Projection of Planes
Lecture - 5

Slides by Prof. Salil S. Kulkarni

Motivation

- The surfaces of many 3D objects can be represented by planes

Typical Problems

- To find the true shape of a plane given its principal views
- To find the angle of inclinations of the plane with the principal planes given its principal views
- To draw the principal views of a plane given its true shape and orientation

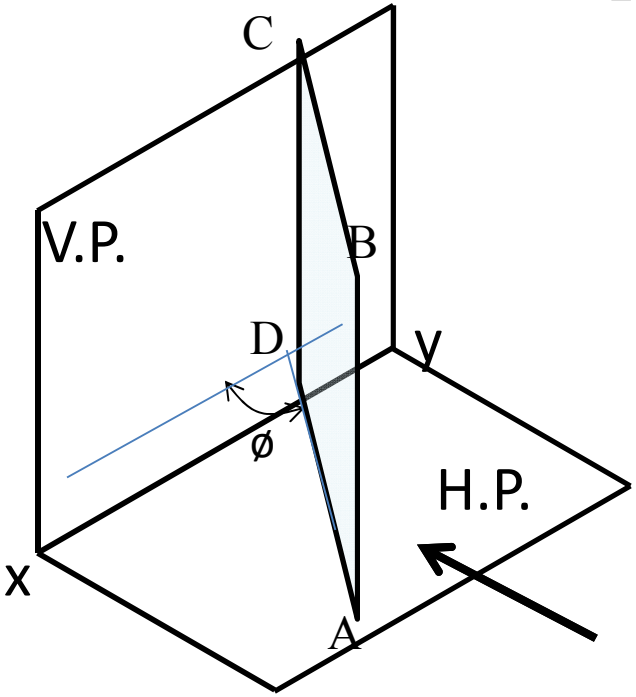
Types of Planes

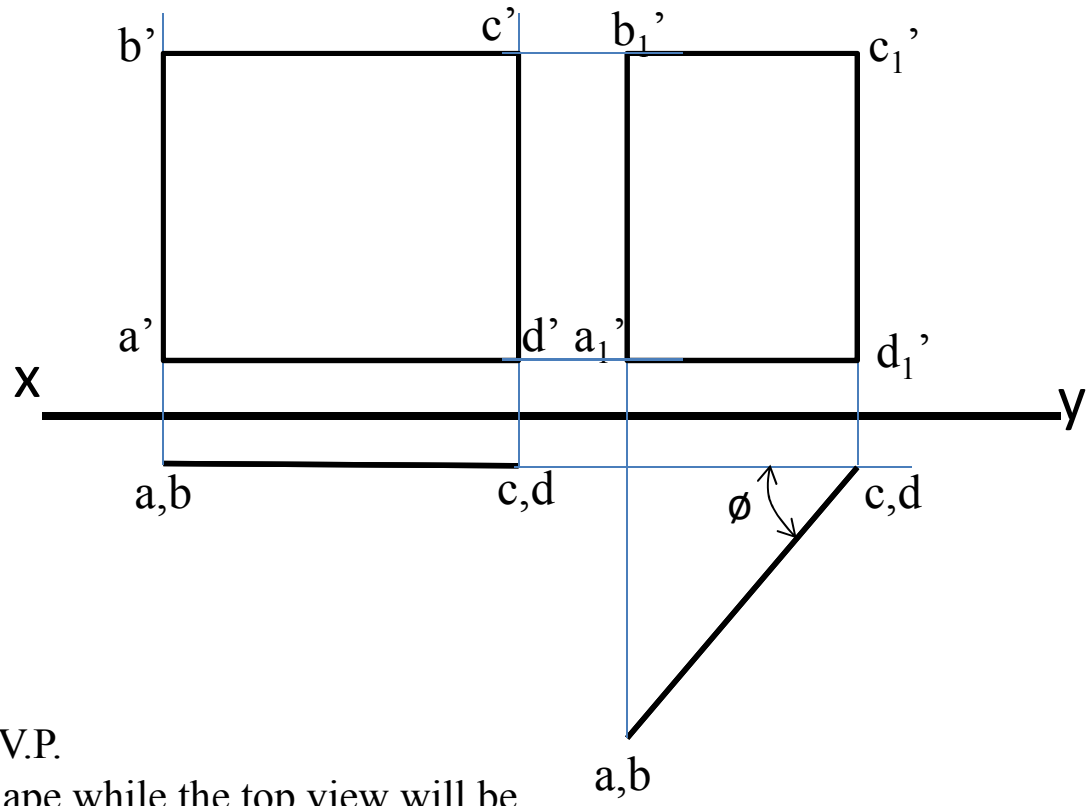
Depending on its orientation with respect to the reference planes, a plane can be classified as

- Perpendicular plane
  - Perpendicular to both the reference planes (profile plane)
  - Perpendicular to one and parallel to the other
    - Perpendicular to H.P. and parallel to V.P.
    - Perpendicular to V.P. and parallel to H.P.
  - Perpendicular to one and inclined to the other
    - Perpendicular to H.P. and inclined to V.P.
    - Perpendicular to V.P. and inclined to H.P.

- Oblique plane
  - Inclined to both the reference planes

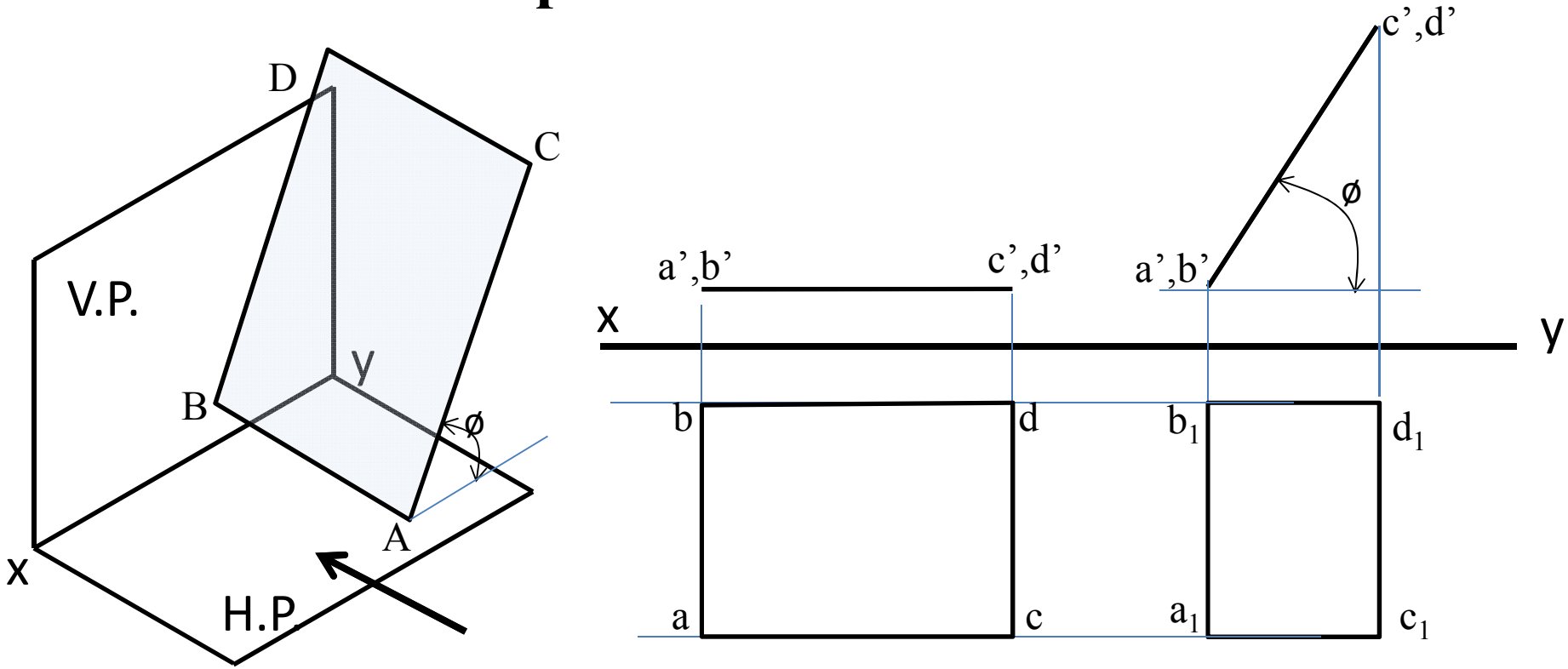
Projection of a Plane Inclined to the V.P. and Perpendicular to the H.P.





-Assume the plane to be parallel to the V.P.
-The front view will be show its true shape while the top view will be a line parallel to the xy line
-The plane is tilted so that it is inclined to the V.P. at the given angle
-The new top view will be inclined to the xy axis at the true inclination
-In the front view the corners of the plane will move parallel to the xy axis

Projection of a Plane Inclined to the H.P. and Perpendicular to the V.P.



-Assume the plane to be parallel to the H.P.
-The top view will be show its true shape while the front view will be a line parallel to the xy line
-The plane is tilted so that it is inclined to the H.P. at the given angle
-The new front view will be inclined to the xy axis at the true inclination
-In the top view the corners of the plane will move parallel to the xy axis

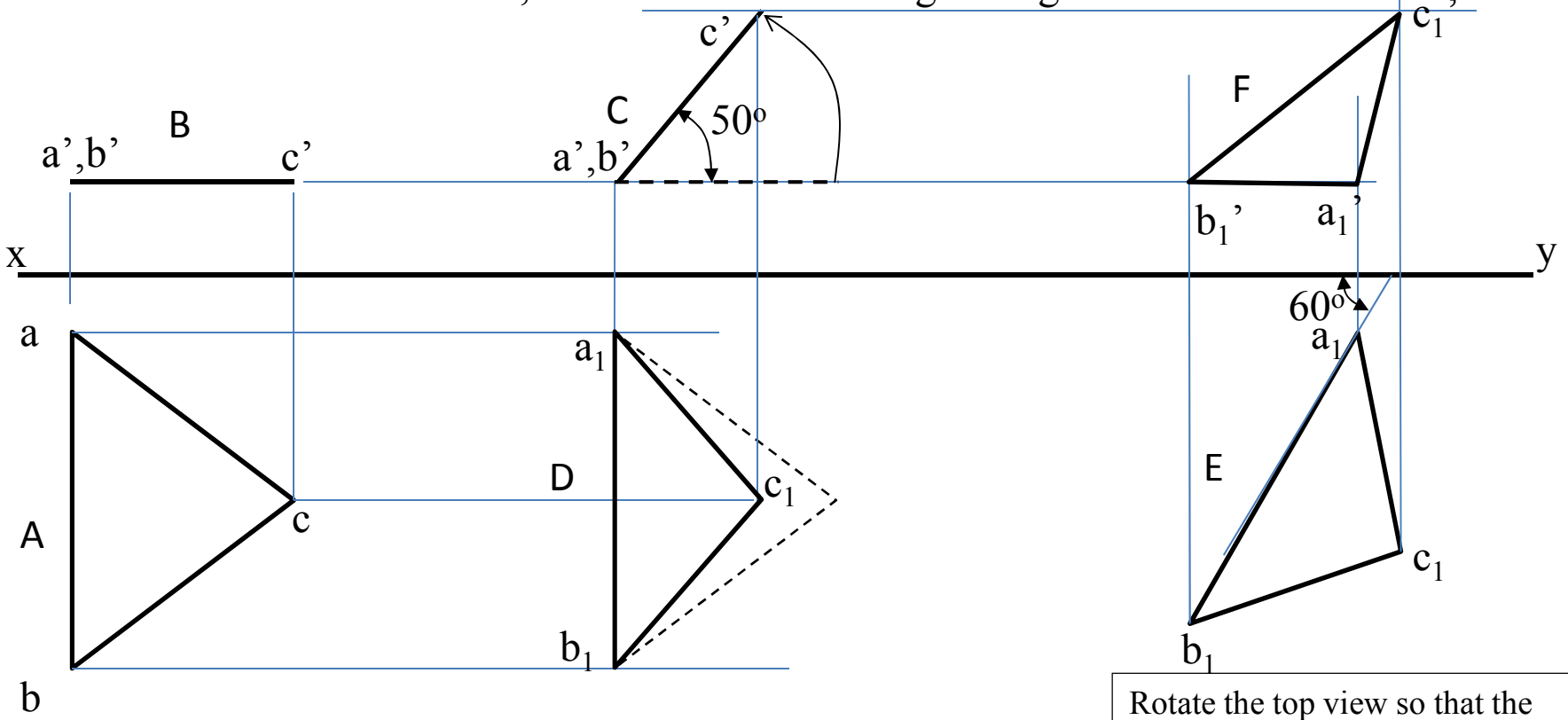
Summary: Projection of a plane inclined to one reference plane and perpendicular to the other reference plane

1. Assume the plane parallel to that reference plane to which it is to be made inclined

2. Tilt the plane to the required inclination

Projection of Oblique Planes

Problem: Draw projections of an isosceles triangle ABC with side AB (base) parallel to the H.P. and inclined at 60° to the V.P., and the surface making an angle of 50° with the H.P. ,



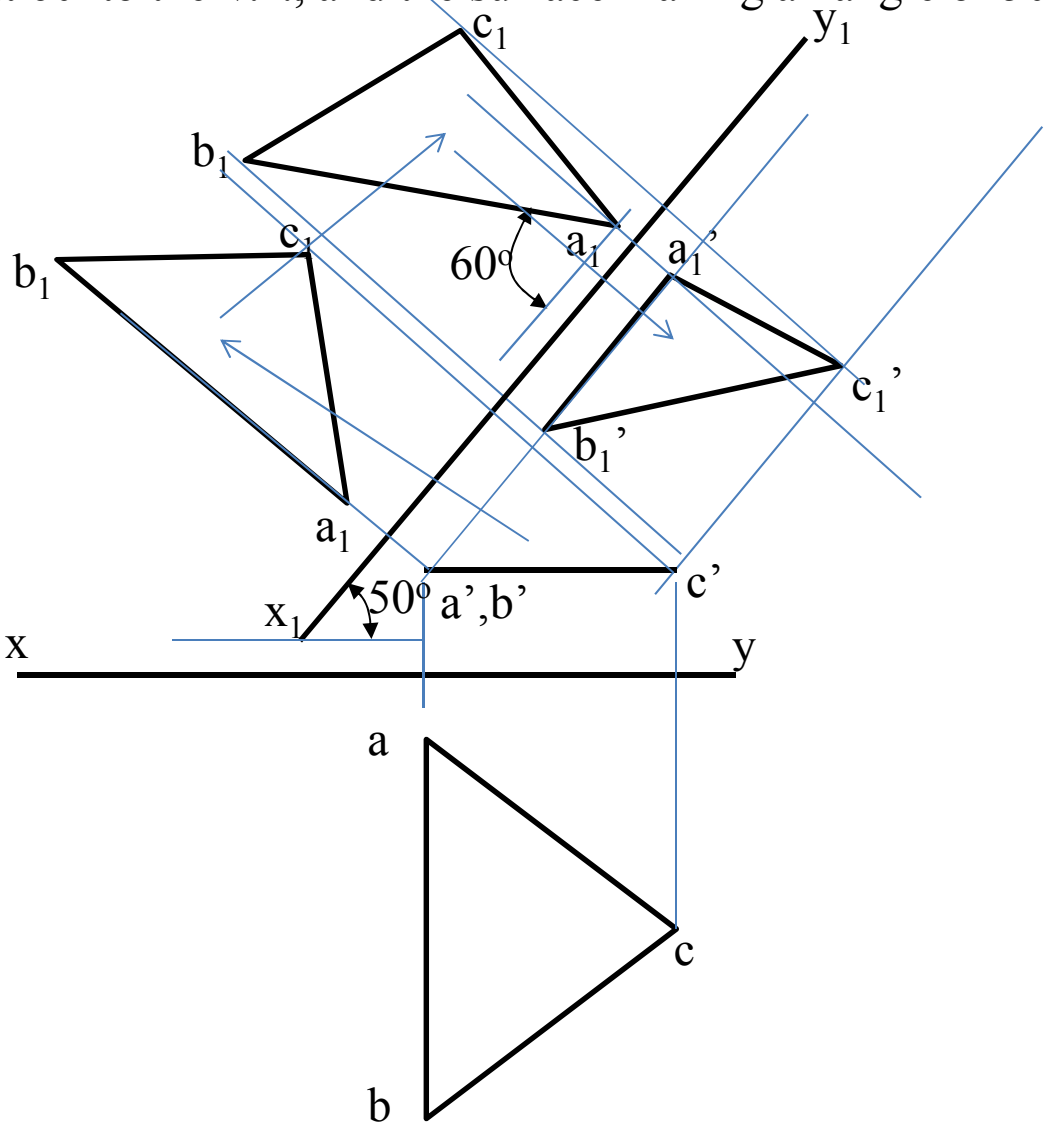
Assume that the triangle is parallel to the H.P. with edge AB perpendicular to the xy axis. The top view shows its true shape and size and the front view is a line parallel to the xy axis

Tilt the triangle so that its makes the required angle with the H.P. Draw the new front view of triangle. It is inclined at the true angle with the H.P. Draw the new top view by moving points parallel to the xy axis

Rotate the top view so that the edge AB makes the required angle with the V.P. The shape and size of the top view does not change. In the front view the distances of the corners from xy remain the same as the second front view

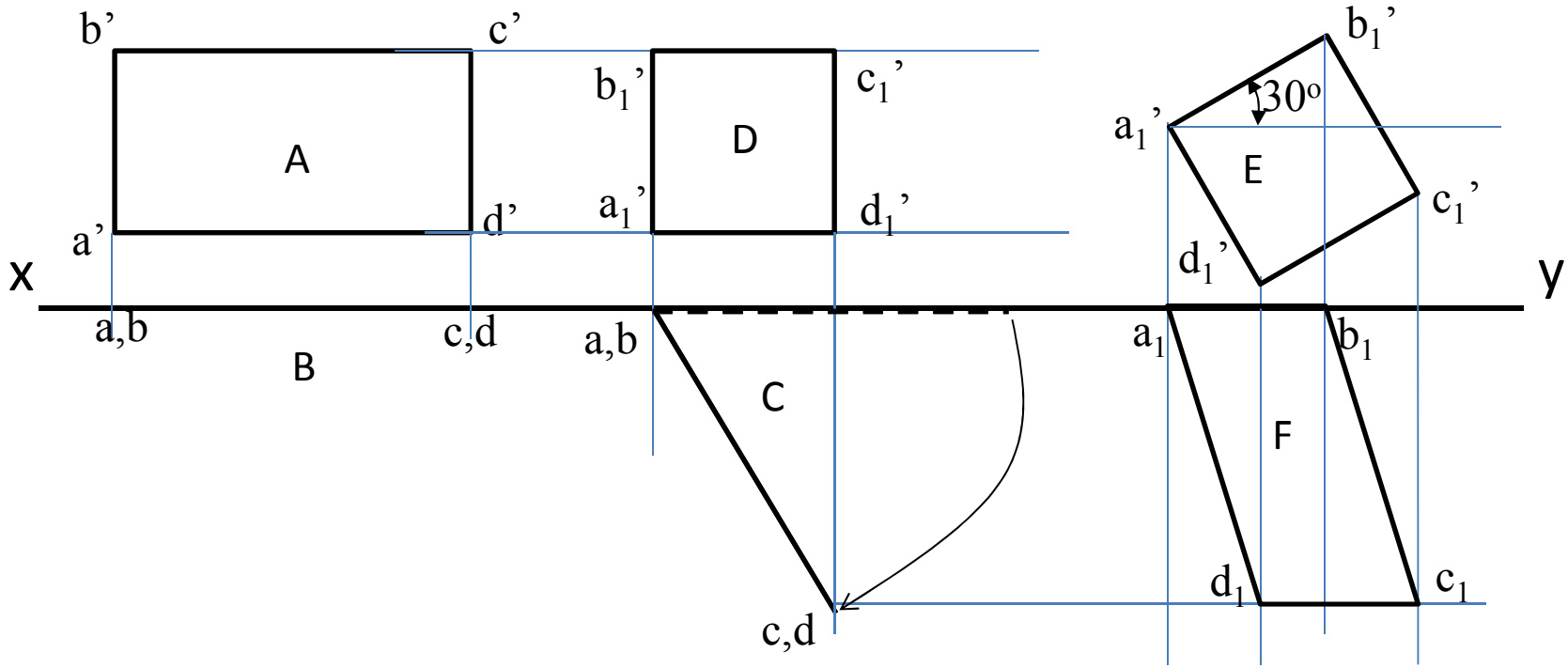
Projection of Oblique Planes Using Auxiliary Planes

Problem: Draw projections of an isosceles triangle ABC with side AB (base) parallel to the H.P. and inclined at 60° to the V.P., and the surface making an angle of 50° with the H.P.



Projection of Oblique Planes

Problem: A thin rectangular plane of sides 100 mm x 50 mm has its shorter side in the V.P. and inclined to 30 ^{o} to the H.P. Project its top view if the front view is a square of 50 mm long sides



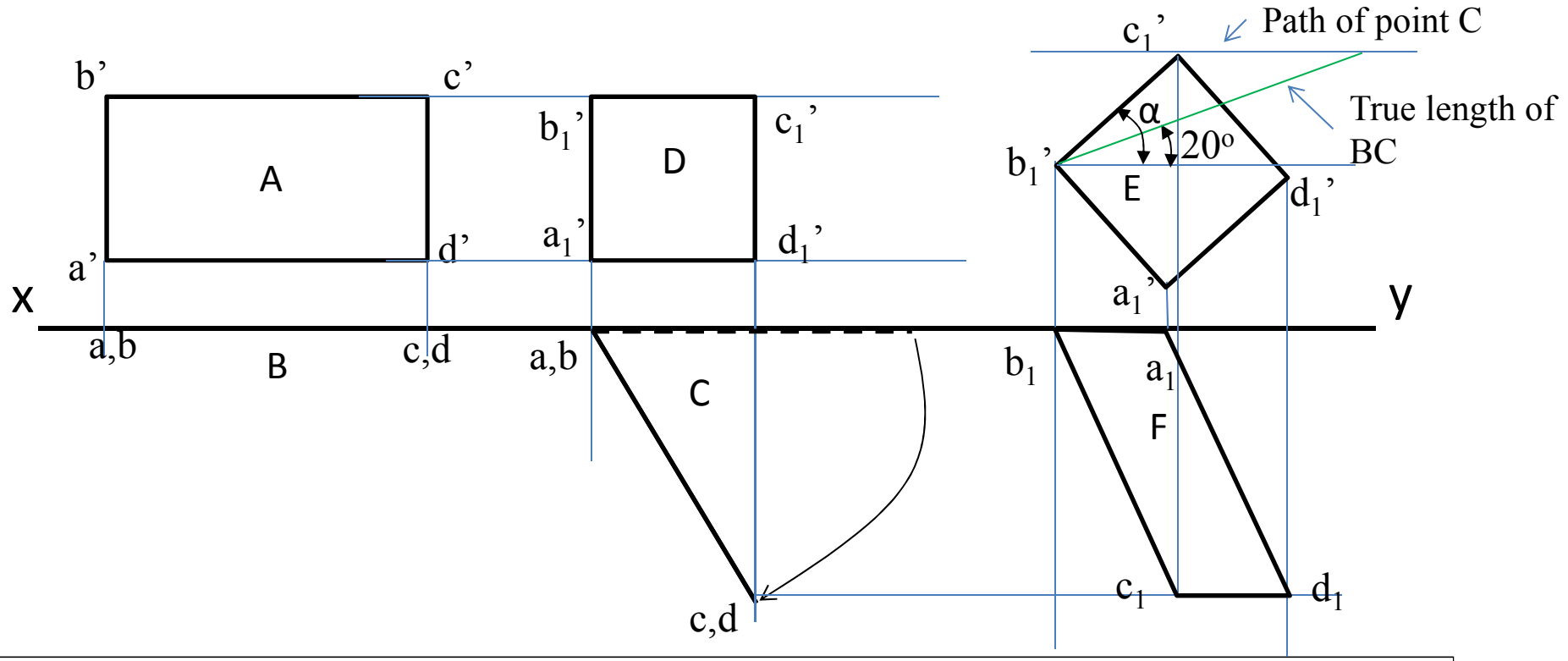
Assume that the rectangle is parallel to the V.P. with edge AB perpendicular to the xy axis. The front view shows its true shape and size and the top view lies in the xy axis

The plane is inclined to the V.P. as the front view is not of true shape and size.
Tilt the rectangle about the edge AB so that the new front view appears as a square
It is inclined at the true angle with the V.P.
Draw the new front view by moving points parallel to the xy axis

Rotate the front view so that the edge AB makes the required angle with the H.P. The shape and size of the front view does not change. In the top view the distances of the corners from xy remain the same as the second top view

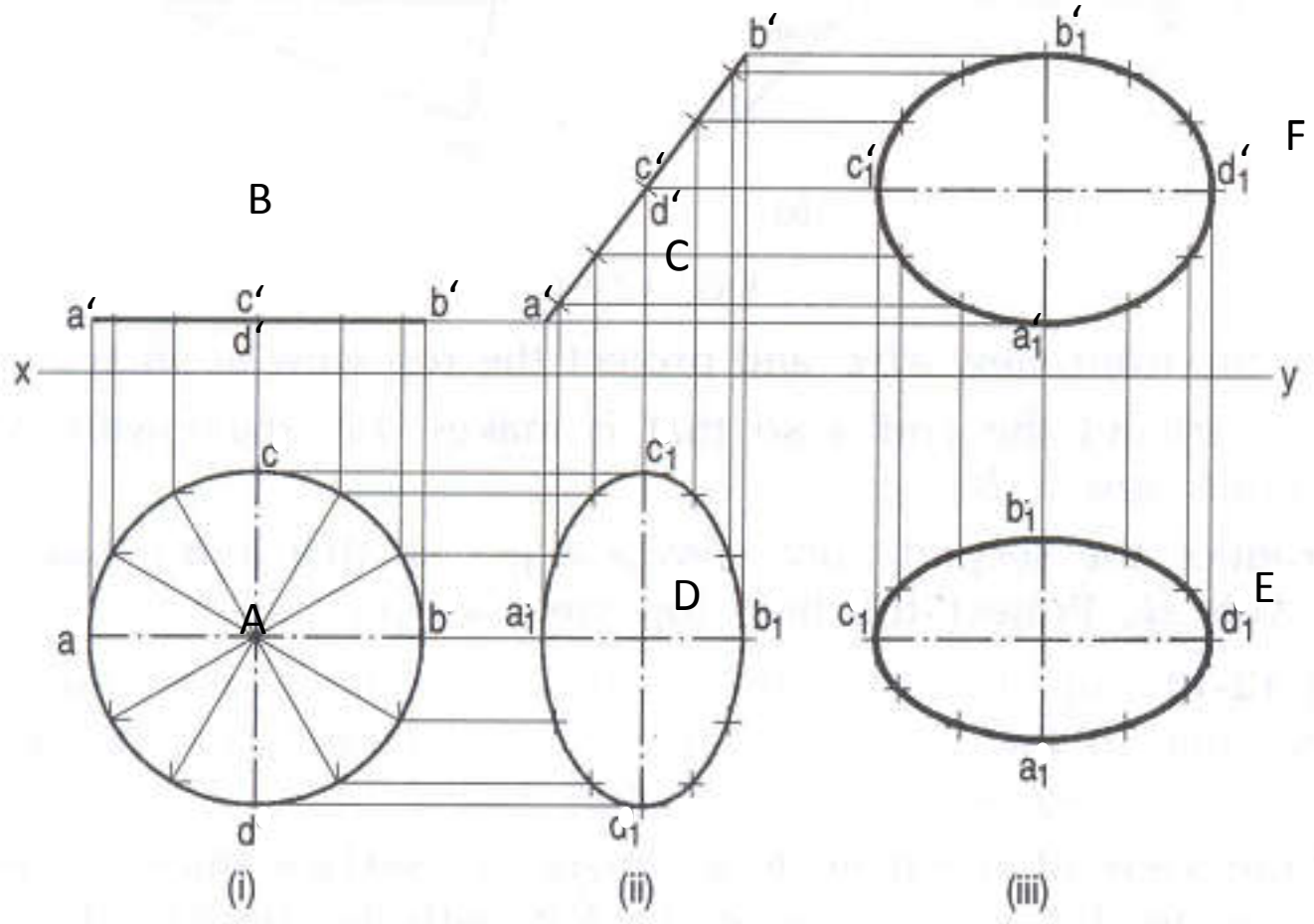
Projection of Oblique Planes

Problem: A thin rectangular plane of sides 100 mm x 50 mm has its shorter side in the V.P. The longer side is inclined to 20 ^{o} to the H.P. Project its top view if the front view is a square of 50 mm long sides



First two steps are the same as the previous problem
Rotate the front view so that the edge BC makes the required angle with the H.P. Length b_1' c_1' does not represent the true length of side BC. Therefore the apparent of BC with xy axis (α) needs to be found out. Rotate the top view such that b_1' c_1' makes an angle α with the xy axis. The shape and size of the front view does not change. In the top view the distances of the corners from xy remain the same as the second top view

Problem: A thin rectangular circular plate of 50 mm diameter appears as an ellipse with major axis 50 mm and minor axis 30 mm in the top view. Draw the projections when the major axis appears horizontal



Ref: Engineering Drawing by N. D. Bhatt et. al

Summary: Projection of an Oblique Plane

Given: True shape of the plane, the angle of inclination with one of the reference planes, the angle an edge makes with the reference plane

1. Assume the plane parallel to that reference plane to which it is to be made inclined. Draw one edge perpendicular to the xy axis. The true shape will be seen in one of the views while the other view will appear as a line.

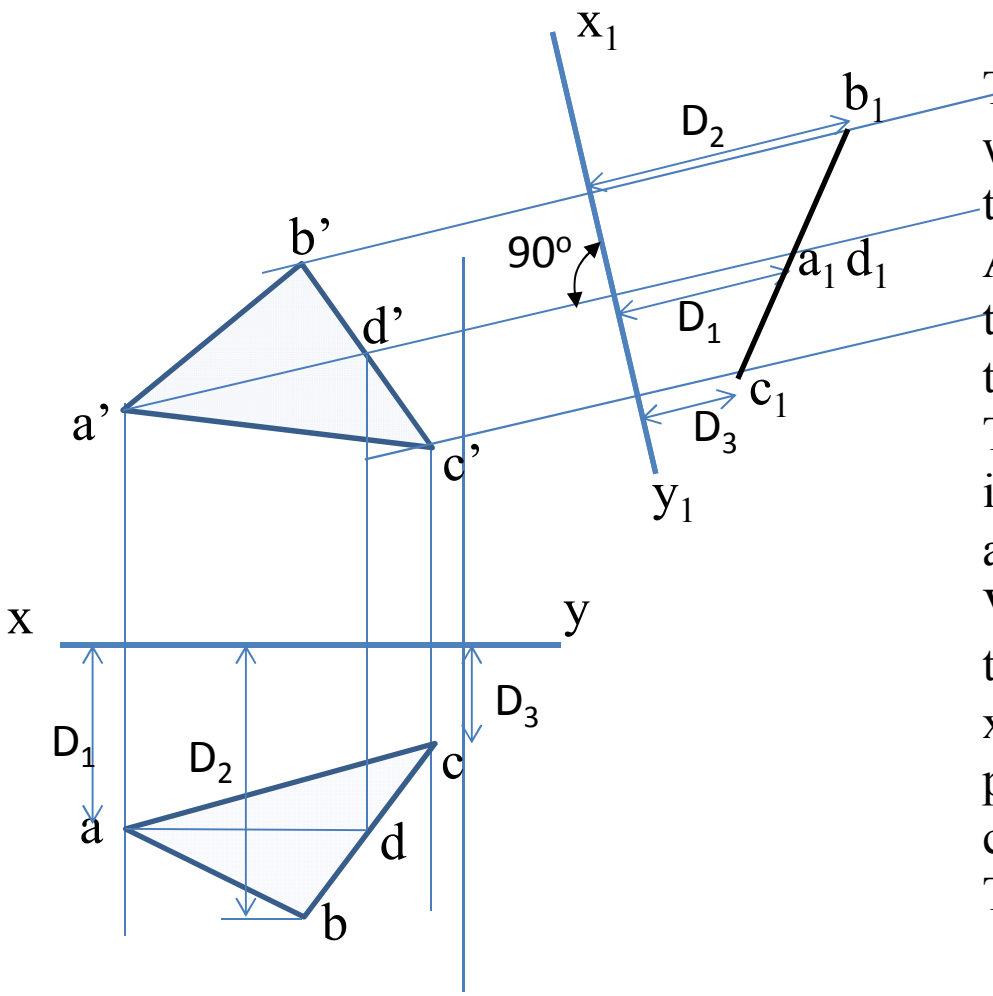
2. Tilt the plane about the perpendicular edge to the required inclination

3. Rotate the appropriate view so that the edge makes the required angle with the reference axis. Make sure that the angle of rotation is drawn taking into account the true length of the edge. The size and shape of this view does not change during the rotation. Project the other view so that the distances of the corners from the xy axis are preserved

To Find the Edge View of an Oblique Plane

Given: The front view and top view of plane ABC

Edge view of a plane is obtained by looking at the plane with the direction of viewing parallel to the plane



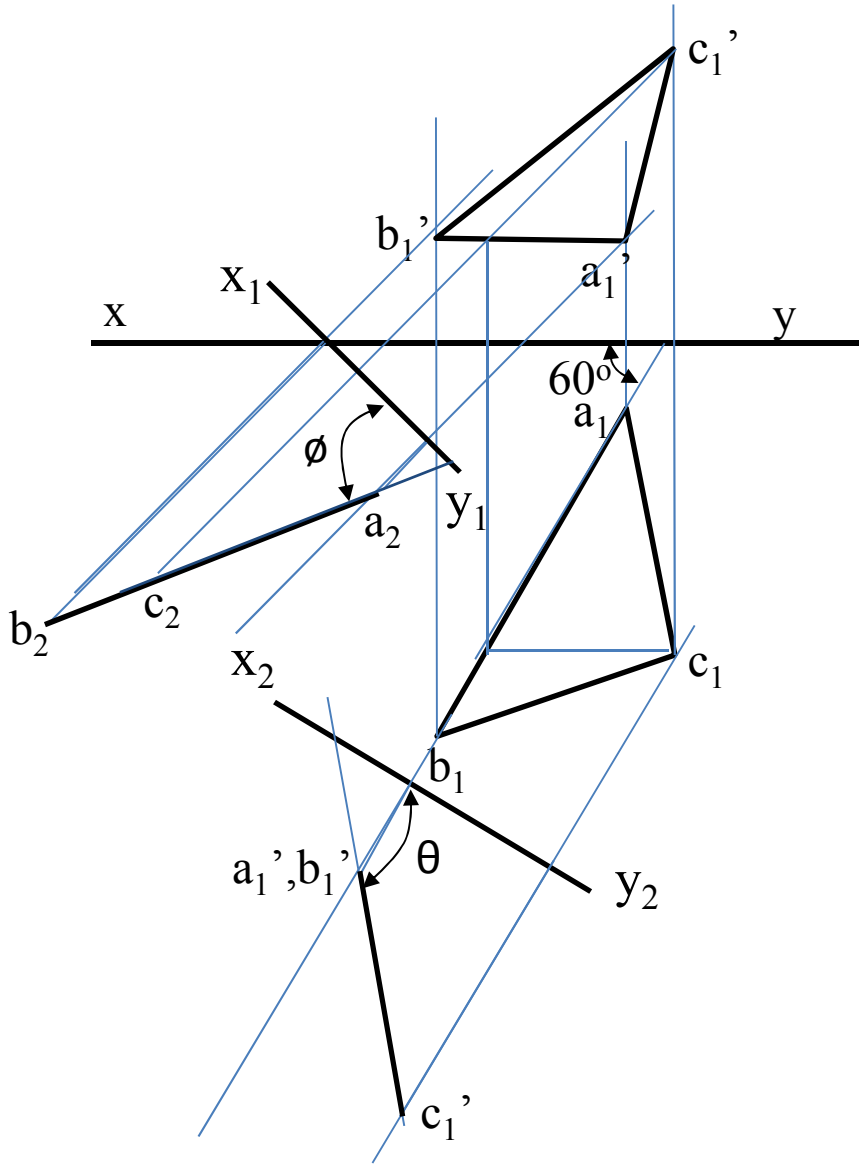
To the find the edge view of ABC we need to find a plane perpendicular to it

A plane which is perpendicular to the true length view of a line is perpendicular to the plane containing the line

Therefore construct a line a'd' which is a true length view. Do this by drawing a line ad parallel to the xy in the other View. Then construct a plane perpendicular to true length view. This represented by x_1y_1. Draw projectors from a', b' and c' perpendicular x_1y_1 . Locate points a_1, b_1 and c_1 by transferring the depth dimensions. This is the edge view of the plane ABC

Projection of Oblique Planes

Problem: To find the angle of the inclination of the plane with the reference planes



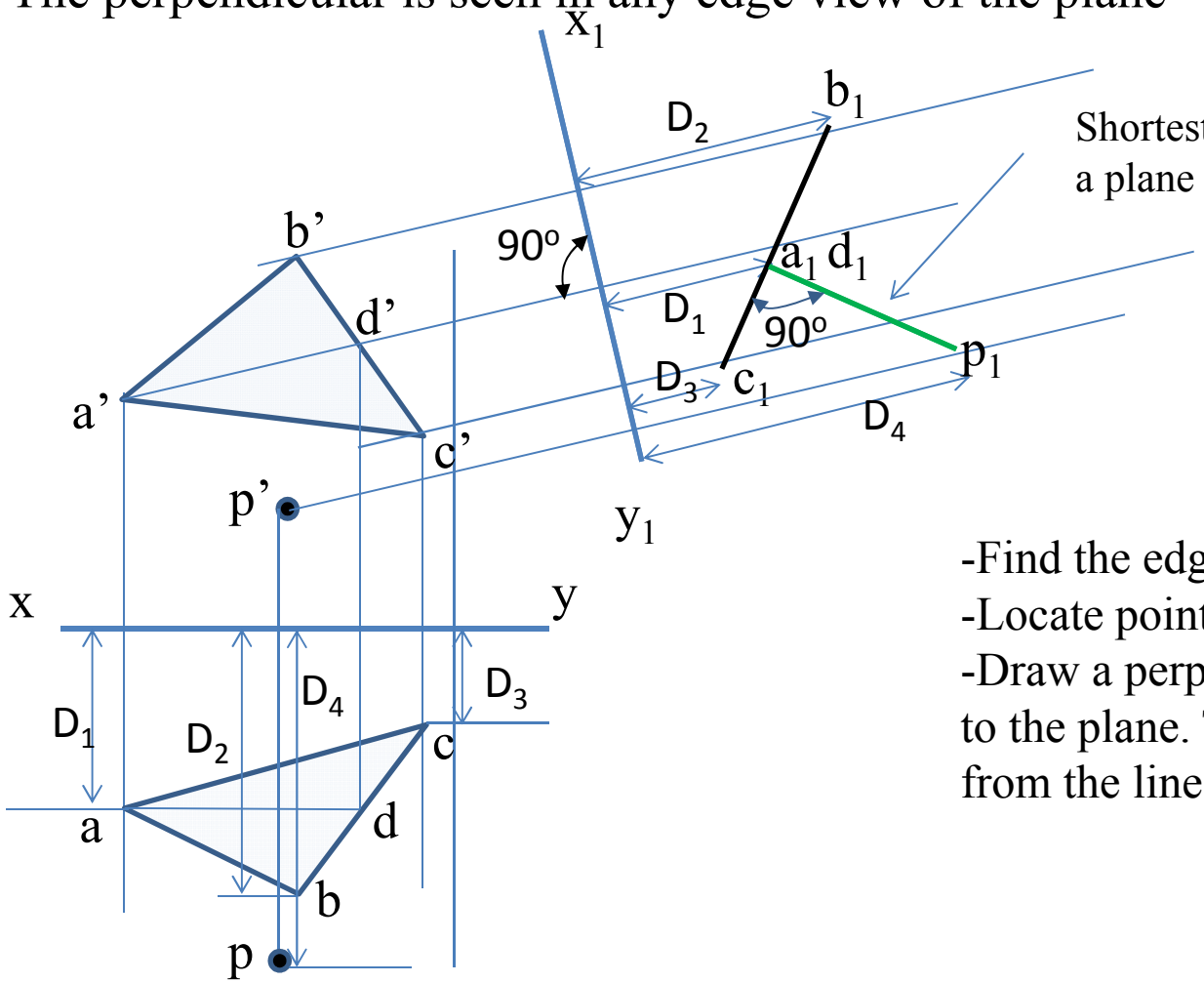
-Draw the front view and the top view of the plane.
-Draw the edge view of the plane using the front view. This gives the angle of inclination with the V.P. (ø)
-Draw the edge view of the plane using the top view. This gives the angle of inclination with the H.P. (θ)

To Find the Shortest Distance from a Point to an Oblique Plane

Given: The front view and top view of plane ABC and a point P

The shortest distance is measured along the perpendicular from the point to the plane

The perpendicular is seen in any edge view of the plane



Shortest distance between a point and a plane

-Find the edge view of a plane

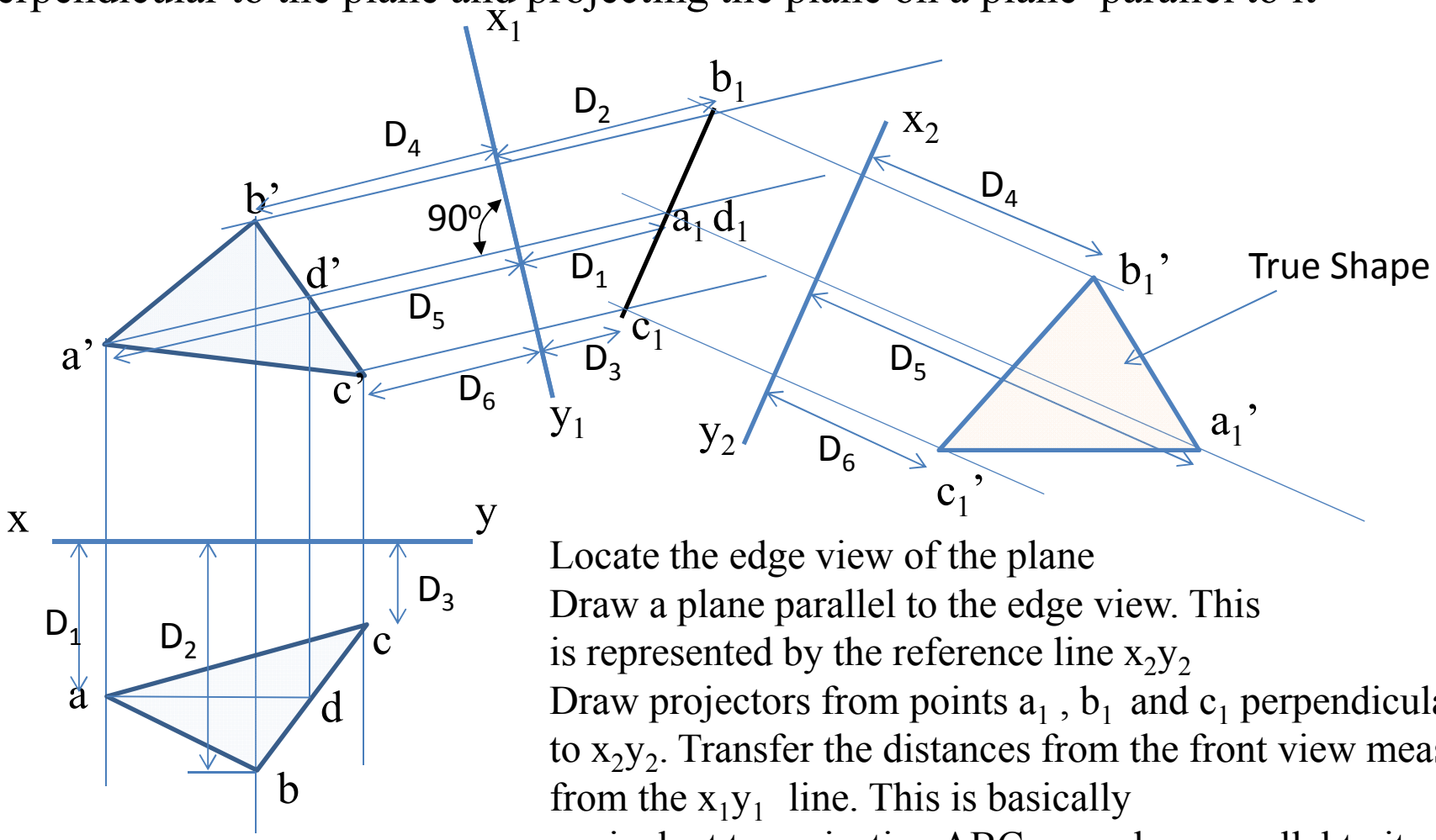
-Locate point P in the same view, i,e. p_1

-Draw a perpendicular from p_1 to the plane. This is the shortest distance from the line to the plane

To Determine the True Shape and Size of an Oblique Plane

Given: The front view and top view of plane ABC

The true shape and size of a plane can be seen by viewing in the direction perpendicular to the plane and projecting the plane on a plane parallel to it



Locate the edge view of the plane

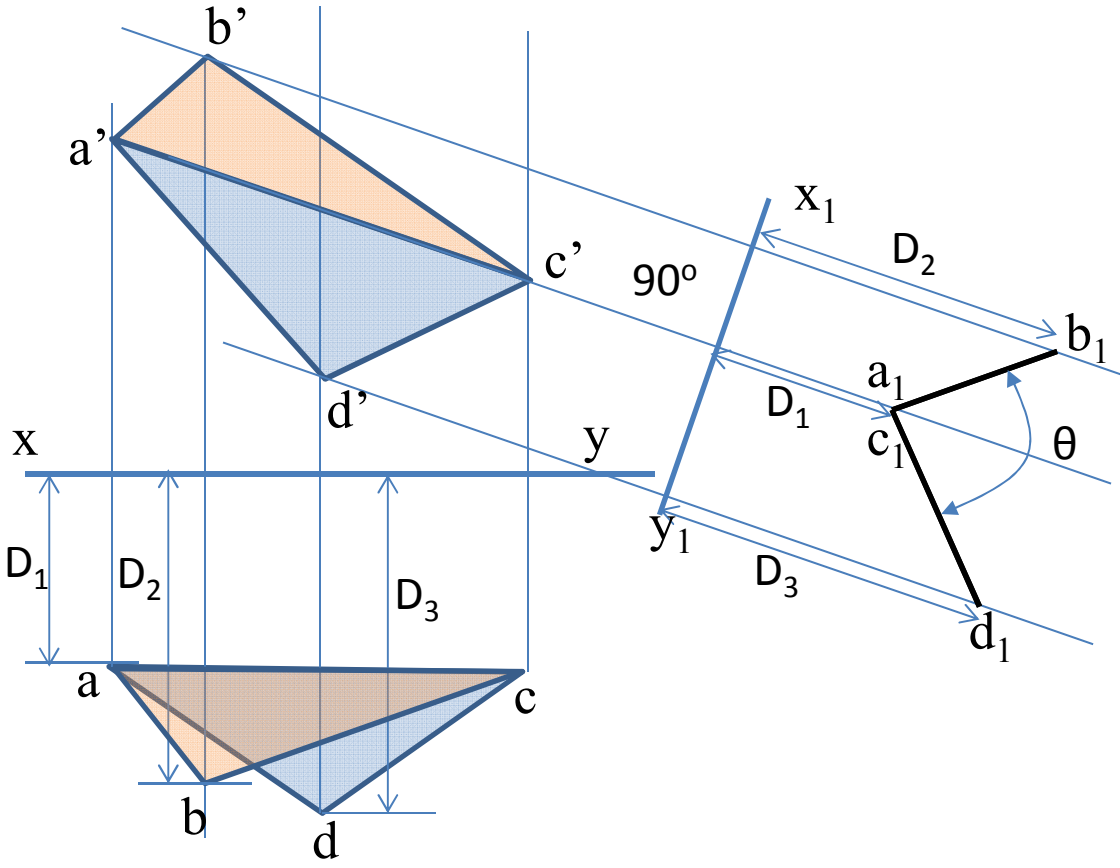
Draw a plane parallel to the edge view. This is represented by the reference line x_2y_2

Draw projectors from points a_1 , b_1 and c_1 perpendicular to x_2y_2. Transfer the distances from the front view measured from the x_1y_1 line. This is basically equivalent to projecting ABC on a plane parallel to it

This represents the true shape of the plane

To Find the Angle Between Two Intersecting Planes

Given: The front view and top view of two intersecting planes, ABC and ABD



-The angle of intersection can be seen on a plane perpendicular to both the planes
-The two planes will appear as two intersecting lines with the angle between them equal to the angle between the planes
-To find a plane perpendicular to both the planes, find a plane perpendicular to the intersection line
-This is done by finding the true length view of the intersection line.
-Then a plane is constructed perpendicular to the true length view. This is represented by x_1 y_1
-Draw projectors from a', b' c' and d' perpendicular x_1y_1 . Locate points a_1, b_1 c_1 and d_1 by transferring the depth dimensions.
This gives the edge views of the planes ABC and ADC. The angle can now be measured

In this particular figure as ac, the line of intersection, is parallel to the xy line, a'c' is the true length view of the line

Points to Remember

1. If the true shape and size of a plane is seen in its front (top) view, then it is parallel to the V.P. (H.P.).

2. If the front (top) view is not the true shape, then the plane is inclined to the V.P. (H.P.)

3. If a line is in the V.P. (H.P.), its true length is seen in the front (top) view

4. If a plane or a line does not change its relation with the reference plane (e.g. a plane or a line which is perpendicular to a plane remains perpendicular), the projection on that reference plane does not change in size and shape.

4. The angle of inclinations of the plane can be obtained by drawing edge view using the front view and the top view. The edge views are the auxiliary front and auxiliary top views

5. To obtain the true shape of a plane given its projections, one needs to proceed by first drawing the edge view of the plane. Then the true shape is obtained by drawing an auxiliary view using a reference line drawn parallel to the edge view

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