SRIVENKATESHWARAA

COLLEGE OF ENGINEERING AND TECHNOLOGY

(Approved by AICTE, New Delhi & Affiliated to Pondicherry University, Puducherry)

**Ariyur, Puducherry-605 102.**

DEPARTMENT OF MECHANICAL ENGINEERING


# Lecture notes

## SUBJECT / CODE: MACHINE DRAWING / MET44

**B.Tech. / MECHANICAL ENGINEERING / IV SEMESTER**<<


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AP/MECH

# MACHINE DRAWING / MET44

## Contents

# Unit –I

Conventions for sectioning and dimensioning, screw threads, rivets, bolts, nuts, pins, keys, cotter, gear, springs and welds. Component drawing assigning fits and tolerance machine symbol, surface finish geometrical tolerance.

## Engineering drawing

- Engineering drawing is the language of engineers that communicates ideas and information from one mind to another.
- Engineering drawing is a graphic language. It cannot be spoken or read aloud.
- Every language has its own rules of grammar. Engineering drawing also has been devised according to certain rules.
- Without deep and sound knowledge of engineering drawing, an engineer would be a complete failure.

## Need for correct drawings

- The drawings prepared by any technical person must be clear, unmistakable in meaning and there should not be any scope for more than one interpretation, or else litigation may arise.
- In a number of dealings with contracts, the drawing is an official document and the success or failure of a structure depends on the clarity of details provided on the drawing. Thus, the drawings should not give any scope for mis-interpretation even by accident.
- It would not have been possible to produce the machines/automobiles on a mass scale where a number of assemblies and sub-assemblies are involved, without clear, correct and accurate drawings. To achieve this, the technical person must gain a thorough knowledge of both the principles and conventional practice of draughting. If these are not achieved and or practiced, the drawings prepared by one may convey different meaning to others, causing unnecessary delays and expenses in production shops.

Hence, an engineer should possess good knowledge, not only in preparing a correct drawing but also to read the drawing correctly.

The study of machine drawing mainly involves learning to sketch machine parts and to make working and assembly drawings. This involves a study of those **conventions in drawings** that are widely adopted in engineering practice.

## Drawings convey the following critical information

- *Geometry* – the shape of the object; represented as views; how the object will look when it is viewed from various angles, such as front, top, side, etc.
- *Dimensions* – the size of the object is captured in accepted units.
- *Tolerances* – the allowable variations for each dimension.
- *Material* – represents what the item is made of.
- *Finish* – specifies the surface quality of the item, functional or cosmetic. For example, a mass marketed product usually requires a much higher surface quality than, say, a component that goes inside industrial machinery.

## Principles of engineering drawing

- Engineering drawings are to be prepared on standard size drawing sheets.
- The correct shape and size of the object can be visualized from the understanding of not only the views of it but also from the various types of lines used, dimensions, notes, scale, etc.
- To provide the correct information about the drawings to all the people concerned, the drawings must be prepared, following certain standard practices, as recommended by **Bureau of Indian Standards (BIS)**.

## Drawing sheet

Engineering drawings are prepared on drawing sheets of standard sizes. The use of standard size sheet, saves paper and facilitates convenient storage of drawings.

### Sheet sizes

The basic principles involved in arriving at the sizes of drawing sheets are:

*(a)* X: Y = 1:√2

*(b)* XY = 1

Where X and Y are the sides of the sheet. For a reference size A0 having a surface area of $1m^2$, X = 841 mm and Y = 1189 mm. The successive format sizes are obtained either by halving along the length or doubling along the width, the areas being in the ratio 1:2.

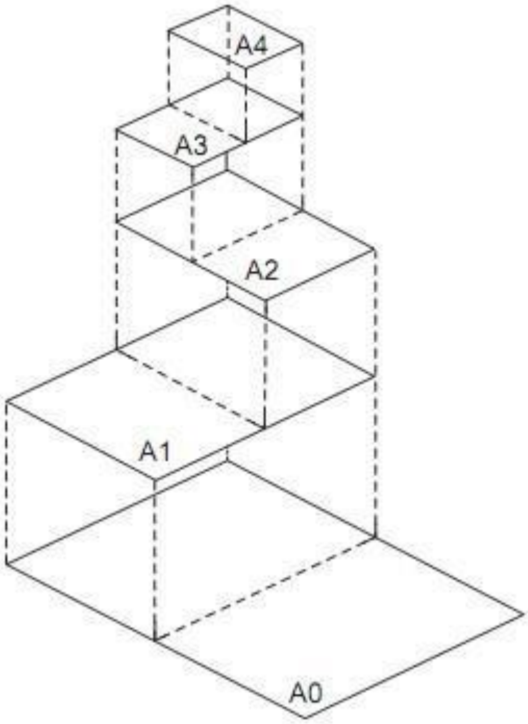



*Fig.1.1.sheet size*

The original drawing should be made on the smallest sheet, permitting the necessary clarity and resolution. The preferred sizes according to ISO-A series of the drawing sheets are given below

*Table.1.1.Designation of sizes*

| *Designation* | *Dimensions* (mm) |
|---|---|
| A0 | 841 × 1189 |
| A1 | 594 × 841 |
| A2 | 420 × 594 |
| A3 | 297 × 420 |
| A4 | 210 × 297 |

### Title box

The title block should lie within the drawing space such that, the location of it, containing the identification of the drawing, is at the bottom right hand corner. This must be followed, both for sheets positioned horizontally or vertically.

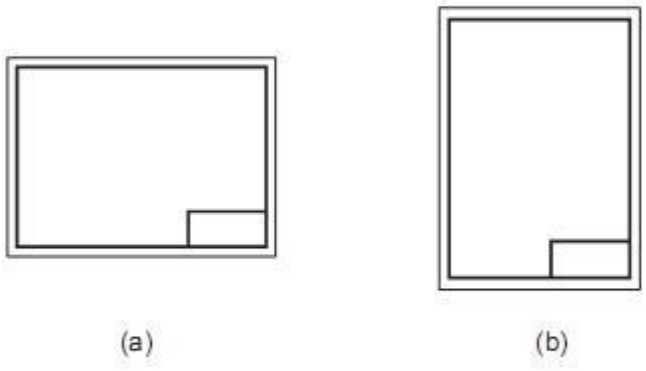



*Fig.1.2.Location of title box*

The direction of viewing of the title block should correspond in general with that of the drawing. The title block can have a maximum length of 170 mm. Figure shows a typical title block, providing the following information:

*(i)* Title of the drawing
*(ii)* Sheet number
*(iii)* Scale
*(iv)* Symbol, denoting the method of projection
*(v)* Name of the firm
*(vi)* Initials of staff drawn, checked and approved.

**NOTE** According to Bureau of Indian Standards, SP-46:1998, ‘‘Engineering Drawing Practice for Schools and Colleges’’, First angle projection is preferred.

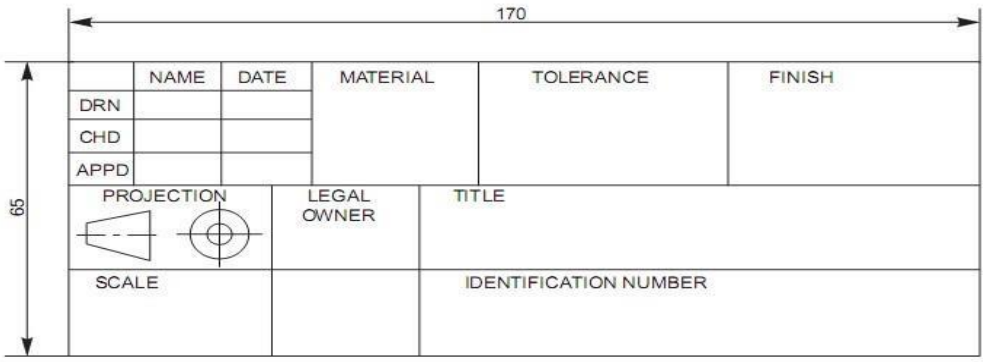



*Fig.1.3.Details in title box*

## Scales

Scale is the ratio of the linear dimension of an element of an object as represented in the drawing, to the real linear dimension of the same element of the object itself. Wherever possible, it is desirable to make full size drawings, so as to represent true shapes and sizes. If this is not practicable, the largest possible scale should be used. While drawing very small objects, such as watch components and other similar objects, it is advisable to use enlarging scales.

The complete designation of a scale should consist of the word Scale, followed by the indicationof its ratio as:

SCALE -1: 1 for **full size,** SCALE -×: 1 for **enlarged scales,** SCALE -1: ×for **reduced scales**.
The designation of the scale used on the drawing should be shown in the title block.

The recommended scales for use on technical drawings are given below. The scale andthe size of the object in turn, will decide the size of the drawing.

*Table.1.2.Recommended scales*

| *Category* | *Recommended Scales* | | |
|---|---|---|---|
| Enlarged scales | 50:1 | 20:1 | 10:1 |
| | 5:1 | 2:1 | |
| Full size | | | 1:1 |
| Reduced scales | 1:2 | 1:5 | 1:10 |
| | 1:20 | 1:50 | 1:100 |
| | 1:200 | 1:500 | 1:1000 |
| | 1:2000 | 1:5000 | 1:10000 |

## Lines

Lines of different types and thicknesses are used for graphical representation of objects. The types of lines and their applications are shown below

*Table.1.3.Types of lines and their applications*

| *Line* | *Description* | *General Applications* |
|---|---|---|
| A | Continuous thick | A1 Visible outlines |
| B | Continuous thin (straight or curved) | B1 Imaginary lines of intersection<br>B2 Dimension lines<br>B3 Projection lines<br>B4 Leader lines<br>B5 Hatching lines<br>B6 Outlines of revolved sections in place<br>B7 Short centre lines |
| C | Continuous thin, free-hand | C1 Limits of partial or interrupted views and sections, if the limit is not a chain thin |
| D | Continuous thin (straight) with zigzags | D1 Line (see Fig. 2.5) |
| E | Dashed thick | E1 Hidden outlines |
| G | Chain thin | G1 Centre lines<br>G2 Lines of symmetry<br>G3 Trajectories |
| H | Chain thin, thick at ends and changes of direction | H1 Cutting planes |
| J | Chain thick | J1 Indication of lines or surfaces to which a special requirement applies |
| K | Chain thin, double-dashed | K1 Outlines of adjacent parts<br>K2 Alternative and extreme positions of movable parts<br>K3 Centroidal lines |

## Coinciding lines

The invisible line technique and axis representation should be followed as per there commendations given in Table

*Table.1.4.Invisible lines*

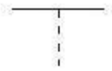
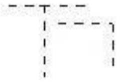
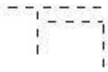
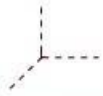
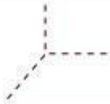
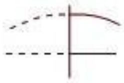
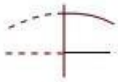
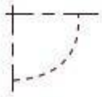
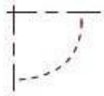
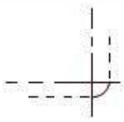
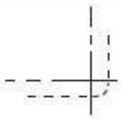
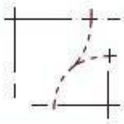
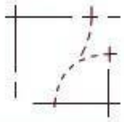
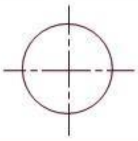
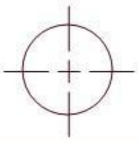
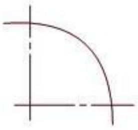
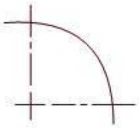
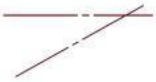
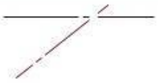
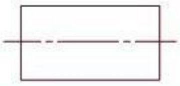
| *Instructions* | *Correct* | *Incorrect* |
|---|---|---|
| Begin with a dash, not with a space |  |  |
| Dashes intersect without a gap between them |  |  |
| Three dashes meet at the intersection point |  |  |
| As a continuation of a visible line/arc, begin with space |  |  |
| Invisible arcs begin with a dash |  |  |
| Small arcs may be made solid |  |  |
| Two arcs meet at the point of tangency |  |  |

*Table.1.5.Axis lines*

| *Instructions* | *Correct* | *Incorrect* |
|---|---|---|
| Axis line starts and ends with a longer dash |  |  |
| Two axes intersect with longer dashes |  |  |
| |  |  |
| |  |  |
| Axis extends the boundary with a longer dash |  |  |

**Dimensioning**

The art of writing the various sizes or measurements on the finished drawing of an object is known as dimensioning.

### General principles of dimensioning

1. As far as possible, dimensions should be placed outside the view.
2. Dimensions should be taken from visible outlines rather than from hidden lines.
3. Dimensioning to a centre line should be avoided except when the centre line passes through the centre of a hole.
4. Each feature should be dimensioned once only on a drawing.
5. Dimensions should be placed on the view or section that relates most clearly to the corresponding features.
6. Each drawing should use the same unit for all dimensions, but without showing the unit symbol.
7. No more dimensions than are necessary to define a part should be shown on a drawing.
8. No features of a part should be defined by more than one dimension in any one direction.

### Drawing termination and origin indication

Dimension lines should show distinct termination, in the form of arrow heads or oblique strokes or where applicable, an origin indication.

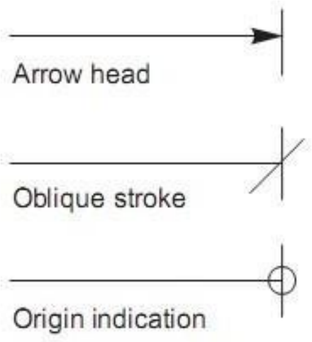



*Fig.1.4.Termination and origin indication*

1. The arrow head is drawn as short lines, having an included angle of 15°, which is closed and filledin.
2. The oblique stroke is drawn as a short line, inclined at 45°.
3. The origin indication is drawn as a small open circle of approximately 3 mm in diameter.

The size of the terminations should be proportionate to the size of the drawing on which they are used. Where space is limited, arrow head termination may be shown outside the intended limits of the dimension line that is extended for that purpose. In certain other cases, an oblique stroke or a dot may be substituted.

Where a radius is dimensioned, only one arrow head termination, with its point on the arc end of the dimension line, should be used. However, the arrow head termination may be either on the inside or outside of the feature outline, depending upon the size of feature.

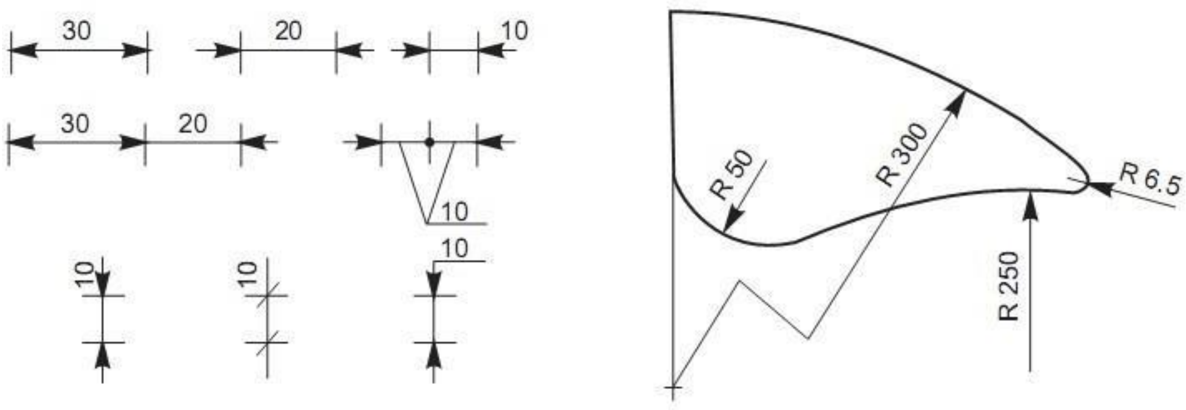



*Fig.1.5.: Termination and origin indication*

### Method of indicating dimensions

Dimensions should be indicated on a drawing, according to one of the following two methods. However, only one method should be used on any one drawing.

1. Aligned system
2. Uni-directional system

### Aligned system

*(i)* Dimensions should be placed parallel to their dimension lines and preferably near the middle, above and clear-off the dimension line. An exception may be made where superimposed running dimensions are used.

*(ii)* Dimensions may be written so that they can be read from the bottom or from the right side of the drawing.

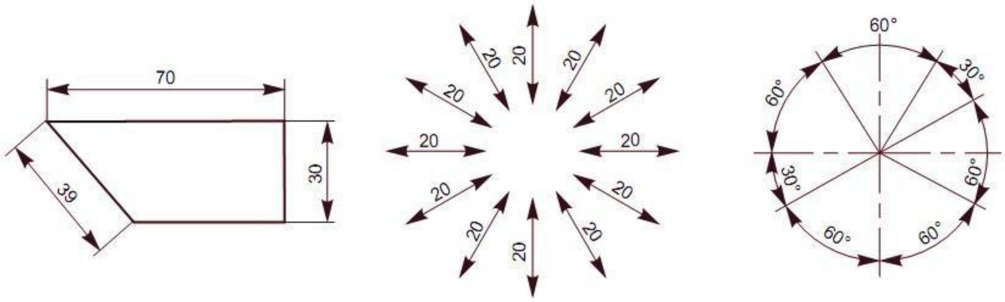



*Fig.1.6.: Aligned system*

### Uni-directional system

Dimensions should be indicated so that they can be read from the bottom of the drawing only. Nonhorizontal dimension lines are interrupted, preferably near the middle, for insertion of the dimension.

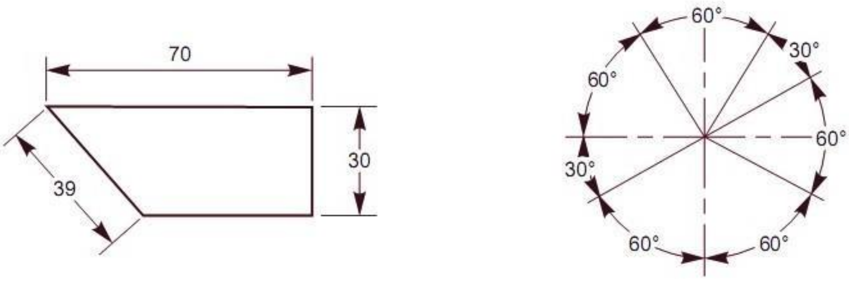



*Fig.1.7.Uni-directional system*

The following indications (symbols) are used with dimensions to reveal the shape identification and to improve drawing interpretation. The symbol should precede the dimensions.

Φ: Diameter S Φ: Spherical diameter R: Radius SR: Spherical radius □: Square

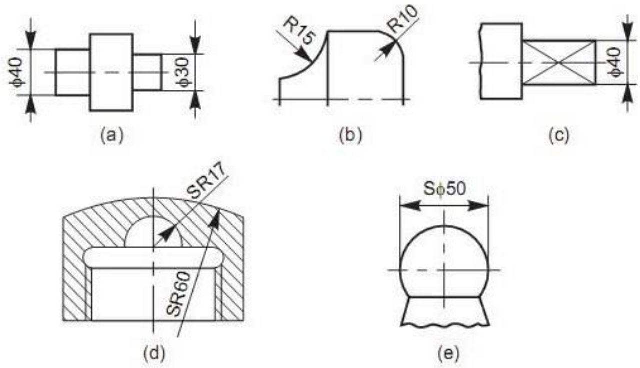



*Fig.1.8.Shape identification symbols*

### Arrangements of dimensions

The arrangement of dimensions on a drawing must indicate clearly the design purpose. The following are the ways of arranging the dimensions.

### Chain dimensions

Chains of single dimensions should be used only where the possible accumulation of tolerances does not endanger the functional requirement of the part.

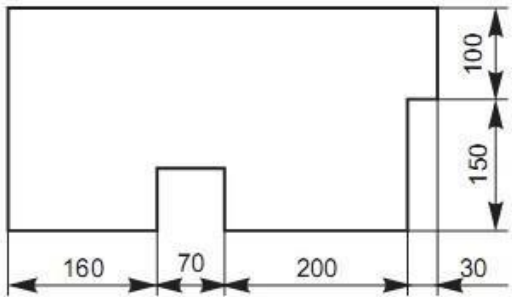



*Fig.1.9.Chain dimensions*

### Parallel dimensions

In parallel dimensioning, a number of dimension lines,parallel to one another and spaced-out are used. This method is used where a number of dimensions have a common datum feature.

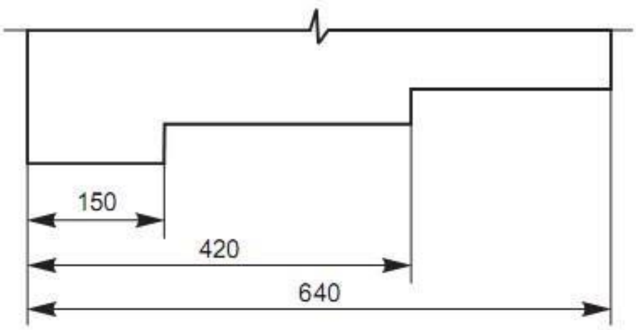



*Fig.1.10.: Parallel dimensions*

### Special indications

Diameters should be dimensioned on the most appropriate view to ensure clarity. The dimension value should be preceded by Φ.

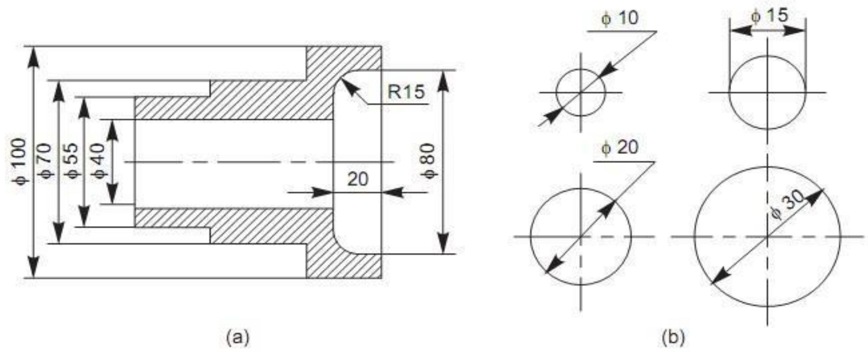



*Fig.1.11.Dimensioning of diameter*

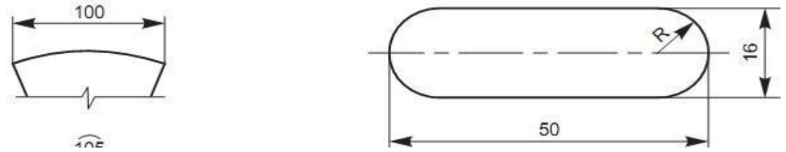



*Fig.1.12.: Dimensioning of radius*

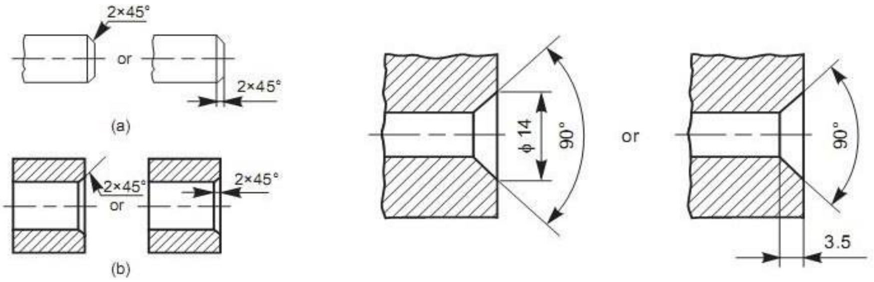



*Fig.1.13.: Dimensioning chamfers and countersunk*

**Sectional views**

In order to show the inner details of a machine component, the object is imagined to be cut by a cutting plane and the section is viewed after the removal of cut portion. Sections are made by at cutting planes and are designated by capital letters and the direction of viewing is indicated by arrow marks.

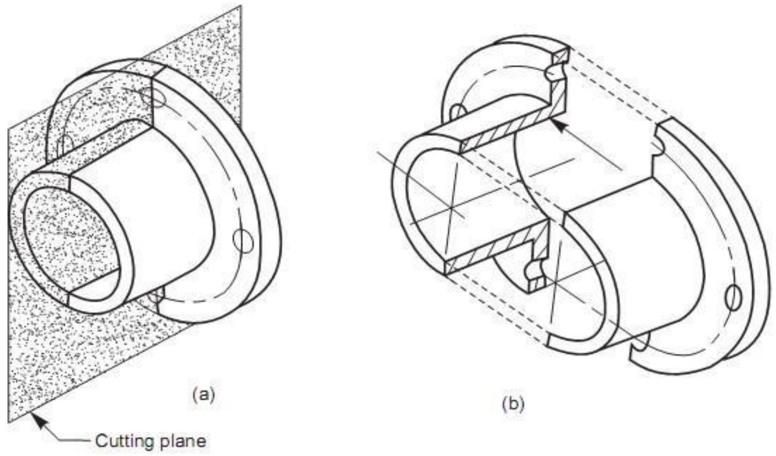


*Fig.1.14.Principles of sectioning*

### Hatching sections

- Hatching is generally used to show areas of cut sections.
- The simplest form of hatching is generally adequate for the purpose, and may be continuous thin lines (type B) at a convenient angle, preferably 45°, to the principal outlines or lines of symmetry of the sections.

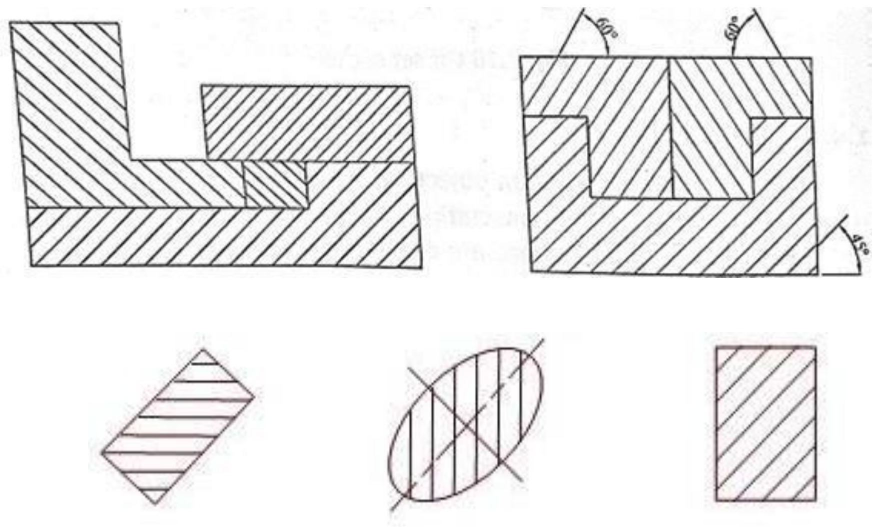



*Fig.1.15.Preferred hatching angle*

- Separate areas of a section of the same component shall be hatched in an identical manner.
- The hatching of adjacent components shall be carried out with different directions or spacing.
- In case of large areas, the hatching may be limited to a zone, following the contour of the hatched area.
- Where sections of the same part in parallel planes are shown side by side, the hatching shall be identical, but may be off-set along the dividing line between the sections.
- Hatching should be interrupted when it is not possible to place inscriptions outside the hatched area.

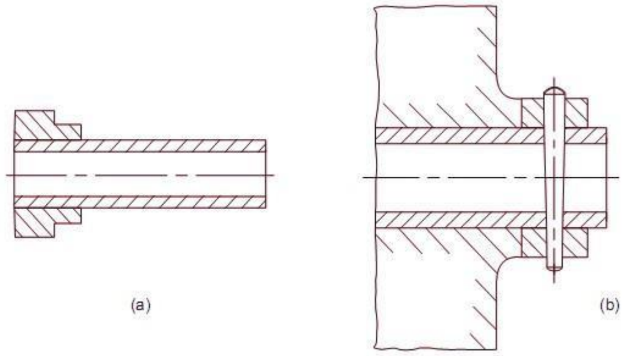



*Fig.1.16.Hatching of adjacent components*

### Full section

- A sectional view obtained by assuming that the object is completely cut by a plane is called a full section or sectional view.
- The sectioned view provides all the inner details, better than the un-sectioned view with dotted lines for inner details.
- The cutting plane is represented by its trace (V.T) in the view from the front and the direction of sight to obtain the sectional view is represented by the arrows.

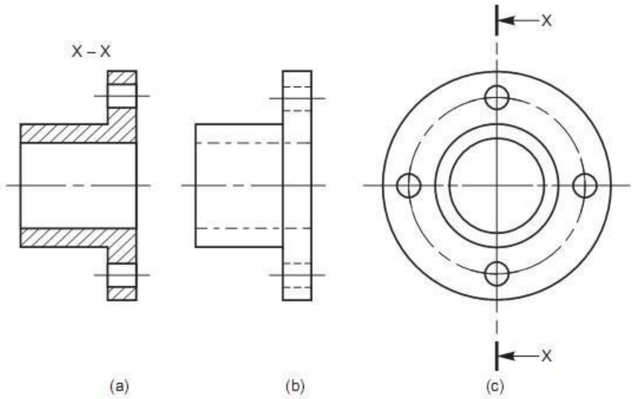



*Fig.1.17.Section and un-sectioned views*

Figure below represents the correct and incorrect ways of representing a sectional view. Sections are used primarily to replace hidden line representation, hence, as a rule, hidden lines are omitted in the sectional views.

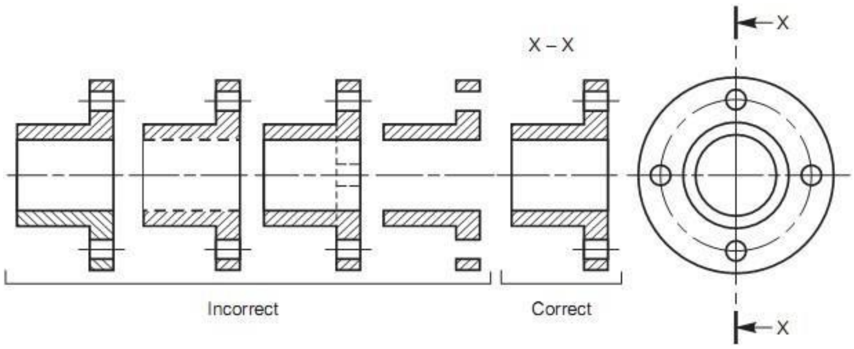



*Fig.1.18.Incorrect and correct sections*

### Half sections

- A half sectional view is preferred for symmetrical objects. For a half section, the cutting plane removes only one quarter of an object. For a symmetrical object, a half sectional view is used to indicate both interior and exterior details in the same view. Even in half sectional views, it is a good practice to omit the hidden lines.
- The half sectional view from the front. It may be noted that a center line is used to separate the halves of the half section. Students are also advised to note the representation of the cutting plane in the view from above, for obtaining the half sectional view from the front.

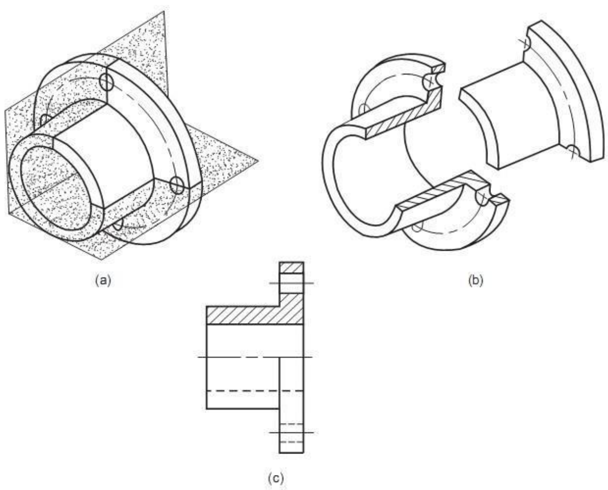


*Fig.1.19.Method of obtaining half sectional view*

**Conventions in engineering drawing**

- The conventions of materials save time and labour of the drawing work.
- Long members of uniform cross sections such as rods, shafts, pipes, etc. are generally shown in the middle by the conventional breaks so as to accommodate their view of whole length on the drawing sheet without reducing the scale.
- Conventional representation is adopted in case where complete description of the machine component would involve unnecessary time or space on the drawing.

The conventional representation of common features given by I.S.I as below

*Table.1.6.Convention for various materials*

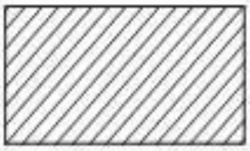
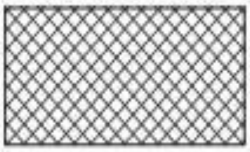
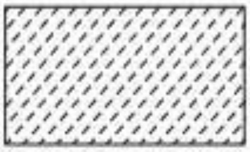
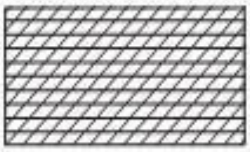
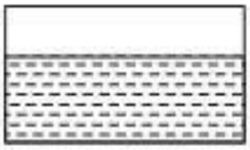
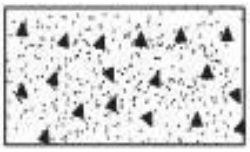
| Type | Convention | Material |
| --- | --- | --- |
| Metals |  | Steel, Cast Iron, Copper and its Alloys, Aluminium and its Alloys, etc. |
| |  | Lead, Zinc, Tin, White-metal, etc. |
| Glass |  | Glass |
| Packing and Insulating material |  | Porcelain, Stoneware, Marble, Slate, etc. |
| |  | Asbestos, Fibre, Felt, Synthetic resin products, Paper, Cork, Linoleum, Rubber, Leather, Wax, Insulating and Filling materials, etc. |
| Liquids |  | Water, Oil, Petrol, Kerosene, etc. |
| Wood |  | Wood, Plywood, etc. |
| Concrete |  | A mixture of Cement, Sand and Gravel |

*Table.1.7.Conventional breaks*

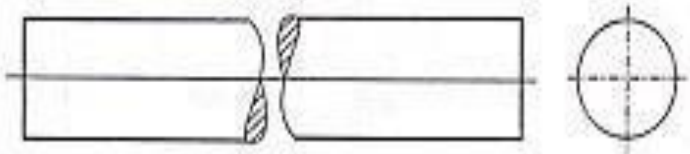
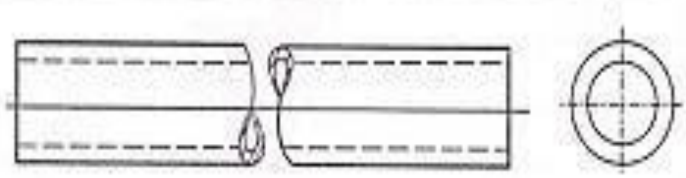
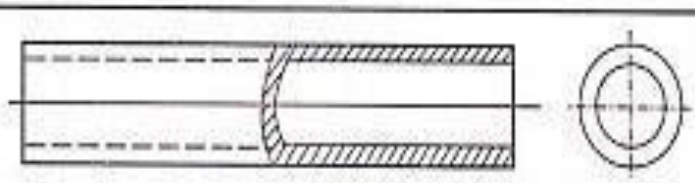
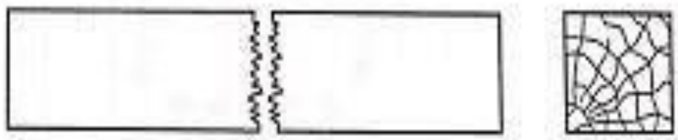
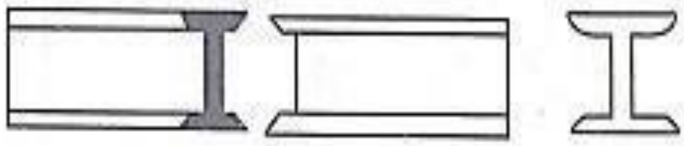
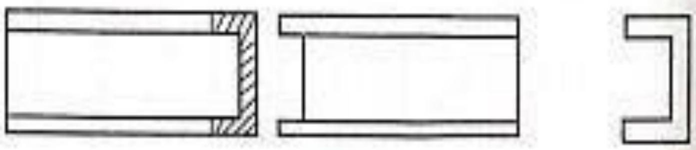
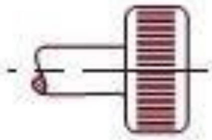
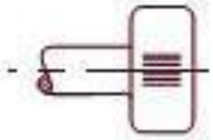
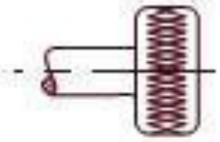
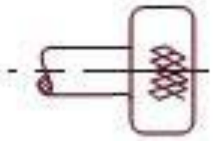
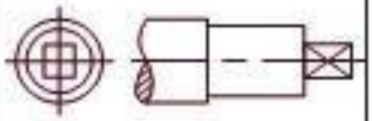
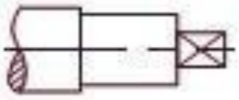
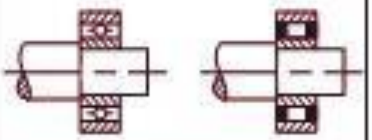
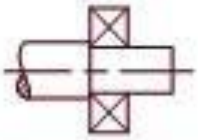
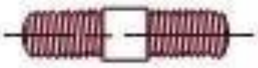
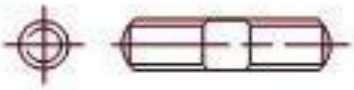
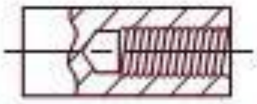
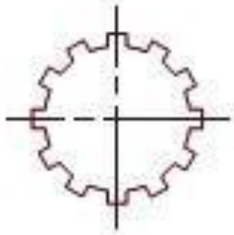
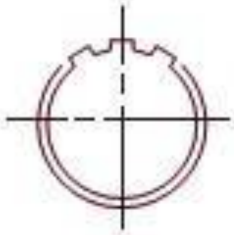
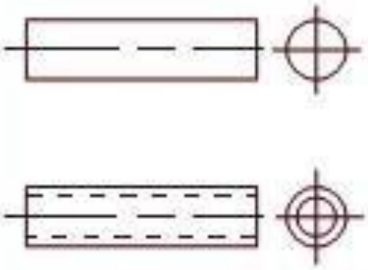
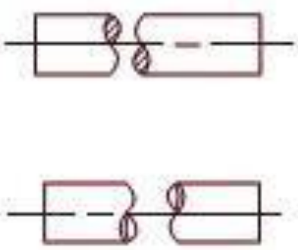
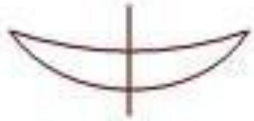
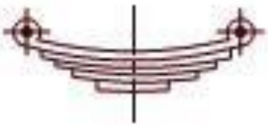
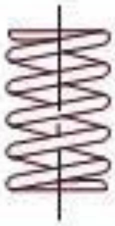
| S. NO. | OBJECT | CONVENTION |
|---|---|---|
| 1. | RECTANGULAR SECTION |  |
| 2. | ROUND SECTION |  |
| 3. | PIPE OR TUBING |  |
| 4. | PIPE OR TUBING |  |
| 5. | WOOD RECTANGULAR SECTION |  |
| 6. | ROLLED SECTION |  |
| 7. | CHANNEL SECTION |  |

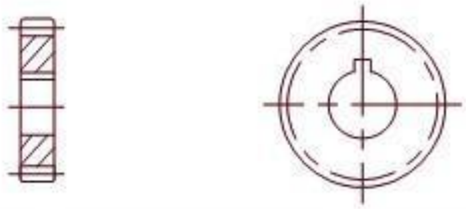
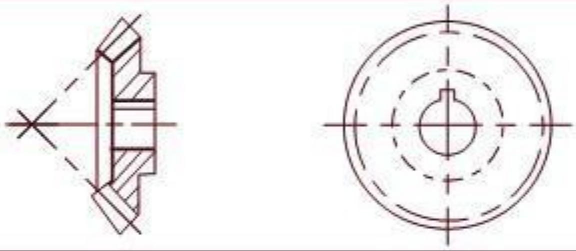
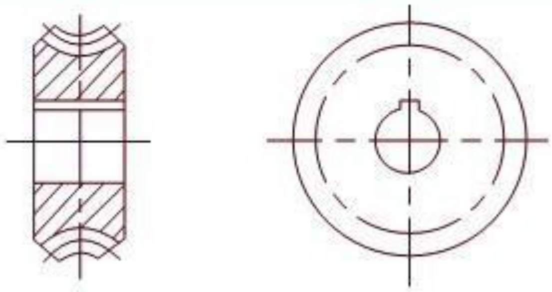
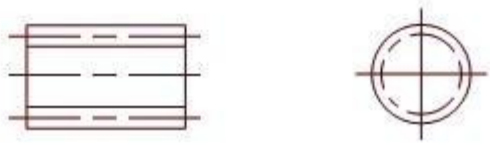
*Table.1.8.Conventional representation of common features*

| 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 |  |

## SCREWED FASTENERS

- A machine element used for holding or joining two or more parts of a machine or structure is known as a fastener. The process of joining the parts is called fastening.
- The fasteners are of two types: permanent and removable (temporary). Riveting and welding processes are used for fastening permanently. Screwed fasteners such as bolts, studs and nuts in combination, machine screws, set screws, etc., and keys, cotters, couplings, etc., are used for fastening components that require frequent assembly and disassembly.

Screwed fasteners occupy the most prominent place among the removable fasteners. In general, screwed fasteners are used:

***(i)*** To hold parts together,

***(ii)*** To adjust parts with reference to each other and ***(iii)***To transmit power.

## Screw thread nomenclature

A screw thread is obtained by cutting a continuous helical groove on a cylindrical surface (external thread). The threaded portion engages with a corresponding threaded hole (internal thread); forming a screwed fastener.

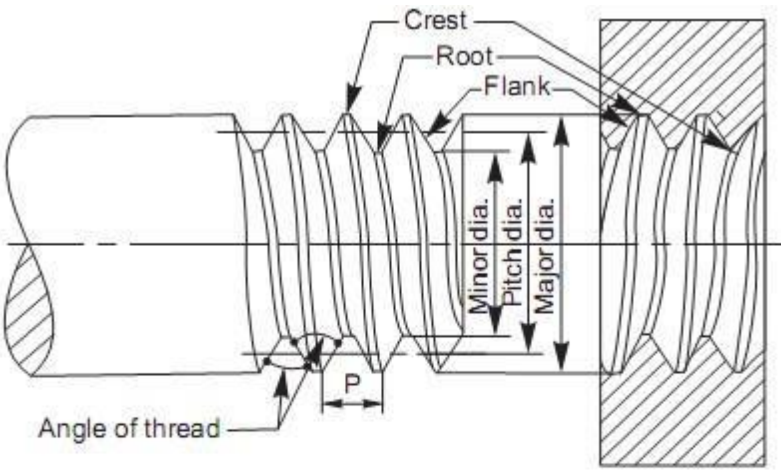



*Fig.1.20.Screw thread nomenclature*

**1. Major (nominal) diameter**

This is the largest diameter of a screw thread, touching the crests on an external thread or the roots of an internal thread.

**2. Minor (core) diameter**

This is the smallest diameter of a screw thread, touching the roots or core of an external thread (root or core diameter) or the crests of an internal thread.

**3. Pitch diameter**

This is the diameter of an imaginary cylinder, passing through the threads at the points where the thread width is equal to the space between the threads.

**4. Pitch**

It is the distance measured parallel to the axis, between corresponding points on adjacent screw threads.

**5. Lead**

It is the distance a screw advances axially in one turn.

**6. Flank**

Flank is the straight portion of the surface, on either side of the screw thread.

**7. Crest**

It is the peak edge of a screw thread that connects the adjacent flanks at the top.

**8. Root**

It is the bottom edge of the thread that connects the adjacent flanks at the bottom.

**9. Thread angle**

This is the angle included between the flanks of the thread, measured in an axial plane.

Bureau of Indian Standards (BIS) adapts ISO (International Organization for Standards) metric threads which are adapted by a number of countries apart from India.

It may be noted from the figure that in order to avoid sharp corners, the basic profile is rounded at the root (minor diameter) of the design profile of an external thread. Similarly, in the case of internal thread, rounding is done at the root (major diameter) of the design profile.

### Other thread profiles

Apart from ISO metric screw thread profile, there are other profiles in use to meet various applications.

**V-threads**

This thread profile has a larger contact area, providing more frictional resistance to motion. Hence, it is used where effective positioning is required. It is also used in brass pipe work.

**British standard whit-worth (B.S.W) threads**

This thread form is adopted in Britain in inch units. The profile has rounded ends, making it less liable to damage than sharp V-thread.

**Buttress threads**

This thread is a combination of V-and square threads. It exhibits the advantages of square thread, like the ability to transmit power and low frictional resistance, with the strength of the V-thread. It is used where power transmission takes place in one direction only such as screw press, quick acting carpenters vice, etc.

**Square threads**

Square thread is an ideal thread form for power transmission. In this, as the thread flank is atright angle to the axis, the normal force between the threads, acts parallel to the axis, with zero radial component. This enables the nut to transmit very high pressures, as in the case of a screw jack and other similar applications.

**ACME threads**

It is a modified form of square thread. It is much stronger than square thread because of the wider base and it is easy to cut. The inclined sides of the thread facilitate quick and easy engagement and disengagement as for example, the split nut with the lead screw of a lathe.

**Worm threads**

Worm thread is similar to the ACME thread, but is deeper. It is used on shafts to carry power toworm wheels.

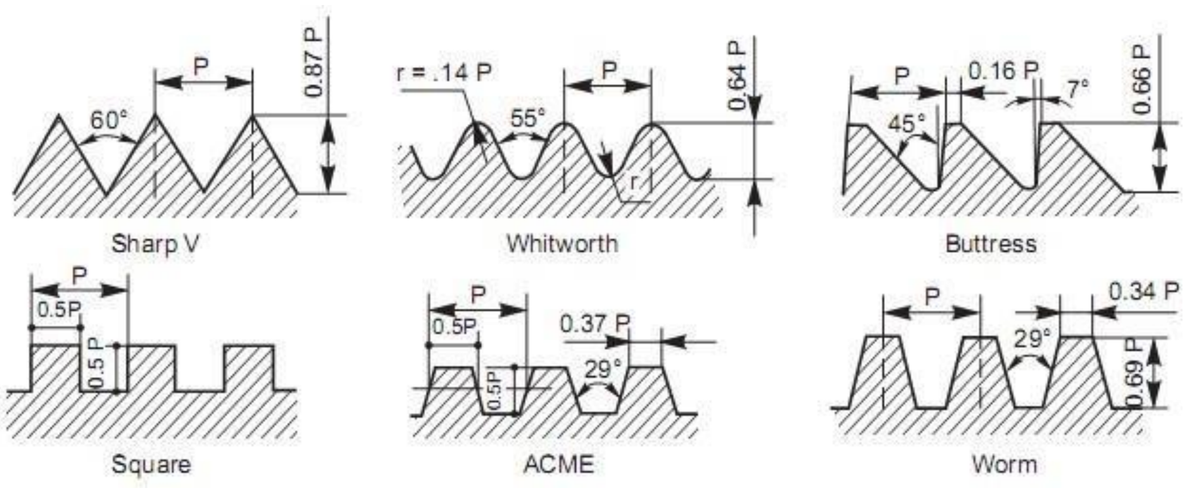



*Fig.1.21.Types of thread profiles*

### Representation of threads

The true projection of a threaded portion of a part consists of a series of helices and it takes considerable time to draw them. Hence it is the usual practice to follow some conventional methods to represent screw threads.

The crests of threads are indicated by a continuous thick line and the roots, by a continuous thin line. For hidden screw threads, the crests and roots are indicated by dotted lines. For threaded parts in section, hatching should be extended to the line defining the crest of the thread. In the view from side, the threaded roots are represented by a portion of a circle, drawn with a continuous thin line, of length approximately three-quarters of the circumference.

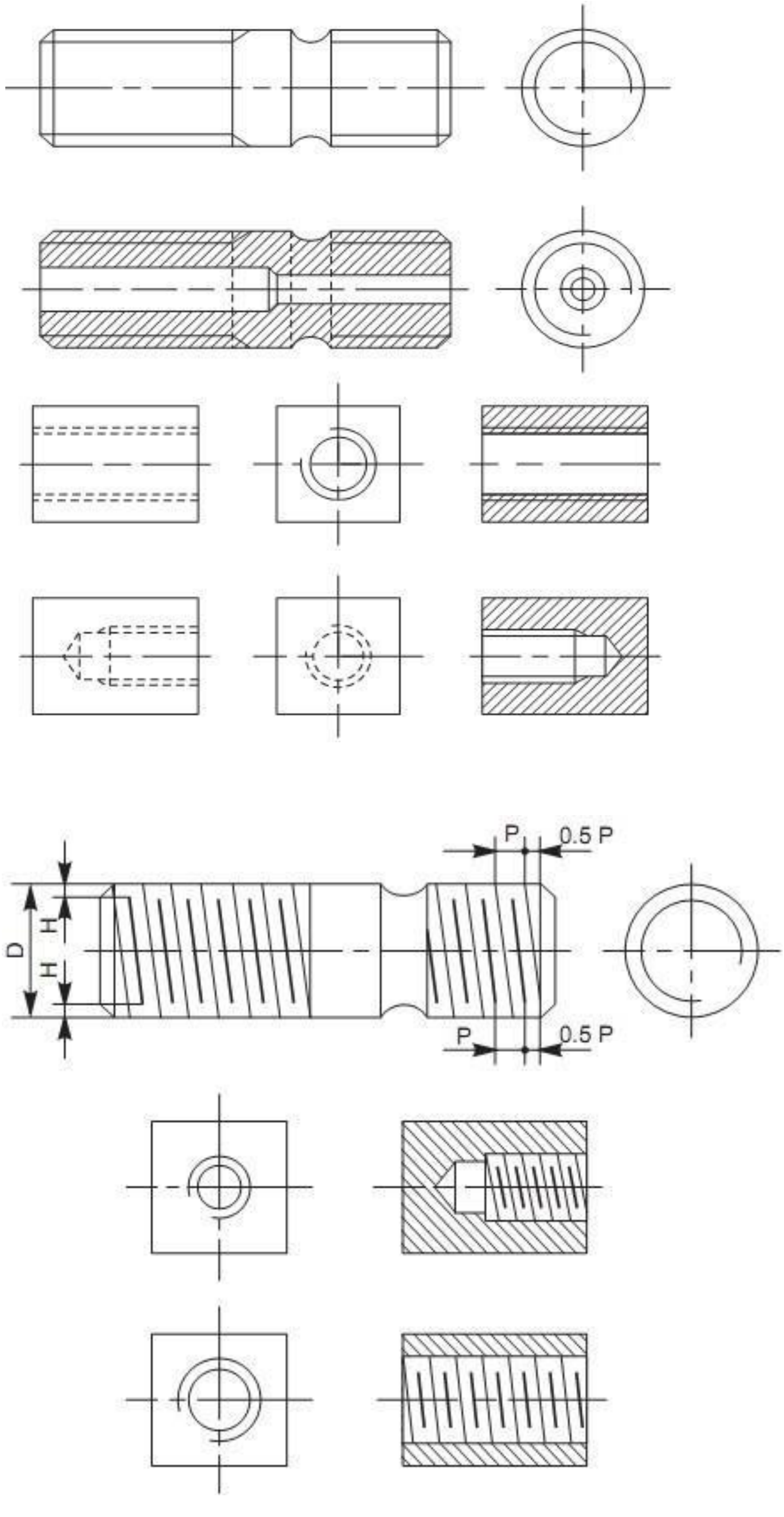



*Fig.1.22.Schematic representation of threaded parts-V-threads*

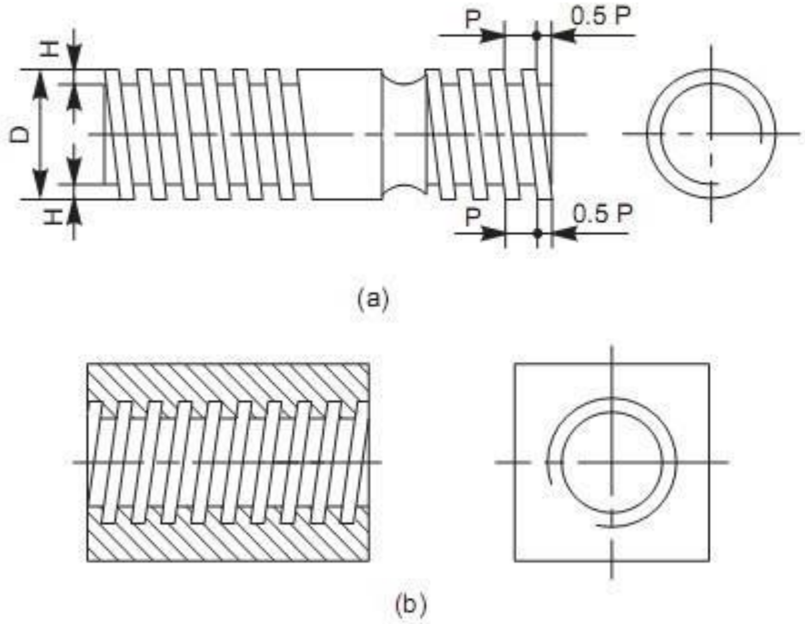



*Fig.1.23.Schematic representation of threaded parts-Square-threads*

### Hexagonal and square headed bolts

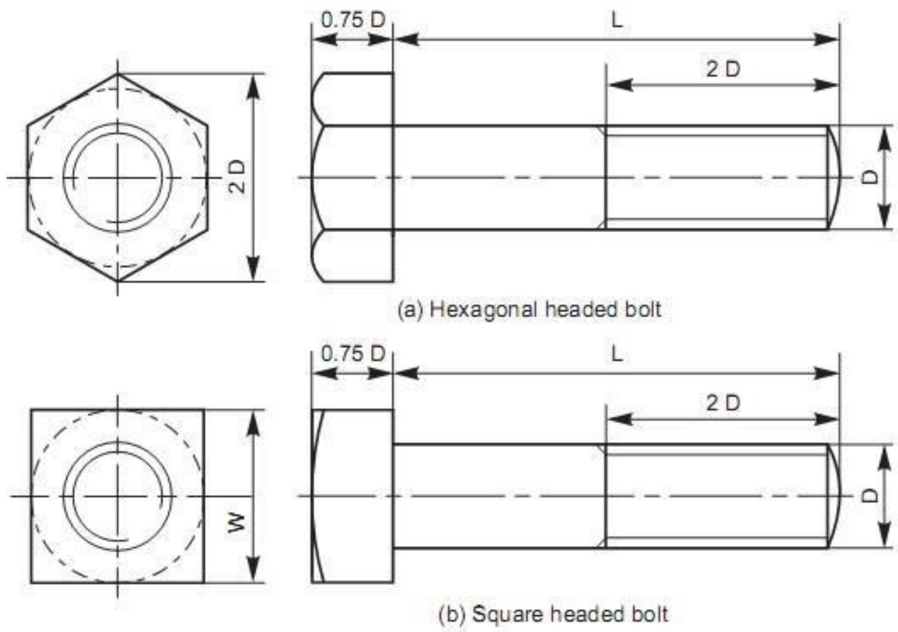



*Fig.1.24.Hexagonal and square headed bolts*

### Washer

A washer is a cylindrical piece of metal with a hole to receive the bolt. It is used to give a perfect seating for the nut and to distribute the tightening force uniformly to the parts under the joint. It also prevents the nut from damaging the metal surface under the joint.

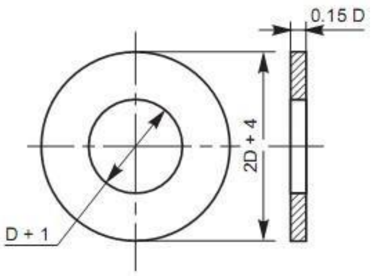



*Fig.1.25.Washer*

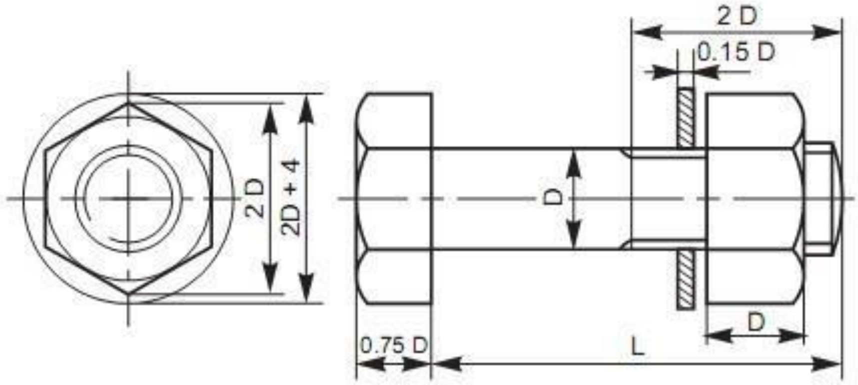



*Fig.1.26.A hexagonal headed bolt with a nut and a washer in position*

## Other forms of bolts

**Square headed bolts with square neck**

It is provided with a square neck, which fits into a corresponding square hole in the adjacent part, preventing the rotation of the bolt.

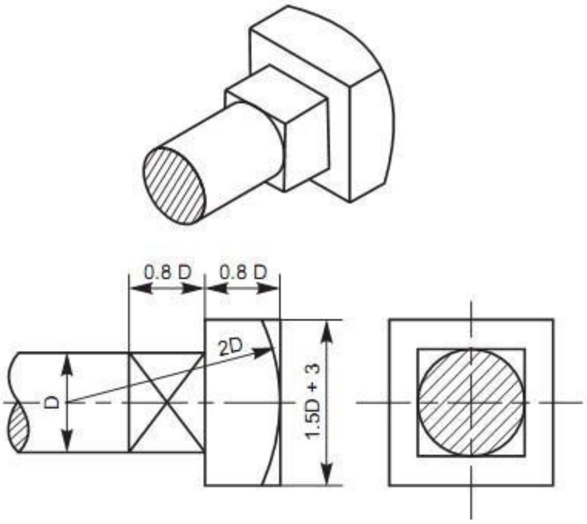



*Fig.1.27.Square headed bolts with square neck*

**T-headed bolts with square neck**

In this, a square neck provided below the head, prevents the rotation of the bolt. This type of bolt isused for fixing vices, work pieces, etc., to the machine table having T-slots.

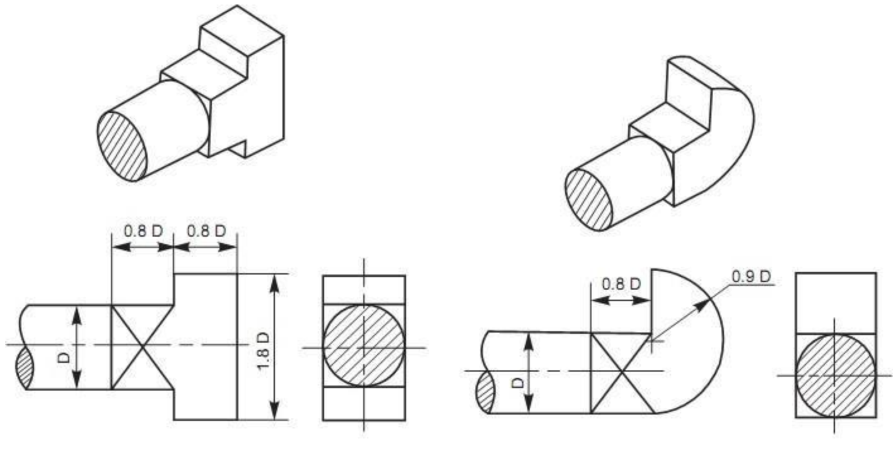



*Fig.1.28.Hook bolts*

**Hook bolts**

This bolt passes through a hole in one part only, while the other part is gripped by the hookshaped bolt head. It is used where there is no space for making a bolt hole in one of the parts. The square neck prevents the rotation of the bolt.

**Eye bolts**

In order to facilitate lifting of heavy machinery, like electric generators, motors, turbines, etc., eye bolts are screwed on to their top surfaces. For fitting an eye bolt, a tapped hole is provided, above the center of gravity of the machine.

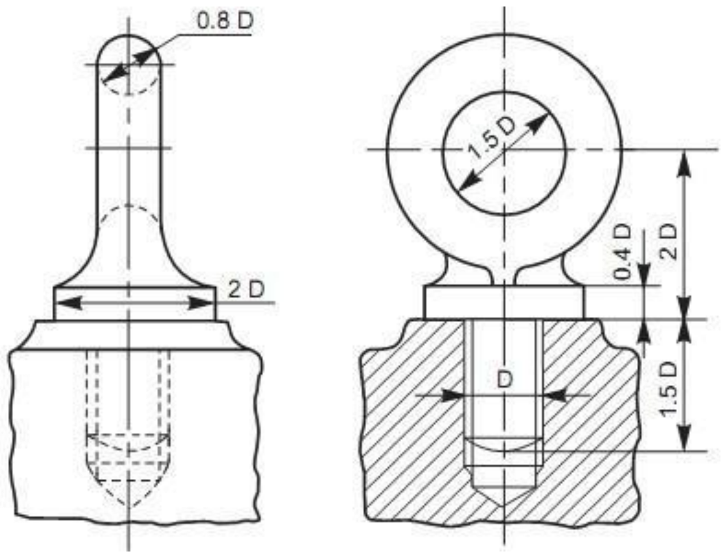



*Fig.1.29. Eye bolts*

**Stud bolt or stud**

It consists of cylindrical shank with threads cut on both the ends. It is used where there is no place for accommodating the bolt head or when one of the parts to be joined is too thick to use an ordinary bolt.

The stud is first screwed into one of the two parts to be joined, usually the thicker one. A stud driver, in the form of a thick hexagonal nut with a blind threaded hole is used for the purpose. After placing the second part over the stud, a nut is screwed-on over the nut end. It is usual to provide in the second part, a hole which is slightly larger than the stud nominal diameter. Figure 1.54*b* shows a stud joint.

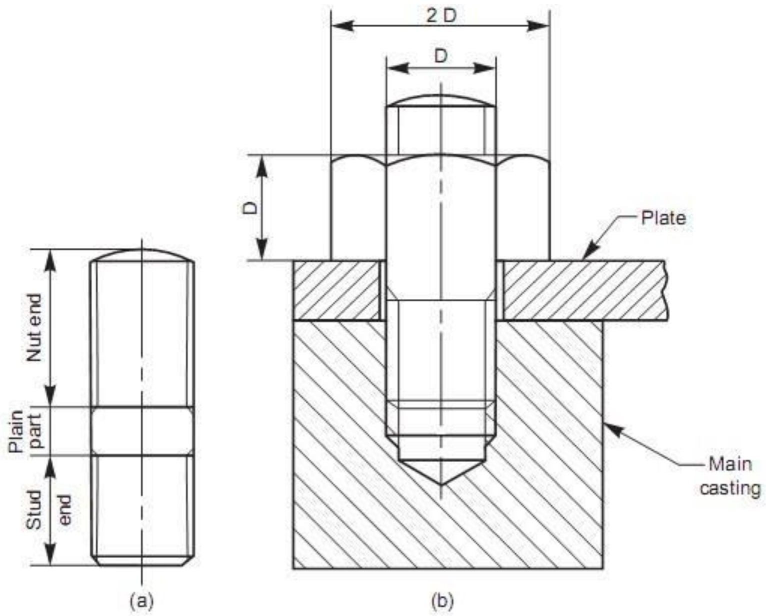



*Fig.1.30.(a) stud (b) stud joint*

## Other forms of Nuts

**Flanged nuts**
This is a hexagonal nut with a collar or flange, provided integral with it. This permits the use of a bolt in a comparatively large size hole.

**Cap Nut**
It is a hexagonal nut with a cylindrical cap at the top. This design protects the end of the bolt from Corrosion and also prevents leakage through the threads. Cap nuts are used in smoke boxes or locomotive and steam pipe connections.

**Dome nut**
It is another form of a cap nut, having a spherical dome at the top

**Capstan nut**
This nut is cylindrical in shape, with holes drilled laterally in the curved surface. A tommy barmay be used in the holes for turning the nut. Holes may also be drilled in the upper flat face of the nut.

**Slotted or ring nut**
This nut is in the form of a ring, with slots in the curved surface, running parallel to the axis. Aspecial Cspanner is used to operate the nut. These nuts are used on large screws, where the use of ordinary spanner is inconvenient.

**Wing nut**
This nut is used when frequent removal is required, such as inspection covers, lids, etc. It isoperated by the thumb.

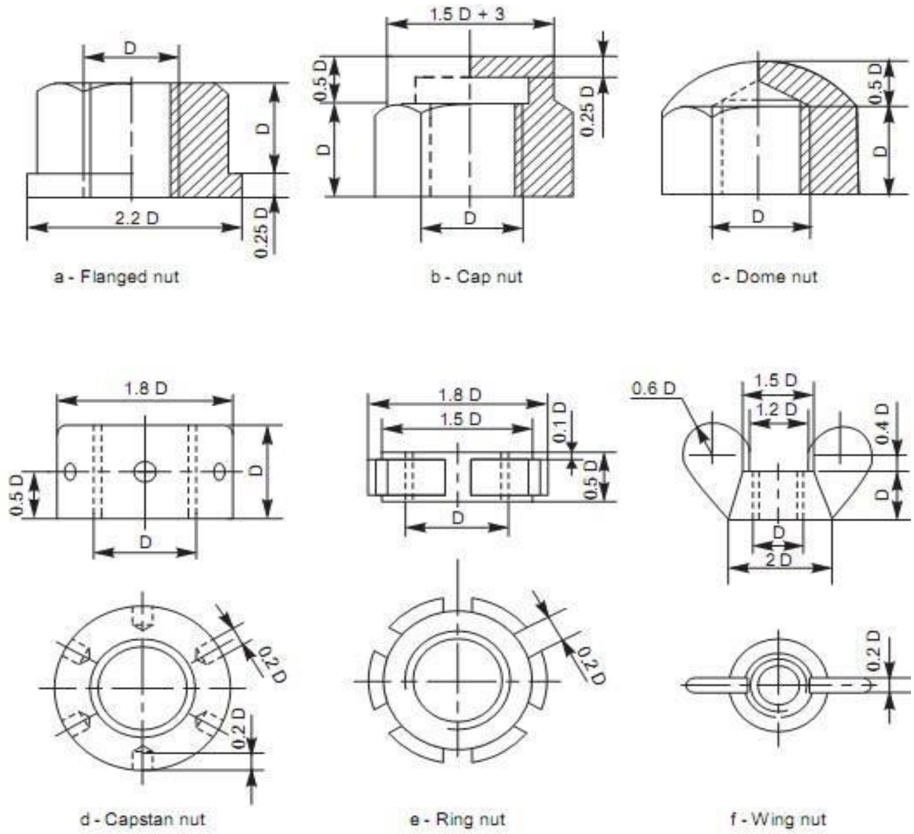



*Fig.1.31.other forms of nuts*

### Cap screws and machine screws

Cap screws and machine screws are similar in shape, differing only in their relative sizes. Machine screws are usually smaller in size, compared to cap screws. These are used for fastening two parts, one with clearance hole and the other with tapped hole. The clearance of the unthreaded hole need not be shown on the drawing as its presence is obvious.

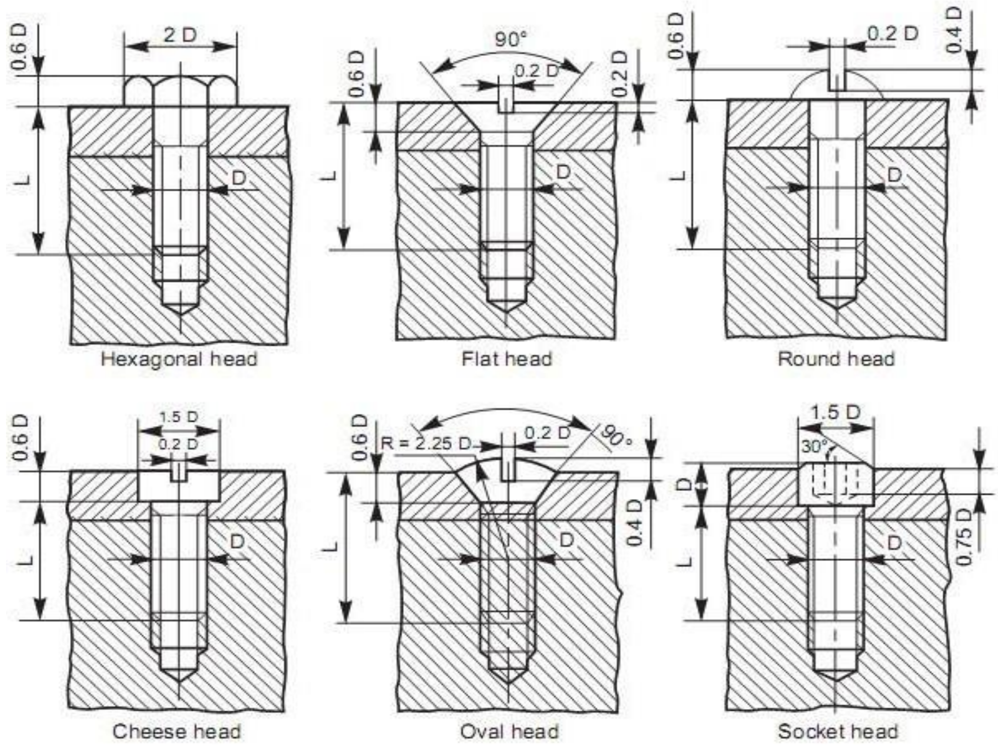
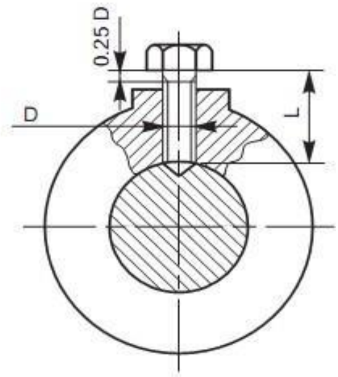


*Fig.1.32.types of machine and cap screws*

### Set screws

- These are used to prevent relative motion between two rotating parts, such as the movement of pulley on shaft.
- Set screws are not efficient and so are used only for transmitting very light loads. For longer life, set screws are made of steel and case hardened. Further, for better results, the shaft surface is suitably machined for providing more grip, eliminating any slipping tendency.



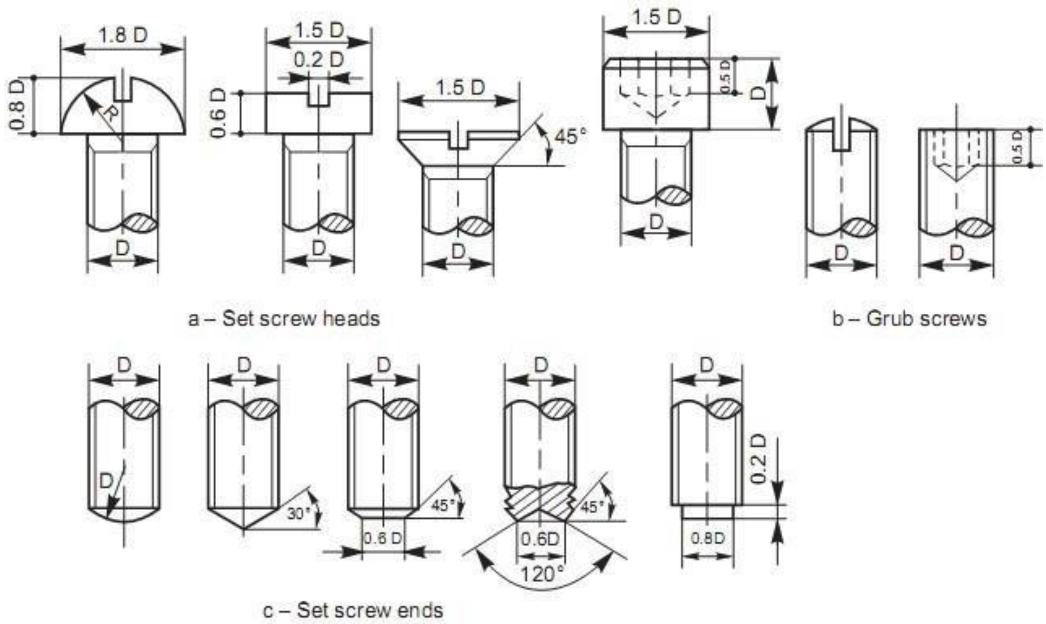




*Fig.1.33.Set screw ends*

### Key, cotter and Pin joints

Keys, cotters and pin joints are some examples of removable (temporary) fasteners. Assembly and removal of these joints are easy as they are simple in shape.

### Keys

- Keys are machine elements used to prevent relative rotational movement between a shaft and the parts mounted on it, such as pulleys, gears, wheels, couplings, etc.
- For making the joint, grooves or keyways are cut on the surface of the shaft and in the hub of the part to be mounted. After positioning the part on the shaft such that, both the keyways are properly aligned, the key is driven from the end, resulting in a firmjoint.
- For mounting a part at any intermediate location on the shaft, first the key is firmly placed in the keyway of the shaft and then the part to be mounted is slid from one end of the shaft, till it is fully engaged with the key.

Keys are classified into three types,

1. Saddle keys,
2. Sunk keys and
3. Round keys.

### Saddle key

These are taper keys, with uniform width but tapering in thickness on the upper side. The magnitude of the taper provided is 1:100. These are made in two forms: 1.Hollow saddle key and
2.Flat saddle key.

### Hollow saddle key

A hollow saddle key has a concave shaped bottom to suit the curved surface of the shaft, on which it is used. A keyway is made in the hub of the mounting, with a tapered bottom surface. When a hollow saddle key is fitted in position, the relative rotation between the shaft and the mounting is prevented due to the friction between the shaft and key.

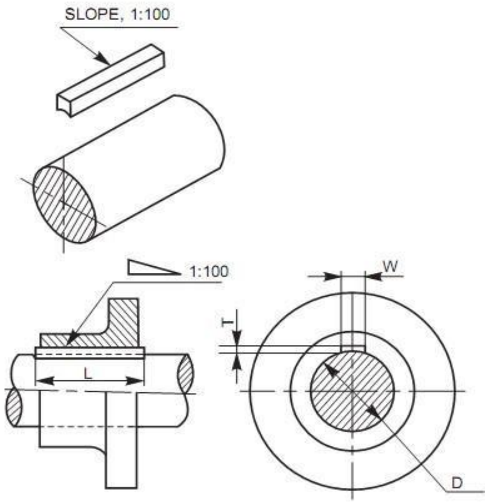



*Fig.1.34.Hollow saddle key*

### Flat saddle key

It is similar to the hollow saddle key, except that the bottom surface of it is flat. Apart from the tapered keyway in the hub of the mounting, a flat surface provided on the shaft is used to fit this key in position.

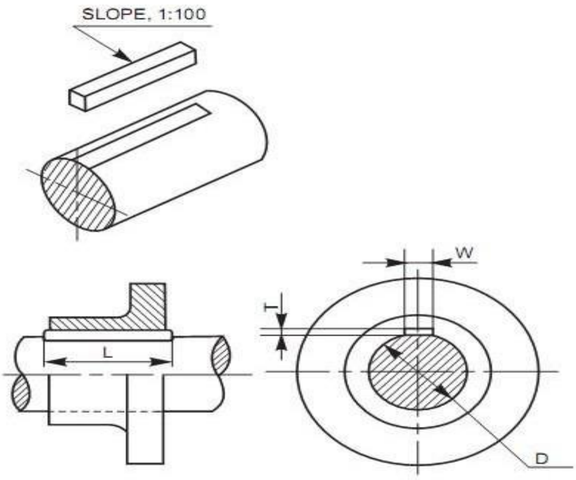



*Fig.1.35.Flat saddle key*

The two types of saddle keys discussed above are suitable for light duty only. However, the flat one is slightly superior compared to the hollow type. Saddle keys are liable to slip around the shaft when used under heavy loads.

### Sunk key

These are the standard forms of keys used in practice, and may be either square or rectangular in crosssection. The end may be squared or rounded. Generally, half the thickness of the key fits into the shaft keyway and the remaining half in the hub keyway. These keys are used for heavy duty, as the fit between the key and the shaft is positive.

Sunk keys may be classified as:

***(i)*** Taper keys,

***(ii)*** Parallel or feather keys and ***(iii)*** Woodruff keys.

### Taper sunk key

These keys are square or rectangularin cross-section, uniform in width but tapered in thickness. The bottom surface of the key is straight and the top surface is tapered, the magnitude of the taper being 1:100. Hence, the keyway in the shaft is parallel to the axis and the hub keyway is tapered.

A tapered sunk key may be removed by driving it out from the exposed small end. If this end is not accessible, the bigger end of the key is provided with a head called gib. Following are the proportions for a gib head:

If D is the diameter of the shaft, then,

Width of key, W = 0.25 D + 2 mm

Thickness of key, T = 0.67 W (at the thicker end)

Standard taper = 1:100

Height of head, H = 1.75 T

Width of head, B = 1.5 T

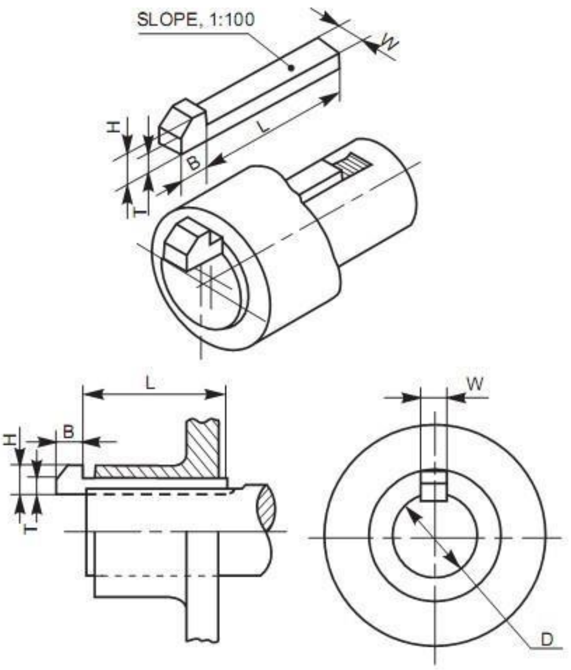



*Fig.1.36.Key with gib head*

### Parallel or feather keys

A parallel or feather key is a sunk key, uniform in width and thickness as well. These keys are used when the parts (gears, clutches, etc.) mounted are required to slide along the shaft; permitting relative axial movement. To achieve this, a clearance fit must exist between the key and the keyway in which it slides.

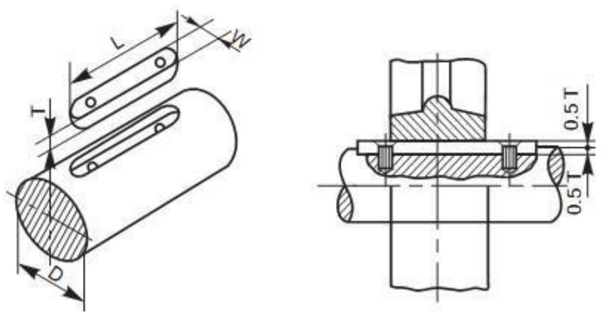



*Fig.1.37.Parallel sunk key*

### Splines

Splines are keys made integral with the shaft, by cutting equi-spaced grooves of uniform cross-section. The shaft with splines is called a splined shaft. The splines on the shaft, fit into the corresponding recesses in the hub of the mounting, with a sliding fit, providing a positive drive and at the same time permitting the latter to move axially along the shaft.

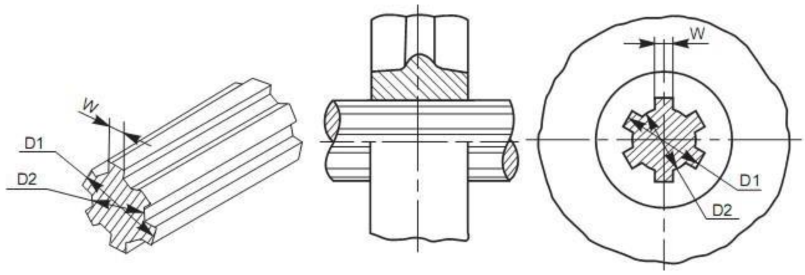



*Fig.1.38.Splined shaft and hub*

### Woodruff key

It is a sunk key, in the form of a segment of a circular disc of uniform thickness. As the bottom surface of the key is circular, the keyway in the shaft is in the form of a circular recess to the same curvature as the key. A keyway is made in the hub of the mounting, in the usual manner. Woodruff key is mainly used on tapered shafts of machine tools and automobiles. Once placed in position, the key tilts and aligns itself on the tapered shaft.

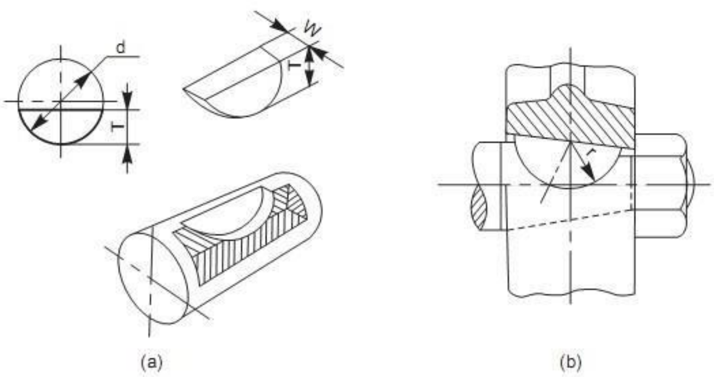



*Fig.1.39.Woodruff key*

### Round key

Round keys are of circular cross-section, usually tapered (1:50) along the length. A round key fits in the hole drilled partly in the shaft and partly in the hub (Fig. 1.74). The mean diameter of the pin may be taken as 0.25 D, where D is shaft diameter. Round keys are generally used for light duty, where the loads are not considerable.

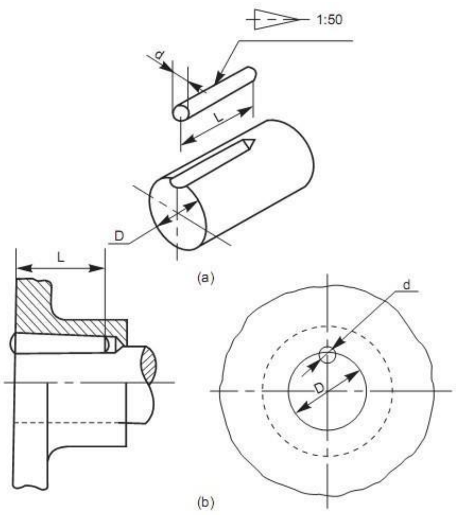



*Fig.1.40.Round key*

### Cotter joints

- A cotter is a flat wedge shaped piece, made of steel. It is uniform in thickness but tapering in width, generally on one side; the usual taper being 1:30. The lateral (bearing) edges of the cotter and the bearing slots are generally made semi-circular instead of straight.
- This increases the bearing area and permits drilling while making the slots. The cotter is locked in position by means of a screw.
- Cotter joints are used to connect two rods, subjected to tensile or compressive forces along their axes. These joints are not suitable where the members are under rotation.

The following are some of the commonly used cotter joints:

1. Cotter joint with sleeve
2. Cotter joint with socket and spigot ends.
3. Cotter joint with in a Gib.

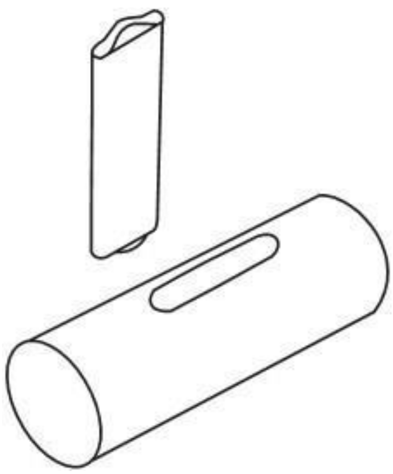
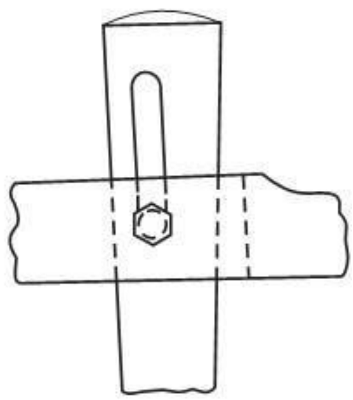



*Fig.1.42.Locking arrangement of cotter Fig.1.41.Cotter and the bearing slot*

### Cotter joint with sleeve

This is the simplest of all cotter joints, used for fastening two circular rods. To make the joint,
The rods are enlarged at their ends and slots are cut. After keeping the rods butt against each other, a sleeve with slots is placed over them. After aligning the slots properly, two cotters are driven-in through the slots, resulting in the joint. The rod ends are enlarged to take care of the weakening effect caused by the slots.

The slots in the rods and sleeve are made slightly wider than the width of cotter. The relative positions of the slots are such, that when a cotter is driven into its position, it permits wedging action and pulls the rod into the sleeve.

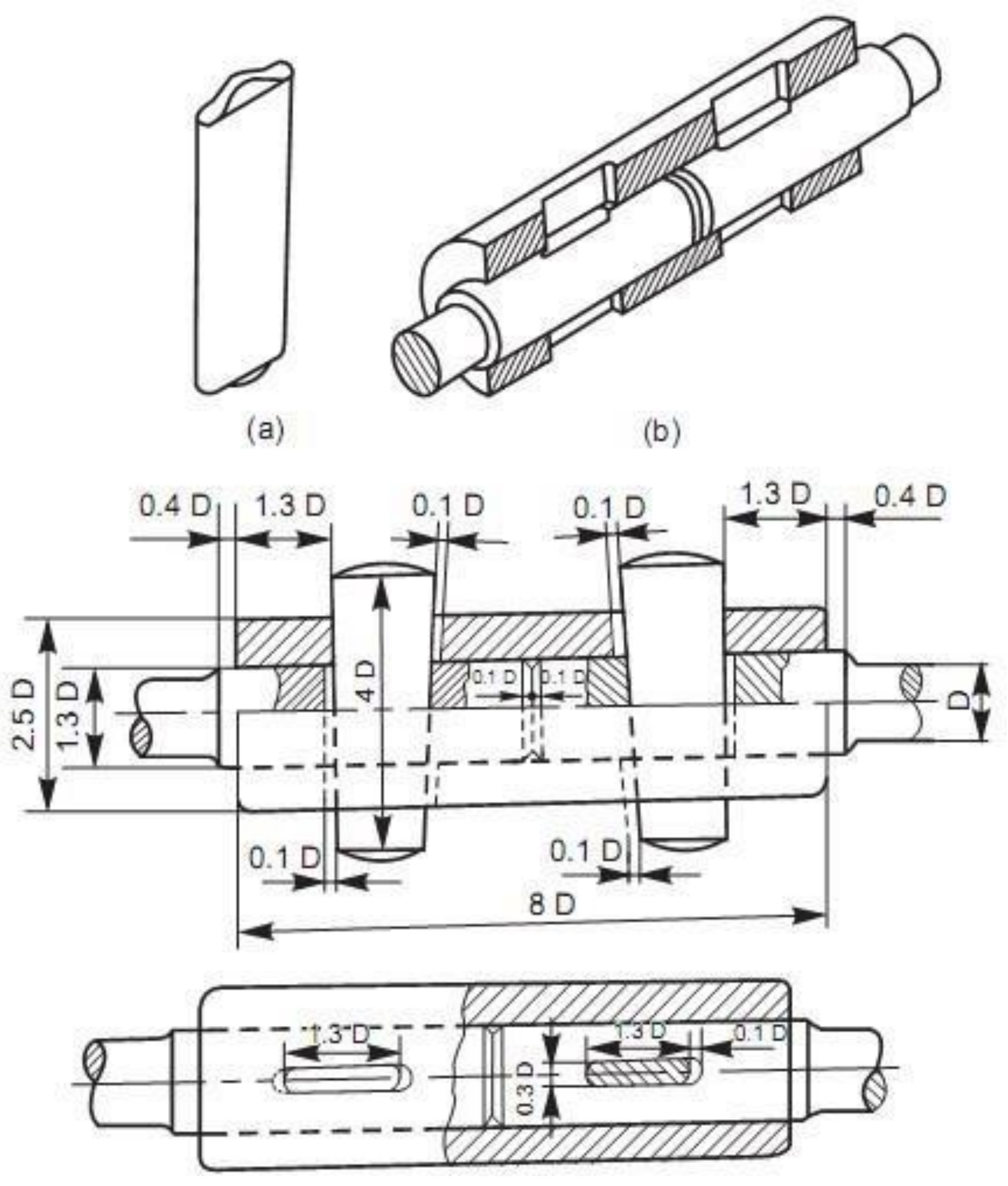



*Fig.1.43.Cotter joint with sleeve*

**Cotter joint with socket and spigot ends.**

This joint is also used to fasten two circular rods. In this, the rod ends are modified instead of using a sleeve. One end of the rod is formed into a socket and the other into a spigot (Fig. 1.78) and slots are cut. After aligning the socket and spigot ends, a cotter is driven-in through the slots, forming the joint.

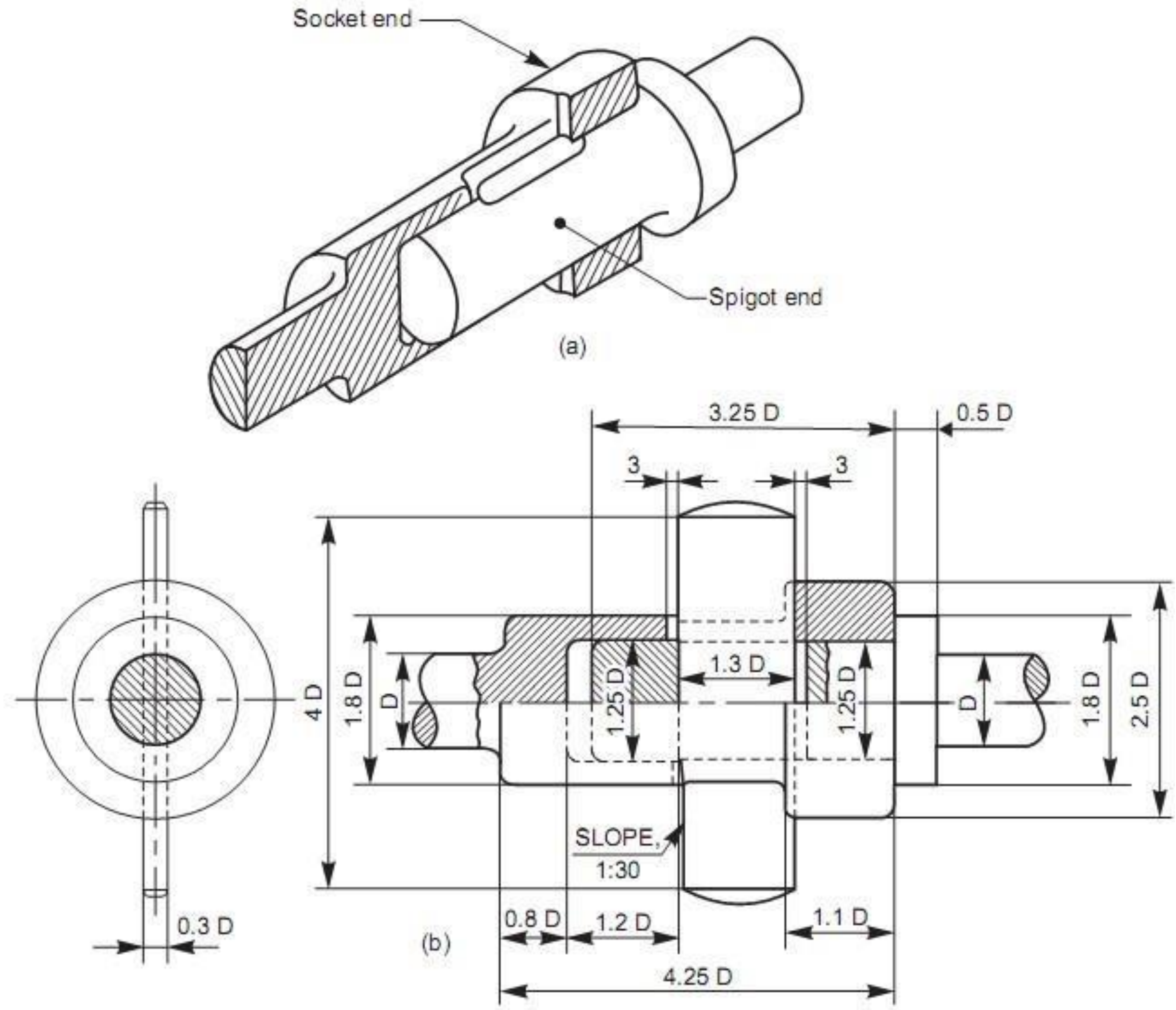



*Fig.1.44.Cotter joint with socket and spigot ends*

**Cotter joint with in a Gib.**

This joint is generally used to connect two rods of square or rectangular cross-section. To make the joint, one end of the rod is formed into a U-fork, into which, the end of the other rod fits in.

When a cotter is driven-in, the friction between the cotter and straps of the U-fork, causes the straps to open. This is prevented by the use of a gib.

A gib is also a wedge shaped piece of rectangular cross-section with two rectangular projections called lugs. One side of the gib is tapered and the other straight. The tapered side of the gib bears against the tapered side of the cotter such that, the outer edges of the cotter and gib as a unit are parallel. This facilitates making of slots with parallel edges, unlike the tapered edges in case of ordinary cotter joint. Further, the lugs bearing against the outer surfaces of the fork, prevents the opening tendency of the straps.

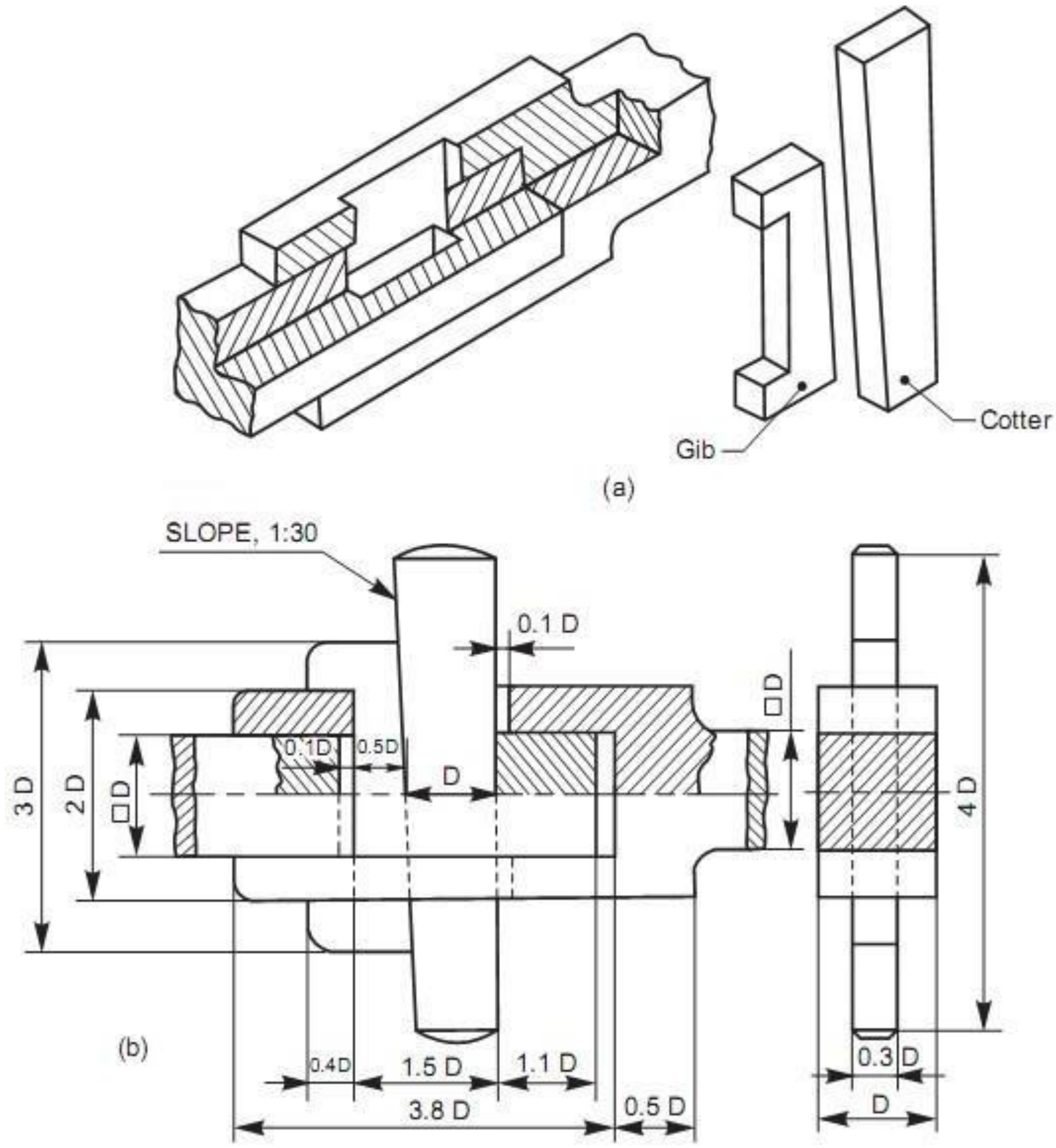



*Fig.1.45.Cotter joint with a gib*

**Pin joints**

In a pin joint, a pin is used to fasten two rods that are under the action of a tensile force; although the rods may support a compressive force if the joint is guided. Some pin joints such as universal joints, use two pins and are used to transmit power from one rotating shaft to another. A pin joint permits a small amount of flexibility or one rod may be positioned at an angle (in the plane containing the rods) with respect to the other rod, after providing suitable guides.

Unlike in cotter joints, the pin in a pin joint is not driven-in with a force fit, but is inserted in the holes with a clearance fit. The pin is held in position, by means of a taper pin or a split pin provided at its end.

**Knuckle joint**

A knuckle joint is a pin joint used to fasten two circular rods. In this joint, one end of the rod is formed into an eye and the other into a fork (double eye). For making the joint, the eye end of the rod is aligned into the fork end of the other and then the pin is inserted through the holes and held in position by means of a collar and a taper pin (Fig. 1.80). Once the joint is made, the rods are free to swivel about the cylindrical pin.

Knuckle joints are used in suspension links, air brake arrangement of locomotives, etc.

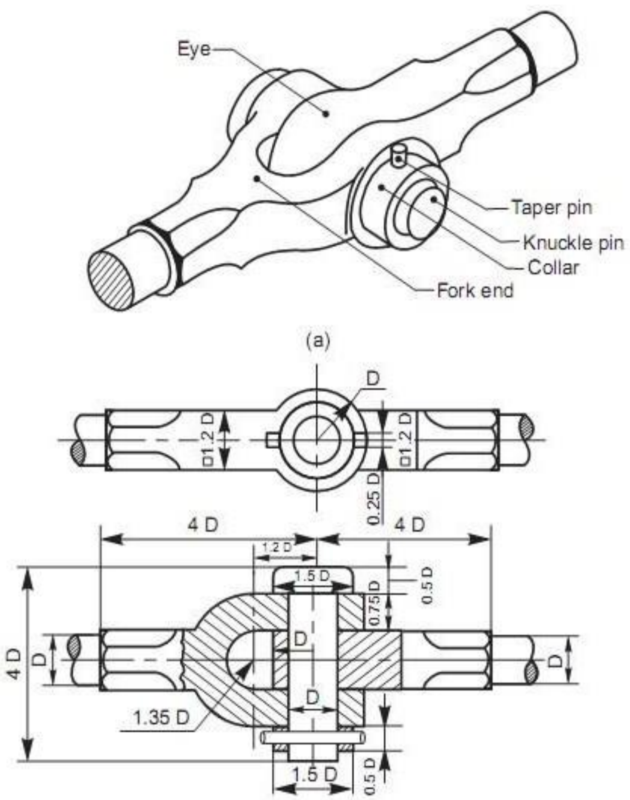



*Fig.1.46.Knuckle joint*

### Universal joint

Universal joints are used to transmit power between two shafts which are not coaxial.It is a rigid coupling that connects two shafts, whose axes intersect if extended. It consists oftwo forks which are keyed to the shafts. The two forks are pin joined to a central block, which has two arms at right angle to each other in the form of a cross. The angle between the shafts may be varied even while the shafts are rotating.

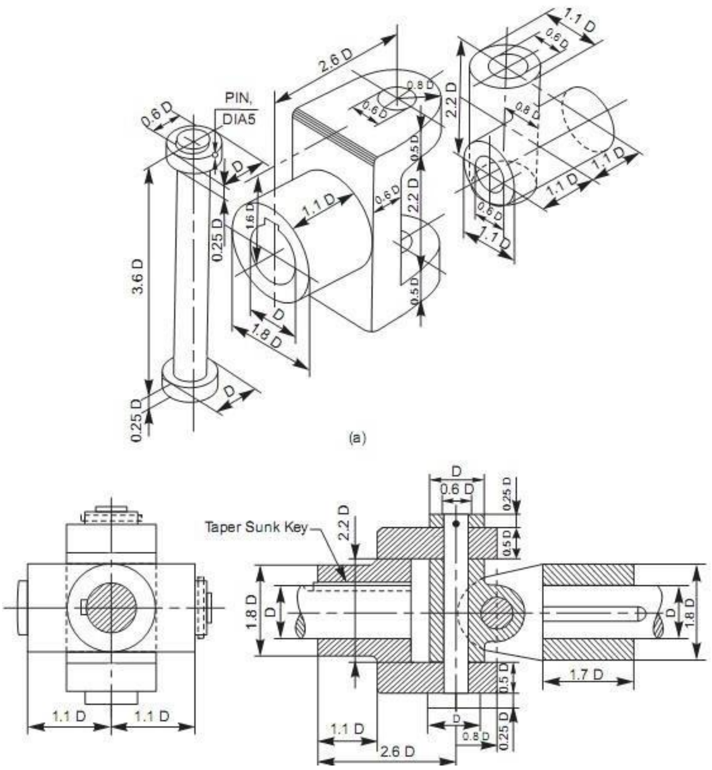



*Fig.1.47.Universal joints*

### Riveted joint

Riveted joints are permanent fastenings and riveting is one of the commonly used method of producing rigid and permanent joints. Manufacture of boilers, storage tanks, etc., involve joining of steel sheets, by means of riveted joints. These joints are also used to fasten rolled steel sections in structural works, such as bridge and roof trusses.

### Rivet

A rivet is a round rod of circular cross-section. It consists of two parts, viz., head and shank. Mild steel, wrought iron, copper and aluminum alloys are some of the metals commonly used for rivets. The choice of a particular metal will depend upon the place of application.

### Riveting

Riveting is the process of forming a riveted joint. For this, a rivet is first placed in the hole drilled through the two parts to be joined. Then the shank end is made into a rivet head by applying pressure, when it is either in cold or hot condition.

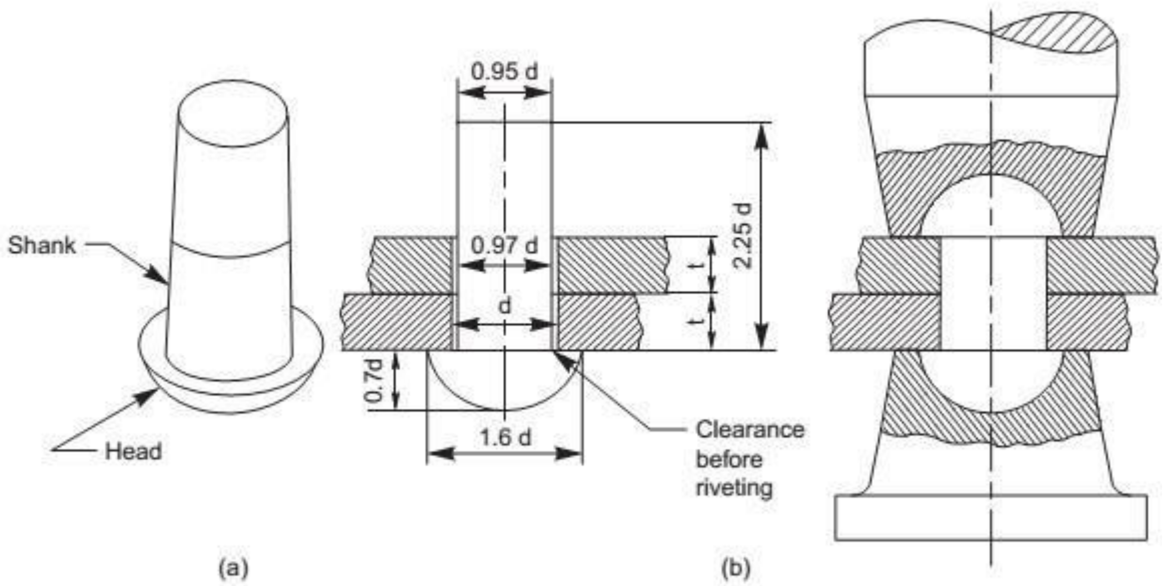



*Fig.1.48.(a) Rivet (b) Riveting*

### Caulking and Fullering

Riveted joints must be made air tight in applications such as boilers and other pressure vessels. Caulking or fullering is done to make the riveted joints air tight.

#### *(i)* Caulking

The outer edges of the plates used in boiler and other pressure vessels are bevelled. To produce air tight riveted joints, these bevelled edges of the plates are caulked. Caulking is an operation in which the outer bevelled edges of the plates are hammered and driven-in by a caulking tool. The caulking tool is in the form of a blunt edged chisel.

#### *(ii)* Fullering

Similar to caulking, fullering is also used to produce air tight joints. Unlike the caulking tool, the width of the fullering tool is equal to the width of the bevelled edges of the plates. Caulking and fullering operations are carried out effectively by applying pneumatic pressure.

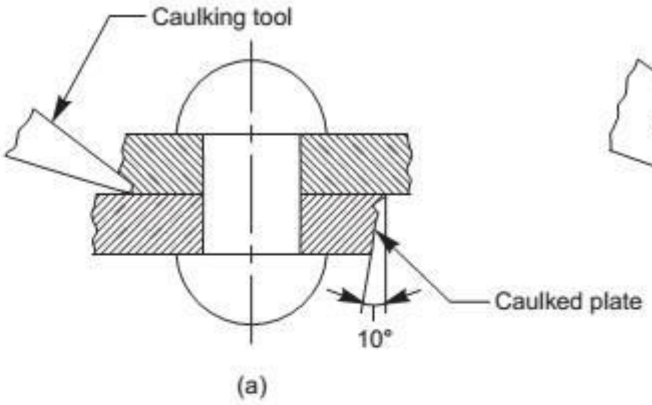



*Fig.1.49.(a) Caulking (b) Fullering*

**Rivet heads**

Various forms of rivet heads, used in general engineering works and boiler construction and as recommended by Bureau of Indian Standards, are shown below

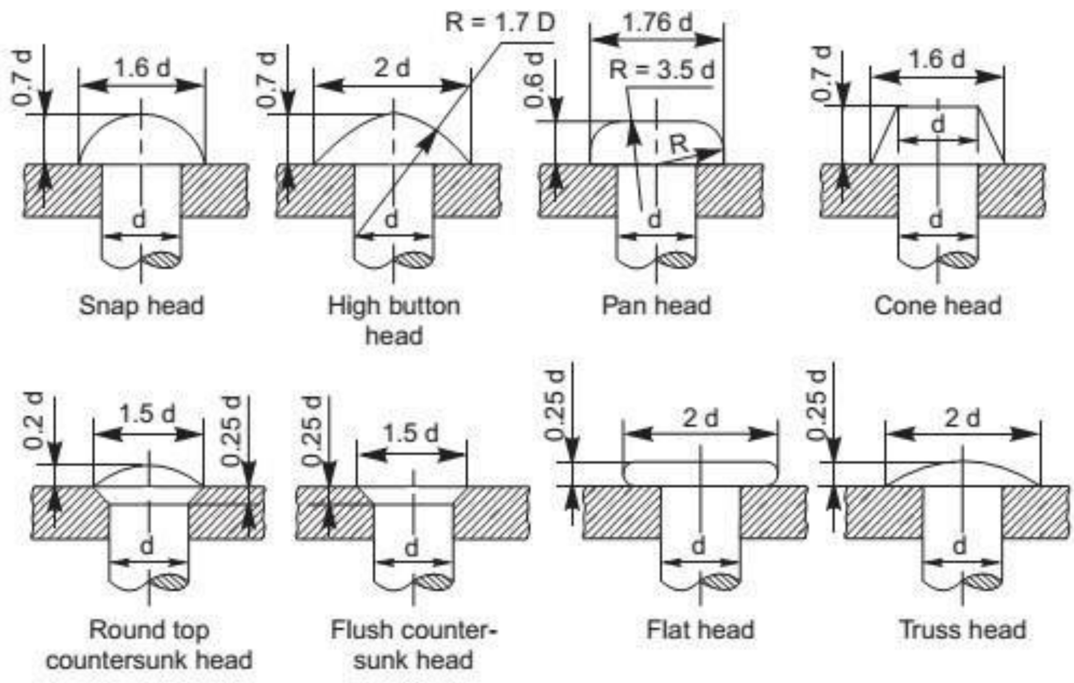



*Fig.1.50.Types of rivet heads*

The definitions of the terms, associated with riveted joints are given below:

***(i)* Pitch**

It is the distance between the centres of the adjacent rivets in the same row. It is denoted by ‘p’ and usually taken as 3d, where dis the rivet diameter.

***(ii)* Margin**

It is the distance from the edge of the plate to the centre of the nearest rivet. It is usually taken as

1.5d, where dis the rivet diameter. It is denoted by ‘m’.

### *(iii)* Chain riveting

If the rivets are used along a number of rows such that the rivets in the adjacent rows are placed directly opposite to each other, it is known as chain riveting.

### *(iv)* Zig-zag riveting

In a multi-row riveting, if the rivets in the adjacent rows are staggered and are placed inbetween those of the previous row, it is known as zig-zag riveting.

### *(v)* Row pitch

It is the distance between two adjacent rows of rivets. It is denoted by ‘$p_r$’ and is given by, $p_r$= 0.8p,

for chain riveting $p_r$= 0.6p, for zig-zag riveting.

### *(vi)* Diagonal pitch

This term is usually associated with zig-zag riveting and is denoted by ‘$p_d$’. It is the distance between the centres of a rivet in a row to the next rivet in the adjacent row.

## Classification of rivet joints

Riveted joints may be broadly classified into:

1.Structural joints and 2.Pressure vessel joints.

These joints are used mainly for joining metal sheets used in the construction of boilers, water tanks and pressure vessels. Obviously, these joints must be made air-tight, as the above vessels are required to retain fluids and withstand internal fluid pressure as well. For manufacturing boilers, water tanks and pressure vessels, the edges of the plates to be joined (in case of lap joints only) are first bevelled. The plates are then rolled to the required curvature of the shell. Holding the plates together, holes are then drilled and riveting is followed.

Boiler joints are classified as:

1. Lap joints,
2. Butt joints and
3. Combination of lap and butt joints.

### 1. Lap joints

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 of rivets used in the joint, lap joints are further classified as single riveted lap joint, double riveted lap joint and so on.

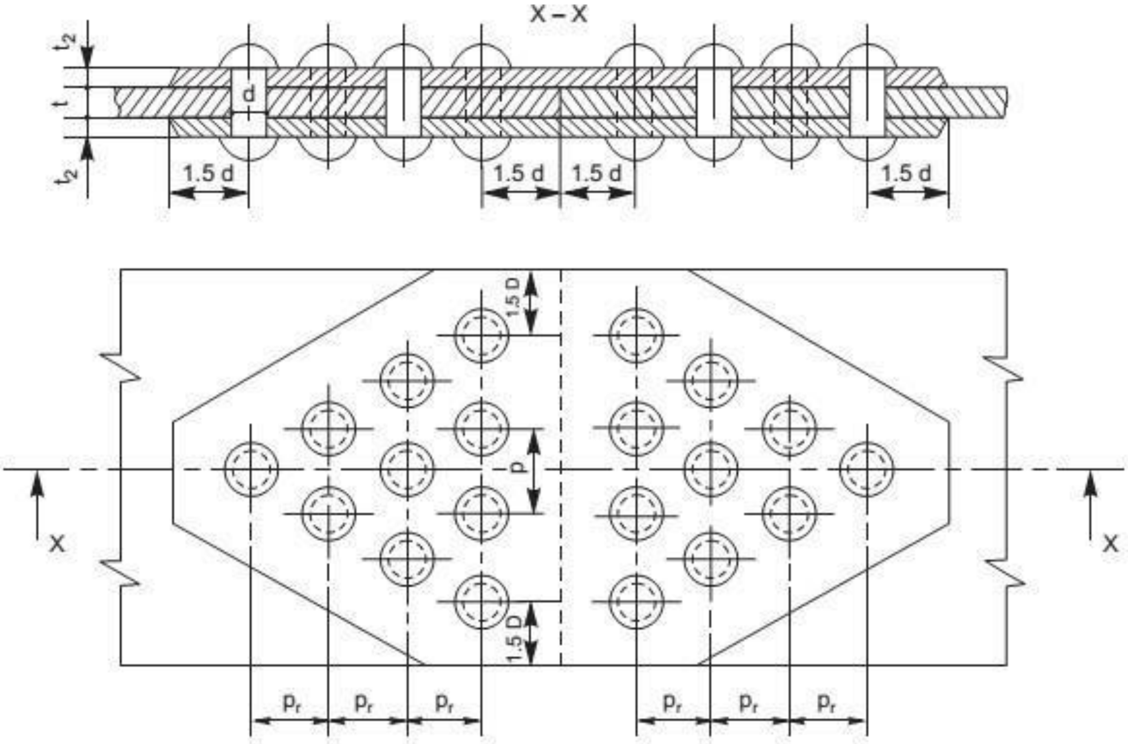



*Fig.1.51.Double strap diamond butt joint*

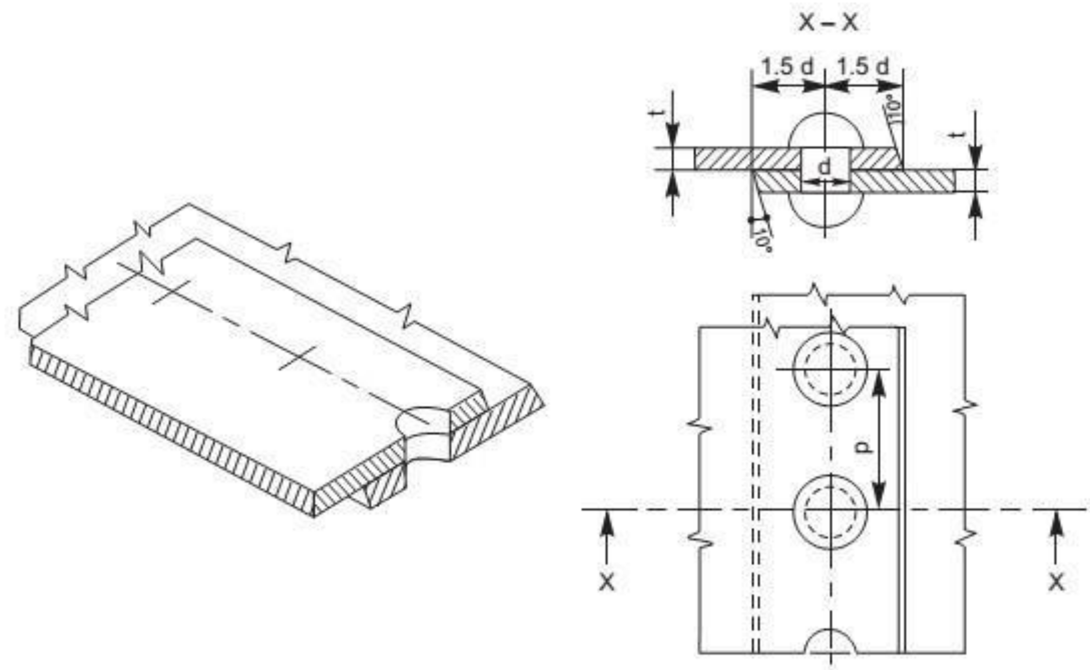



*Fig.1.52.Single riveted lap joint*

The size of the rivet, dis taken as, $d= 6 \sqrt{t}$ mm

Where-‘t’ is the thickness of the plates to be joined in millimetres.

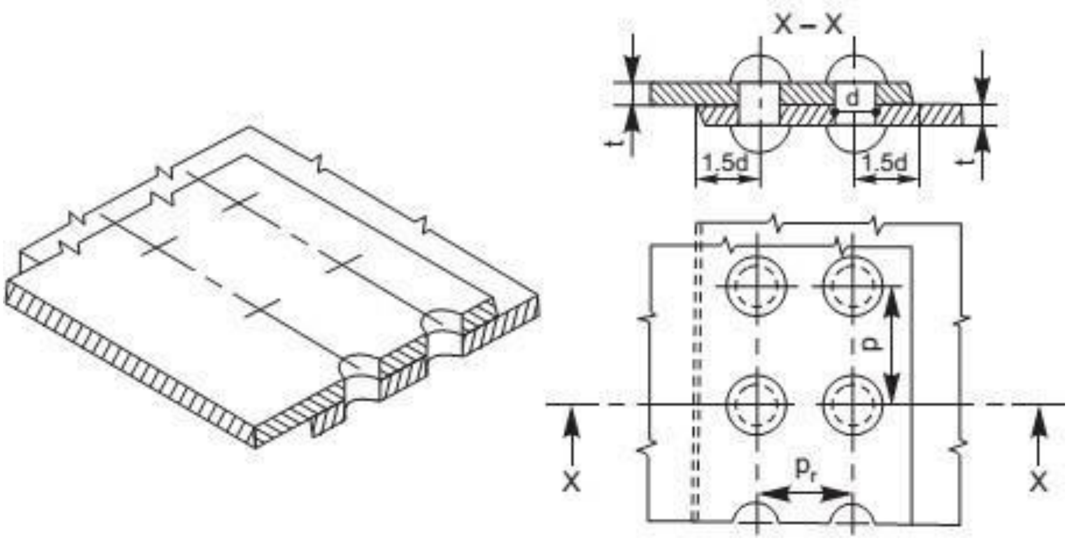



*Fig.1.53.Double riveted chain lap joint*

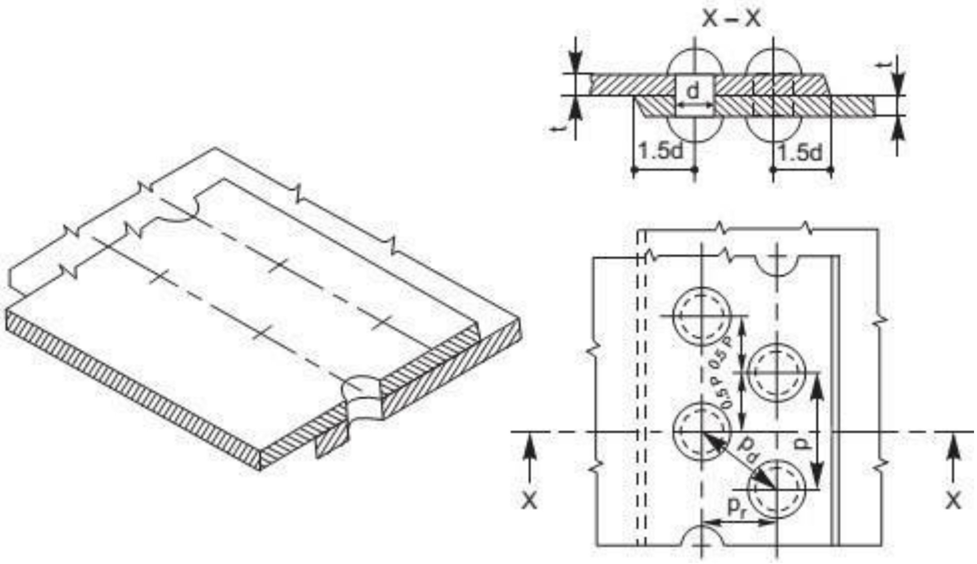



*Fig.1.54.Double riveted zig-zig lap joint*

## 2. Butt joint

In a butt joint, the plates to be joined, butt against each other, with a cover plate or strap,either on one or both sides of the plates; the latter one being preferred. In this joint, the butting edges of the plates to be joined are square and the outer edges of the cover plate(s) is (are) bevelled.

These joints are generally used for joining thick plates, and are much stronger than lap joints.

In a single strap butt joint, the thickness of the strap (cover plate) is given by, $t_1$= 1.125t

If two straps are used, the thickness of each cover plate is given by, $t_2$= 0.75t

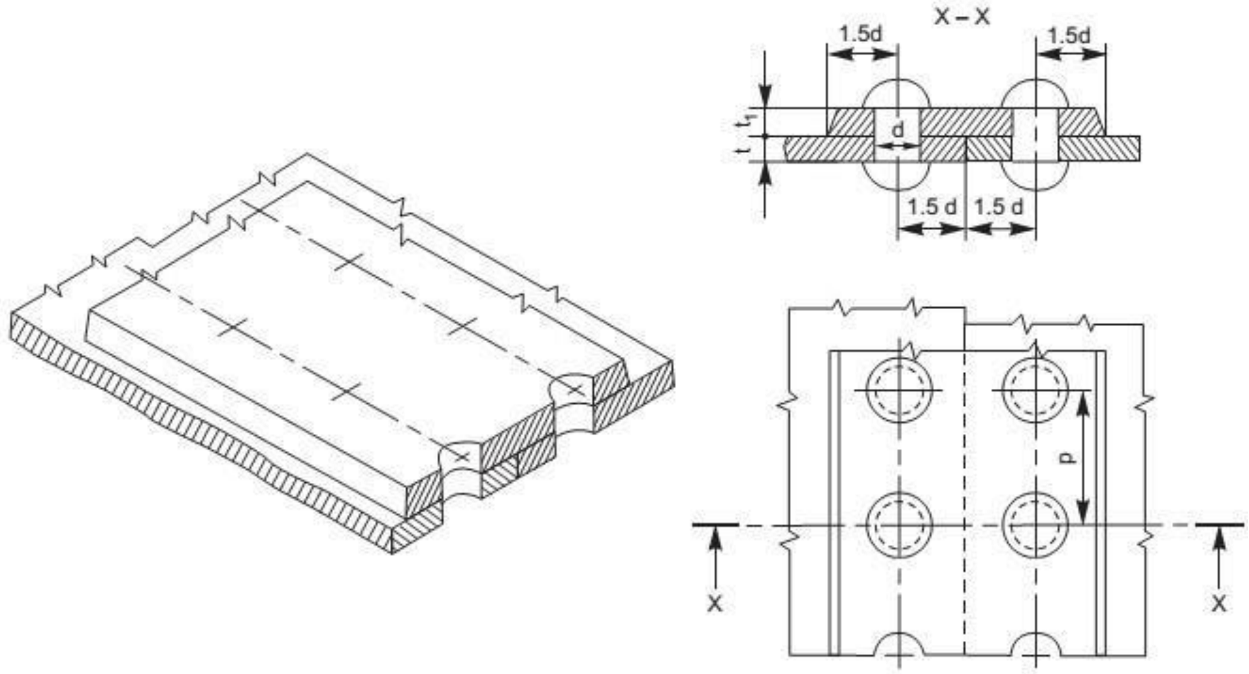



*Fig.1.55.Single riveted  single strap butt joint*

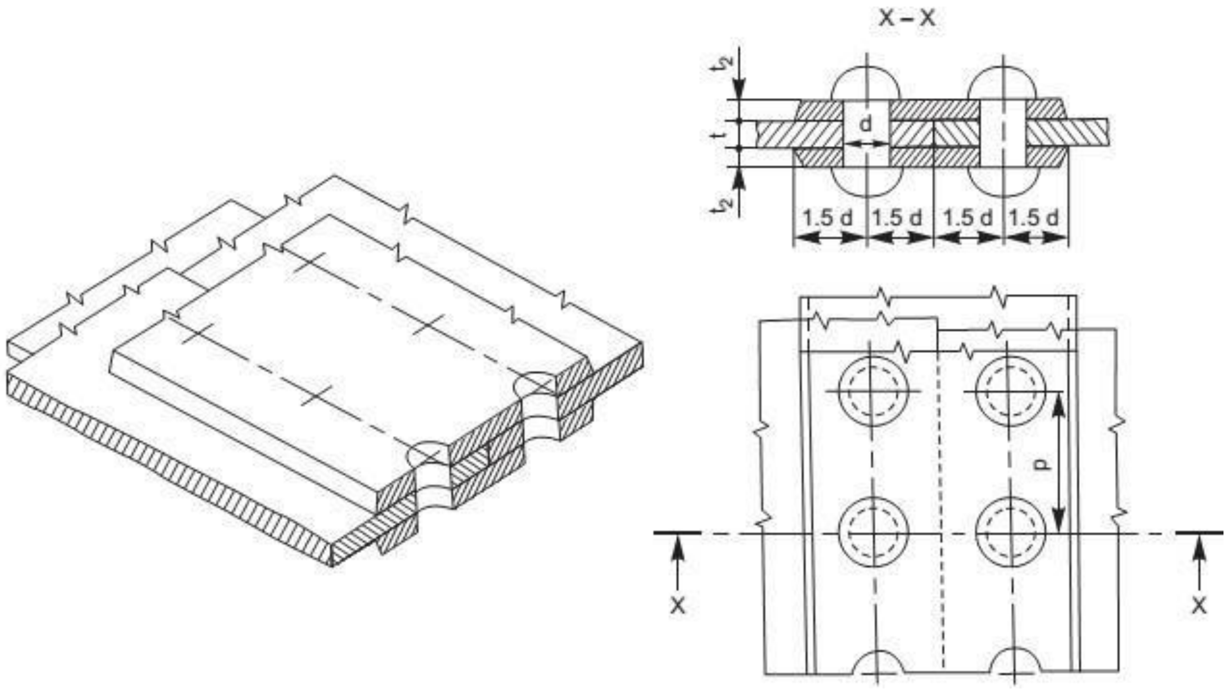



*Fig.1.56.Single riveted double strap butt joint*

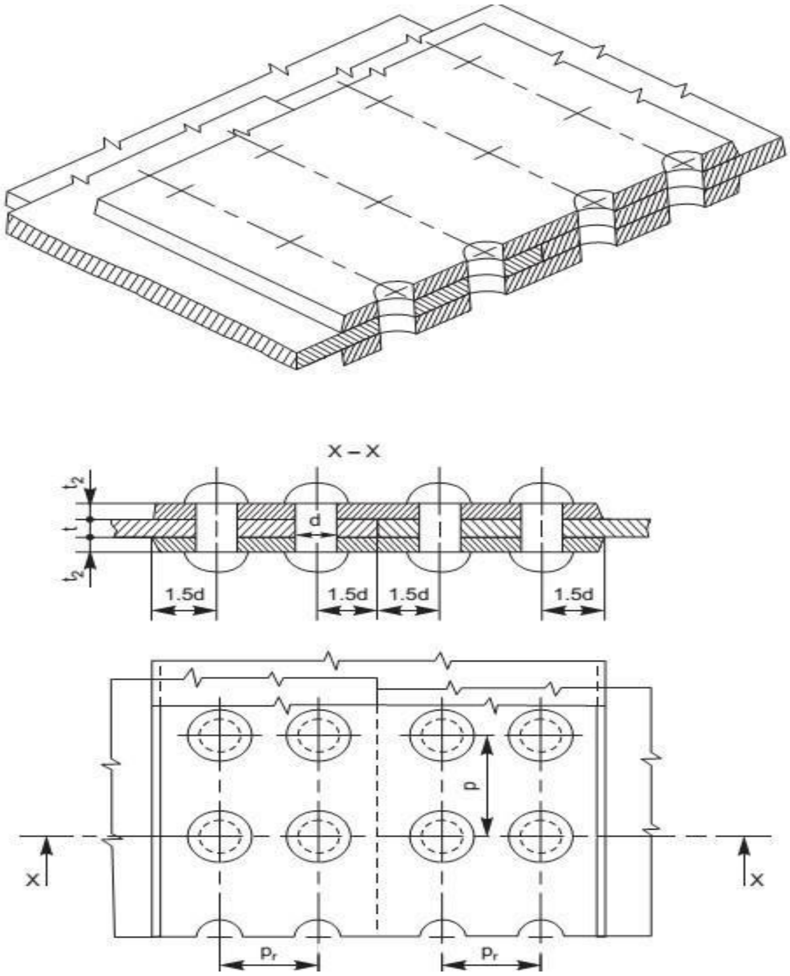



*Fig.1.57.Double riveted double strap chain butt joint*

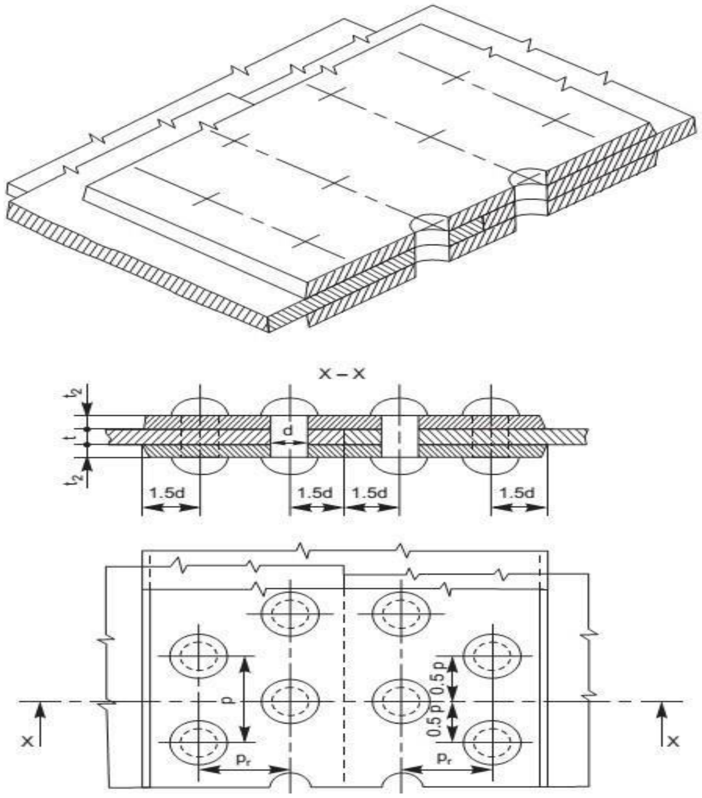



*Fig.1.58.Double riveted double strap zig-zig butt joint*

### Welded joints

Welding is an effective method of making permanent joints between two or more metal parts. Cast iron, steel and its alloys, brass and copper are the metals that may be welded easily. Production of leak proof joints that can withstand high pressures and temperatures are made possible with advanced welding technology. For this reason, welding is fast replacing casting and forging wherever possible. When compared to riveting, welding is cheaper, stronger and simpler to execute at site with considerable freedom in design. Hence, it is widely used in ship building and structural fabrication in place of riveting.

### Welded joint and symbols

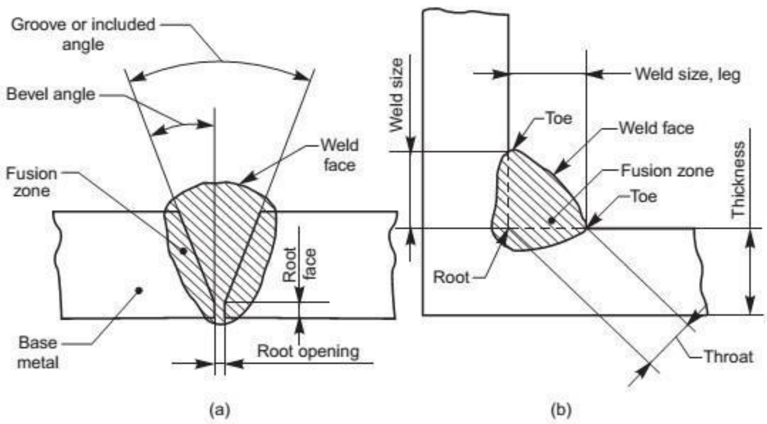



*Fig.1.59.(a) Butt weld (b) Fillet weld*

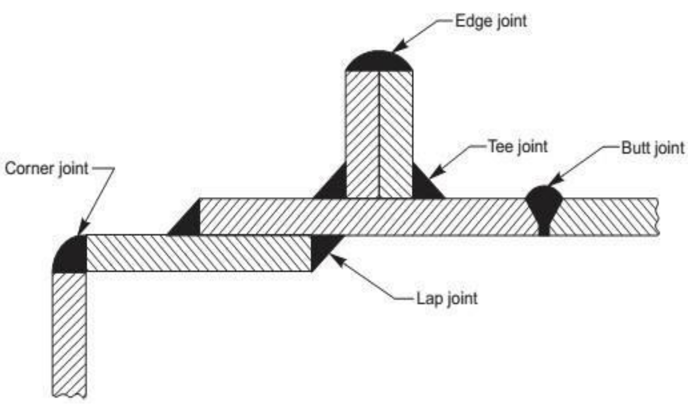



*Fig.1.60.Types of joints*

Various categories of welded joints (welds) are characterized by symbols which, in general are similar to the shape of welds to be made. These symbols are categorized as:

*(i)* Elementary symbols,
*(ii)* Supplementary symbols,
*(iii)* Combination of elementary and supplementary symbols and *(iv)*Combination of elementary symbols.

### Position of welded symbols on the drawings.

The complete method of representation of the welds on the drawing comprises, in addition to the symbol (3), the following:

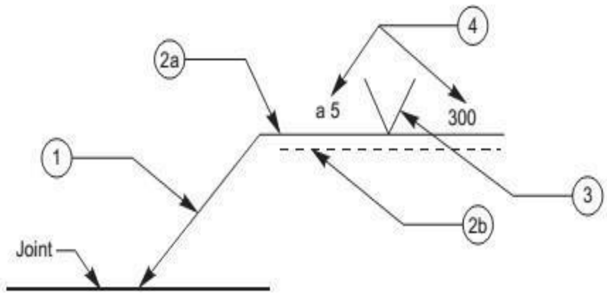



*Fig.1.61.Position of welded symbols on the drawings*

*(i)* An arrow line (1) per joint,

*(ii)* A dual reference line, consisting of two parallel lines; one continuous and one dashed (2a, 2b) and *(iii)*A certain number of dimensions (4) and conventional signs (3).

**NOTE:** The dashed line may be drawn either above or below the continuous line. For symmetrical welds, the dashed line is omitted

*Table.1.9.Elementary welding symbols*

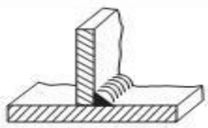
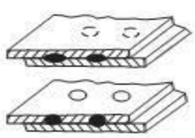
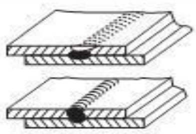
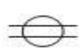
| *No.* | *Designation* | *Illustration* | *Symbol* |
|---|---|---|---|
| 1. | Butt weld between plates with raised edges (the raised edges being melted down completely) |  |  |
| 2. | Square butt weld |  |  |
| 3. | Single-V butt weld |  |  |
| 4. | Single-bevel butt weld |  |  |
| 5. | Single-V butt weld with broad root face |  |  |
| 6. | Single-bevel butt weld with broad root face |  |  |
| 7. | Single-U butt weld (parallel or sloping sides) |  |  |
| 8. | Single-U butt weld |  |  |
| 9. | Backing run; back or backing weld |  |  |
| 10. | Fillet weld |  |  |
| 11. | Plug weld; plug or slot weld |  |  |
| 12. | Spot weld |  |  |
| 13. | Seam weld |  |  |

*Table.1.10.Supplementary welding symbols*

| *Shape of weld surface* | *Symbol* |
|---|---|
| (*a*) Flat (usually finished flush) |  |
| (*b*) Convex |  |
| (*c*) Concave |  |

*Table.1.11.Combination of elementary and supplementary symbols*

| *Designation* | *Illustration* | *Symbol* |
|---|---|---|
| Flat (flush) single-V butt weld |  |  |
| Convex double-V butt weld |  |  |
| Concave fillet weld |  |  |
| Flat (flush) single-V butt weld with flat (flush) backing run |  |  |

## Limits, Tolerances and Fits

The manufacture of interchangeable parts require precision. Precision is the degree of accuracy to ensure the functioning of a part as intended. However, experience shows that it is impossible to make parts economically to the exact dimensions. This may be due to,

***(i)*** Inaccuracies of machines and tools,
***(ii)*** Inaccuracies in setting the work to the tool, and ***(iii)***Error in measurement, etc.

The workman, therefore, has to be given some allowable margin so that he can produce a part, the dimensions of which will lie between two acceptable limits, a maximum and a minimum.

- ➢ The system in which a variation is accepted is called the limit system ➢The allowable deviations are called tolerances.
- ➢ The relationships between the mating parts are called fits.

The study of limits, tolerances and fits is a must for technologists involved in production. The same must be reflected on production drawing, for guiding the craftsman on the shop floor.

## Need of Limits and fits

- ➢ Mass production and specialisation.
- ➢ Standardisation
- ➢ Interchangeability

### Limit system

Following are some of the terms used in the limit system:

**a) Tolerances**

- The permissible variation of a size is called tolerance.
- It is the difference between the maximum and minimum permissible limits of the given size.
- If the variation is provided on one side of the basic size, it is termed as unilateral tolerance. Similarly, if the variation is provided on both sides of the basic size, it is known as bilateral tolerance.

**b) Limits**

- The two extreme permissible sizes between which the actual size is contained are called limits.
- The maximum size is called the upper limit and the minimum size is called the lower limit.

**c)Deviation**

- It is the algebraic difference between a size (actual, maximum, etc.) and the corresponding basic size.

**d)Actual deviation**

- It is the algebraic difference between the actual size and the corresponding basic size. **e)Upper deviation**
- It is the algebraic difference between the maximum limit of the size and the corresponding basic size.

**f) Lower deviation**

- It is the algebraic difference between the minimum limit of the size and the corresponding basic size.

**g) Allowance**

- An allowable is the algebraic difference in dimension between the mating parts.
- If the allowance is positive, it will result in minimum clearance between the mating parts and if the allowance is negative, it will result in maximum interference. **h)Basic size**

It is determined solely from design calculations. If the strength and stiffness requirements need a 50mm diameter shaft, then 50mm is the basic shaft size. If it has to fit into a hole, then 50 mm is the basic size of the hole. Figure illustrates the basic size, deviations and tolerances.

Here, the two limit dimensions of the shaft are deviating in the negative direction with respect to the basic size and those of the hole in the positive direction. The line corresponding to the basic size is called the zero line or line of zero deviation.

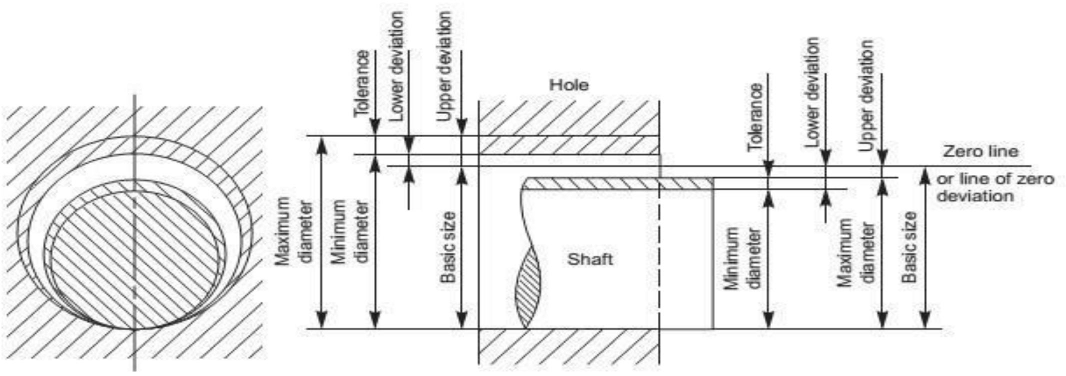



*Fig.1.62. Diagram illustrating basic size deviation and tolerances*

**j) Design size**

It is that size, from which the limits of size are derived by the application of tolerances. If there is no allowance, the design size is the same as the basic size. If an allowance of 0.05 mm for clearance is applied, say to a shaft of 50 mm diameter, then its design size is (50 – 0.05) = 49.95mm. A tolerance is then applied to this dimension.

### k) Actual size

It is the size obtained after manufacture.

### l) Clearance

In a fit a positive difference between the size of the hole and shat (the hole being greater than the shaft) allowing relative movement between them is called a clearance.

### m) Interferences

In a fit a negative difference between the size of the hole and shat (the shaft being greater than the hole) allowing relative movement between them is called interference.

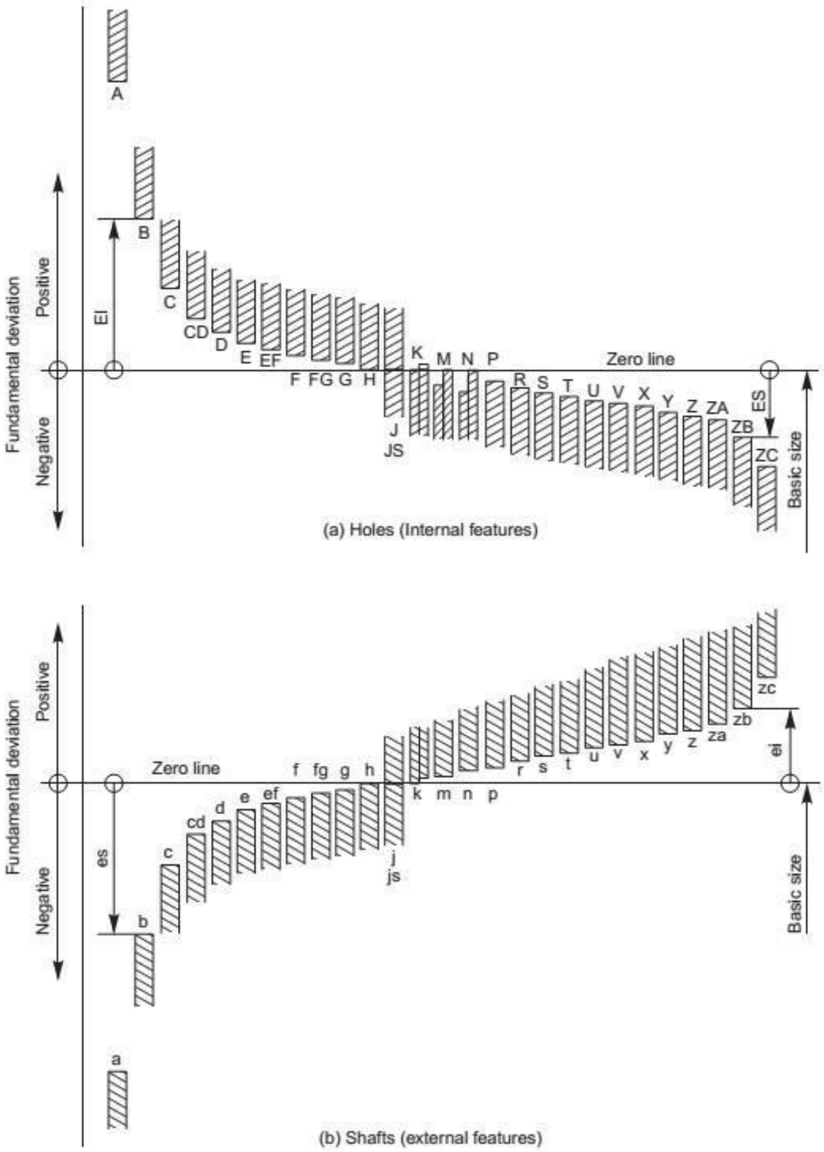



*Fig.1.63. Graphical illustration of tolerance zones*

## Fits

- The relation between two mating parts is known as a fit. Depending upon the actual limits of the hole or shaft sizes, Fits may be classified as

1. Clearance fit,
2. Transition fit and
3. Interference fit.

### Clearance fit

- It is a fit that gives a clearance between the two mating parts.

### Minimum clearance

It is the difference between the minimum size of the hole and the maximum size of the shaft in a clearance fit.

### Maximum clearance

It is the difference between the maximum size of the hole and the minimum size of the shaft in a clearance or transition fit.

The fit between the shaft and hole in Fig. 1.125 is a clearance fit that permits a minimum clearance (allowance) value of 29.95 – 29.90 = + 0.05 mm and a maximum clearance of + 0.15 mm.

### Transition fit

This fit may result in either an interference or a clearance, depending upon the actual values of the tolerance of individual parts. The shaft in Fig. 1.126 may be either smaller or largerthan the hole and still be within the prescribed tolerances. It results in a clearance fit, whenshaft diameter is 29.95 and hole diameter is 30.05 (+ 0.10 mm) and interference fit, when shaft diameter is 30.00 and hole diameter 29.95 (– 0.05 mm).

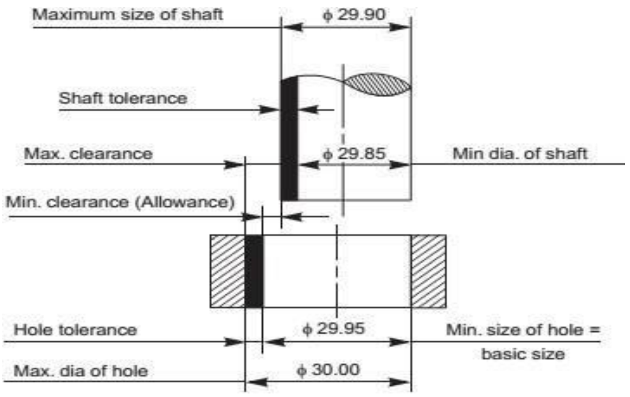



*Fig.1.64. Clearance fit*

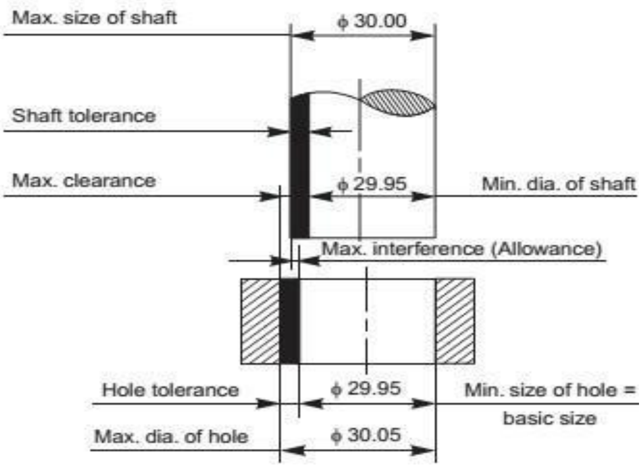



*Fig.1.65. Transition fit*

### Interference fit

If the difference between the hole and shaft sizes is negative before assembly; an interference fit is obtained.

### Minimum interference

It is the magnitude of the difference (negative) between the maximum size of the hole and the minimum size of the shaft in an interference fit before assembly.

### Maximum interference

It is the magnitude of the difference between the minimum size of the hole and the maximum size of the shaft in an interference or a transition fit before assembly.

The shaft in Fig. 1.127 is larger than the hole, so it requires a press fit, which has an effect similar to welding of two parts. The value of minimum interference is 30.25 – 30.30 = – 0.05 mm and maximum interference is 30.15 – 30.40 = – 0.25 mm.

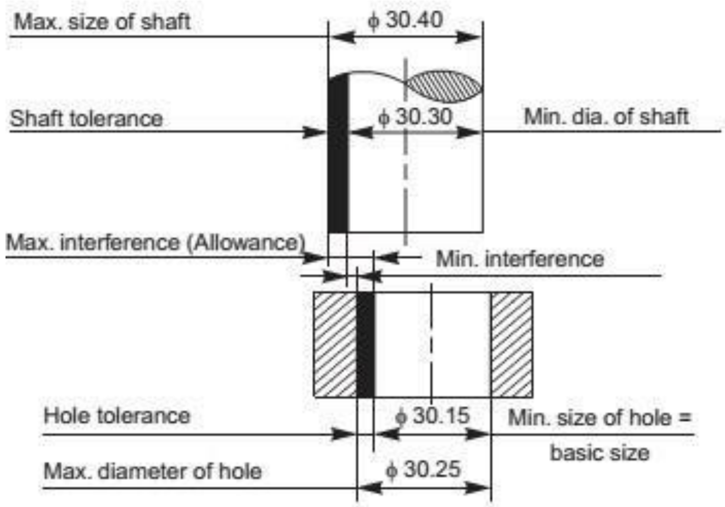



*Fig.1.66. Interference fit*

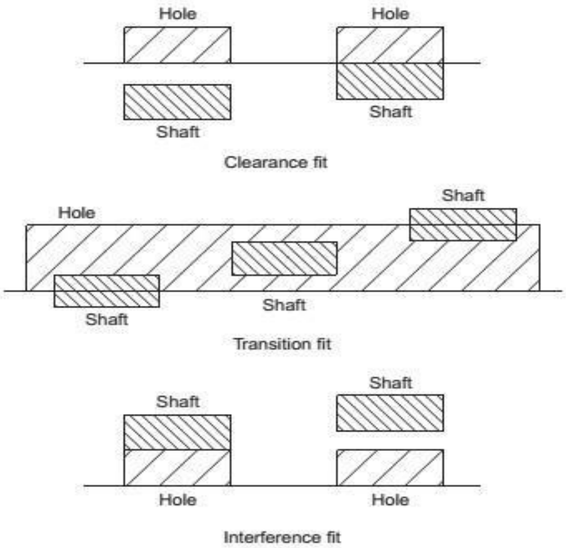



*Fig.1.67. Schematic representation of fits*

### Hole basis and shaft basis system

In working out limit dimensions for the three classes of fits; two systems are in use, viz., the hole basis system and shaft basis system.

### Hole basis system

In this system, the size of the shaft is obtained by subtracting the allowance from the basic size of the hole. This gives the design size of the shaft. Tolerances are then applied to each part separately. In this system, the lower deviation of the hole is zero. The letter symbol for this situation is 'H'.

The hole basis system is preferred in most cases, since standard tools like drills, reamers, broaches, etc., are used for making a hole.

### Shaft basis system

In this system, the size of the hole is obtained by adding the allowance to the basic size of the shaft. This gives the design size for the hole. Tolerances are then applied to each part. In this system, the upper deviation of the shaft is zero. The letter symbol for this situation is 'h'.

The shaft basis system is preferred by (i) industries using semi-finished shafting as raw materials, e.g., textile industries, where spindles of same size are used as cold-finished shafting and (ii) when several parts having different fits but one nominal size is required on a single shaft.

The representation of the hole basis and the shaft basis systems schematically. Table 1.26 gives equivalent fits on the hole basis and shaft basis systems to obtain the same fit.

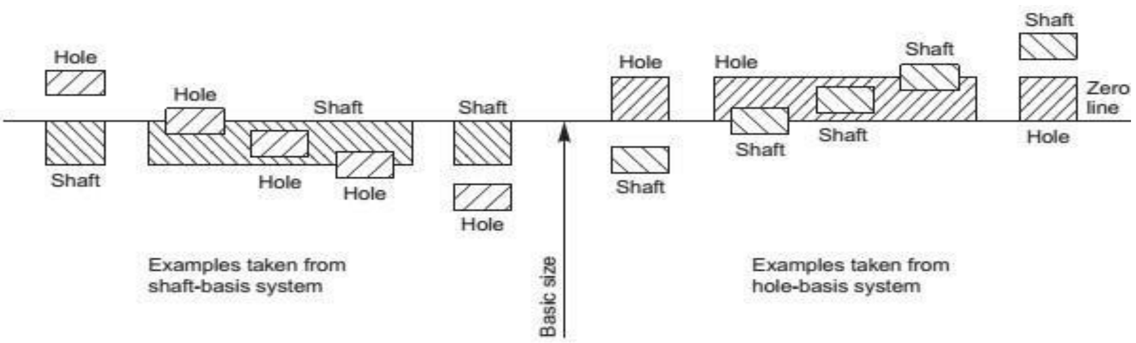



Fig.1.68. *Examples illustrating shaft basis and hole basis system*

### Surface Texture.

- Surface texture or surface finished is the amount of geometric irregularity produced on the surface.
- Surface finish is important for the proper functioning of mating parts. Parts such as piston, cylinder, gear, bearings required a very smooth finish for their function.

The two principle reasons for surface finish control are

i. Friction reduction ii. The control of wear

**Importance of surface finish**

1. Surface finish is important for the wear service of certain piece subject to dry friction. Eg.: Machine tool bits, stamping dies, threading dies, rolls, clutch plates etc.
2. Smooth surface finishes are essential on certain high precision pieces. Eg.:Micrometer anvils, gauges and gauge blocks, etc.
3. Smoothness in the surface is often important for the visual appeal of the finished product. Eg.: Rolls, extrusion dies, and precision casting dies.
4. Surface finish control may be necessary to ensure quiet operation. Eg.: Gear and other parts.

**Controlled surface**

- ➢ The surfaces which make contact with other surface are known as controlled surface.
- ➢ The surface structure of controlled surface will affect the function of the finished product. The degree of surface finish is a factor in cost during manufacturing.

**Controlled surface**

➢Surface does not need further machining after they are initially formed by casting, forging, or machining. The texture will not affect the function of the finished product of these surface do not make contract with other surfaces. These surface are referred as uncontrolled surface. The geometrical characteristics of a surface include,

1.Macro-deviations,
2.Surface waviness, and
3.Micro-irregularities.

The surface roughness is evaluated by the height, Rt and mean roughness index Ra of the microirregularities. Following are the definitions of the terms indicated in Fig. 16.1:

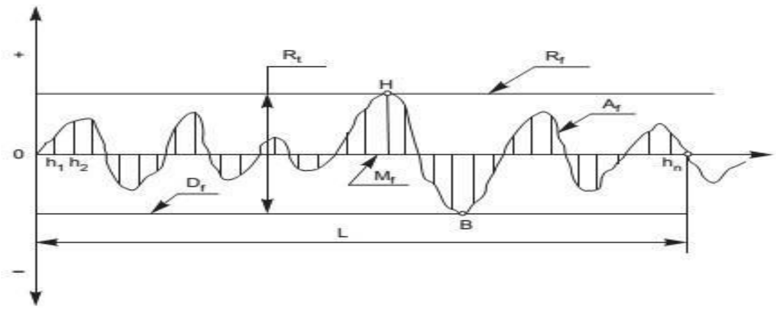



*Fig.1.69.* Surface texture

❖ **Actual profile, $A_t$**

It is the profile of the actual surface obtained by finishing operation.

❖ **Reference profile, Rf**

It is the profile to which the irregularities of the surface are referred to. It passes through the highest point of the actual profile.

❖ **Datum profile, Df**

It is the profile, parallel to the reference profile. It passes through the lowest point B of the actual profile.

❖ **Mean profile, Mf**

It is that profile, within the sampling length chosen (L), such that the sum of the materialfilled areas enclosed above it by the actual profile is equal to the sum of the material-void areasenclosed below it by the profile.

❖ **Peak-to-valley Height, Rt**

It is the distance from the datum profile to the reference profile.

❖ **Mean roughness index, Ra**

It is the arithmetic mean of the absolute values of the heights hi between the actual and mean profiles. It is given by,

$R_a = \int_{x=0}^{x=L} |hi|$ dx, where Lis the sampling length

❖ **Surface roughness number**

The surface roughness number represents the average departure of the surface from perfection over a prescribed sampling length, usually selected as 0.8 mm and is expressed in microns. The measurements are usually made along a line, running at right angle to the general direction of tool marks on the surface.

Surface roughness values are usually expressed as the Ra value in microns, which are determined from **(Fig. 1.130),**

$$\mathbf{Ra} = \frac{h1+h2+h3+\cdots+hn}{n}$$

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

1. Straight edge
2. Surface guage
3. Optical flat
4. Tool maker’s microscope
5. Profilometer
6. Profilograph
7. Talysurf

*Table.1.1.Surface roughness values & grades*

| Roughness value Rain µm | 50 | 25 | 12.5 | 6.3 | 3.2 | 1.6 | 0.8 | 0.4 | 0.2 | 0.1 | 0.05 | 0.025 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Roughness grade number | N12 | N11 | N10 | N9 | N8 | N7 | N6 | N5 | N4 | N3 | N2 | N1 |
| Roughness symbol | ~ | ∇ | | ∇∇ | | | ∇∇∇ | | | ∇∇∇∇ | | |

*Table.1.2.Symbol for direction of lay*

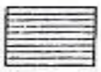
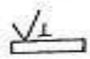
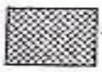
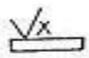
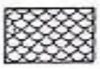
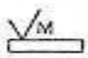
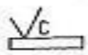
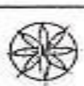
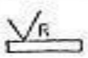
| Meaning | Symbol | Diagram indicates the direction of lay | Indication of lay on drawing | Interpretation |
|---|---|---|---|---|
| Parallel | = |  |  | Parallel to the plane of projection of the view in which the symbol is used |
| Perpendicular | ⊥ |  |  | Perpendicular to the plane of projection of the view in which the symbol is used |
| Crossed | X |  |  | Crosses in two slant directions relative to the plane of projection of the view in which the symbol is used |
| Multi directional | M |  |  | Multi direction to the plane of projection of the view |
| Circular | C |  |  | Approximately circular relative to the centre of the surface in which the symbol in which the symbol is applied |
| Radial | R |  |  | Approximately radial relative to the centre of the surface to which the symbol is applied |

*Table.1.3.Surface roughness symbols*

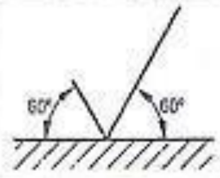
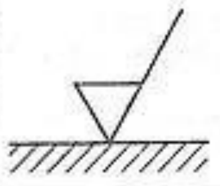
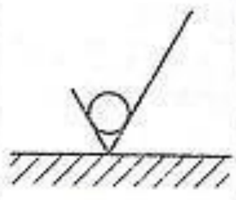
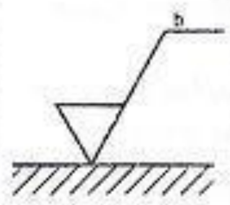
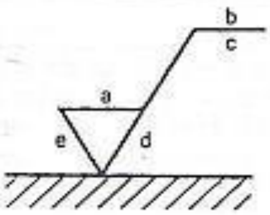
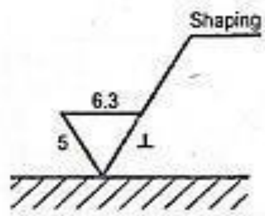
| | |
|---|---|
|  | **Basic symbol:** It is used to indicate surface finish by any production process other than machining. It consists of two legs of unequal length inclined at 60° to the line representing the surface. |
|  | **Symbol for surface finish by machining process:** If the surface finish is to be obtained by removal of material by any of the machining process, a horizontal bar is added to the shorter leg of basic symbol. |
|  | **Symbol for surface finish without removal of material:** If the surface finish is to be obtained without removal of material or when a surface to be left in the condition obtained from a preceding process, a circle is added to the basic symbol. |
|  | **Symbol for surface finish by a particular machining process:** If the surface finish is to be produced by a particular machining method such as milling, shaping, chrome plating etc., the method shall be indicated above a horizontal line added to the longer leg of the basic symbol. |

*Table.1.4.Surface roughness symbol with all the characteristics*

| Standard symbol | Example |
|---|---|
|  a – Surface roughness value in microns (or) roughness grade number |  A surface with maximum roughness value of 6.3 microns |
| b – Production method (or) coating method | Production method is shaping process |
| c – Sampling length | Sampling length is 2.5 mm |
| d – Direction of lay | The direction of lay is perpendicular to the plane of projection of view |
| e – Machine allowance | Machine allowance is 5 mm |

# Unit –II

## Assembly drawing

An assembly drawing is one which shows the location of each part in the finished product. It gives only a few main dimensions and hidden details are omitted.

An assembly drawing shall contain the following information

A. Main views.
B. Necessary section views if necessary.
C. Pictorial view if required for better understanding.
D. Overall dimensions.
E. Identification of individual parts.

A material and parts list shall also be added in tabular form, showing following details.

1. Part number
2. Part name
3. Quantity
4. Material

Thus an assembly drawing will show the relative position of each part, overall dimension of the product, bill of materials etc.

## Bill of materials and part list

An assembled drawing consists of many parts; each part is made of same of different material. There may be more than one part of same size and shape. All this informationis furnished in a bill of material or part list.

A specimen form of bill of materials and part list is shown below **Bill of material**

| **Sl.No.** | **Parts Name** | **Material** | **No. off** |
|---|---|---|---|
| 1 | Sleeve | M.S | 1 |
| 2 | Rod | M.S | 2 |
| 3 | Cotter | Steel | 2 |

## Sleeve and cotter joint

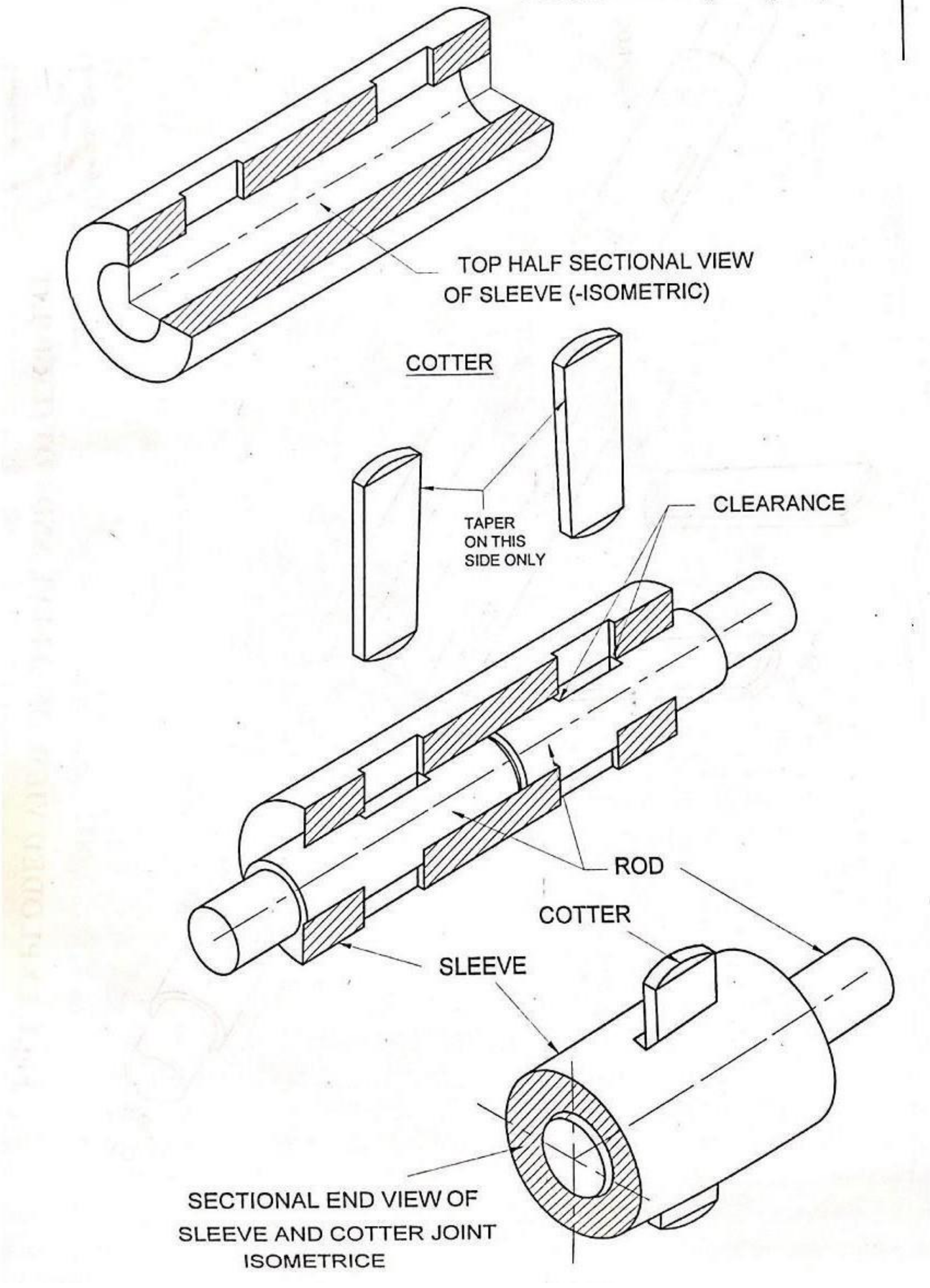
A sleeve and cotter joint consists of one sleeve, two cotters and two rods which are to be joined together. Cotters are flat wedge shaped pieces of steel of rectangular cross section. Cotters are uniform in thickness but tapering in width, generally on one side only. It is inserted at right angles to the axis of the rod to be connected. It is used to connect rigidly two rods subjects to tensile or compressive force. The diameter of the rod ends are enlarged to compensate the weakening effect caused by the cotter joint.

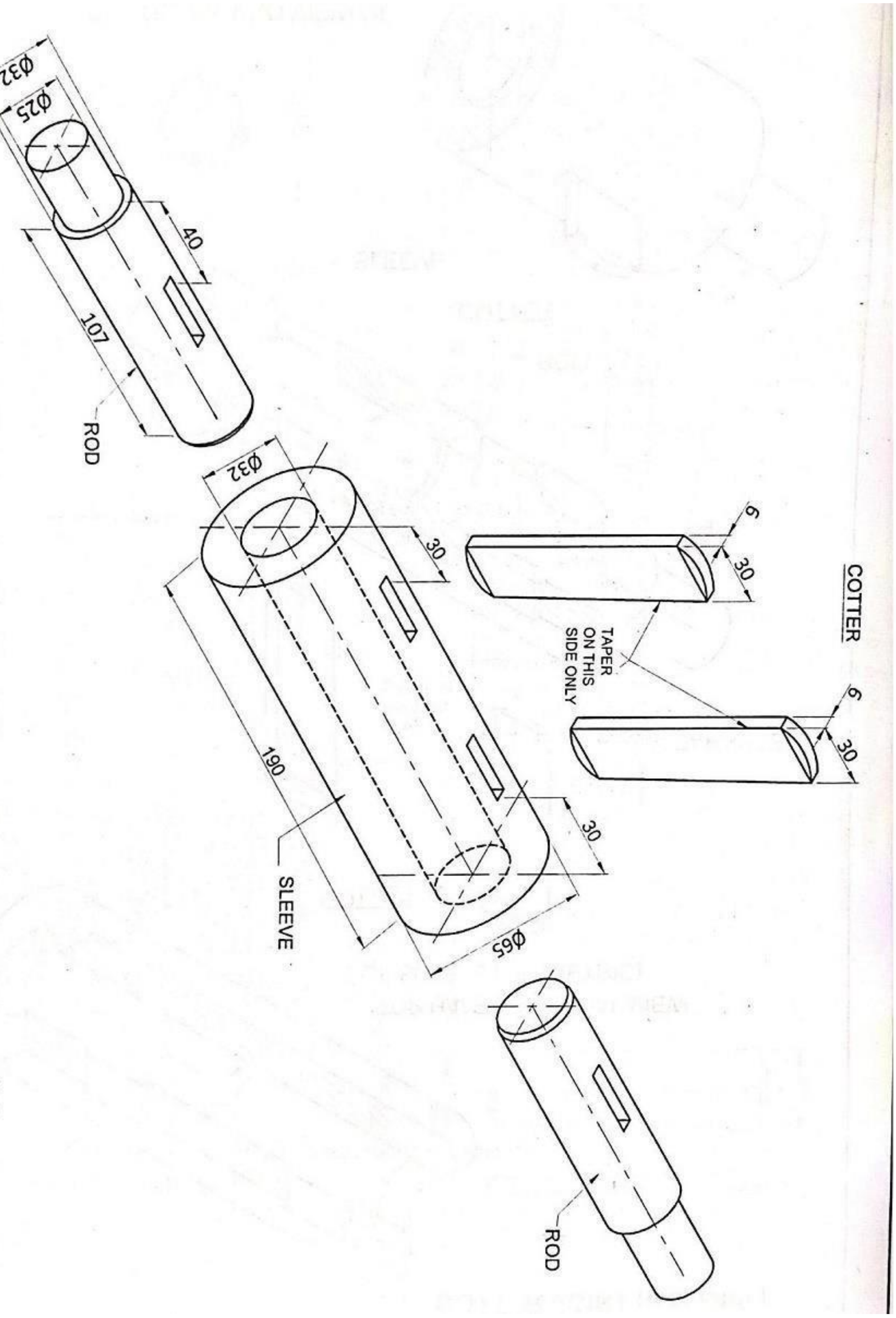
A clearance is provided to allow the tightening adjustment. It is generally upto 3mm when the cotter is in fixed position.

**Application**

The sleeve and cotter joints are used in connecting piston rod to cross head, pump rods, strap type connecting rod ends foundation bolts etc.

## ASSEMBLY AND SECTIONAL DETAILS OF SLEEVE AND COTTER JOINT (isometric)



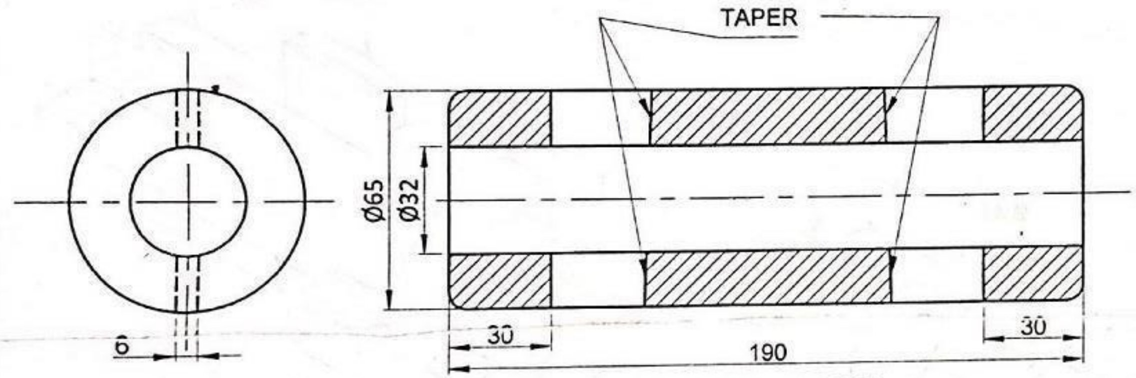



*All dimensions are in mm*

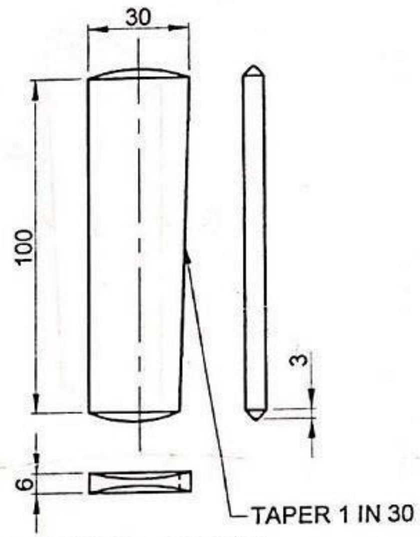
*Draw the following views for the given detail drawing of Sleeve and Cotter joint.*

1 (a) *Top half sectional elevation.*
(b) *Plan and*
(c) *Left side view*

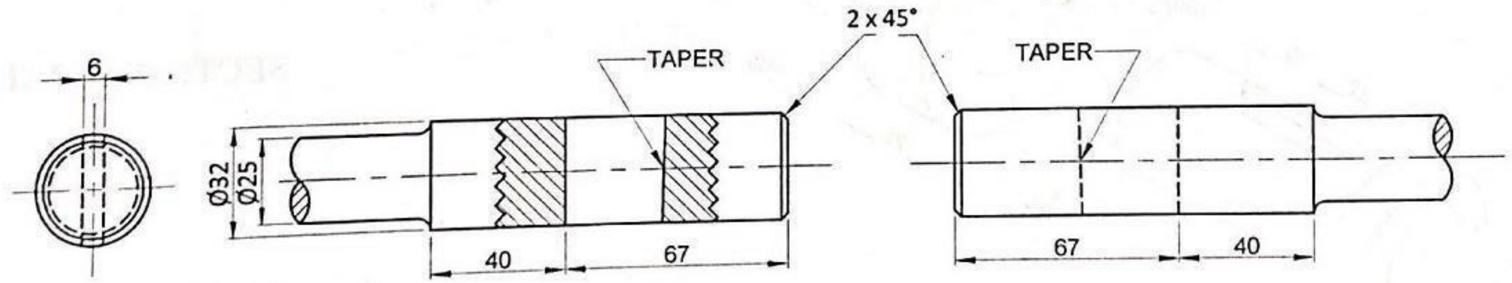
2. (a) *Sectional elevation*
(b) *Sectional plan and*
(c) *Sectional left side view*




SLEEVE - 1 OFF



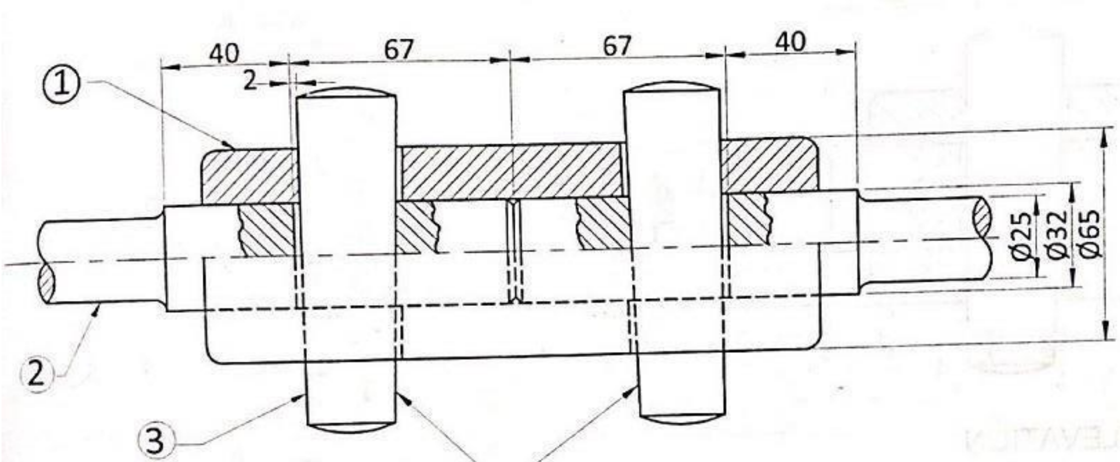

COTTER - 2 OFF



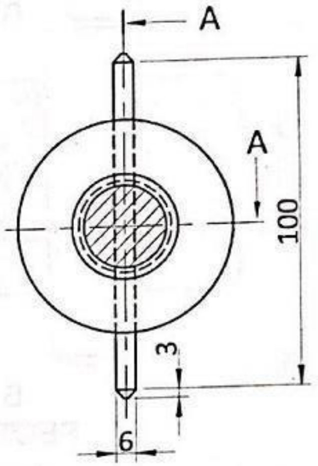

RODS - 1

**SLEEVE AND COTTER JOINT**

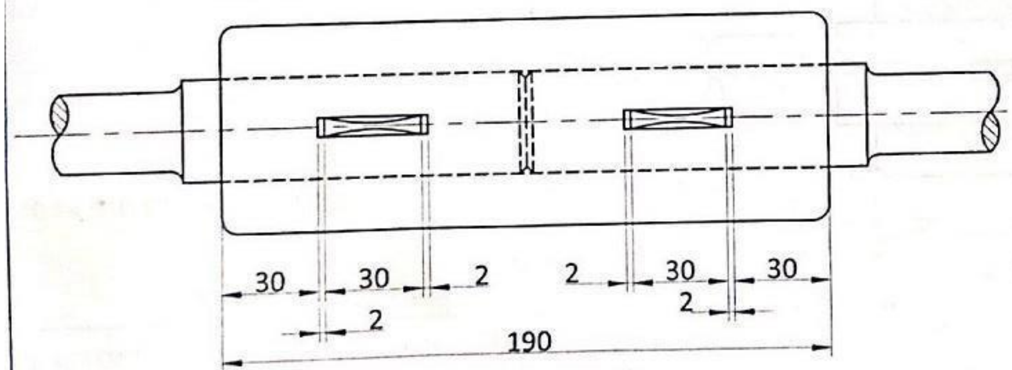
*All dimensions are in mm*




TOP HALF SECTIONAL ELEVATION (SECTION AT - A A)




LEFT SIDE VIEW



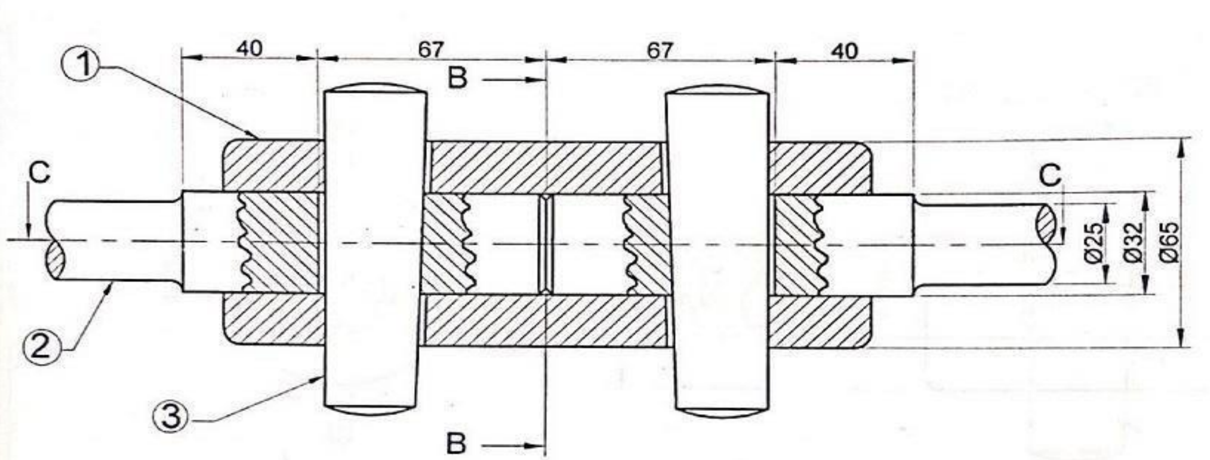

PLAN

*All dimensions are in mm*

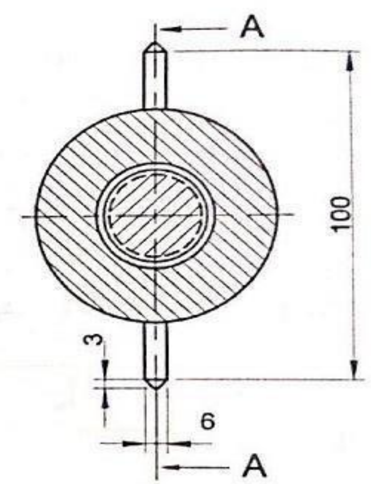
*BILL OF MATERIAL*

| S.No. | PART NAME | MATERIAL | NO.OFF |
|---|---|---|---|
| 1 | SLEEVE | MILD STEEL | 1 |
| 2 | ROD | MILD STEEL | 2 |
| 3 | COTTER | STEEL | 2 |

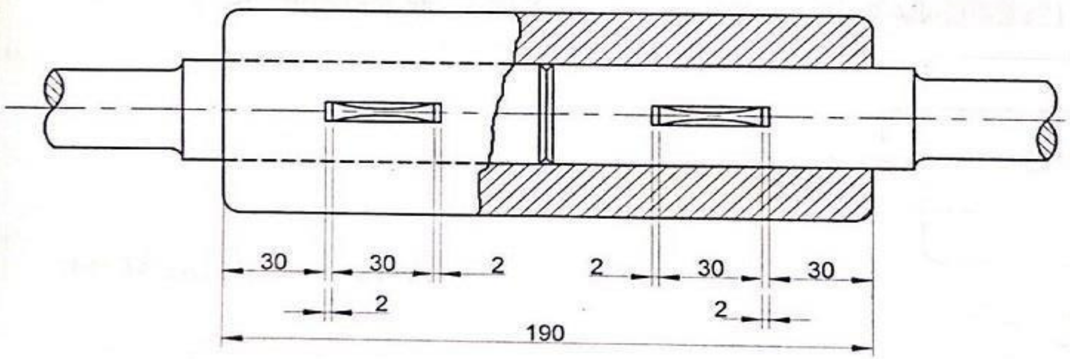
*SLEEVE AND COTTER JOINT*




SECTIONAL ELEVATION




SECTIONAL L.S VIEW




SECTIONAL PLAN

*All dimensions are in mm*

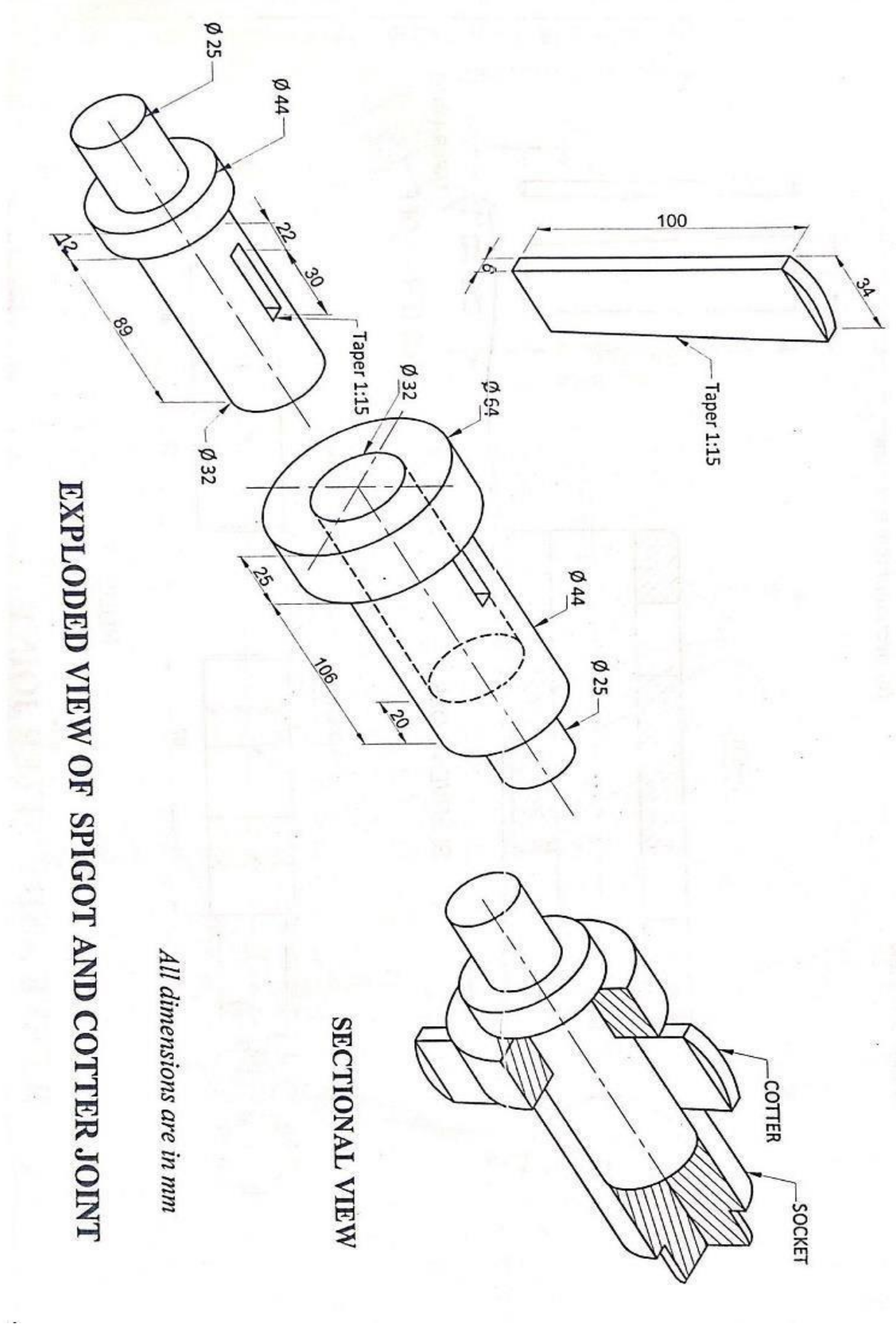
*BILL OF MATERIAL*

| S.No. | PART NAME | MATERIAL | NO.OFF |
|---|---|---|---|
| 1 | SLEEVE | MILD STEEL | 1 |
| 2 | RODS | MILD STEEL | 2 |
| 3 | COTTER | STEEL | 2 |

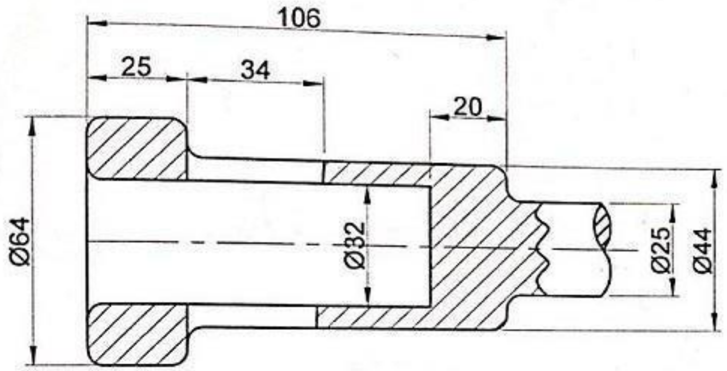
*SLEEVE AND COTTER JOINT*

## Spigot & cotter joint

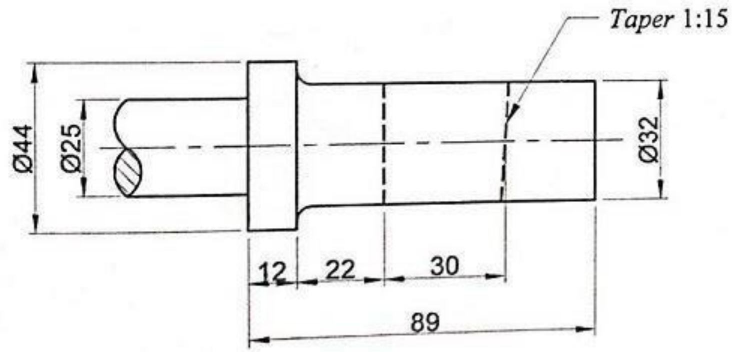
In the spigot and cotter joint, one of the round rods to be joined is made into the form of a solid rod with a flanged end (called spigot) and the rod, made in the form of socket to receive the spigot internally. Both the socket and spigot have rectangular slots cut perpendicular to the axis. When the spigot is fitted into the socket, these slots align vertically and a cotter is driven in, connecting both the parts. The cotter and slots are straight on one side and tapered on the other. On assembly, clearances form suitably so that the cotter can be driven out easily by force for dismantling.



*Draw the following Views for the given detail drawing of SPIGOT AND COTTER JOINT*
*(a) Sectional front view*
*(b) Plan*

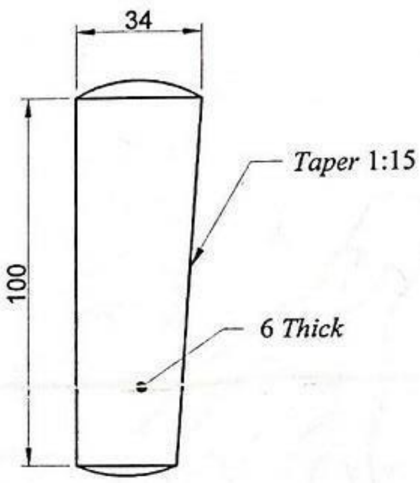



*SOCKET(M.S)*




*SPIGOT (Rod)M.S*

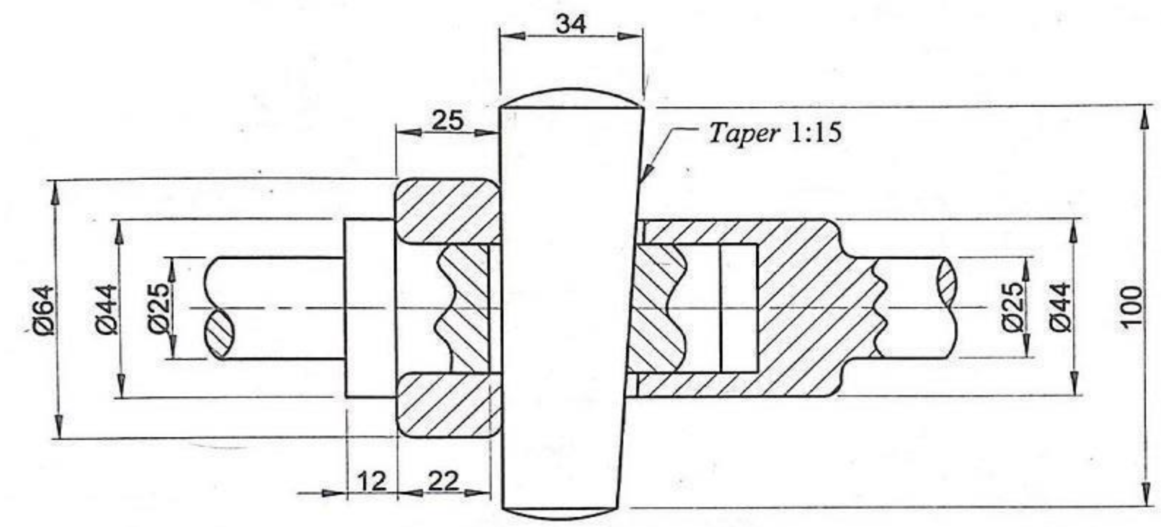
*FILLET RADIUS R3 WHEREVER NOT SPECIFIED*



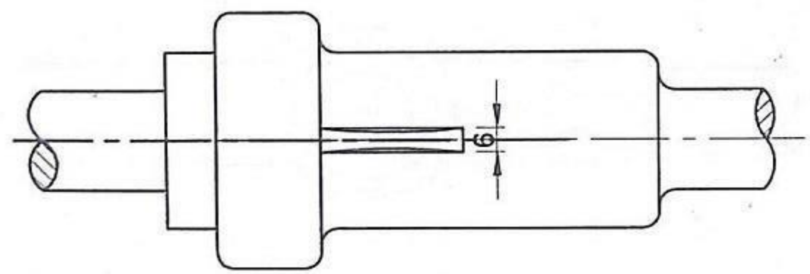

*COTTER(Steel)*

*All dimensions are in mm*

**SPIGOT AND COTTER JOINT**




FULL SECTIONAL FRONT VIEW




TOP VIEW

SPIGOT AND COTTER JOINT

*All dimension are in mm*

| PART. NO. | PART NAME | MATERIAL | NO.OFF |
|---|---|---|---|
| 1 | SOCKET | M.S | 1 |
| 2 | SPIGOT(ROD) | M.S | 1 |
| 3 | COTTER | STEEL | 1 |

## Knuckle joint

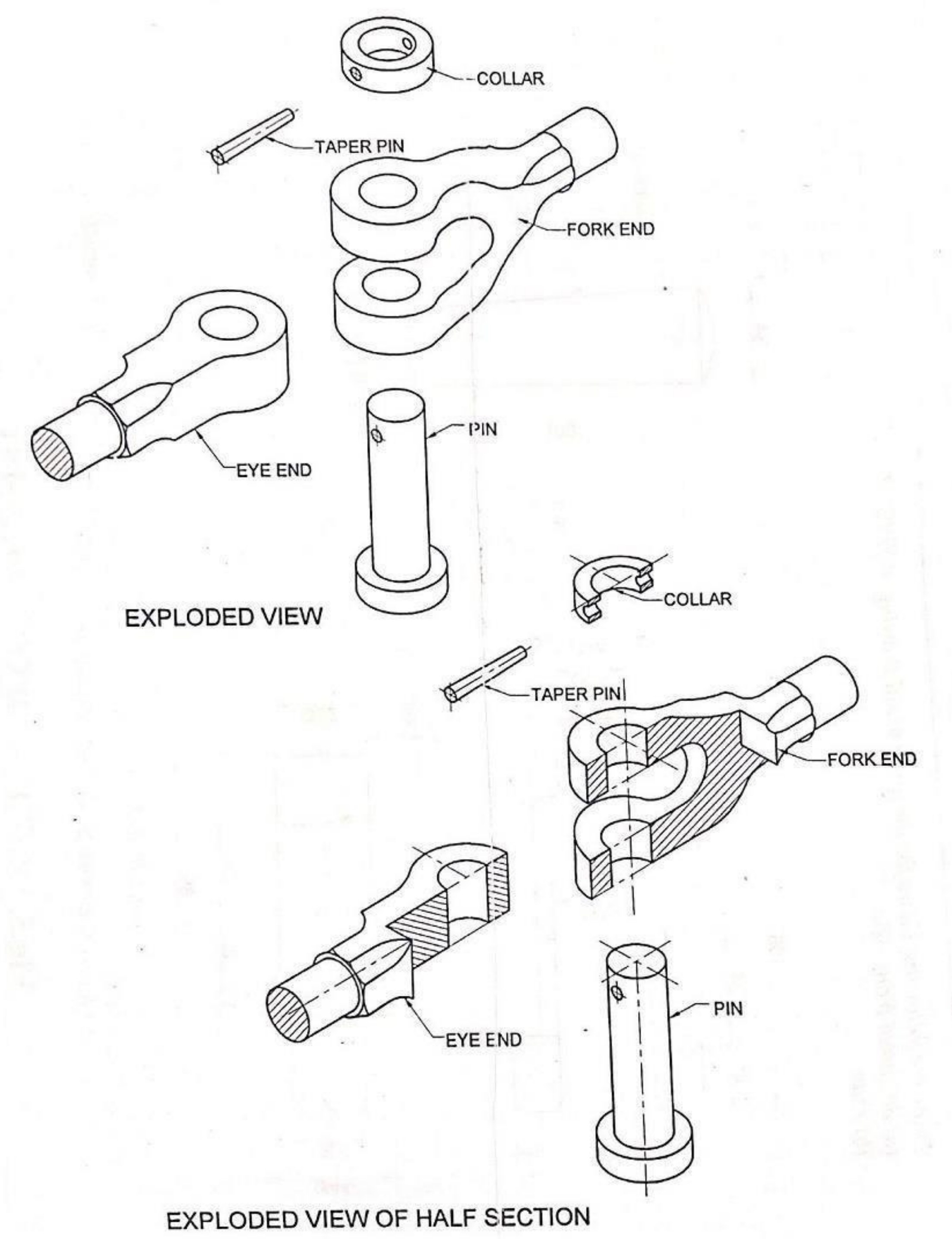
The rod ends connected by knuckle pin is called knuckle joint. Knuckle joints are used when the rods are required to have a small angular movement in one plane and can be used for rotary and transverse motions.

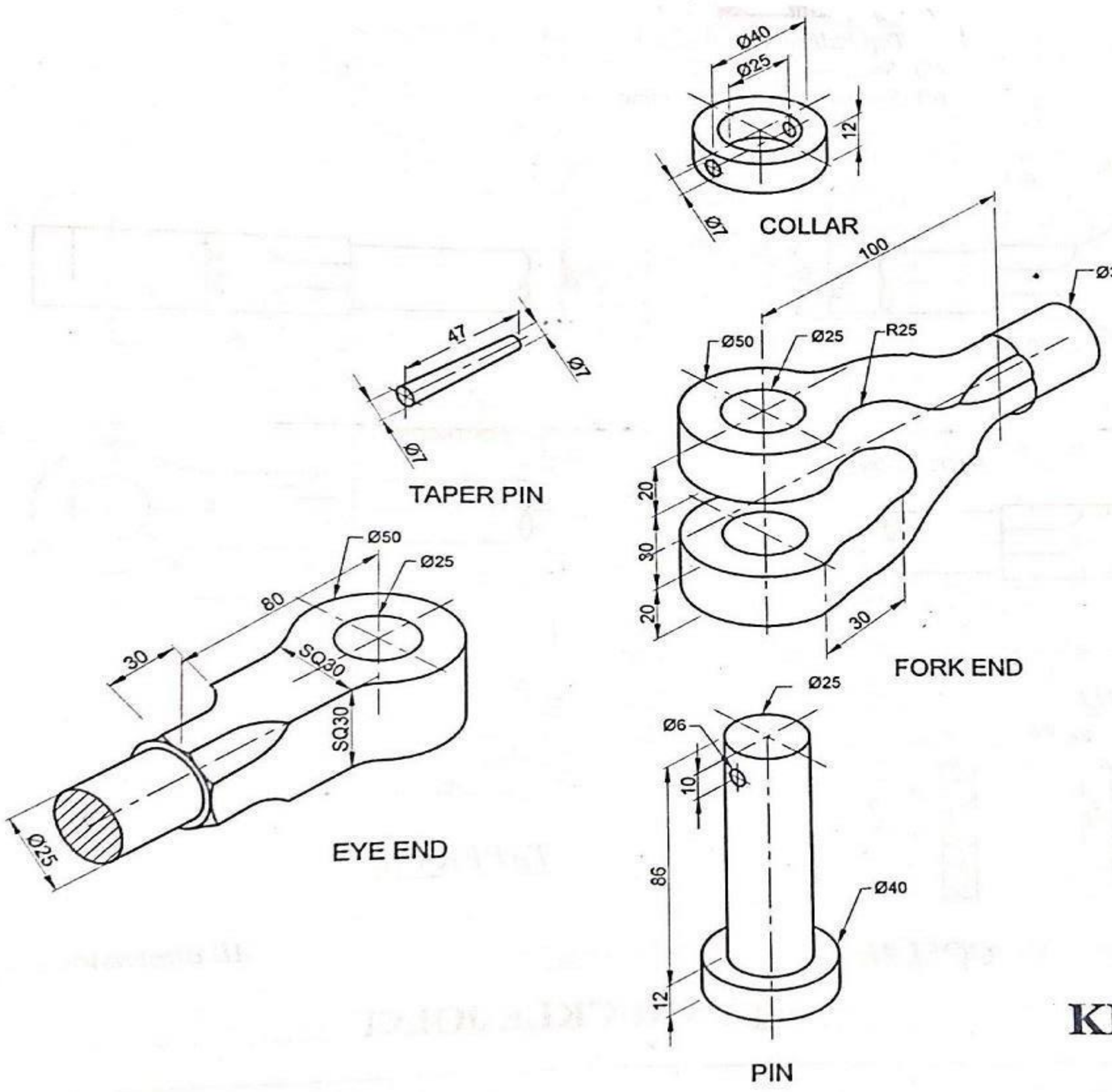
One end of the rod ends is forged into the shape of a 'fork' (double eye) and other in the shape of an eye. The eye end is inserted between the jaws, of the fork end. After alignment of holes, a knuckle pin is passed into them. The knuckle pin has a head at one end and collar at the other end. The pin is secured by a taper pin.

### Application

1. These type of joints are used as ties for roof trusses and chain links.
2. Steam engine value rod and eccentric are connected by means of this joint.

**EXPLODED VIEW OF KNUCKLE JOINT**





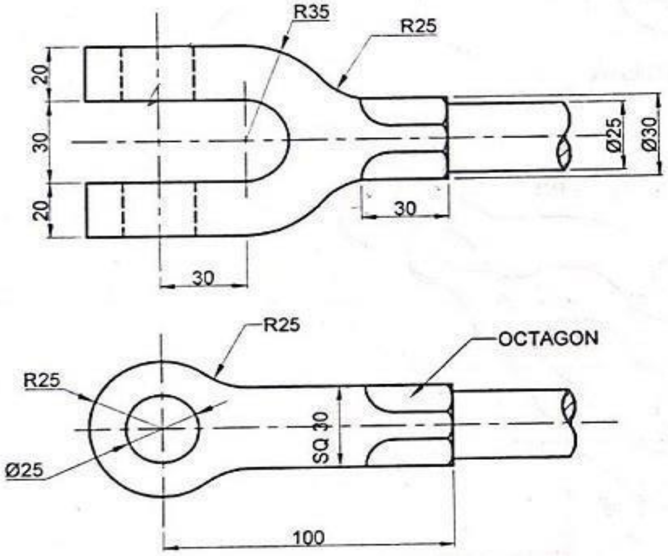

*All dimensions are in mm*

# KNUCKLE JOINT

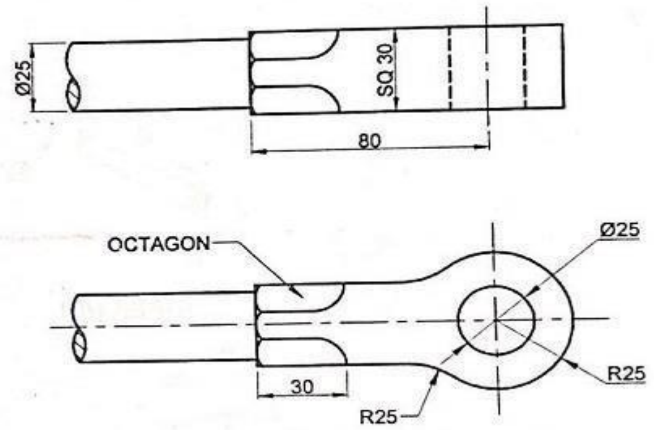
*Draw the following views for the given detail drawing of Knuckle Joint.*

*1. (a) Sectional elevation*
*(b) Plan and*
*(c) Right side view*

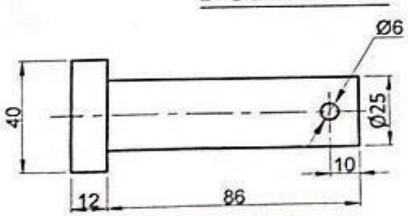
*2. (a) Top half sectional elevation*
*(b) Sectional plan and*
*(c) Sectional Right side view*



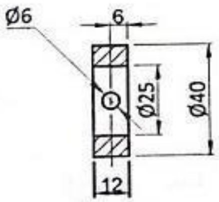

*FORK END*



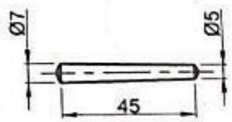

*EYE END*




*PIN*



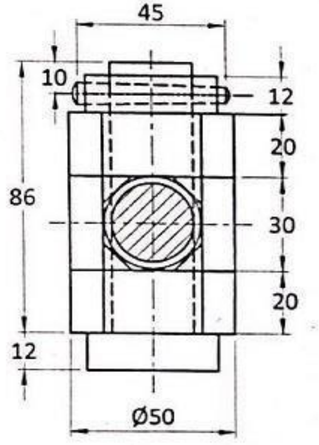

*COLLAR*



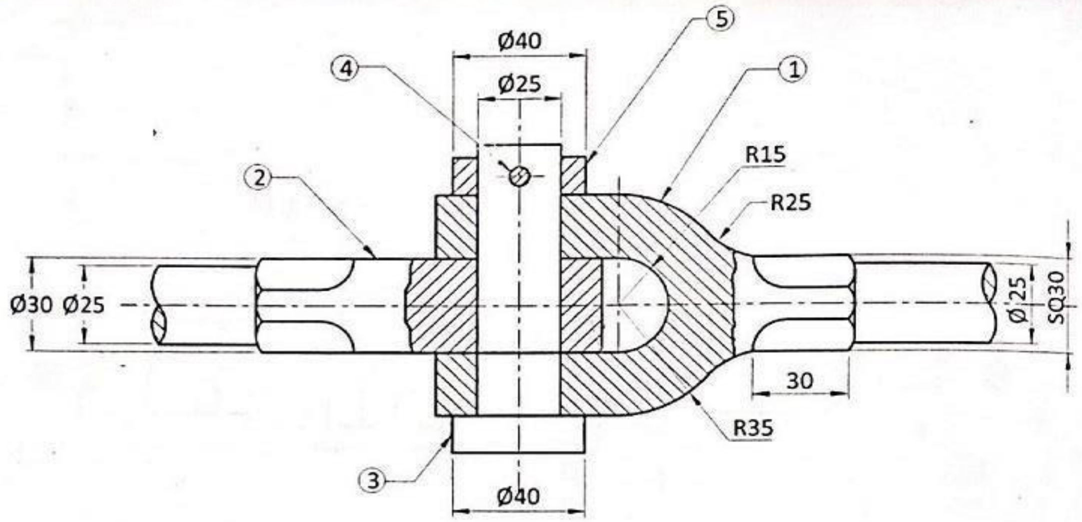

*TAPER PIN*

*All dimensions are in mm*

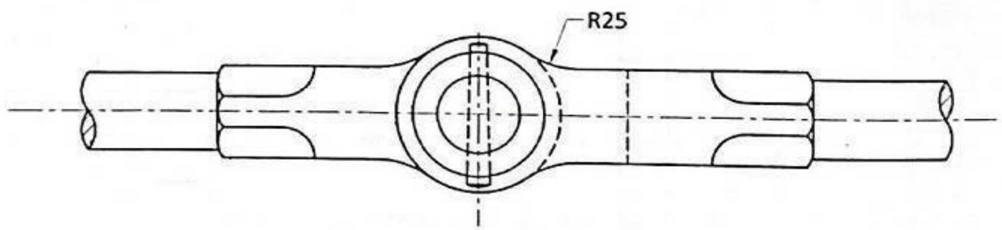
**KNUCKLE JOINT**




*RIGHT SIDE VIEW*




*SECTIONAL ELEVATION*



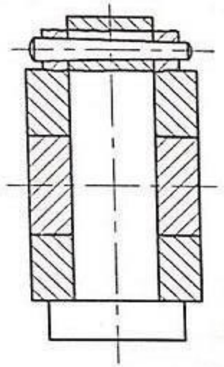

*PLAN*

*ALL DIMENSIONS ARE IN mm*

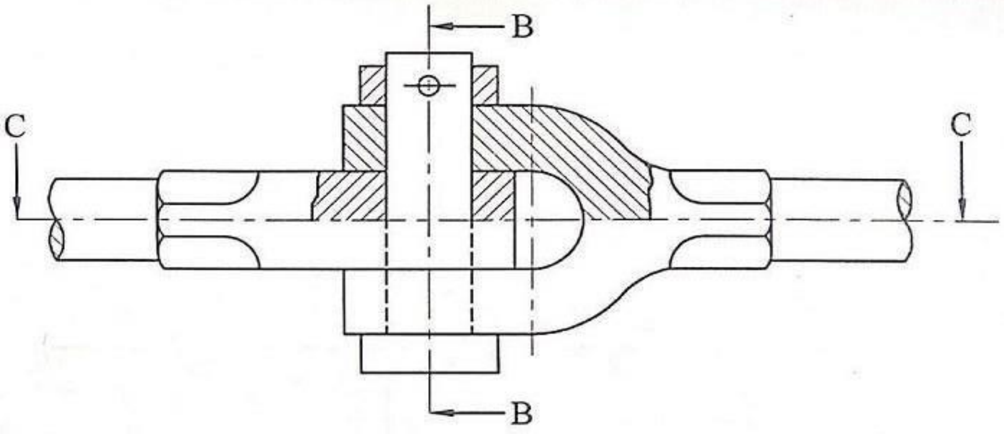
*BILL OF MATERIAL*

| PART NO. | PART NAME | MATERIAL | NO.OFF |
|---|---|---|---|
| 1 | FORK END | FORGED STEEL | 1 |
| 2 | EYE END | FORGED STEEL | 1 |
| 3 | PIN | MILD STEEL | 1 |
| 4 | TAPER PIN | MILD STEEL | 1 |
| 5 | COLLER | MILD STEEL | 1 |

# KNUCKLE JOINT



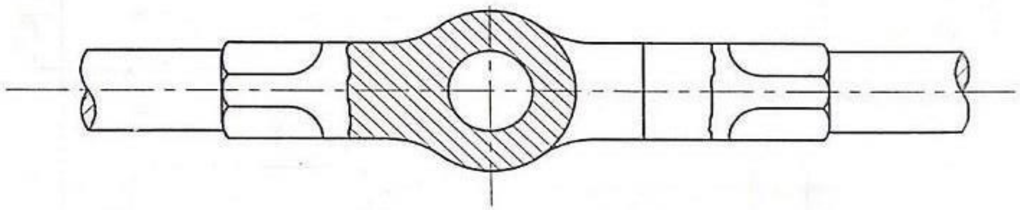
SECTIONAL RIGHT SIDE VIEW




TOP SECTIONAL ELEVATION

BILL OF MATERIAL

| PART NO. | PART NAME | MATERIAL | NO.OFF |
|---|---|---|---|
| 1 | FORK END | FORGED STEEL | 1 |
| 2 | EYE END | FORGED STEEL | 1 |
| 3 | PIN | MILD STEEL | 1 |
| 4 | TAPER PIN | MILD STEEL | 1 |
| 5 | COLLER | MILD STEEL | 1 |



SECTIONAL PLAN

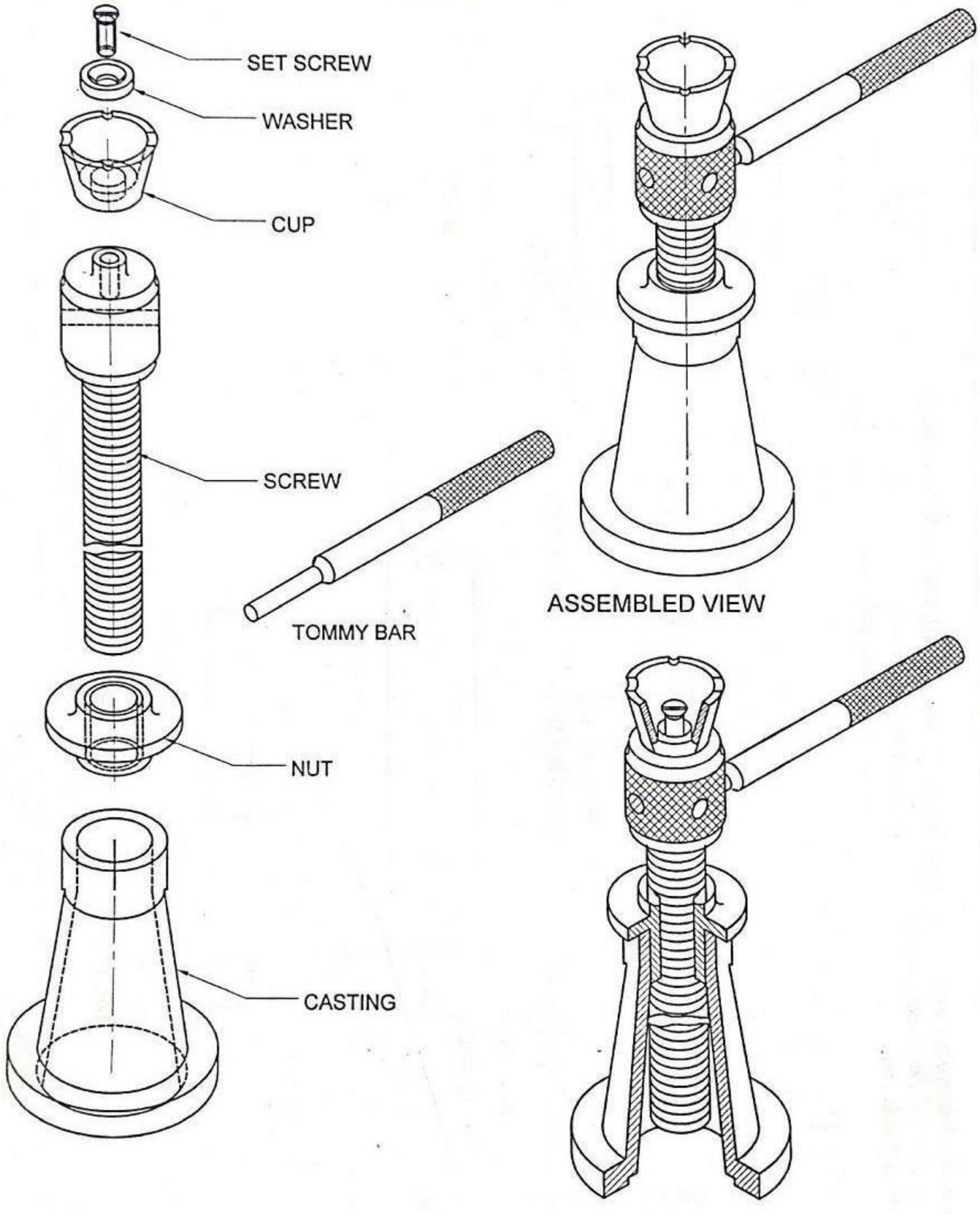
ALL DIMENSIONS ARE IN MM

# KNUCKLE JOINT

## Screw jack

Screw jacks are used for raising heavy bodies through very small heights. In it, the screw works in a nut which is press fitted into the main body. A tommy bar is inserted into a hole through the enlarged head of a screw and when this is turned, the screw will move up or down, thereby raising or lowering the load.

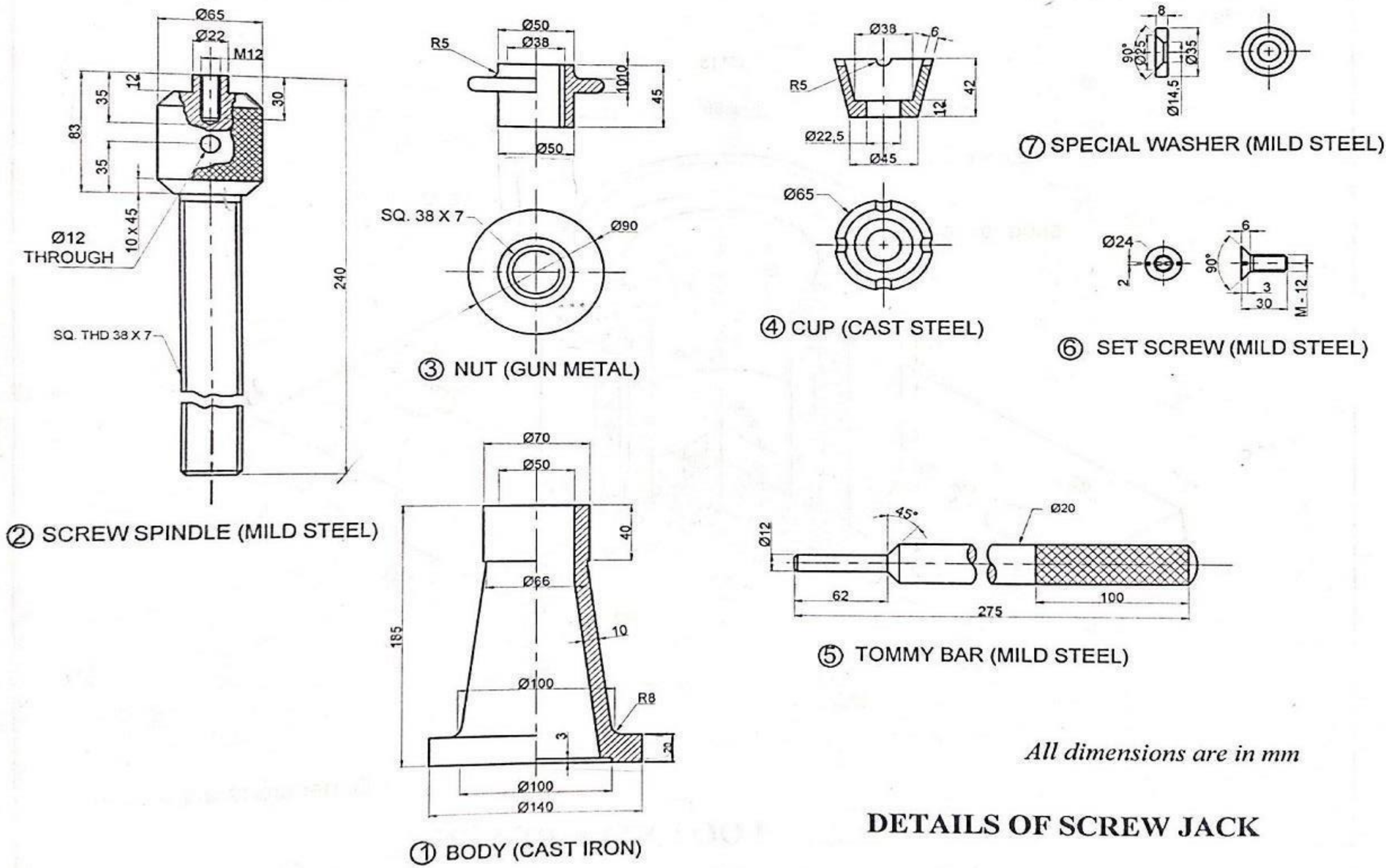
A cup is placed at the top of the screw to carry the load conveniently. This is serrated to provide a better grip to the load. The cup, on assembly, is free to rotate independently of the screw.




EXPLODED VIEW OF SCREW JACK HALF SECTIONAL VIEW

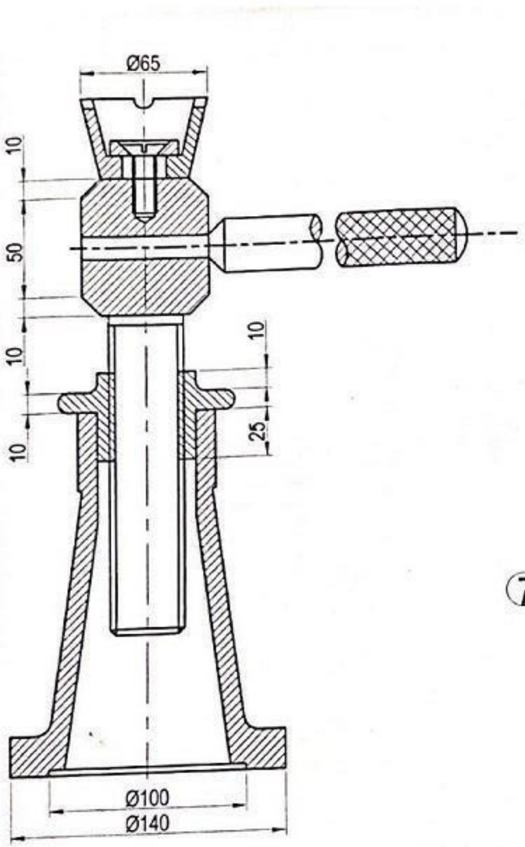
Detailed drawing of a screw jack is given in the Fig. Assemble the parts and Draw the following views.

1. (a) Sectional elevation
   (b) Top view
   (c) Right half sectional side view
2. (a) Half sectional elevation
   (b) Top view

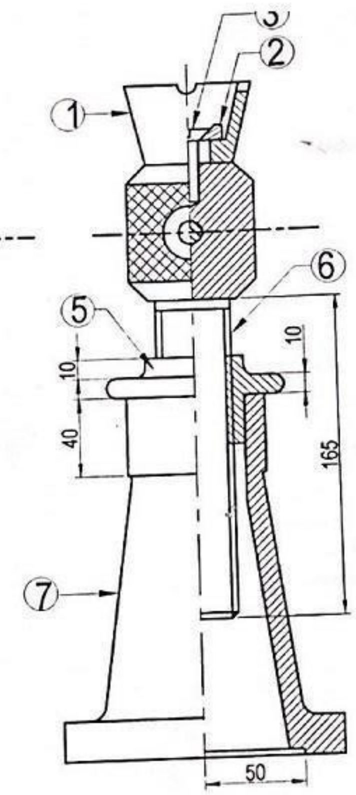



*All dimensions are in mm*

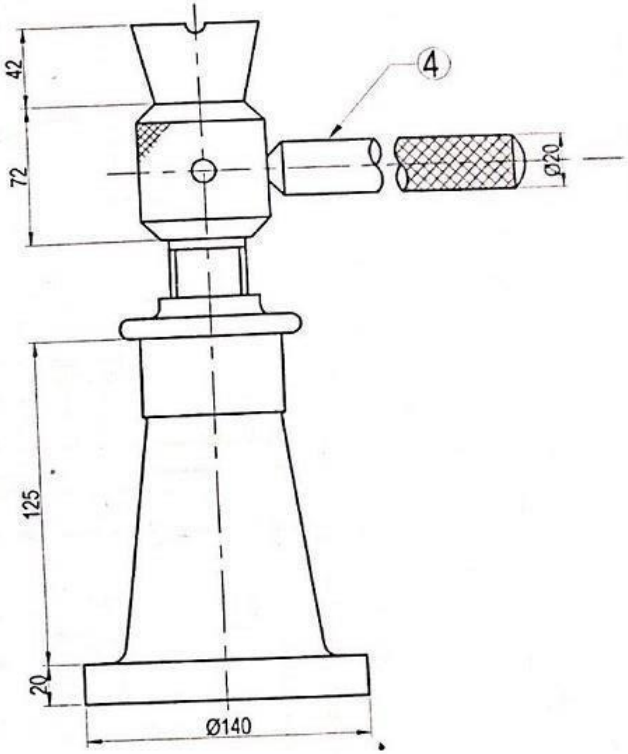
**DETAILS OF SCREW JACK**




SECTIONAL ELEVATION

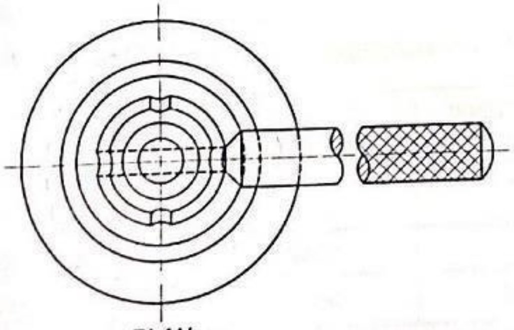



RIGHT HALF SECTIONAL FRONT VIEW




ELEVATION

*All dimensions are in mm*



PLAN

BILL OF MATERIALS

| PART NO | PART NAME | MATERIAL | NO.OFF | PART NO | PART NAME | MATERIAL | NO.OFF |
|---|---|---|---|---|---|---|---|
| 1 | CUP | CS | 1 | 4 | TOMMY BAR | M.S | 1 |
| 2 | WASHER | MS | 1 | 5 | NUT | GM | 1 |
| 3 | SET SCREW | MS | 1 | 6 | SCREW | MS | 1 |
| *SCREW JACK* | | | | 7 | CASTING | CI | 1 |

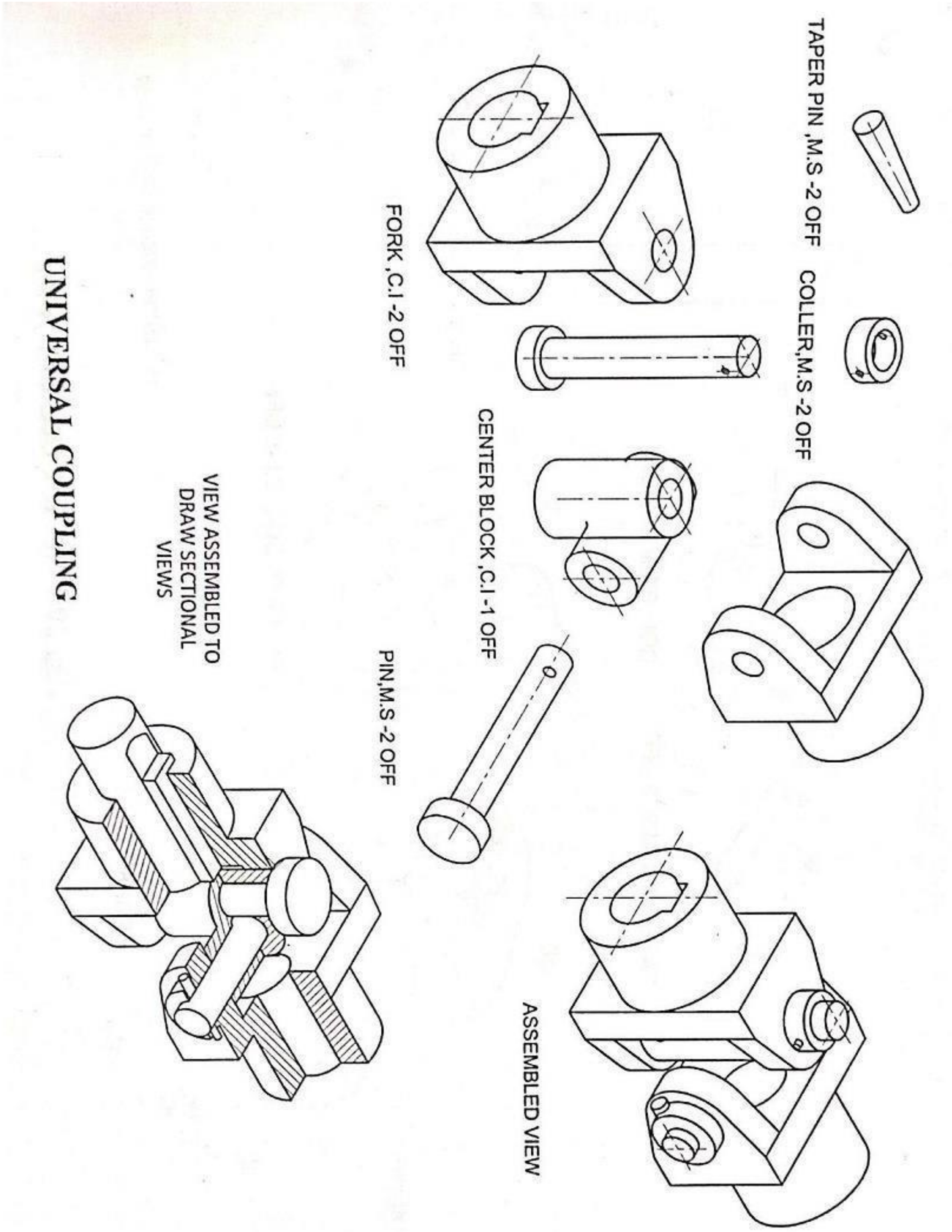
## Universal coupling (hook's joint)

This type of coupling is used to couple together two shafts whose axes intersect. The angle between the two shafts is usually less than $30^{o}$. The angle between the two shafts may be varied even when they are in motion.

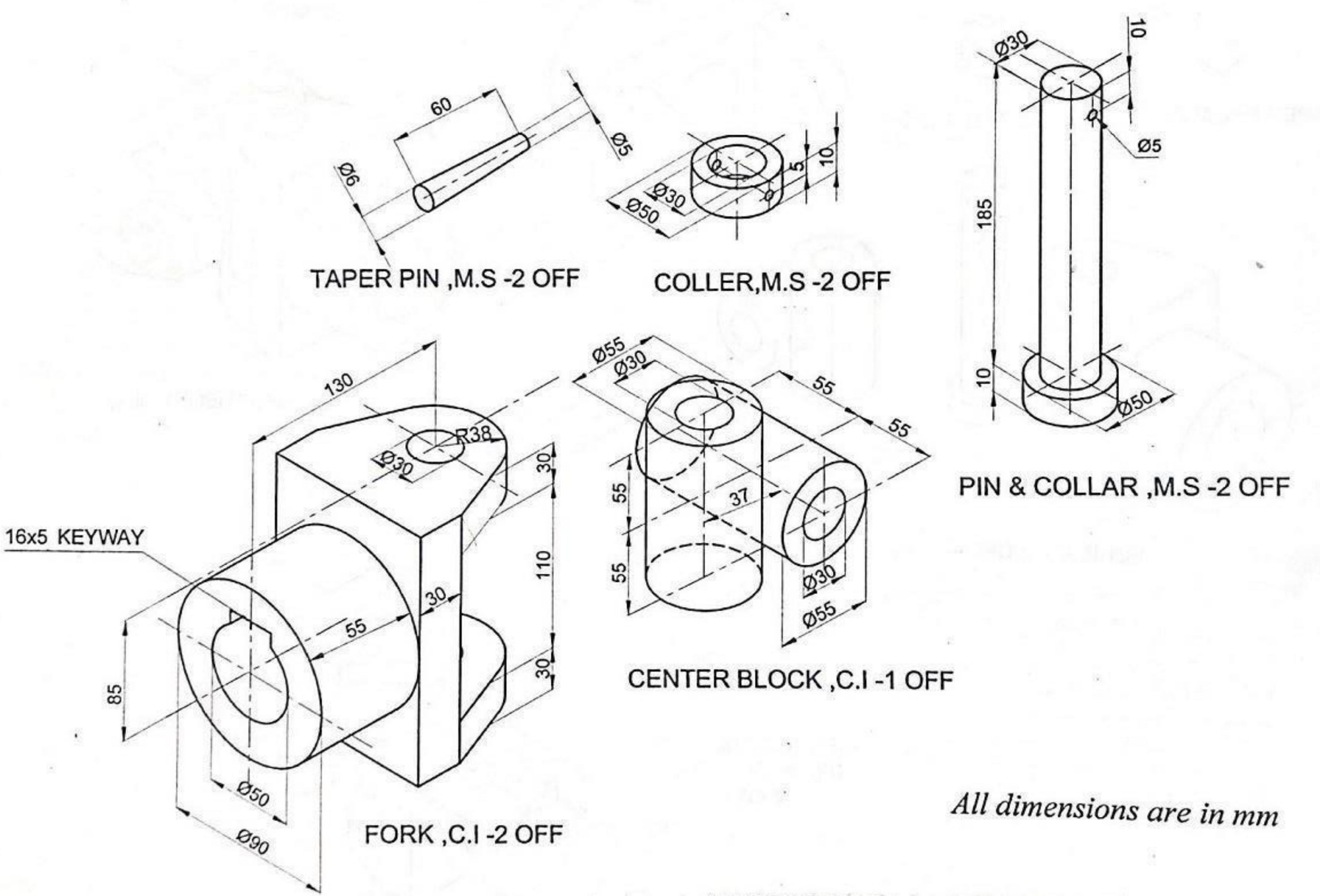
It consists of two forks, one central block, two cylinder pins with circular collars and two locking or taper pins. The forks are secured on the ends of the two shafts by means of keys. The central block is placed between these forks and pins are passed through the forks are central block holes.

### Application

They are used in automobile propeller shaft, differential, milling machine and multiple drilling machines etc.



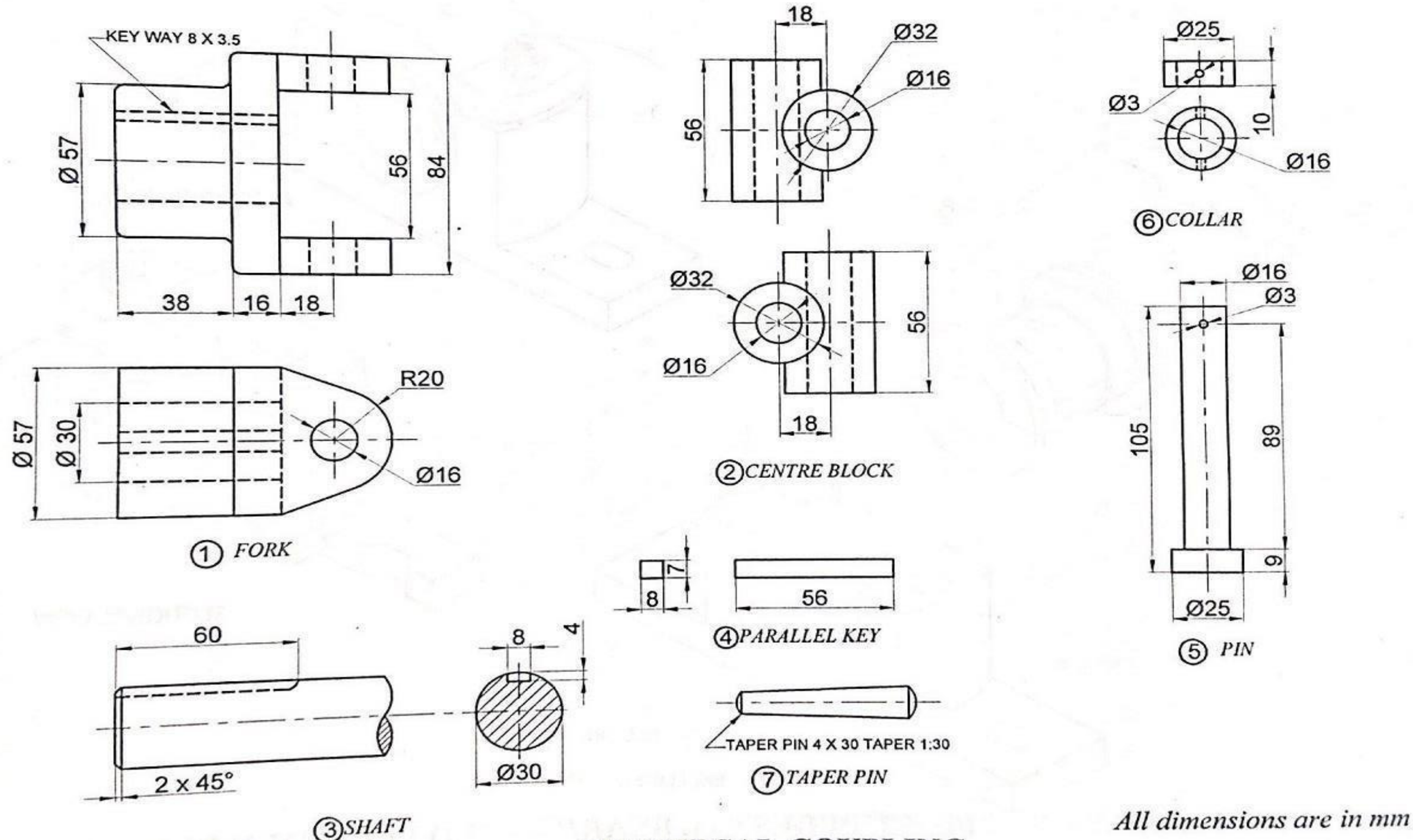
*Draw the following Assembled views (a) (1) Sectional elevation (2) Half sectional Plan (3) Right side view*




*All dimensions are in mm*

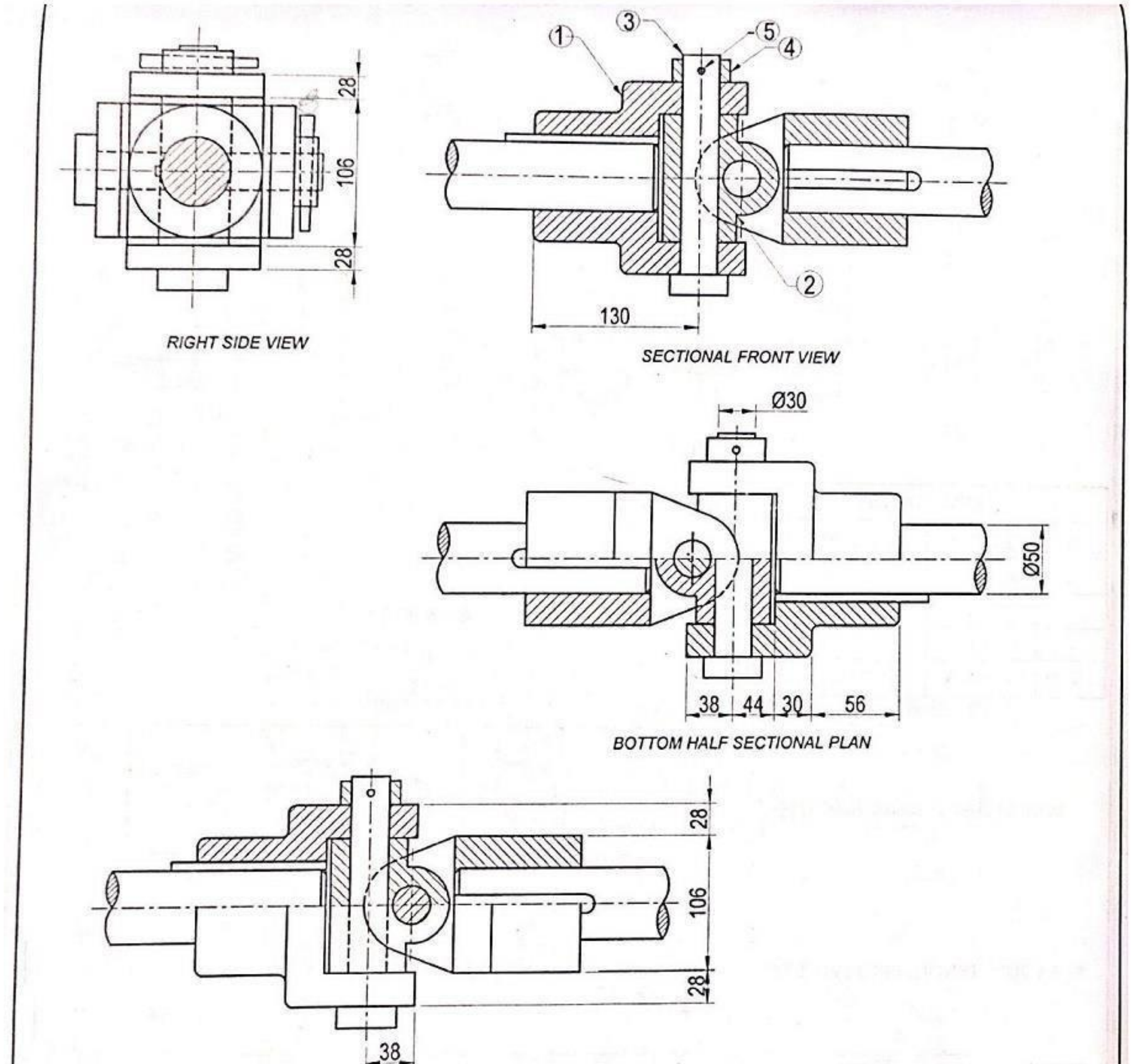
# UNIVERSAL COUPLING

Draw the following Assembled views (a) (1) Sectional elevation (2) Half sectional Plan (3) Right side view
(b) (1) Top half sectional elevation (2) Plan




All dimensions are in mm

UNIVERSAL COUPLING



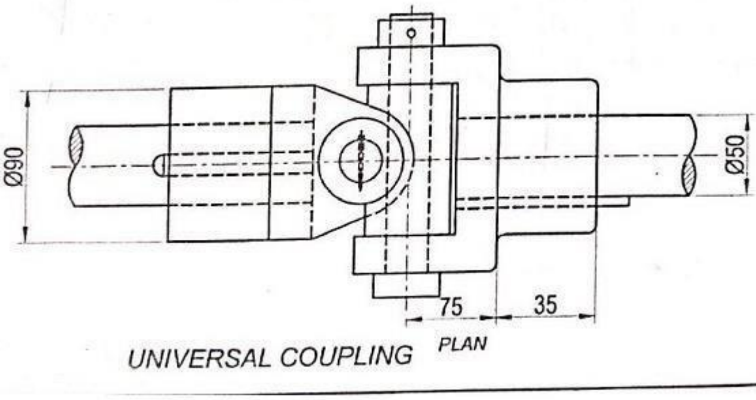

RIGHT SIDE VIEW

SECTIONAL FRONT VIEW

BOTTOM HALF SECTIONAL PLAN

TOP HALF SECTIONAL ELEVATION

*All dimensions are in mm*




PLAN

UNIVERSAL COUPLING

BILL OF MATERIAL

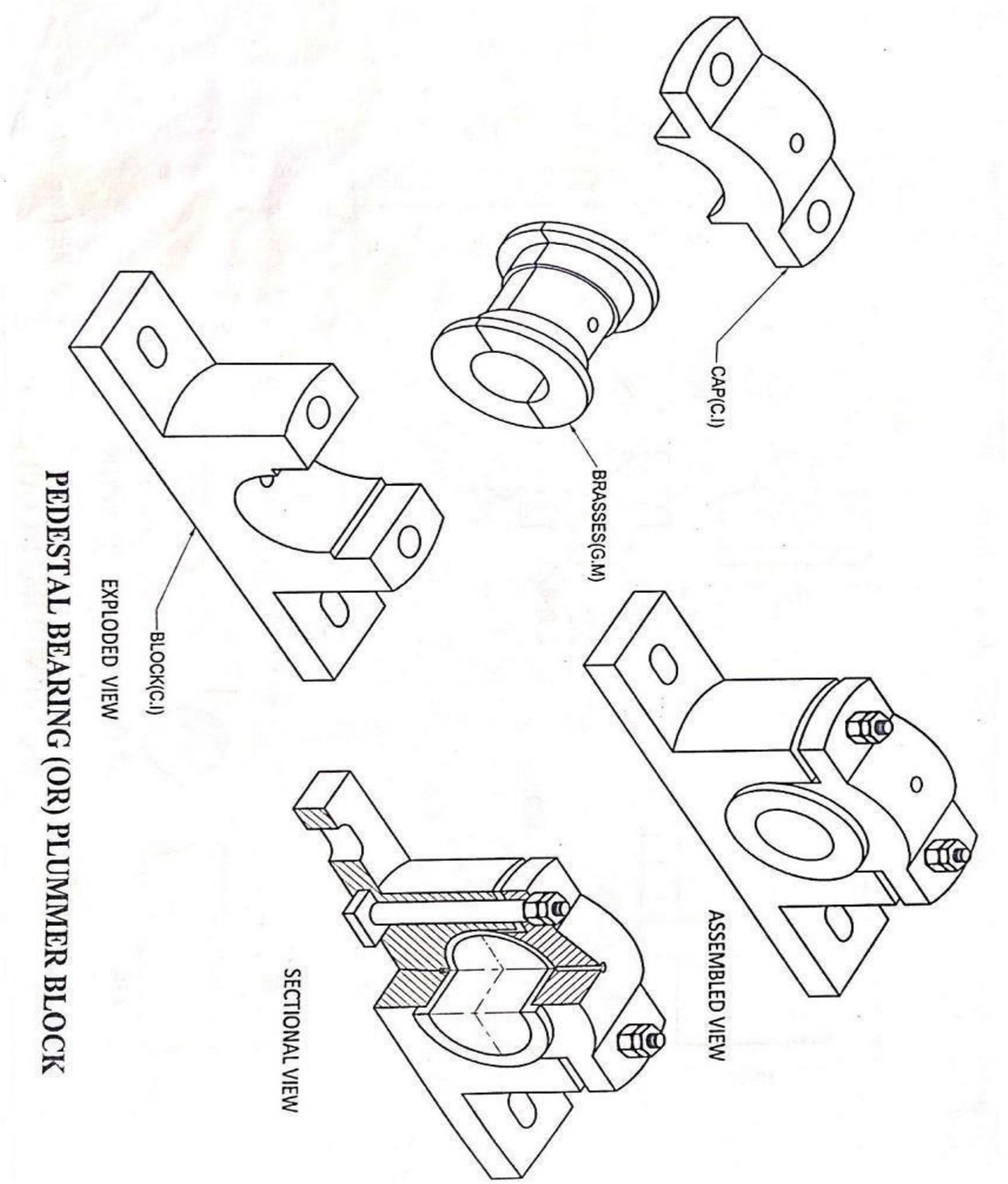
| PART NO. | PART NAME | MATERIAL | NO.OFF |
|---|---|---|---|
| 1 | FORK | CAST IRON | 2 |
| 2 | CENTRE BLOCK | CAST IRON | 1 |
| 3 | PIN | MILD STEEL | 2 |
| 4 | COLLAR | MILD STEEL | 2 |
| 5 | TAPER PIN | MILD STEEL | 2 |

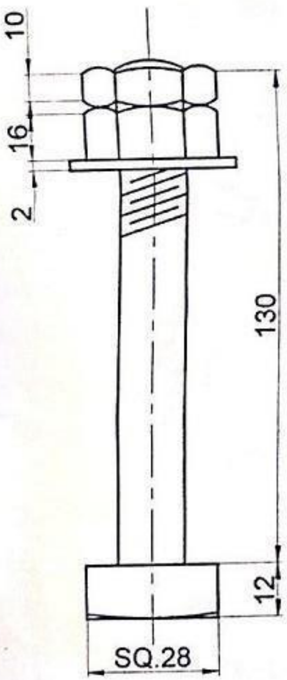
**Plummer block (pedestal bearing)**

A Plummer block consists of a cast iron block with a sole gun metal brasses or steps made in two halves, a cast iron cap and two mild steel bolts. It is a split type of journal bearing to support horizontal shafts. It is used for supporting shafts running at high speed. The brasses are provided in between the block and cup and fastened by using two square headed bolts and lock nuts. The block has hole. The bottom brass has a sung. It seats on the sung hold provided in the block. This arrangement is to prevent the rotation of the bush. Collars provided at the both end of the brasses to prevent axial movement of the brasses.

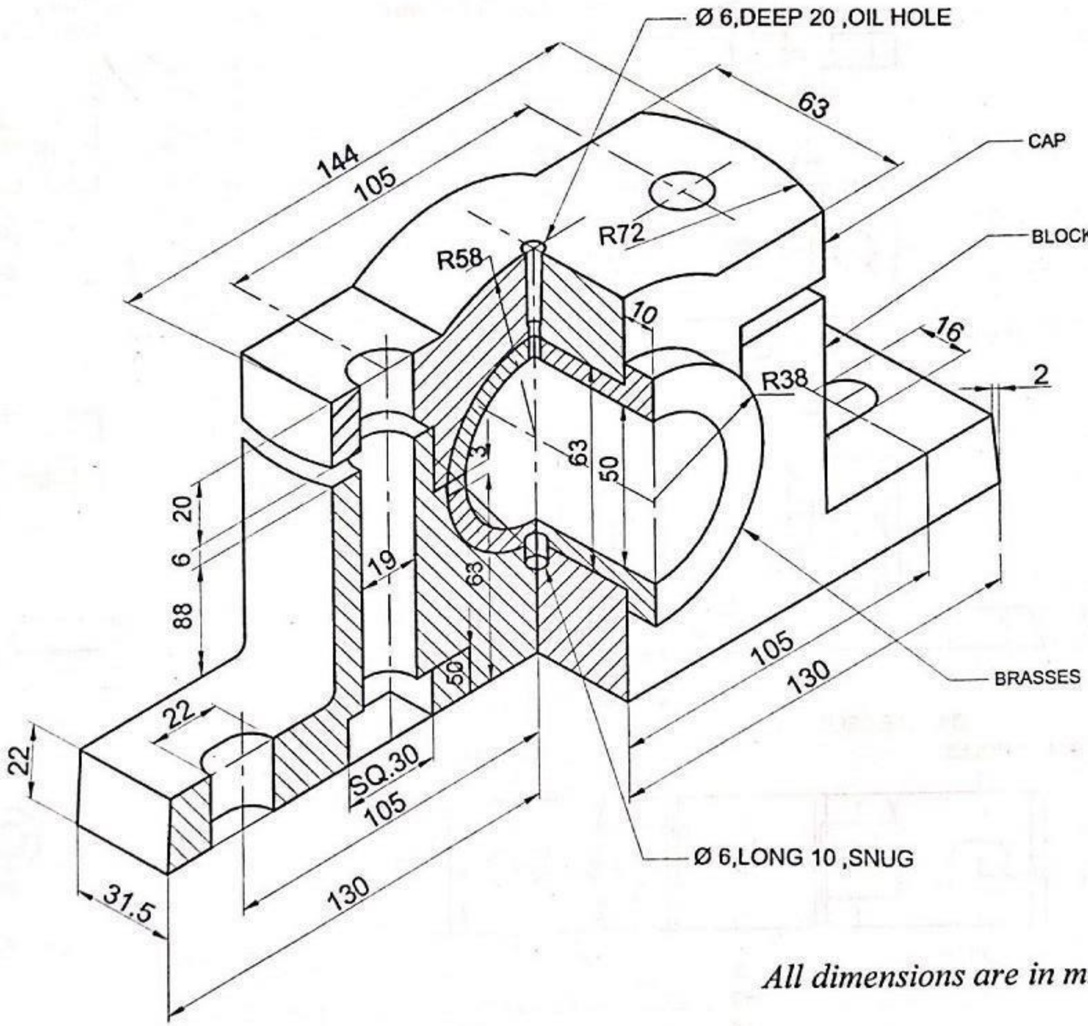
**Application**

It is used to support the shaft which rotated at high speed.






BOLT & NUT (M.S)



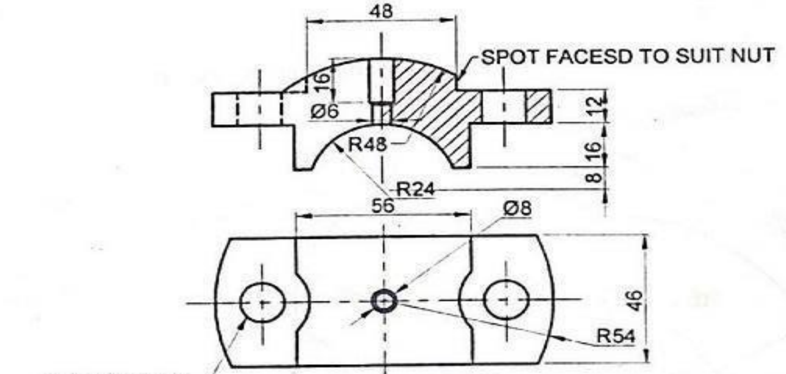

*All dimensions are in mm*

## PEDESTAL BEARING (OR) PLUMMER BLOCK

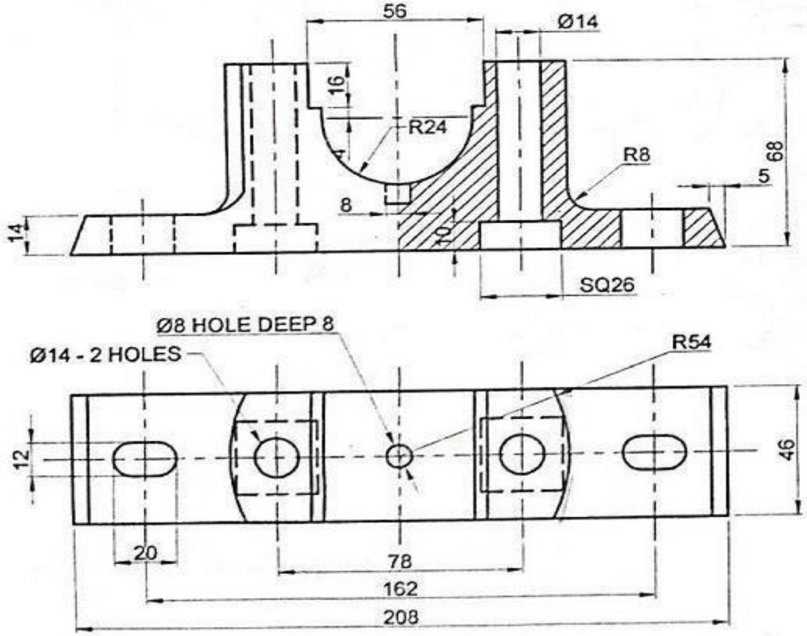
Draw the following assembled views.

(a) 1. Right sectional front view
2. Plan
3. Left half sectional side view

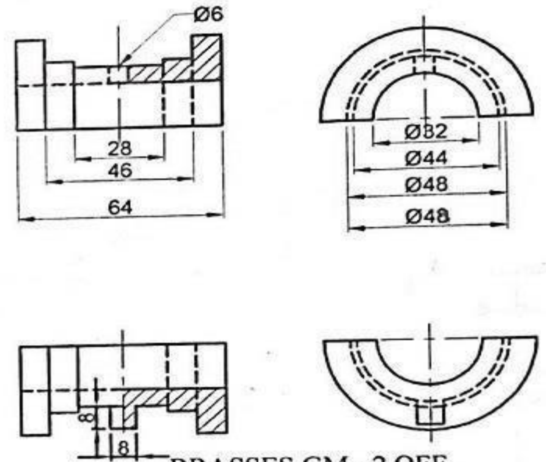
(b) 1. Sectional elevation
2. Right side view



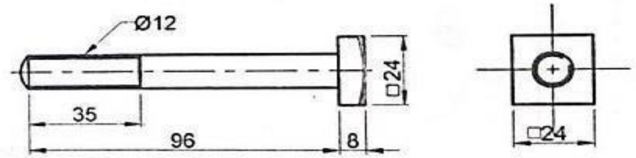

CAP C.I - 1 OFF

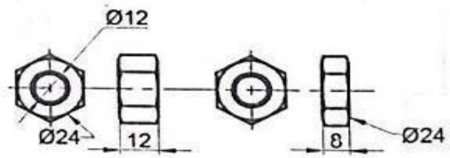



BODY C.I - 1 OFF




BRASSES GM - 2 OFF

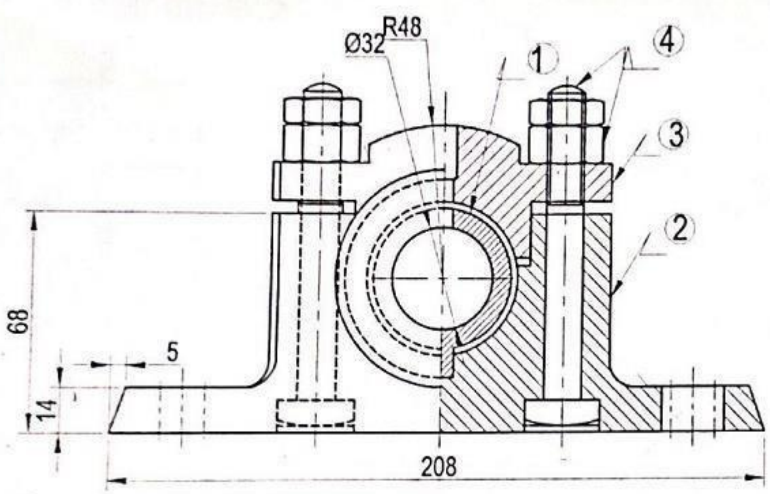


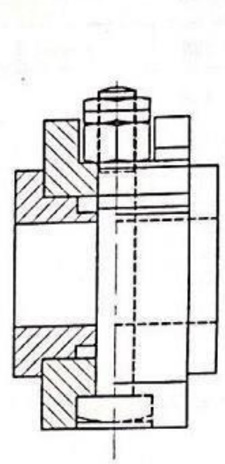

NUTS & LOCK NUTS M.S - 2 OFF

*All dimensions are in mm*

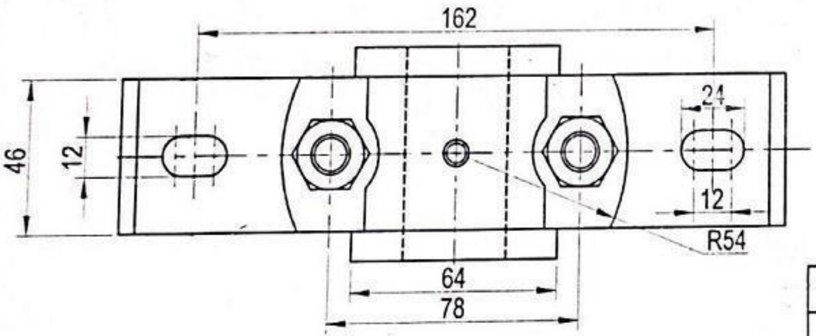
# PEDESTAL BEARING (OR) PLUMMER BLOCK




RIGHT HALF SECTIONAL ELEVATION



LEFT HALF SECTIONAL SIDE VIEW

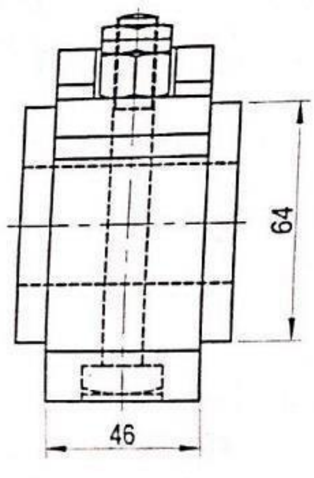



TOP VIEW

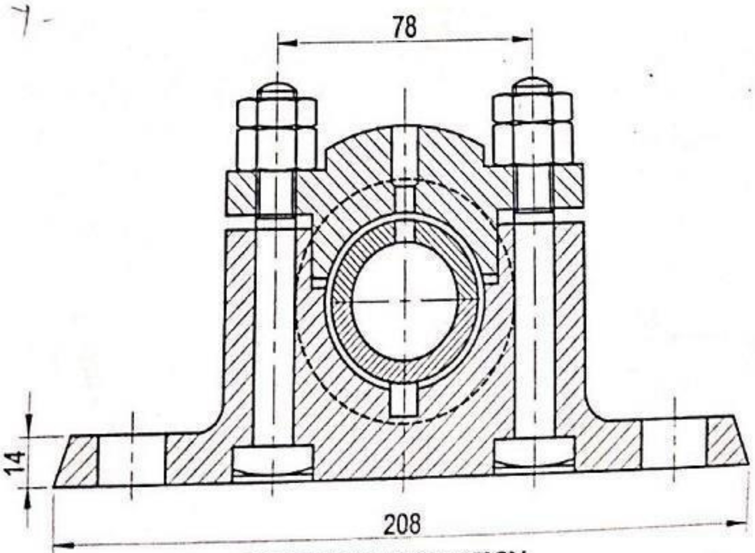
*All dimensions are in mm*

| PART NO | PART NAME | MATERIAL | NO.OFF |
|---|---|---|---|
| 1 | BRASSES | GUN METAL | 2 |
| 2 | BODY | CAST IRON | 1 |
| 3 | CAP | CAST IRON | 1 |
| 4 | BOLT & NUTS | MILD STEEL | 2 |

*BILL OF MATERIALS* — *PLUMMER BLOCK*




R.S. VIEW



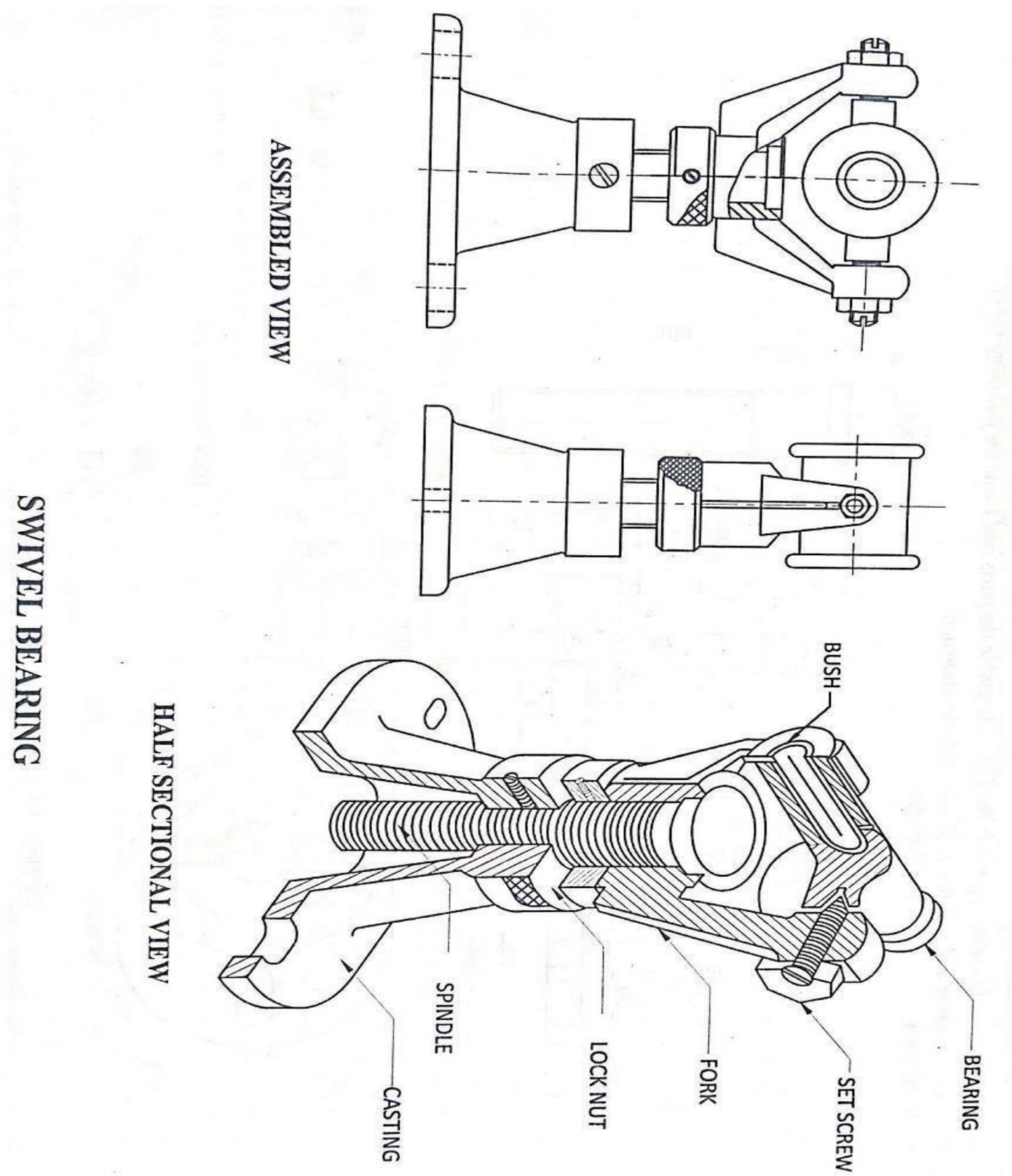

SECTIONAL ELEVATION

PLUMMER BLOCK

## Swivel bearing

Swivel bearing is a self-aligning bearing. It is very difficult to achieve perfect alignment of shaft in bearing. Also in some case, the shaft while running may slightly move away from its centre of rotation. In such cases a self-aligning bearing is used.

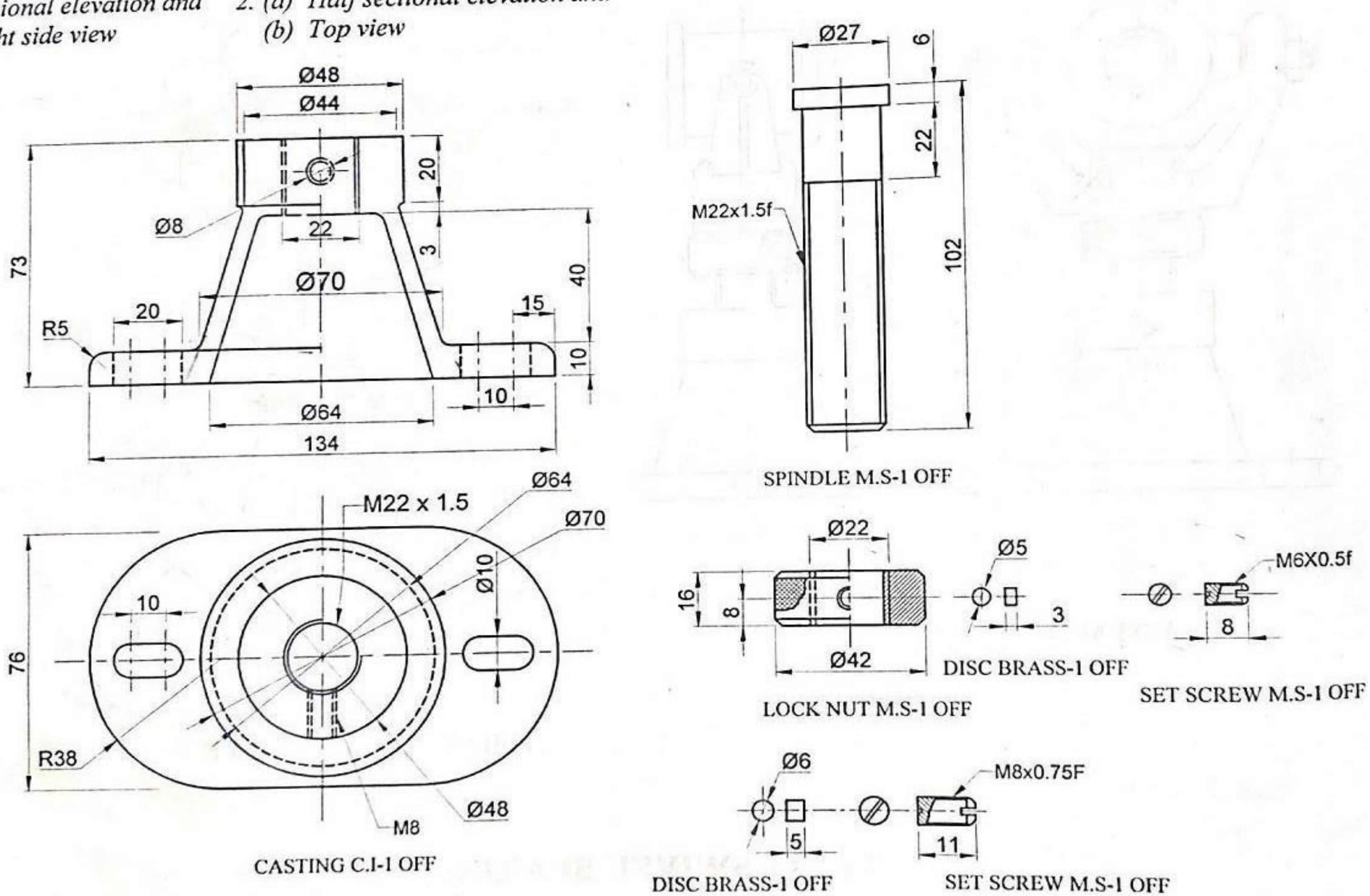
This bearing consist of a pedestal, a threaded spindle, a fork and a bearing with bush. Two holes are provided in the base of the pedestal for fixing it in the machine body. The thread spindle is screwed in the fork, lock nut and then in the threaded hole of the pedestal. The threaded spindle can be moved up and down and then locked by in any position by a screw. The knurled nut also can be moved up and down and then locked by in any position by a screw. The knurled nut also can be moved and locked at any position by a set screw. Brass discs are used between the set screws tip and the thread in the spindle to avoid the damaging of thread. Bush attached bearing block is held in position between the forks by set screws. The bearing will turn about the conical points of the set screws to adjust itself according to the position of shaft.



*Part drawing of a swivel bearing is given in the Fig. Assemble the parts and Draw the following views.*

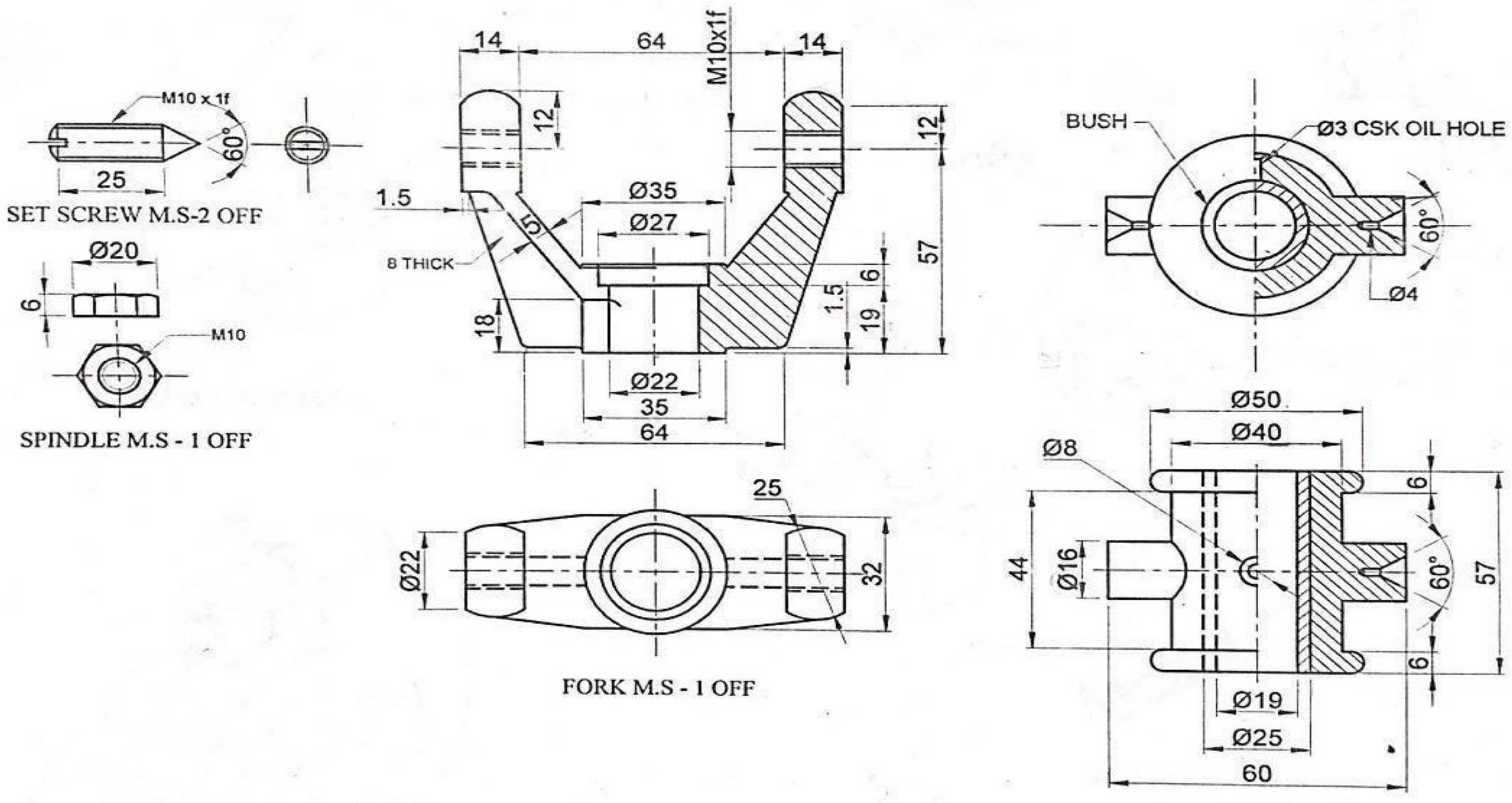
*1. (a) Sectional elevation and (b) Right side view*

*2. (a) Half sectional elevation and (b) Top view*




**SWIVEL BEARING**

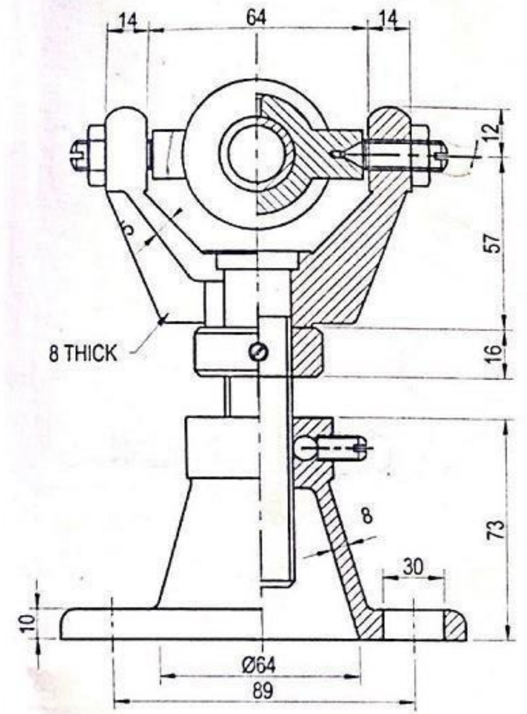
*All dimensions are in mm*



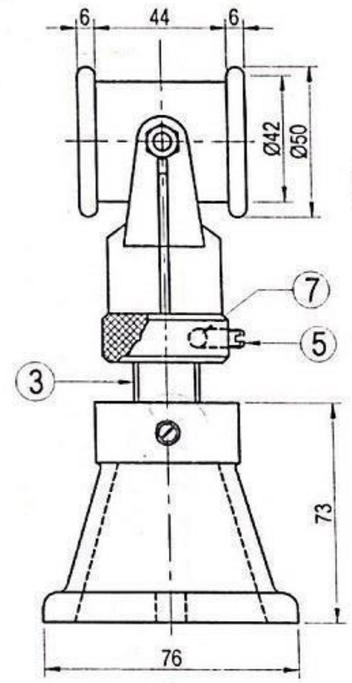

BEARING C.I -1 OFF

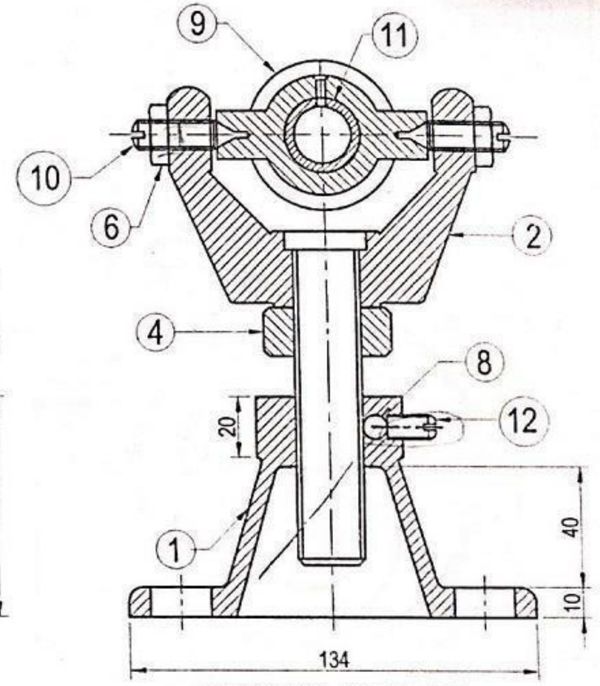
**SWIVEL BEARING (continued)**

*ALL DIMENSIONS ARE IN MM*



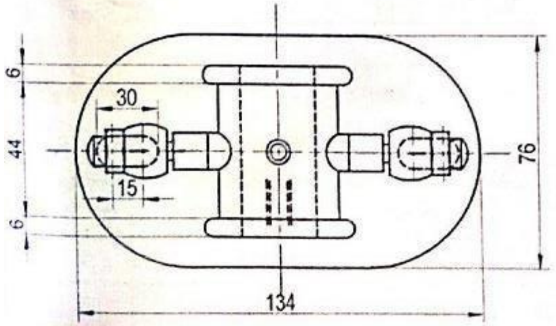

HALF SECTIONAL ELEVATION





SECTIONAL ELEVATION

*All dimensions are in mm*



PLAN

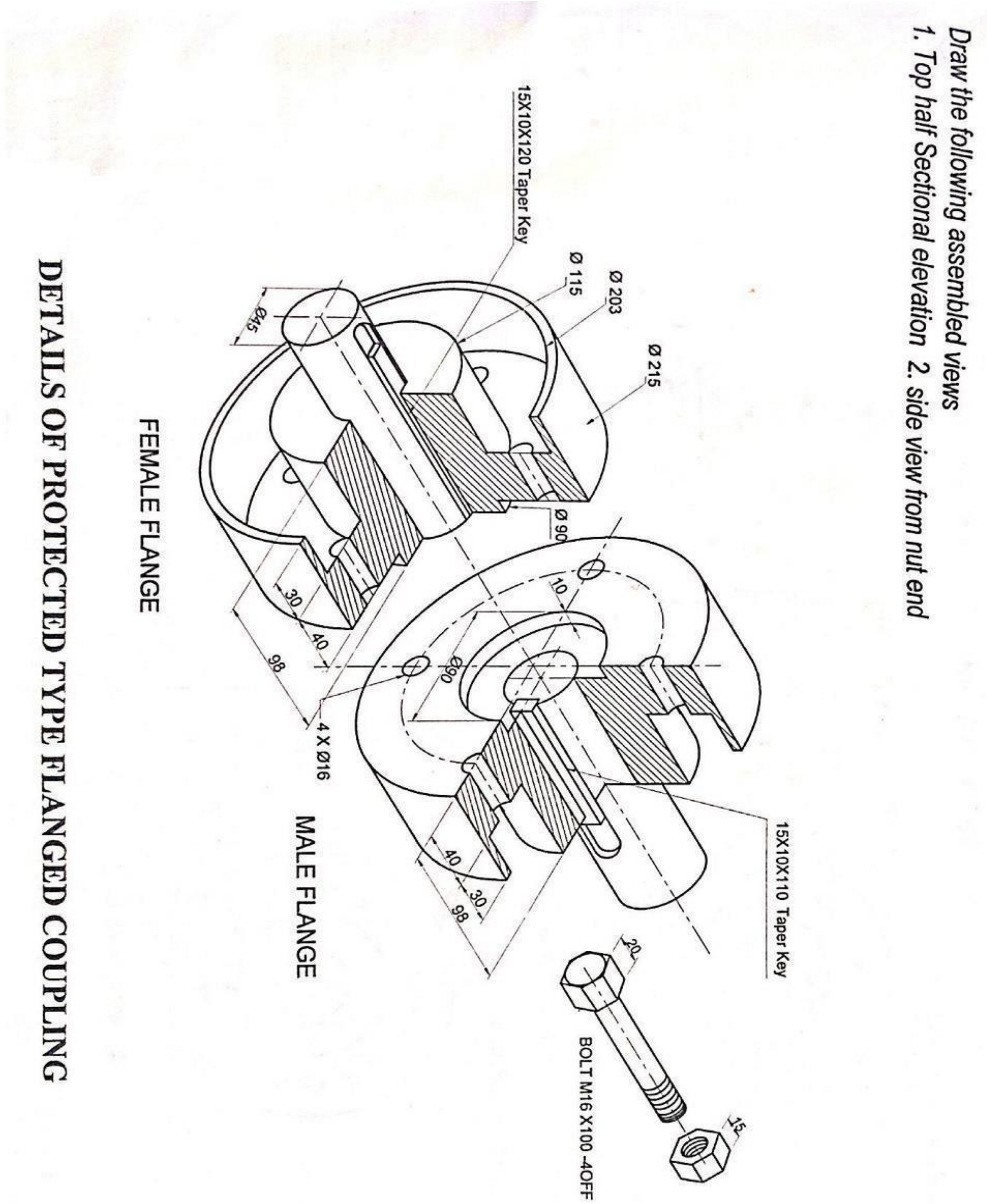
# SWIVEL BEARING

*BILL OF MATERIALS*

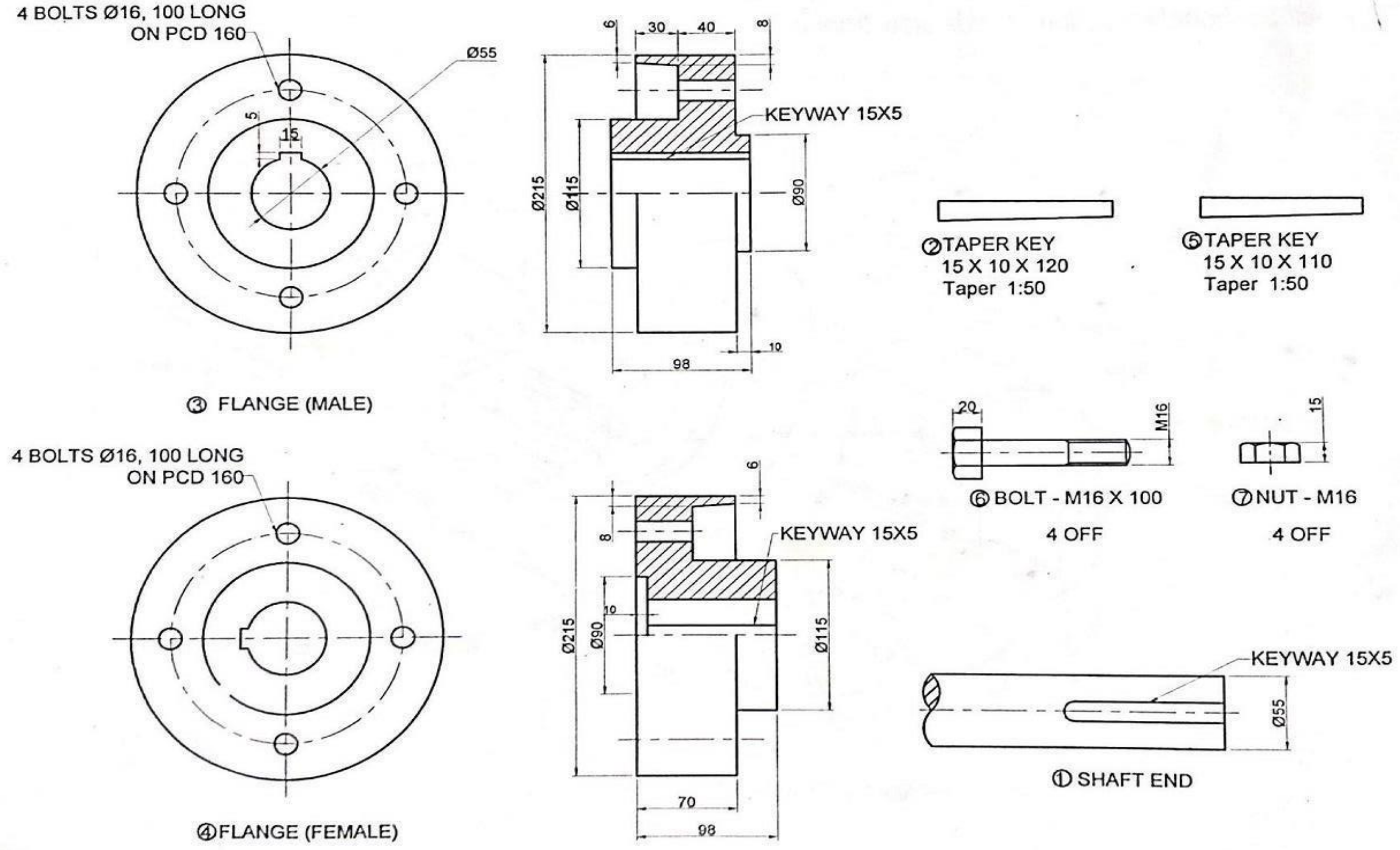
| PART NO | *PART NAME* | MATERIAL | NO. OFF | PART NO | PART NAME | MATERIAL | NO. OFF |
|---|---|---|---|---|---|---|---|
| 01 | CASTING | C.I | 1 | 07 | DISC | BRASS | 1 |
| 02 | FORK | MS | 1 | 08 | DISC | BRASS | 1 |
| 03 | SPINDLE | MS | 1 | 09 | BEARING | C.I | 1 |
| 04 | LOCK NUT | MS | 1 | 10 | SET SCREW | MS | 1 |
| 05 | SET SCREW | MS | 2 | 11 | BUSH | BRASS | 1 |
| 06 | NUT | MS | 2 | 12 | SET SCREW | MS | 1 |

**Protected type flange coupling**

Coupling are used for connecting shafts of two machines to function as a single unit. The protected type flange coupling is a standard form of coupling used for transmitting the rotating power from one shaft to another shaft. It consists of two flange with rectangular keys and bolt with nuts. In this each flange is provided with an assembler projection. It shelters the bolt heads of the nuts. Hence it prevents them from catching clothes of workmen. To keys the axial alignment as concentric, by the circular projection on one flange and a corresponding recess is provided. The male extension fits into the recess leaving some clearance in between them for further adjustments.

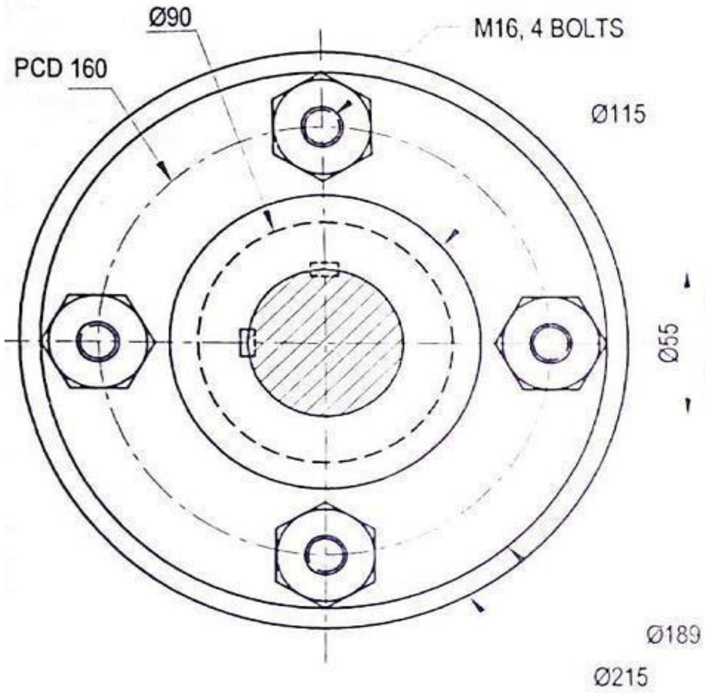


*Draw the (i) Top half sectional elevation and (ii) Side view from nut end*

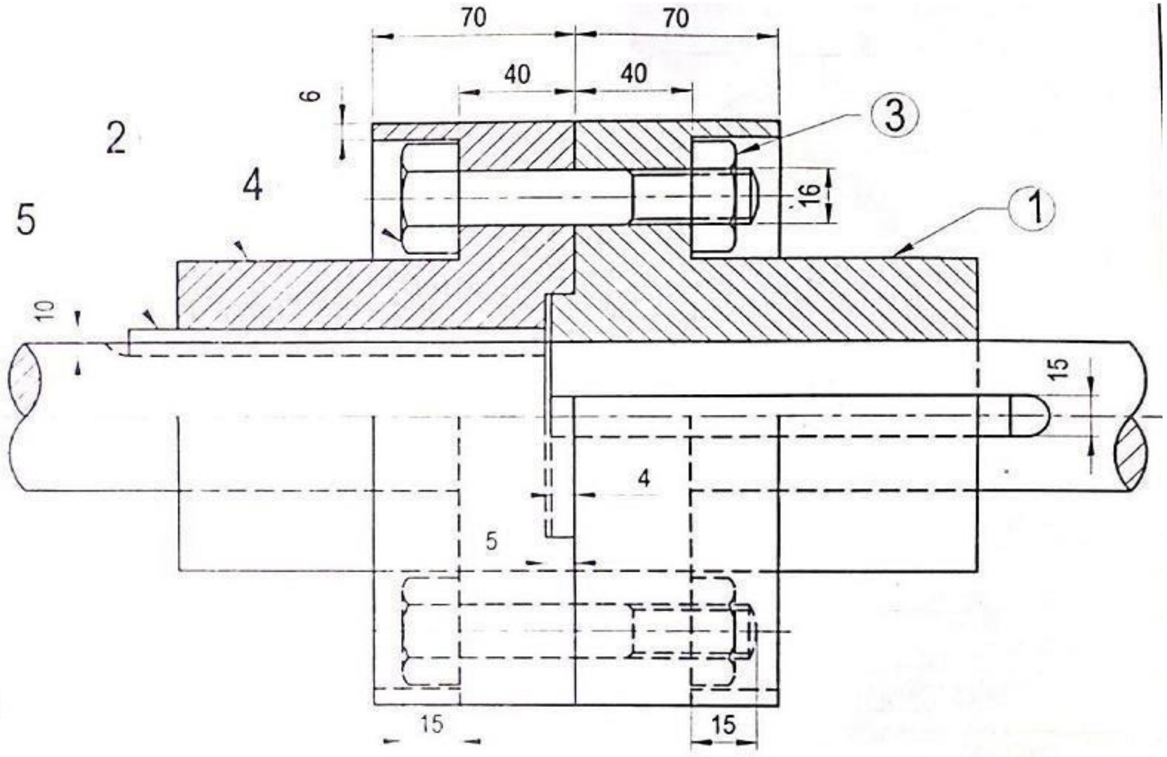



*All Dimensions are in mm*

**DETAILS OF PROTECTED TYPE FLANGED COUPLING**




RIGHT SIDE VIEW




TOP HALF SECTIONAL FRONT VIEW

All dimensions are in mm

BILL OF MATERIALS

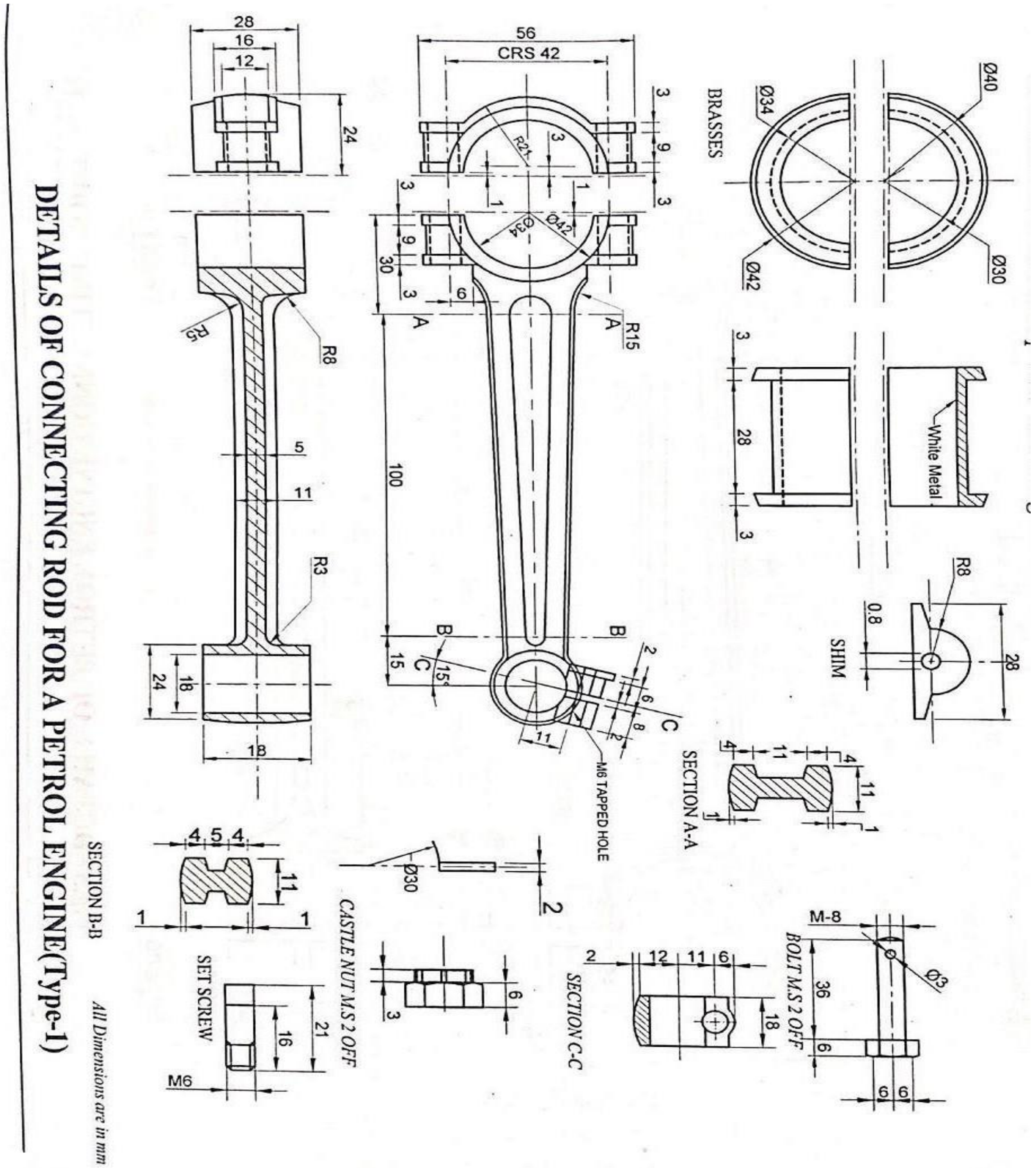
| PART NO | PART NAME | MATERIAL | NO.OFF |
|---|---|---|---|
| 1 | FLANGE (MALE) | CAST IRON | 1 |
| 2 | FLANGE (FEMALE) | CAST IRON | 1 |
| 3 | NUT | MILD STEEL | 4 |
| 4 | BOLT | MILD STEEL | 4 |
| 5 | KEYS | MILD STEEL | 2 |

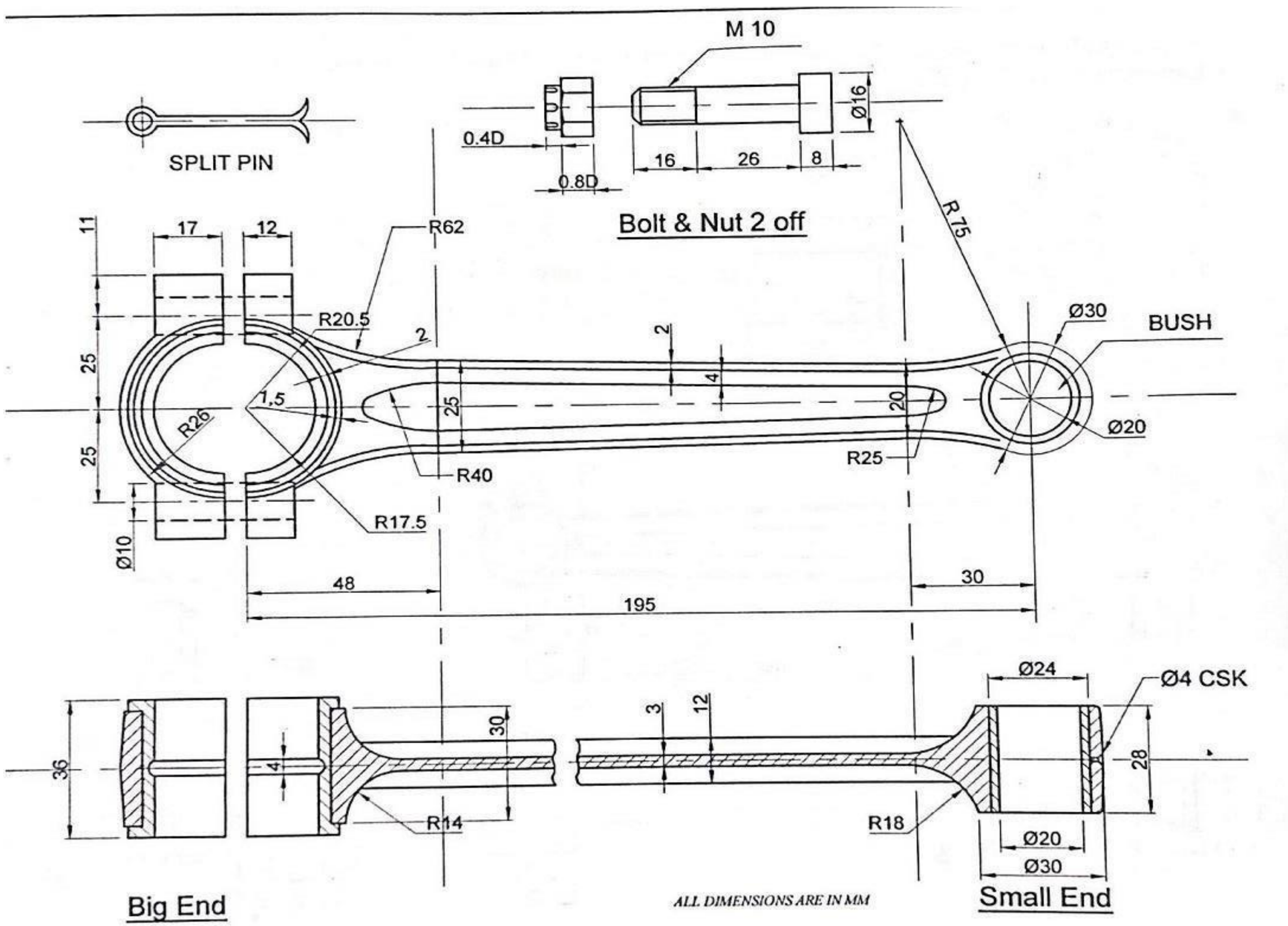
*FLANGED COUPLING (PROTECTED TYPE )*

### Petrol engine connecting rod.

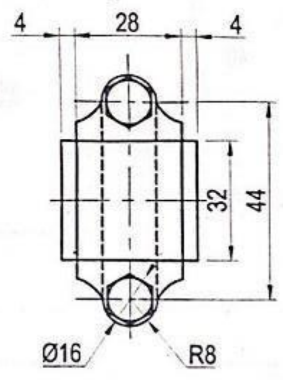
The connecting rod is made of forged I-section rod. A bronze bush is fitted into the smaller end of the rod with a tight fit. The split brasses lined with white metal are fitted one in the big end of the connecting rod and other in the cover. The cover is held firmly to the big end of the connecting rod with the shims held between them using two studs and nuts. The studs are locked the connecting rod using two pins. The nuts are locked in position on the studs using split pins.

The connecting rod of an I.C engine transforms the rectilinear motion of the piston to which it is directly connected to the rotary motion of the crank. They are made of I-section to enable them to withstand the crushing forces to which they will be subjected to resist varying bending forces while being as light as possible. One end of the connecting rod will be relatively smaller in size, known as small end. This end will be secured to the piston. The other end of the connecting rod is known as big end. This end will be secured to the crank using crankpin. Arrangement are provided for lubrication of both big and small end.

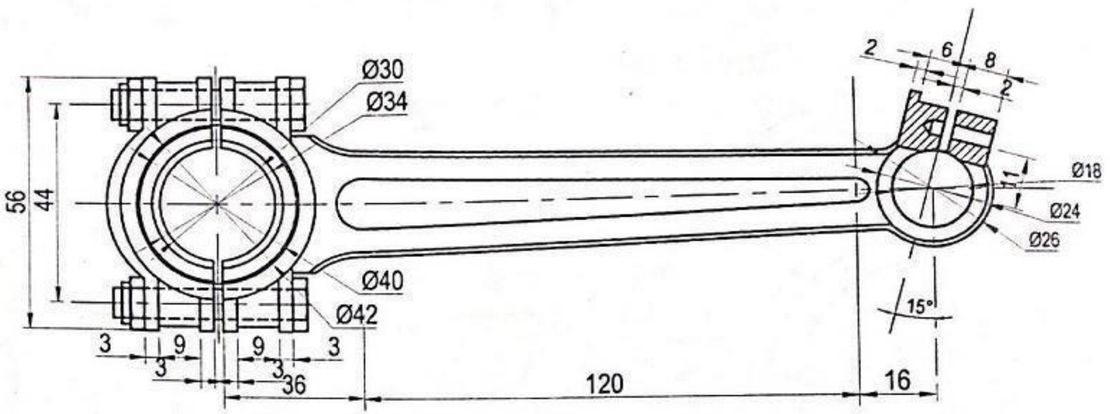




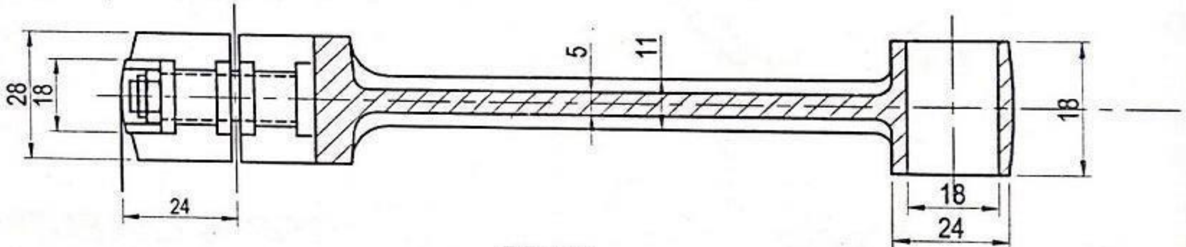

DETAILS OF PETROL ENGINE CONNECTING ROD(Type-2)




RIGHT SIDE VIEW




ELEVATION




PLAN

ALL DIMENSIONS ARE IN MM

BILL OF MATERIAL

| PART NO. | PART NAME | MATERIAL | NO.OFF |
|---|---|---|---|
| 1 | CONNECTING ROD | FORGED STEEL | 1 |
| 2 | COVER | FORGED STEEL | 1 |
| 3 | BRASSES | GUN METAL | 2 |
| 4 | SHIMS | GUN METAL | 2 |
| 5 | BOLT | M.S | 2 |
| 6 | CASTLE NUT | M.S | 2 |
| 7 | SET SCREW | M.S | 1 |
| 8 | SPLIT PIN | M.S | 2 |

CONNECTING ROD -1

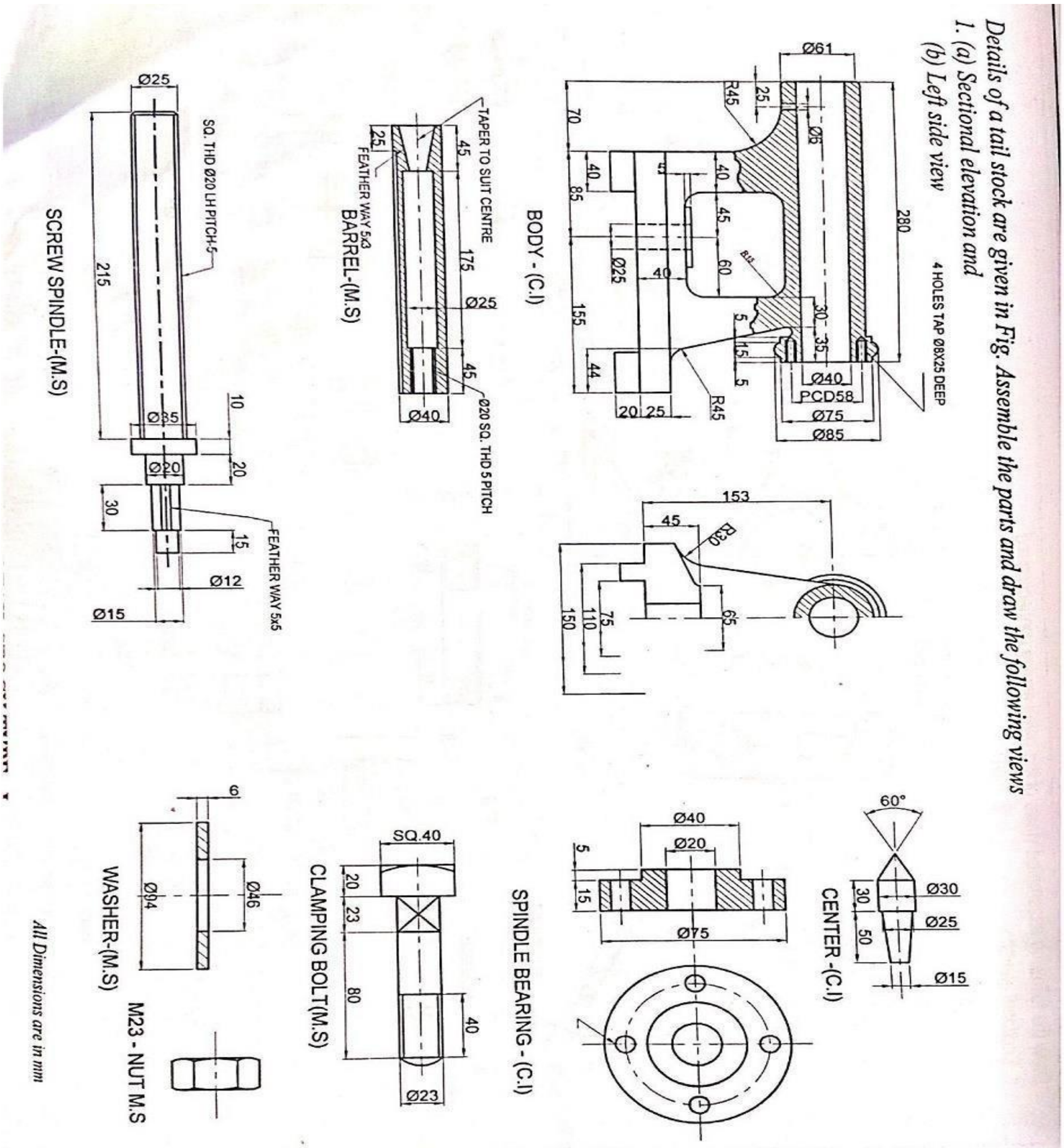
### Tail stock

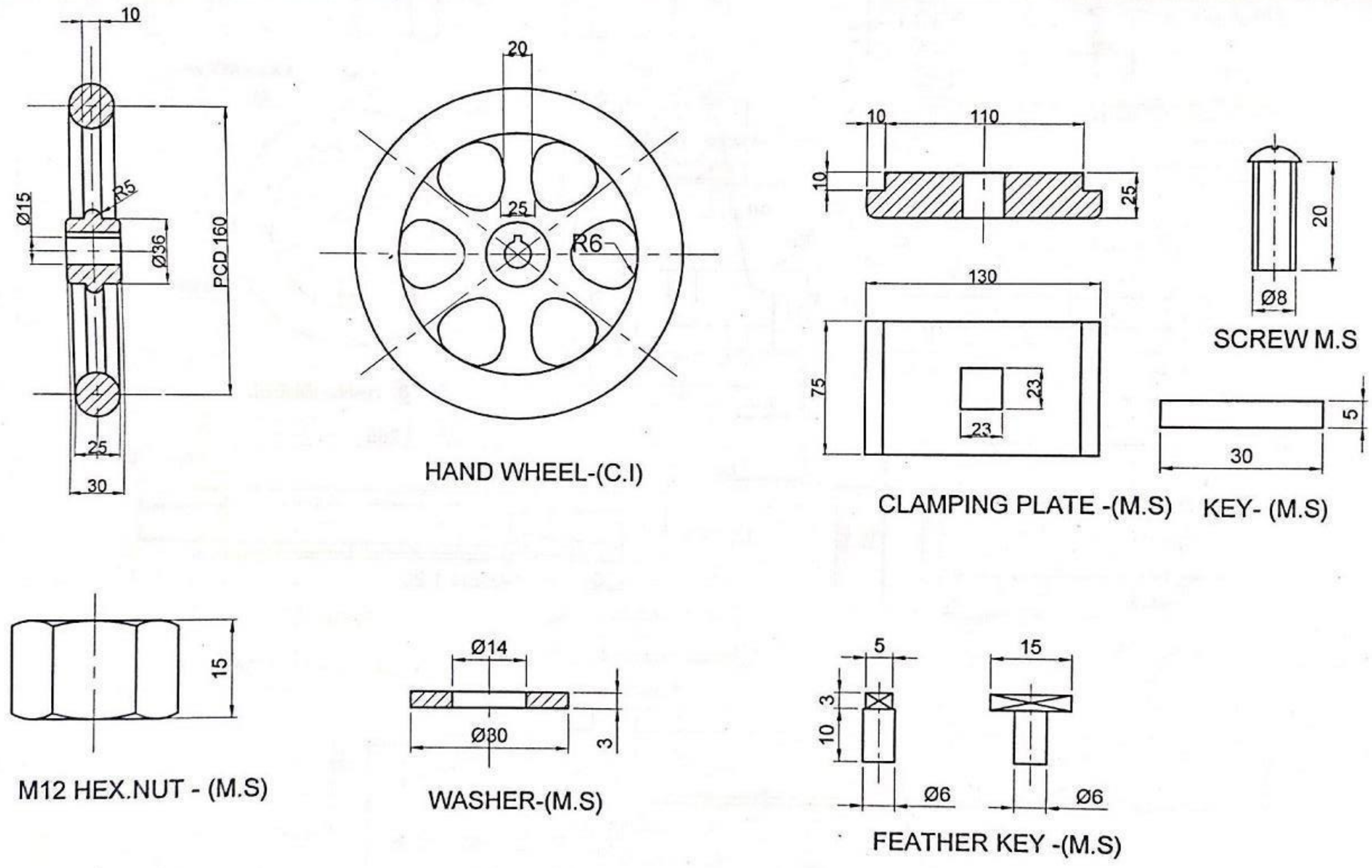
Tail stock is part of a lathe machine used to support lengthy jobs during turning operations. When works of different lengths are to be turned between centres, it can be moved on the lathe bed to the required position and fixed there by means of a clamping bolt.

The barrel is fitted into bore of the tail stock body. The barrel has a small thread portion at its end and the spindle is inserted into the barrel through this. The feather, a loose key, enters the key way on the underside of the barrel and prevent its rotation. The hand wheel is mounted on the end of the spindle by means of a key and is retained in position by a nut. The spindle bearing is placed between the hand wheel and the tail-stock body.

When the hand wheel is turned, it causes the barrel to move in or out of the body. A tapered hole is provided at the front end of the barrel for inserting the centre and in some cases, at the tapered shank of drill or reamer.

When the barrel is adjusted to the required position. It can then be clamped in this position by means of locking lever. The entire unit is clamped onto the lathe bed with a clamping plate and a square headed bolt.





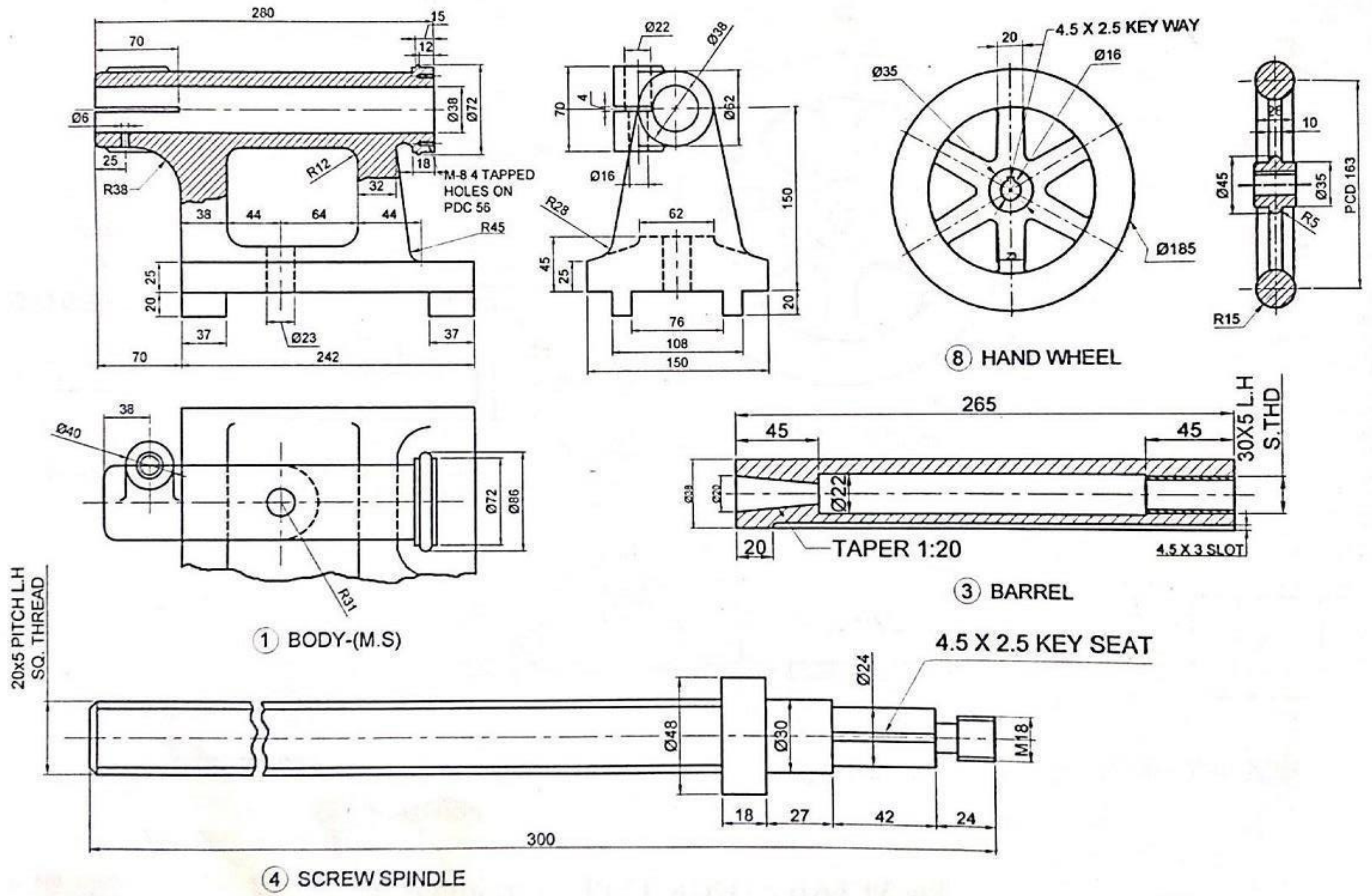

**TAILSTOCK TYPE - I (continued)**

ALL DIMENSIONS ARE IN MM

*Details of a tail stock are given in Fig. Assemble the parts and draw the following views*

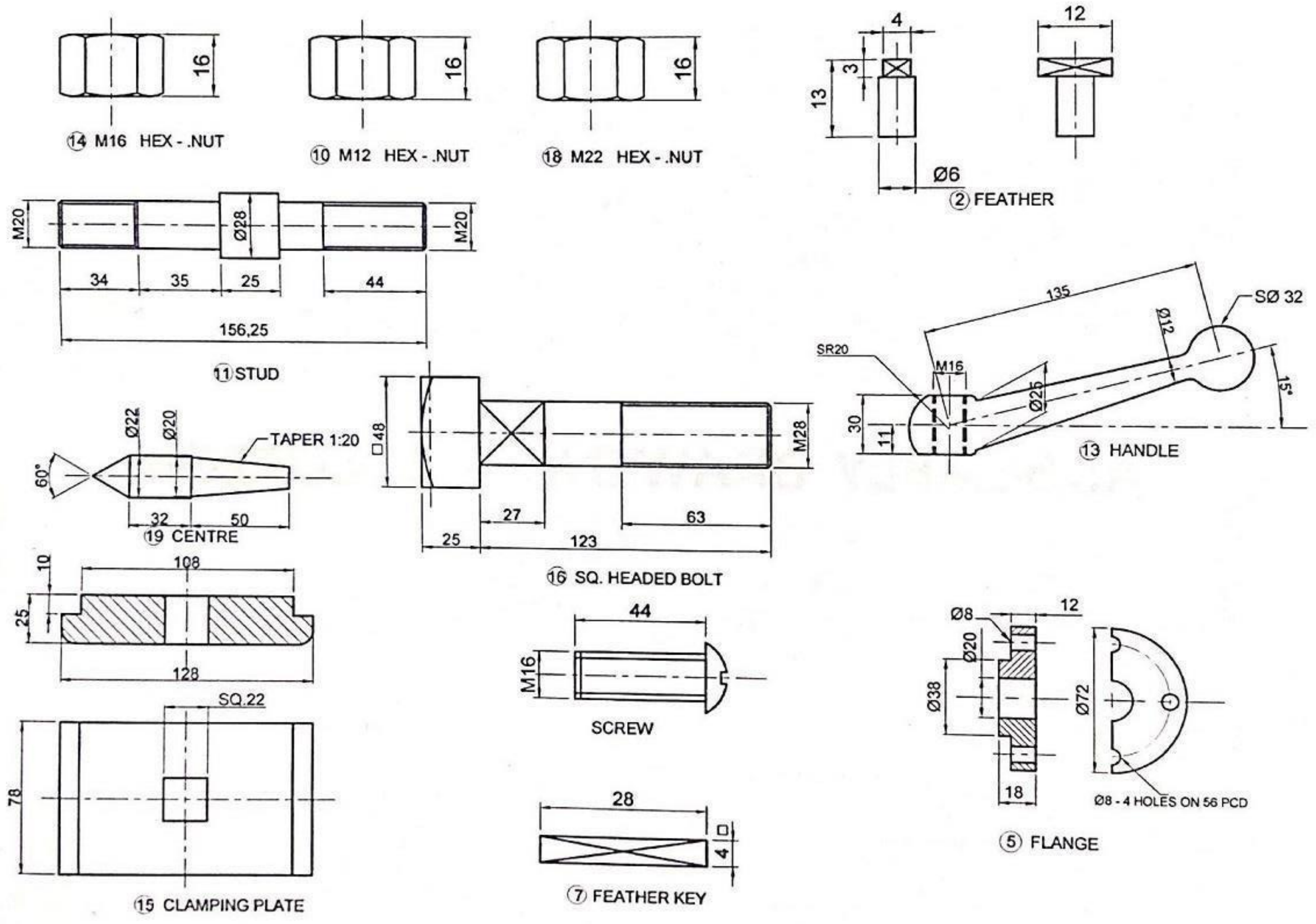
*1. (a) Sectional elevation and*

*(b) Left side view*



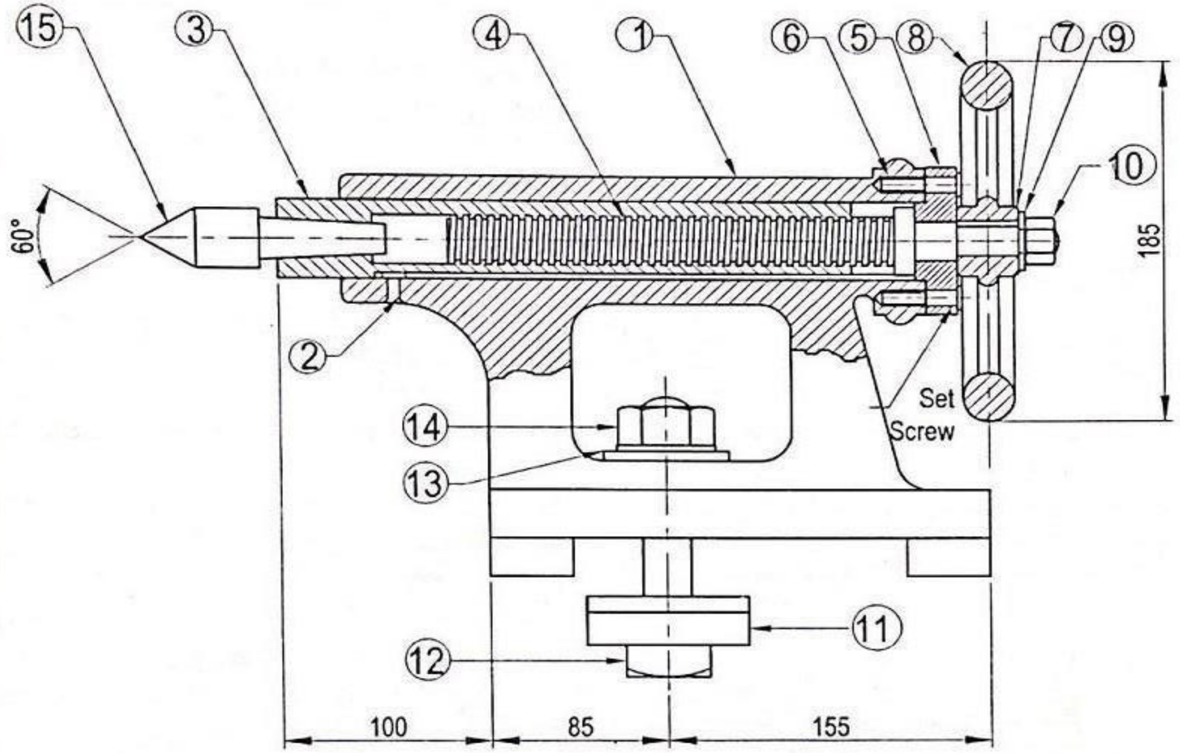

*All Dimensions are in mm*

**DETAILS OF TAIL STOCK TYPE - 2**

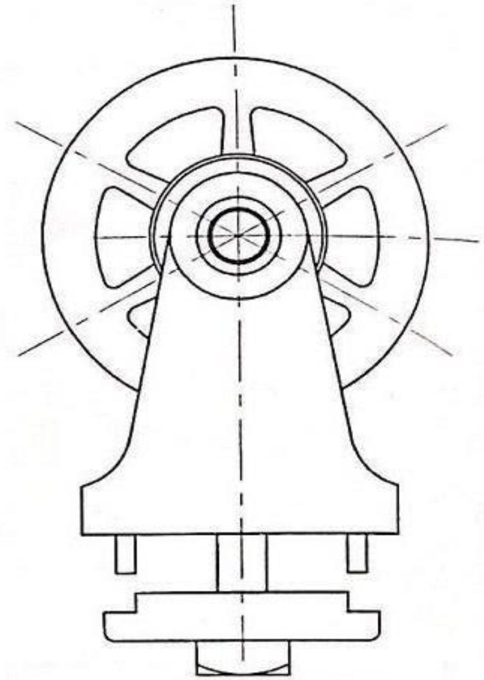



**TAILSTOCK TYPE - 2(continued)**

*All Dimensions are in mm*




ELEVATION



LEFT SIDE VIEW

*All Dimensions are in mm*

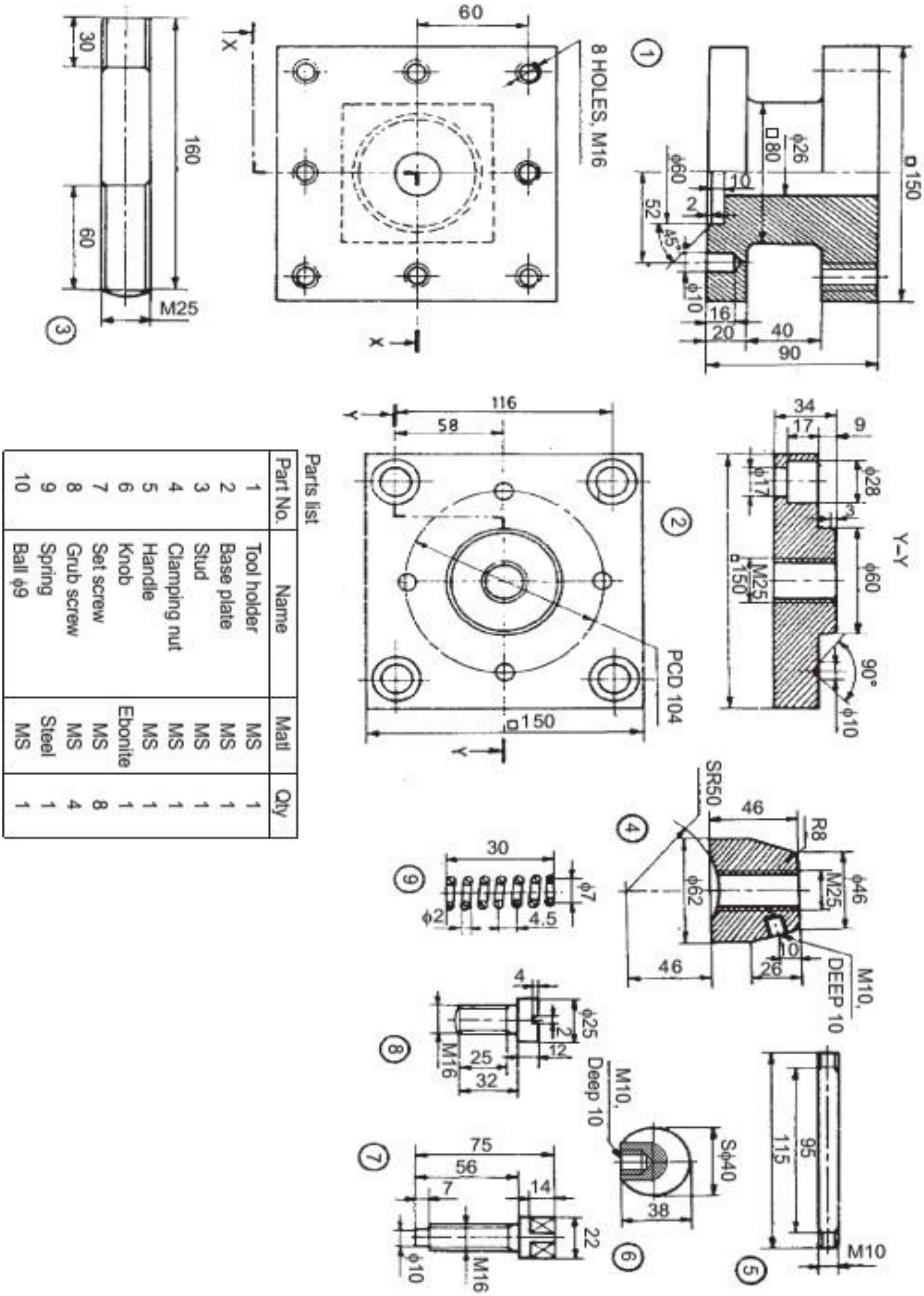
## BILL OF MATERIALS

| PART NO | PART NAME | MATERIAL | NO.OFF |
|---|---|---|---|
| 1 | BODY | CAST IRON | 1 |
| 2 | FEATHER | MILD STEEL | 1 |
| 3 | BARREL | CAST IRON | 1 |
| 4 | SCREW SPINDLE | MILD STEEL | 1 |
| 5 | FLANGE | CAST IRON | 1 |
| 6 | SCREW | MILD STEEL | 4 |
| 7 | FEATHER KEY | MILD STEEL | 1 |
| 8 | HAND WHEEL | CAST IRON | 1 |
| 9 | WASHER M12 STD | MILD STEEL | 1 |
| 10 | HEXAGONAL NUT M12 | MILD STEEL | 1 |
| 11 | CLAMPING PLATE | CAST IRON | 1 |
| 12 | SQ. HEADED BOLT | MILD STEEL | 1 |
| 13 | WASHER M22 STD | MILD STEEL | 1 |
| 14 | HEXAGONAL NUT M22 | MILD STEEL | 1 |
| 15 | CENTRE | CAST STEEL | 1 |

# *TAIL STOCK*

## Tool holder

The details of a tool holder. Assemble the details and draw the following views to a full size scale: Front view half in section (b) Write side end view.

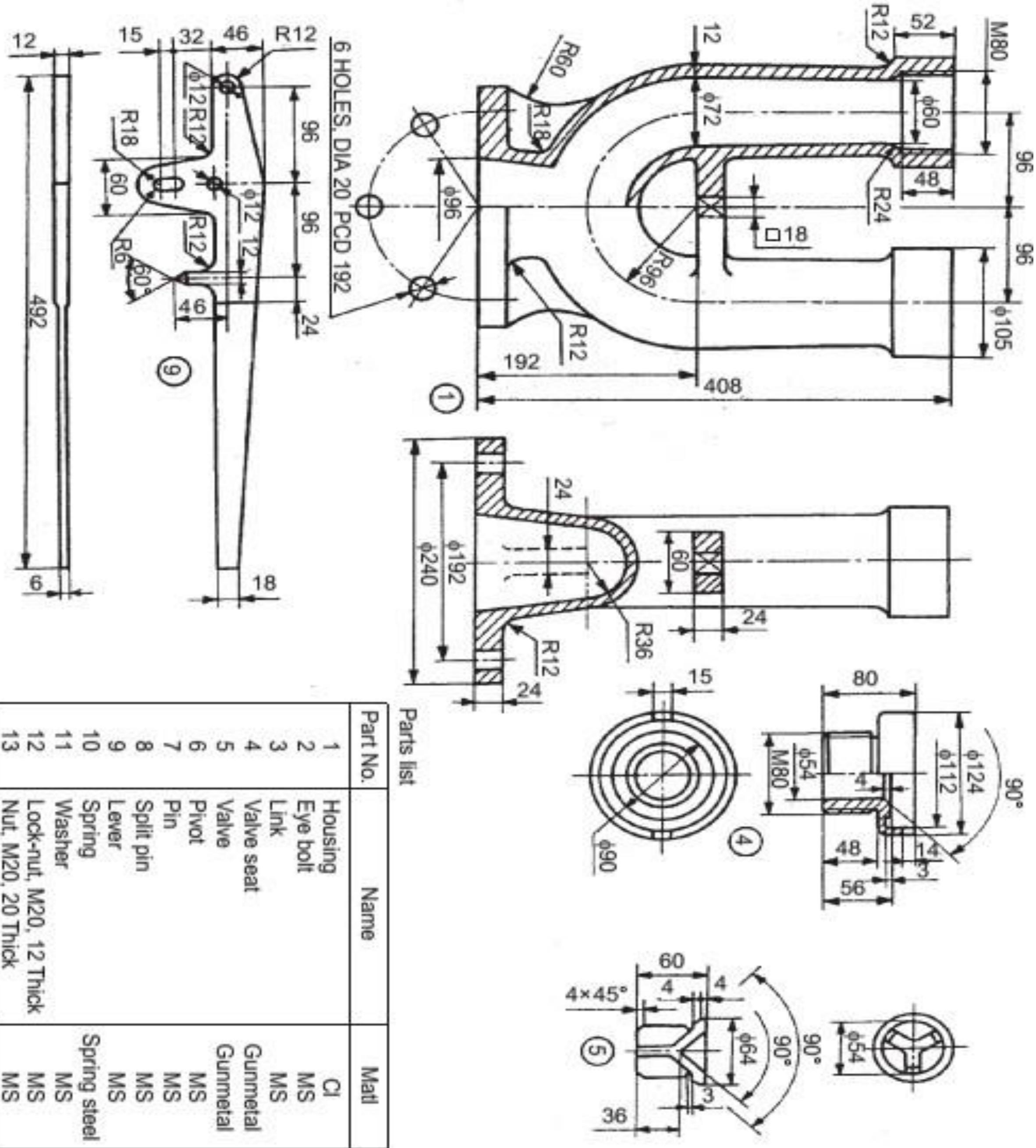


Parts list

| Part No. | Name | Matl | Qty |
|---|---|---|---|
| 1 | Tool holder | MS | 1 |
| 2 | Base plate | MS | 1 |
| 3 | Stud | MS | 1 |
| 4 | Clamping nut | MS | 1 |
| 5 | Handle | MS | 1 |
| 6 | Knob | Ebonite | 1 |
| 7 | Set screw | MS | 8 |
| 8 | Grub screw | MS | 4 |
| 9 | Spring | Steel | 1 |
| 10 | Ball φ9 | MS | 1 |

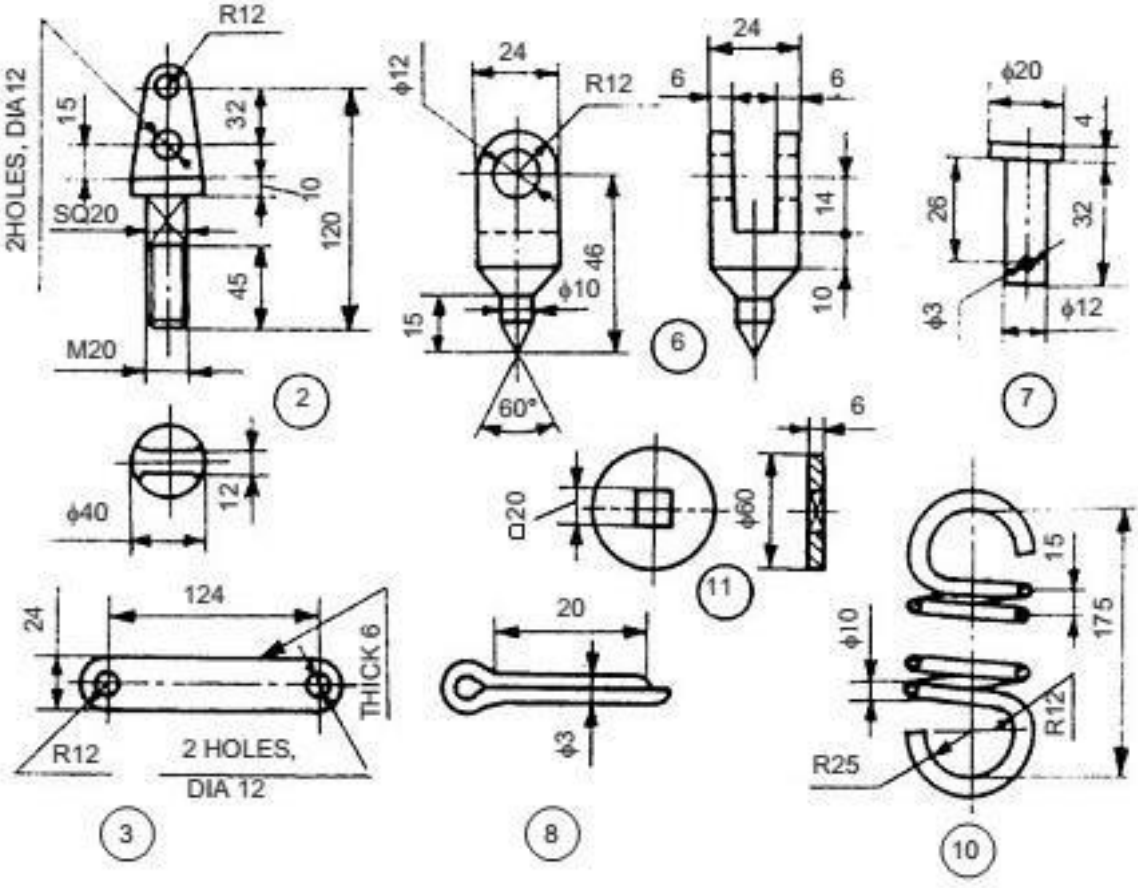
**Ramsbottom safety valve**

The details of a Ramsbottom safety valve. Assemble the details and draw the following views to a full size scale: Front view half in section (b) Write side end view.



Parts list

| Part No. | Name | Matl | Qty |
|---|---|---|---|
| 1 | Housing | CI | 1 |
| 2 | Eye bolt | MS | 1 |
| 3 | Link | MS | 2 |
| 4 | Valve seat | Gunmetal | 2 |
| 5 | Valve | Gunmetal | 2 |
| 6 | Pivot | MS | 1 |
| 7 | Pin | MS | 3 |
| 8 | Split pin | MS | 3 |
| 9 | Lever | MS | 1 |
| 10 | Spring | Spring steel | 1 |
| 11 | Washer | MS | 1 |
| 12 | Lock-nut, M20, 12 Thick | MS | 1 |
| 13 | Nut, M20, 20 Thick | MS | 1 |


R12
2HOLES, DIA 12
15
32
10
SQ20
120
45
M20
2
ϕ40
12
ϕ12
24
R12
46
ϕ10
15
60°
24
6
6
14
10
6
ϕ20
4
26
32
ϕ3
ϕ12
7
6
□20
ϕ60
11
24
124
THICK 6
R12
2 HOLES,
DIA 12
3
20
ϕ3
8
15
175
ϕ10
R12
R25
10

# Machine drawing
## 2 mark question and answer

**1. What are the Classifications of drawing?**

1. Machine drawing.
2. Production drawing.
3. Part drawing.
4. Assembly drawing.
    i. Design assembly drawing.
    ii. Detailed assembly drawing.
    iii. Sub-assembly drawing.

**2. What is Machine drawing?**

It is relating to machine parts or components. It is presented through a number of orthographic views, so that the size and shape of the component is fully understood.

**3. What is Production drawing?**

A production drawing, also referred to as working drawing, should furnish all the dimensions, limits and special finishing processes such as heat treatment, honing, lapping, surface finish, etc., to guide the craftsman on the shop floor in producing the component. The title should also mention the material used for the product, number of parts required for the assembled unit, etc.

**4. What is Part drawing?**

Component or part drawing is a detailed drawing of a component to facilitate its manufacture. All the principles of orthographic projection and the technique of graphic representation must be followed to communicate the details in a part drawing.

**5. What is Assembly drawing ?**

A drawing that shows the various parts of a machine in their correct working locations is an assembly drawing

**6. What is Detailed assembly drawing?**

It is usually made for simple machines, comprising of a relatively smaller number of simple parts. All the dimensions and information necessary for the construction of such parts and for the assembly of the parts are given directly on the assembly drawing. Separate views of specific parts in enlargements, showing the fitting of parts together, may also be drawn in addition to the regular assembly drawing.

**7. What is convention of code?**

- The representation of any matter by some sign or mark on the drawing is known as convention or code.
- The conventions make the drawing simple and easy to draw.

**8. What is dimensioning?**

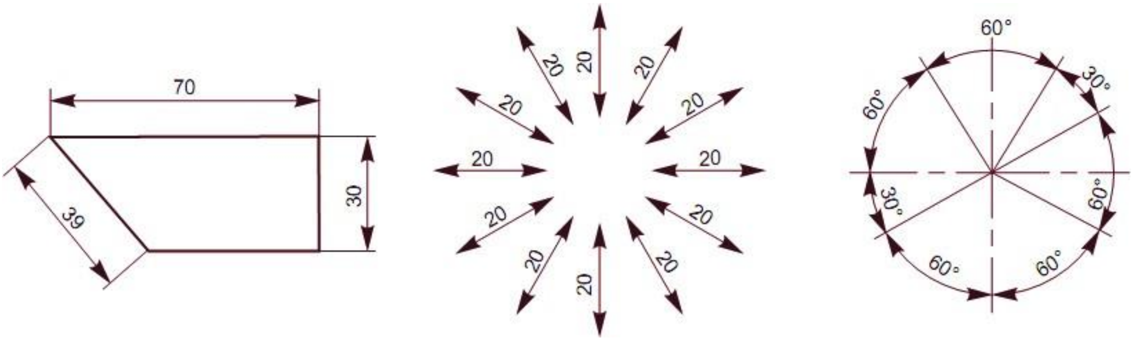
The art of writing the various sizes or measurements on the finished drawing of an object is known as dimensioning.

**9. What are the types of system of placing dimensions?**

i. Aligned system
ii. Unidirectional system

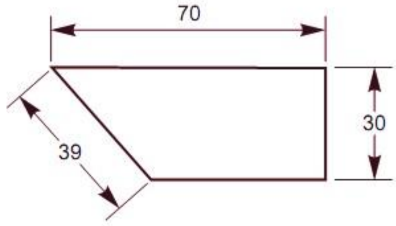
**10. What is Aligned system?**

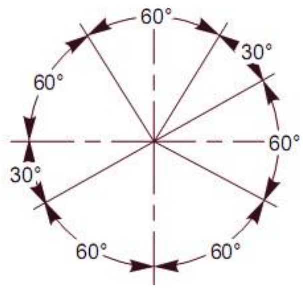
all dimension are placed so that they may be read from the bottom or the right hand edges of the drawing sheet. Here all the dimensions are placed normal and above the dimension lines.



**11. What is unidirectional system?**

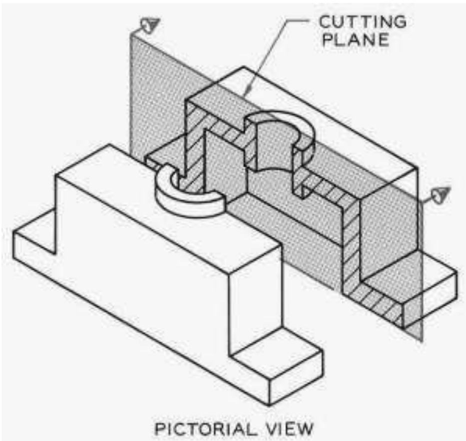
In this system, all dimensions are placed so that they may be read from bottom edge of the drawing sheet.




**12. What is sectioning?**

A section is an imaginary cut taken through an object to reveal the shape or interior construction.




**13. What the Purpose of Sectioning?**

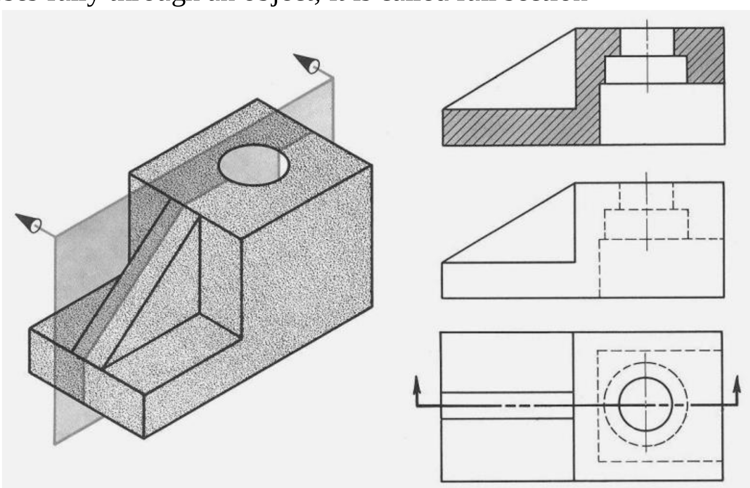
- On many occasions, the interior of an object is complicated or the component parts of a machine are drawn assembled.
- The interior features are represented by hidden lines in usual orthographic views, which results in confusion and difficulty in understanding the drawing
- In order to avoid confusion in such cases objects are sectioned

**14. What are the types of sectioning?**

- Full sectioning
- Half sectioning
- Broken-out sectioning
- Rotated sectioning
- Removed sectioning
- Assembly sectioning

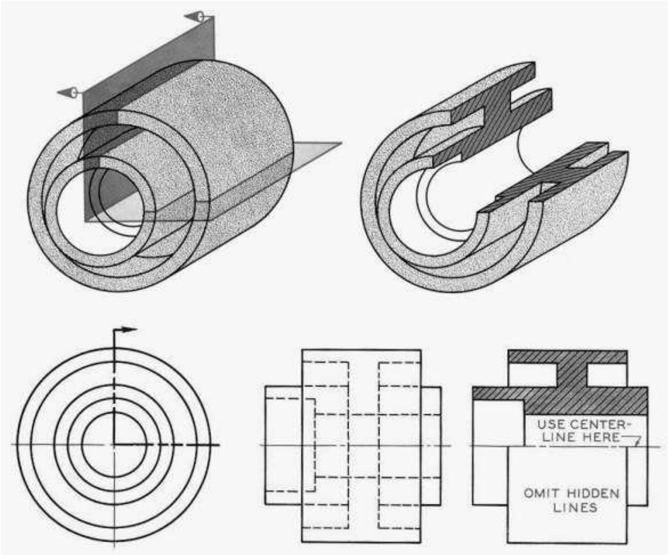
**15. What is full sectioning?**

When cutting plane passes fully through an object, it is called full section



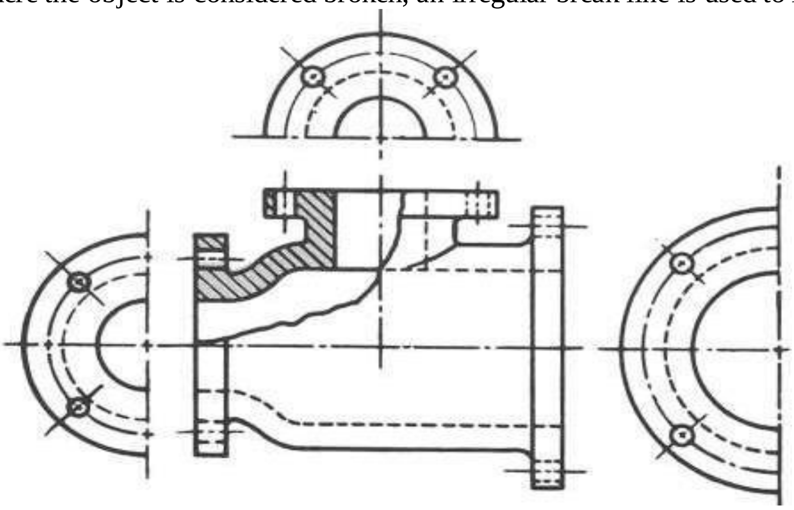
**16. What is half sectioning?**

- A half section is made by cutting halfway through an object
- Thus, one-half is drawn in section and the other half is an outside view.
- Usually, hidden lines are not used (inside details are visible on the section view).



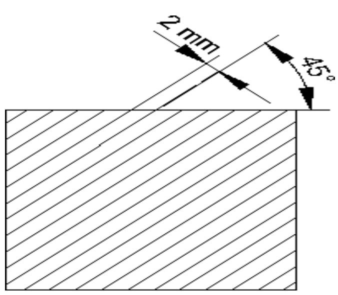

**17. What is broken-out sectioning?**

- This type of section shows only an interior portion of the object insection.
- Cutting plane passes partially through the object. The area immediately in front of the plane is broken and removed, which reveals interior details in this area.
- At the point where the object is considered broken, an irregular break line is used to indicate the break.

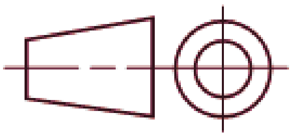


**18. What is Section Lining (Cross-Hatching)?**

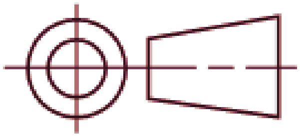
- Section lining of a cut surface is indicated by fine lines, which are drawn as continuous lines usually at an angle of 45º with uniform distance (about 2 mm).For smaller or larger areas, distance between lines can be from 1 mm to 4 mm.
- Section lining or cross-hatching lines should not be parallel or perpendicular to any main visible line bounding the sectioned area.



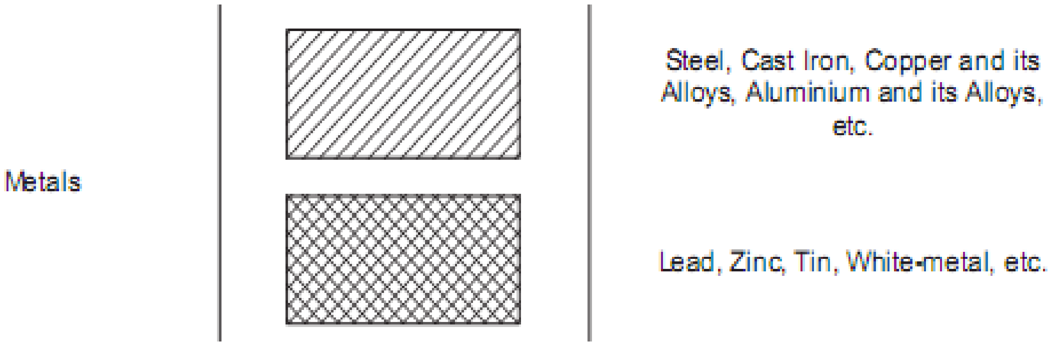
**19. Draw the symbol for first angle projection.**



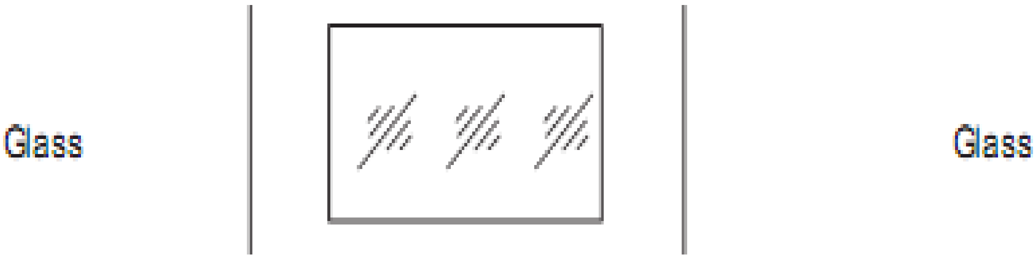
**20. Draw the symbol for third angle projection.**



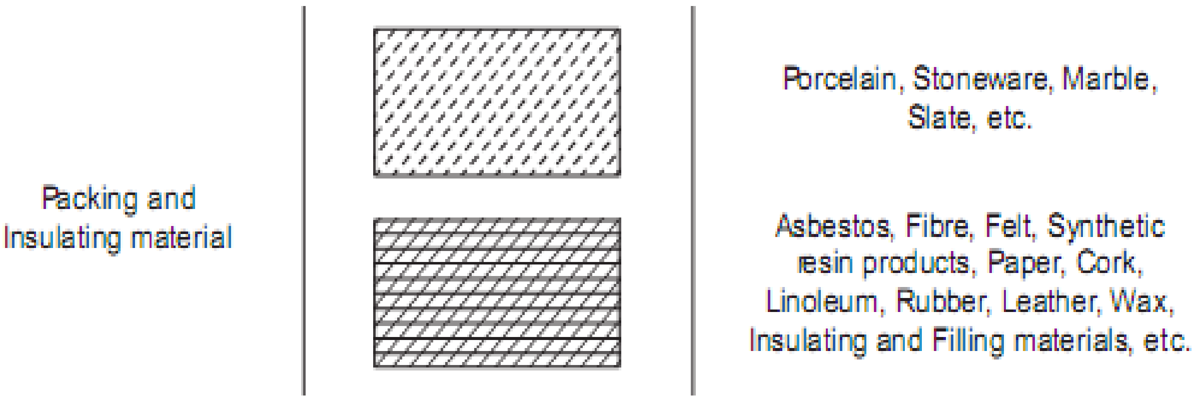
**21. Draw the Conventions of section line for metals.**



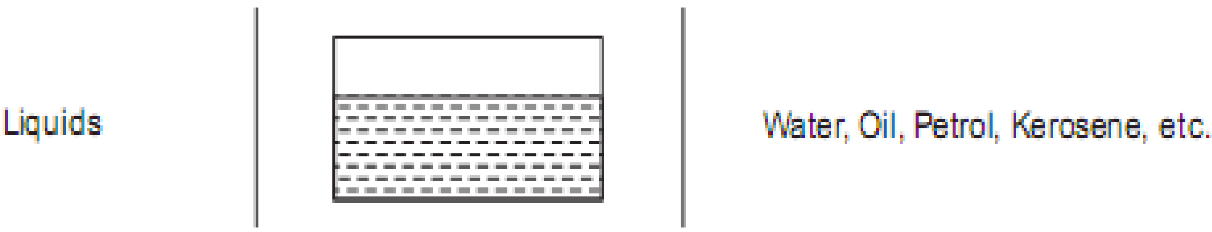

**22. Draw the Conventions of section line for Glass.**




**23. Draw the Conventions of section line for Packing and insulation materials.**



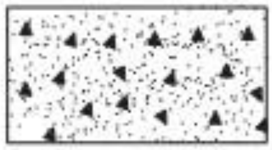

**24. Draw the Conventions of section line for Liquids.**



**25. Draw the Conventions of section line for wood.**

| | | |
|---|---|---|
| Wood |  | Wood, Plywood, etc. |

**26. Draw the Conventions of section line for concreate.**

| | | |
|---|---|---|
| Concrete |  | A mixture of Cement, Sand and Gravel |

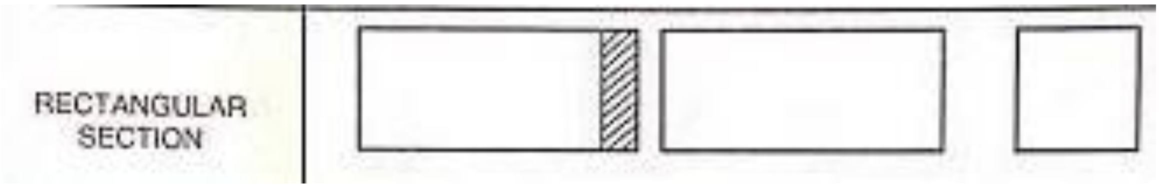
**27. Give the types of line.**

| *Line* | *Description* | *General Applications* |
|---|---|---|
| A | Continuous thick | A1 Visible outlines |
| B | Continuous thin (straight or curved) | B1 Imaginary lines of intersection<br>B2 Dimension lines<br>B3 Projection lines<br>B4 Leader lines<br>B5 Hatching lines<br>B6 Outlines of revolved sections in place<br>B7 Short centre lines |
| C | Continuous thin, free-hand | C1 Limits of partial or interrupted views and sections, if the limit is not a chain thin |
| D | Continuous thin (straight) with zigzags | D1 Line (see Fig. 2.5) |
| E | Dashed thick | E1 Hidden outlines |
| G | Chain thin | G1 Centre lines<br>G2 Lines of symmetry<br>G3 Trajectories |
| H | Chain thin, thick at ends and changes of direction | H1 Cutting planes |
| J | Chain thick | J1 Indication of lines or surfaces to which a special requirement applies |

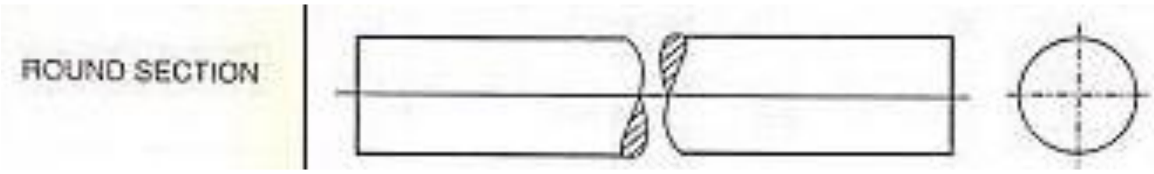
**28. What is the use of Conventional representation of machine components?**

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.

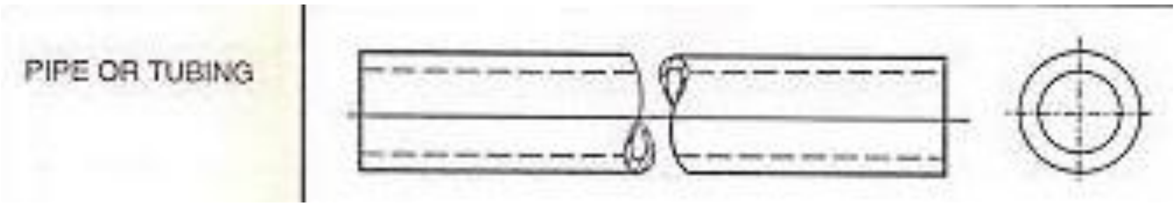
**29. Draw the convention break for rectangular section.**



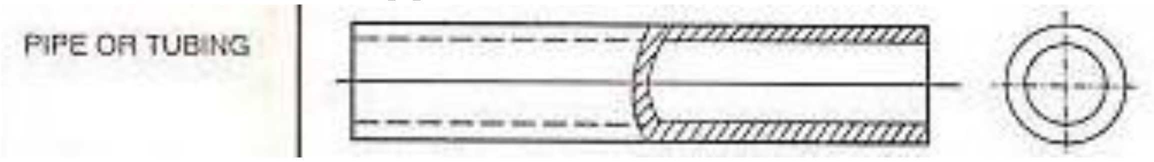

**30. Draw the convention break for round section.**



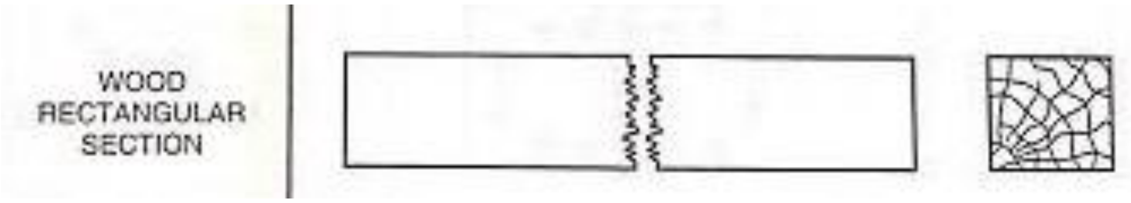

**31. Draw the convention break for pipe section.**



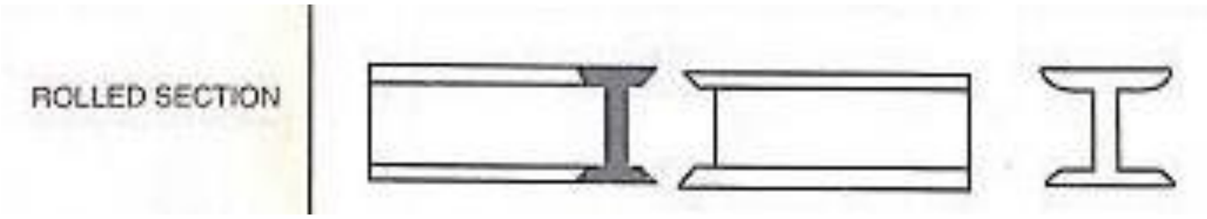

**32. Draw the convention break for pipe section.**



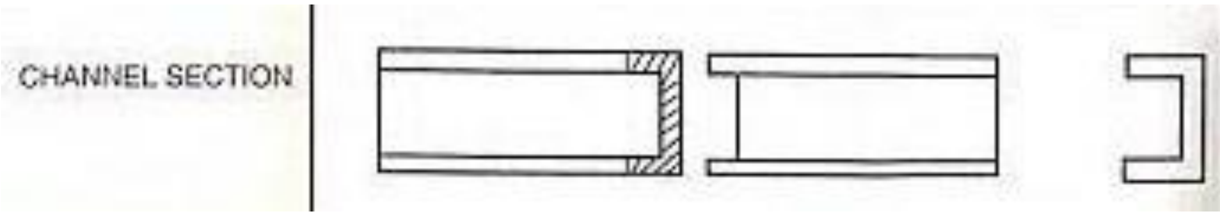

**33. Draw the convention break for wood rectangular section.**



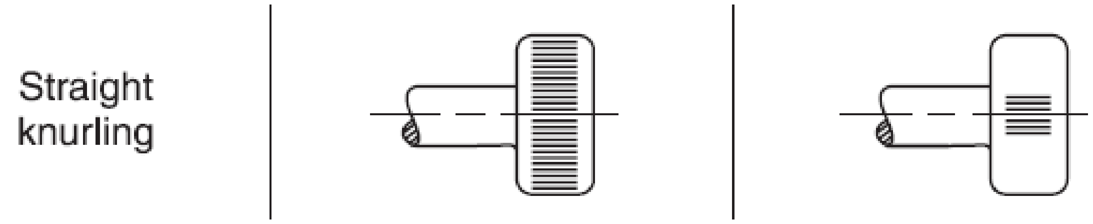

**34. Draw the convention break for rolled I section.**



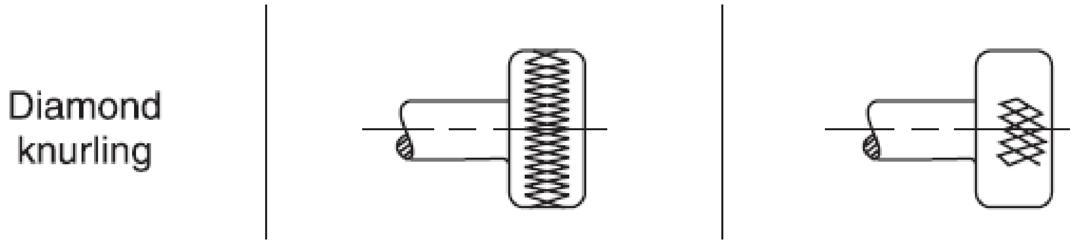

**35. Draw the convention break for channel section.**



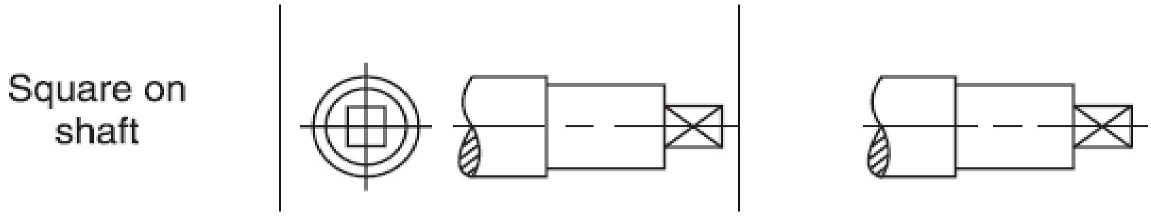

**36. Draw the convention for straight knurling.**



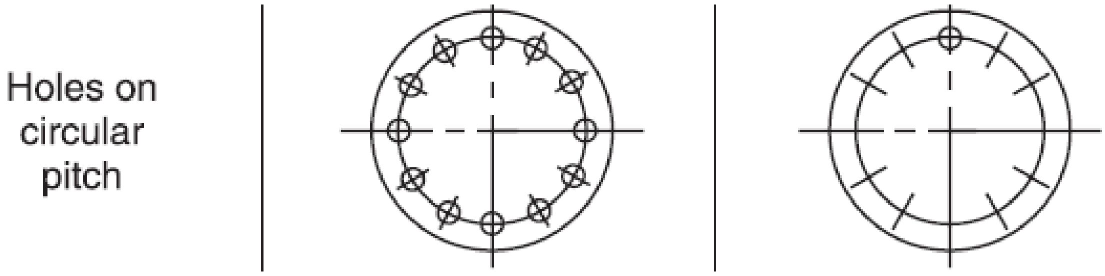

**37. Draw the convention for Diamond knurling.**



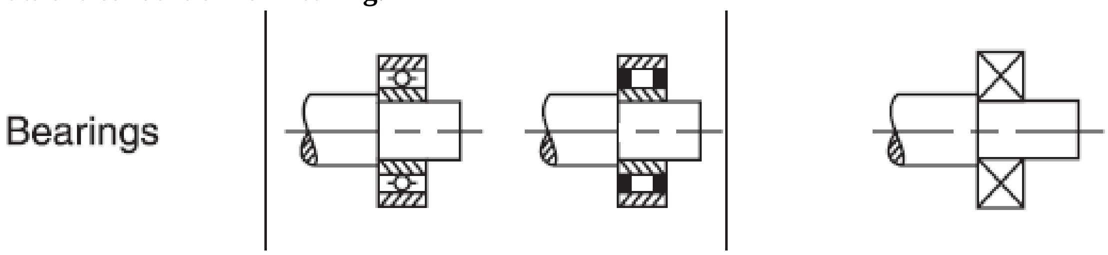

**38. Draw the convention for square on shaft.**



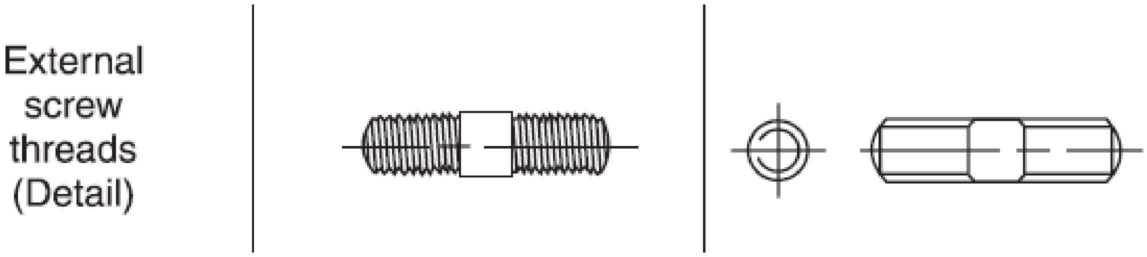

**39. Draw the convention for holes on circular pitch.**




**40. Draw the convention for Bearing.**

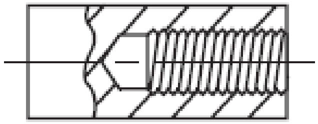


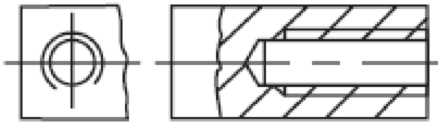

**41. Draw the convention for External screw threads.**




**42. Draw the convention for internal screw threads.**

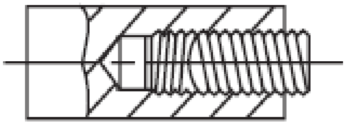
Internal screw threads (Detail)

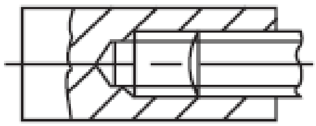




**43. Draw the convention for screw threads (assembly).**

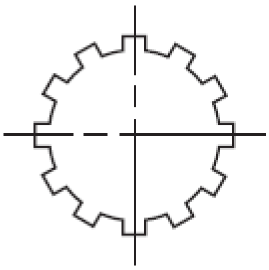
Screw threads (Assembly)

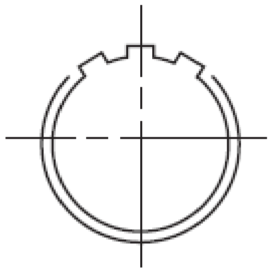




**44. Draw the convention for splined shafts.**

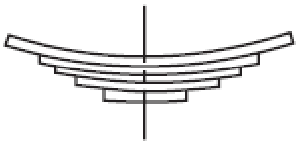
Splined shafts

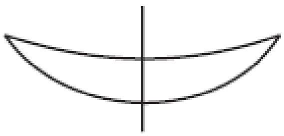




**45. Draw the convention for semi-elliptic leaf spring.**

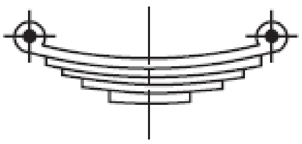
Semi-elliptic leaf spring

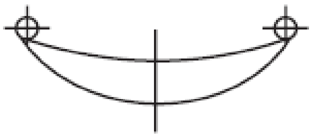




**46. Draw the convention for semi-elliptic leaf spring with eyes.**

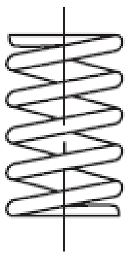
Semi-elliptic leaf spring with eyes

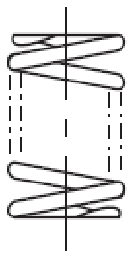


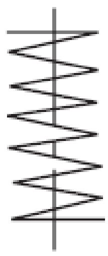


**47. Draw the convention for cylindrical compression spring.**

Cylindrical compression spring

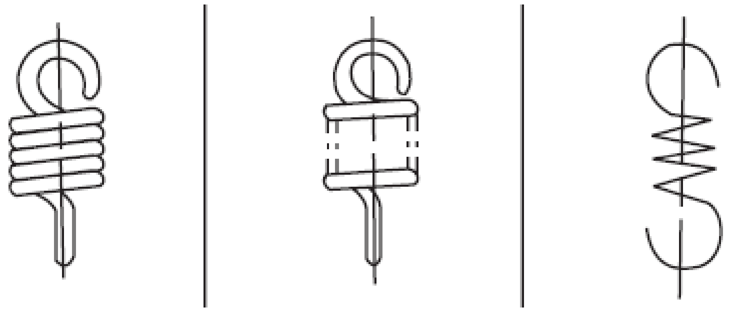






**48. Draw the convention for cylindrical tension spring.**

Cylindrical tension spring

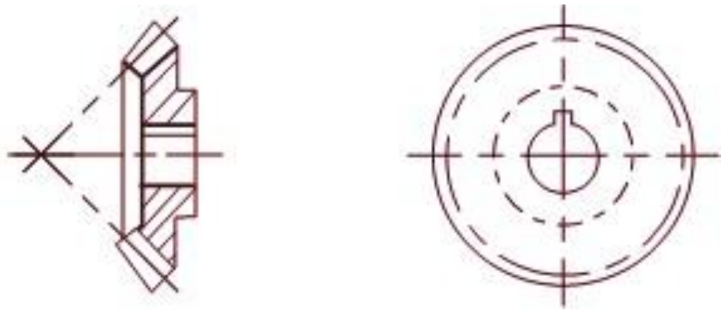


**49. Draw the convention for spur gear.**

Spur gear

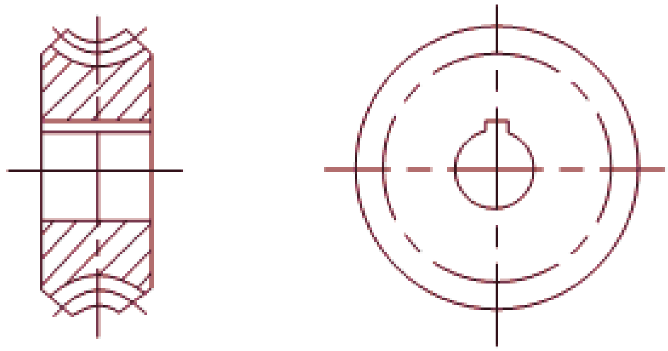
**50. Draw the convention for bevel gear.**

Bevel gear



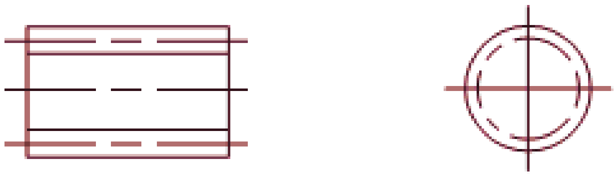
**51. Draw the convention for worm gear.**

Worm wheel



**52. Draw the convention for worm.**

Worm



**53. What is fasteners?**

A machine element used for holding or joining two or more parts of a machine or structure is known as a fastener. The process of joining the parts is called fastening.

**54. What are the types of fasteners?**

The fasteners are of two types: permanent and removable (temporary).

- Permanent - Riveting and welding processes are used for fastening permanently.
- Removable (temporary)-Screwed fasteners such as bolts, studs and nuts in combination, machine screws, set screws, etc., and keys, cotters, couplings, etc., are used for fastening components that require frequent assembly and disassembly.

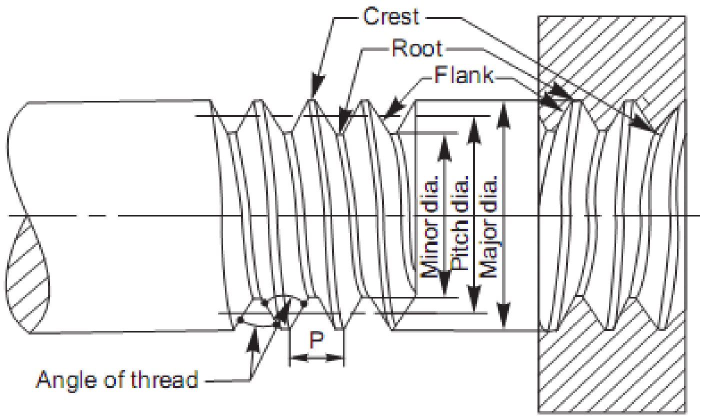
**55. What are the uses of screwed fasteners?**

- To hold parts together,
- To adjust parts with reference to each other and
- To transmit power.

**56. What is screw threads?**

A screw thread is obtained by cutting a continuous helical groove on a cylindrical surface (external thread). The threaded portion engages with a corresponding threaded hole (internal thread); forming a screwed fastener.

**57. Draw and give the Screw thread nomenclature.**




**58. What you mean by Major (nominal) diameter in screw threads?**

This is the largest diameter of a screw thread, touching the crests on an external thread or the roots of an internal thread.

**59. What you mean by Minor (core) diameter in screw threads?**

This is the smallest diameter of a screw thread, touching the roots or core of an external thread (root or core diameter) or the crests of an internal thread.

**60. What you mean by Pitch diameter in screw threads?**

This is the diameter of an imaginary cylinder, passing through the threads at the points where the thread width is equal to the space between the threads.

**61. What you mean by Pitch in screw threads?**

It is the distance measured parallel to the axis, between corresponding points on adjacent screw threads.

**62. What you mean by Lead in screw threads?**

It is the distance a screw advances axially in one turn.

**63. What you mean by Flank in screw threads?**

Flank is the straight portion of the surface, on either side of the screw thread.

**64. What you mean by crest in screw threads?**

It is the peak edge of a screw thread that connects the adjacent flanks at the top.

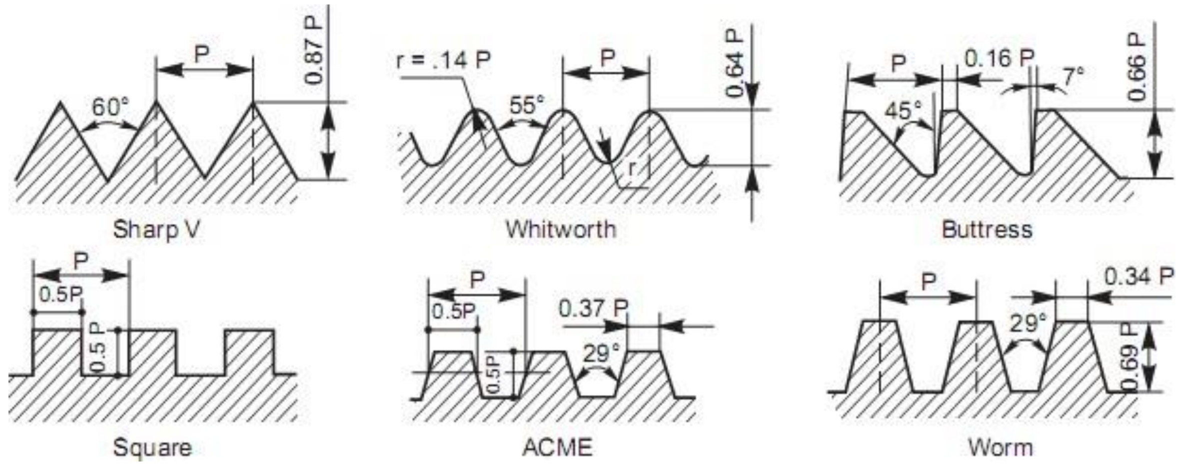
**65. What you mean by Root in screw threads?**

It is the bottom edge of the thread that connects the adjacent flanks at the bottom.

**66. Give the type of treads.**

- V-threads
- British standard whit-worth (B.S.W) threads
- Buttress thread
- Square threads
- ACME threads
- Worm threads

**67. Draw and give the type of treads.**




**68. What you mean by M10 × 1.25?**

ISO metric screw thread is designated by the letter 'M' followed by the value of the nominal diameter and pitch, the two values being separated by the sign '×'. So nominal diameter 10mm and pitch 1.25mm

**69. What you mean by ACME 40 × 8?**

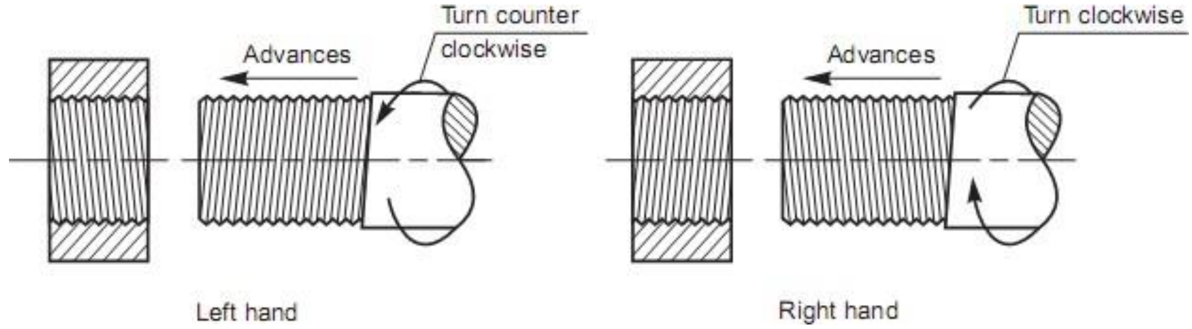
ACME thread of nominal diameter 40 mm and pitch 8 mm

**70. What you mean by WORM 40 × 10?**

WORM thread of nominal diameter 40 mm and pitch 10 mm

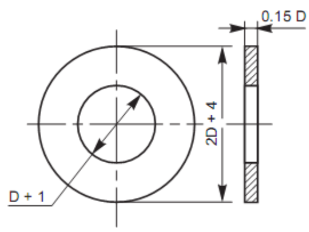
**71. What is Right hand and left hand threads?**

Screw threads may be right hand or left hand, depending on the direction of the helix. A right hand thread is one which advances into the nut, when turned in a clockwise direction and a left hand thread is one which advances into the nut when turned in a counter clockwise direction.




**72. What is washer? And give its purpose.**

A washer is a cylindrical piece of metal with a hole to receive the bolt. It is used to give a perfect seating for the nut and to distribute the tightening force uniformly to the parts under the joint. It also prevents the nut from damaging the metal surface under the joint.



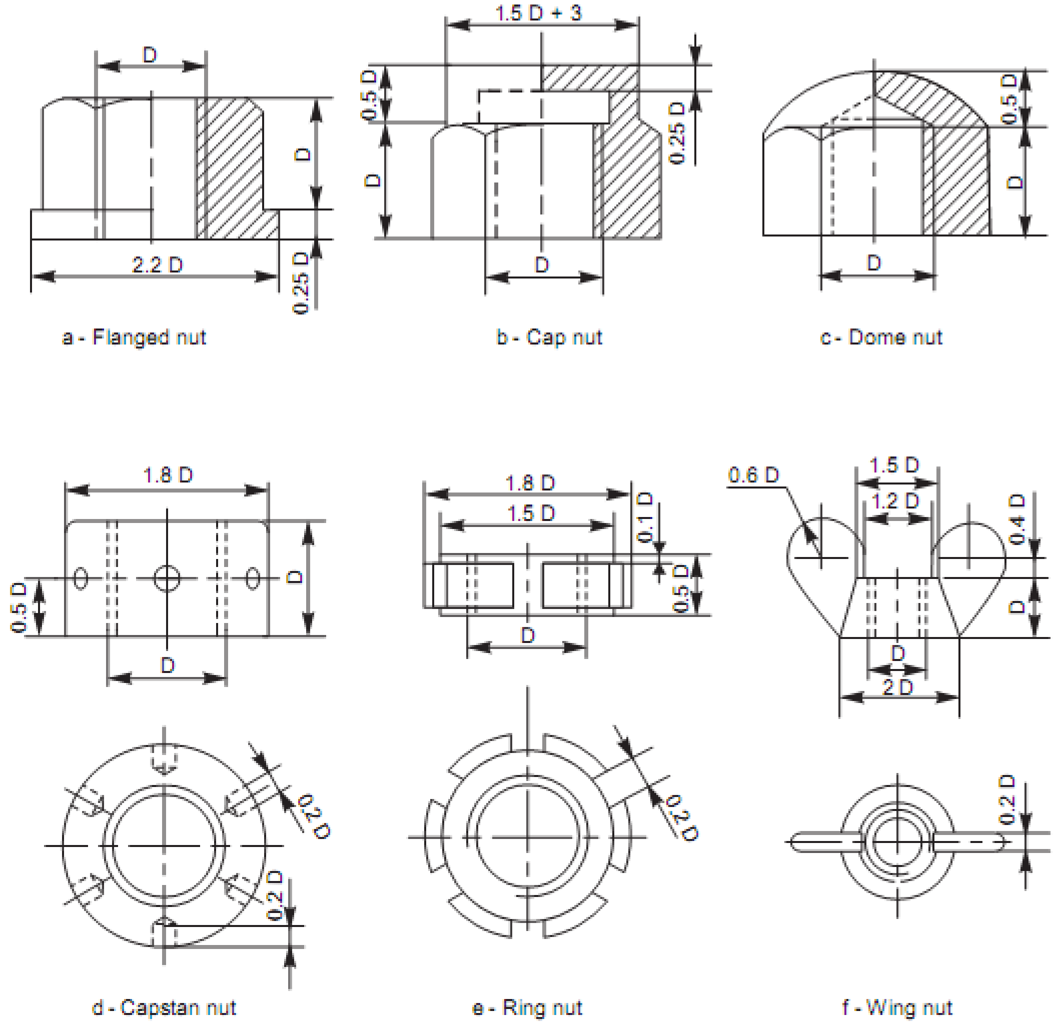

**73. Give the type of bolts.**

- Hexagonal bolts
- Square headed bolts
- Square headed bolts with square neck
- T-headed bolts with square neck
- Hook bolts
- Eye bolts

- Stud bolt or stud

**74. Give the type of nuts**

- Flanged nuts
- Cap Nut
- Dome nut
- Capstan nut
- Slotted or ring nut
- Wing nut




**75. What is key?**

Keys are machine elements used to prevent relative rotational movement between a shaft and the parts mounted on it, such as pulleys, gears, wheels, couplings, etc.

**76. What are the types of keys?**

Keys are classified into three types,

1. Saddle keys,
2. Sunk keys and
3. Round keys.

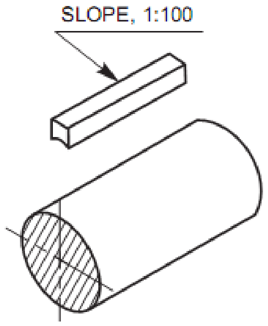
**77. What you mean by Saddle key?**

These are taper keys, with uniform width but tapering in thickness on the upper side. The magnitude of the taper provided is 1:100. These are made in two forms:

1. Hollow saddle key and
2. Flat saddle key.

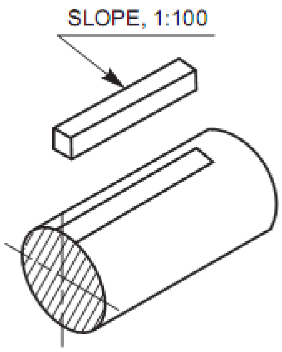
**78. What you mean by Hollow saddle key?**

1. A hollow saddle key has a concave shaped bottom to suit the curved surface of the shaft, on which it is used.
2. A keyway is made in the hub of the mounting, with a tapered bottom surface.
3. When a hollow saddle key is fitted in position, the relative rotation between the shaft and the mounting is prevented due to the friction between the shaft and key.




**79. What you mean by Flat saddle key?**

It is similar to the hollow saddle key, except that the bottom surface of it is flat. Apart from the tapered keyway in the hub of the mounting, a flat surface provided on the shaft is used to fit this key in position.




**80. What you mean by Sunk key?**

- These are the standard forms of keys used in practice, and may be either square or rectangular in cross-section. The end may be squared or rounded.
- Generally, half the thickness of the key fits into the shaft keyway and the remaining half in the hub keyway. These keys are used for heavy duty, as the fit between the key and the shaft is positive.

**81. What are the classification of sunk keys?**

Sunk keys may be classified as:

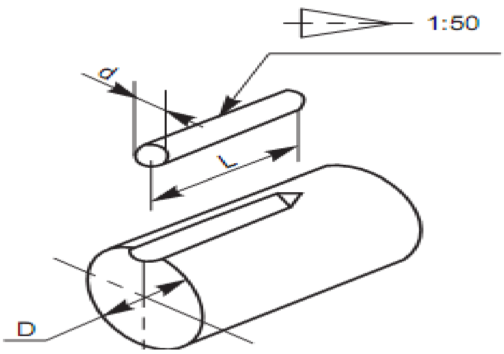
***(i)*** Taper keys,

***(ii)*** Parallel or feather keys and

***(iii)*** Woodruff keys.

**82. Round key**

Round keys are of circular cross-section, usually tapered (1:50) along the length. A round key fits in the hole drilled partly in the shaft and partly in the hub.



**83. What is cotter?**

A cotter is a flat wedge shaped piece, made of steel. It is uniform in thickness but tapering in width, generally on one side; the usual taper being 1:30. The lateral (bearing) edges of the cotter and the bearing slots are generally made semi-circular instead of straight.

**84. Name the type of cotter joints**

1. Cotter joint with sleeve
2. Cotter joint with socket and spigot ends.
3. Cotter joint with in a Gib.

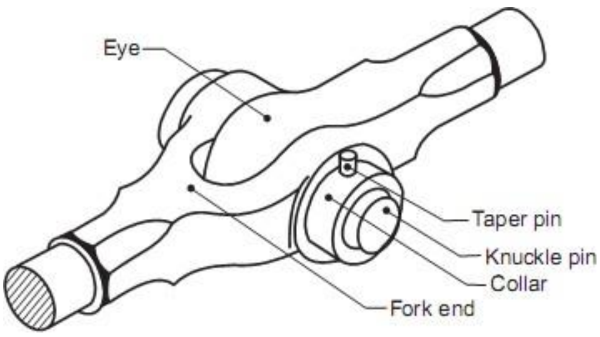
**85. What is pin joints?**

A pin is used to fasten two rods that are under the action of a tensile force; although the rods may support a compressive force if the joint is guided. Some pin joints such as universal joints, use two pins and are used to transmit power from one rotating shaft to another.

**86. What is Knuckle joint? And give its application.**

A knuckle joint is a pin joint used to fasten two circular rods. In this joint, one end of the rod is formed into an eye and the other into a fork (double eye). For making the joint, the eye end of the rod is aligned into the fork end of the other and then the pin is inserted through the holes and held in position by means of a collar and a taper pin. Once the joint is made, the rods are free to swivel about the cylindrical pin.

Knuckle joints are used in suspension links, air brake arrangement of locomotives, etc.

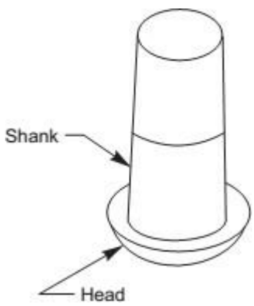



**87. What is universal coupling?**

Universal joints are used to transmit power between two shafts which are not coaxial. It is a rigid coupling that connects two shafts, whose axes intersect if extended. It consists of two forks which are keyed to the shafts. The two forks are pin joined to a central block, which has two arms at right angle to each other in the form of a cross. The angle between the shafts may be varied even while the shafts are rotating.

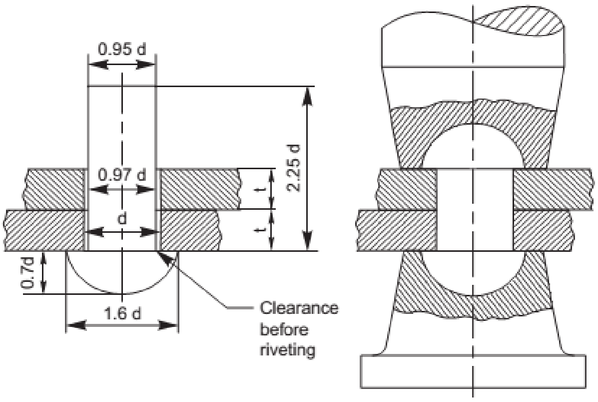
**88. What is rivet?**

A rivet is a round rod of circular cross-section. It consists of two parts, viz., head and shank. Mild steel, wrought iron, copper and aluminium alloys are some of the metals commonly used for rivets. The choice of a particular metal will depend upon the place of application.



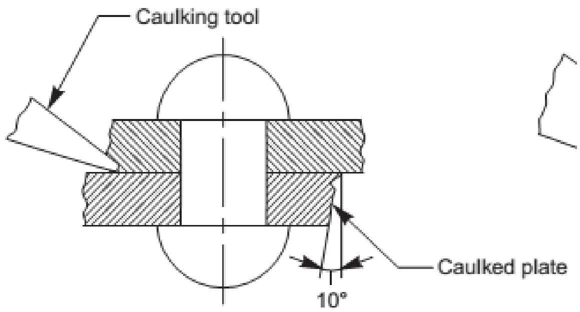

**89. What is Riveting?**

Riveting is the process of forming a riveted joint. For this, a rivet is first placed in the hole drilled through the two parts to be joined. Then the shank end is made into a rivet head by applying pressure, when it is either in cold or hot condition.



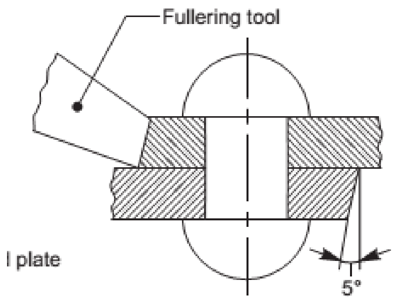

**90. What is caulking?**

To produce air tight riveted joints, these bevelled edges of the plates are caulked. Caulking is an operation in which the outer bevelled edges of the plates are hammered and driven-in by a caulking tool. The caulking tool is in the form of a blunt edged chisel.




**91. What is Fullering?**

Fullering is also used to produce air tight joints. Unlike the caulking tool, the width of the fullering tool is equal to the width of the bevelled edges of the plates. Caulking and fullering operations are carried out effectively by applying pneumatic pressure.



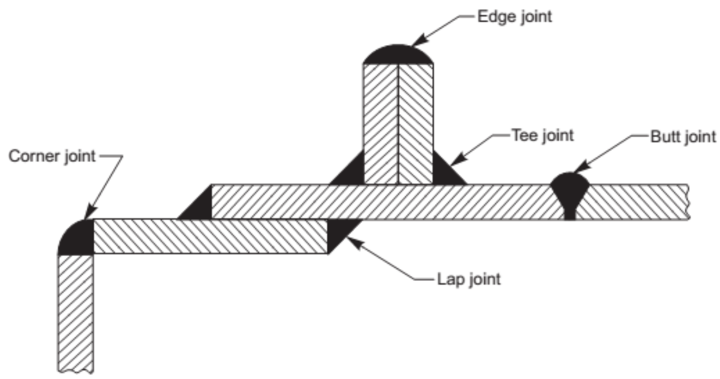

**92. Give the Classification of rivet joints.**

Riveted joints may be broadly classified into:

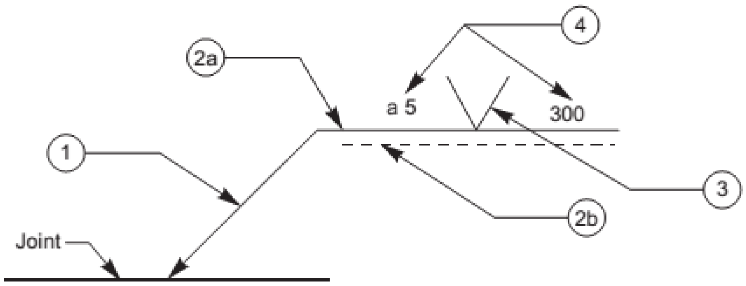
1. Structural joints and
2. Pressure vessel joints.

Boiler joints are classified as:

1. Lap joints,
2. Butt joints and
3. Combination of lap and butt joints.




**93. Name the Position of welded symbols on the drawings.**

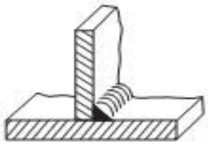
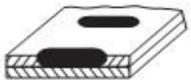
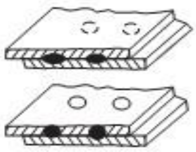
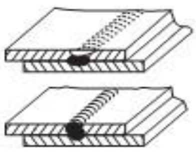
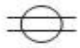



1. An arrow line (1) per joint,
2. A dual reference line, consisting of two parallel lines; one continuous and one dashed (2a, 2b) and
3. A certain number of dimensions (4) and conventional signs (3).

**94. Give the Elementary welding symbols.**

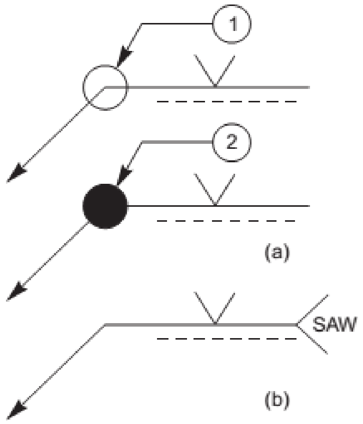
| *Shape of weld surface* | *Symbol* |
|---|---|
| (*a*) Flat (usually finished flush) | — |
| (*b*) Convex | ⌒ |
| (*c*) Concave | ‿ |

| *Designation* | *Illustration* | *Symbol* |
|---|---|---|
| Flat (flush) single-V butt weld |  |  |
| Convex double-V butt weld |  |  |
| Concave fillet weld |  |  |
| Flat (flush) single-V butt weld with flat (flush) backing run |  |  |

| No. | Designation | Illustration | Symbol |
|---|---|---|---|
| 1. | Butt weld between plates with raised edges (the raised edges being melted down completely) |  |  |
| 2. | Square butt weld |  |  |
| 3. | Single-V butt weld |  |  |
| 4. | Single-bevel butt weld |  |  |
| 5. | Single-V butt weld with broad root face |  |  |
| 6. | Single-bevel butt weld with broad root face |  |  |
| 7. | Single-U butt weld (parallel or sloping sides) |  |  |
| 8. | Single-U butt weld |  |  |
| 9. | Backing run; back or backing weld |  |  |
| 10. | Fillet weld |  |  |
| 11. | Plug weld; plug or slot weld |  |  |
| 12. | Spot weld |  |  |
| 13. | Seam weld |  |  |

**95. Explain about welding Conventional signs.**

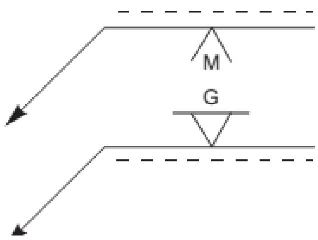
The two conventional signs used for welding as per BIS are a circle at the elbow (1), connecting the arrow and the reference line to indicate welding all around and, by a filled-in circle (2) at the elbow to indicate welding on site.




Another convention as per International Standards Organization, indicates the process of welding. For this, the abbreviation of the welding process is written as a note at the tail end of the arrow, forming a 90°V. Here, SAW stands for submerged arc welding.

**96. How to mention the surface finish of weld?**

Finishing of welds other than cleaning, shall be indicated by suitable contour and finish symbols, viz., chipping C, machining M and grinding G.



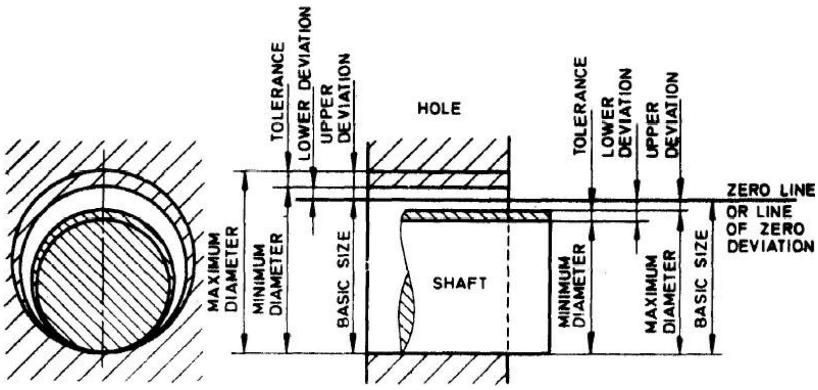

**97. What is the need of Limits Tolerances and Fits?**

The manufacture of interchangeable parts require precision. Precision is the degree of accuracy to ensure the functioning of a part as intended. However, experience shows that it is impossible to make parts economically to the exact dimensions. This may be due to,

i. Inaccuracies of machines and tools,
ii. Inaccuracies in setting the work to the tool, and
iii. Error in measurement, etc.

The workman, therefore, has to be given some allowable margin so that he can produce a part, the dimensions of which will lie between two acceptable limits, a maximum and a minimum.

**98. Draw the basic size deviation and tolerances system?**




**99. What is Tolerances?**

- The permissible variation of a size is called tolerance.
- It is the difference between the maximum and minimum permissible limits of the given size.

- If the variation is provided on one side of the basic size, it is termed as unilateral tolerance. Similarly, if the variation is provided on both sides of the basic size, it is known as bilateral tolerance.

**100. What is limits?**

The two extreme permissible sizes between which the actual size is contained are called limits. The maximum size is called the upper limit and the minimum size is called the lower limit.

**101. What is deviation?**

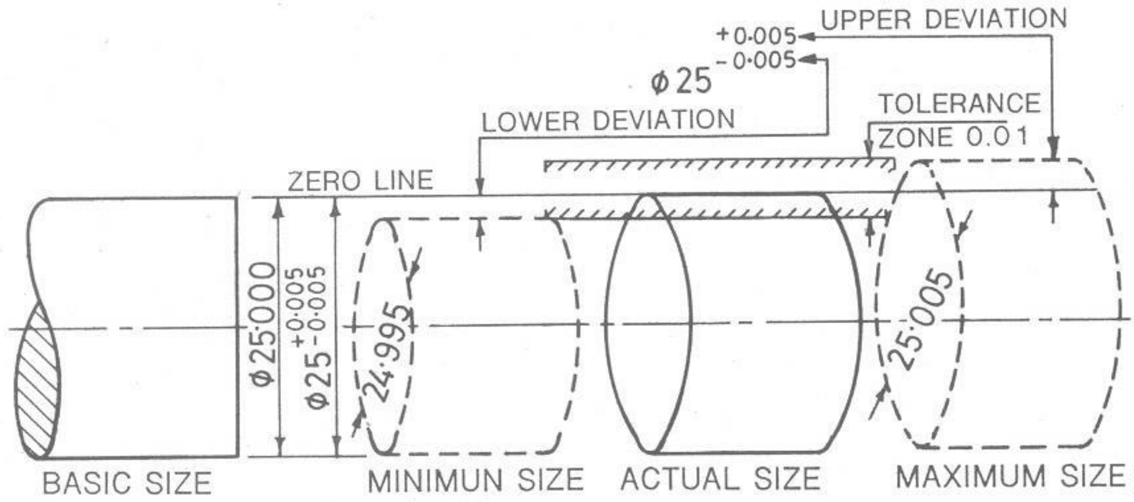
It is the algebraic difference between a size (actual, maximum, etc.) and the corresponding basic size.

**For hole**

Max Hole size – Basic Size = Upper Deviation
Min Hole size – Basic Size = Lower Deviation

**For shaft**

Basic Size - Max shaft size = Upper Deviation
Basic Size – Min shaft size = Lower Deviation




**102. What is Upper deviation?**

It is the algebraic difference between the maximum limit of the size and the corresponding basic size.

**103. What is Lower deviation?**

It is the algebraic difference between the minimum limit of the size and the corresponding basic size.

**104. Define Allowance.**

It is the dimensional difference between the maximum material limits of the mating parts, intentionally provided to obtain the desired class of fit. If the allowance is positive, it will result in minimum clearance between the mating parts and if the allowance is negative, it will result in maximum interference.

**105. Define fit.**

The relationships between the mating parts are called fits. Or condition of looseness or tightness between two mating parts being assembled together

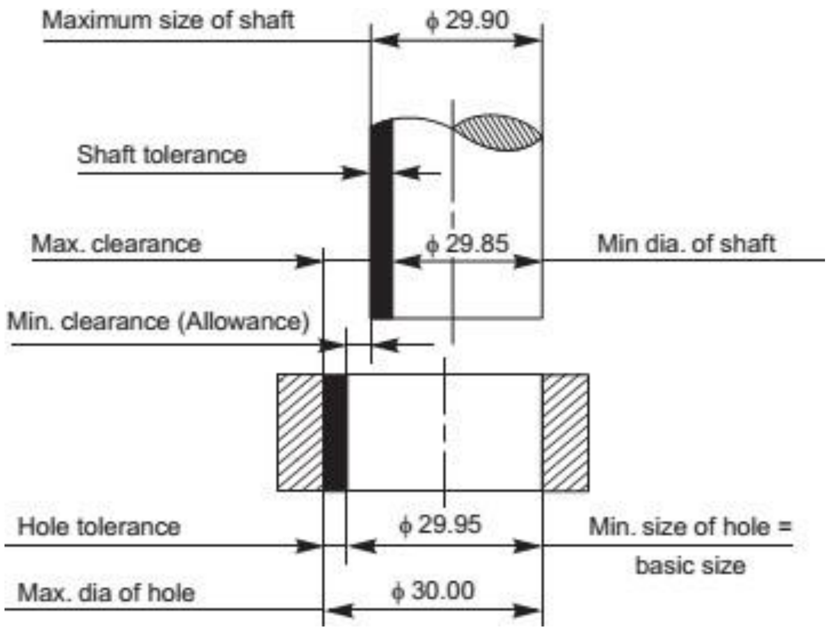
**106. Give the types of fit.**

1. Clearance Fit
2. Interference Fit
3. Transition Fit

**107. Define clearance fit.**

It is a fit that gives a clearance (condition of looseness) between the two mating parts.

Maximum shaft dimension < Minimum hole dimension




**108. Define Minimum clearance.**

It is the difference between the minimum size of the hole and the maximum size of the shaft in a clearance fit.

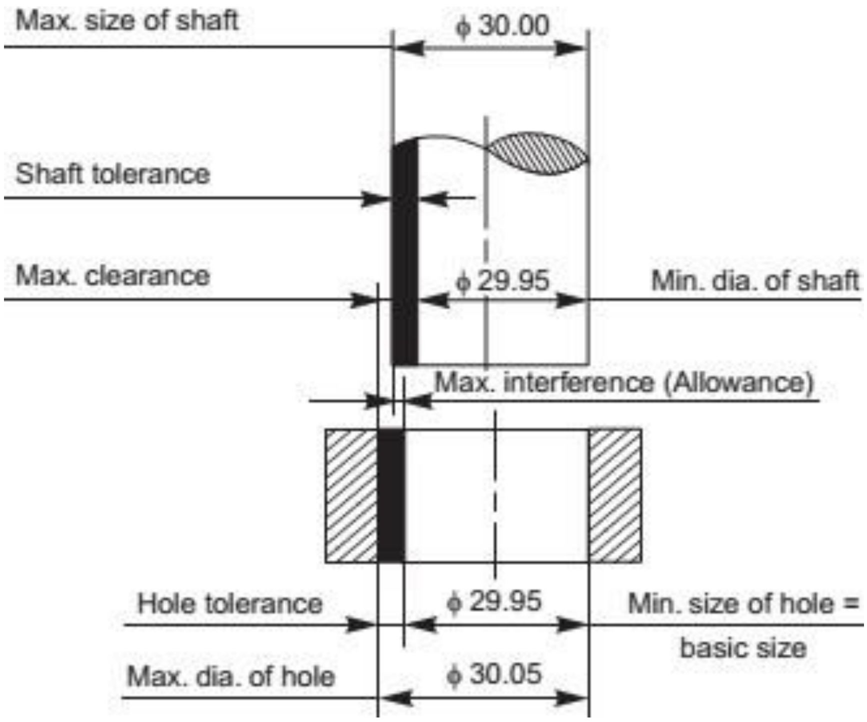
**109. Define Maximum clearance**

It is the difference between the maximum size of the hole and the minimum size of the shaft in a clearance or transition fit.

**110. Define Transition fit.**

This fit may result in either an interference or a clearance, depending upon the actual values of the tolerance of individual parts. The shaft in Fig. may be either smaller or larger than the hole and still be within the prescribed tolerances. It results in a clearance fit, when shaft diameter is 29.95 and hole diameter is 30.05 (+ 0.10 mm) and interference fit, when shaft diameter is 30.00 and hole diameter 29.95 (– 0.05 mm).

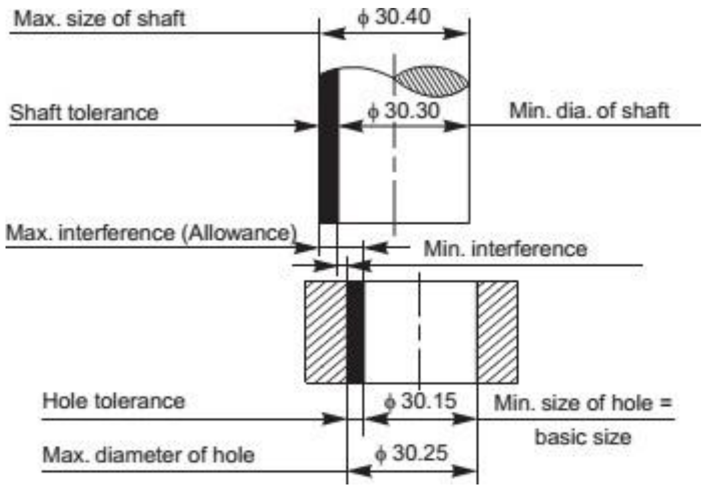
Obtained by overlapping of tolerance zones of shaft and hole. Does not guarantee neither clearance nor interference fit



**111. Define Interference fit.**

If the difference between the hole and shaft sizes is negative before assembly; an interference fit is obtained.

Maximum Hole size < Minimum Shaft size




**112. Define Minimum interference.**

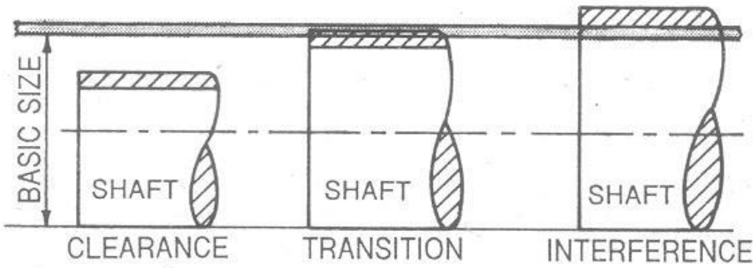
It is the magnitude of the difference (negative) between the maximum size of the hole and the minimum size of the shaft in an interference fit before assembly.

**113. Define Maximum interference.**

It is the magnitude of the difference between the minimum size of the hole and the maximum size of the shaft in an interference or a transition fit before assembly.

**114. What is Hole basis system**

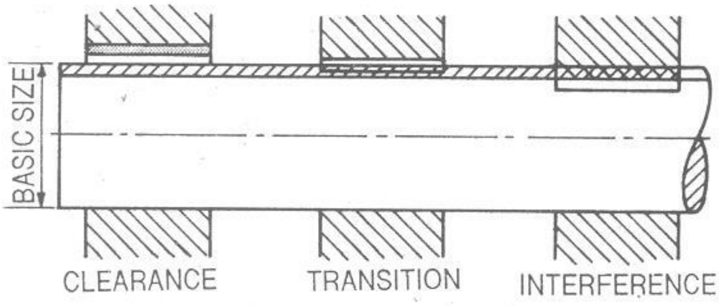
Size of hole is kept constant, shaft size is varied to get different fits. In this system, the lower deviation of the hole is zero. The letter symbol for this situation is ‘H’.




(i) HOLE BASIS SYSTEM

**115. What is Shaft basis system?**

Size of shaft is kept constant, hole size is varied to get different fits. In this system, the upper deviation of the shaft is zero. The letter symbol for this situation is ‘h’.




(ii) SHAFT BASIS SYSTEM

**116. What is Surface Texture or surface finish?**

- Surface texture or surface finish is the amount of geometric irregularity produced on the surface.
- Surface finish is important for the proper functioning of mating parts. Parts such as piston, cylinder, gear, bearings required a very smooth finish for their function.

The two principle reasons for surface finish control are

i. Friction reduction

ii. The control of wear

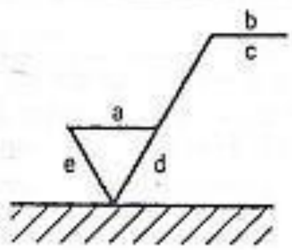
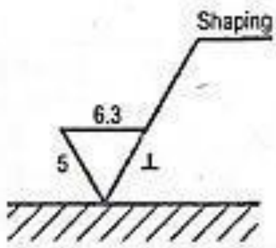
**117. Give the Importance of surface finish**

- Surface finish is important for the wear service of certain piece subject to dry friction. Eg.: Machine tool bits, stamping dies, threading dies, rolls, clutch plates etc.
- Smooth surface finishes are essential on certain high precision pieces. Eg.:Micrometer anvils, gauges and gauge blocks, etc.
- Smoothness in the surface is often important for the visual appeal of the finished product. Eg.: Rolls, extrusion dies, and precision casting dies.
- Surface finish control may be necessary to ensure quiet operation. Eg.: Gear and other parts.

**118. Give Surface roughness values & grades**

| Roughness value Rain µm | 50 | 25 | 12.5 | 6.3 | 3.2 | 1.6 | 0.8 | 0.4 | 0.2 | 0.1 | 0.05 | 0.025 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Roughness grade number | N12 | N11 | N10 | N9 | N8 | N7 | N6 | N5 | N4 | N3 | N2 | N1 |
| Roughness symbol | ~ | ▽ | | ▽▽ | | | ▽▽▽ | | | ▽▽▽▽ | | |

**119. Explain the Surface roughness symbol with all the characteristics**

| Standard symbol | Example |
|---|---|
|   a – Surface roughness value in microns (or) roughness grade number |   A surface with maximum roughness value of 6.3 microns |
| b – Production method (or) coating method | Production method is shaping process |
| c – Sampling length | Sampling length is 2.5 mm |
| d – Direction of lay | The direction of lay is perpendicular to the plane of projection of view |
| e – Machine allowance | Machine allowance is 5 mm |

**120. Give the Symbol for direction of lay**

| Meaning | Symbol | Diagram indicates the direction of lay | Indication of lay on drawing | Interpretation |
|---|---|---|---|---|
| Parallel | = | | √= | Parallel to the plane of projection of the view in which the symbol is used |
| Perpendicular | ⊥ | | √⊥ | Perpendicular to the plane of projection of the view in which the symbol is used |
| Crossed | X | | √X | Crosses in two slant directions relative to the plane of projection of the view in which the symbol is used |
| Multi directional | M | | √M | Multi direction to the plane of projection of the view |
| Circular | C | | √C | Approximately circular relative to the centre of the surface in which the symbol in which the symbol is applied |
| Radial | R | | √R | Approximately radial relative to the centre of the surface to which the symbol is applied |

**121. What is the use of Bearing?**

The bearing is used for support long shafts, requiring intermediate support, especially when the shaft cannot be introduced into the bearing, end-wise.

**122. What is the use of Swivel bearing?**

Swiveling or self-aligning bearing is used to support shafts where there are possibilities of misalignment. These, like Plummer blocks, may be placed at any desired location.

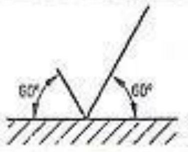
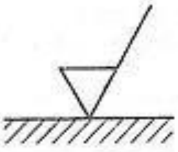
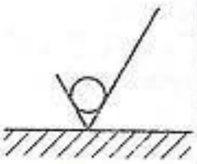
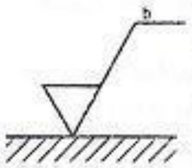
**123. What is the use of Screw jack?**

Screw jacks are used for raising heavy loads through very small heights. The tommy bar is inserted into a hole through the enlarged head of the screw and when this is turned, the screw will move up or down, thereby raising or lowering the load.

**124. What is connecting? And where it is used.**

The connecting rod acts as a link between the piston and the crankshaft. They are generally made of steel or aluminum alloys. The rod is usually of I-cross section with big end on the crank pin side and small end on the gudgeon pin side. The rods are made by forging dies. The ends are lined with split bushes made of white metal or brass. Arrangements are made for lubrication of big end ‘and small end.

**125. Give the Surface roughness symbols**

| | |
|---|---|
|  | **Basic symbol:** It is used to indicate surface finish by any production process other than machining. It consists of two legs of unequal length inclined at 60° to the line representing the surface. |
|  | **Symbol for surface finish by machining process:** If the surface finish is to be obtained by removal of material by any of the machining process, a horizontal bar is added to the shorter leg of basic symbol. |
|  | **Symbol for surface finish without removal of material:** If the surface finish is to be obtained without removal of material or when a surface to be left in the condition obtained from a preceding process, a circle is added to the basic symbol. |
|  | **Symbol for surface finish by a particular machining process:** If the surface finish is to be produced by a particular machining method such as milling, shaping, chrome plating etc., the method shall be indicated above a horizontal line added to the longer leg of the basic symbol. |

**126. What is Lathe tail-stock? And why it is used.**

It is a part of a lathe machine and is used to support lengthy jobs. To accommodate works of different lengths between centers, the tail-stock may be moved on the lathe bed to the required position and clamped by means of a clamping bolt.

**127. What is Four way tool post? What is its purpose?**

This is used to hold four different tools at a time. The tool holder may be rotated and clamped to facilitate the use of any one of the tools at a time.

**128. What is ramsbottom safety valve?**

It is a boiler mounting and a safety device which protects the boiler against building-up of excess pressure. The spring used in the safety valve is set to act when the steam pressure exceeds the set value and allows the steam to escape. Thus, only the permissible value of steam pressure is allowed inside the boiler.

**129. What is the primary use of conventions in mechanical engineering practice?**

- The complete drawing of a machine component involves a lot of time or space.
- Its convention may be drawn in its place to represent the actual machine component.

**130. What are the three types of cotter joints?**

- Cotter joint with sleeve
- Cotter joint with socket & spigot ends
- Cotter joint with a gib

**131. What is pin joint?**

Pin joints invariably use a pin or pins in order to fasten two rods which may be under axial load.

**132. What is rivet?**

- A rivet is a small metal rod of circular cross-section .
- It consists of two parts head and shank
- Mild steel, wrought iron, copper and aluminium are some of the metals commonly used for making rivets.

**133. How do you designate a V-thread?**

- All v-threads have a large resistance to shear due to their increased thickness at the root compared to other profiles.
- Thread profile has a larger area of the thread flank and therefore provides more friction.
- The angle between the teeth is 60°

**134. Name the various types of sections?**

- Section in one plane
- Section in two parallel planes
- Section in three successive planes
- Section in two intersecting planes

**135. What is left hand and right hand screw threads**

- A right hand thread is one which advances into the nut when turned clockwise.
- A left hand thread is one which advances into the nut when turned counter-clockwise.

**136. Name the commonly used materials for rivets**

Mild steel, Wrought iron, Copper and Aluminium are some of the metals commonly used for making rivets.

**137. Write down the advantages of welded joints over riveted joints.**

- Lighter weight due to elimination of straps, gusset plate, etc.
- Increased efficiency of the joint which may be as high as 100%
- Lower cost
- Ease of fabrication
- Less noisy

**138. Under what conditions, a woodruff key is used?**

- A woodruff key is a particular kind of sunk key in which the key is a part of a segment of a circular disc of uniform thickness.
- Generally used on tapered shafts of machine tools and automobiles.

**139. Why a gib is used in combination with a cotter**

- This is generally used to join two square rods
- A gib is also a wedge-like element which is used along with the cotter
- One side of the gib is tapered and the other is straight.

**140. State various principles to be followed while dimensioning a drawing.**

- Dimensions should be placed on the view which shows the relevant features most clearly.
- Dimensions marked in one view need not be repeated in another view.
- Dimensions should be placed outside the diagram
- Dimensions should be taken from visible outlines rather than from hidden lines.

**141. What is the basic requirement of a rivet?**

- The rivet is placed in a hole drilled or punched through the two parts to be joined and the shank end is made into a rivet head either by cold working or by applying pressure in the red-hot condition.
- It is done under the application of steady force by means of hydraulic or pneumatic pressure.

**142. Write about the cotter joint with gib?**

- This is generally used to join two square rods.
- A gib is also a wedge like element which is used along with the cotter

**143. What is universal coupling? Write its applications**

- A central block in the form of a cross is positioned between the forks by means of four pins
- A fork is keyed to the end of each shaft
- This coupling is also called as Hooke’s joint
- This is used when the shaft axes are intersecting

**144. What is stop valve?**

Stop valves are used to control the flow of steam from a boiler to its engine.
The design is such that the incoming steam from the boiler can be directed to any one of two paths provided.

**145. Name few joints for hydraulic pipes**

- Hydraulic pipes are normally used for conveying water, oil, sewage, etc.

The different types of hydraulic joints are:

- Socket and spigot joints
- Flanged joint
- Union joint
- Expansion joint

**146. Why are washes used in bolted joints**

- A washer is a cylindrical piece of metal placed between the nuts to provide smooth bearing surface for the nut to turn on.
- It spreads the pressure of the nut over the greater area
- It also prevents the nut from cutting into the metal

**147. Name different forms of journal bearing?**

- Solid bearing
- Bushed bearing
- Pedestal bearing (or) Plumber block

**148. What are the various types of V-threads**

- British Standard Whitworth (BSW)
- British association threads (BA)
- Sellers threads
- Metric threads
- Unified threads

**149. List the types of keys**

- Key for power transmission
- Key for machine tools
- Light and medium duty keys
- Heavy duty keys
- Square key
- round key
- woodruff key
- feather key

**150. List the various types of gears?**

- Spur gear
- Helical gear
- Bevel gear
- Worm gear
- Rack and pin

**151. Mention the types of riveted joints which are commonly used in engineering practice**

- Riveted joints
- Lap joints
- Butt joints
- Single riveted
- Double riveted
- Triple riveted
- Single cover plate
- Double cover plate

**152. give the practical applications of screwthreads**

- Used to tighten pieces together as in the cases of bolts & nuts, studs & nut, top bolt, screws, etc.
- it is used for power transmission

**153. explain hole basis and shaft basis system**

- In hole basis system the different clearances and interferences are obtained in associating various shafts with single hole, whose lower deviation is zero.
- In shaft basis system the different clearances and interferences are obtained in association various holes with a single shaft, whose upper deviation is zero.

**154. Under what condition a sectional view is preferred**

- When objects with a complicated interior construction are drawn, their projection involve a large number of broken lines which overlap and intersect each other and thereby confuse the drawings.
- Sectional views with conventional representation are given to make the objects clear and understandable.

**155. What is the function of connecting rod in an I.C engine**

- A connecting rod connects the cross head with crank.
- It is normally forged and made of steel.
- It may be circular or rectangular cross-section
- Two ends of the connecting rods are referred to as large end and small end.

## QUESTION BANK

### UNIT-I
### 2 MARKS

1. What you mean by convention?
2. Where and why a cutting plane is drawn in a drawing?
3. Draw the conventional line for long break.
4. Draw the conventional line for short break.
5. Draw the conventional line for hidden edges.
6. Draw the conventional line for cutting plane. (cutting plane line)
7. What is the application of long break lines? Give one example.
8. What is the application of cutting plane lines? Give one example.
9. What is the application of hidden lines? Give one example.
10. Draw the conventional representation of steel.
11. Draw the conventional representation of glass.
12. Draw the conventional representation of wood.
13. Draw the conventional representation of cast iron.
14. Draw the conventional representation of aluminum.
15. Draw the conventional breaks for rectangular section.
16. Draw the conventional breaks for round rod or round section.
17. Draw the conventional breaks for pipe or tube.
18. Draw the conventional breaks for wood rectangular section.
19. Draw the conventional breaks for channel section.
20. Draw the conventional representation of ratchet and pinion.
21. Draw the conventional representation of bearings.
22. Draw the conventional representation of straight knurling.
23. Draw the conventional representation of holes on a linear pitch.
24. Draw the conventional representation of holes on circular pitch.
25. How to represent repeated parts conventionally?
26. How to represent external threads conventionally?
27. Draw the conventional representation of internal threads.
28. Draw the conventional representation of splined shaft.
29. Draw the conventional representation of chain wheel.
30. What is the importance of dimensioning?
31. What do you mean by the term notation of dimensioning?
32. What are the types of dimensioning system?
33. What are aligned system and unidirectional system of dimensioning?
34. What are the general rules of dimensioning?
35. Draw the symbol for first angle projection.
36. Draw the symbol for third angle projection.
37. What do you mean by screw threads and give its practical application?
38. What is the difference between:
    i. Nominal and major diameter
    ii. Pitch and lead
    iii. Right hand and left hand threads
    iv. V and square threads
39. What is the necessity of conventional representation of screw threads?
40. Define nut. Give the important types of nuts used in the engineering practice.
41. Define bolt. Give its important types used in engineering field.
42. What are multi start threads? Where these are used and why?

43. Define washer and give its various types.
44. What is welding? And give its types.
45. What is a welded joint?
46. What are the types of welded joints?
47. Draw a right handed V threads conventionally by thick and thin lines method on a rod of 24 mm diameter rod and 40mm long.
48. Draw the conventional representation of spur gear (detail).
49. Draw the conventional representation of spur gear (assembly).
50. Draw the conventional representation of bevel gear (detail).
51. Draw the conventional representation of bevel gear (assembly).
52. Draw the conventional representation of worm gear (detail).
53. Draw the conventional representation of worm gear (assembly).
54. **What is limits and fit?**
55. What is the need of limits and fits?
56. Define tolerance?
57. Define allowance and clearance?
58. Explain unilateral and bilateral tolerance.
59. Sketch a figure illustrating the following terms as per B.I.S:
    a. Basic-size and zero line
    b. Upper and lower deviation
    c. Tolerance zone
    d. High and low limits.
60. Explain the following terms as per I.S. 919:
    i. Deviation
    ii. Fundamental deviation
    iii. Grade of tolerance.
    iv. Basic shaft and basic hole.
    v. Go and not go limit.
61. Give the meaning of the following:
    i. $\phi$ 48H7/p6
    ii. 46g6
    iii. $50^{+0.015}_{+0.000}$
62. Find the basic size, type of fit and tolerance of a 45mm diameter shaft rotating normal in a bearing.
63. Fix the limits of tolerance and allowance for a 25mm diameter shat and hole pair designated H8/d9. Comment on the application of this type of fit represented.
64. Compute the fundamental deviation for a circular hole of 45mm diameter finished to H8 tolerance.
65. Compute the fundamental deviations for a circular shaft of 60mm diameter finished to g7 tolerance is designated as $\phi$ 60g7
66. Determine the limits of size of a 100 mm hole of C9 designation.
67. Calculate the maximum and minimum clearances of a fit with the designation 100H 11/g7
68. Compute the following table for 70 H7 S6 fit and state the type of fit.
69. A medium force fit on a 50 mm diameter shaft requires H7 holes and P6 shaft. Give the proper hole and shaft dimensions in accordance with basic hole standard.
70. Determine the tolerance and allowances for a slow speed shaft and its sliding bearing having a basic size of 200mm.
71. What are the advantages of welded joints over riveted joints?
72. What are left handed and right handed screw thread?
73. Under what circumstances cotter joints are commonly used?
74. What is the function of a valve and valve seat?
75. What do you mean by transition fit?

76. How will you indicate machining allowance?
77. Draw any thread nomenclature?
78. What do you meant by basic size?
79. How will you represent double start, right hand ‘V’ thread?
80. Explain with neat sketch dimensioning of screw thread.
81. What is the necessity of conventional representation of screw threads?
82. What is the difference between allowance and clearance?
83. How is the blow off cock operated? 14. What is a flexible coupling? What are its advantages?
84. Why a gib is used in combination with a cotter?
85. What are the advantages of weld joints?
86. Sketch the symbol to indicate weld all round?
87. Explain the benefits of assembly of parts by using CAD?
88. What are the various types of welding?
89. How do you hatch if there are more than two adjacent parts?
90. Draw the conventional representation of glass and wood.
91. Explain with a simple sketch the aligned system of dimensioning.
92. What is the function of a bush in a bearing?
93. What is the function of a tool post of a lathe machine?
94. What are the uses of a Plummer block?
95. Differentiate between boiler mountings and accessories.
96. What is the importance of sectioning?
97. Sketch neatly any two types of triangular threads. State the angle of the threads in each case and dimension the depth, assuming pitch of 10mm.
98. Show by sketch conventional method of showing square thread nominal diameter 20mm and pitch 3mm.
99. show by suitable diagrams a system of: (a) chain dimensioning (b) parallel dimensioning
100. What are the permanent and temporary fastenings? Give examples.
101. What is the difference between a lap and butt riveted joints?
102. What is welding and what type of fastening it is?
103. What are the fundamental types of welded joints?
104. Define the terms: depth of thread, pitch, lead, slope, flank, thread angle, crest root and axis of thread.
105. What are multi-start threads? Where these are used and why?
106. Name three kinds of rigid shaft couplings? State why they are called “rigid”?

## UNIT-II
## 2MARKS

1. What is key? Give the main classification of keys?
2. What is the difference between sunk key and saddle key?
3. What are cotters and where are they used?
4. What is the difference between a key and cotter? Tell the purposes for which they are in engineering practice.
5. What do you mean by spline shaft?
6. What do you understand by a coupling? Name the different types of couplings.
7. How do you differentiate between the following coupling:
   1. A rigid and a flexible coupling;
   2. Flange and box coupling;
   3. Lap type and split type of muff coupling?
8. What is flexible coupling? What are its advantages?
9. What do you mean by a bearing? What is the function of a bearing?
10. Name the different types of bearings?
11. What is the function of a bush in a bearing?
12. Why bearings are lubricated?
13. What are the advantages of plummer block over closed and open bearings?
14. Why collars are provided on the brasses?
15. Where the swivel bearing is used?
16. When the foot-step bearing is used? Name its parts.
17. What are the advantages of ball and roller bearings upon journal bearing?
18. What is an I.C. engine? Name its different parts
19. Name the reciprocating and revolving parts of an I.C. engine?
20. What is the difference between petrol engine and diesel engine?
21. What is the function of a piston?
22. Why piston rings are provided on the piston?
23. What is the function of a connecting rod?
24. How a connecting rod is fitted with the piston?
25. What you mean by a valve?
26. What is a valve seat? How the valve seat is secured to the body of valve?
27. What are the different types of valves?
28. What is the function of stop valve?
29. What is the function of a blow off cock?
30. Where the blow off cock used?
31. What is a knuckle joint and where is it used?
32. Why clearances are provided in cotter joints?
33. Why are the annular recesses provided at the side of flanges in a protected flange coupling?
34. How are boiler(Rivet) joints classified?
35. What is the application of universal joint?
36. What is a knuckle joint and where is it used?
37. Why clearances are provided in cotter joints?
38. What are the classifications of sunk keys.
39. Write a short note on cotter joint and pin joint.
40. What is a universal coupling? Why it is so named?
41. Differentiate a collar joint and a pin-joint.
42. Define and show the diagrammatic representation of the interference fit.

## Assembly drawing

**30 MARKS**

1. Draw the top view and sectional front view of a single riveted lap joint. Take the diameter of rivet=24mm
2. Draw the top view and sectional front view of a double riveted lap joint (chain type). Take the diameter of rivet=24mm
3. Draw the top view and sectional front view of a double riveted lap joint (Zig-zag). Take the diameter of rivet=24mm
4. Draw the top view and sectional front view of a single riveted single cover Butt joint. Take the diameter of rivet=24mm
5. Draw the top view and sectional front view of a single riveted double cover Butt joint. Take the diameter of rivet=24mm
6. Fig1. shows the details of a screw-jack. Draw the following views of the assembly to some suitable scale: (a) Front view-right half in section, and (b) Top views Also prepare a part list and Bill of Materials.

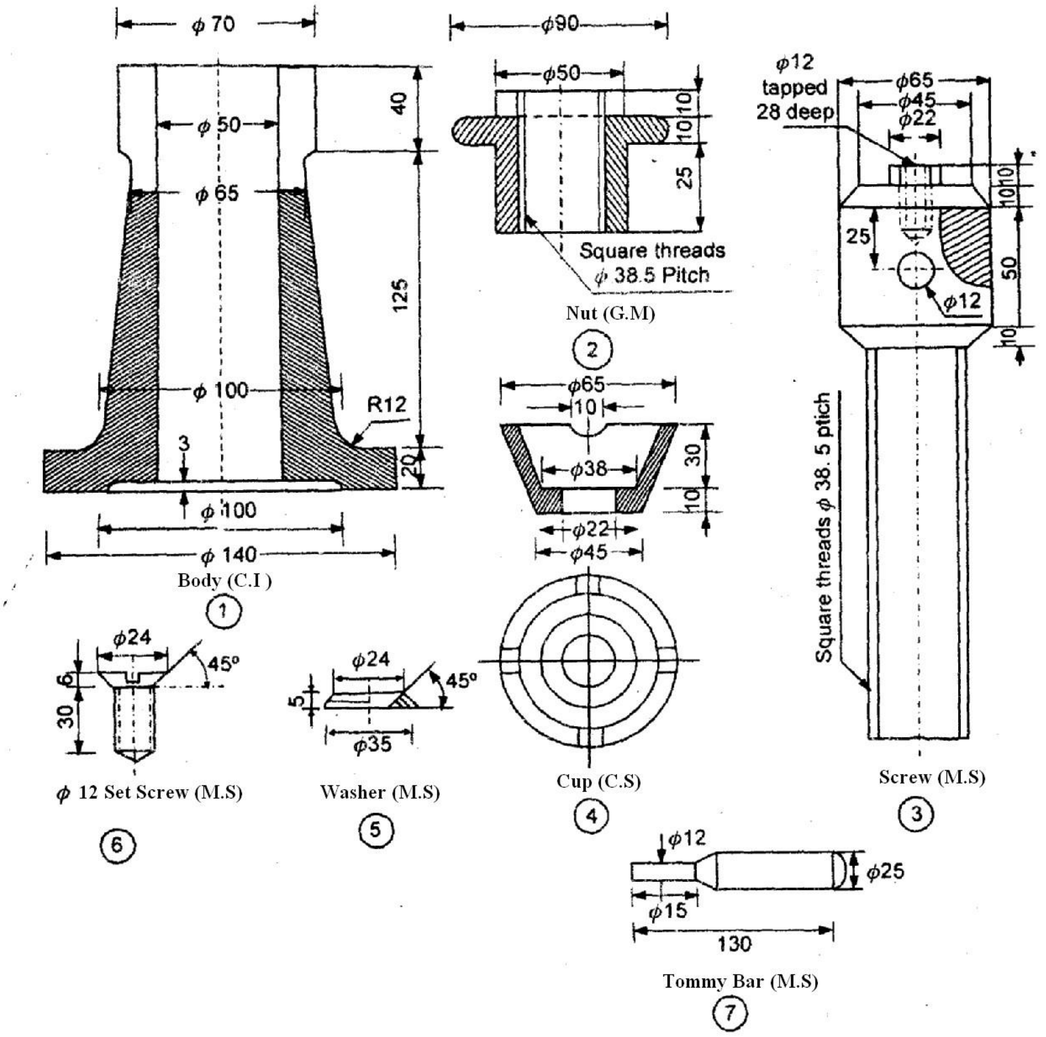



Fig.1

7. Detail of swivel bearing are shown in Fig. 2. assemble the part and draw.(a)Front view right half in section, and (b) Top views Also prepare a part list and Bill of Materials.

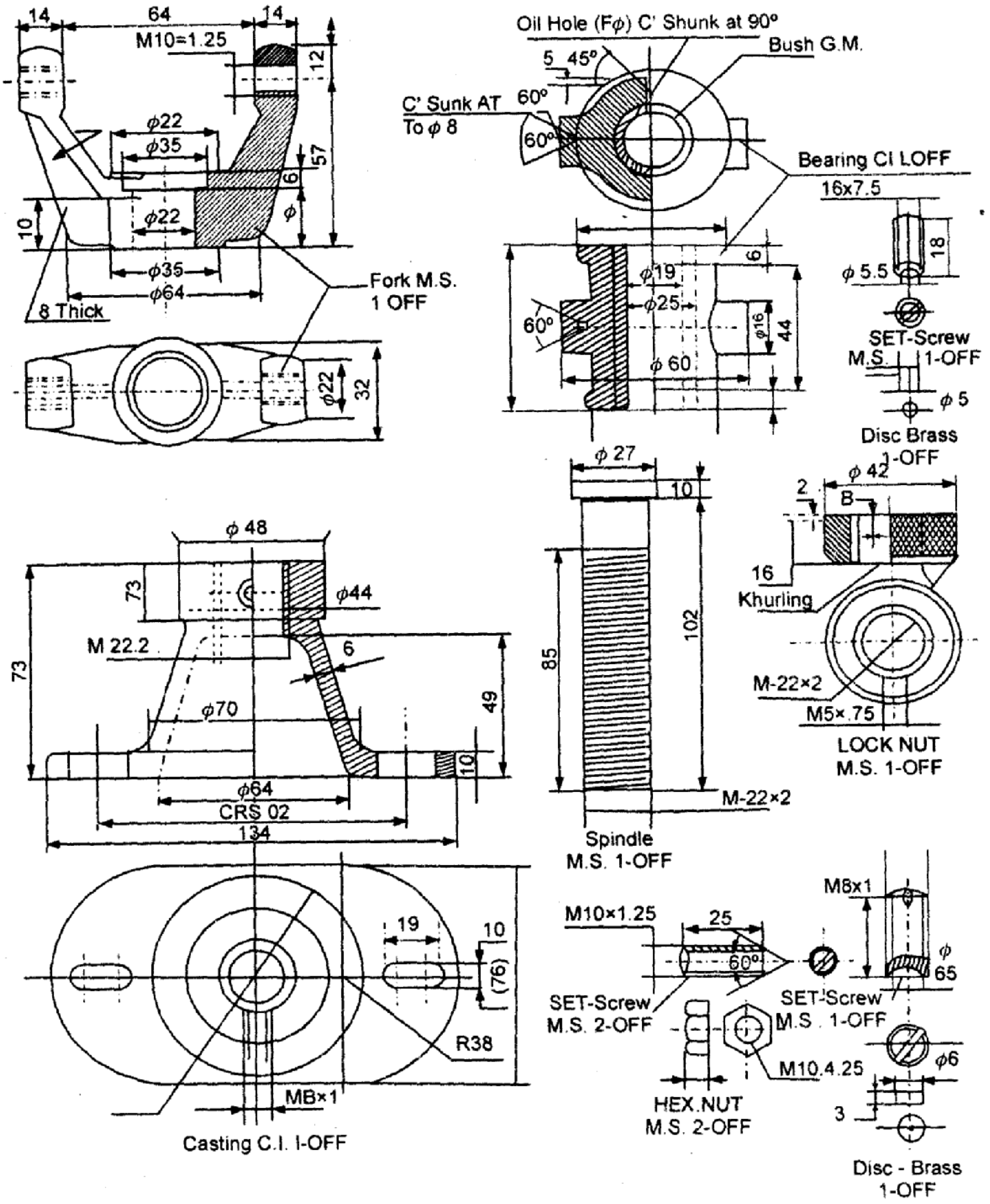



Fig.2

8. Fig. 3. shows the details of an I.C. engine connecting rod. Draw the following views full-size scale (a) Front view upper half in section (b) Side view, and (c) Half-sectional plan.

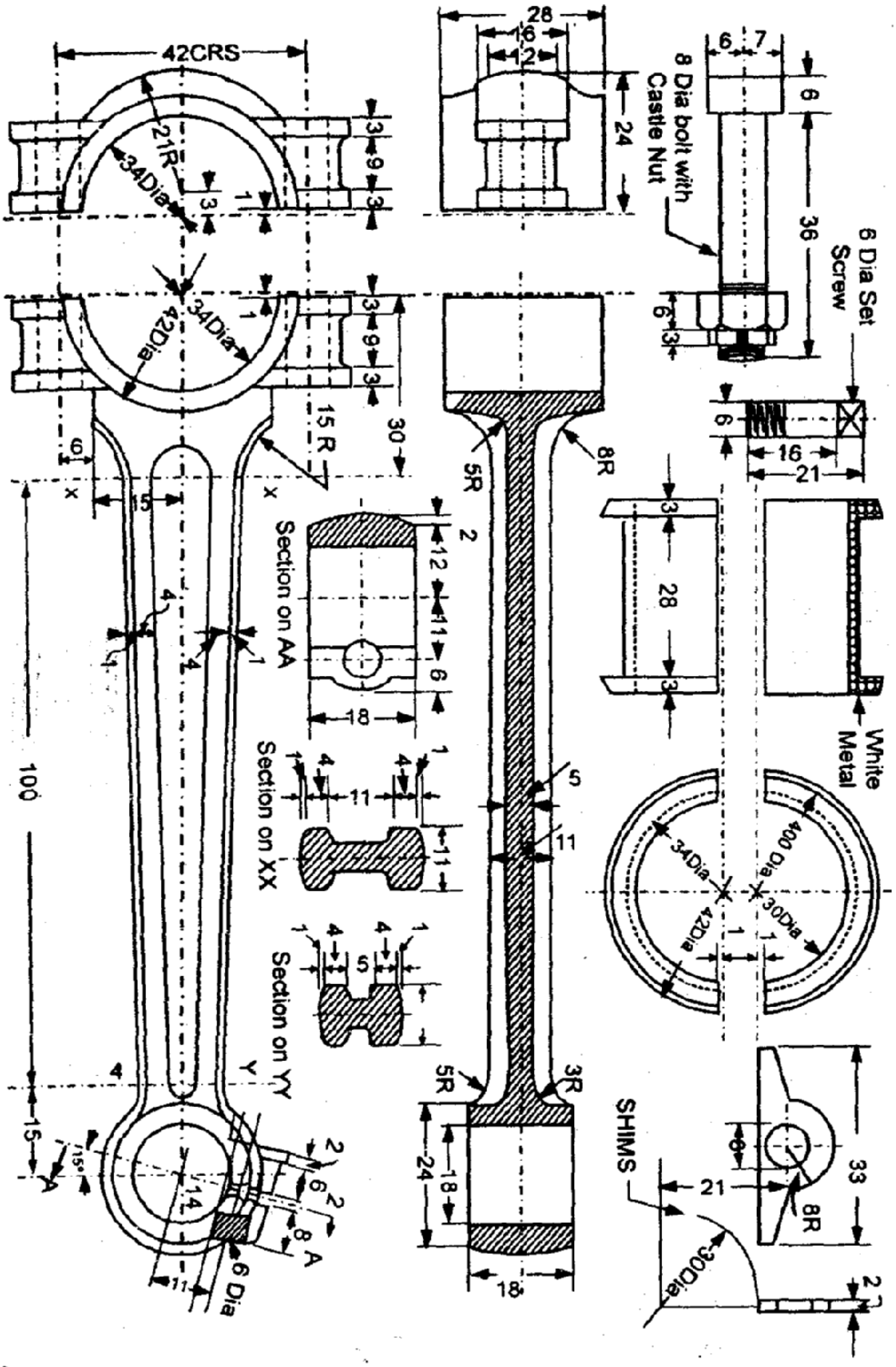



Fig.3.

9. Fig 4. Shows the detail of lathe tail stock, assemble the part and draw the following views: (a)Front view half in section (b) Write side end view.

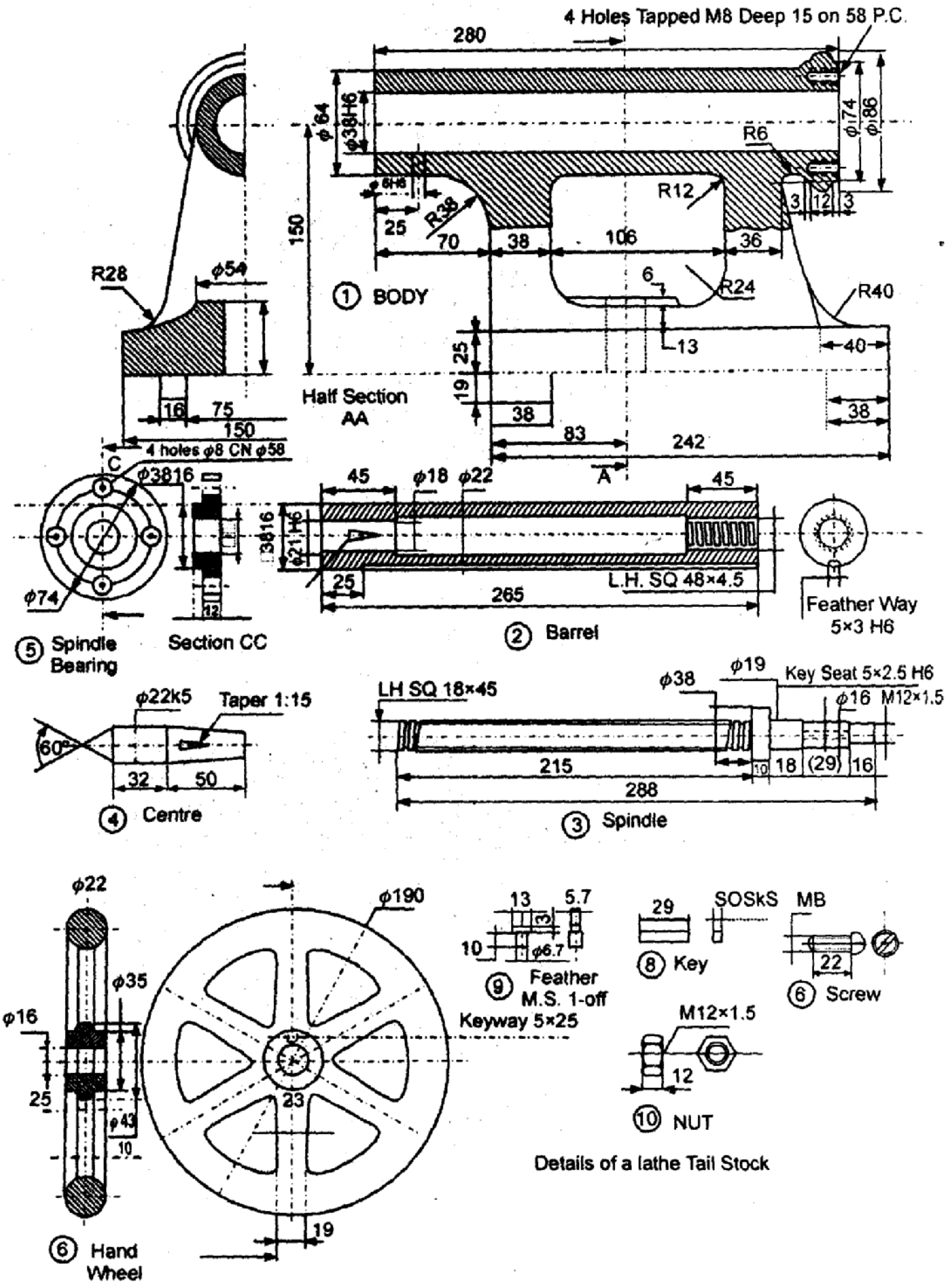
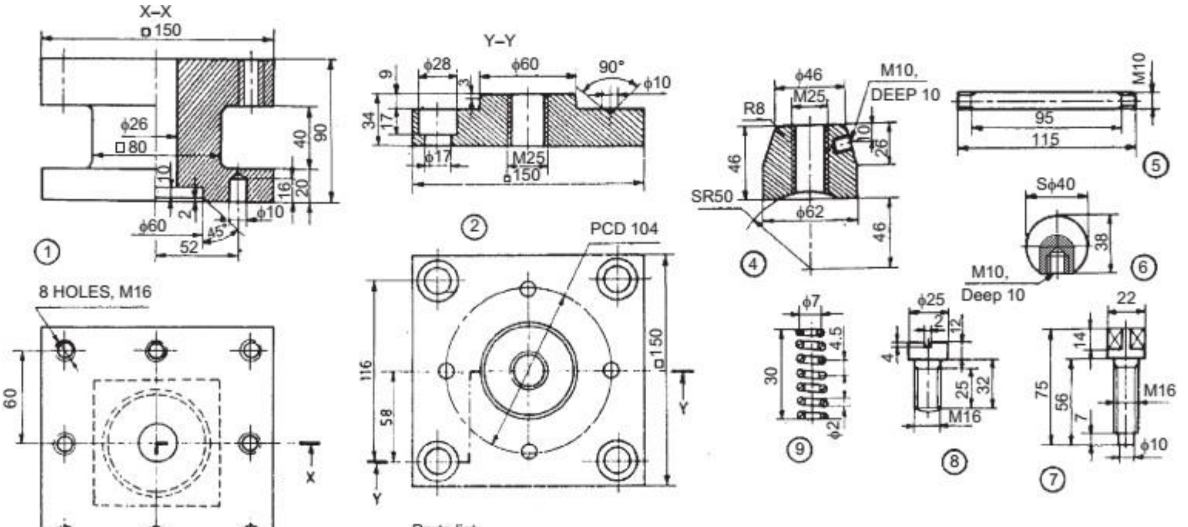



Fig.4

10. Fig. 5 shows the details of a tool holder. Assemble the details and draw the following views to a full size scale:Front view half in section (b) Write side end view.

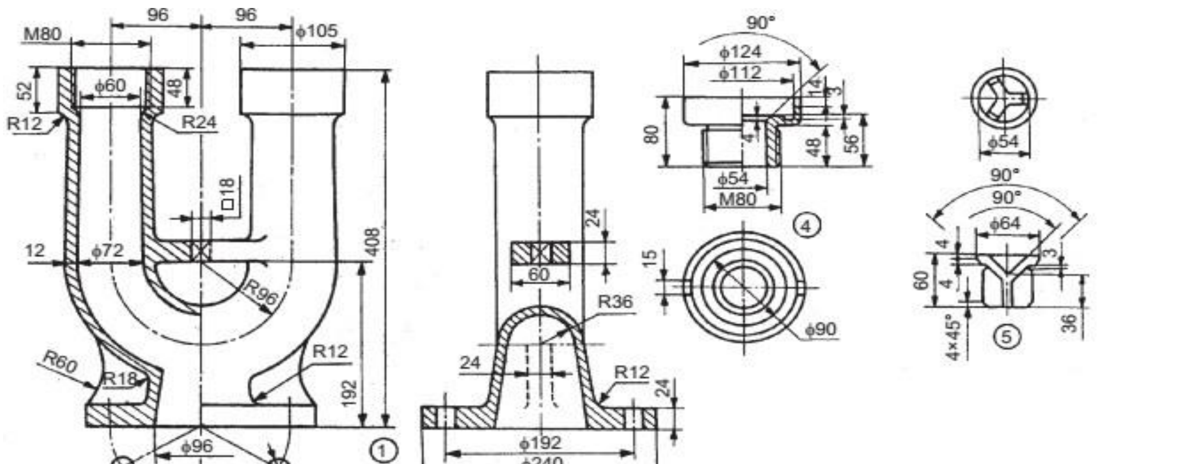



Parts list

| Part No. | Name | Matl | Qty |
|---|---|---|---|
| 1 | Tool holder | MS | 1 |
| 2 | Base plate | MS | 1 |
| 3 | Stud | MS | 1 |
| 4 | Clamping nut | MS | 1 |
| 5 | Handle | MS | 1 |
| 6 | Knob | Ebonite | 1 |
| 7 | Set screw | MS | 8 |
| 8 | Grub screw | MS | 4 |
| 9 | Spring | Steel | 1 |
| 10 | Ball ϕ9 | MS | 1 |

Fig.5

11. Fig. 6 shows the details of a Ramsbottom safety valve. Assemble the details and draw the following views to a full size scale: Front view half in section (b) Write side end view.




Parts list

| Part No. | Name | Matl | Qty |
|---|---|---|---|
| 1 | Housing | CI | 1 |
| 2 | Eye bolt | MS | 1 |
| 3 | Link | MS | 2 |
| 4 | Valve seat | Gunmetal | 2 |
| 5 | Valve | Gunmetal | 2 |
| 6 | Pivot | MS | 1 |
| 7 | Pin | MS | 3 |
| 8 | Split pin | MS | 3 |
| 9 | Lever | MS | 1 |
| 10 | Spring | Spring steel | 1 |
| 11 | Washer | MS | 1 |
| 12 | Lock-nut, M20, 12 Thick | MS | 1 |
| 13 | Nut, M20, 20 Thick | MS | 1 |

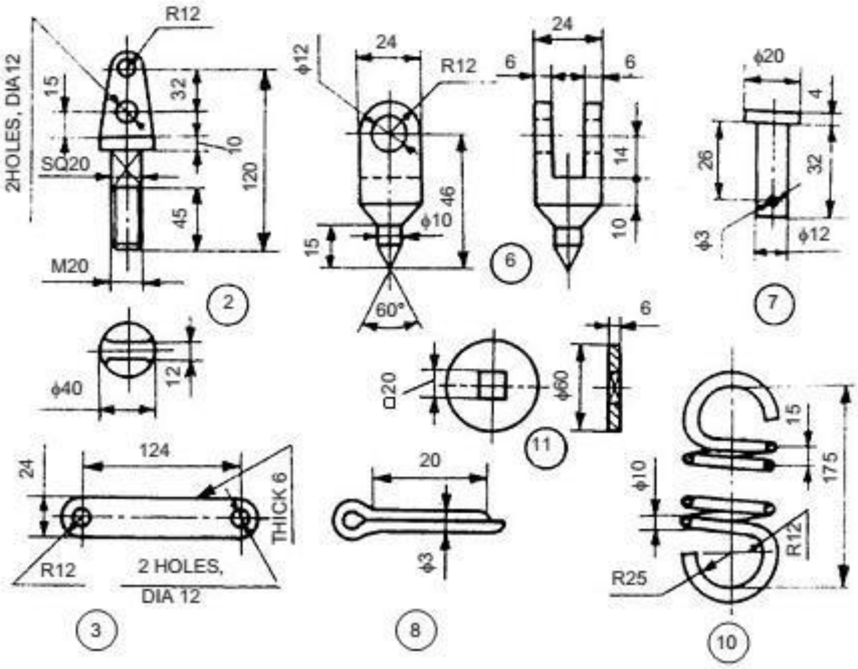
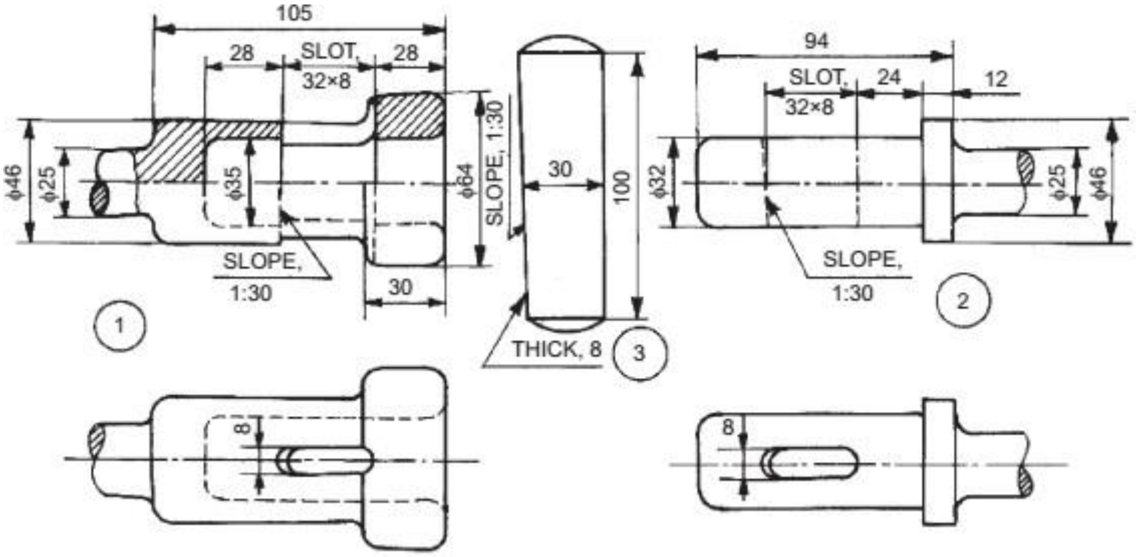



Fig.6

12. Fig7..shows the details of a Socket and spigot joint. Draw the following views of the assembly to some suitable scale: (a) Front view-right half in section, and (b) Top views Also prepare a part list and Bill of Materials.

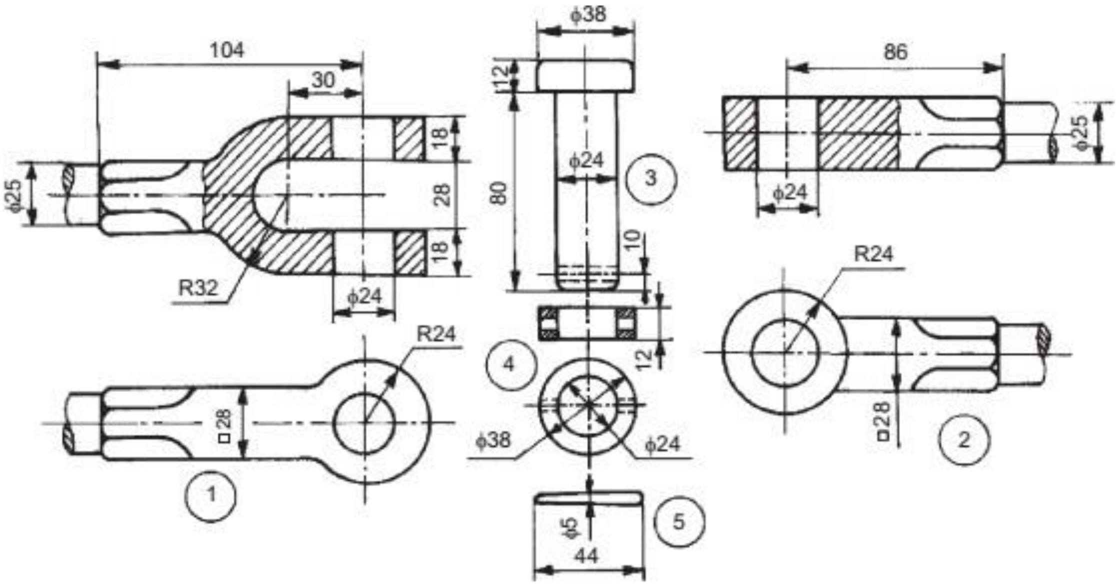



Parts list

| Sl. No. | Name | Matl. | Qty. |
|---|---|---|---|
| 1 | Socket end | MS | 1 |
| 2 | Spigot end | MS | 1 |
| 3 | Cotter | HCS | 1 |

Fig.7

13. Assemble the parts of a knuckle joint, shown in Fig. 8 and draw, (i) sectional view from thefront and (ii) view from above.

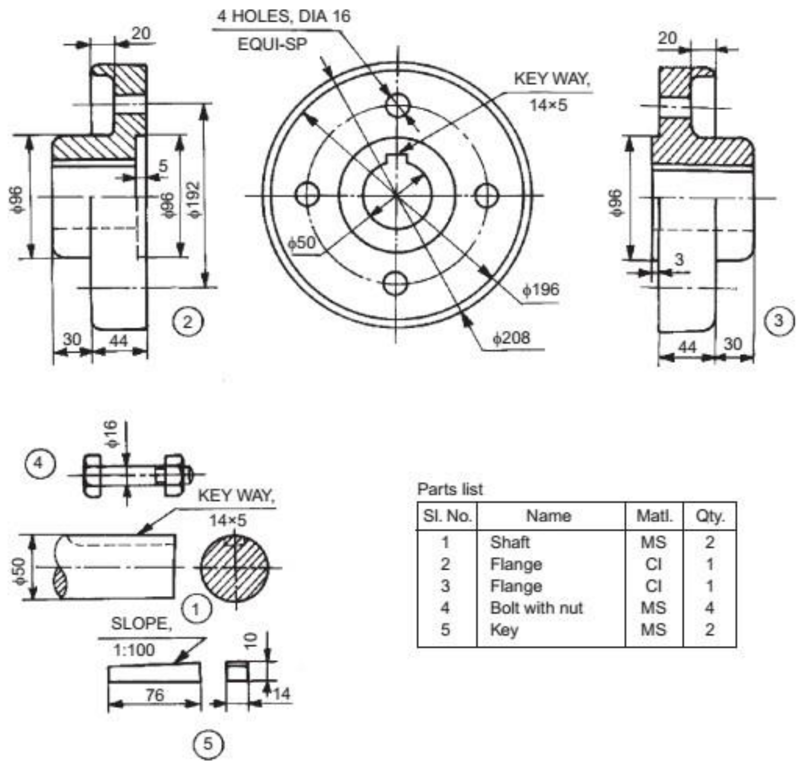



Parts list

| Sl. No. | Name | Matl. | Qty. |
|---|---|---|---|
| 1 | Fork end | Forged steel | 1 |
| 2 | Eye end | Forged steel | 1 |
| 3 | Pin | Mild steel | 1 |
| 4 | Collar | Mild steel | 1 |
| 5 | Taper pin | Mild steel | 1 |

Fig.8

14. Assemble the parts of a protected flanged coupling shown in Fig. 9 and draw the followingviews: (i) Half sectional view from the front, with top half in section, and(ii) View from the right.

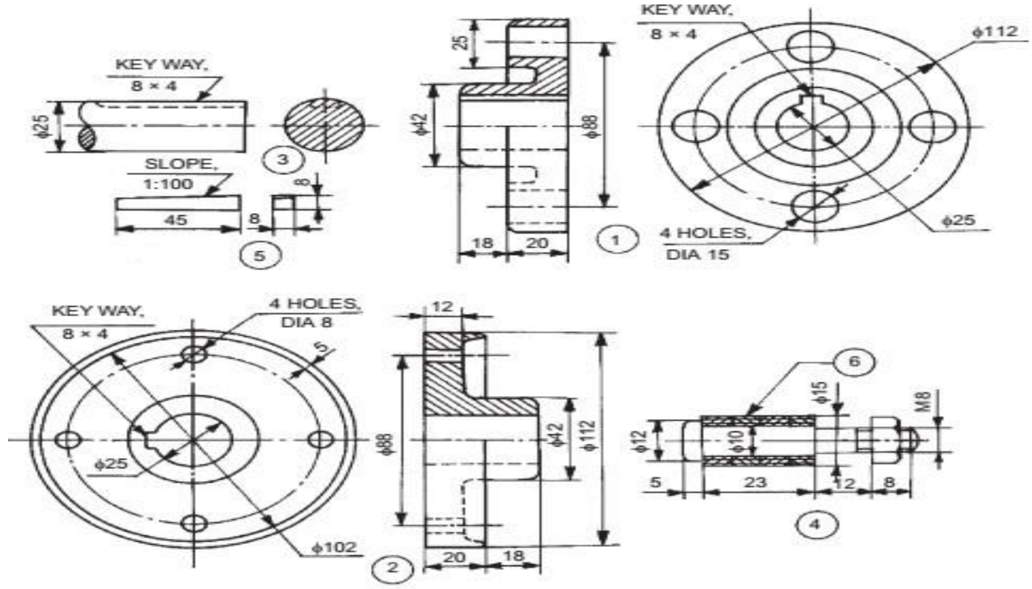



Parts list

| Sl. No. | Name | Matl. | Qty. |
|---|---|---|---|
| 1 | Shaft | MS | 2 |
| 2 | Flange | CI | 1 |
| 3 | Flange | CI | 1 |
| 4 | Bolt with nut | MS | 4 |
| 5 | Key | MS | 2 |

Fig. 9

15. Assemble the parts of the bushed pin type flanged coupling shown in Fig. 10 and draw, (i) halfsectional view from the front, with top half in section and (ii) view fromthe right.

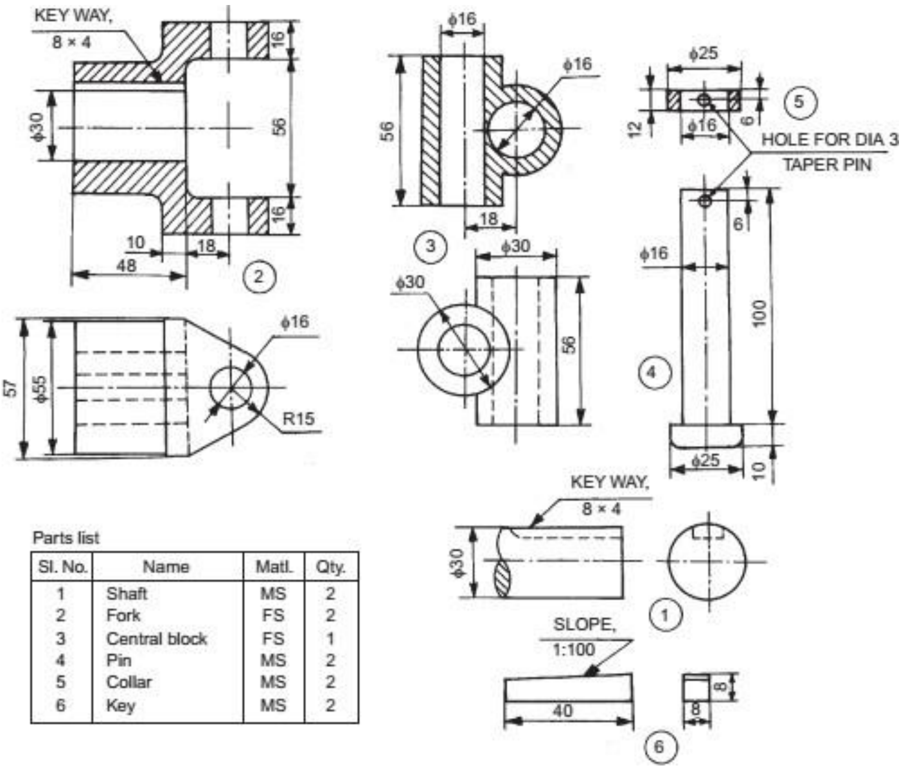



Parts list

| Sl. No. | Name | Matl. | Qty. |
|---|---|---|---|
| 1 | Flange | CI | 1 |
| 2 | Flange | CI | 1 |
| 3 | Shaft | MS | 2 |
| 4 | Pin with nut | MS | 4 |
| 5 | Feather key | MS | 2 |
| 6 | Bush | Nylon | 16 |

Fig.10

16. Assemble the parts of universal coupling and, shown in Fig. 11 and draw, (i) sectional viewfrom the front and (ii) view from the right.

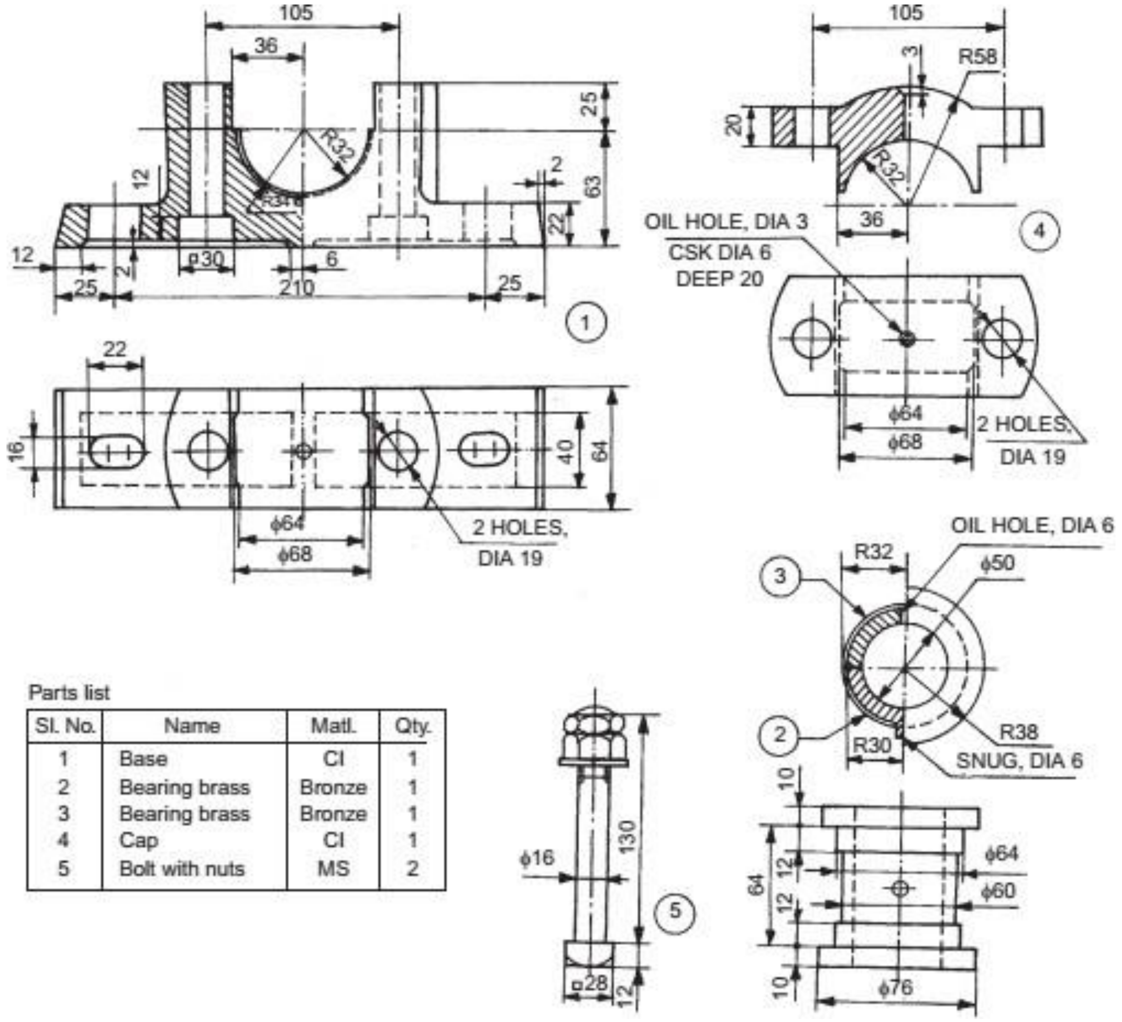



Parts list

| Sl. No. | Name | Matl. | Qty. |
|---|---|---|---|
| 1 | Shaft | MS | 2 |
| 2 | Fork | FS | 2 |
| 3 | Central block | FS | 1 |
| 4 | Pin | MS | 2 |
| 5 | Collar | MS | 2 |
| 6 | Key | MS | 2 |

Fig.11

17. Assemble the parts of the plummer block, shown in Fig. 12 and draw the following views: (i) Half sectional view from the front, with left half in section, and (ii) View from above.




Parts list

| Sl. No. | Name | Matl. | Qty. |
|---|---|---|---|
| 1 | Base | CI | 1 |
| 2 | Bearing brass | Bronze | 1 |
| 3 | Bearing brass | Bronze | 1 |
| 4 | Cap | CI | 1 |
| 5 | Bolt with nuts | MS | 2 |

Fig.12

**5614073**

B.Tech. DEGREE EXAMINATION, APRIL/MAY 2015.

Fourth Semester

Mechanical Engineering

MACHINE DRAWING

(2009 -12 Batch & 2013-2014 Batch onwards)

Time : Three hours | Maximum : 50 marks

Plan in separate sheet.

PART A — (10 × 2 = 20 marks)

Answer ALL questions.

All questions carry equal marks.

1. State the various principles to be followed while dimensioning a drawing.
2. Draw symbols for first and third angle methods of projection.
3. What is the basic requirement of rivets?
4. Write about the cotter joint with gib.
5. Compare the difference between the cotters joint and pin joint.
6. What is universal coupling? Write its applications.
7. Under what situations, the pedestal bearing is preferred.
8. Sketch the symbolic representation of weld joint.
9. Draw the symbol of bearing.
10. What is the function of connecting rod in I.C. engines?

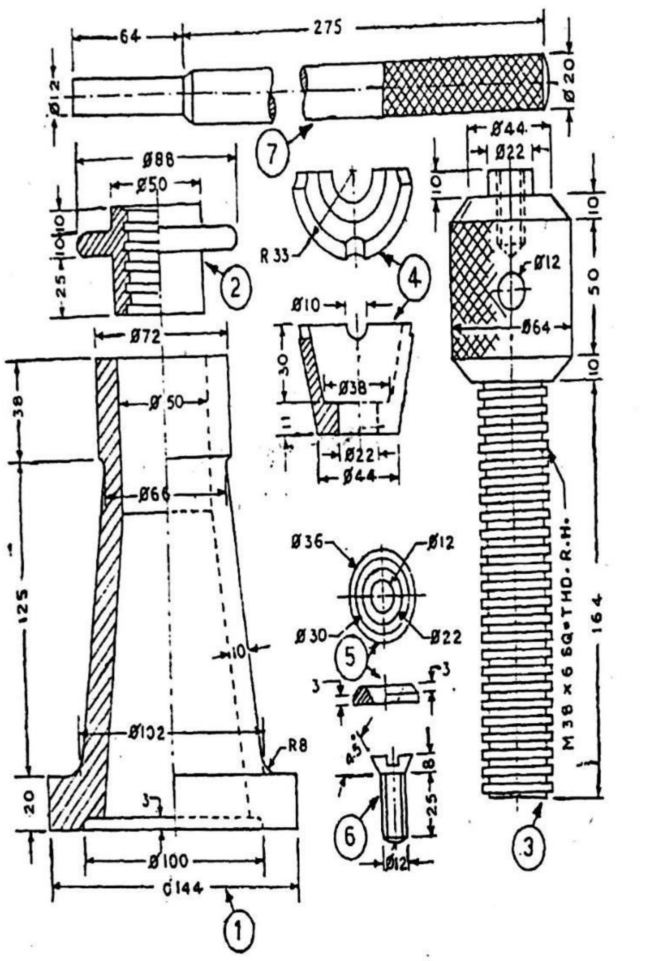
PART B — (1 × 30 = 30 marks)

Answer ONE question.

11. The figure 1, Shows the detailed parts of the Screw Jack. Assemble the parts and draw the following views
    (a) Sectional front view
    (b) Top view.

Or

12. Details of a Plumber Block are shown in the fig.2 Assemble the parts and draw the following views
    (a) Sectional front view
    (b) Top view.



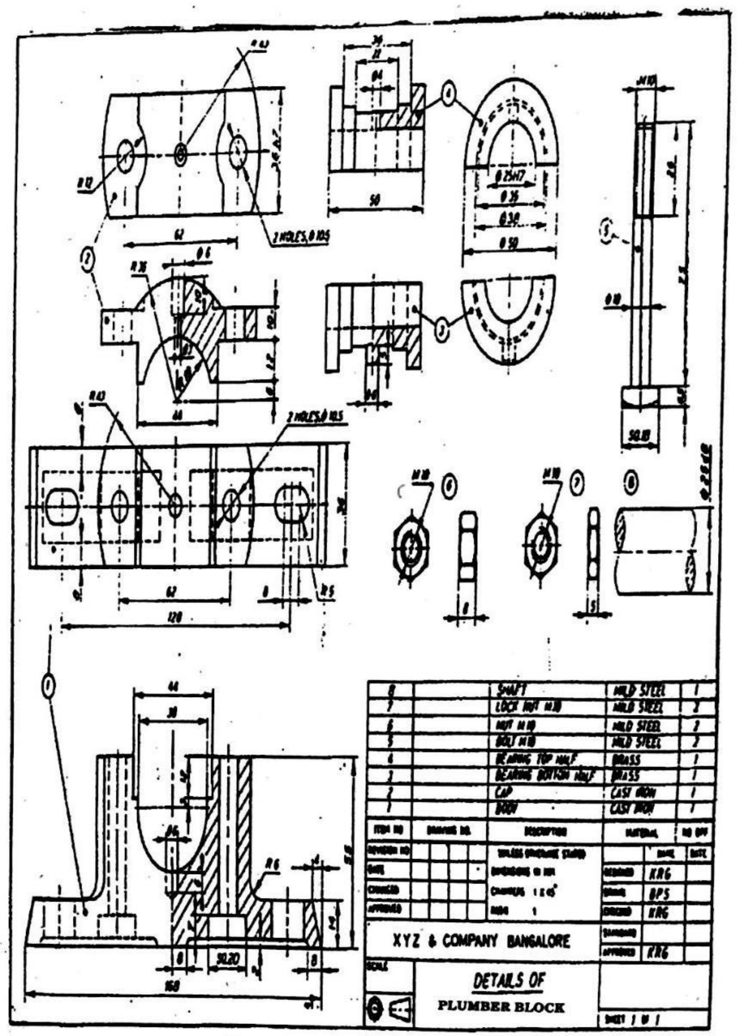

## SCREW JACK

| Part No | Part Name | No.off | Material |
|---|---|---|---|
| 1 | CASTING | 1 | C.I |
| 2 | NUT | 1 | G.M |
| 3 | SCREW | 1 | M.S |
| 4 | CUP | 1 | C.S |
| 5 | WASHER | 1 | M.S |
| 6 | SET SCREW | 1 | M.S |
| 7 | TOMMY BAR | 1 | M.S |

Fig 1

2

**5614073**

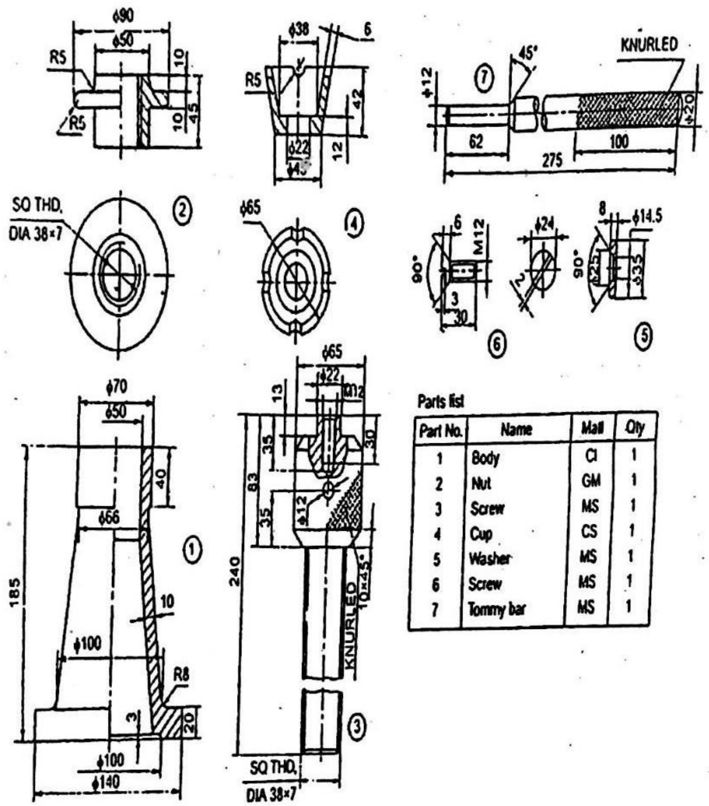



Details of Plumber Block

Fig 2

3

**5614073**




Parts list

| Part No. | Name | Mat'l | Qty |
|---|---|---|---|
| 1 | Body | CI | 1 |
| 2 | Nut | GM | 1 |
| 3 | Screw | MS | 1 |
| 4 | Cup | CS | 1 |
| 5 | Washer | MS | 1 |
| 6 | Screw | MS | 1 |
| 7 | Tommy bar | MS | 1 |

Fig. 2 Screw jack





# 5614073

B.Tech. DEGREE EXAMINATION, NOVEMBER 2016.

Fourth Semester

Mechanical Engineering

MACHINE DRAWING

(From 2009–10 and 2013–14 Batches onwards)

Time : Three hours Maximum : 50 marks

Answer ALL questions.

Missing data if any may be suitably assumed.

PART A — (10 × 2 = 20 marks)

1. What are foundation bolts and where are they used?

2. What s set screw? What is its function?

3. What is a key and mention its usage?

4. Differentiate between cotter joint and pin joint.

5. Draw the sketch for triple riveted lap joint.

6. How to represent various types of welding in the machine drawing?

7. What is a gear? State its functions.

8. What is meant by fundamental tolerance? How tolerance is denoted?

9. Define the term fit and how fits are classified?

10. How to represent the surface finish in drawing?

PART B — (1 × 30 = 30 marks)

Answer any ONE questions.

11. Assemble the parts of the bushed pin type flanged coupling shown in the Fig. 1 and draw

(a) Half sectional view showing top half in section

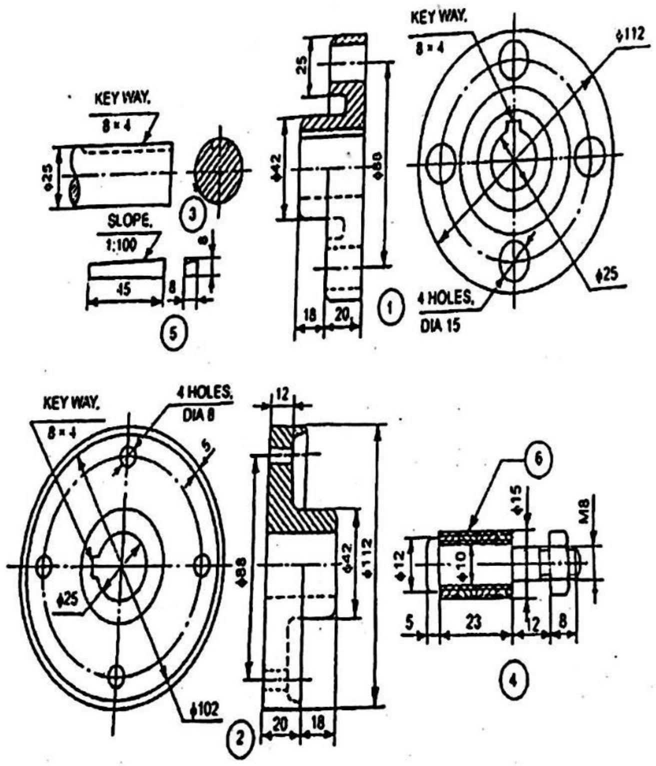
(b) Right side view.

12. Fig. 2 shows the different parts of a screw jack. Assemble all the parts and draw the following views

(a) Front view showing right half in section.

(b) Top view.






Parts list

| Sl. No. | Name | Matl. | Qty. |
|---|---|---|---|
| 1 | Flange | CI | 1 |
| 2 | Flange | CI | 1 |
| 3 | Shaft | MS | 2 |
| 4 | Pin with nut | MS | 4 |
| 5 | Feather key | MS | 2 |
| 6 | Bush | Nylon | 16 |

Fig. 1 Bushed pin type flanged coupling

# 5614073

**B.Tech. DEGREE EXAMINATION, APRIL/MAY 2016.**

**Fourth Semester**

**Mechanical Engineering**

**MACHINE DRAWING**

**(From 2009 – 10 and 2013 – 14 batches onwards)**

**Time : Three hours** **Maximum : 50 marks**

**Answer ALL questions.**

## PART A — (10 × 2 = 20 marks)

1. Define tolerance.
2. What is shaft basis system?
3. Draw the symbol for surface finish by machining process.
4. Explain right hand thread.
5. Define fits.
6. Draw the following symbols for
   (a) Flatness and
   (b) Cylindricity.
7. Give the applications of knuckle joint.
8. Where is universal coupling used?
9. What is bill of materials?
10. Draw the ACME thread.

## PART B — (1 × 30 = 30 marks)

11. The details of a connecting rod are shown in figure (1). Assemble all the parts correctly and draw the following views of assembled connecting rod. Assume suitable scale.

(a) Sectional elevation and

(b) Top view.

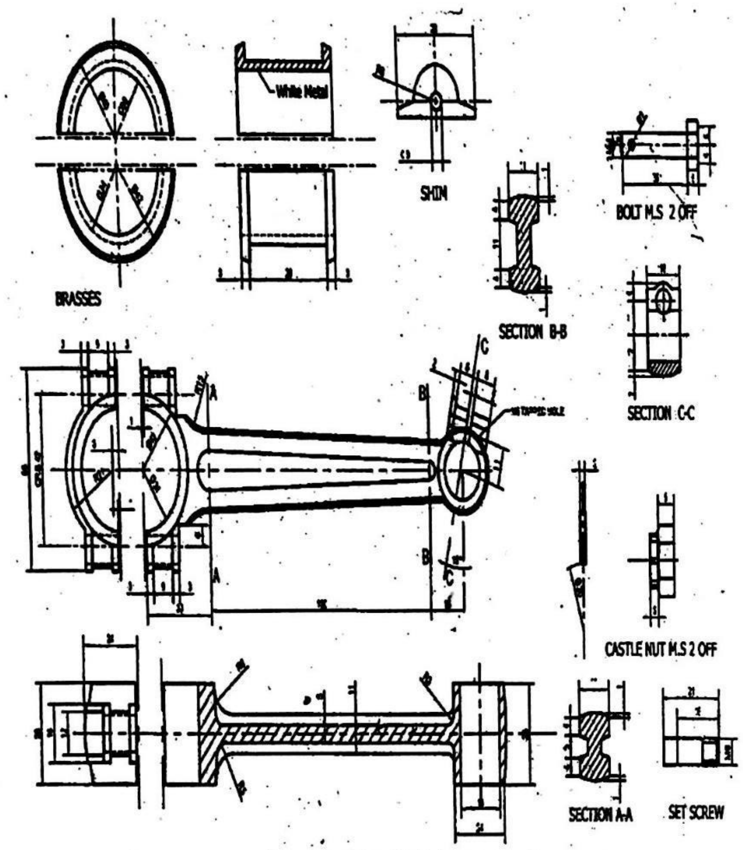



Fig. (1) **CONNECTING ROD**

All Dimensions are in mm

Or

2 **5614073**

12. The details of a Swivel bearing are shown in figure (2). Assemble all the parts correctly and draw the following views of assembled Swivel bearing. Assume suitable scale.

(a) Sectional elevation and

(b) Top view.

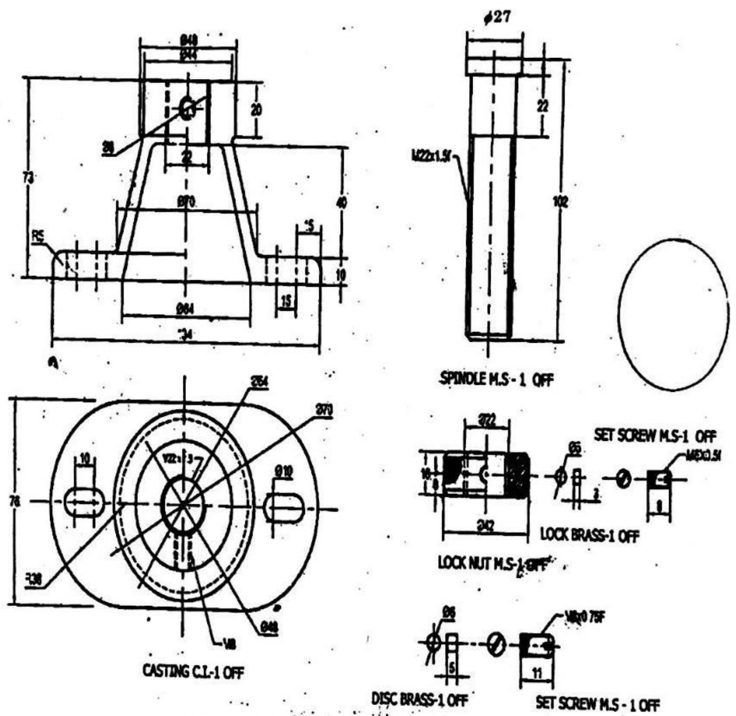



Fig. (2) **SWIVEL BEARING**

All Dimensions are in mm

3 **5614073**

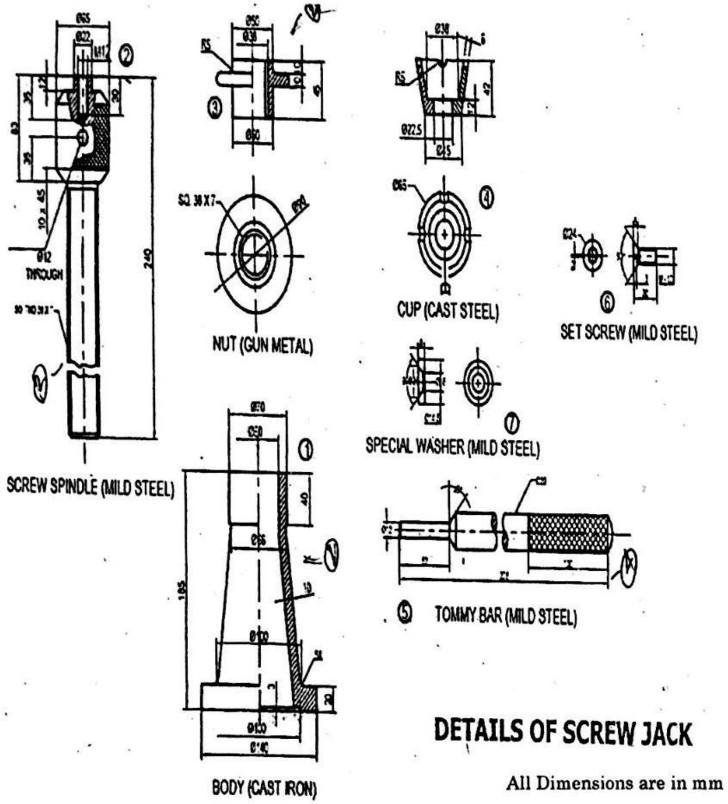



Fig (2)

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**5614073**

B.Tech. DEGREE EXAMINATION, NOVEMBER 2015.

Fourth Semester

Mechanical Engineering

MACHINE DRAWING

(2009–12 Batch onwards)

Time : Three hours Maximum : 50 marks

PART A — (10 × 2 = 20 marks)

Answer ALL questions.

All questions carry equal marks.

1. What are the type of sections?

2. Define Limits.

3. Explain hole basis system.

4. Draw the symbols for following tolerance

   (a) Position

   (b) Symmetry

5. What is surface texture?

6. Draw the symbol for surface finish without removal of material.

7. Name any four types of fasteners with application.

8. Name the type of threads?

9. Give the application of plummer block.

10. List the informations contained in an assembly drawings.

PART B — (1 × 30 = 30 marks)

11. The details of a knuckle joint are shown in figure. (1)

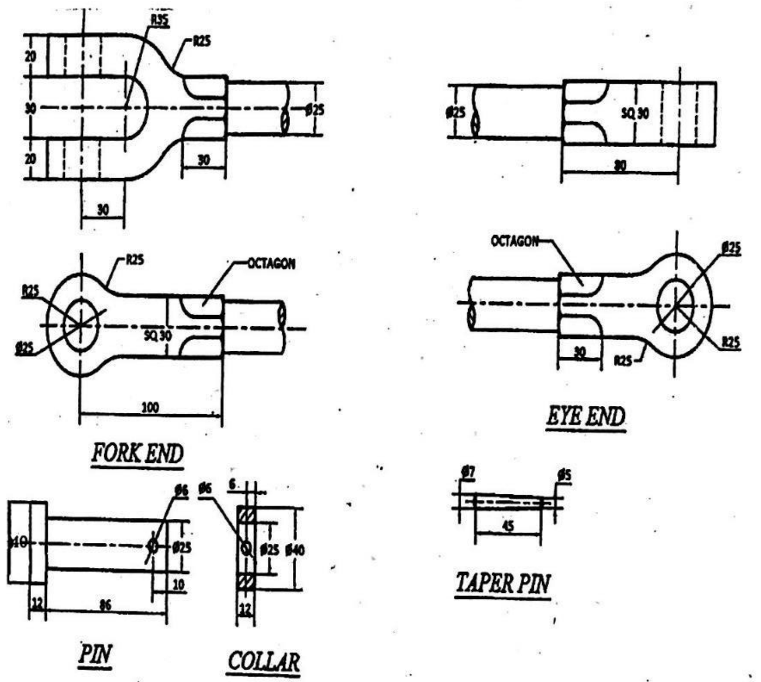
Assemble all the parts correctly and draw the following views of assembled knuckle joint. Assume suitable scale

(a) Sectional elevation,

(b) Plant and

(c) Right side view






KNUCKLE JOINT

Fig (1)

All Dimensions are in mm

Or

12. The details of a screw jack are shown in figure.(2) Assemble all the parts correctly and draw the following views of assembled

Screw jack. Assume suitable scale.

(a) Sectional elevation,

(b) Top View and

(c) Right side view