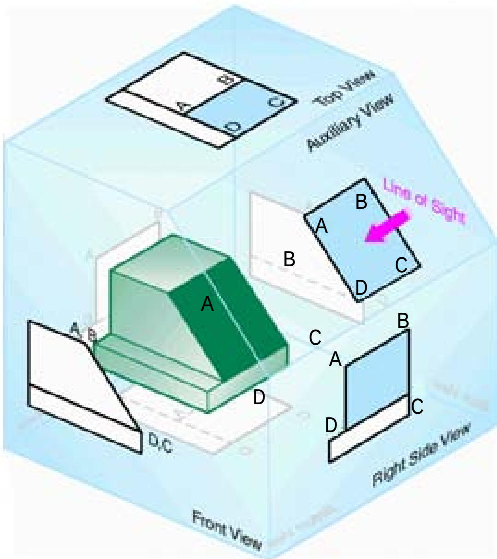
UNIT 2

AUXILIARY VIEWS



Learning Competencies:

At the end of this chapter you will have through understanding on the following topics.

- **The basic principle of orthographic projection;**
- **The type, use and application of auxiliary views ;**
- **Draw primary and secondary auxiliary views;**
- **Use reference lines properly as an aid in constructing auxiliary views;**
- **Construct partial and complete auxiliary views.**

2.1 Introduction

1. Form a group and discuss on projection, principal planes of projection and types of planes from your past experience of grade 11.
2. How do you find the true shape of a surface which is not parallel to the principal planes?

In many objects there are external surfaces that are inclined to one or all of the three principal planes of projection. The projection of the object on any of the principal projection planes will not give the actual size and shape descriptions of these inclined faces. For practical reasons, it is essential to know the true size and shape description of the surfaces for accurate manufacturing of objects. When it is desired to show the true size and shape of a non principal surface, the object should be projected on a plane parallel to that surface. This additional imaginary projection plane is known as *auxiliary plane*, and the resulting view obtained is thus an *auxiliary view*.

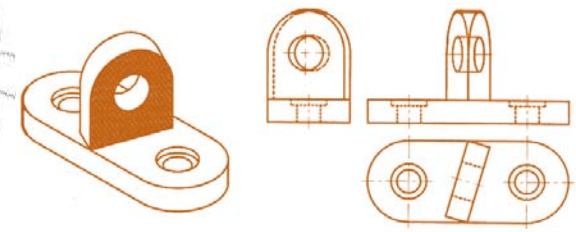
The underlying basic principles of projecting principal views of an object are also applied to auxiliary views. That is, auxiliary projection is a kind of orthographic projection as viewed by an observer stationed at infinite distance away from an object and looking towards the object perpendicular to its inclined surface.

In this chapter, the basic principles of auxiliary projection of an object will be discussed.

Uses of Auxiliary Views

1. What do you think is the importance of auxiliary view?
2. How can you project the true shape of an inclined plane on orthographic projection?

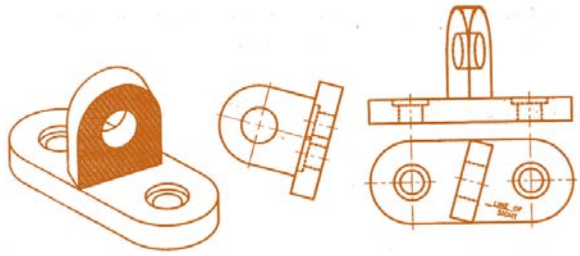
Inclined features on an object that are not parallel to any of the principal planes of projection always appear foreshortened and distorted in the regular views of the object. The true shape of such a surface is shown only when the line of sight is in a direction perpendicular to the plane of projection. In Fig.2.1, the shaded surface of the object is an inclined feature that does not appear in true size and shape in either of the front or right side views.



a) Pictorial representation b) Orthographic views

Fig. 2.1 Principal views of an object with inclined features

The true shape and relationship of such inclined features are shown by appropriate auxiliary views. Auxiliary views are aligned with the views from which they are projected, and this enables an observer to view objects orthographically from any desired position. The shaded surface in Fig.2.2 is shown in its true shape and size on the auxiliary plane; because in this view the line of sight is perpendicular to the inclined surface.



a)Pictorial representation   b) Orthographic views

Fig.2.2 Uses of auxiliary view

In general, auxiliary views are used for determining;

- the true length and inclinations of a line,
- the point view of a line and edge view of a plane,
- the true shape and size of a plane,
- the distance between two skew lines,
- the projections of solids,
- the true shapes of sections of solids,
- Curves of intersections, etc.

2.2 Overview of Orthographic Projection

The practical application of orthographic projection to the description of the geometry of three dimensional objects is very important. The geometry of relations between points, lines and planes is essential to the design of various products. On many occasions, different problems arise in technical drawing that may be solved easily by applying the basic principles of orthographic projection. Practical solid geometry or merely descriptive geometry deals with the representations of physical objects such as points, lines, planes and solid objects on various picture planes based on the principles of orthographic projection.

Before passing to those principles, it is worth noting to understand the following concepts clearly.

- *Reference Line (Folding or Hinge Line):* It is the line of intersection between two mutually perpendicular projection planes. Such lines are used as base lines from which all measurements of distances of points along the projectors are taken in relation to other projections. It is represented by a phantom line (a line pattern formed by a series of one long dash followed by two short dashes). It is named after the notation of the two intersecting perpendicular planes.
- *Horizontal-Projection (Top View):* It is a view of an object formed by an orthographic projection onto a horizontal projection plane. It is also called a plan or top view of the object. The projectors in horizontal projection are assumed to be vertical.
- *Elevation Views:* a view created on a picture plane placed perpendicular to the horizontal plane of projection. The picture plane is termed as elevation plane. The common types of elevation planes are the frontal and profile projection planes. Front and side views of an object are the *principal elevation views*. It is possible to have an infinite number of elevation views

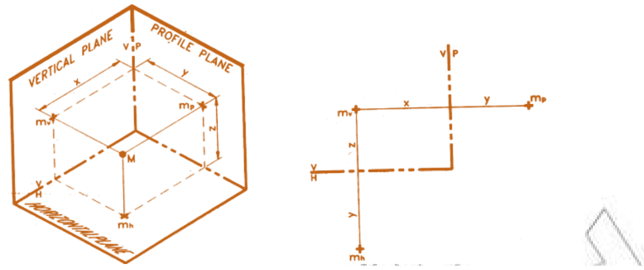
other than the common ones. Such views are referred to as *auxiliary elevation views.* In all elevation views, the horizontal projection plane is always projected as a line.

2.2.1 Projection of a Point in Space

- Imagine a point in a space or in a room. Can you define the location of the point with respect to the wall, ceiling or floor in the case of a room?

  What is the relation b/n line and point?

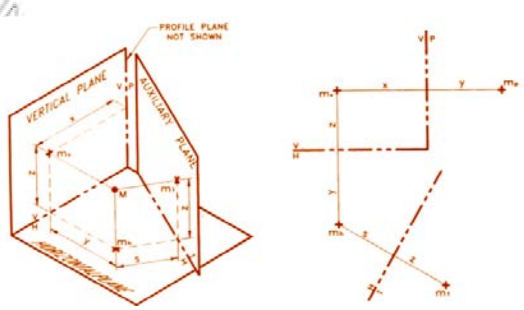
A point in space can be considered as physically real object and represented by a small dot or a small cross. Its location in space is usually identified by finding two or more projection of the point. Orthographic projections of a point on various planes are obtained by extending projectors perpendicular to the picture planes and transferring distance from one plane to another in reference to the folding lines. Figure 2.3 shows a pictorial and orthographic representation of a point M situated z units distance above the horizontal plane, x units distance to the left of the profile plane and y units distance in front of the vertical plane. The front view is labeled as m_v, the top view is labeled as m_h and the left side view is labeled as m_p. The subscripts v, h and p signify the vertical plane, horizontal plane and profile plane respectively.



b) Pictorial representation b) Orthographic views

Fig. 2.3 Principal projections of a point

When the horizontal and profile projection planes in Fig.2.3(a) are rotated about the reference lines V/H and V/P respectively until both are in line with the vertical plane, the orthographic views shown in Fig. 2. 3 (b) will be obtained. Notice that distance z from this reference line to the vertical projection of the point (m_v) is the height of the point in space above the horizontal projection plane. Likewise, the length y on the horizontal projection plane represents the distance of point M in space from the vertical plane and so on. Now, let us further project the same point M on an auxiliary elevation plane (1), which is s-units distance from the point. (See Fig 2.4)



a) Pictorial representation b) Orthographic views

Fig.2.4 Auxiliary projection of a point

As illustrated in Fig.2.4 the auxiliary projection of the point (m_1) is also located at z distance from reference line H/1. This is because both the auxiliary plane (1) and the vertical plane (V) are perpendicular to the horizontal plane. Thus, the elevation z of point M in space above the horizontal plane will be truly projected on all elevation planes, which are perpendicular to the horizontal plane. The distance z on the vertical plane can therefore be directly transferred with the help of a divider to the elevation plane (1) in order to locate the position of m_1 accurately.

Checkpoint 2.1

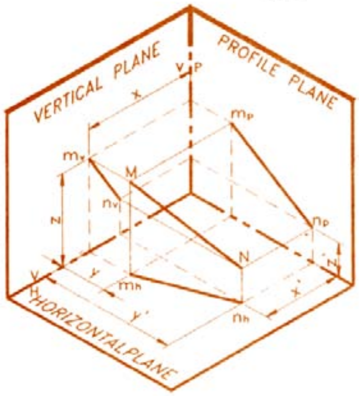
Three points R, S and T in space are located according to the distances specified in the following table.

Point	R	S	T
In front of V.P.	32	13	18
Above the H.P.	26	34	15
To the Left of P.P.	41	14	12

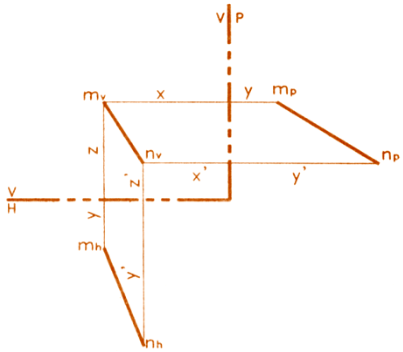
Draw the principal projections of the three points on the same set of planes.

2.2.2 Projection of a Line

The projection of a straight line can be obtained finding the projections of the end points of the line and joining the respective projections by straight lines. Fig 2.5 shows the principal projections of line *MN* in space. As shown in the figure, the distance y of point *M* in front of the vertical plane is shown on both the horizontal and profile projection planes. This is because both planes are common perpendicular to the vertical plane. The projections of point *N* are also located in a similar way, at a distance of y' from the reference lines.



(a) Pictorial representation



(b) Orthographic views

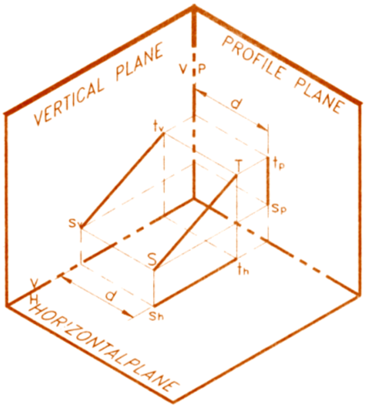
Fig. 2.5 principal projections of a line

Activity 2.1

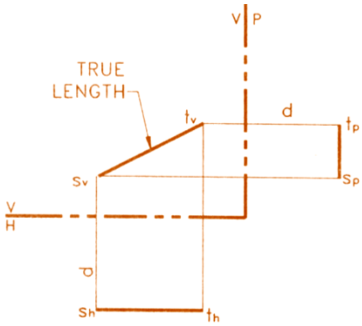
1. Sketch a line when it is
   - parallel to the vertical plane
   - Parallel to the profile plane
   - Parallel to the horizontal plane and observe their appearances in different projection planes.
2. Imagine a line inclined to the three principal planes and show it's projection on the three projection planes with the help of sketch.
3. How do you think you can find the true length of an inclined line to all the principal planes?

A. True Length Projection (Normal View) of a Line

A straight line will appear in true length when it is projected on to a plane of projection placed parallel to the line. Depending up on the picture plane with respect to which the line is parallel, straight lines are classified as: *front line, horizontal line*, and *profile line.*



(a) Pictorial representation

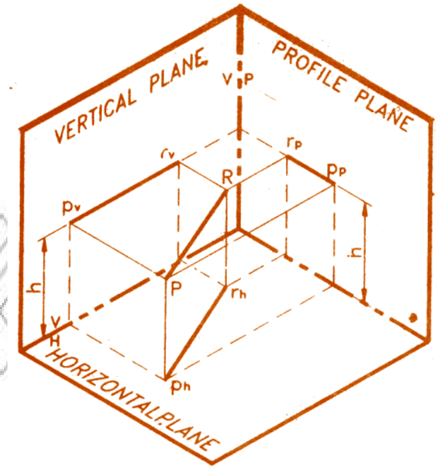


(b) Orthographic views

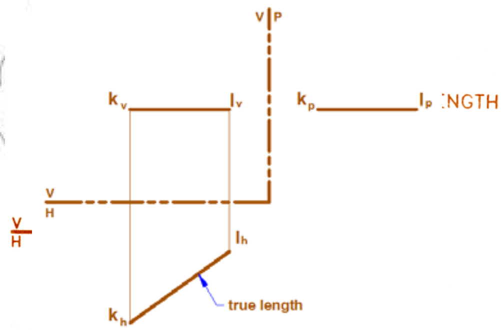
Fig. 2.6 Projections of a vertical line

(i) *Frontal Line:* A line parallel to the vertical plane of projection is termed as a frontal line. It appears in true length in the vertical picture plane. Line *ST* in Fig.2.6 is a frontal line because points *S* and *T* are located at the same distance d in front of the vertical plane. Note that the front view $s_v t_v$ of line *ST* is a true length projection.

(ii) *Horizontal Line:* A line parallel to the horizontal projection plane is called a horizontal line. It appears in true length in the horizontal plane of projection. Line PR shown in Fig.2.7 is a horizontal line with its end points located h distance above the horizontal plane.



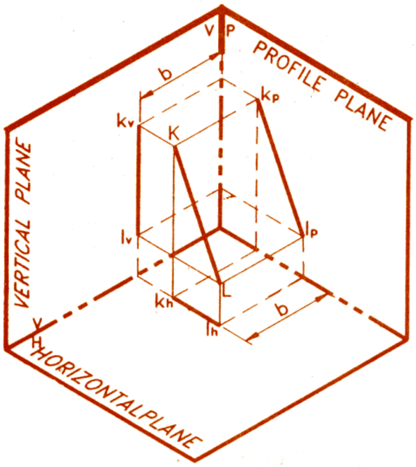
(a) Pictorial representation



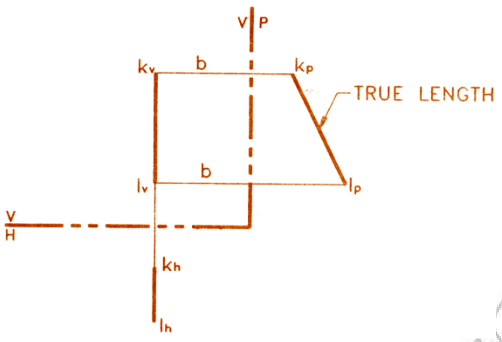
(a) Orthographic views

Fig. 2.7 Projections of a horizontal line

(iii) *Profile Line:* A line parallel to the profile plane of projection is known as a profile line. It appears in true length on the profile plane of projection. Fig.2.8 illustrates the principal projection of a profile line KL, located at b distance from the profile plane.



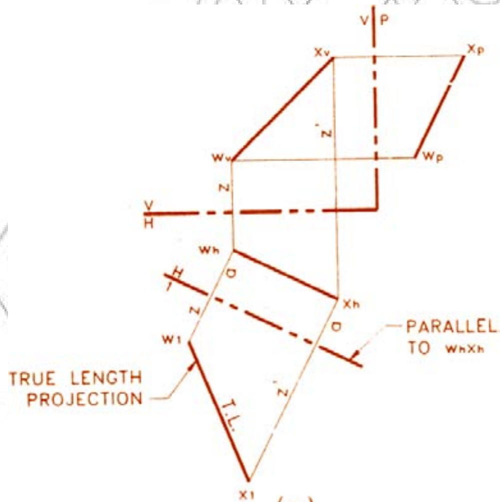
(a) Pictorial representation



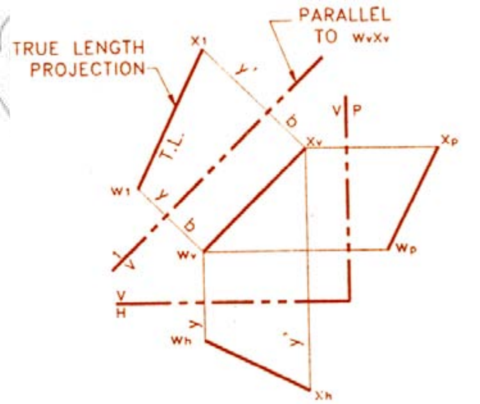
(b) Orthographic views

Fig. 2.8 Projections of a profile line

(iv) Oblique Line: A line inclined to all the three principal planes of projection is named as an oblique line. None of the three principal projections of this line appears in true length and non of the projections are parallel to anyone of the adjacent reference lines. Fig.2.9(a) shows the projection of an oblique line *WX*. To find the true length of this line, an auxiliary plane (1) parallel to the line and perpendicular to the, horizontal plane of projection is assumed. The position of this auxiliary plane on the horizontal plane of projection is shown by the reference line H/1, which is parallel to the top view w_h x_h of the line. Since both endpoints are at the same distance *a* from auxiliary plane (1), line WX is parallel to this plane in space and its projection onto the auxiliary plane is a true length projection.



(a)



(b)

Fig. 2.9 True length projection of an Oblique line

In general, the following steps can be employed to determine the true length of an oblique.

Step 1: **Draw the vertical and horizontal projection of the oblique line.**

Step 2: **Parallel to the top view of the line and at any convenient distance from the top view, draw a reference line(example: line H/1), which is the auxiliary view of the horizontal plane of projection.**

Step 3: **Through end points of the horizontal projection, draw projectors perpendicular to the reference line.**

Step 4: **On the projectors constructed in step-3, set off the respective height locations of the end points to determine auxiliary projections of the end points. These distances can be obtained from vertical projection of the oblique line.**

Step 5: **Connect, by straight lines, auxiliary projections of the end points. This line represents the oblique line in true length.**

Notice that it was not necessary to use an auxiliary plane perpendicular to the horizontal plane to find the true length of line WX in Fig.2.9. The auxiliary plane could also be either perpendicular to the vertical plane and parallel to the front view w_vx_v or perpendicular to the profile plane and parallel to the side view w_px_p of the line. Fig. 2.9(b) shows the use of an auxiliary plane (1) perpendicular to the vertical plane to find the true length of the same line. Here, the locations of w_1 and x_1 on auxiliary plane 1 can be transferred from either the horizontal plane or the profile plane since both are adjacent perpendicular planes to the vertical plane.

B. Bearing and Slope of a Line

1. Have you ever seen a traffic pole sign showing the degree of inclination on the road?
2. Can you define slope literally?
3. It is true that the sun rises in the east and sets in the north, but what is the direction flow of the sun? Is it towards the north or south that the sun travels to reach at the west?

The *bearing* of a line is the angle the horizontal projection of a line makes with respect to the points of the compass. It is given in degrees (0 to 90^0) measured from either north (N) or south (S) direction. The baring reading indicates the quadrant in which the line is located on the horizontal projection. The north line is usually assumed to be vertical unless a different direction is specified. For line AB shown in Fig.2.10, the bearing is given to be Nβ^0E.

Notice that in bearing representation, the North or South direction should be indicated first, the angle between the N-S line and the horizontal projection of the line is then specified next and finally its direction from the reference endpoint toward east or west is mentioned.

Slope of a line is the angle the line makes with the horizontal projection plane. It is seen in a view where the line appears in its true length and the horizontal plane at the same time appears as an edge view. Therefore, true slope of a line is measured from an elevation plane(1) that contains the true length projection of a line. It should be recalled that an elevation plane is any plane that is perpendicular to the horizontal projection plane. Slope of the oblique line AB in fig.2.11 is α^0 up from A or simply α^0 clockwise. This is because point A is more closer to the horizontal plane than point B.

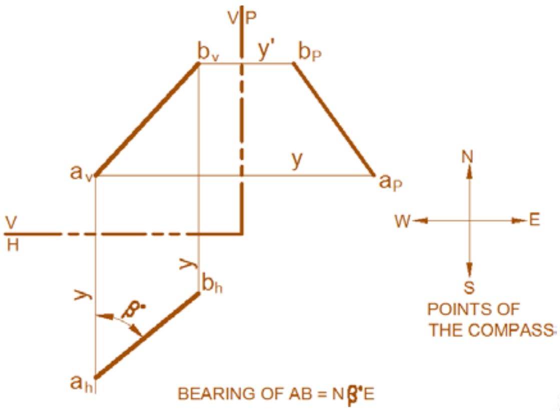


Fig. 2.10 Bearing of a line

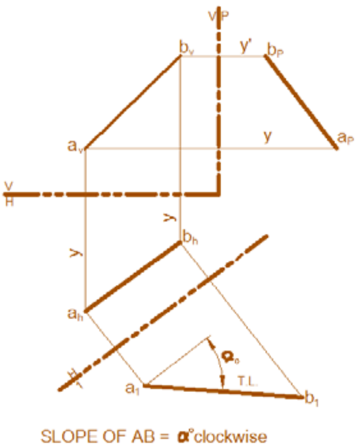


Fig. 2.11 Slope of a line

C. Point Projection (End View) of a Line

1. Can you imagine a line appearing as a point?
2. Hold your pen or pencil and consider it as a line. Then try to coincide the starting and ending point of the line (pen or pencil) from your point of view. Try to see it as a point.

A line can be projected as a point on a projection plane that is perpendicular to the line. When the true length of a line appears on one of the principal planes of projection, only one auxiliary plane perpendicular to the true length of projection is needed to show the lines as a point. However, in the case of an oblique line a secondary auxiliary plane(2) which is perpendicular to the true length view is required. Therefore, a point view of a line always comes after a true length view. Fig. 2.12 shows the point projection of an oblique line AB.

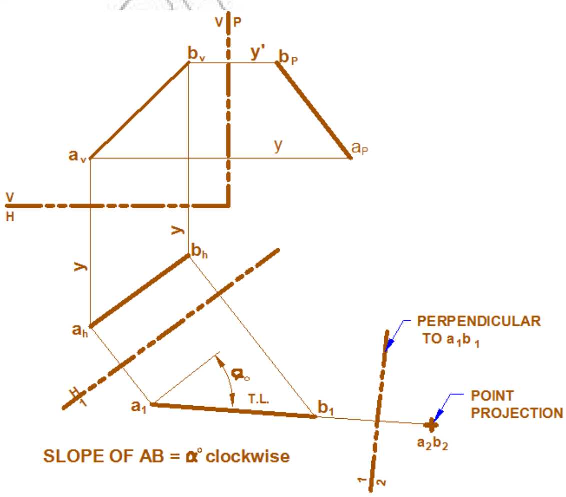
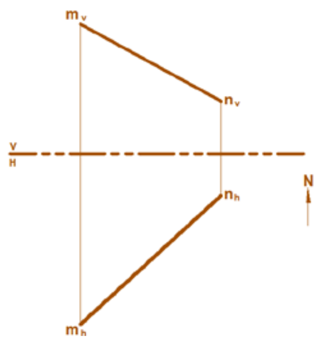


Fig. 2.12 Point projection of a line

Checkpoint 2.2

The vertical and horizontal projection of line MN in space are as shown in the Figure. Trace the given views onto your drawing paper and find:

- **A. The bearing and true slope of line MN.**
- **B. True length projection of the line, and**
- **C. The point projection of the line.**



2.2.3. Projection of a plane

1. List down the types of planes you know.
2. Can you define a plane in terms of line?

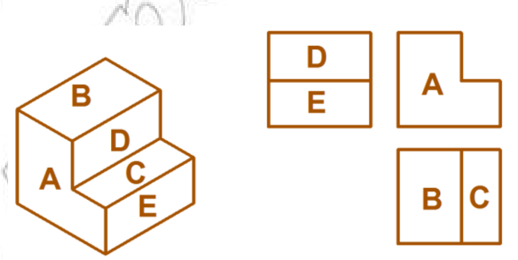
Theoretically, a plane is considered to be a flat surface with unlimited extent. However, for graphical purposes, planes are bounded with straight line segments. Basically, there are four ways by which planes can be formed or represented:

- i) By two intersecting lines in space,
- ii) By two parallel lines in space,
- iii) By any three non collinear points in space, and
- iv) By a line and a point not on the line.

A. Types of plane surfaces:

Plane surfaces may occur in any of the following three positions:

(i) ***Principal Plane:*** is a plane surface that is parallel to either of the principal planes of projection, and thus its projection on a plane to which it is parallel will be a normal view. A principal plane parallel to the vertical projection plane is referred as a *vertical plane*. Similarly, a principal plane parallel to the horizontal projection plane is a *horizontal plane* and a plane aligned with the profile projection plane is a *profile pane*. In Fig. 2.13, surface A is a vertical plane, B and C are horizontal planes and surfaces D and E are profile planes.



(a) PICTORIAL DRAWING (b) ORTHOGRAPHIC VIEWS

Fig.2.13 Principle surface of an object

(ii) ***Inclined Plane:*** It is a surface that is inclined to two of the principal planes but perpendicular to the third principal projection plane. For the object shown in Fig.2.14, the shaded surface F is an inclined plane while all other surfaces are principal planes.

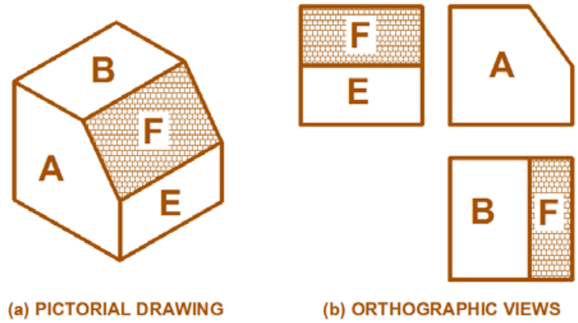


Fig. 2. 14 Inclined surface of an object

(iii) Oblique or Skew Plane: It is a plane surface that is inclined to all the three principal planes of projection. The shaded surface G in fig. 2.15 represents an oblique surface.

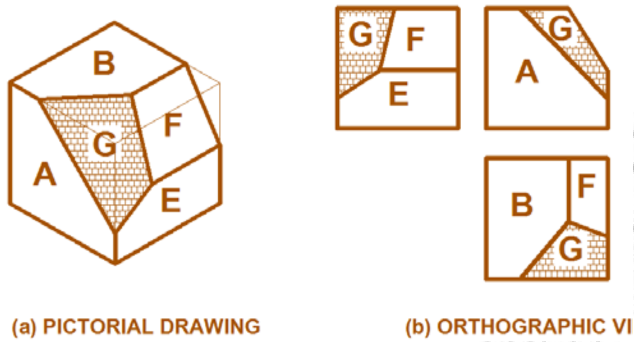
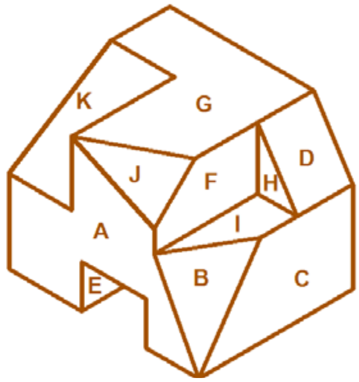


Fig. 2. 15 Oblique surface of an object

Checkpoint 2.3

The object shown in the Figure contains different types of plane surfaces. Identify the type for each labeled surface as vertical, horizontal, profile, inclined or oblique planes.



B. Principal Projections of a Plane

Views of a plane in space can be obtained by projecting the vertices of the plane on various projection planes. Fig. 2.16 shows the principal projections of an oblique plan ABC in space.

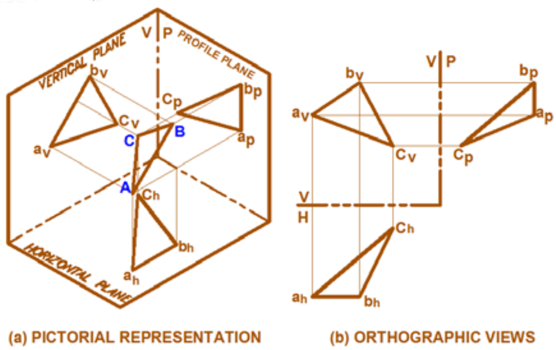


Fig. 2.16 Principal projections of a plan

C. Edge View of a Plane

Can you imagine a plane appearing as an edge or a line?

Hold a paper or one of your set square and try to coincide the edges of the plane (paper or set square) on a single line from your point of view. Did you visualize it as an edge? Any plane in space can be projected at most as a true shape or at least as edge view. When a plane is vertical, its edge view will be seen from above on the top view. If it is a horizontal plane, it will appear as an edge on all elevation views including the vertical and profile planes. However, if the plane is inclined or oblique to the principal planes, it should be projected on an auxiliary plane that is perpendicular to any one line on the plane.

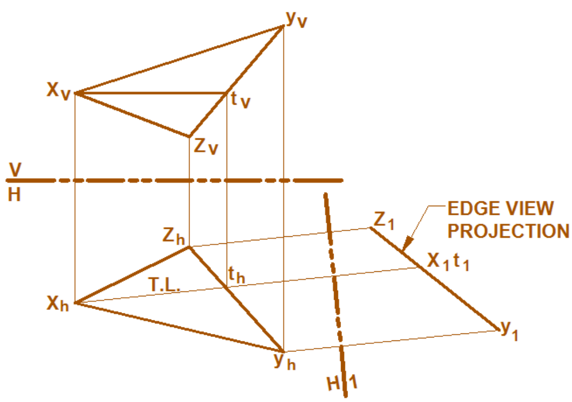


Fig. 2.17 Edge view of an oblique plane

To simplify the steps required to find the edge view, the arbitrary line that falls on the plane can deliberately be selected as a horizontal line. Thus, the projection of this line on the vertical plane (front view) is parallel to reference line V/H and its top view will be a true length projection. For the oblique plane XYZ shown in Fig. 2.17, line XT is a horizontal line. The auxiliary elevation plane (1) perpendicular to $x_h t_h$ is thus a projection plane perpendicular to plane XYZ and gives its edge view. In general, the steps to be followed to obtain the edge view of an oblique plane XYZ in space from two given principal views are as follows:

i. Construct the projection of a horizontal line XT that falls on the given plane, the front view of this $x_v t_v$ should be parallel to reference line V/H.

ii. Project line XT on the horizontal plane. Its top view $x_h t_h$ is a true length projection.

iii. Setup an auxiliary plane (1) perpe-ndicular to $x_h t_h$

iv. Project points X, Y and Z onto auxiliary plane (1). The projection $x_1y_1z_1$ will be a straight line, representing the edge view of plane XYZ.

D) Normal (True Shape) View of Plane

Normal view of a given plane in space is the view that gives the actual size and shape of the plane. To find the true size and shape projection of an oblique plane, it is necessary to setup an auxiliary plane parallel to the given plane. General procedures used to find the true shape projection of plane are the following: (Ref. Fig. 2.18)

(i) First, find the edge view of the given plane.

(ii) Setup an auxiliary projection plane (2) parallel to the edge view of the given plane.

(iii) Project the edge view of the plane onto the parallel projection plane (2). Since all edges of the plane are at equal distance from plane (2), every side of the plane will be projected in true length and in effect the plane is shown in its true size and shape.

In Fig. 2.18, the vertical and horizontal projections of an oblique plane KLM are given. The true shape projection of the plane is then shown on auxiliary plane (2).

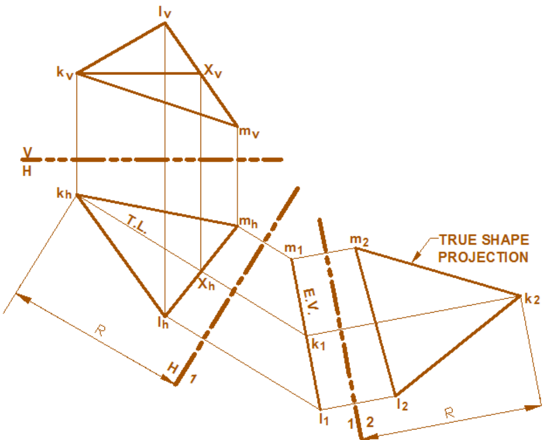
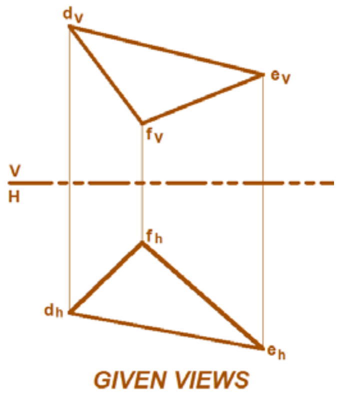


Fig. 2.18 Normal view of an oblique plane

Checkpoint 2.4

Vertical and horizontal projections of planes DEF in space are shown in the figure below. Trace these views on to your drawing paper to full scale and find the true shape projection of the plane.



2.3 Auxiliary Projection of Objects

2.3.1 Auxiliary Plane

How do you think is possible to project the true shape of an inclined plane found on an object?

Relate the principal planes and auxiliary plane, specially their orientation with respect to the basic principal planes. Look at the Fig.2.19 that shows an object projected onto all six of the major orthographic planes. As you can see, every side of the object in the diagram is parallel to one of the six planes. Because of this, the shape that is projected onto each plane is the same as the actual shape of the side of the object. For example, the L-shape projected onto the vertical plane (VP) mirrors exactly the shape of that side of the object. Whenever this is the case, we say that the orthographic drawing shows the *true shape* of the object.

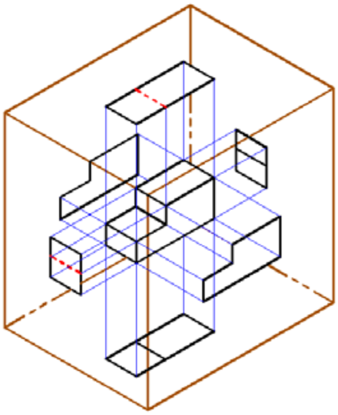


Fig. 2.19 The six principal projection of an object

Similarly, going back to the same diagram, you can see that the lengths of the lines projected to the orthographic planes are the same lengths that are found on the original object. When this is the case, we say that the orthographic drawing shows *true lengths*. Again, we get true lengths when the sides of the object are parallel to the orthographic planes.

However, there are many objects containing sides that are not parallel to the orthographic planes. Here are some examples as shown in Fig.2.20:

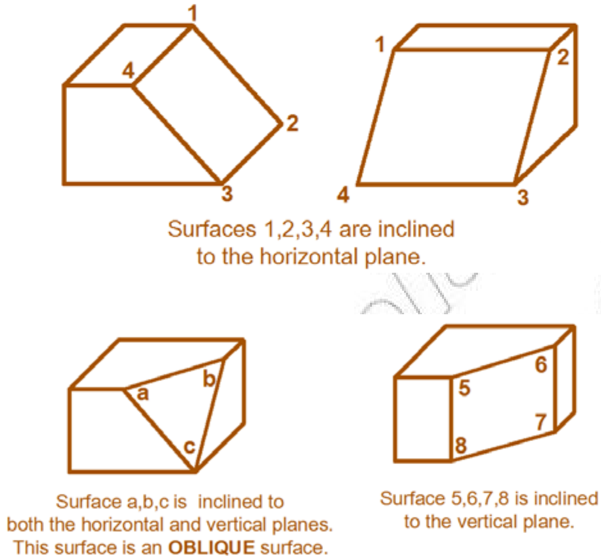


Fig. 2.20 An Object With Inclined And Oblique Surface

When we draw orthographic projections of these and similar objects, we can end up with shapes and lengths that are not the true ones (typically they are shorter). In the remainder of this unit, we'll focus on the technique for getting around this problem. This technique involves drawing what are known as auxiliary views to get at true shapes and lengths onto auxiliary projection plane parallel to the inclined or oblique surfaces.

The method of projecting the image of an object to an auxiliary plane is identical to the method used for projecting an image to one of the principal planes; that is, the projectors are parallel and the observer is positioned at an infinite distance away from the object.

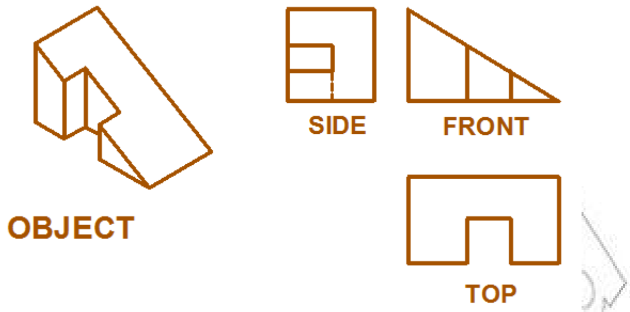
2.3.2 Construction of Auxiliary Views

As we have just learned, there are times when we cannot completely describe an object using the six major planes. This is especially true when the object or part of it is inclined or at an oblique angle to the major planes. In this case, we create a special orthographic view called an auxiliary view.

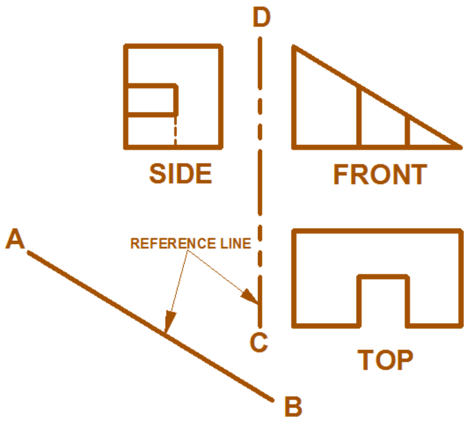
In this section, you'll learn how to create auxiliary views. Auxiliary views are very useful when you want to make certain details clearer or you want to show the true shape of surfaces which are not perpendicular or parallel to the major planes.

However, it is possible to add an auxiliary view to a drawing of even a simple object. Let's follow the steps mentioned in table below, just to learn how to draw auxiliary views.

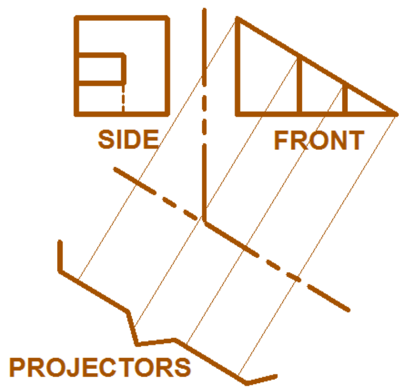
Step	Action
1	Draw two adjacent principal views, one of which must show the inclined surface as an edge.
2	Light draw a reference line (AB) parallel to the edge of the inclined plane.
3	Light draw a reference line (CD) between the two principal views. Use AB and CD to locate points in the auxiliary view.
4	Draw projectors from the inclined edge rotating reference line AB parallel with the inclined surface. These projectors are perpendicular to the inclined edge and the reference line as shown in Fig2.21.
5	Using a compass or dividers, transfer distances from reference line CD to the various points in the side view.
6	Darken all object outlines of the primary view and erase all projectors and reference lines. The completed primary auxiliary view shows the true shape of the inclined surface.



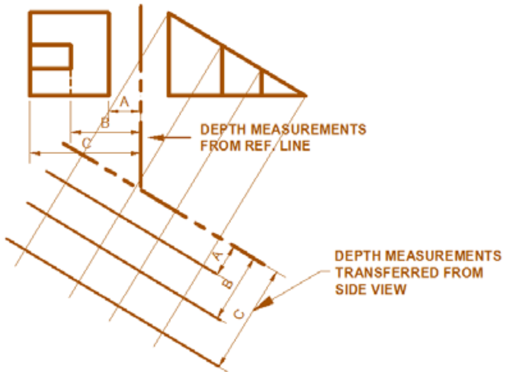
STEP 1



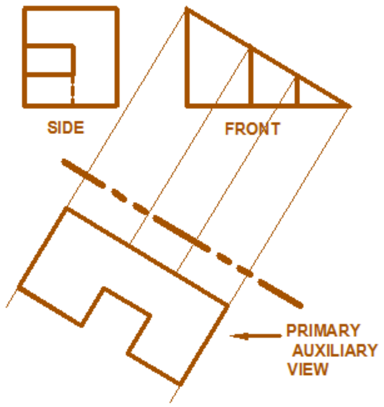
STEP 2 & 3



STEP 4



STEP 5



STEP 6

Fig 2.21 Drawing an auxiliary view.

Activity 2.2

1. How many auxiliary planes did you use to find the point view of a line or edge view of a plane?
2. Name them in your own convention of naming.

2.4 Types of Auxiliary Views

Auxiliary views are classified according to the position of planes in relation to the principal planes.

2.4.1 Primary Auxiliary Views

When an auxiliary plane is inclined to four of the six major planes of projection and is square with the other two, the view we obtain is called a primary auxiliary view. So far in this unit, all of the auxiliary views we've seen are primary auxiliary views.

Naturally an auxiliary plane will be making angles with two principal planes which will be different from 90^0 but it will still make 90^0 with the third. The auxiliary view is named after the view on the third plane; so there are three types of primary auxiliary views:

i. front,
ii. top and
iii. side auxiliary view.

The drawings below show examples of these three primary auxiliary views, given an object with an inclined face.

i. *Front Auxiliary*

Fig 2.22 shows that when we start our projection from the front, we get an auxiliary elevation. We started our projection from the front because the front contains the edge view of the inclined face. An edge view shows true length.

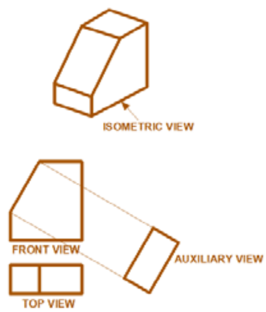


Fig. 2.22 Front Auxiliary View

ii. Top Auxiliary

In fig. 2.23 the edge view of the inclined face is shown on the top view. So we start our projection from the top and get top auxiliary view.

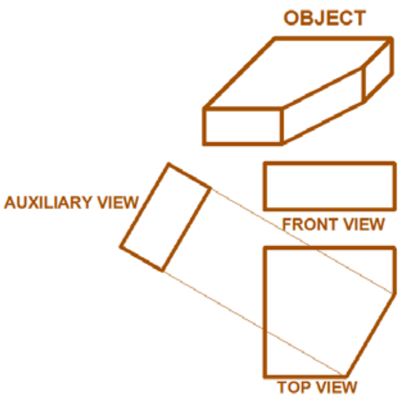


Fig. 2.23 Top Auxiliary View

iii. Side Auxiliary

In the fig 2.24, the edge view of the inclined face is shown on the right side view. So we start our projections from this view.

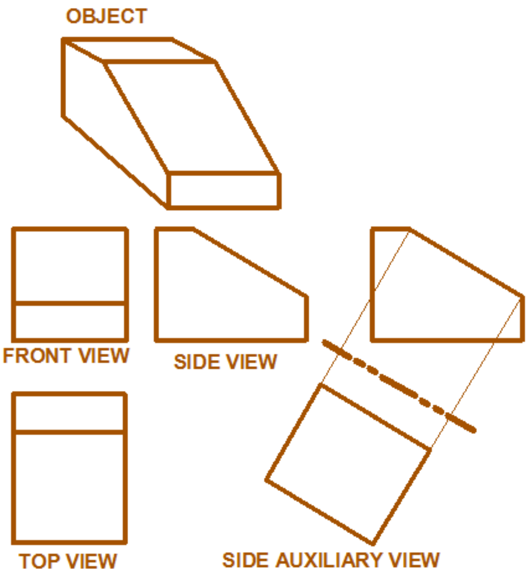
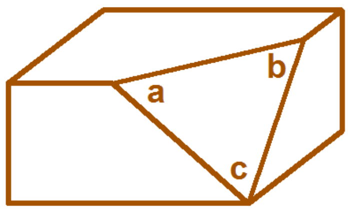


Fig. 2.24 The Side Auxiliary View

2.4.2 Secondary Auxiliary View

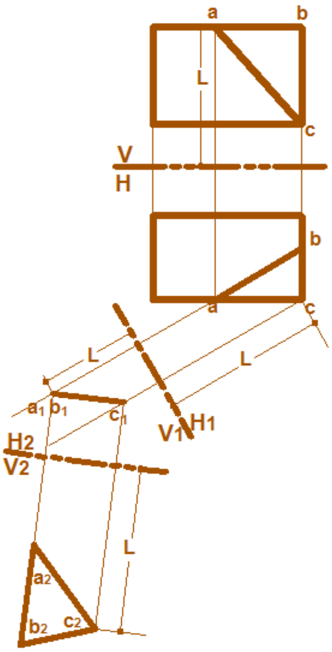
Sometimes an object has a face inclined to all six major orthographic planes. When this is so, we must first draw a primary auxiliary view to obtain an edge view of the inclined face, and then a secondary auxiliary view to show its true shape. In such a drawing, the primary auxiliary view, or edge view, also provides the surface's true angle of inclination to the horizontal or vertical plane. (That is, from an edge view you can measure these angles). Following are an example that utilise edge and secondary auxiliary views.

Example: Given the object below, draw an orthographic projection that shows the true shape of surface abc.



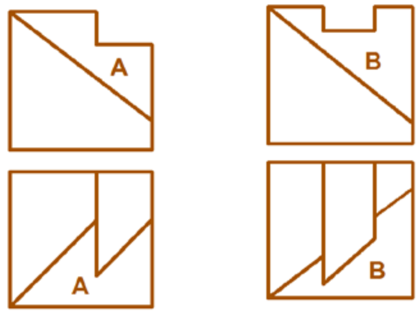
1. Draw the top and front view of the object
2. Begin drawing the edge view of the oblique surface: project construction lines from the top view and draw a V1/H1 reference line.
3. Complete the edge view: with a compass, transfer points a, b and c from the top view to the auxiliary view. The straight line that results is the edge view of surface abc.

4. Draw the secondary auxiliary view: project perpendicular construction lines from the edge view and draw a reference line V2/H2 at a convenient position. Then transfer points from the plan to the new plan by taking measurements from the V1/H1 line and marking the equivalent distance from the V2/H2 line. The new plan is a partial secondary auxiliary view that shows the true shape of surface abc.



Checkpoint 2.5

The leveled planes shown in the views given by the figure below represents oblique surfaces on the respective objects. Find the secondary auxiliary views of these surfaces



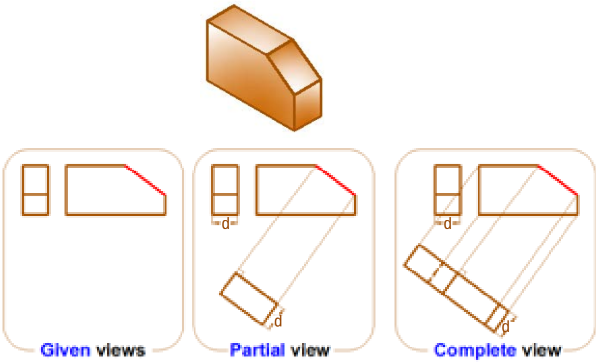
2.4.3 Other Features in Auxiliary

Partial and Complete Auxiliary Views

As mentioned previously, one of the major purposes of an auxiliary view is to show the true shape of a surface that is not parallel or perpendicular to the major planes. However, in some cases a complete auxiliary view is a distorted view of an object, making it of little value. In such cases, we use what is called a partial auxiliary view.

A partial auxiliary view is just what it sounds like: an auxiliary view of part of an object. For example, we often use a partial auxiliary view to show an irregular inclined face of a component. If we used a complete auxiliary view of such a component, the part of the view other than the inclined face would be distorted. In general, we use partial auxiliary views to show true shapes of inclined and oblique surfaces.

For example, in Fig.2.25 (a) is a drawing of an object showing two of the major orthographic planes.



(a) (b) (c)

Fig. 2.25 Partial and complete view of an object

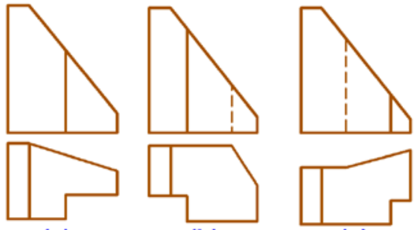
However, none of the two views shows the true shape of surface ABCD. (This is true of the other three orthographic views as well). The problem is that surface ABCD is inclined to a major orthographic plane.

Instead, to see the true shape of surface ABCD, we must draw an auxiliary view. We'll draw this view by positioning ourselves in such a way that we look at the surface directly from its front (this is our line of site). This auxiliary view is shown Fig.2.25 (b).

Notice that the above auxiliary view only shows the surface ABCD and not the whole view. This makes it a partial auxiliary view. If we drew the whole object, the rest would be distorted as shown in Fig.2.25 (c).

Checkpoint 2.6

For the objects shown in figure below, make the partial and complete auxiliary view of the inclined surface.



(a) (b) (c)

Circular Features in Auxiliary Views

Circular features in auxiliary projection appear elliptical, not circular. The most com monly used method to draw the true shape of the curved surface is the plotting of a series of points on the line. The more points are plotted on the line, the accuracy of the curve or circular feature is better. The easiest way to explain this method of auxiliary projection is the projection of a truncated cylinder. This shape seen in the auxiliary projection is an ellipse, as shown in Fig.2.26.

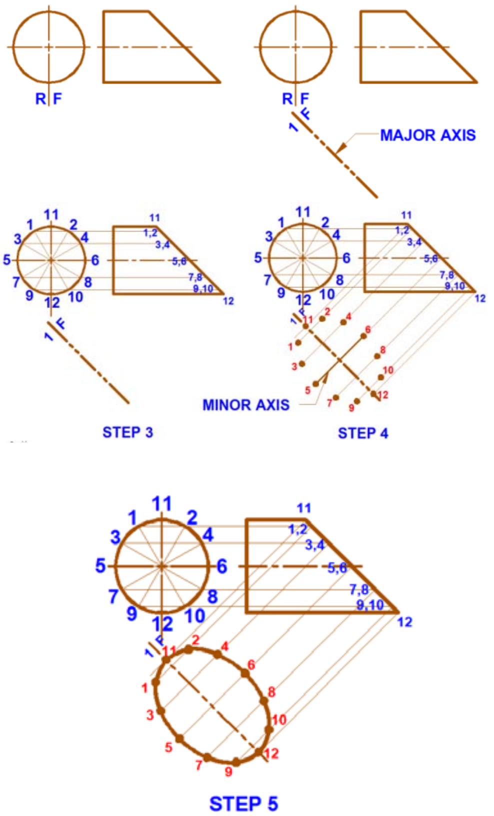


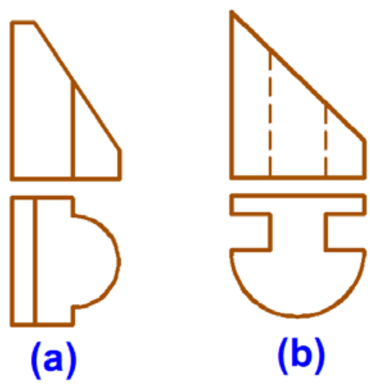
Fig. 2. 26 Projection of circular features in auxiliary view

The approach to projection of a circular shape is explained below.

1. Draw the front and side view of the turnicated cylinder.
2. Center line (F/1) of the auxiliary view is drawn parallel to the edge line.
3. The parameter of the circle in the side view needs to be divided into equal slices or equally spaced points. Our example is divided in 12 equally spaced points, 30° apart. The circumference of the circle (360°) is divided in 12 equal spaces, 360°/12=30°. These points are then projected to the edge line on the front view.
4. Then these points are a projected at right angles toward and past the center line of the auxiliary view. And the widths between the center line and individual points taken from the side view are transferred to the auxiliary view.
5. When all the widths have been transferred from the front view to the auxiliary view, the resulting points of intersection are connected to give the preferred elliptical shape.

Checkpoint 2.7

The object represented in figure below, have circular features on their inclined surfaces. Find the partial auxiliary views of the objects on projection plane parallel to the inclined surface.



Half Auxiliary View

Complete view representations of symmetrical objects are not usually recommended in practical drawings. That, if a principal or auxiliary view of an object is symmetrical about a given line, only a half view representation may be drawn to save both space requirement and essential drafting time. In Fig. 2.27, half view representations of the top and partial auxiliary views of a bended pipe flange are used to accurately describe its shape and size.

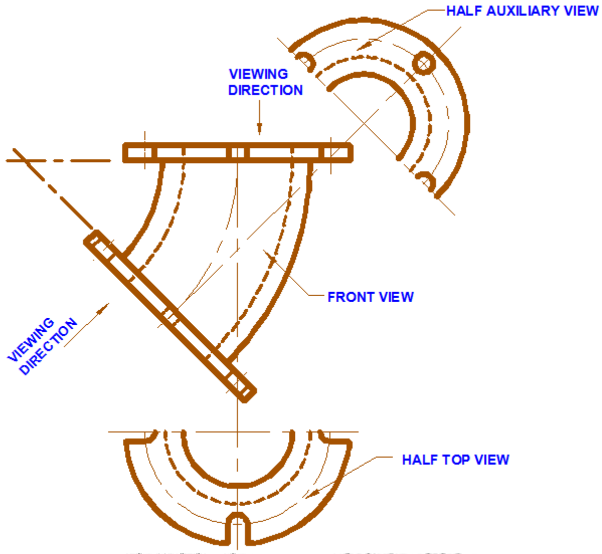


Fig. 2.27 Half view representation of a symmetrical object

Key terms

- ***Principal planes:*** surfaces those are horizontal and vertical.
- ***Reference line:*** a line from which angular or linear measurements are reckoned. Also known as datum line.
- ***True length:*** The actual length of any given line or surface. Sometimes the true shapes of surfaces on a 3D object are not obvious on a 2D drawing.

Unit Summary

When a surface of an object is not parallel to one of the three principal views, an auxiliary view may be used to obtain the true size of the surface. An auxiliary view is usually only a partial view showing the desired features.

An auxiliary view should be positioned close to the principal view so that both views can be read together. A centre line represents the axis of symmetry. Projectors are usually drawn at 90 degrees to the inclined surface. Measurements from one view are projected across to the auxiliary view. Auxiliary views may be projected from any of the three principle views.

A primary auxiliary view is projected onto a plane that is perpendicular to one of the principal planes of projection and is inclined to the other two. A secondary auxiliary view is projected from a primary auxiliary view into a plane that is inclined to all three principal projection planes.

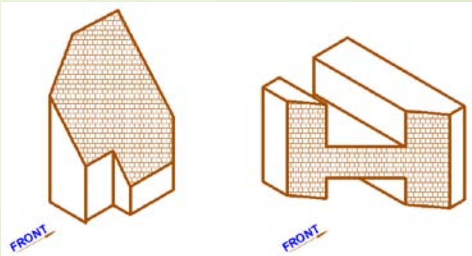
Generally, auxiliary views are used to show the true shape or true angle of features that appear distorted in the regular views. Basically, auxiliary views have the following four uses:

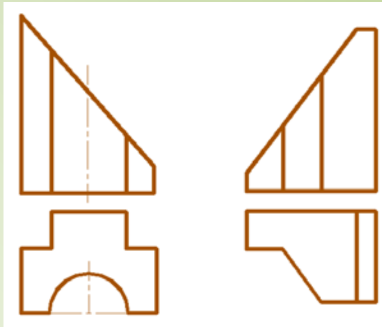
- True length of line
- Point view of line
- Edge view of plane
- True size of plane

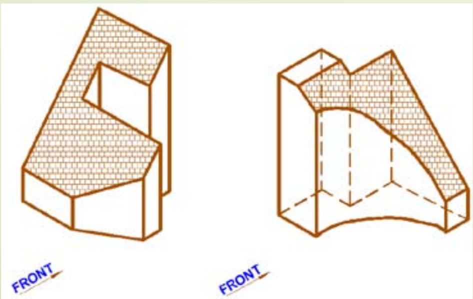
To draw an auxiliary view of a curved surface a number of random points on the curve in one of the principle views must be taken. These data points can then be projected into the auxiliary view. Sometimes it is required to draw an auxiliary view first from one principal view before being able to obtain another complete principle view. Auxiliary views are also used to find the lines of intersection of surfaces.

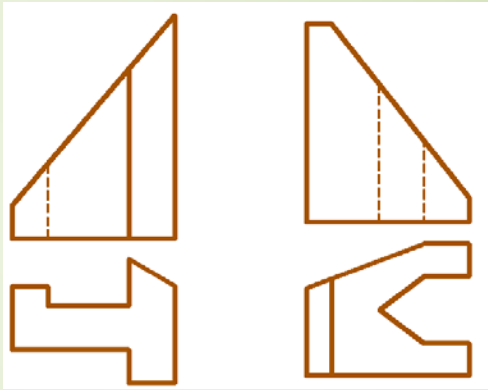
Exercise

EXERCISE I. Draw the principal and partial auxiliary views

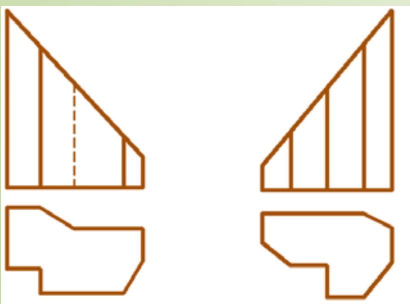




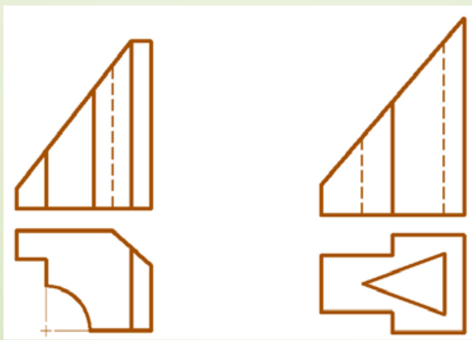




EXERCISE II: Draw partial auxiliary

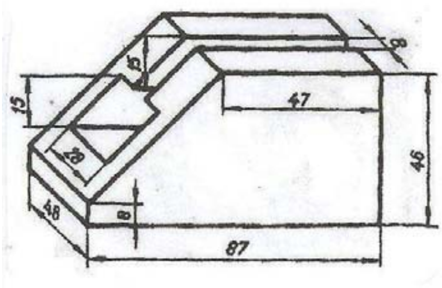


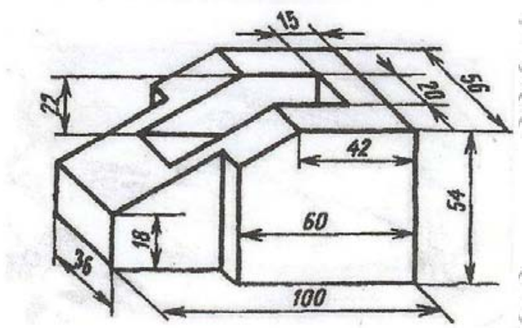
EXERCISE III: Draw complete auxiliary



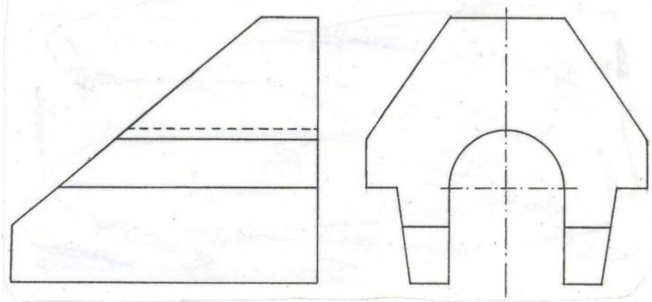
Project:

I. Draw the principal views and the partial auxiliary view of the inclined surface of the given objects.

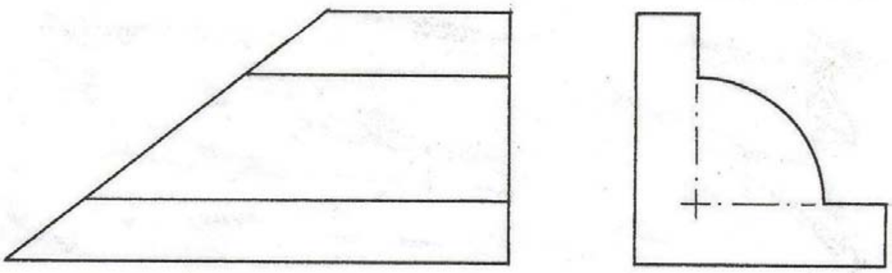




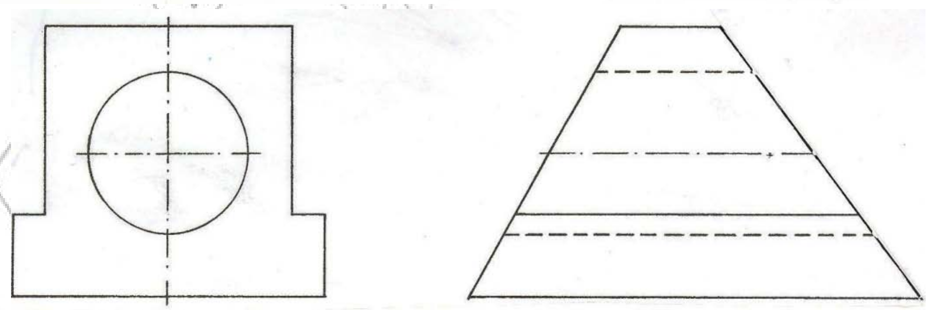
II. Draw partial and complete primary auxiliary views of the object shown below. Transfer the dimension from the given views.



1.



2.



3.