

# PROJECTIONS & MEASURED PERSECTIVES

## Projections

### INTRODUCTION

For centuries man tried to show his three-dimensional creations clearly and accurately by the two-dimensional medium of drawings. Three kind of projections are introduced, namely:-

- a) Third Angle Projection
- b) Isometric Projection
- c) Sectional View

### THIRD ANGLE PROJECTION

True two-dimensional views can be obtained simply on the drawing board. One method of doing this is shown in Fig. 1

In this way, six orthographic views of the object can be obtained. As most engineering shapes have some symmetry, it is usually found that three views are sufficient to describe the shape completely: the plan, the front view, and one of the side views. Obtaining the required two-dimensional views on the face of a cube is only half of the problem. They must now be conventionally arranged on a plane so that dimensions can be transferred from one view to another and a trained eye can quickly infer the shape of the object. The generally accepted way of doing this is third angle projection. Imagine that the cube in Fig. 1 is cut along its dotted edges and hinged along the edges shown by solid lines. Now swing point G across to lie on DA produced and swing point E across to lie on DC produced. Fig. 2 shows the cube laid out flat in this way. This is third angle projection. The PLAN is vertically above the FRONT VIEW and the RIGHT SIDE must be level with the FRONT VIEW. There are four basic arrangements of the orthographic views of an object.

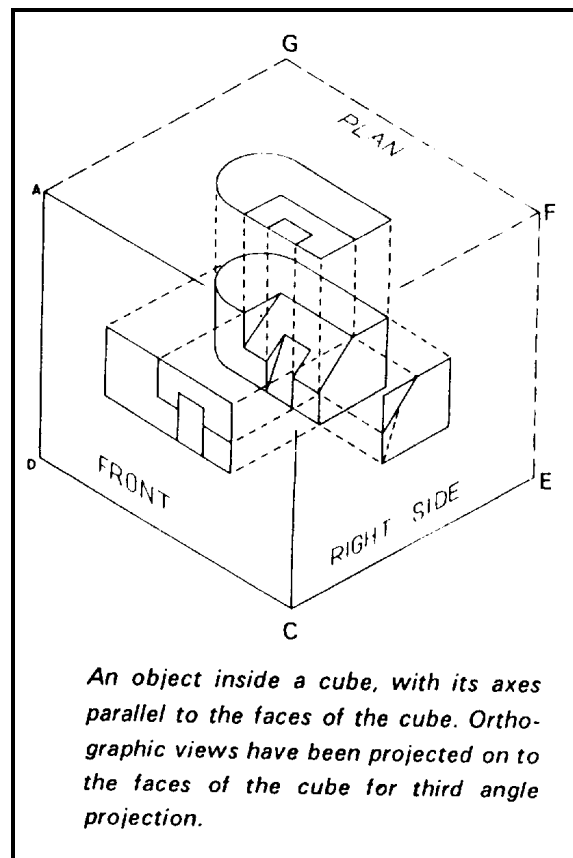


Figure 1

These are obtained by putting the object into one of the four named quadrants shown in Fig. 3. Whichever quadrant is used, the plan is viewed from above and the front view from the right, thereby causing the images in third angle projection to be brought back on to their respective planes of projection. Fig. 4 compares first angle (a) and third angle (b) projections.

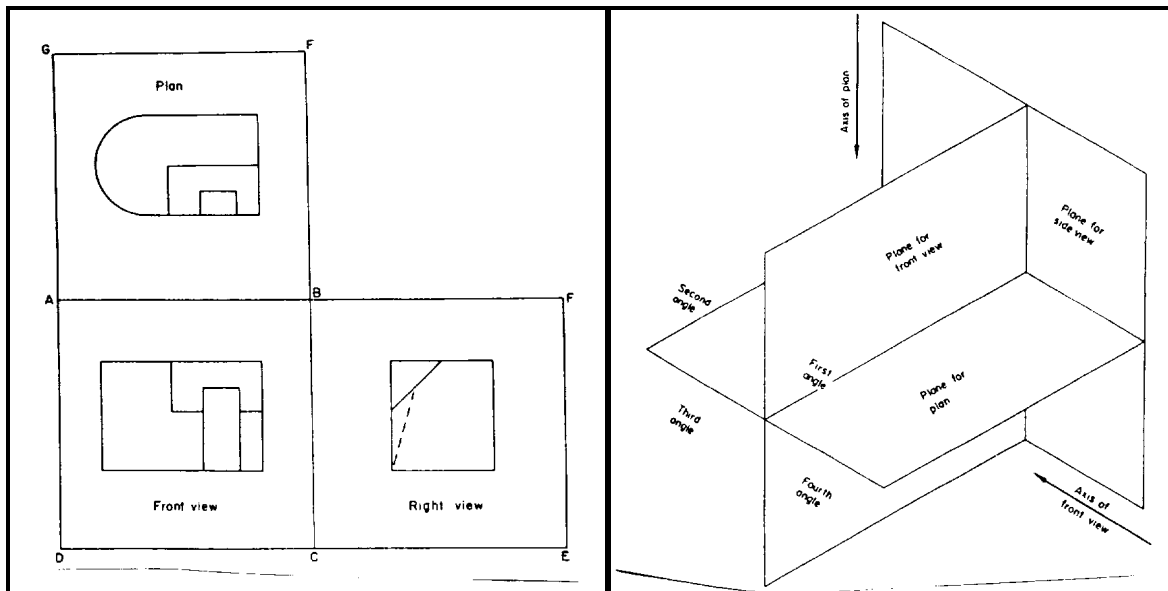


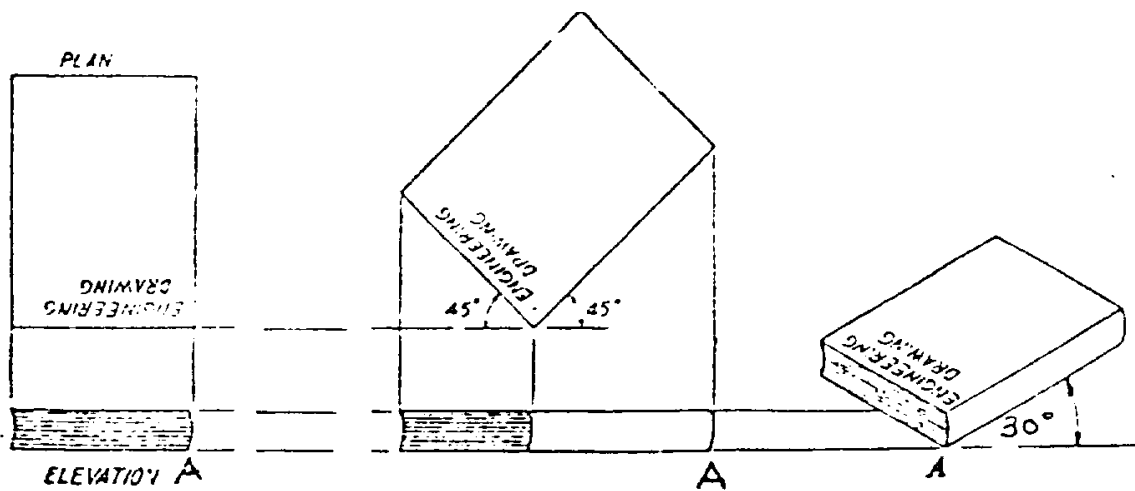
Figure 2

Figure 3

### ISOMETRIC VIEWS

Two ways of producing isometric views:

- (1) Isometric projection - using isometric scale.
- (2) Isometric drawing - measure and transfer the actual lengths.



Orthographic View  
of a book

Rotate the book  
through  $45^\circ$

Isometric projection of  
the book appears on  
V.P. when it is tilted  
forward about A

Figure 4 Isometric Projection

# ISOMETRIC LENGTH

<p>These lines are called Isometric Axis.</p>	<p>Any lines as those shown dotted, parallel to the isometric axis are called Isometric Lines.</p>	<p>All planes so formed by isometric lines are called Isometric Planes.</p>

All planes constituting the cuboid are called Isometric square.

All the edges except those shown dotted appear to be shorter than the actual length.

Considering the plane DEFG, when it is rotated about DF until the plane is parallel to V.P. the plane shows its true shape.

$$\begin{aligned}
 \frac{\text{Isometric Length}}{\text{Actual Length}} &= \frac{DG}{DG'} \\
 &= \frac{DO \sec 30^\circ}{DO \sec 45^\circ} \\
 &= \frac{\sqrt{2}}{\sqrt{3}} \text{ or } 0.816
 \end{aligned}$$

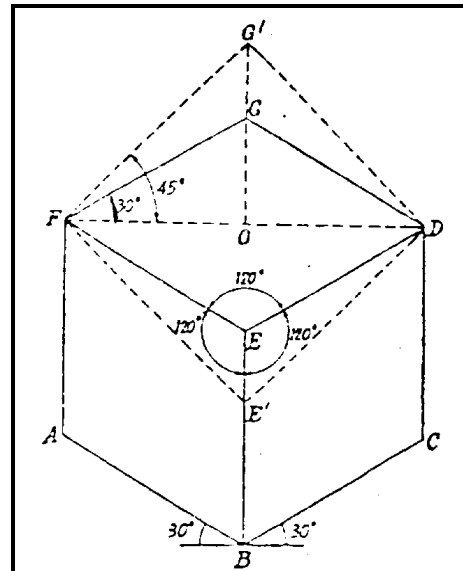


Figure 5

For Instance, the length of isometric line is reduced to 81.6% of the actual length.

## ISOMETRIC SCALE

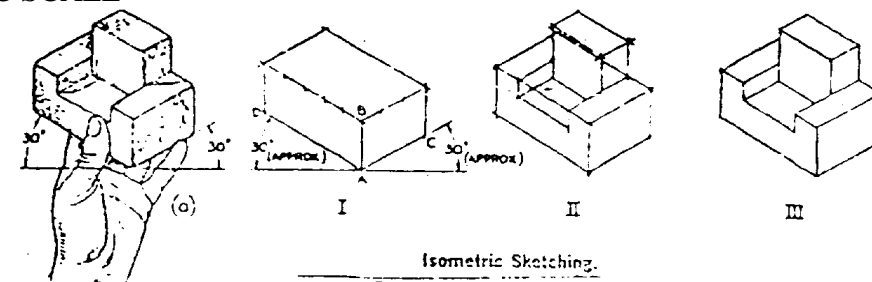


Figure 6



## TWO WAYS IN DRAWING ISOMETRIC SQUARES IN PLAN & IN ELEVATION

The sides in isometric square are equal to sides in true square.

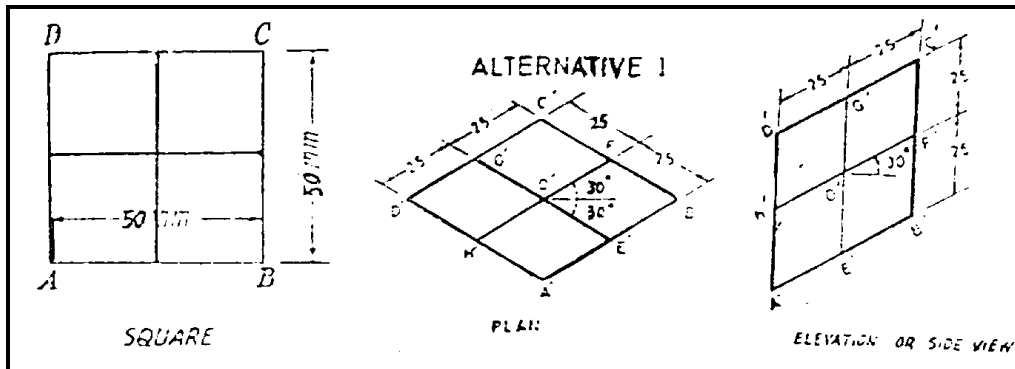


Figure 9

In an isometric square the shorter diagonal is equal to side of the square.

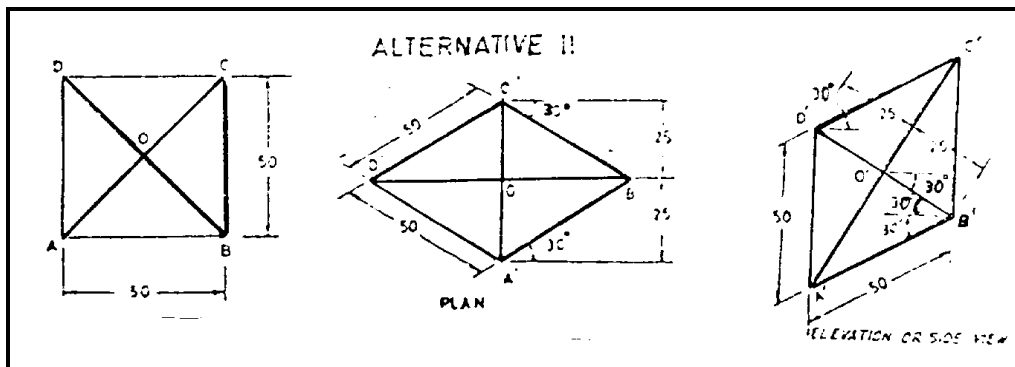


Figure 10

## INCLINED LINES IN ISOMETRIC

Since non-isometric lines do not appear in their true length in isometric drawing, they can be drawn by locating the position of their extreme points.

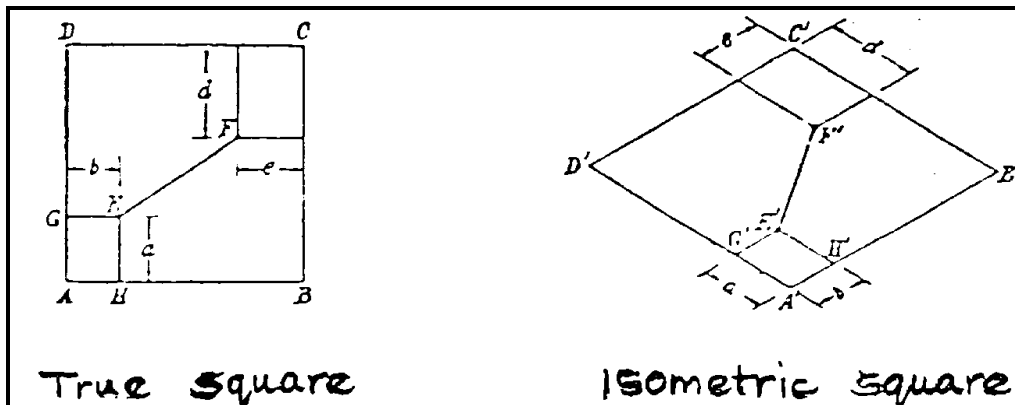


Figure 11

## OBLIQUE LINES IN ISOMETRIC

Only lines parallel to isometric axis can be measured from orthographic projections.

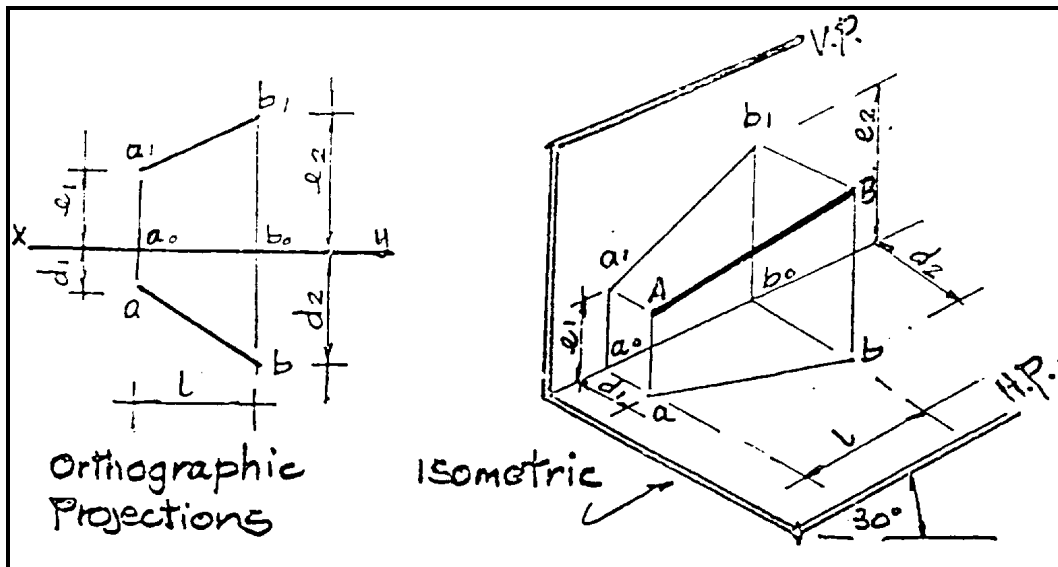


Figure 12

## ANGLES IN ISOMETRIC

Since angles do not appear in their true shape in isometric, they may be plotted by locating the position of points.

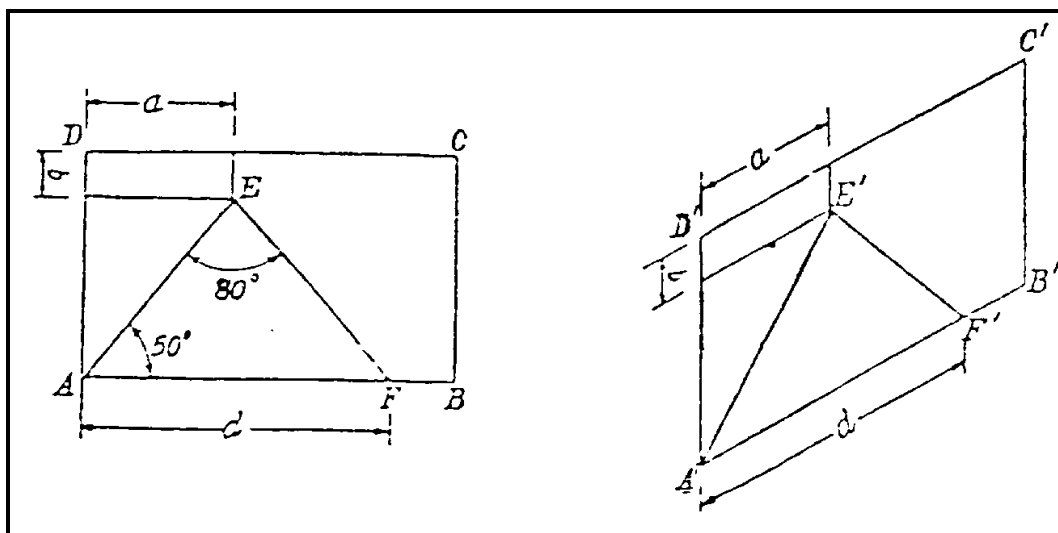


Figure 13

## CURVES IN ISOMETRIC

Curves can be drawn in isometric by enclosing them in a square/rectangle. Points are chosen on the curves and are located on isometric square/rectangle. Closer intervals of points can produce more accurate curves.

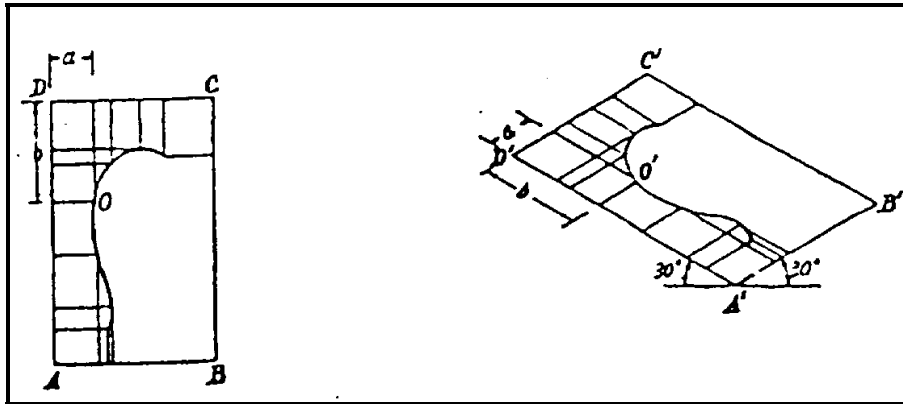


Figure 14

## CIRCLES IN ISOMETRIC

Circles can be drawn by choosing various points on the actual circle and then transferring these points with respect to isometric lines for isometric circle.

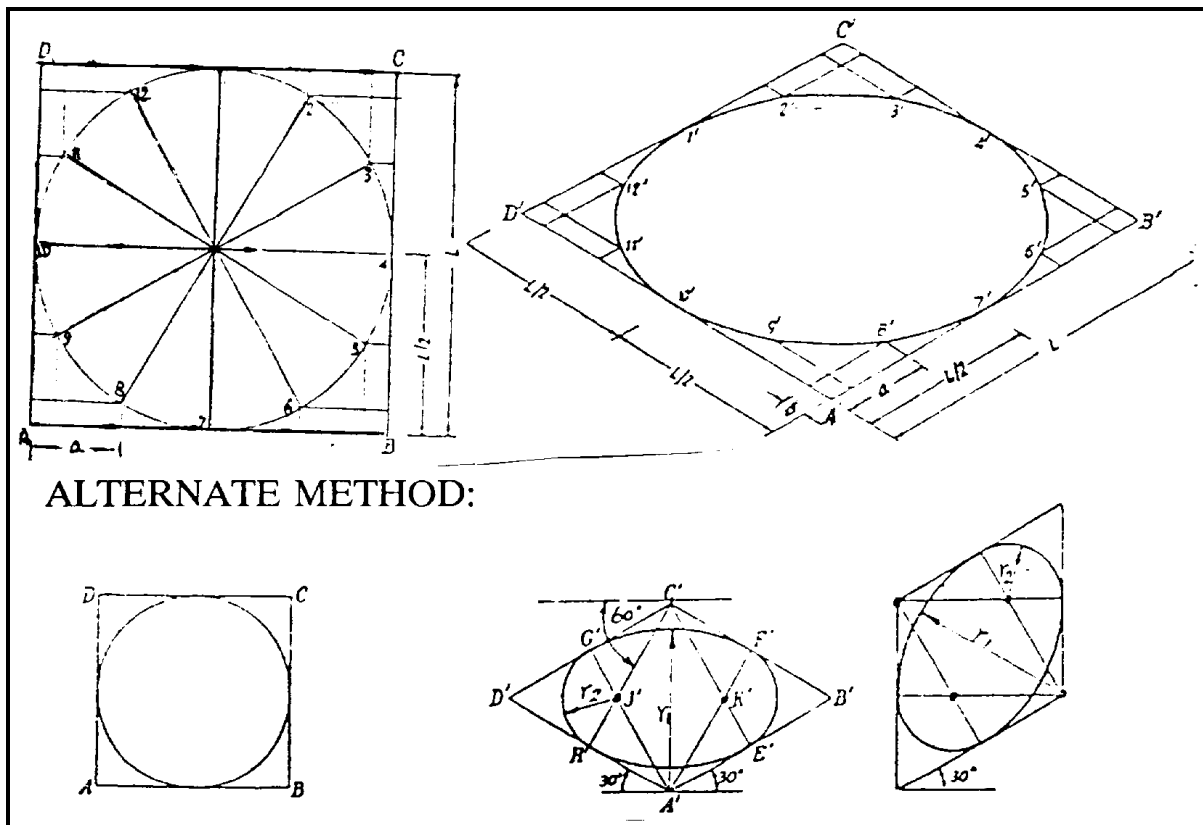


Figure 15

## SPHERES IN ISOMETRIC

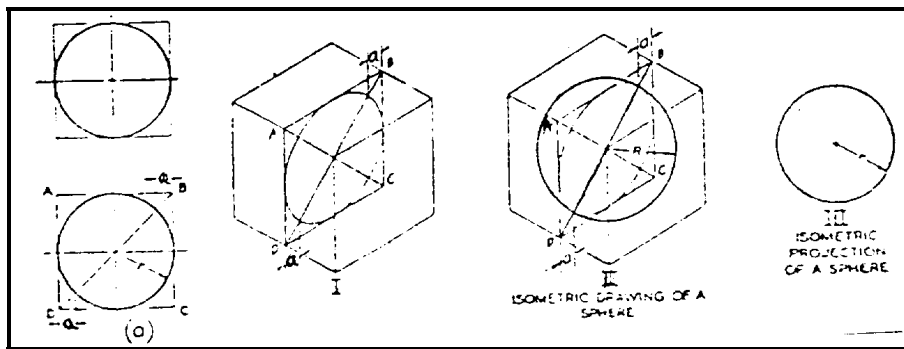


Figure 16

- I. For isometric drawing, consider the sphere to be enclosed in a cube. The great circle (the circle cut by a plane through the centre and parallel to one face of the cube) may be selected as the lines on the surface. The points on the diagonal located by measurements 'a' establish the ends of the major axis from which the radius R of the sphere is determined.
- II. The resulting drawing is the isometric drawing of the sphere. Its diameter is  $\sqrt{3/2}$  times the actual diameter of the sphere in 'a'.
- III. The isometric projection of the sphere is simply a circle whose diameter is equal to the true diameter of the sphere.

### EXAMPLE 1

From the given plans and elevations, produce isometric drawings.

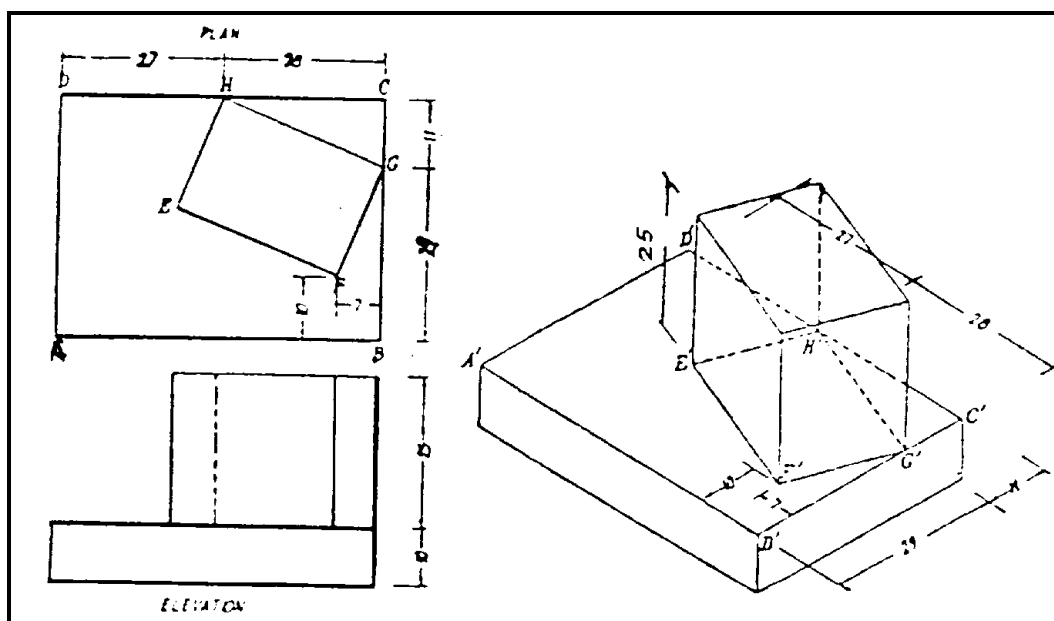


Figure 17

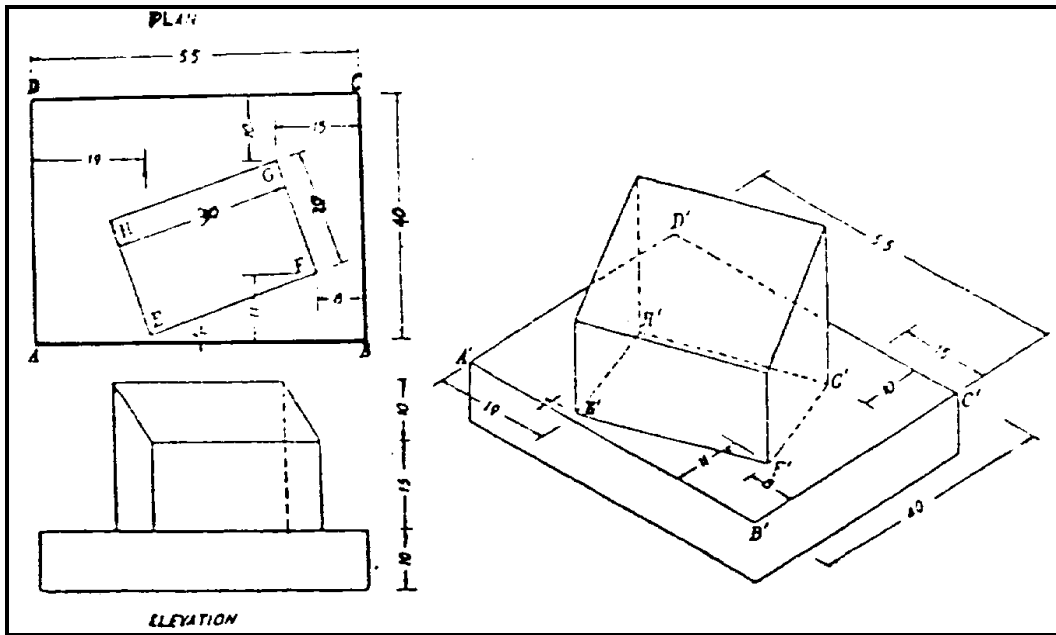


Figure 18

EXAMPLE 2

Draw isometric drawings of i) a frustum of cone and ii) a pentagonal prism.

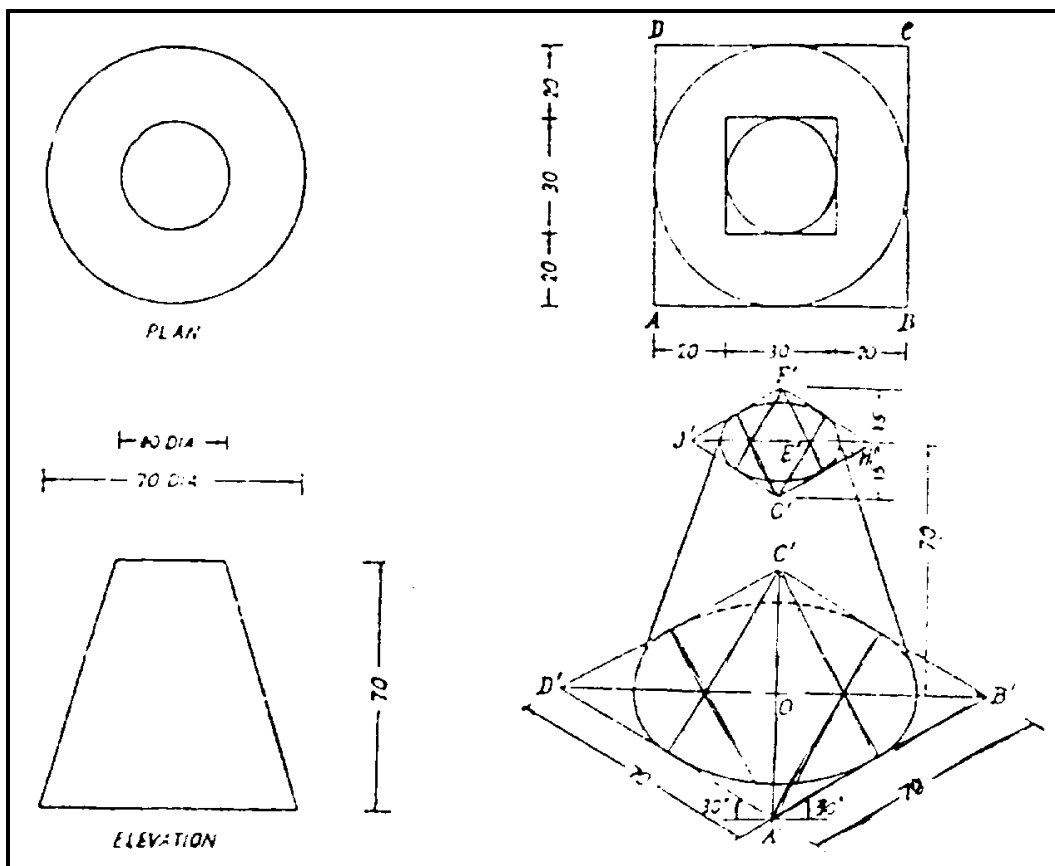


Figure 19 - A Frustum of Cone

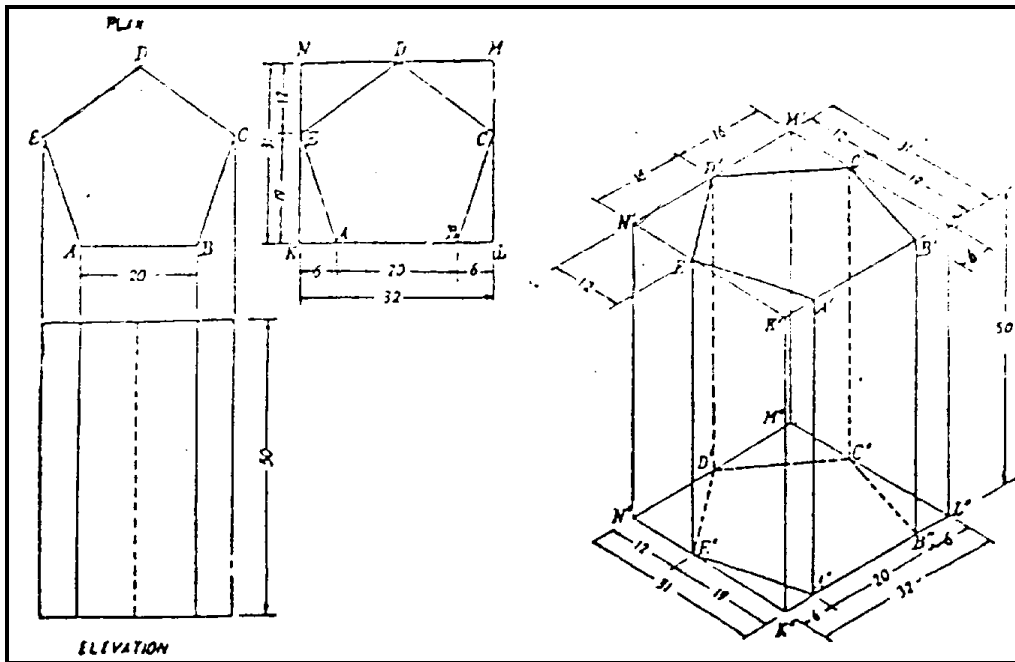


Figure 20 - A Pentagonal Prism

EXAMPLE 3

Draw the isometric projection of a cone bearing. Hidden lines need not be shown.

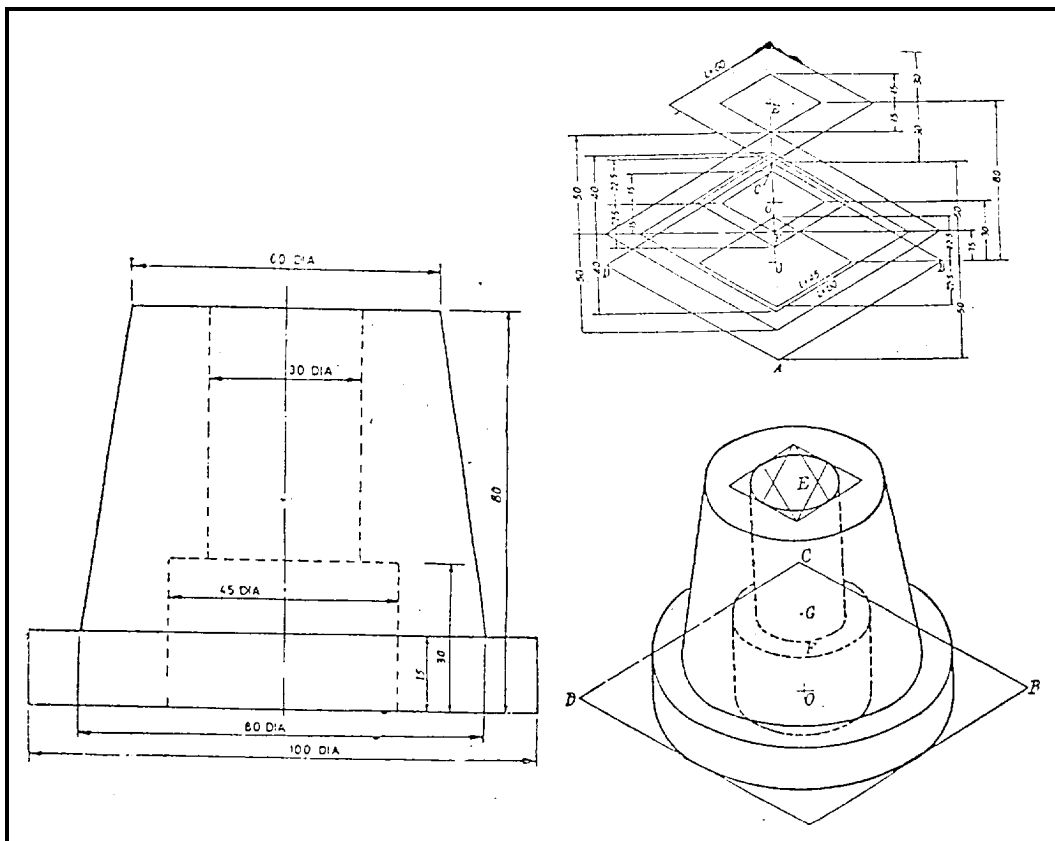


Figure 21

## SECTIONAL VIEWS

**PURPOSE :** A sectional view of an object is to show the shape of the parts hidden from view which would otherwise have to be defined by dotted lines.

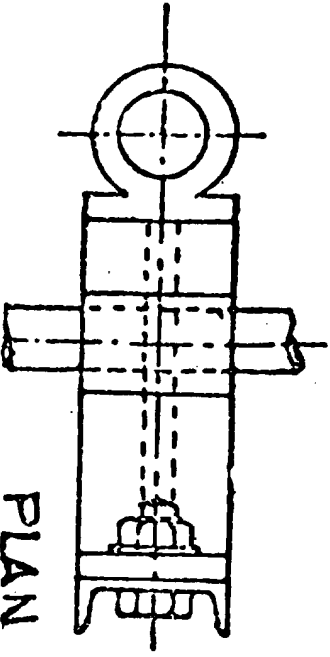
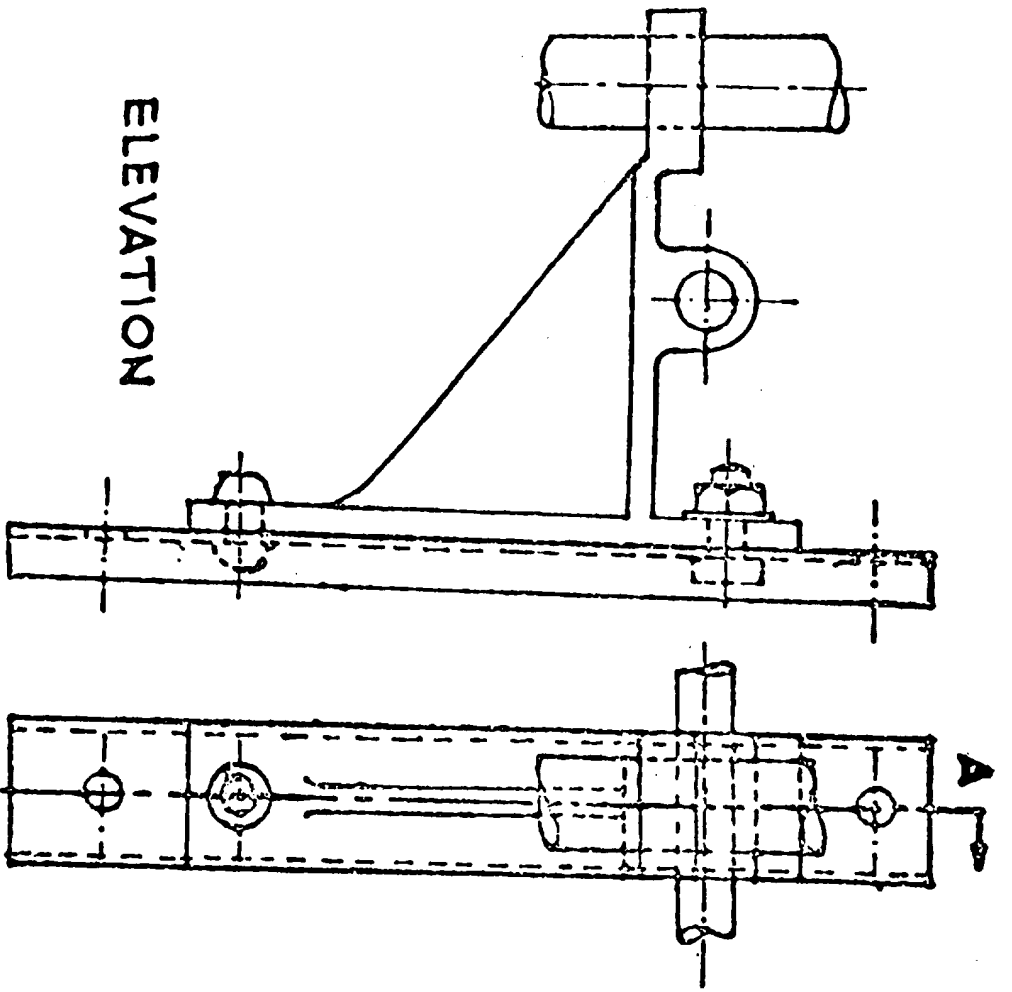
**PROCEDURE :** A thick long chain dotted line representing the cutting plane is inserted in the normal view across the portion which is imagined to be removed. The cutting planes are usually marked with letters, e.g. sections A-A, B-B. Arrowheads are used to indicate the direction of viewing. Sometimes, it is not required to show the cutting plane if the object is symmetrical about a centre line.

### CONVENTIONS & REQUIREMENTS :

A sectional view should show not only the section supposed to be cut but also those parts which are visible beyond the section. Hidden details for those parts which are not seen will have to be omitted in order to avoid confusion & the overlapping of lines. The areas of the actual sections are usually cross-hatched. The spacing of the hatching lines depends on the area to be covered. A narrower section requires closer section lines. Normally These lines should be about 3mm apart & be drawn at 45° with uniformly thin lines equally spaced.

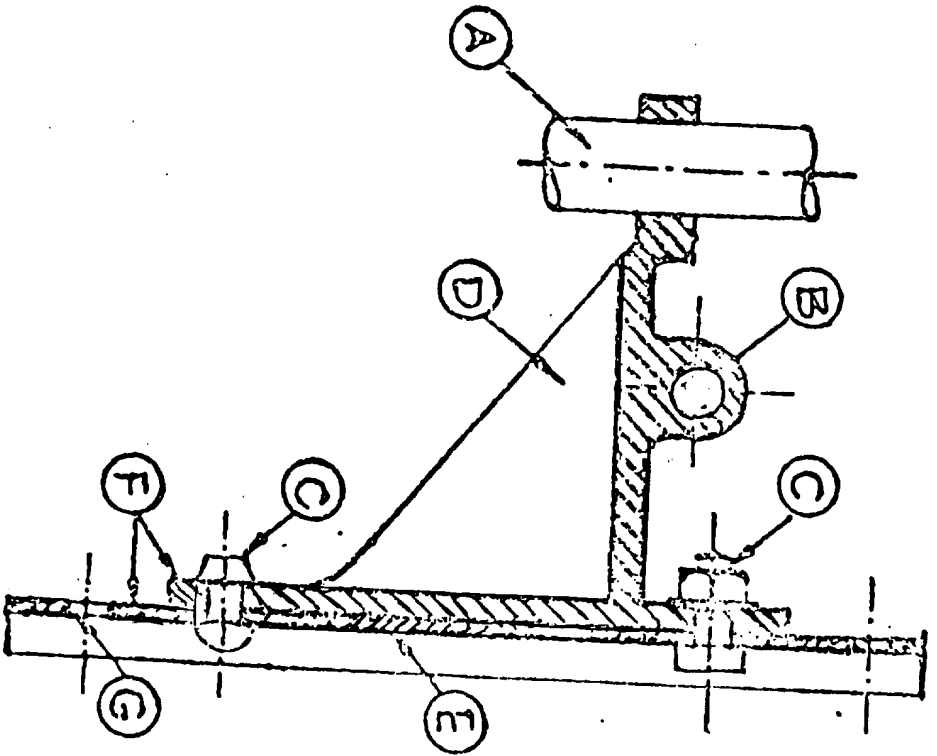
**EXAMPLE :** In the following example, note that the hidden lines are not shown on the sectioned surface. There are few points which require to give attention to:

- a) Shafts, rods are not sectioned.
- b) The shaft is sectioned when the cutting plane is perpendicular to the axis.
- c) Rivets, bolts, nuts and washers are not sectioned.
- d) The rib is not sectioned when the cut is longitudinal.
- e) Hatching lines have to be closer when the sectioned surface is narrow.
- f) Adjacent parts are to be hatched in opposite directions.
- g) When sectioning through holes, show the lines visible behind cutting plane.



END ELEVATION

SECTION A-B



## CONVENTIONS & ILLUSTRATIONS OF VARIOUS TYPES OF SECTIONAL VIEWS

### (1) Section (Full):

Fig. 22 shows pictorially the application of a section plane. In order to show a complete visualisation of the component, sectional views are often drawn, where the hidden details are numerous, overlapping or in anyway confusing.

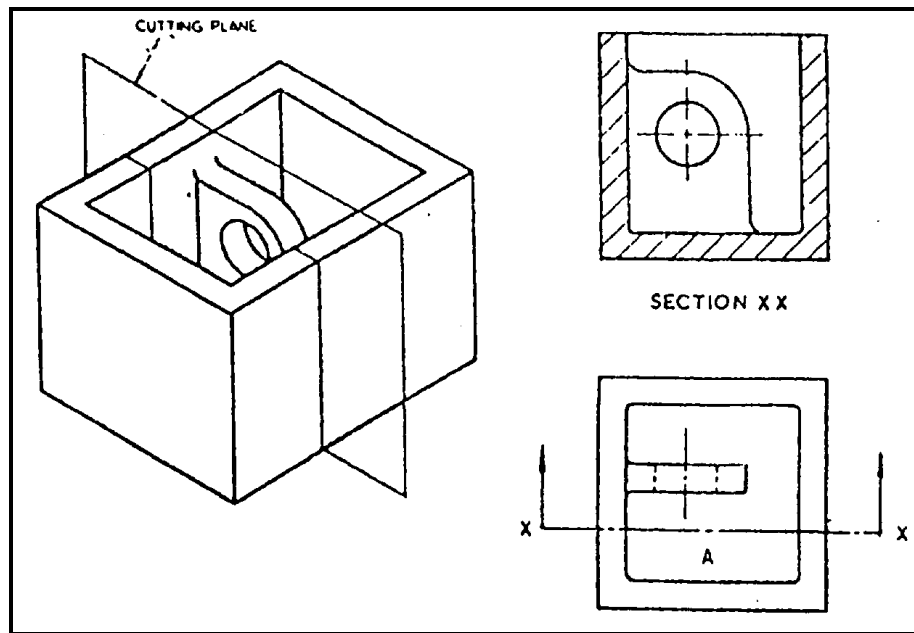


Figure 22

When as in Fig. 23, the section is in one plane and along a centre line, it is not necessary to show a section plane line or section title.

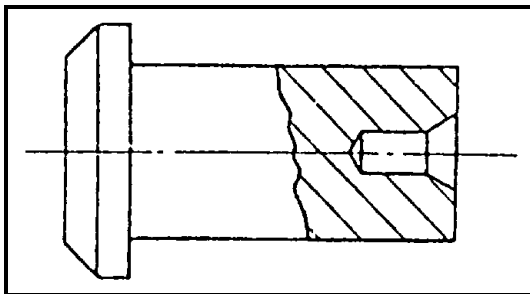


Figure 24

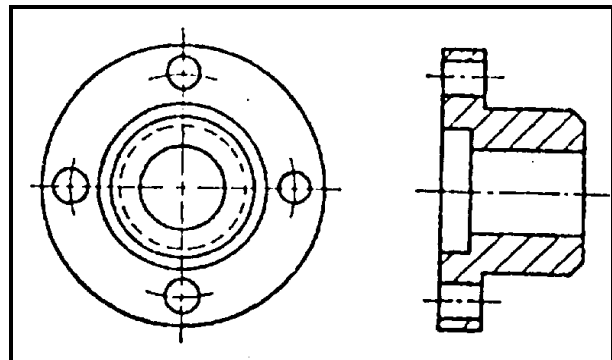


Figure 23

(2) Part Section: When full sectioning of a component is more than is required for complete shape description, or in order to show a detail that

would otherwise be hidden, a part section is drawn. (Fig. 24)

(3) Half Section: This method enables the shape description of the outside & inside of a component to be shown in the minimum number of views. Normally only components which are symmetrical about a centre line are drawn in this way. Hidden lines on the half drawn as an outside view are shown only if necessary for dimensioning or clarity. (Fig. 25)

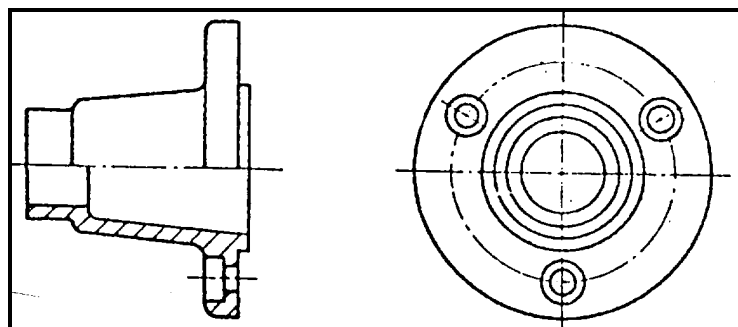


Figure 25

(4) Offset Section:  
 When there are sections more than one plane, the cutting plane is offset to include features of the component. Note that section XX is not in direct projection with the parent view and is known as a removed section.

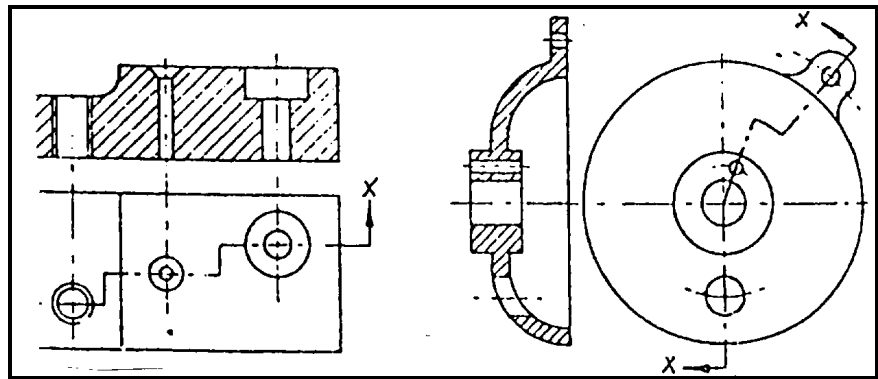


Figure 26

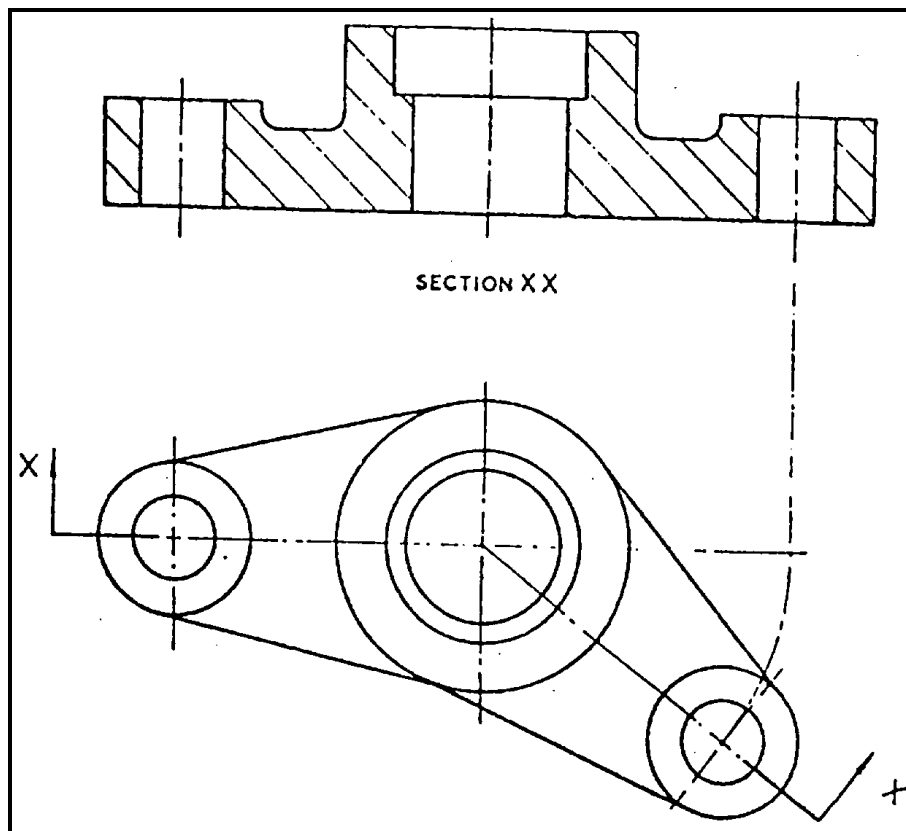


Figure 27

A conventional section along the horizontal centre line of the component shown in Fig. 27 will provide details of only one of the two features. By rotating the cutting plane to a position which will pass through both features and then treating it as a single plane the complete shape description can be shown in two views.

(6) Exceptions (Ribs & Webs): A section taken down the length of a web, as in this example, give a false impression of solidity. To correct this impression the web is not sectioned or cross hatched. This convention also applies to ribs and similar parts.

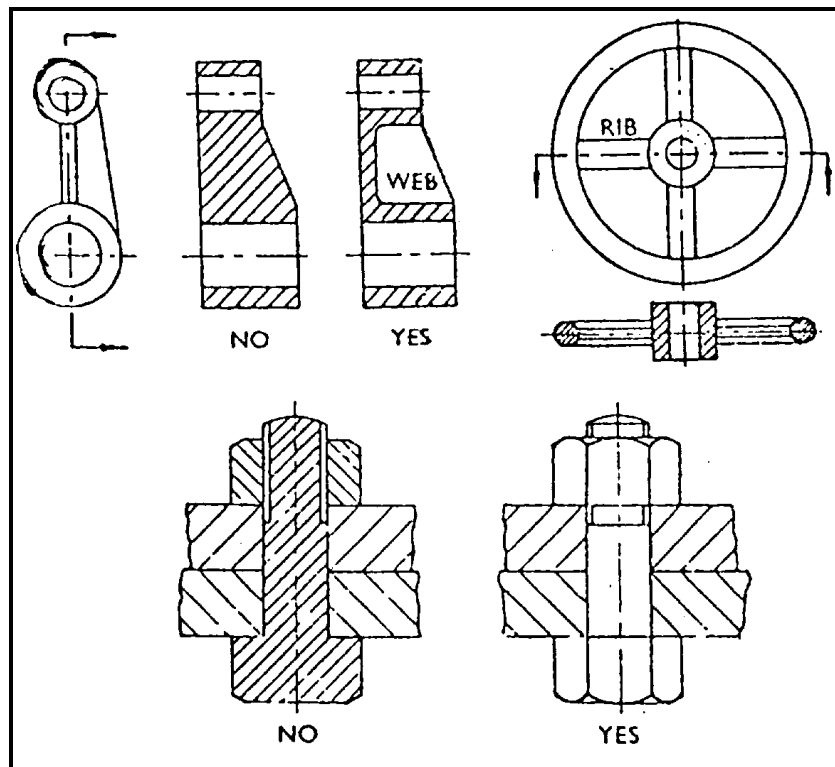


Figure 28

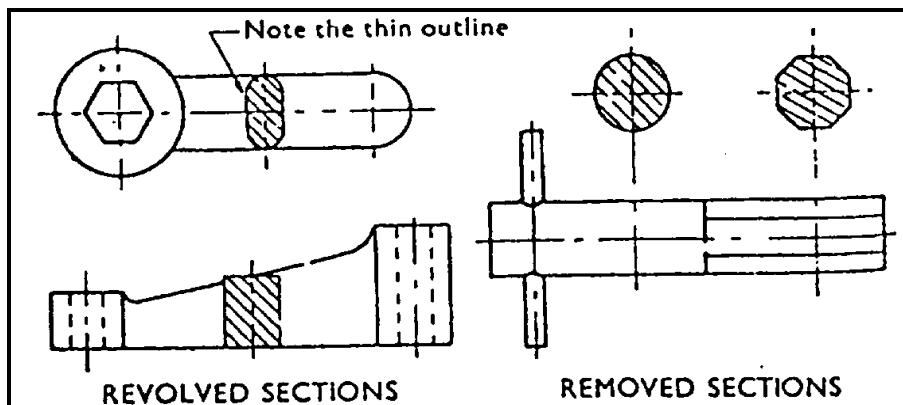


Figure 29

(7) Revolved Section: These section enable the cross section of the component to be shown on an outside view. The cutting plane is revolved through 90° as shown in Fig. 29.

(8) Cross-Hatching or Section Lining: To make the cut surface easier to visualise, symbolic lines are drawn as shown in the examples.

