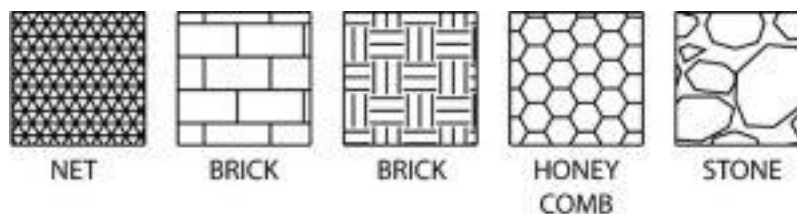
Once again, here is a graphic example of a cutting plane line and the section that develops from it.



Section Lining

The lines in the figure above, which look like saw marks, are called section lining. They are found on most sectional views, and indicate the surface which has been exposed by the cutting plane. Notice that the square hole in the object has no section lining, since it was not changed by sectioning.

Different kinds of section lining is used to identify different materials. When an object is made of a combination of materials, a variety of section lining symbols makes materials identification easier. Here are a few examples:

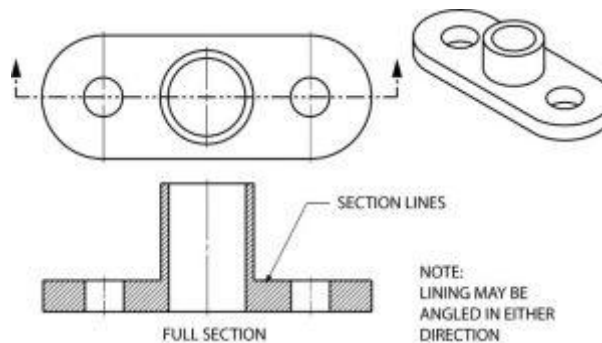


Section lines are very light. When sketching an object or part that requires a sectional view, they are drawn by eye at an angle of approximately 45 degrees, and are spaced about 1/8" apart. Since they are used to set off a section, they must be drawn with care.

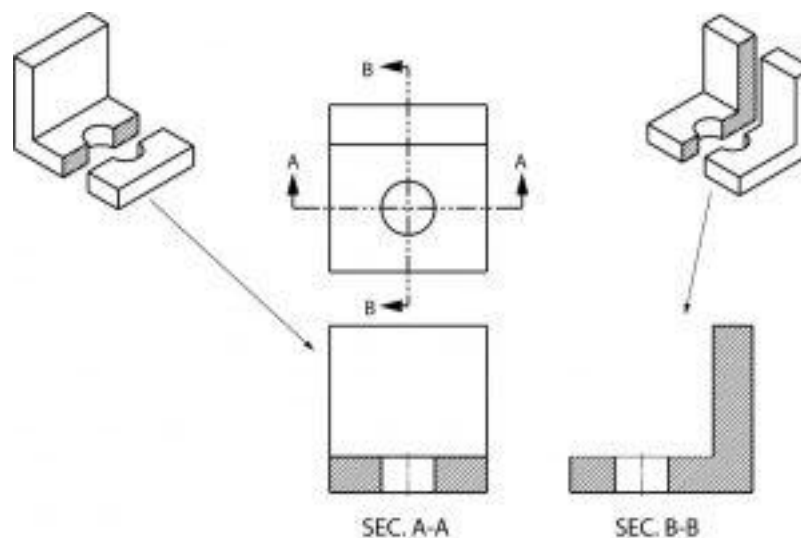
It is best to use the symbol for the material being shown as a section on a sketch. If that symbol is not known, you may use the general purpose symbol, which is also the symbol for cast iron.

Full Sections

When a cutting plane line passes entirely through an object, the resulting section is called a full section Fig. 7 illustrates a full section.



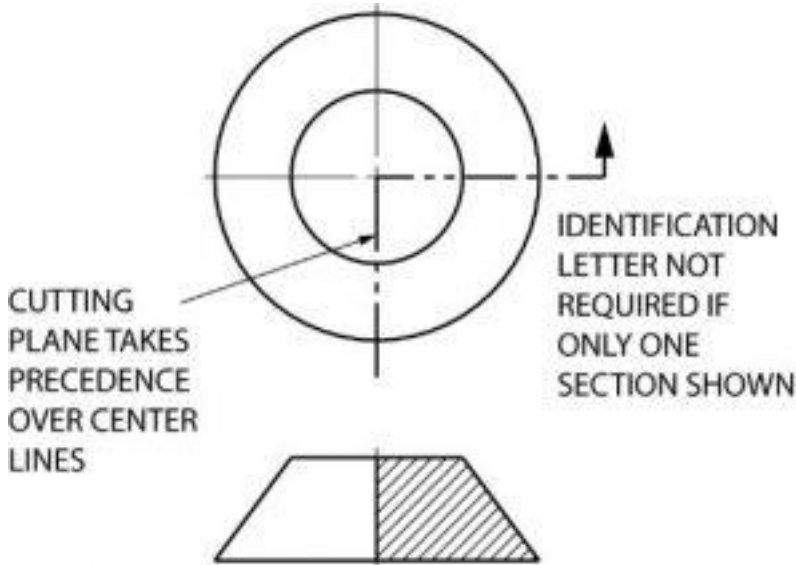
It is possible to section an object whenever a closer look intentionally is desired. Here is an object sectioned from two different directions.



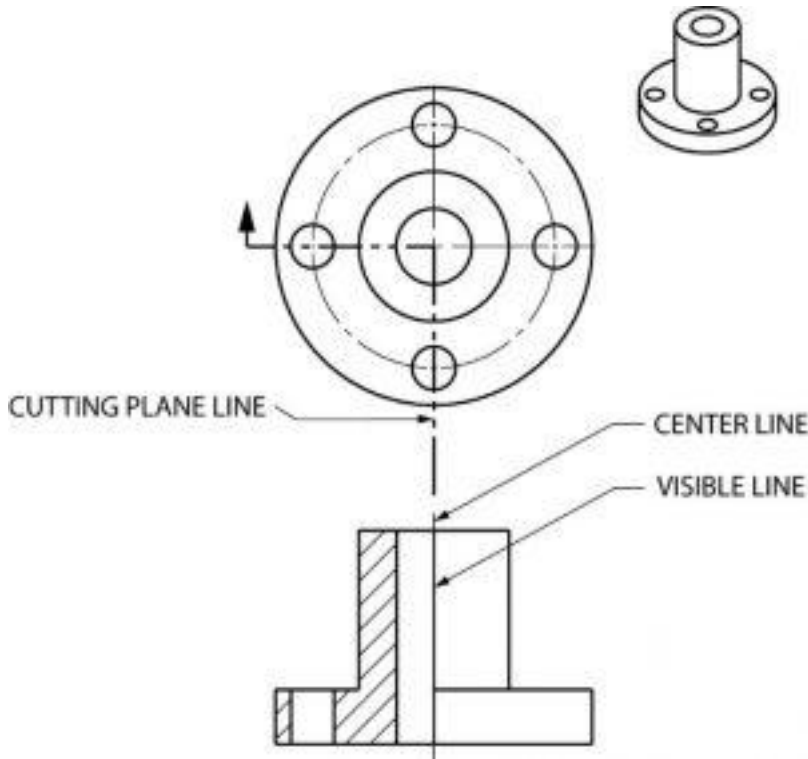
Half Sections

If the cutting plane is passed halfway through an object, and one-quarter of the object is removed, the resulting section is a half section. A half section has the advantage of showing both inside and outside configurations.

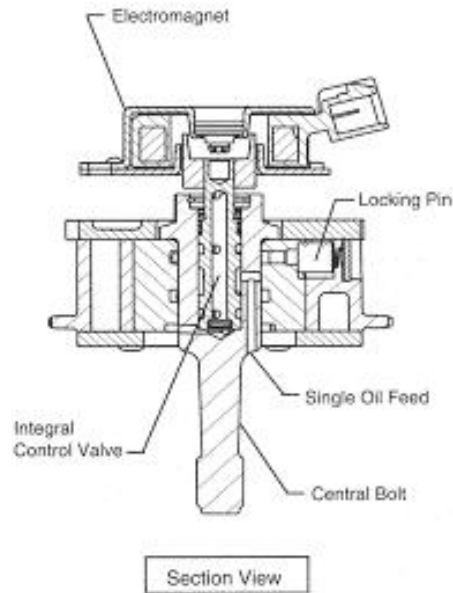
It is frequently used for symmetrical objects. Hidden lines are usually not shown on the unsectioned half unless they are needed for clearness or for dimensioning purposes. As in all sectional drawings, the cutting plane take precedence over the center line.



Here is another example of a half section. Remember that only one fourth of the object is removed with a half section, whereas half of the object is generally removed with a full section.

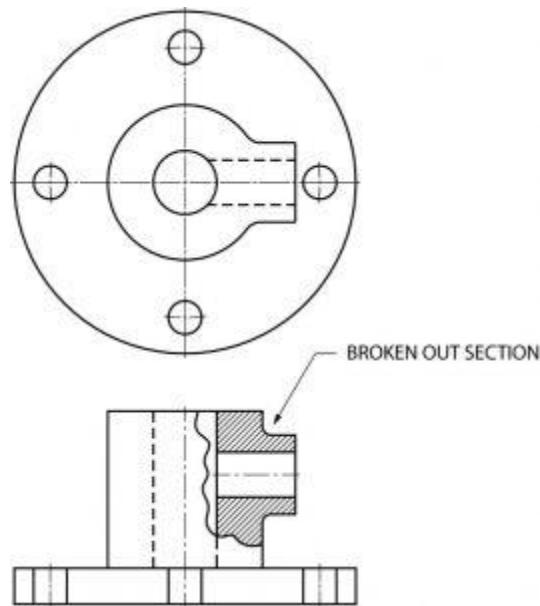


This manufacturer’s drawing, using both full and half section, illustrates the advantages of sectional views. The different line directions indicate different parts and materials used in the assembly of this valve.



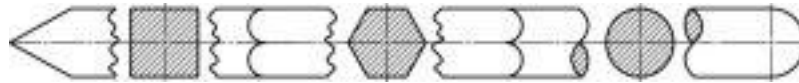
Broken Out Sections

In many cases only a small part of a view needs to be sectioned in order to show some internal detail. In the figure below, the broken out section is removed by a freehand break line. A cutting plane line does not need to be shown, since the location of the cut is obvious.



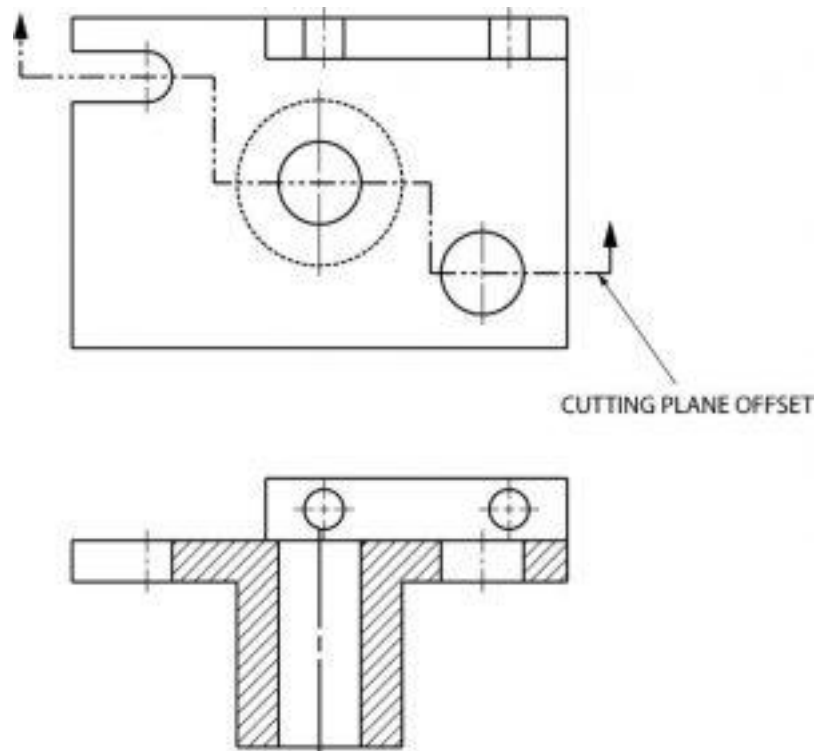
Revolved Sections

A revolved section shows the shape of an object by rotating a section 90 degrees to face the viewer. The three revolved sections illustrated in the spear-like object of figure 12 show the changes that take place in its shape.



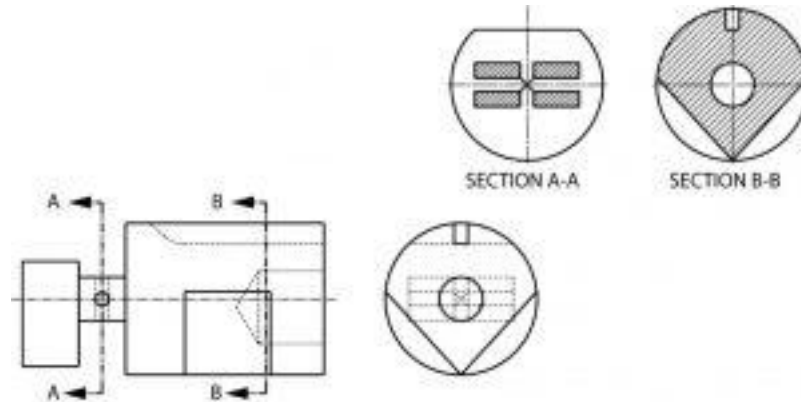
Offset Sections

An offset section is a means of including in a single section several features of an object that are not in a straight line. To do this, the cutting plane line is bent, or “OFFSET” to pass through the features of the part.



Removed Sections

A section removed from its normal projected position in the standard arrangement of views is called a “removed” section. Such sections are labeled SECTION A-A, SECTION B-B, etc., corresponding to the letter designation at the ends of the cutting plane line. Removed sections may be partial sections and are often drawn to a different scale.



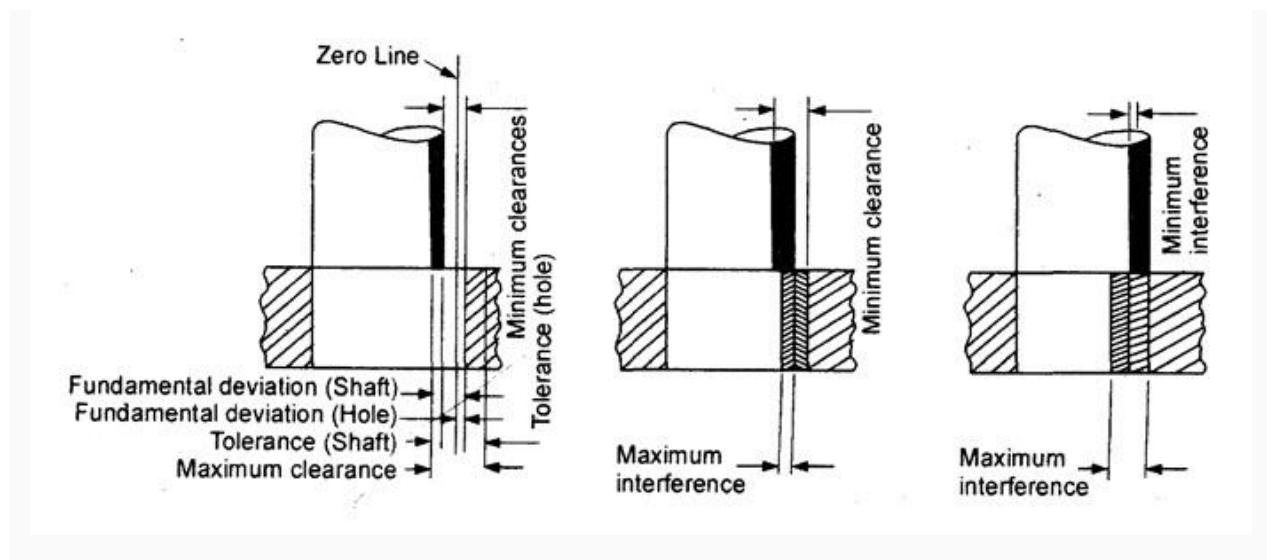
4. CONVENTIONAL REPRESENTATION OF LIMITS, FITS AND TOLERANCES-FORM AND POSITIONAL TOLERANCES AND MACHINING SYMBOLS.

Fits

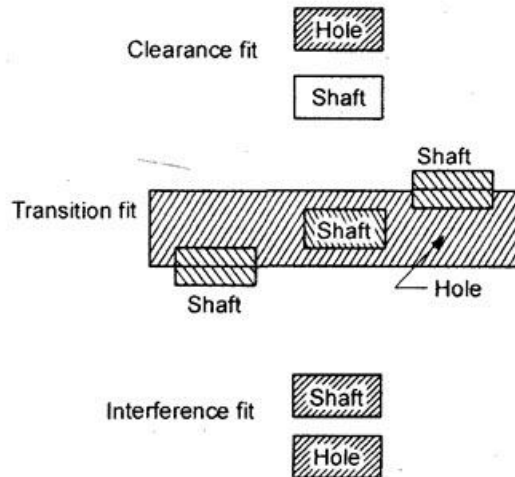
When two parts are to be assembled the relation resulting from the difference between their sizes before assembly is called a fit. The fit signifies the range of tightness or looseness which may result from the application of a specific combination of allowances and tolerances in the design of mating parts.

Types of Fits

The three types of fits are shown below. The disposition of tolerance zones for the three classes of fit are shown in next figure.



Types of fits



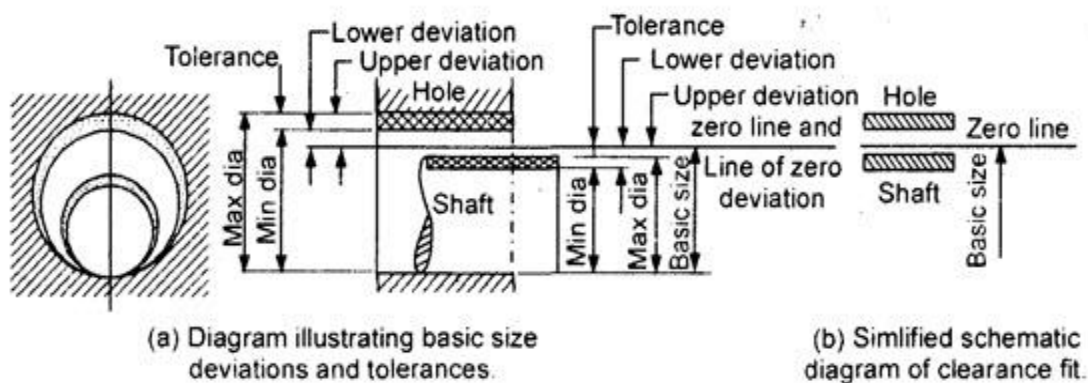
Disposition of tolerance zones for the three classes of fit

There are three general types of fit between the mating parts

1. **Clearance fit:** A clearance fit is one having limits of size so prescribed that a clearance always results when mating parts are assembled.
2. **Interference fit:** An interference fit is one having limits of size so prescribed that an interference always results when mating parts are assembled.
3. **Transition fit:** A transition fit is one having limits of size so prescribed that either a clearance or interference may always result when mating parts are assembled.

Terminology

The terminology used in fits and tolerances is shown in Fig. The important terms are



Terminology for fits and tolerances

Basic size: It is the exact theoretical size arrived at by design. It is also called nominal size.

Actual size: The size of a part as may be found by measurement.

Maximum limit of size: The greater of the two limits of size.

Minimum limit of size: The smaller of the two limits of size.

Allowance: It is an intentional difference between maximum material limits of mating parts. It is a minimum clearance or maximum interference between mating parts.

Deviation: The algebraic difference between a size (actual, maximum, etc.) and the corresponding basic size.

Actual deviation: The algebraic difference between the actual size and the corresponding basic size.

Upper deviation: The algebraic difference between the maximum limit of size and the corresponding basic size.

Upper deviation of hole = ES (& art Superior)

Upper deviation of shaft es

Lower deviation: The algebraic difference between the minimum limit of size and the corresponding basic size.

Lower deviation of hole = EI (Ecart Inferior)

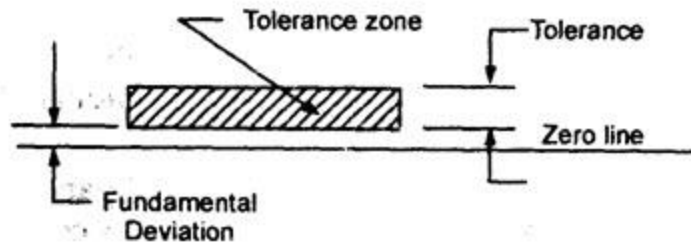
Lower deviation of shaft = ei

Upper deviation Lower deviation + Tolerance

Zero line: It is the line of zero deviation and represents the basic size.

Tolerance zone: It is the zone bounded by the two limits of size of the parts and defined by its magnitude, i.e. tolerance and by its position in relation to the zero line.

Fundamental deviation: That one of the two deviations which is conveniently chosen to define the position of the tolerance zone in relation to zero line, as shown below.



Disposition of fundamental deviation and tolerance zone with respect to the zero line

Basic shaft: A shaft whose upper deviation is zero.

Basic hole: A hole whose, lower deviation of zero.

Clearance: It is the positive difference between the hole size and the shaft size.

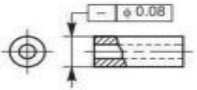
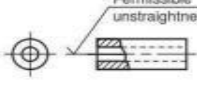
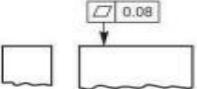
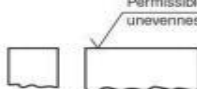
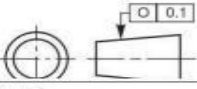

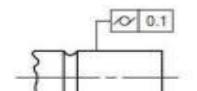
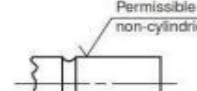
Maximum clearance: The positive difference between the maximum size of a hole and the minimum size of a shaft.

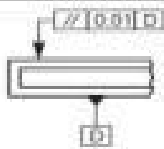

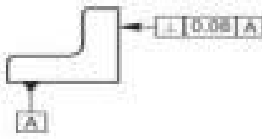
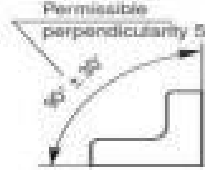
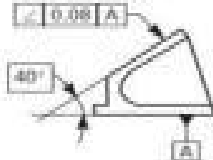

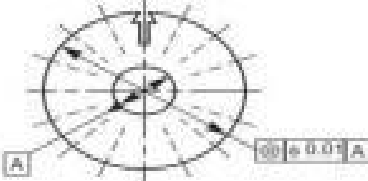
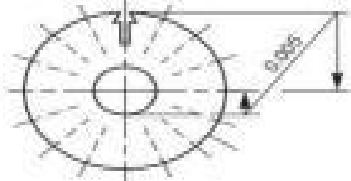


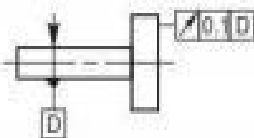

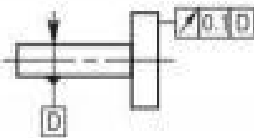
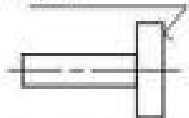
Minimum clearance: The positive difference between the minimum size of a hole and the maximum size of a shaft.

Symbols for Geometric Tolerancing

Feature	Type of Tolerance	Characteristic	Symbol
For individual features	Form	Straightness	—
		Flatness	
		Circularity (roundness)	
		Cylindricity	
For individual or related features	Profile	Profile of a line	
		Profile of a surface	
For related features	Orientation	Angularity	
		Perpendicularity	
		Parallelism	
	Location	Position	
		Concentricity	
	Runout	Circular runout	
		Total runout	

FORM AND POSITIONAL TOLERANCES

<i>As per the standard</i>	<i>As prevalent in industry</i>
<p>1. Straightness tolerance</p> 	<p>Permissible unstraightness 0.08</p> 
<p>2. Flatness tolerance</p> 	<p>Permissible unevenness 0.08</p> 
<p>3. Circularity tolerance</p> 	<p>Permissible ovality 0.2</p> 
<p>4. Cylindricity tolerance</p> 	<p>Permissible non-cylindricity 0.2</p> 

5. Parallelism tolerance	
	
6. Perpendicularity tolerance	
	
7. Angularity tolerance	
	
8. Concentricity and coaxiality tolerance	
	
9. Symmetry tolerance	
	
10. Radial run-out	
	
11. Axial run-out	
	

Systems of indication of tolerances of form and of position

5. SURFACE ROUGHNESS AND ITS INDICATIONS

Surface Roughness: The properties and performance of machine components are affected by the degree of roughness of the various surfaces. The higher the smoothness of the surface, the better is the fatigue strength and corrosion resistance. Friction between mating parts is also reduced due to better surface finish.

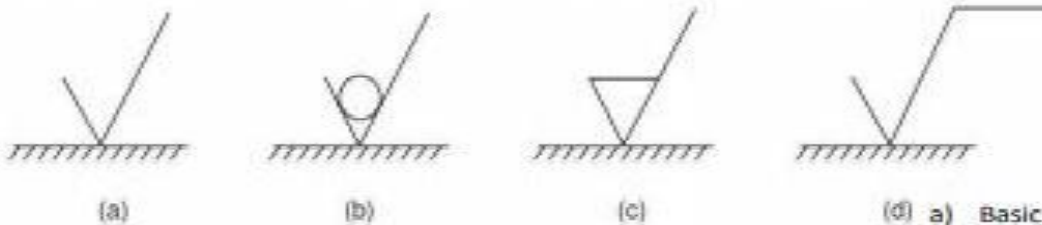
Surface Roughness Number: The surface roughness number represents the average departure of the surface from perfection over a prescribed sampling length and is expressed in microns.

$$R_a = \frac{h_1 + h_2 + h_3 + \dots + h_n}{n}$$

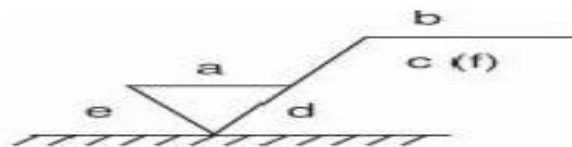
The surface roughness may be measured, using any one of the following:

1. Straight edge
2. Surface gauge
3. Optical flat
4. Tool makers Microscopes
5. Profilometer
6. Profilograph
7. Talysurf

Machine Symbols: The basic symbol consists of two legs of unequal length, inclined at approximately 60° to the line, representing the surface considered. This symbol may be used where it is necessary to indicate that the surface is machined, without indicating the grade of roughness or the process to be used.






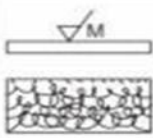

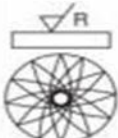
- (d) a) Basic symbol.
 b) Material Removal is Not Allowed
 c) removal Of Material is Allowed.
 d) special surface characteristics



Surface Roughness, Values, Grades and Symbols

Roughness Value Ra μm	Roughness Grade Number	Roughness Symbols
50	N 12	\cong
25	N 11	∇
12.5	N 10	
6.3	N 10	$\nabla\nabla$
3.2	N 9	
1.6	N 8	
0.8	N 6	$\nabla\nabla\nabla$
0.4	N 5	
0.2	N 4	
0.1	N 3	
0.05	N 2	$\nabla\nabla\nabla\nabla$
0.025	N 1	

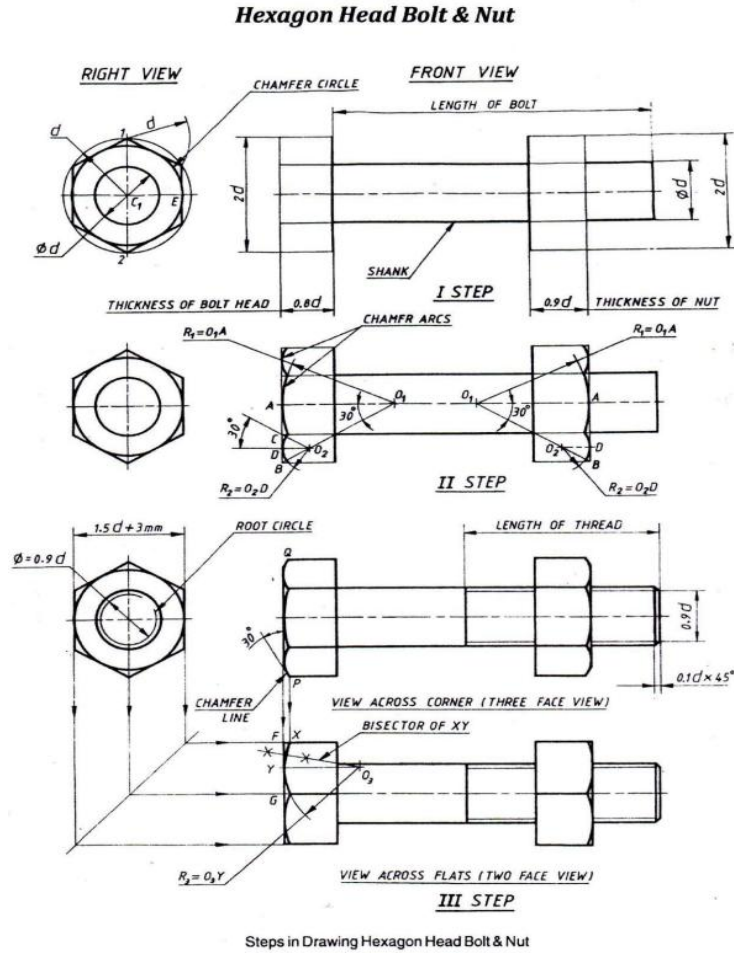
Indication of Special Roughness Characteristics: In certain circumstances, for functional reasons, it may be necessary to specify additional special requirements, concerning surface roughness. If it is required that the final surface texture be produced by one particular production method, this method should be indicated on an extension of the longer arm of the symbol. Also, any indications relating to treatment of coating may be given on the extension of longer arm of the symbol

<i>Symbol</i>	<i>Interpretation</i>	
=	Parallel to the plane of projection of the view in which the symbol is used	
⊥	Perpendicular to the plane of projection of the view in which the symbol is used	
X	Crossed in two slant directions relative to the plane of projection of the view in which the symbol is used	
M	Multi-directional	
C	Approximately circular, relative to the centre of the surface to which the symbol is applied	
R	Approximately radial, relative to the centre of the surface to which the symbol is applied	

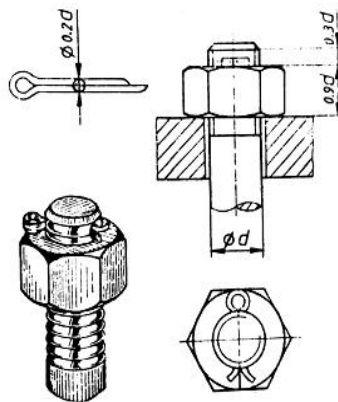
Symbols specifying the directions of lay

EXPERIMENT : 1. TEMPORARY FASTENERS : ASSEMBLY OF NUT AND BOLT

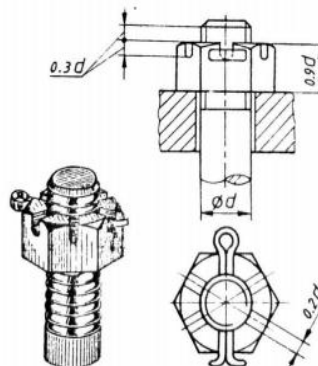
Aim : To model a bolt and nut by creating, modifying assembling and manipulating various features by feature based parametric solid modeling and detailing.



Split pin lock nut assembly



Slotted nut assembly

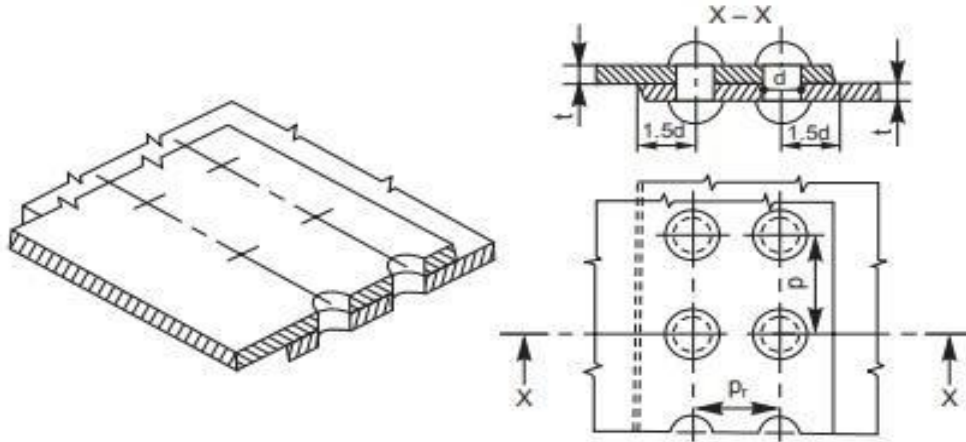


Result: The given Machine Component is modeled is modeled using SOLID WORKS software.

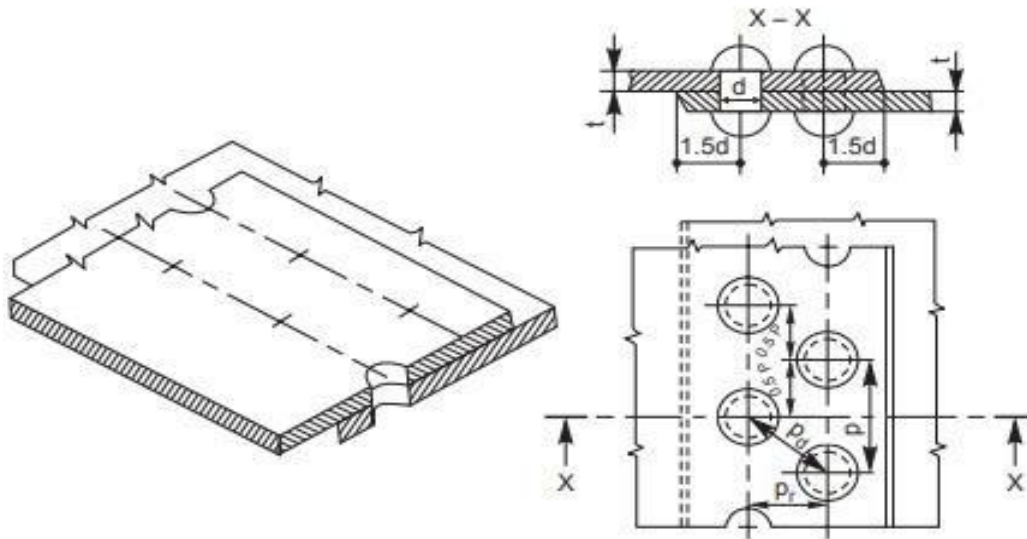
EXPERIMENT 2: PERMANENT FASTENERS : RIVETED JOINTS FOR PLATES

Aim: To create the models of the components for rived joint for plates

Description: In a lap joint, the plates to be riveted, overlap each other. The plates to be joined are first bevelled at the edges, to an angle of about 80° Depending upon the number of rows Riveted Joints of rivets used in the joint, lap joints are further classified as single riveted lap joint, double riveted lap joint and so on. where $d=6\sqrt{t}$ mm.



Double riveted chain lap joint



Double riveted zig-zag lap joint

Result: The given Machine Component is modeled is modeled using SOLID WORKS software.

EXPERIMENT 3: ASSEMBLY OF SLEEVE AND COTTER JOINT

Aim:

1. To create 3D models of Sleeve and Cotter Joint parts using Standard Software
2. To Create the Assembly of Sleeve and Cotter Joint using Standard Software
3. To understand the type of fits and tolerances used in Assembly.

Procedure:

1. The modeling concepts – Solid modeling, Surface modeling were trailed in standard Cad Software 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

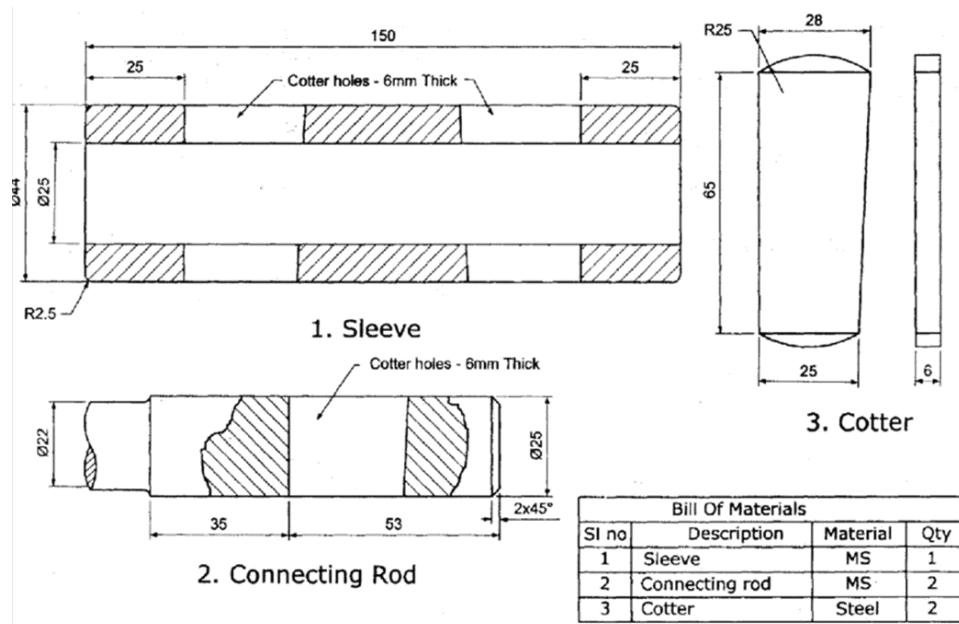
Commands used:

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 Standard Cad software.



EXPERIMENT 4: 3D MODELING - FLANGE COUPLING

Aim : To create the models of the components for the **FLANGE COUPLING** and assemble these components together, as shown below. Save this assembly model as **Flange Coupling.asm**. By using the SolidWorks software.

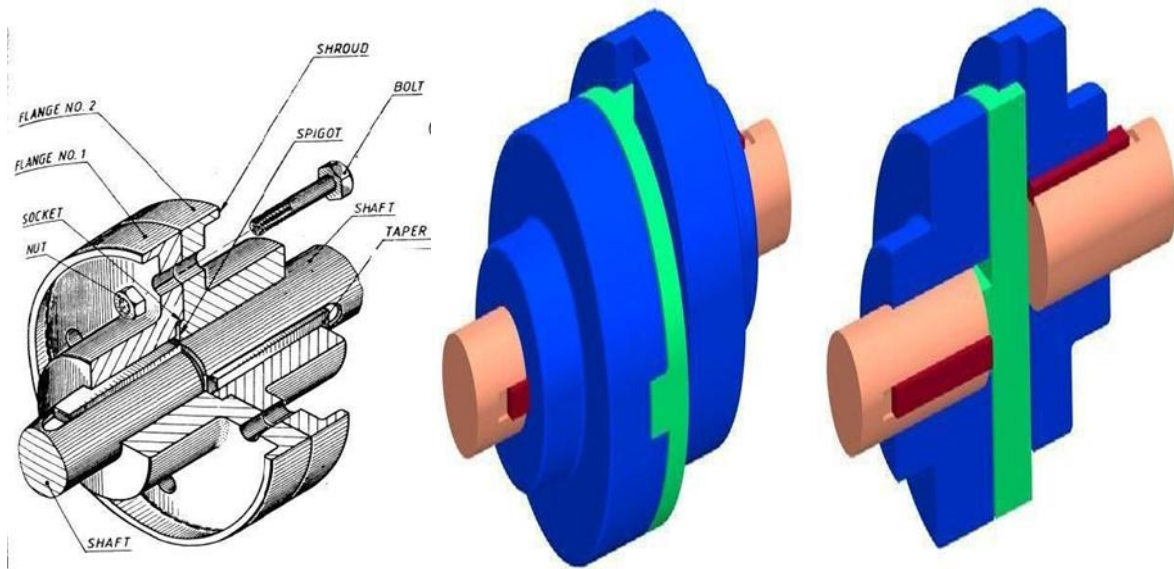
Application :

This type of coupling is a protective type flanged coupling, the bolt heads and nuts are shielded by a peripheral protrusion, called „shroud“, on each flange is shown in fig.5. Alignment of the two shafts is independent of the bolts and is ensured by the provision of a turned projection, called „spigot“, on the flat face of the one of the flanges which fits into a corresponding recess, called „socket“, in the other flange. The length of the spigot projection is kept slightly less than the depth of the socket. The socket and spigot are turned to give a push fit for accurate alignment of the two shafts. The bolt holes are drilled and reamed to give a close running for the bolts in order that the load is taken smoothly without any impact.

Description:

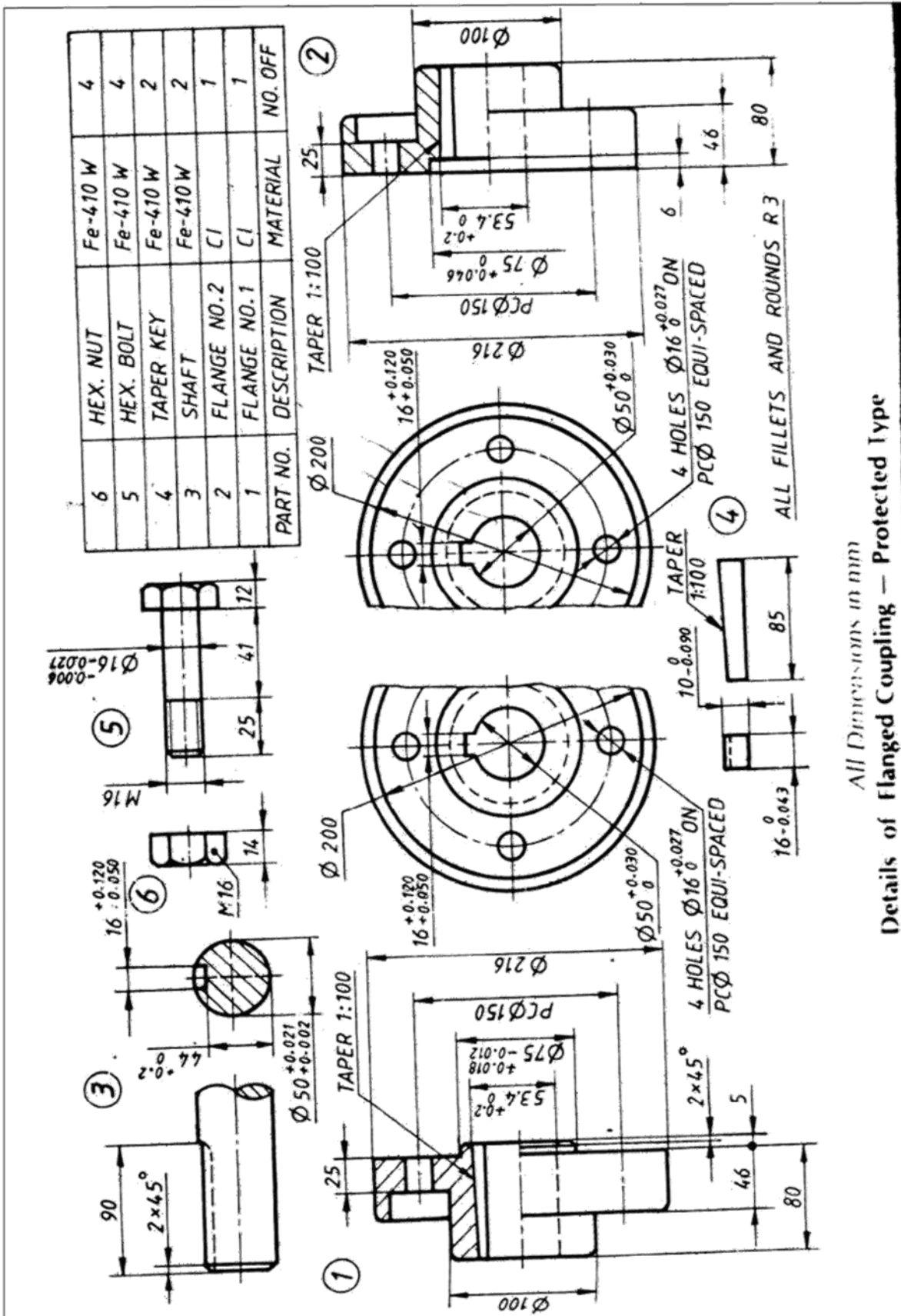
Each of the flanged bosses is securely keyed to the end of each shaft using a tapered key driven from inside. While assembling, generally the two flanges are set such that the keys fitted in them are out of alignment by 90 degrees to each other. The two flanges are bolted together by a number of bolts and nuts. Power is transmitted from one

other through bolts.



RESULT:

The given Machine Component is modeled is modeled using SOLID WORKS software.



EXPERIMENT 5: ASSEMBLY OF KNUCKLE JOINT

Aim:

1. To create 3D models of **Knuckle Joint** parts using Standard Cad Software.
2. To Create the Assembly of Knuckle Joint using Standard Cad Software.

Procedure:

1. The modeling concepts – Solid modeling, Surface modeling were trailed in Standard Cad Software 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:

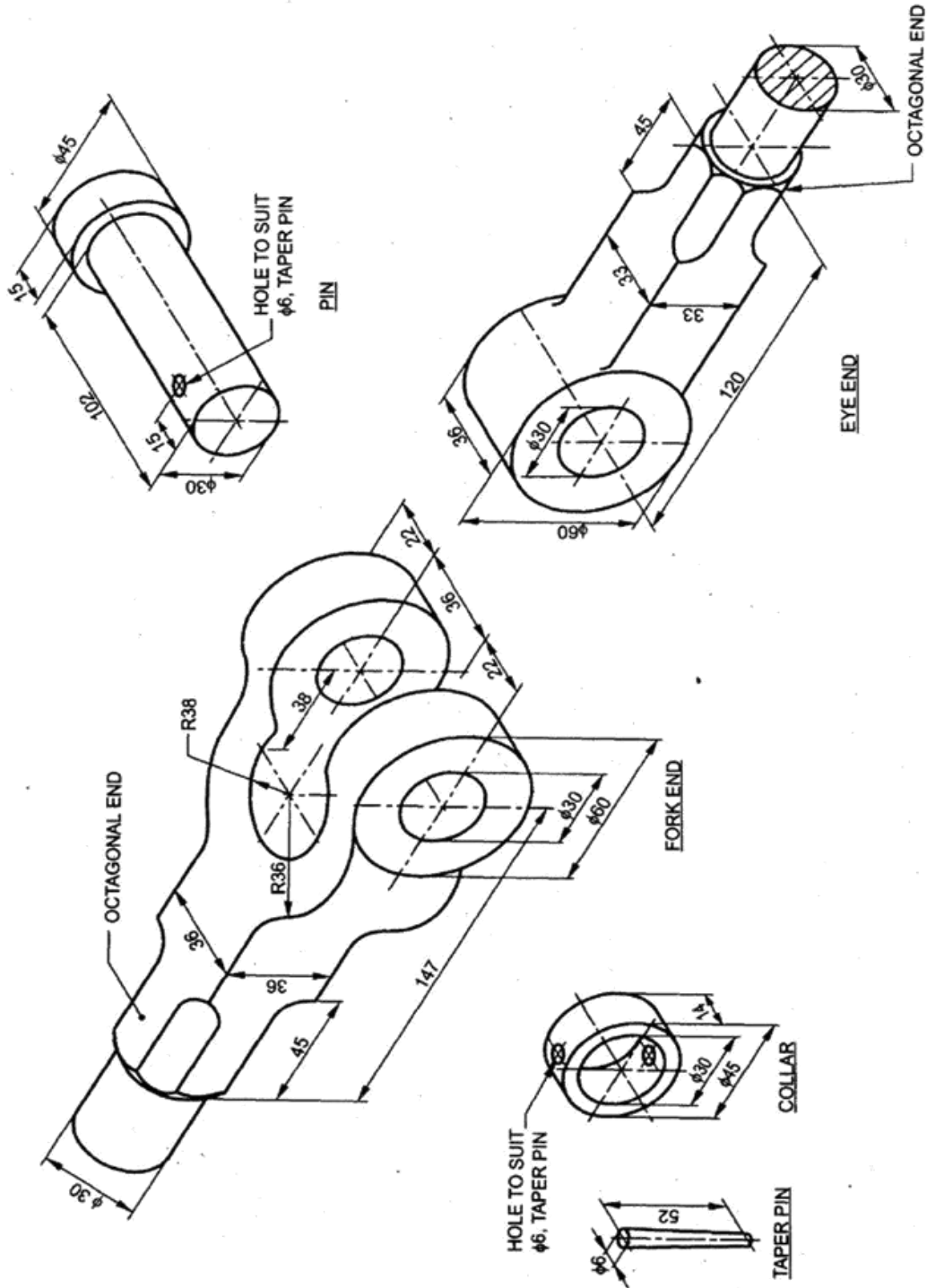
Sketcher Commands: Line, Circle, Arc, Fillet, Trim, Smart Dimension, Relations, Show, and View
Features Commands: Extrude (pad) and Cut, Revolve (shaft), Sweep, and Loft, Fillet/Round, Chamfer, and Draft, Hole - Simple and Hole Wizard, Hole Series, Scale, Shell, Rib, Dome, Freeform, Shape, Deform, Indent, 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 Standard Cad Software.



EXPERIMENT 6: ASSEMBLY OF SCREW JACK**Aim:**

1. To create 3D models of **SCREW JACK** parts using Standard Cad Software
2. To Create the Assembly of **Screw Jack** using Standard Cad Software

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 Standard Cad Software
3. The Assembly of Screw Jack was created as per the drawing specification.

Commands used:

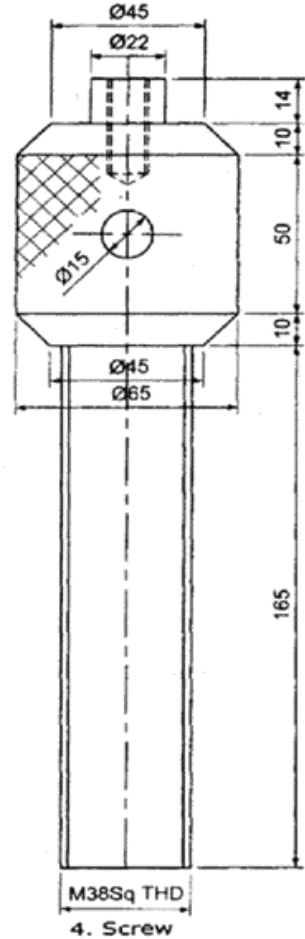
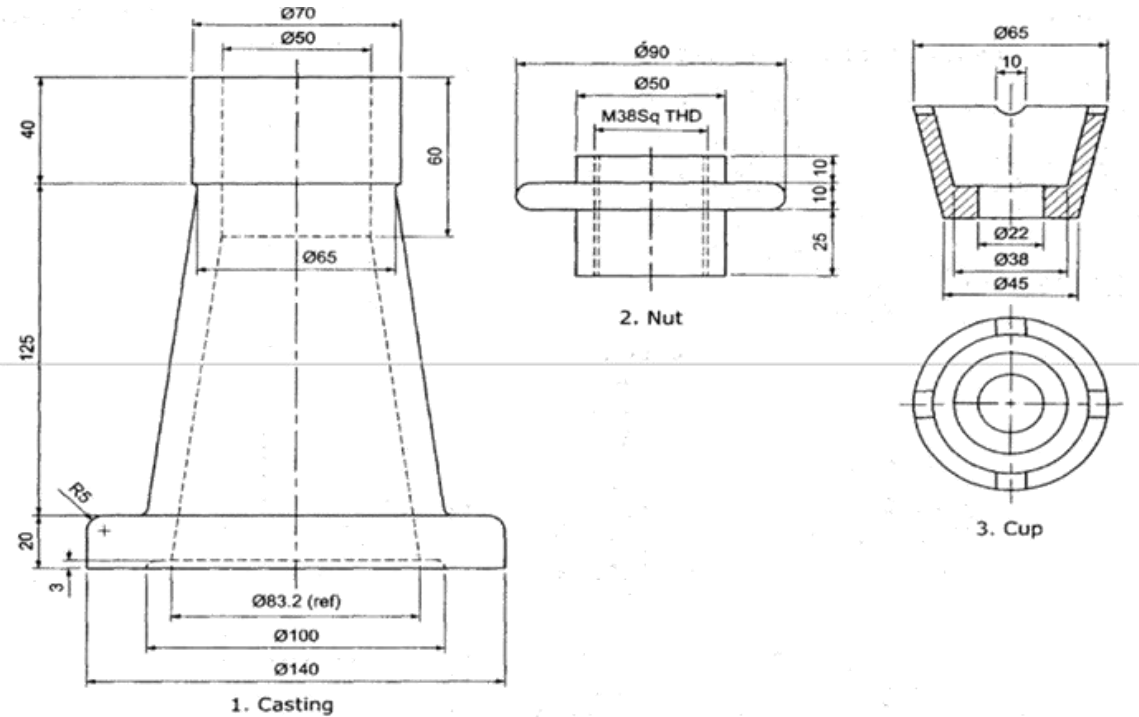
Sketcher Commands: Line, Circle, Arc, Fillet, Trim, Smart Dimension, Relations, Show, and View
Features Commands: Extrude (pad) and Cut, Revolve (shaft), Fillet/Round, Chamfer, Hole - Simple, Pattern, Fastening Features

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 Standard Cad Software.



Bill Of Materials			
Sl no	Description	Material	Qty
1	Casting	CI	1
2	Nut	MS	1
3	Cup	MS	1
4	Screw	MS	1
5	Tommy bar	MS	1
6	Set Screw	MS	1
7	Washer	MS	1

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