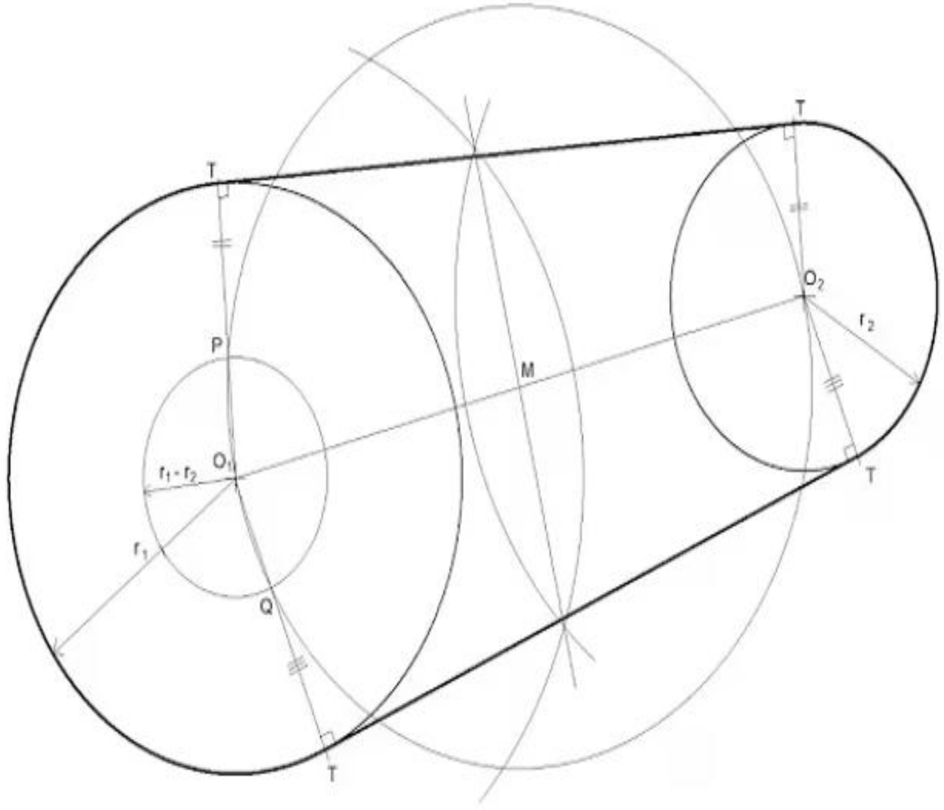
Engineering Drawing
Lecture 2
Tangency and Orthographic Projection

Tangency:

Line tangent to two circles of different diameters

a-state the center o1
b- find the center of the other circle o2
c- then draw the tow circles
d- bisect the distance btn. The two centers to get M
e- take M as center and with radius MO draw circle
f- at center O2 and radius (R1 – R2) draw internal cirle intersect at P and Q with the central circle
g- draw line from O2 passing through P to cut the circle at T
h- also the same to get T
I then transfer these tow lines to the other circle with parallelism to get T
i- these points T are the tangency points , then connect them as shown.



Internal line tangency to two un equal circles:

a- given centers of circles A, B and distance between the two centers

b- draw the two circles

c- bisect the distance between two circles, draw semi circle where the bisecting point is the center

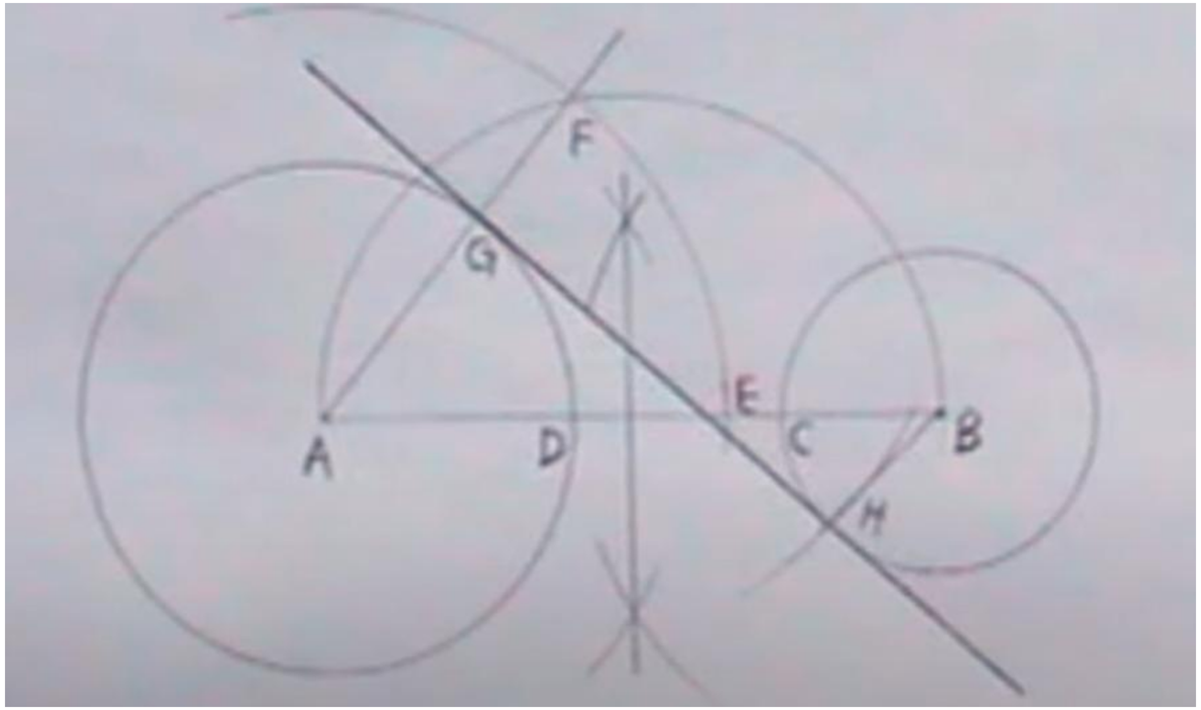
c- draw quadrant with center Aand radius (RA+RB) we get points F and E

d- draw line from A to intersect the semi circle at F

e- the intersecting of this line with the circle is point G which is the tangent point

f- transferline AG parallel to other circle to find the tangent point H

g- draw the tangent line GH.



Internal and external tangents between two un equal circles

- **Upper tangent is the internal tangent and lower is the external one.**
- **1- givens:**
- **a- Radius (R1) of the circle o1 and radius (R2) of the circle o2**
- **b- Distance between the two circles**

To find centers of the two tangents :

For internal tangent : (R3- R1) with center 01 draw an arc, with center 02 and (R3- R2) draw an arc, The intersection of the two arcs is the center of the internal tangent (o3)

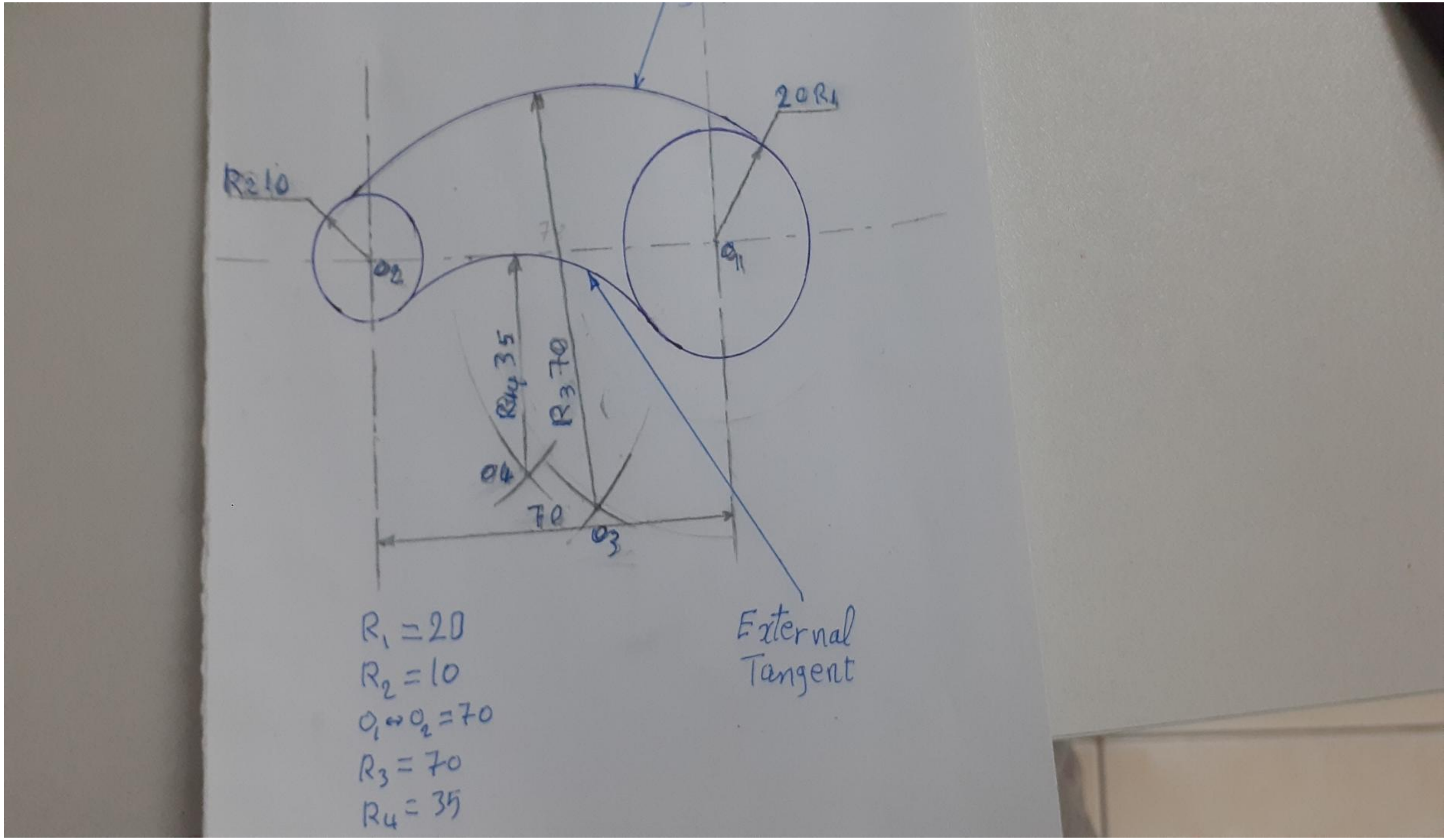
For external tangent with the same steps but instead of substraction you have to add

(R4+R1) with center o1 draw an arc, (R4+R2) with center 02 draw an arc

Intersection of the the two arcs is the center of the external tangent 03

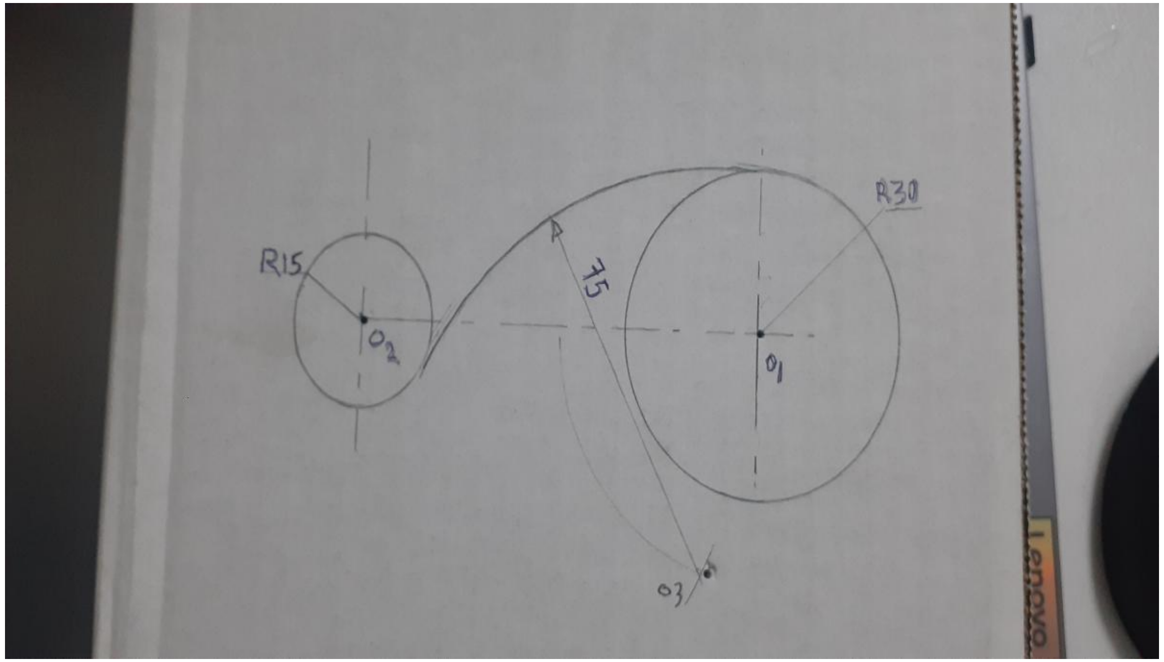
Take 03 aas center and open compass (R3) to draw the external tangent

Internal and External tangents to two un equal circles



An internal external tangent to tow un equal circle:

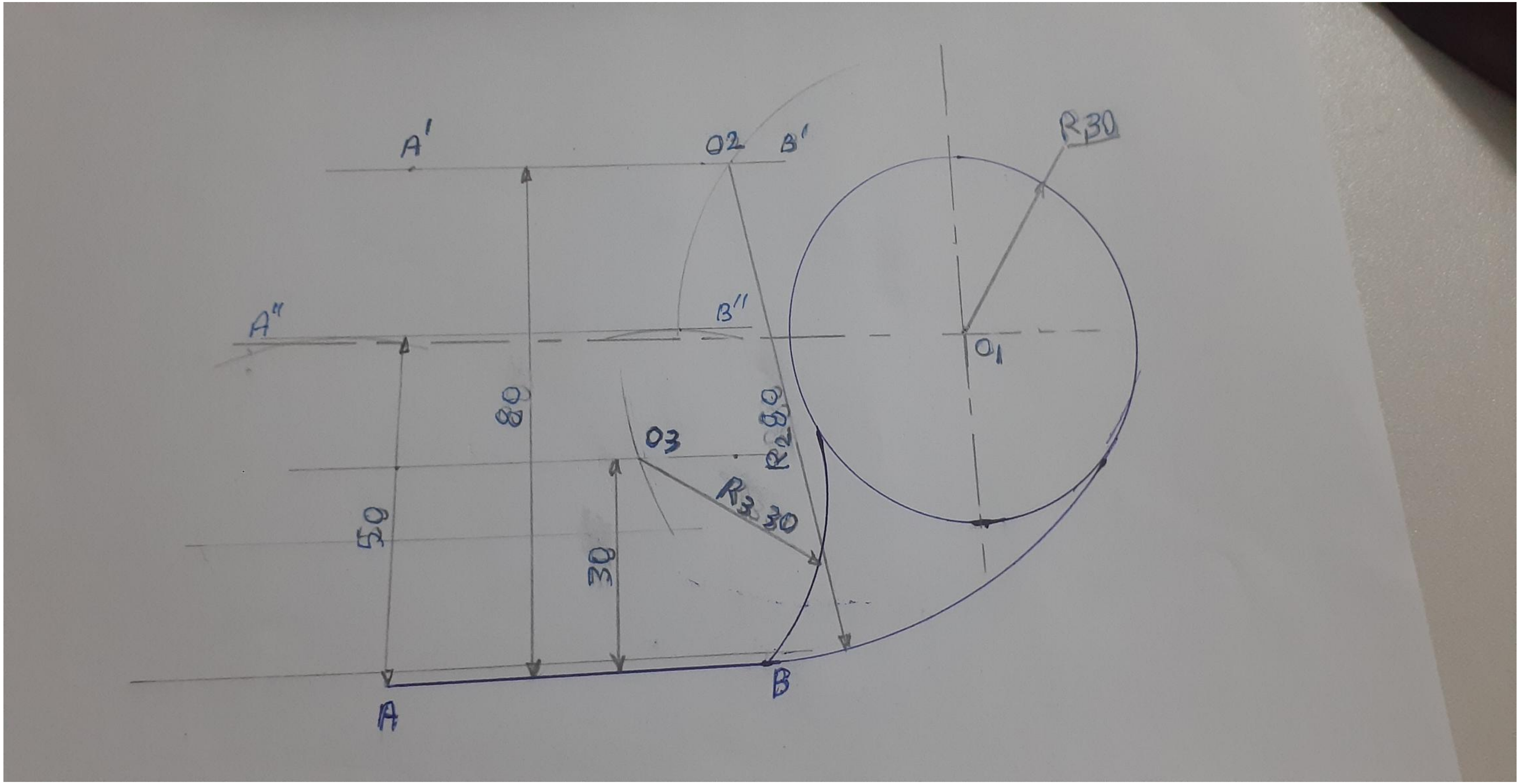
a- this tangent is internal to circle O1, and external to circle O2
b- to find the center of tangent you have to add for external and
with O2draw the curve,
c- and for internal you have to substract and and from point O1 draw
the curve to get center of the tangent O3
then draw the tangent with radius = 75



Internal and External tangents between a circle and line

- **Givens:**
- **The circle and the line AB**
- **<u>For internal tangent R2</u>: (R2- R1) and with center 01 draw an arc**
- **Then draw line parallel to AB with distance equal amount of R3**
- **The intersection of curve and line is the center of the internal tangent 02**
- **<u>For external tangent: (</u>R3+R1) with center 01 draw an arc, draw line parallel to AB the intersection with the arc is the center og external tangent (03)**

Internal and external tangents between a circle and line



Orthgraphic Projection

1- Principles of Projection:

If straight lines are drawn from various points on the contour of an object to meet a plane, the object is said to be projected on that plane. The figure formed by joining, in correct sequence, the points at which these lines meet the plane, is called the projection of the object. The lines from the object to the plane are called projectors.

2- Methods of Projections:

In engineering drawing following four methods of projection are commonly used,

they are:

1- Orthographic projection

2- Isometric projection

3- Oblique projection

4- Perspective projection.

In the above methods (2), (3) and (4) represent the object by a pictorial view

as eyes see it. In these methods of projection a three dimensional object is

represented on a projection plane by one view only. While in the

Orthographic projection an object is represented by two or three views on the mutual perpendicular projection planes.

Each projection view represents two dimensions of an object.

For the complete description of the three dimensional objects at least two or three views are required

Orthographic Projection:

the projection is called orthographic projection.

When the projectors are parallel to each other and also perpendicular to the plane,

Step 1 : Imagine that a person looks at the block [fig. (i)] from a

Theoretically infinite distance, so that the rays of sight from his eyes are parallel to one another ,

and perpendicular to the front surface F. The view of this block will be the Shaded figure, showing the front surface of the object in its true shape and proportion.

Step 2: If these rays of sight are extended further to meet perpendicularly at vertical plane (marked V.P.) set up behind the block.
Step 3: The points at which they meet the plane are joined in proper sequence, the resulting figure (marked F) will also be exactly similar to the front surface and this is known as an elevation or front-view. This figure is the projection of the block. The lines from the block to the plane are the projectors. As the projectors are perpen dicular to the plane on which the projection is obtained, it is the orthographic projection. The projection is shown separately in fig. -1 (ii). It shows only two dimensions of the block viz. the height H and the width W. It does not show the thickness. Thus, we find that only one projection is insufficient for complete description of the object

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height H and the width W. It does not show the thickness. Thus, we find that only one projection is

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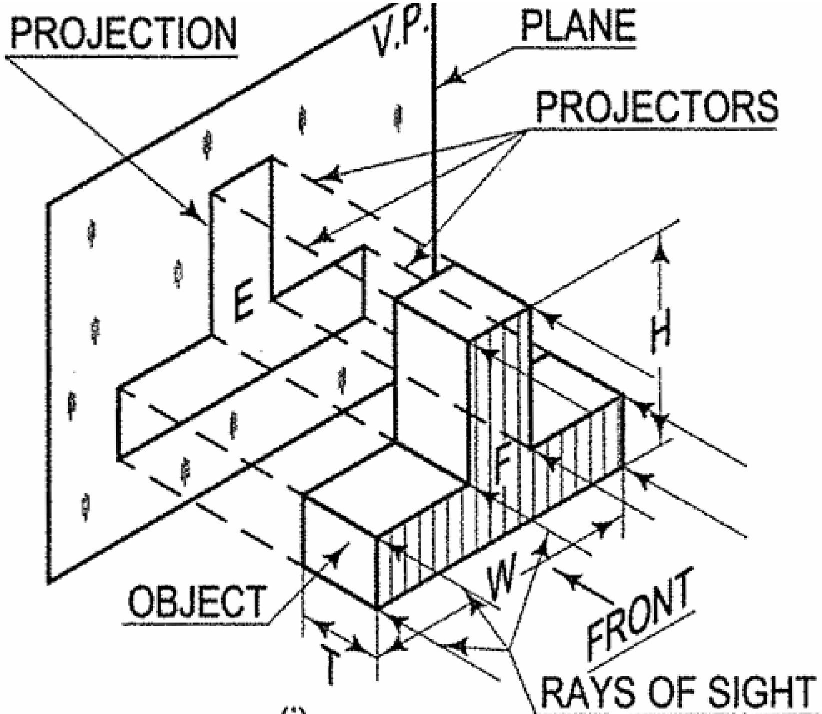
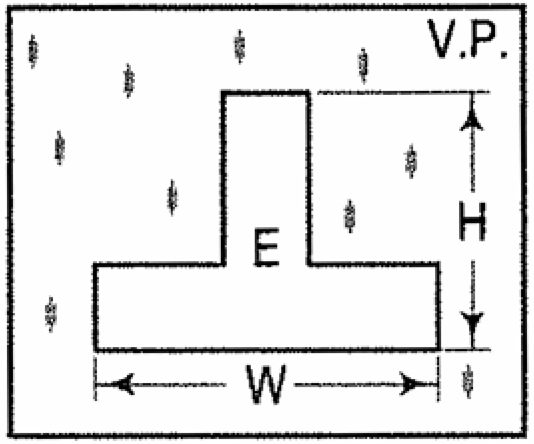
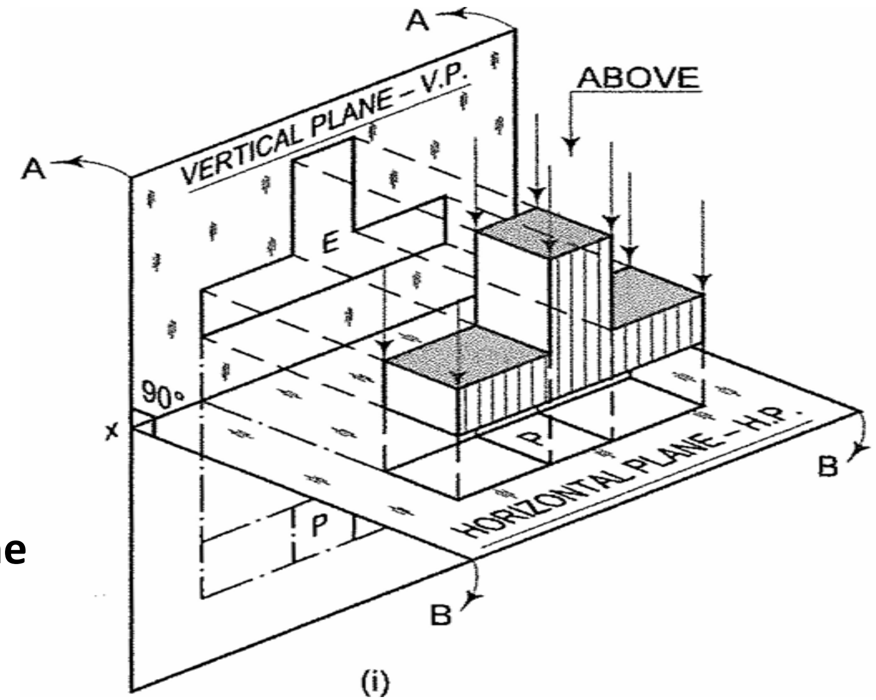


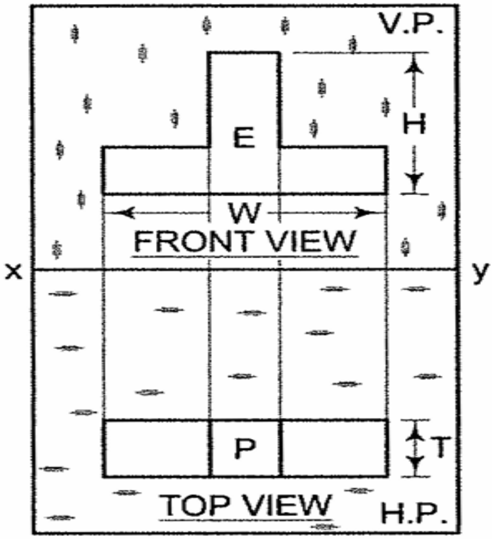


let us further assume that another plane marked H.P. (Horizontal plane)

fig. 2 is hinged at right angles to the first plane



(i)



(ii)

so that the block is in front of the V.P. and above the H.P. The projection on the H.P. (figure P) shows the top surfaces of the block. If a person looks at the block

from above, he will obtain the same view as the figure P and is known as a plan

or top-view. It shows the width W and the thickness T of the block. It however

does not show the height of the bloc

One of the planes is now rotated or turned around on the hinges so that it lies in extension of the other plane. This can be done in two ways: 1-by turning the V.P. in direction of arrows A 2- by turning the H.P. in direction of arrows B. The H.P. when turned and brought in line with the V.P. is shown by dashed lines. The two projections can now be drawn on a flat sheet of paper, in correct relationship

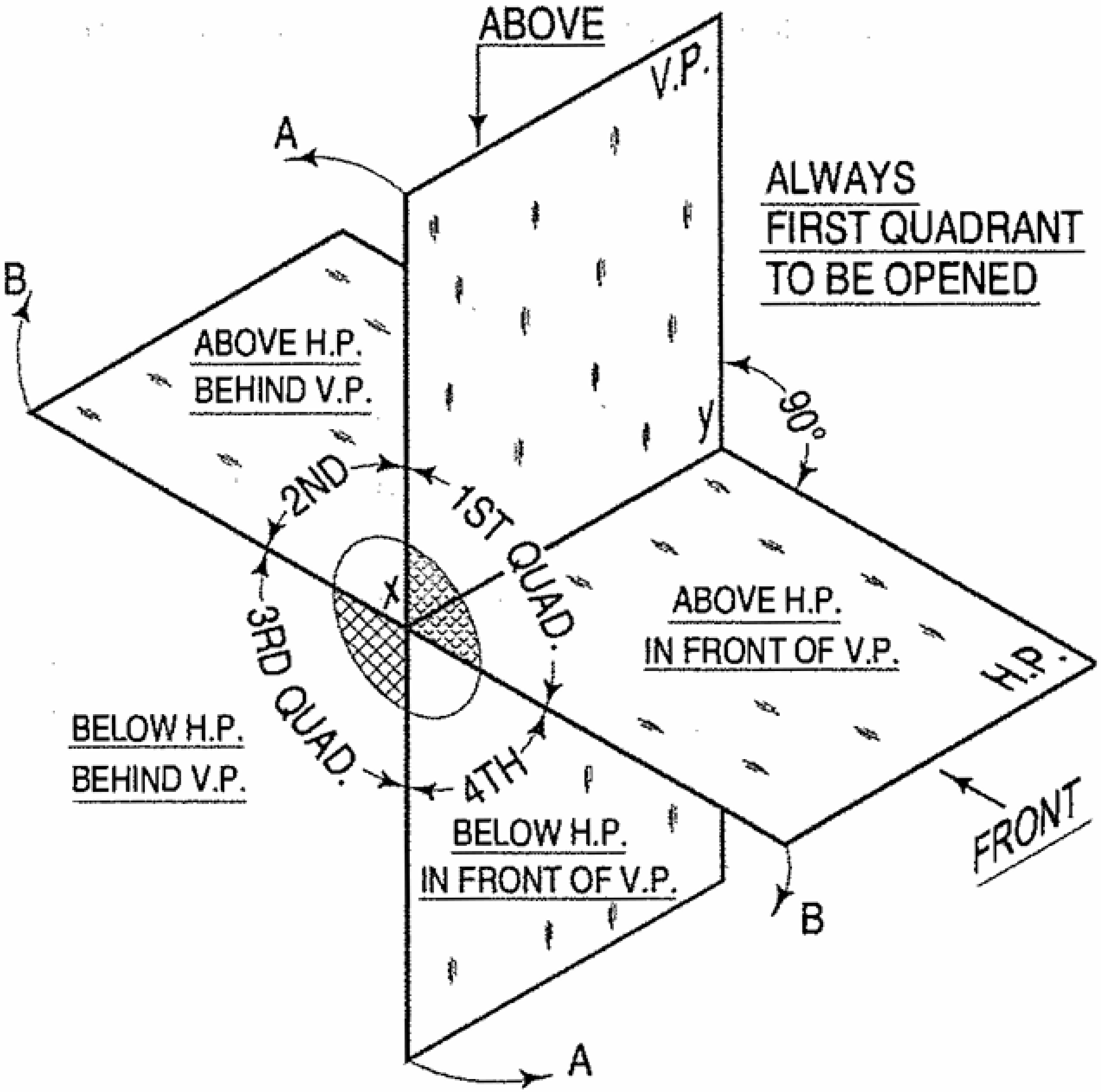
with each other, as shown in fig.

When studied together, they supply all information regarding the shape and the size of the block. Any solid may thus be represented by means of orthographic projections or orthographic views.

Planes of the Projection:

The two planes employed for the purpose of orthographic projections are called reference planes or principal planes of projection. They intersect each other at right angles. The vertical plane of projection (in front of the observer) is usually denoted by the letters V.P. It is often called the frontal plane and denoted by the letters F.P. The other plane is the horizontal plane of projection known as the H.P. The line in which they intersect is termed the reference line and is denoted by the letters xy. The projection on the V.P. is called the front view or the elevation of the object. The projection on the H.P. is called the top view of the plane.

When the planes of projection are extended beyond the line of intersection, they form four quadrants or dihedral angles which may be numbered as in fig. 3. The object may be situated in any one of the quadrants, its position relative to the planes being described as "above or below the H.P." and "in front of or behind the V.P." The planes are assumed to be transparent. The projections are obtained by drawing perpendiculars from the object to the planes, i.e. by looking from the front and from above. They are then shown on a flat surface by rotating one of the planes as already explained.


ABOVE
V.P.
A
ALWAYS
FIRST QUADRANT
TO BE OPENED
B
ABOVE H.P.
BEHIND V.P.
90°
y
2ND
1ST QUAD.
x
3RD QUAD.
4TH
ABOVE H.P.
IN FRONT OF V.P.
H.P.
BELOW H.P.
BEHIND V.P.
BELOW H.P.
IN FRONT OF V.P.
FRONT
B
A

It should be remembered that the first and the third quadrants are always opened out while rotating the planes. The positions of the views with respect to the reference line will change according to the quadrant in which the object may be situated.

First Angle Projection:

We have assumed the object to be situated in front of the V.P. and above the H.P. i.e. in the first quadrant

and then projected it on these planes. This method of projection is known as first-angle projection method.

The object lies between the observer and the plane of projection. In this method, when the views are drawn

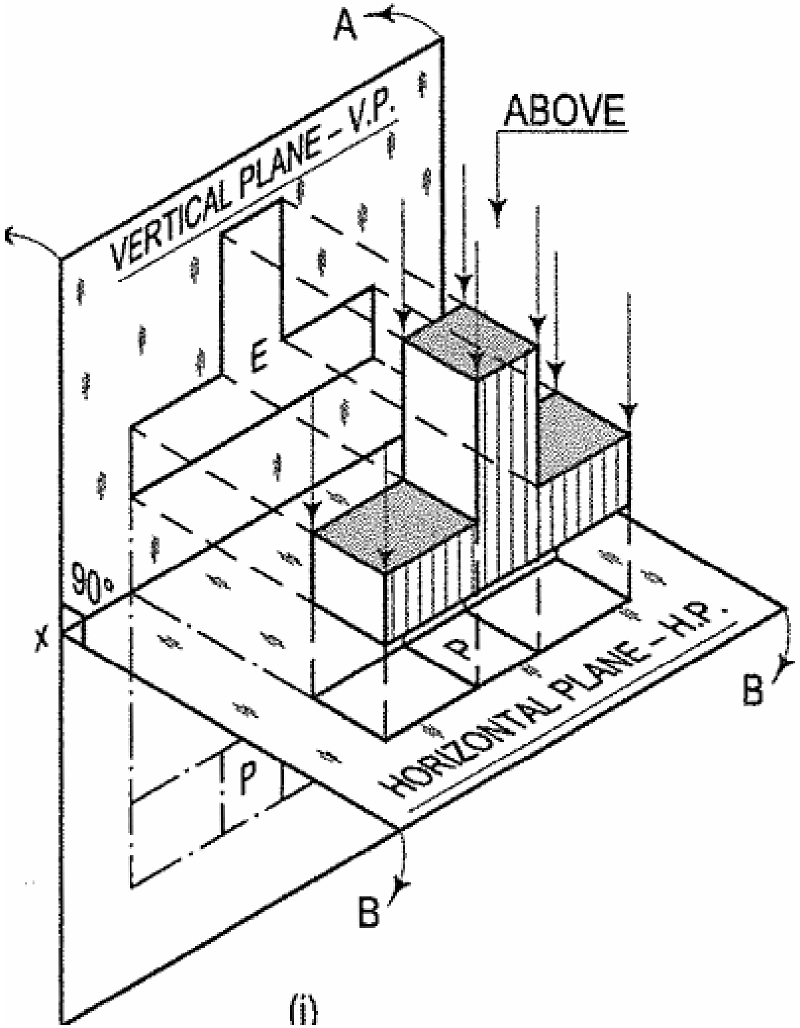
in their relative positions, the top view comes below the front view. In other words, the view seen from

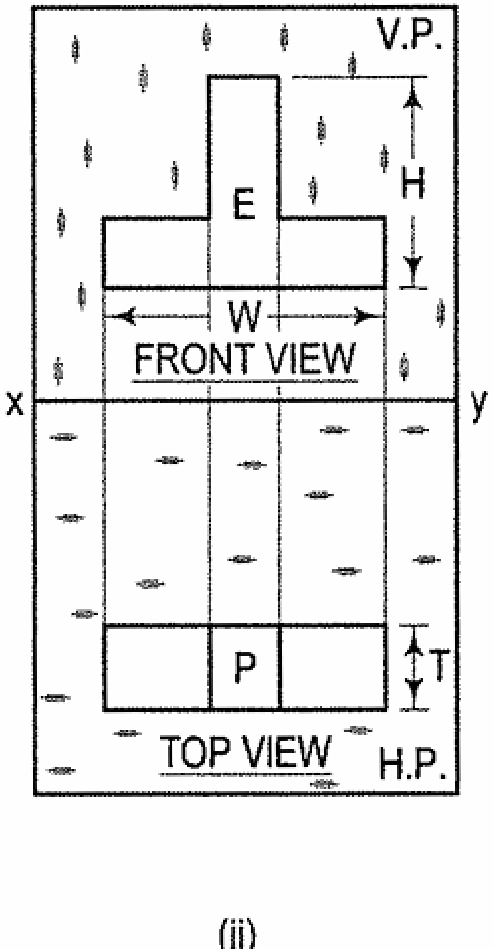
above is placed on the other side of (i.e. below) the front view. Each projection shows the view of that

surface (of the object) which is remote from the plane on which it is projected and which is nearest to

the observer.

First Angle Projection

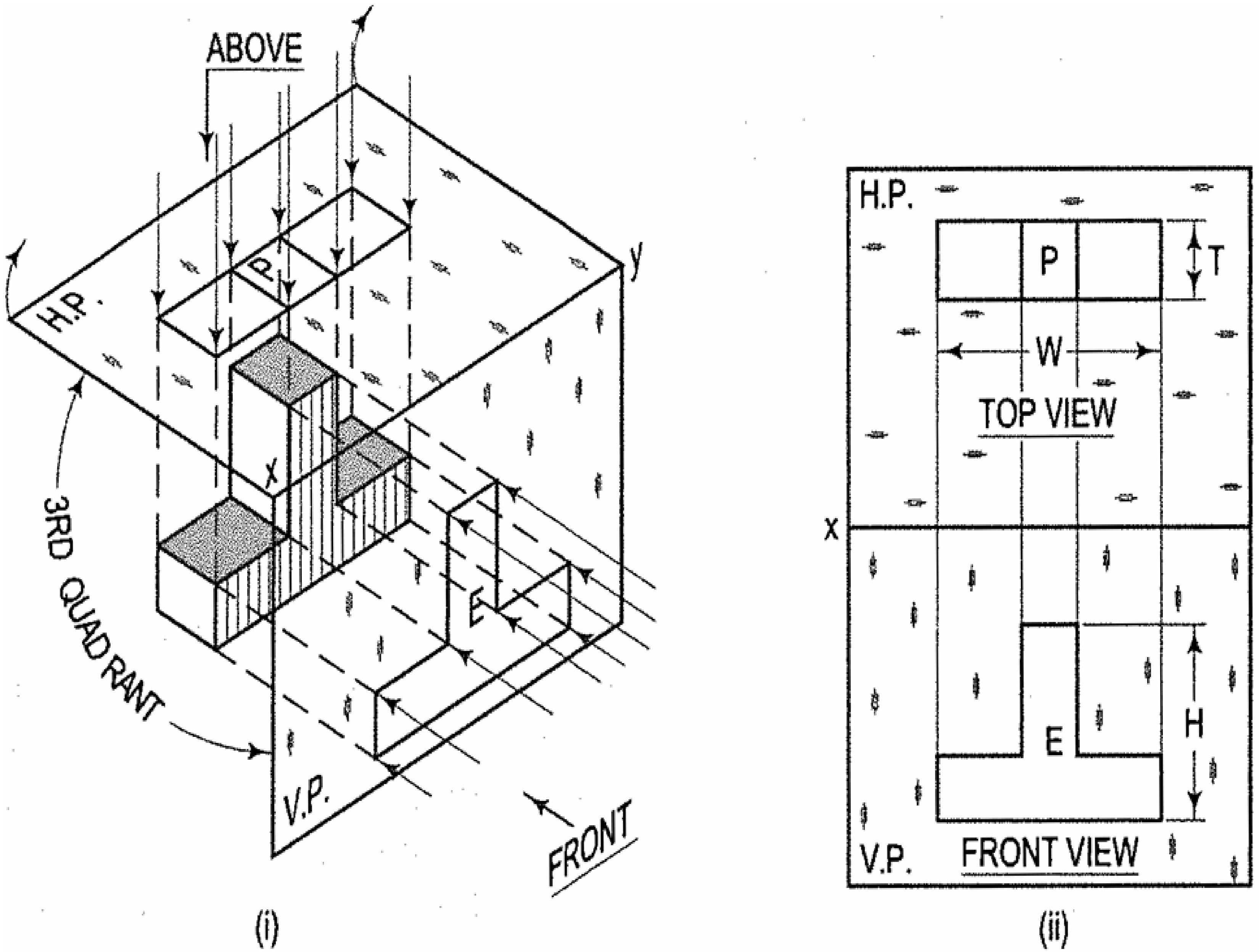




Third Angle Projection:

In this method of projection, the object is assumed to be situated in the third quadrant [fig. -4(i)]. The planes of projection are assumed to be transparent. They lie between the object and the observer. When the observer views the object from the front, the rays of sight intersect the V.P. The figure formed by joining the points of intersection in correct sequence is the front view of the object. The top view is obtained in a similar manner by looking from above. When the two planes are brought in line with each other, the views will be seen as shown in fig. -4(ii). The top view in this case comes above the front view.

Fig. 4(i, ii)



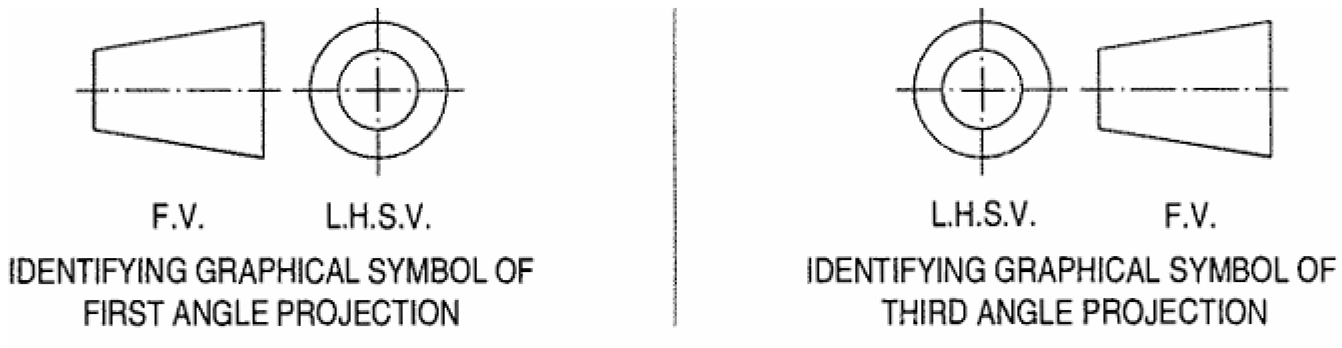
ABOVE
H.P.
P
x
y
3RD QUADRANT
T
E
V.P.
FRONT
(i)
H.P.
P
T
W
TOP VIEW
x
y
E
H
V.P.
FRONT VIEW
(ii)

DIFFERENCE BETWEEN FIRST-ANGLE PROJECTION METHOD AND THIRD-ANGLE PROJECTION METHOD

No.	First-angle projection method	Third-angle projection method
1.	The object is kept in the *first quadrant*.	The object is assumed to be kept in the *third quadrant*.
2.	The object lies between the observer and the plane of projection.	The plane of projection lies between the observer and the object.
3.	The plane of projection is assumed to be non-transparent.	The plane of projection is assumed to be *transparent*.
4.	In this method, when the views are drawn in their relative positions, the *plan* comes *below* the *elevation*, the view of the object as observed from the *left-side* is drawn to the *right of elevation*.	In this method, when the views are drawn in their relative positions, the *plan*, comes *above* the elevation, *left hand side view* is drawn to the *left hand side of the elevation*.

First and third angle projection symboles

Symbols for methods of projection: For every drawing it is absolutely essential to indicate the method of projection adopted. This is done by means of a symbolic figure drawn within the title block on the drawing sheet. The symbolic figure for the first-angle projection method is shown in fig.1, while that for the third-angle projection method is shown in fig. 2 which are self explanatory. These symbolic figures are actually the projections of a frustum of cone of convenient dimensions according to the size of drawing.



Six views of an object:

Six views of an Object: There are three important elements of this projection system, namely (a) an object (b) observer and (c) plane of projection.

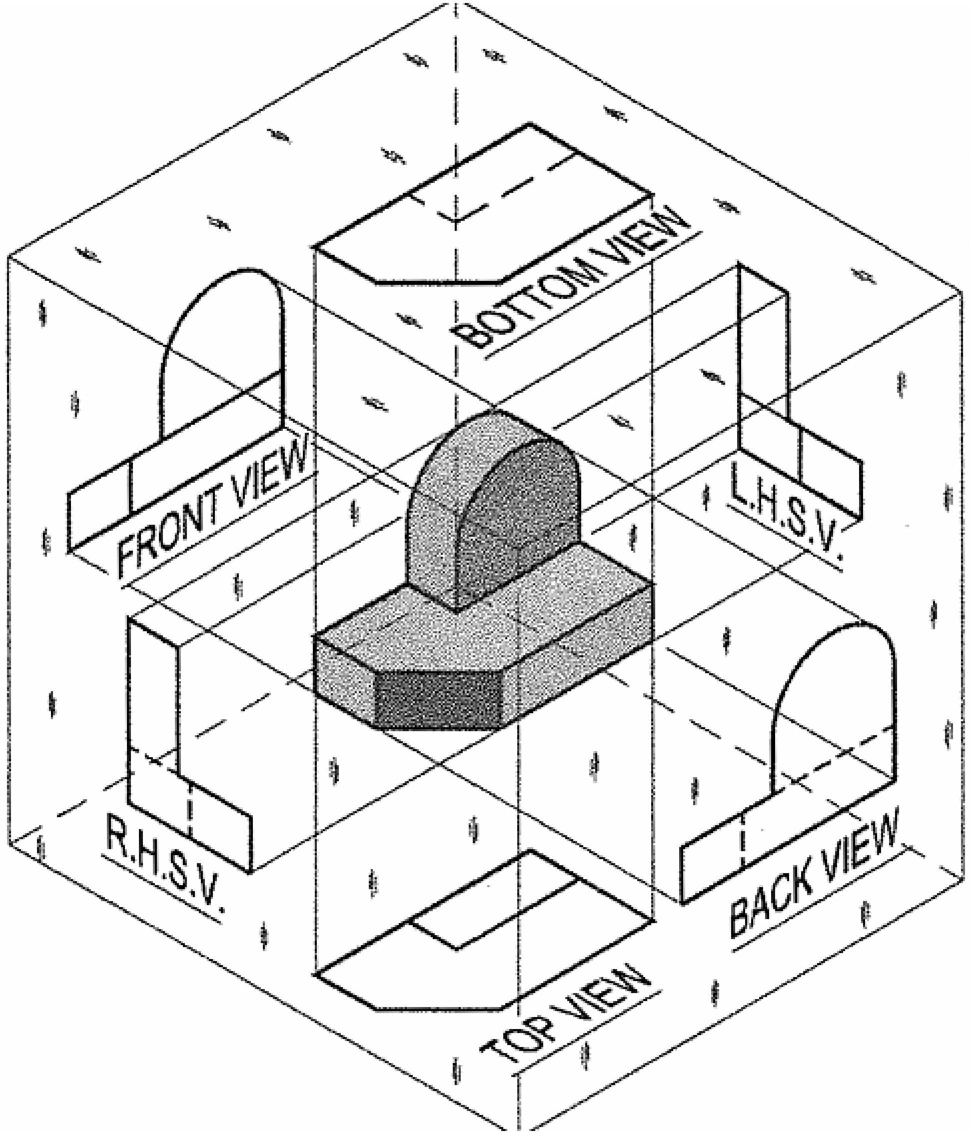
. Very often, two views are not sufficient to describe an object completely.

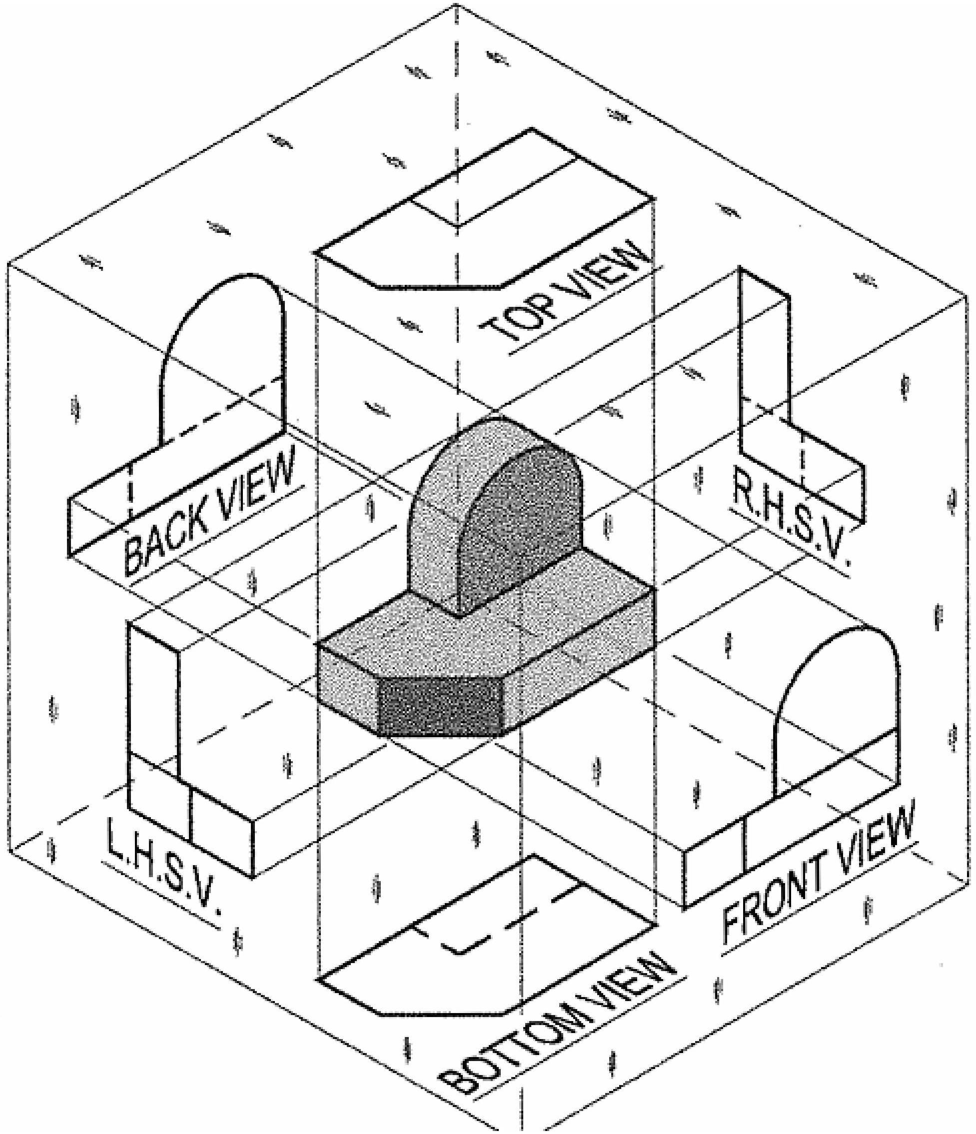
The planes of projection being imaginary, following six views are o1) (2) (3) Front view Top view Left hand side view (4) (5) (6) Right hand side view Back view Bottom view These projections are shown projected on

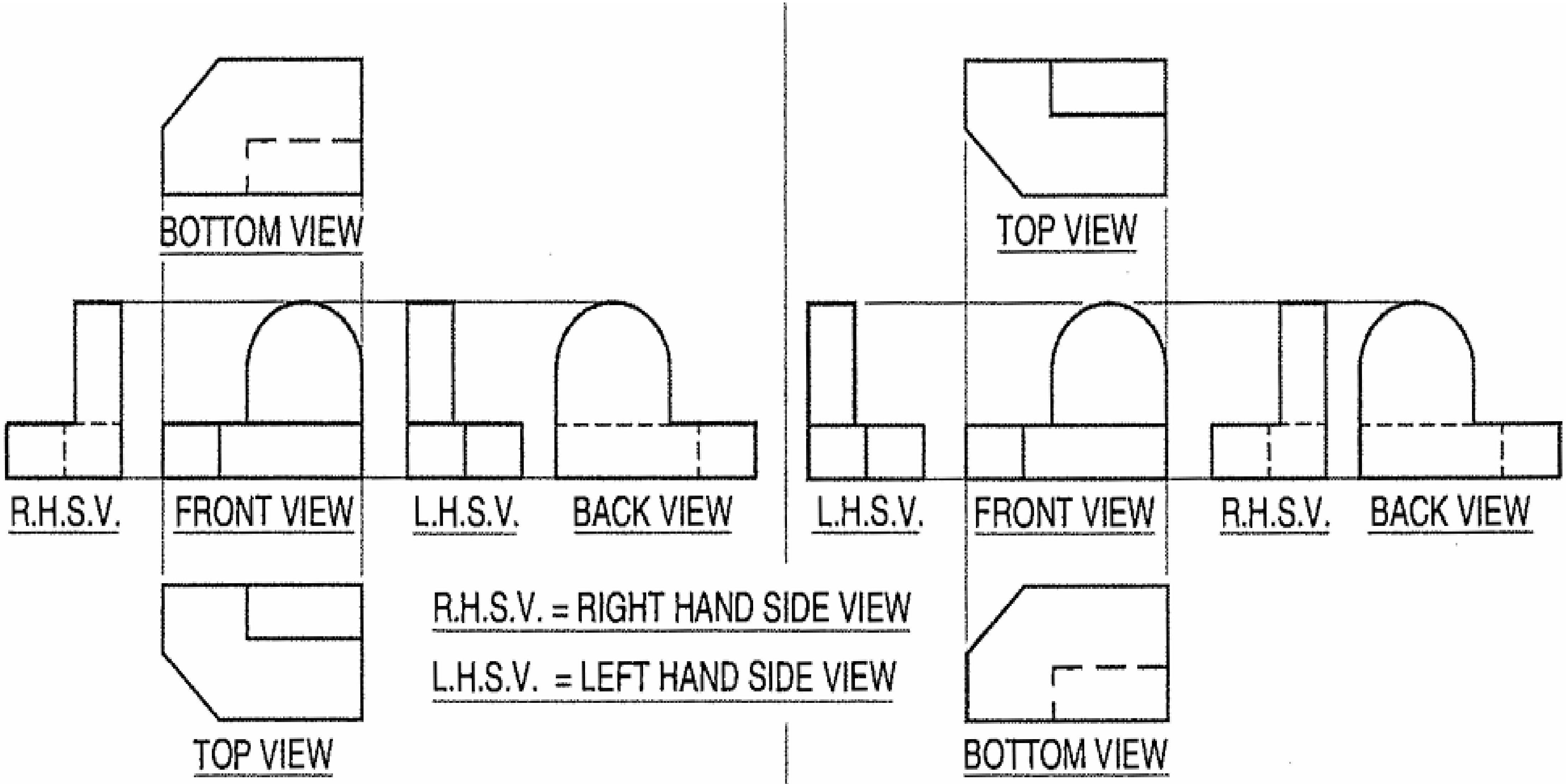
the respective planes, placed by the methods of first-angle projection and third-angle projection as shown:

Ordinarily, two views - the front view and top view are shown. Two other views i.e. L.H.S.V. or R.H.S.V. may be

required to describe an object completely. Only in exceptional cases, when an object is of a very complex nature, five or six views may be found necessary.


BOTTOM VIEW
FRONT VIEW
L.H.S.V.
R.H.S.V.
BACK VIEW
TOP VIEW


TOP VIEW
BACK VIEW
R.H.S.V.
L.H.S.V.
FRONT VIEW
BOTTOM VIEW



FIRST ANGLE PROJECTION

THIRD ANGLE PROJECTION