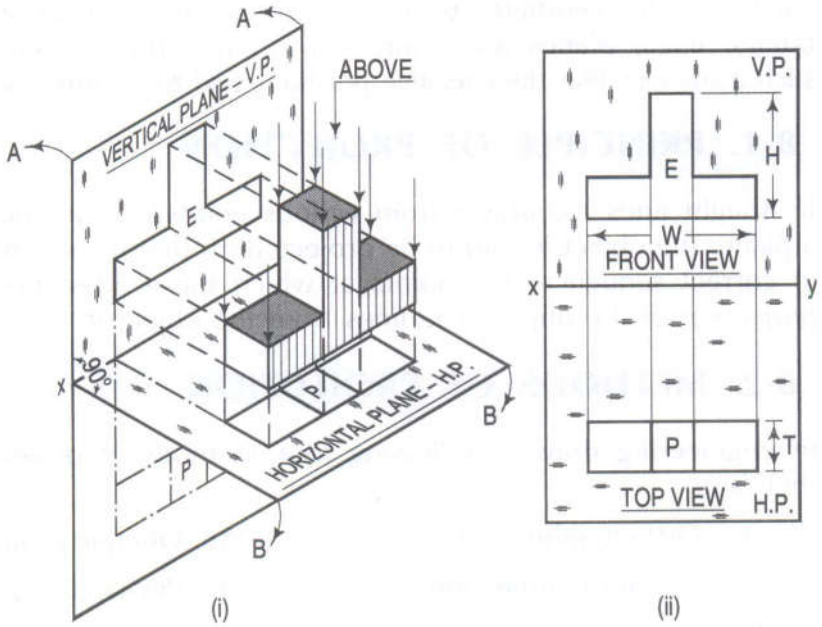
Lecture 10: Isometric Projection
Vivek Sangwan

Based on Slides by Prof. Salil Kulkarni

Introduction

Projection – Representation of a three-dimensional object in a two-dimensional space (plane)
Have studied MULTIVIEW orthographic projections till now



Features of Orthographic projections

- Projectors are parallel to each other and perpendicular to the plane of projection

Features of Multiview Orthographic projections

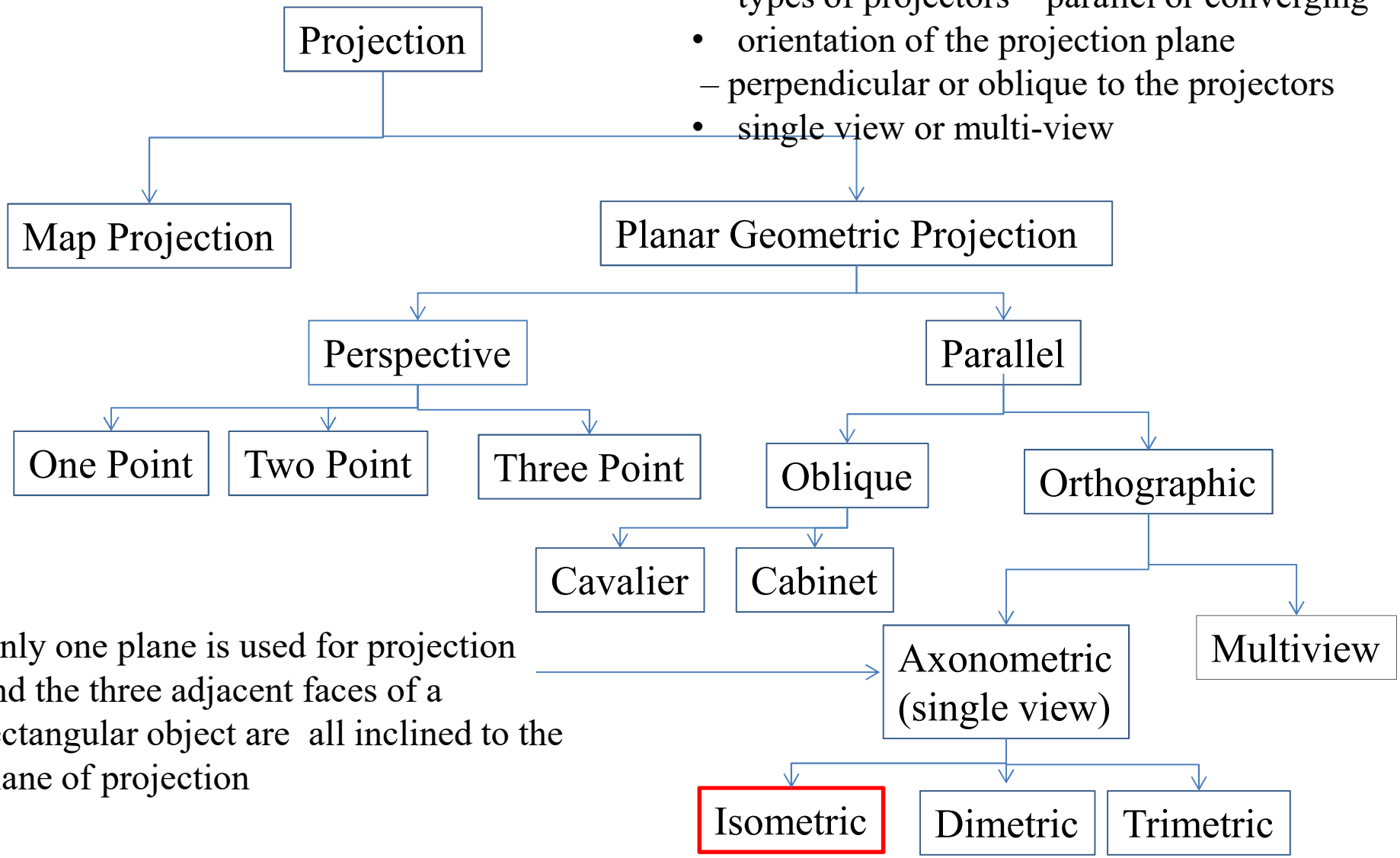
- Consist of two or more views of the object with each view showing at most two dimensions of the object. Front view – height, width, top view – width, depth and side view – height, depth

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

Types of Projections

Projections can be classified based on

- types of projectors – parallel or converging
- orientation of the projection plane – perpendicular or oblique to the projectors
- single view or multi-view

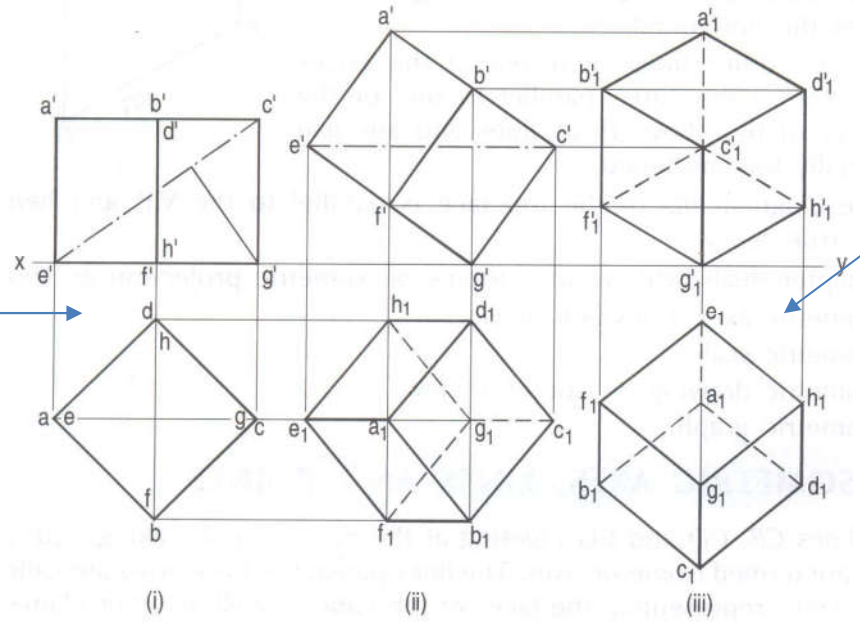


Only one plane is used for projection and the three adjacent faces of a rectangular object are all inclined to the plane of projection

Axonometric Projections

Before projecting the object onto V.P./H.P., if it is rotated about X/Y/Z axes by some arbitrary angle(s), more details of the object become visible as 2 or 3 faces of its bounding cube becomes visible. Such an **orthographic view** preceded by the rotation(s) of the object is called **axonometric projection**. It is a pictorial view as it looks like a 3D view of the object.

Orthographic Projection of Cube

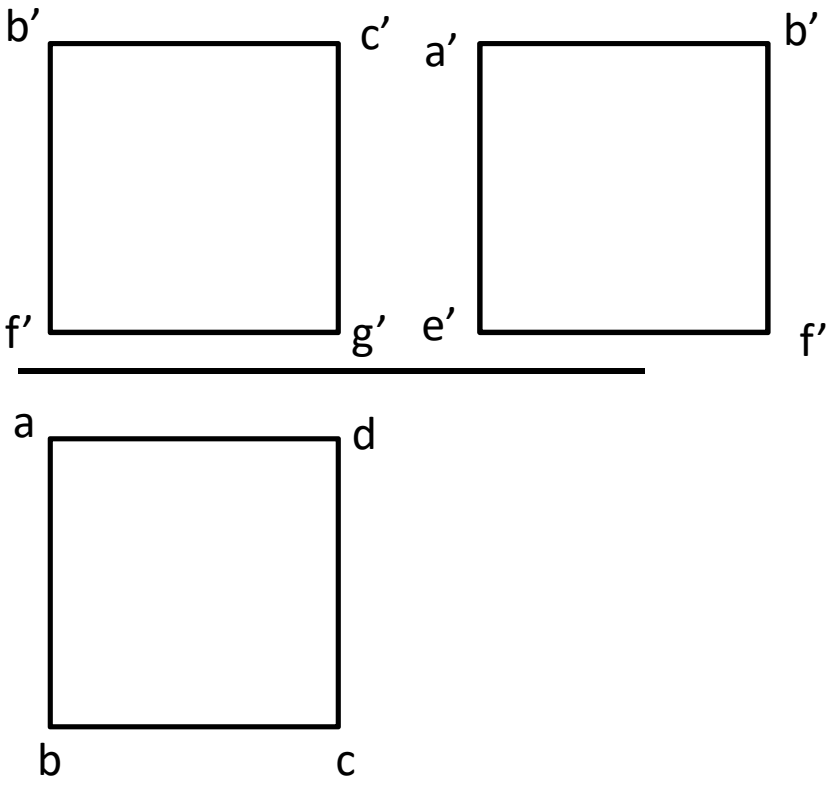


Axonometric (isometric) projection of cube

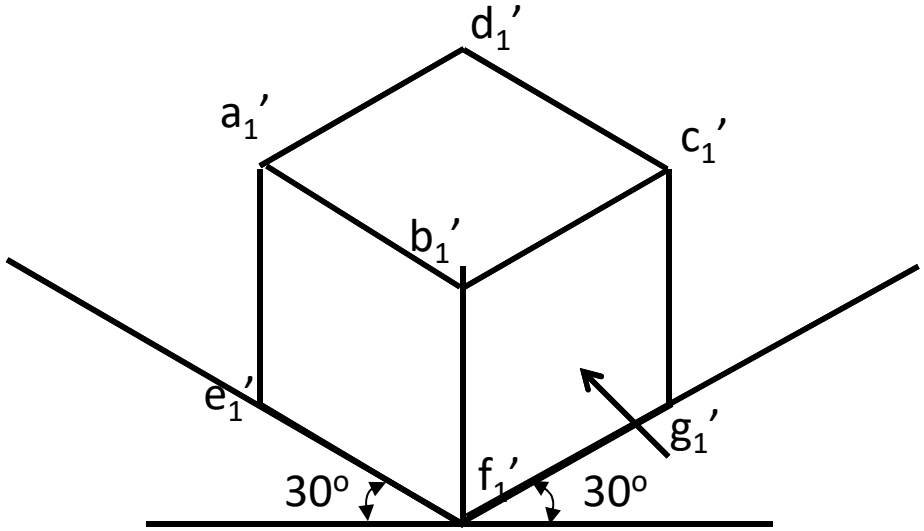
Projection of a Cube

Draw the orthographic and the isometric projections of a cube with base parallel to the XY plane and two adjacent faces parallel to the coordinate planes XZ and YZ. The direction of viewing is normal to the XZ plane

Orthographic projection of a Cube



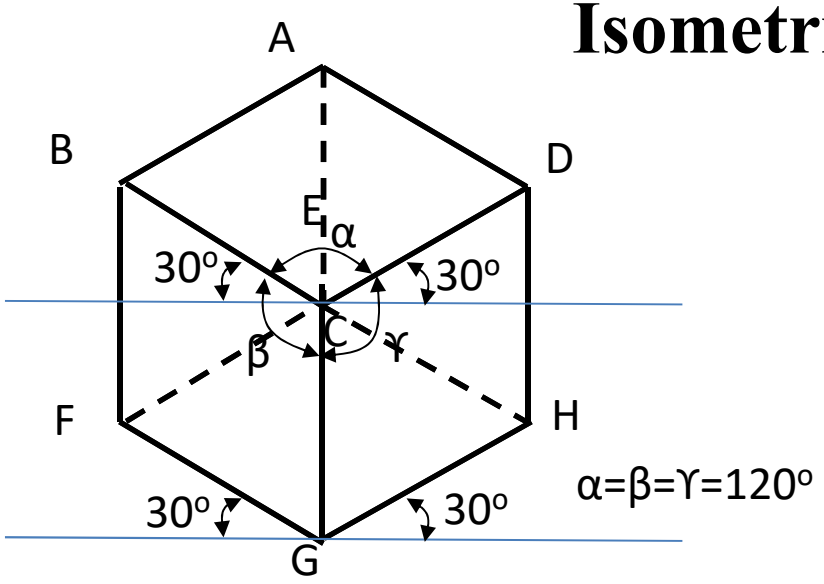
Isometric projection of a Cube

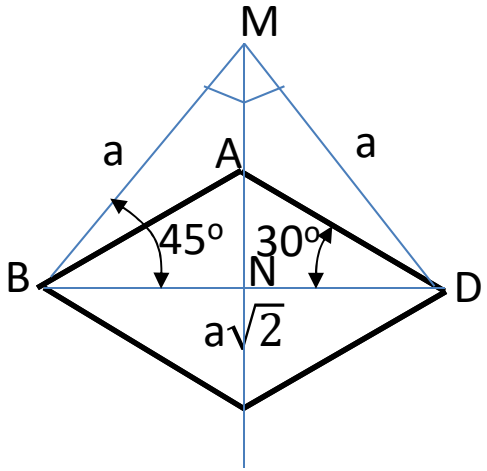


The length of all the sides which were parallel to the co-ordinate axes has decreased (foreshortened) equally

An isometric projection of a cube is found by constructing a view where a solid diagonal of the cube appears as a point

Isometric Projection





$$\cos(45) = \frac{l(BN)}{l(BM)}$$

$$\cos(30) = \frac{l(BN)}{l(AB)}$$

$$\frac{l(AB)}{l(BM)} = \sqrt{\frac{2}{3}}$$

- The front edges - CB, CD and CG are called isometric axes
- CG is for height, CD is for length (width) and CB is for width (length)
- The three faces seen in the isometric projections are the same faces that will be seen in normal orthographic projections: top, front & side
- Lines parallel to the isometric axes are called isometric lines
- Planes representing the faces of the cube and planes parallel to them are called isometric planes
- The angles between the projections of these axes is equal (hence isometric) and is 120°
- 90° of the cube appear as either 60° or 120°

The projected length of an isometric line is $\sqrt{2/3}$ times the true length of the line

Lines which are not parallel to the isometric axis are called non-isometric lines

Non-isometric lines are not shortened in any fixed ratio

Measurements should always be made on isometric lines and isometric axes only

Non-isometric lines are drawn by locating the position of their extremities on isometric planes and then connecting them

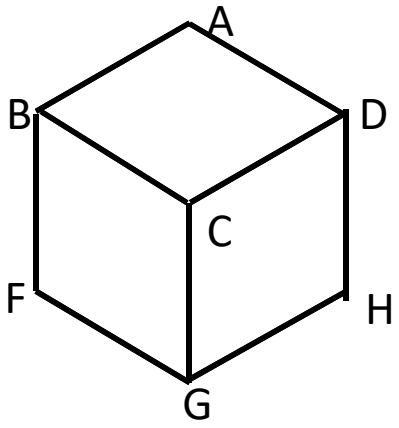
Isometric Drawing

In isometric projection, the projected length of an isometric line is $\sqrt{2/3}$ times the true length of the line

If the decrease (foreshortening) of the line is disregarded and the line is shown with its true length, we get **isometric drawing or an isometric view**

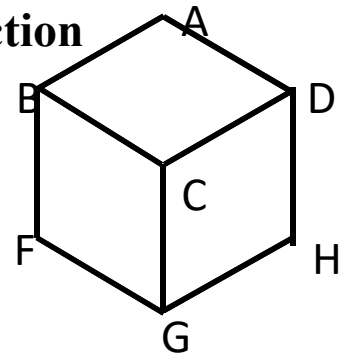
Due to ease of construction and the fact that dimensions can be directly measured from the drawing, the general practice is to use the true length instead of the isometric scale

Isometric view



original size

Isometric projection

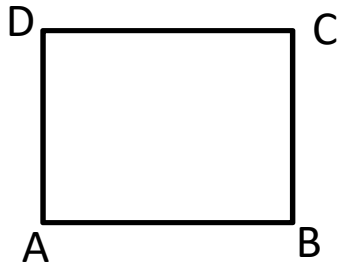


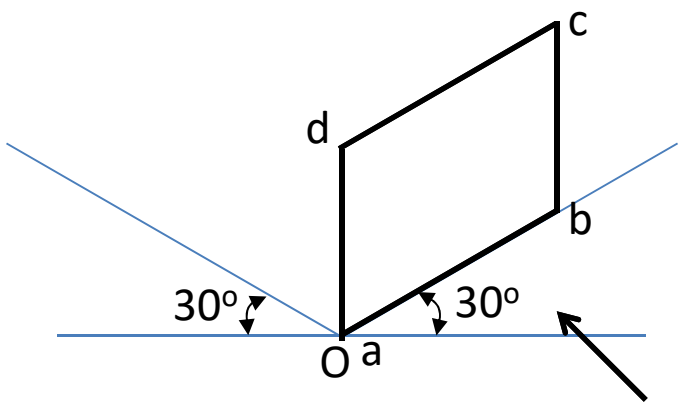
smaller in size

- In an isometric view, for a rectangular solid resting on the H.P. each horizontal face will have its sides parallel to the sloping axes – CD and CB
- Each vertical face will have its vertical sides parallel to the vertical axis CG and the other sides parallel to one of the sloping axis
- In an isometric drawing, vertical edges are shown as vertical lines and horizontal edges are shown as lines making 30^o with the horizontal

Isometric Drawing of a Plane

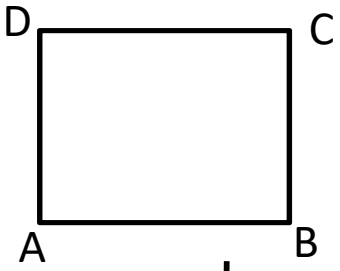
Front view of a plane which is parallel to the V.P. is shown below. Draw its isometric view

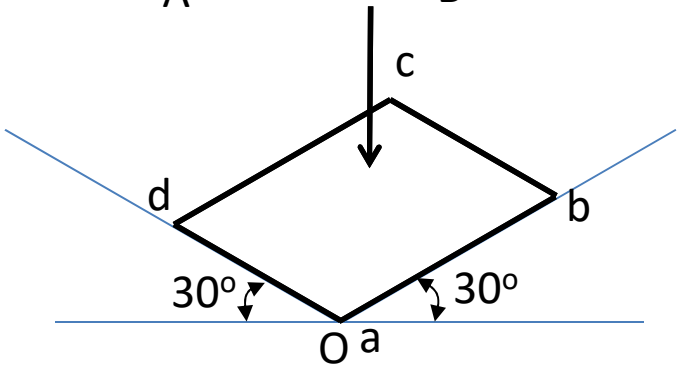




l(AB) = l(ab), l(BC) = l(bc),
l(DC) = l(dc), l(AD) = l(ad)

Top view of a plane which is parallel to the H.P. is shown below. Draw its isometric view





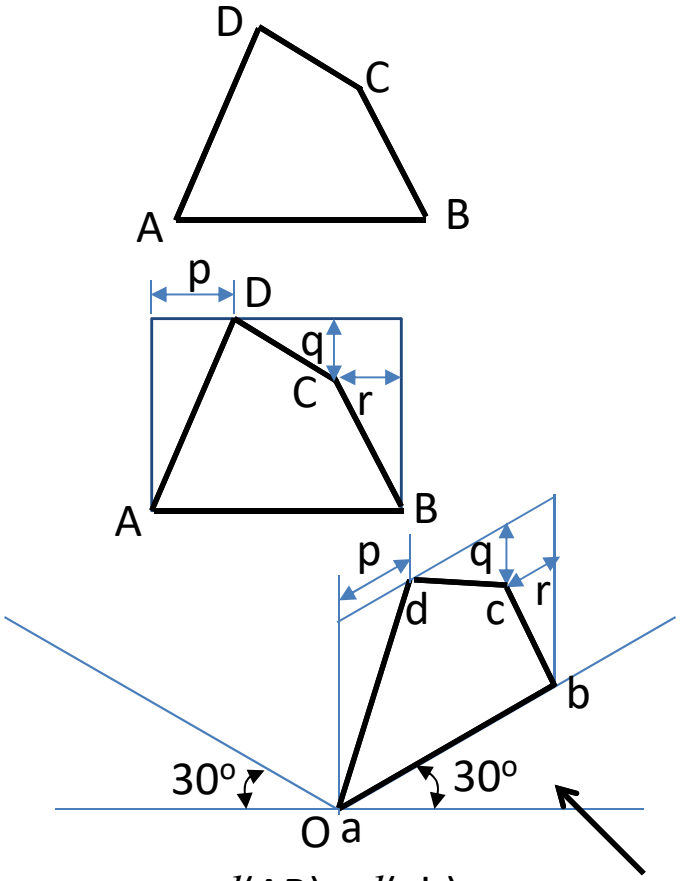
l(AB) = l(ab), l(BC) = l(bc),
l(DC) = l(dc), l(AD) = l(ad)

measurements in the horizontal and the vertical directions in the front view are perpendicular to the P.P. and the H.P., respectively

measurements in the horizontal and the vertical directions in the top view are perpendicular to the P.P. and the V.P., respectively

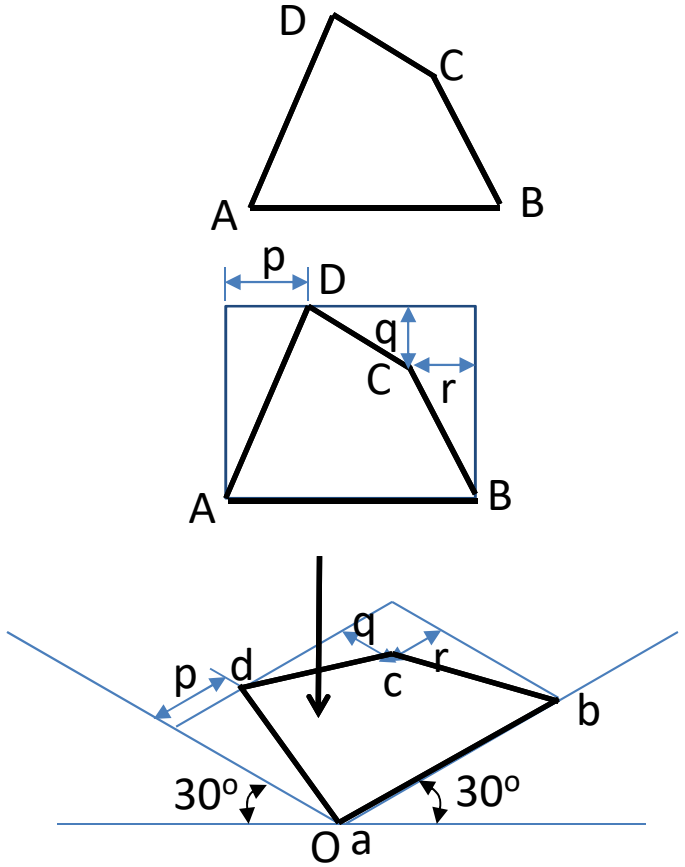
Isometric Drawing of a Plane with Sides not Parallel to the Coordinate Axes

Front view of a plane which is parallel to the V.P. is shown below. Draw its isometric view



l(AB) = l(ab)

Top view of a plane which is parallel to the H.P. is shown below. Draw its isometric view

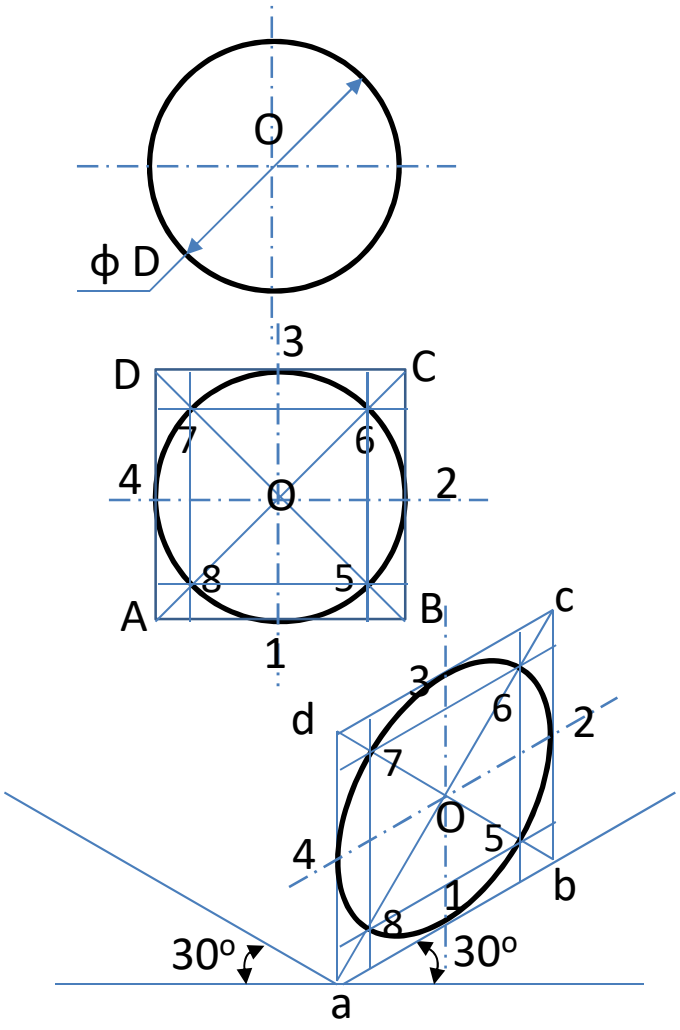


l(AB) = l(ab)

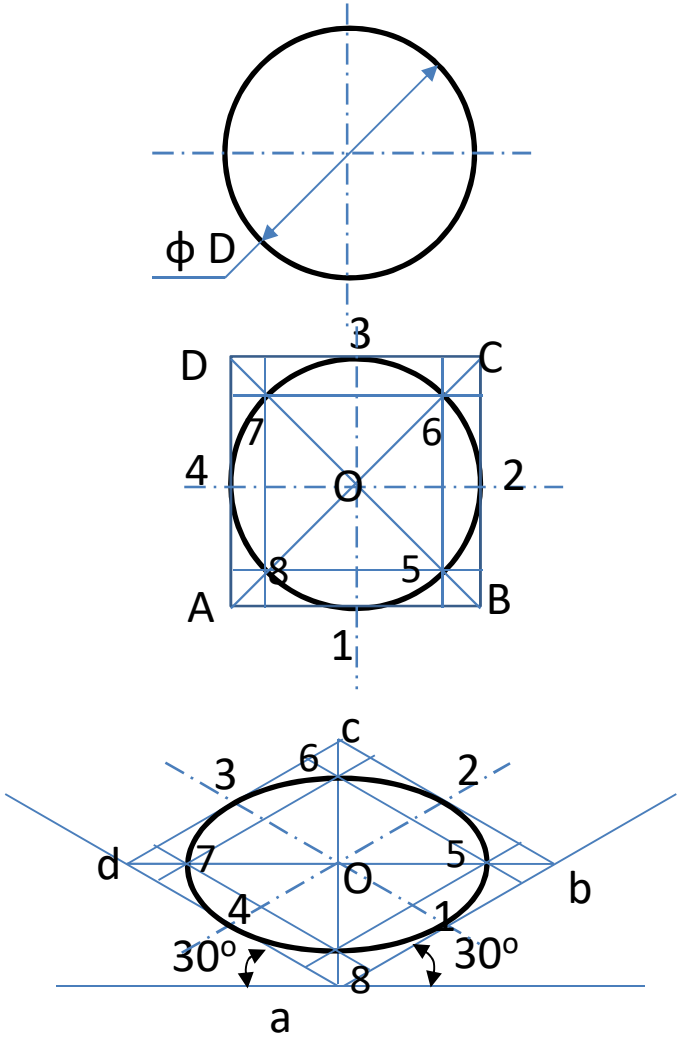
Non-isometric lines are drawn by locating the position of their extremities on isometric planes and then connecting them

Isometric Drawing of a Circle

Front view of a circle which is parallel to the V.P. is shown below. Draw its isometric view



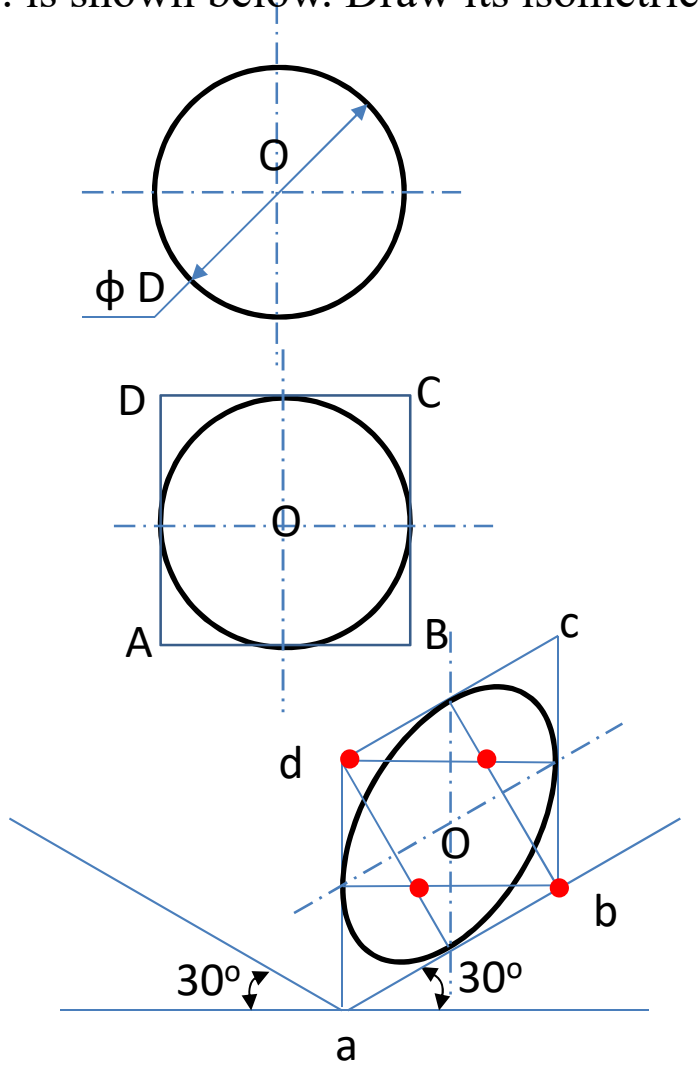
Top view of a circle which is parallel to the H.P. is shown below. Draw its isometric view



The length of the major axis is greater than the true diameter of the circle

Isometric Drawing of a Circle – Four Center Method

Front view of a circle which is parallel to the V.P. is shown below. Draw its isometric view



Four center method

The ellipse is assumed to be made up of arcs of four circles

-Assume that a square circumscribes the circle in the orthographic projection

-In the isometric view, the square becomes a rhombus and the circle becomes an ellipse which is tangent to the rhombus at the midpoints of the sides

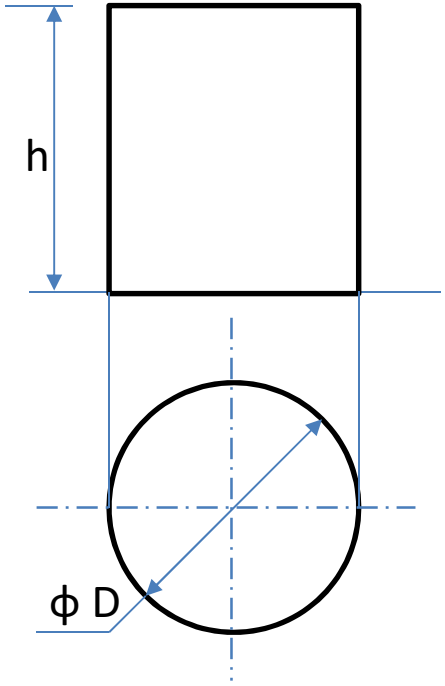
-Draw the bisectors of the sides of the rhombus

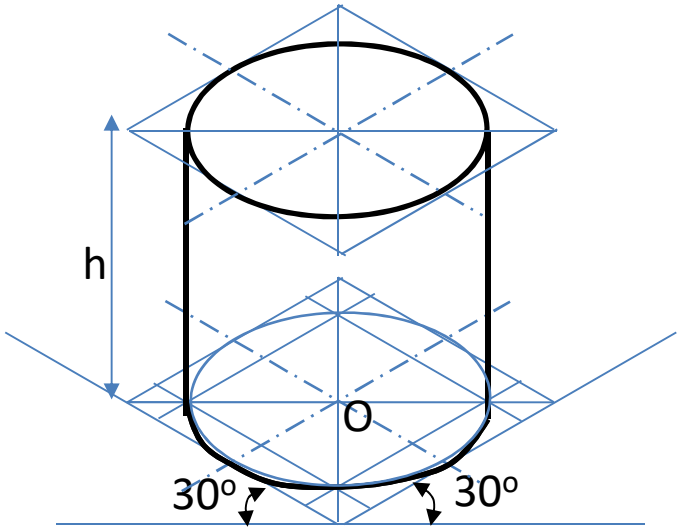
-The points of intersection of the four bisectors are centers of the arcs of the center (red dots)

-The two centers that lie at the corner of the rhombus are centers of the larger arcs, while the remaining intersections are centers of the smaller arcs

Isometric Drawing of a Cylinder

The front and the top view of a cylinder which is resting on the H.P. is shown below. Draw its isometric view

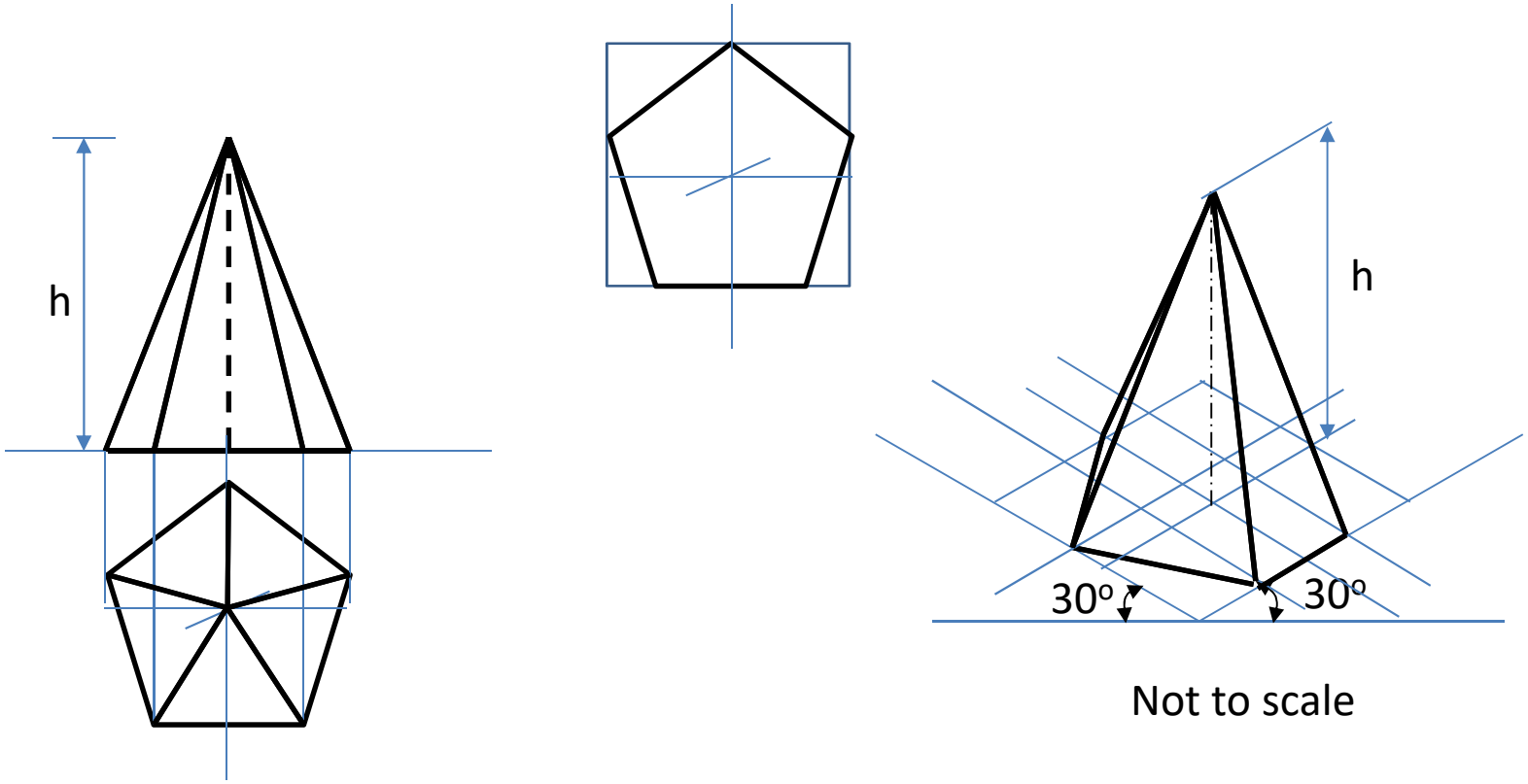




Hidden lines are not shown in isometric views

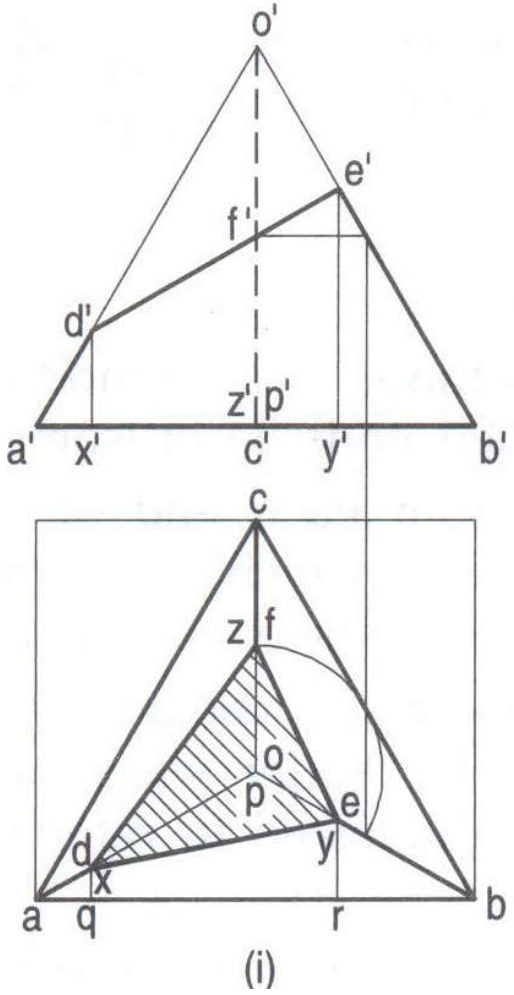
Isometric Drawing of a Pyramid

The front and the top view of a right pentagonal pyramid which is resting on the H.P. is shown below. Draw its isometric view

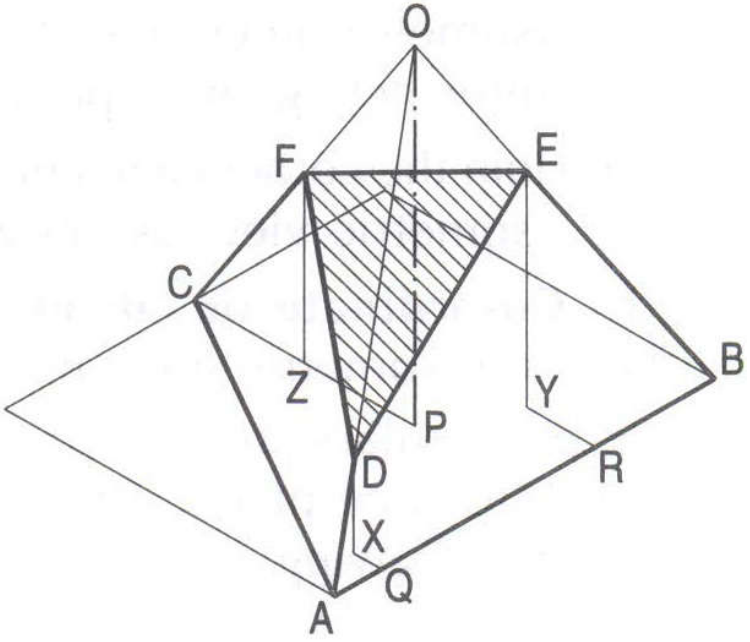


Isometric Drawing of a Truncated Pyramid

The front and the top view of a truncated right triangular pyramid which is resting on the H.P. is shown below. Draw its isometric view



(i)



CP = cp

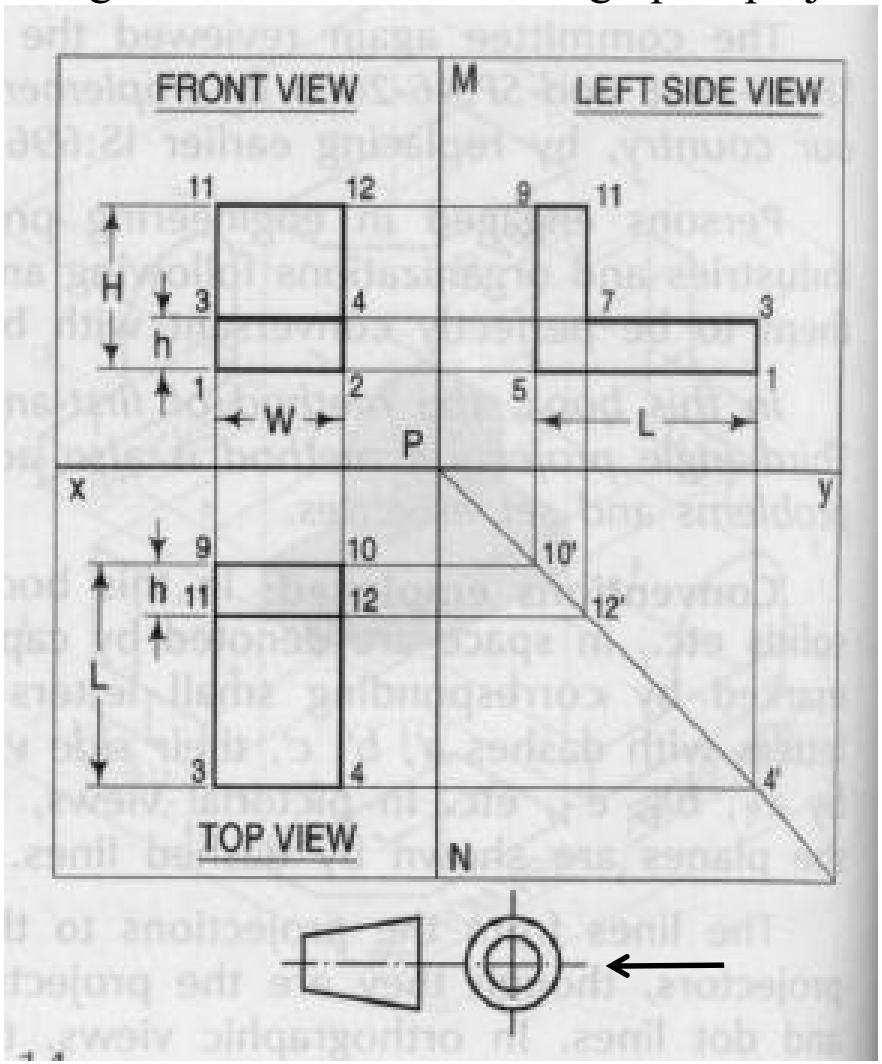
QX = qx RY = ry CZ = cz

XD = x'd' YE = y'e' ZF = z'f '

(ii)

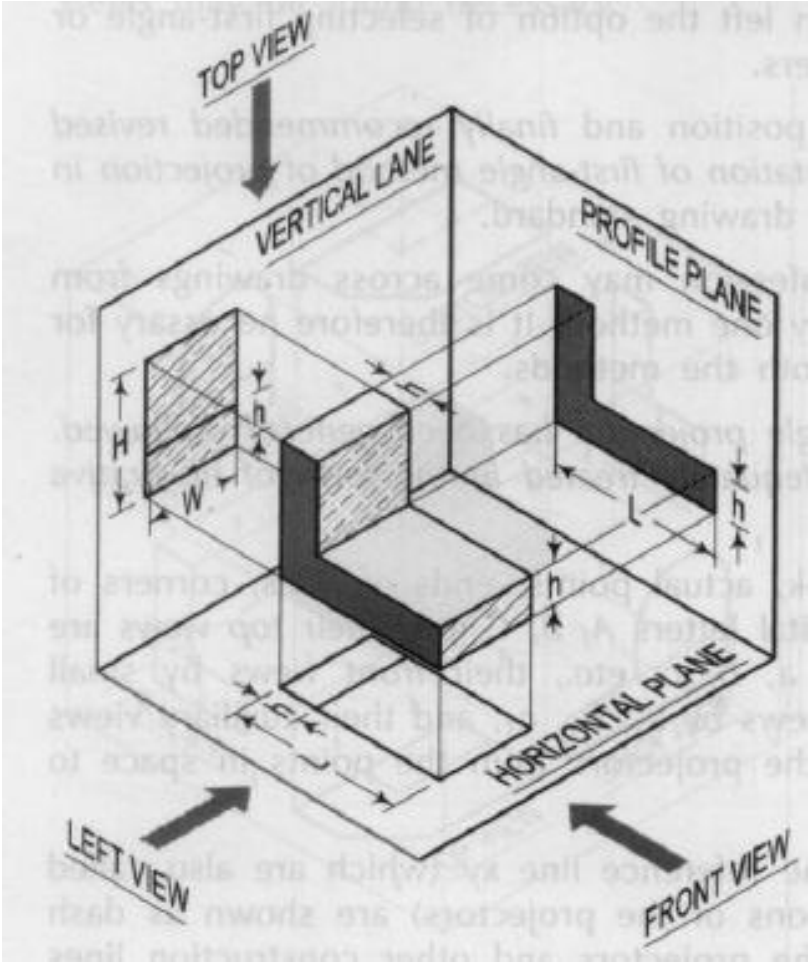
Isometric Drawing of a Typical Solid - Problem

Draw the isometric drawing of the solid whose orthographic projection is as shown below



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

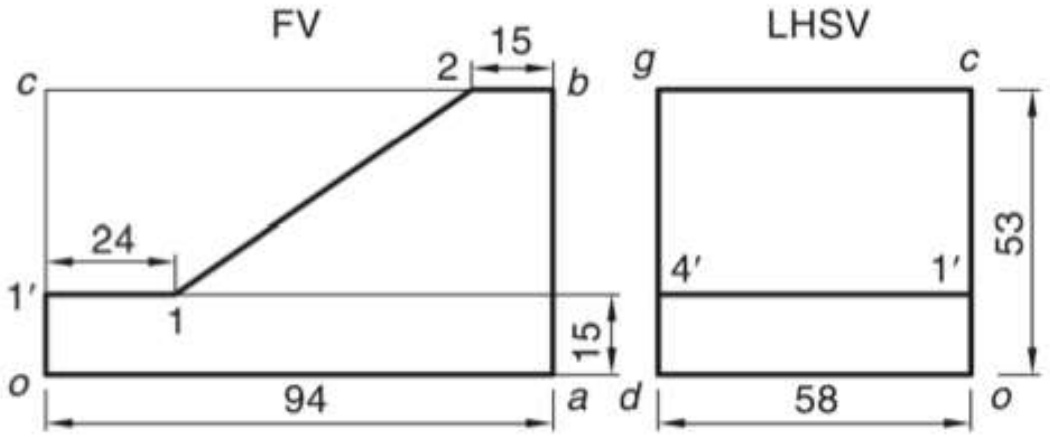
Isometric Drawing of a Typical Solid - Solution

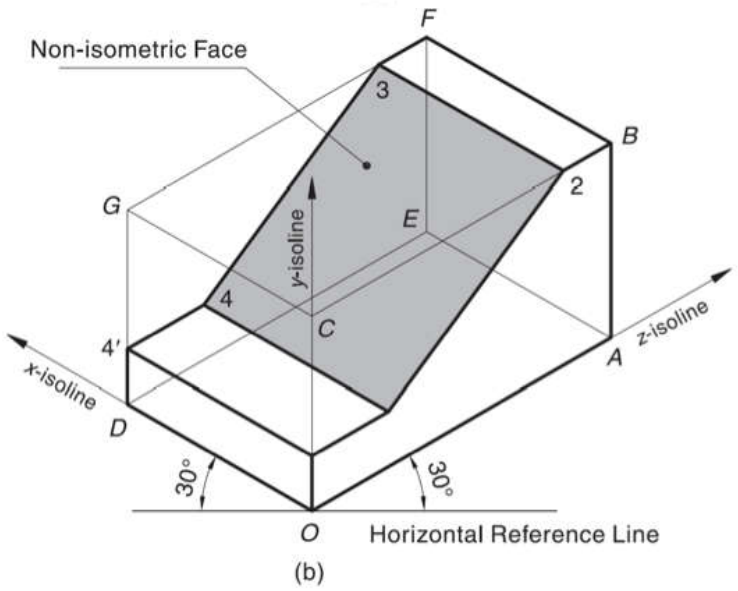


Ref: Engineering Drawing by N. D. Bhatt et. al

Isometric Drawing of a Typical Solid

Draw the isometric drawing of the solid whose orthographic projection is as shown below





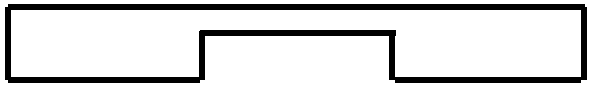
(b)

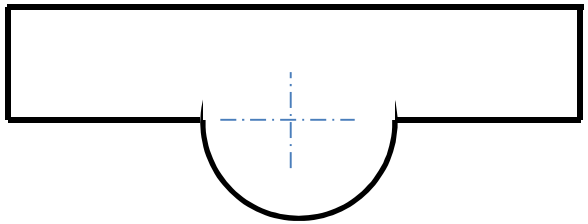
Reading of Orthographic Views

If the front view of the object is as shown, find out the possible top view of the object

Front View

Possible Top Views





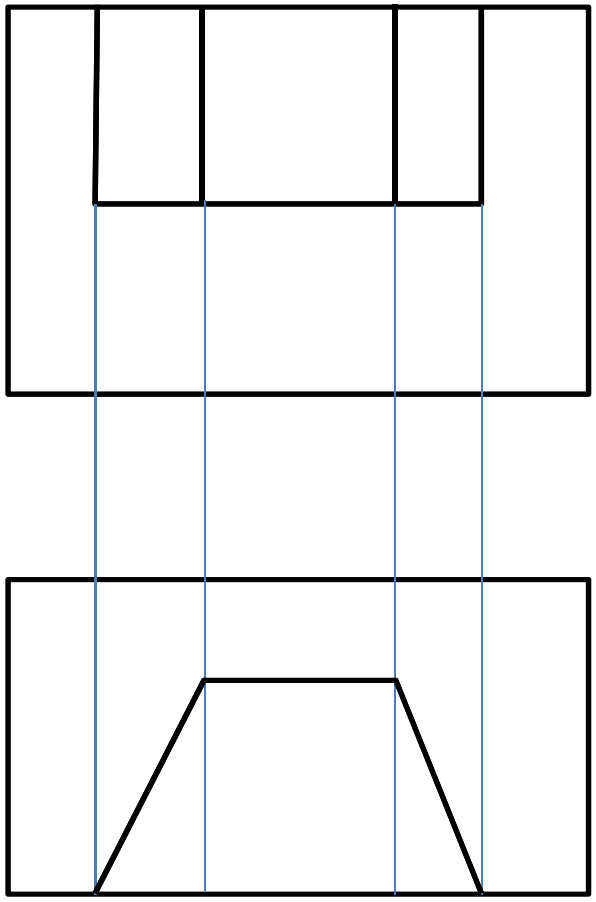
Since any view in an orthographic projection gives only two dimensions of a three-dimensional object, it is not possible to visualize the object from a single view

In an orthographic view

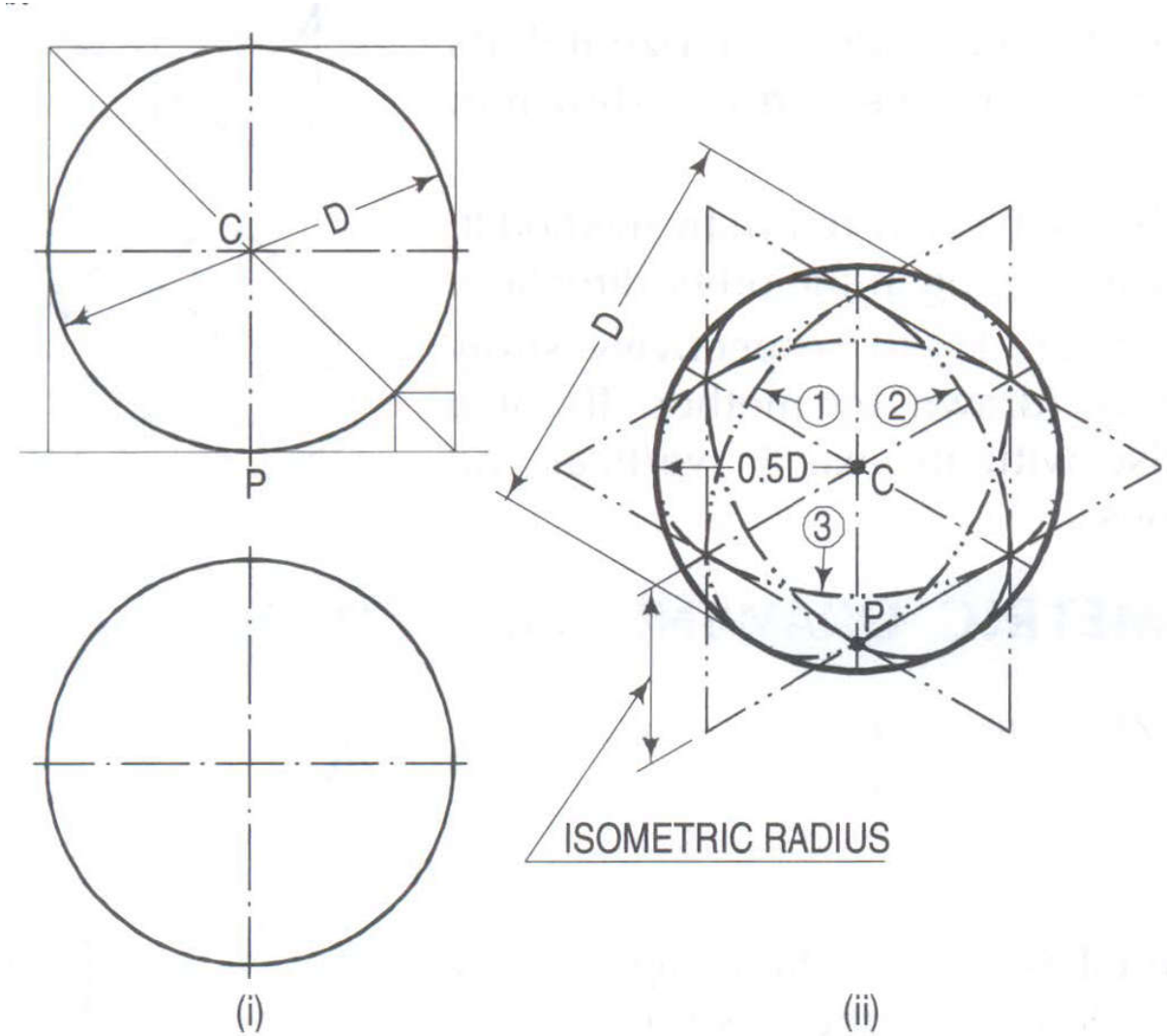
- Each point represents a corner or an edge
- Each line represents an edge or a surface

Isometric Drawing of a Typical Solid

Draw the isometric drawing of the solid whose orthographic projection is as shown below



Isometric View of A Sphere

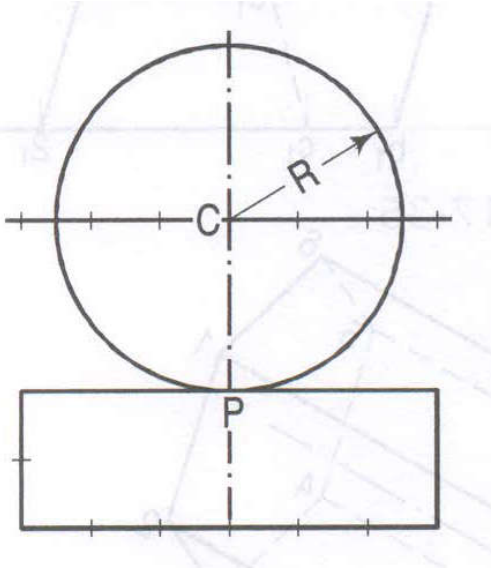


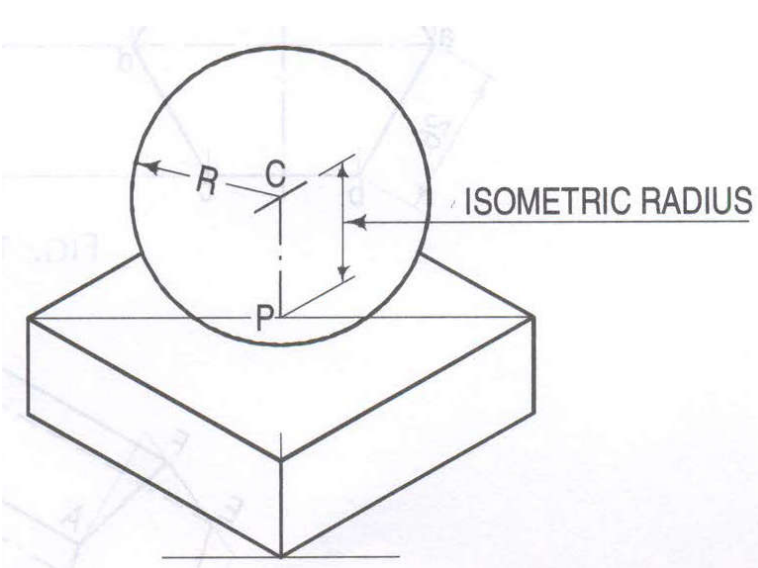
Isometric view of a sphere of diameter *D* is always a circle of diameter *D*

However, radial lines will in general be foreshortened

l(CP) = 0.81 D

Sphere Resting on Square Prism





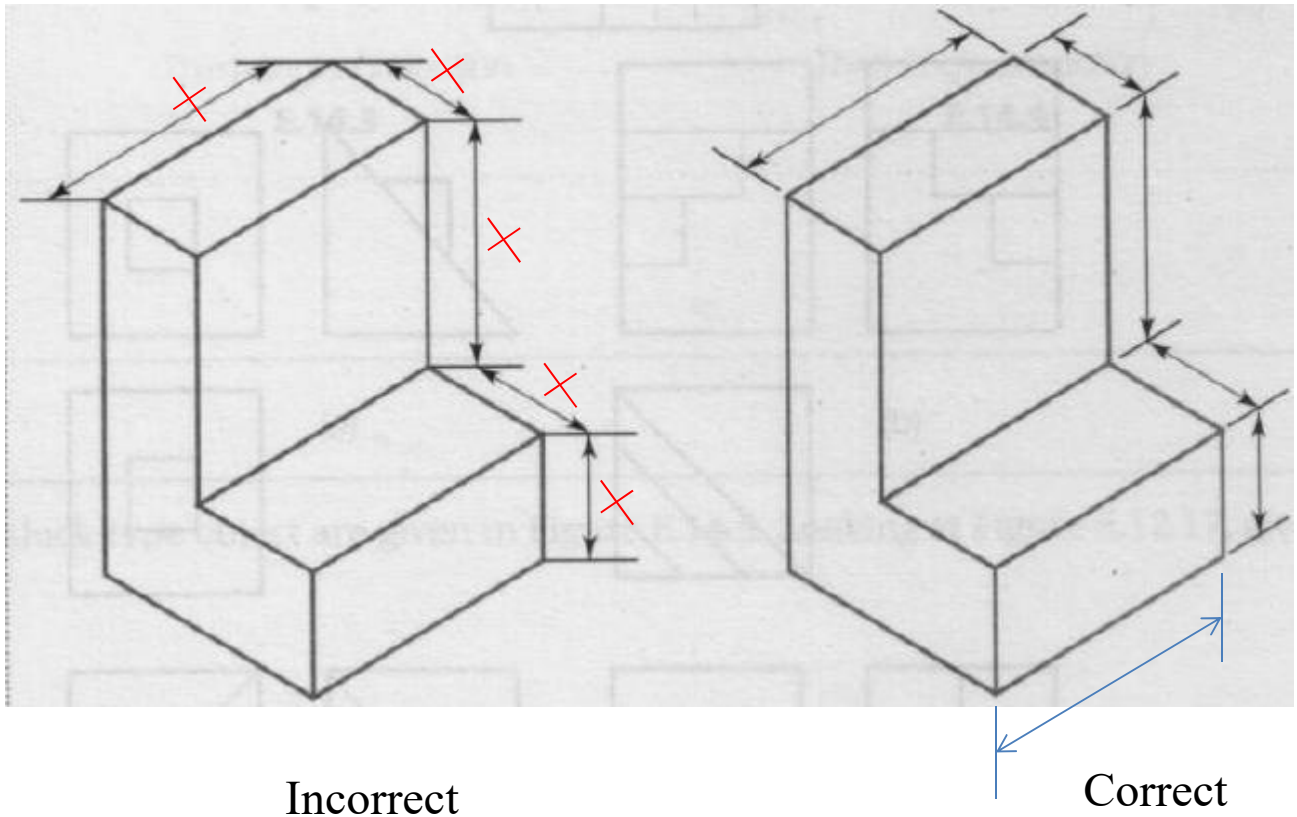
Problem 17-22. *Draw the isometric projection of a sphere resting centrally on the top of a square prism, the front view of which is shown in fig. 17-34(i).*

(i) Draw the isometric projection (using isometric scale) of the square prism and locate the centre *P* of its top surface [fig. 17-34(ii)].

(ii) Draw a vertical at *P* and mark a point *C* on it, such that *PC* = the *isometric radius* of the sphere.

(iii) With *C* as centre and *radius equal to the radius of the sphere*, draw a circle which will be the isometric projection of the sphere.

Dimensioning of Isometric Views



Incorrect

Correct

Engineering Drawing, Shah and Rana

Points to Remember

- When a line is perpendicular to a plane, its projection on that plane is a point, while its projection on the other perpendicular plane is a line equal to its true length
- When a line is inclined to the H.P. and the V.P., its projections are shorter than the true length in both the planes and its inclinations to the xy line are greater than the true inclinations
- When a line is parallel to the a plane, its projection on that plane will show its true length and its true inclination with the other plane
- When a plane is perpendicular to the reference plane, its projection on that plane is a straight line
- When a plane is parallel to a reference plane, its projections on that plane shows its true shape and size
- When a plane is perpendicular to one of the reference plane (A) and inclined to the other the other reference plane (B), its projection on A is a line and shows the angle it makes with B

Isometric Drawing In AutoCAD

- Use the ISODRAFT command, and choose the plane (right/left/top) to draw projections on isometric planes
- Use ELLIPSE command to draw circles on isometric planes
  - After using ISODRAFT command
- Use DIMALIGNED, followed by DIMEDIT and DIMTEDIT to correctly dimension the isometric views

Urls have been posted on moodle. Please check these out before coming to lab

END