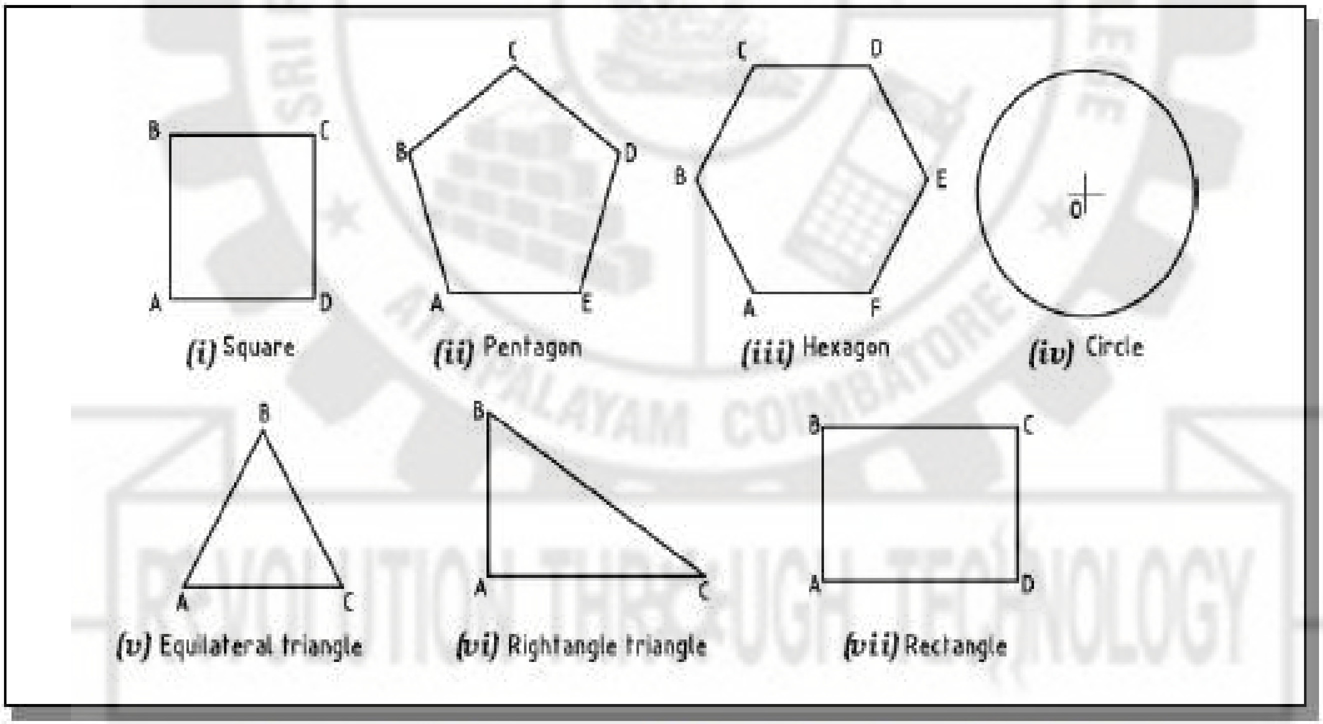
PROJECTIONS OF PLANES

A plane is a two dimensional object having length and breadth only. Its thickness is always neglected. Various shapes of plane figures are considered such as square, rectangle, circle, pentagon, hexagon, etc.



PROJECTIONS OF PLANES

In this topic various plane figures are the objects.

What is usually asked in the problem?

To draw their projections means F.V, T.V. & S.V.

What will be given in the problem?

1. Description of the plane figure.
2. It's position with HP and VP.

In which manner it's position with HP & VP will be described?

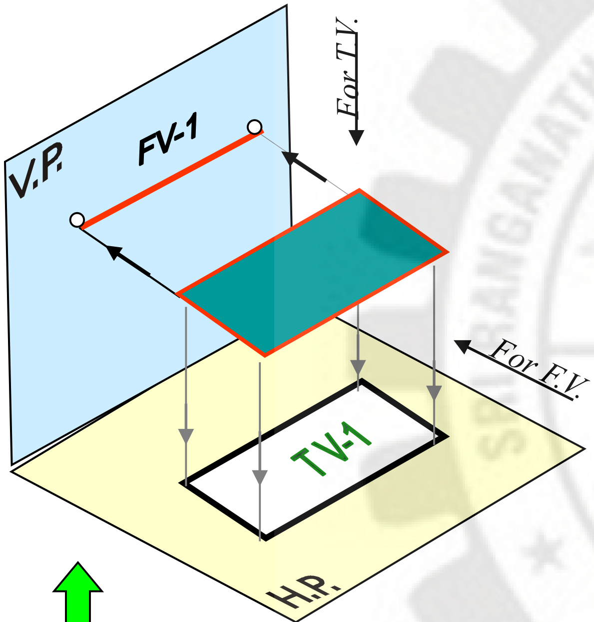
1. **Inclination of it's SURFACE with one of the reference planes will be given.**
2. Inclination of one of it's EDGES with other reference plane will be given

(Hence this will be a case of an object inclined to both reference Planes.)

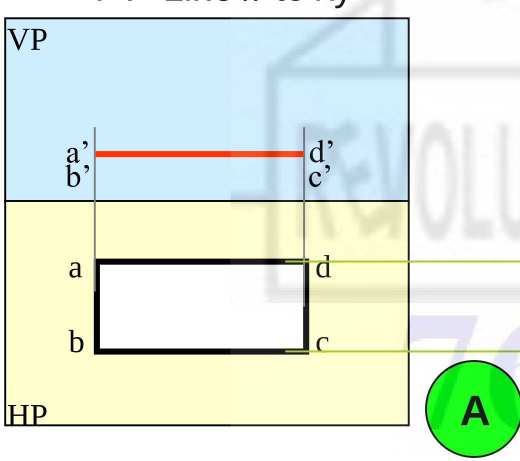
Study the illustration showing surface & side inclination given on next page.

CASE OF A RECTANGLE – OBSERVE AND NOTE ALL STEPS.

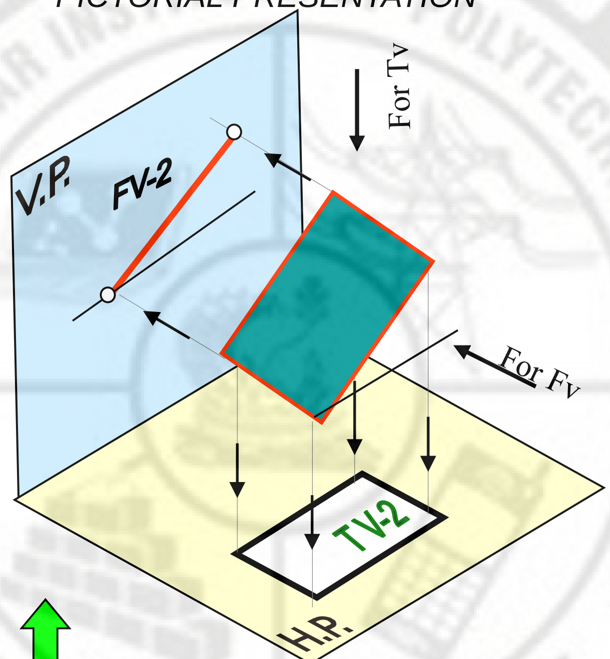
SURFACE **PARALLEL** TO HP
PICTORIAL PRESENTATION



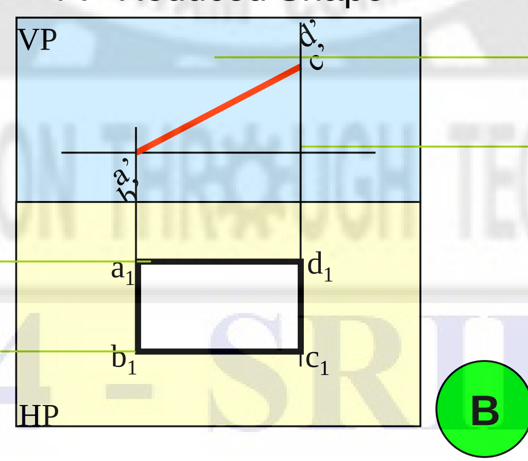
ORTHOGRAPHIC
TV-True Shape
FV- Line // to xy



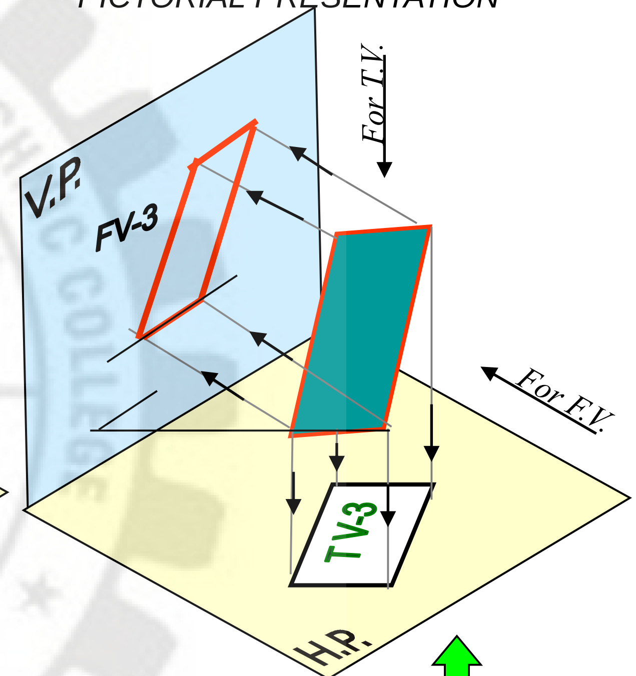
SURFACE **INCLINED** TO HP
PICTORIAL PRESENTATION



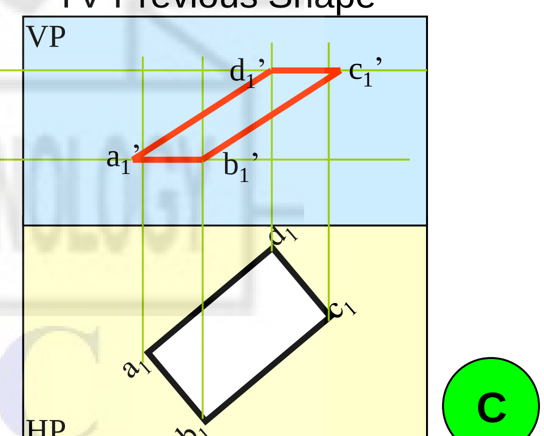
ORTHOGRAPHIC
FV- Inclined to XY
TV- Reduced Shape



ONE SMALL SIDE INCLINED TO VP
PICTORIAL PRESENTATION



ORTHOGRAPHIC
FV- Apparent Shape
TV-Previous Shape



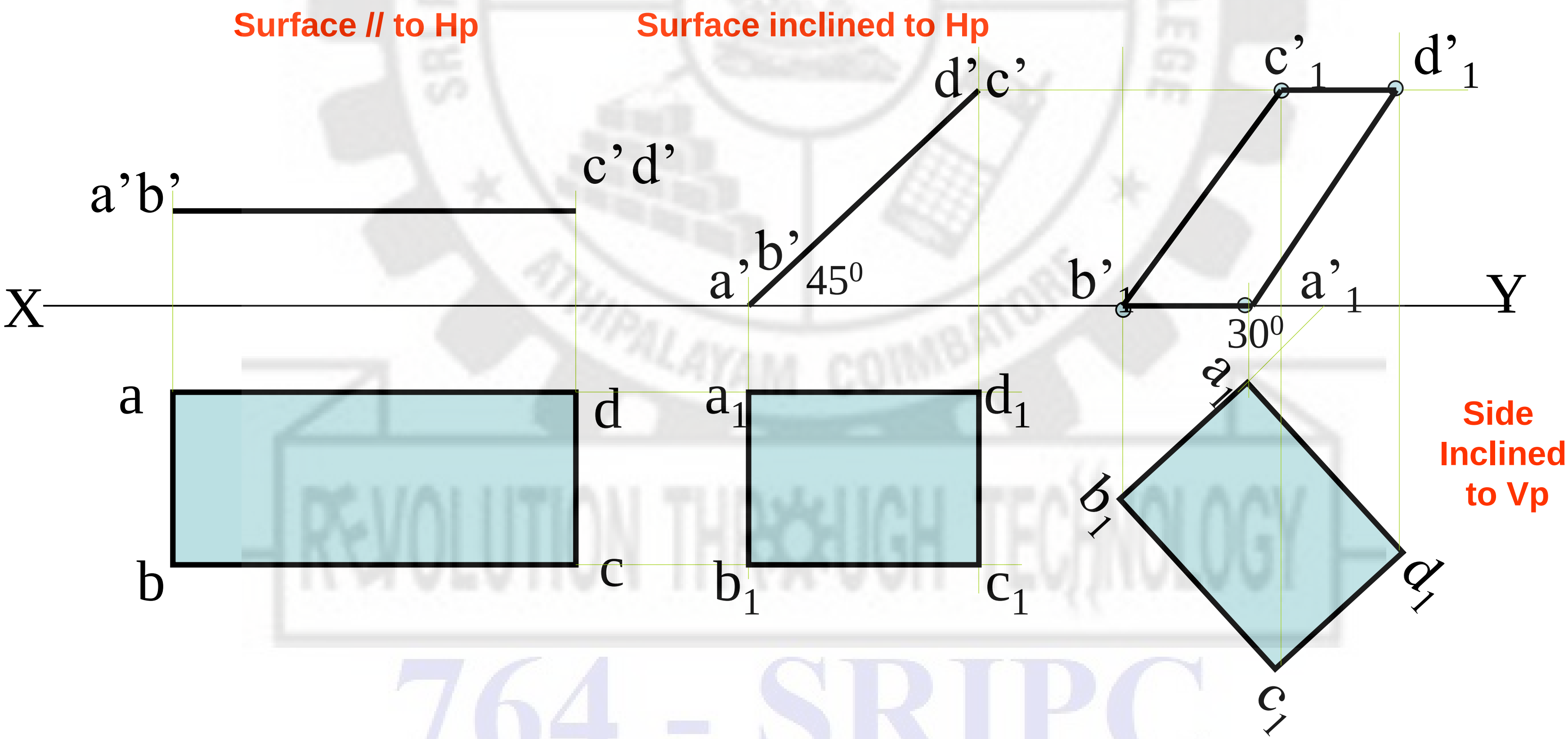
Problem 1:

Rectangle 30mm and 50mm sides is resting on HP on one small side which is 30^0 inclined to VP, while the surface of the plane makes 45^0 inclination with HP. Draw it's projections.

Read problem and answer following questions

1. Surface inclined to which plane? ------- HP
2. Assumption for initial position? ------// to HP
3. So which view will show True shape? --- TV
4. Which side will be vertical? ---One small side.

Hence begin with TV, draw rectangle below X-Y drawing one small side vertical.



Problem 2:

A $30^0 - 60^0$ set square of longest side 100 mm long, is in VP and 30^0 inclined to HP while it’s surface is 45^0 inclined to VP.Draw it’s projections

(Surface & Side inclinations directly given)

Read problem and answer following questions

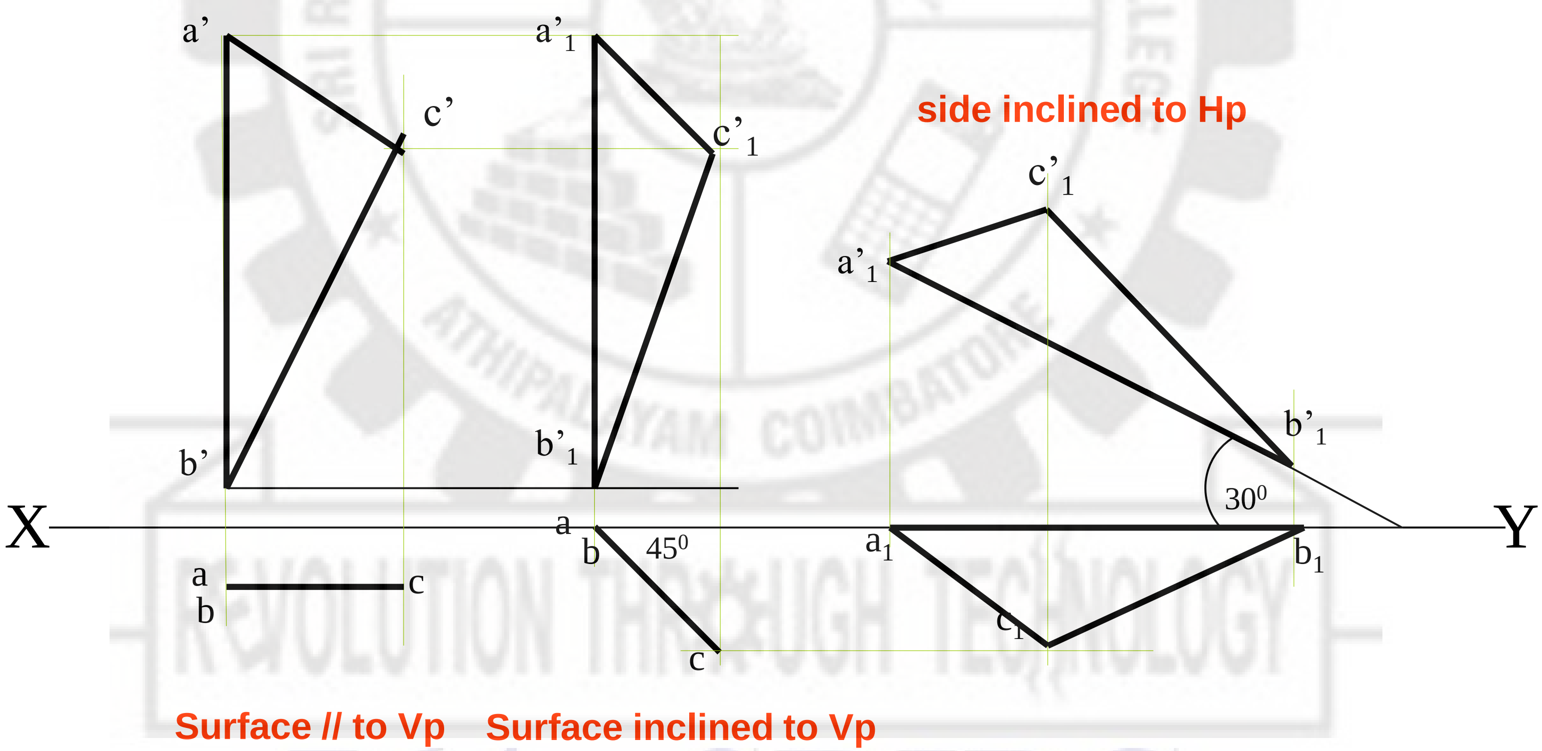
1 .Surface inclined to which plane? ------- VP

2. Assumption for initial position? ------// to VP

3. So which view will show True shape? --- FV

4. Which side will be vertical? ------longest side.

Hence begin with FV, draw triangle above X-Y keeping longest side vertical.



Problem 3:

A $30^0 – 60^0$ set square of longest side 100 mm long is in VP and it's surface 45^0 inclined to VP. One end of longest side is 10 mm and other end is 35 mm above HP. Draw it's projections

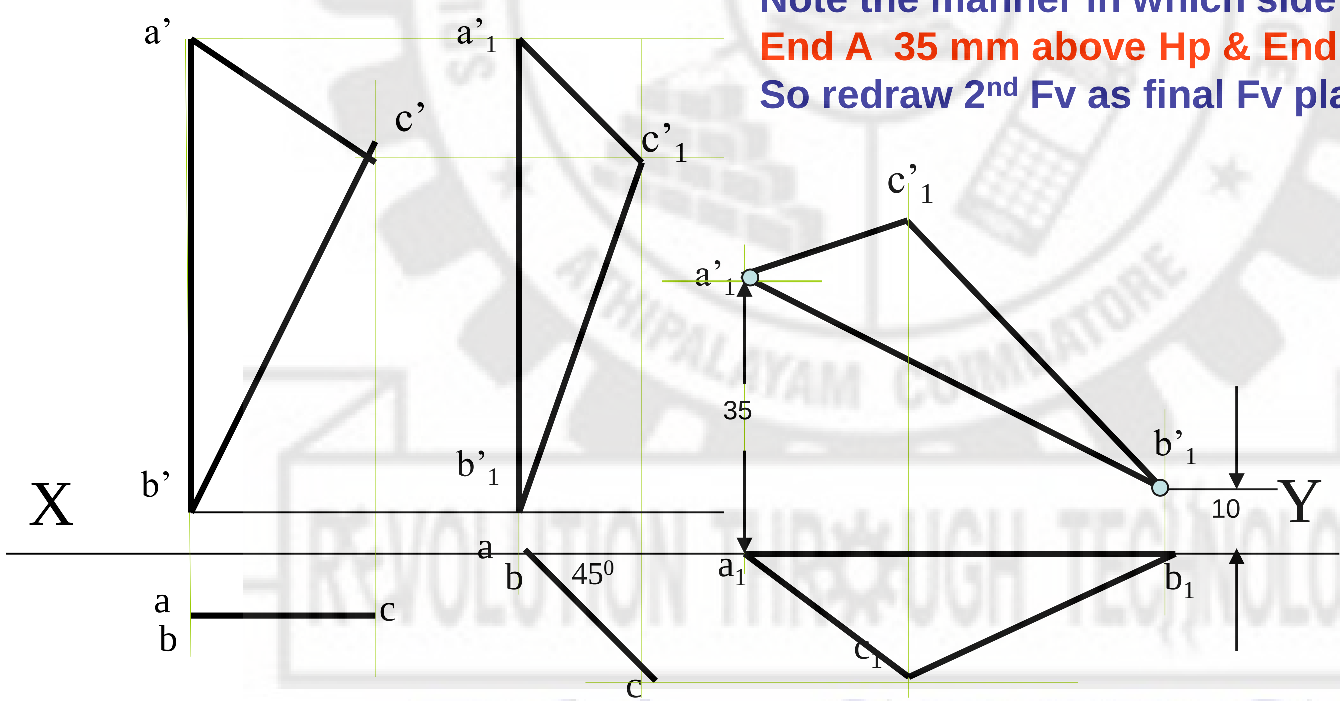
(Surface inclination directly given. Side inclination indirectly given)

<u>Read problem and answer following questions</u>

1 .Surface inclined to which plane? ------- VP
2. Assumption for initial position? ------// to VP
3. So which view will show True shape? --- FV
4. Which side will be vertical? ------longest side.

<u>Hence begin with FV, draw triangle above X-Y keeping longest side vertical.</u>

First TWO steps are similar to previous problem.
Note the manner in which side inclination is given.
End A 35 mm above Hp & End B is 10 mm above Hp.
So redraw 2nd Fv as final Fv placing these ends as said.



Problem 4:

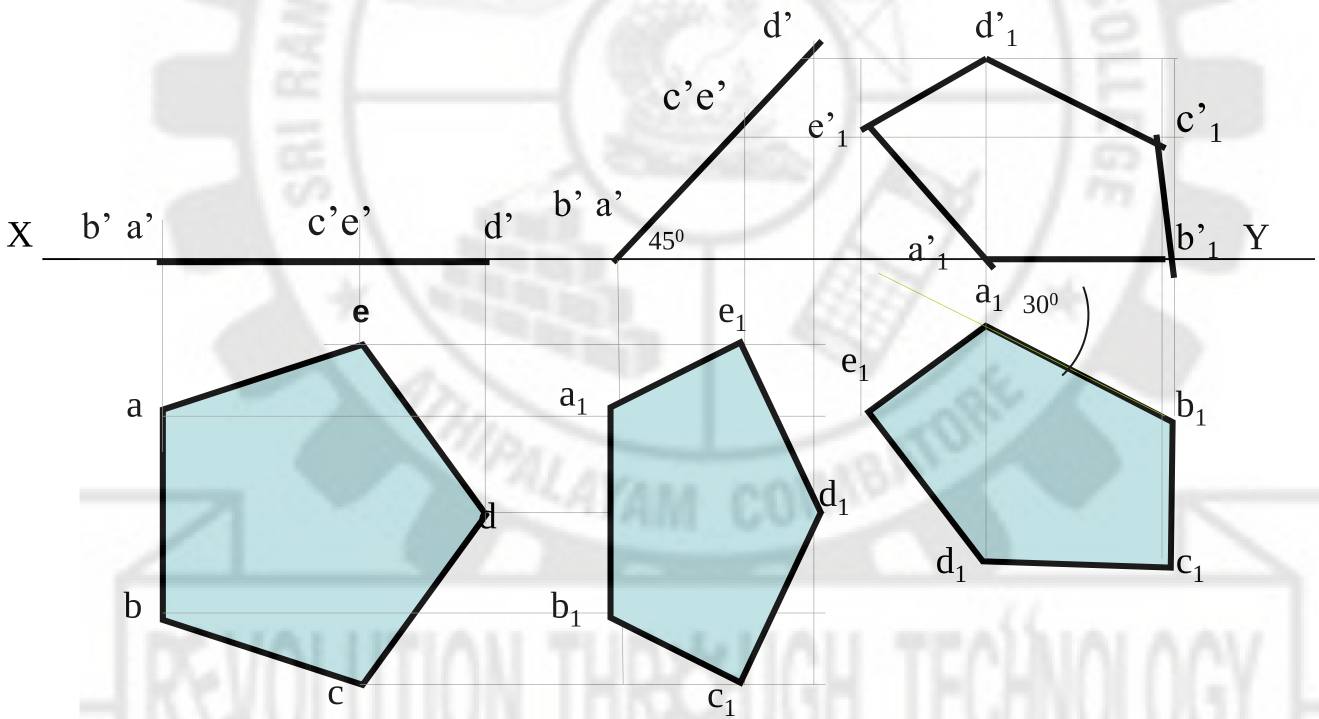
A regular pentagon of 30 mm sides is resting on HP on one of it's sides with it's surface 45^0 inclined to HP.
Draw it's projections when the side in HP makes 30^0 angle with VP

SURFACE AND SIDE INCLINATIONS ARE DIRECTLY GIVEN.

Read problem and answer following questions

1. Surface inclined to which plane? ------- ***HP***
2. Assumption for initial position? ------ ***// to HP***
3. So which view will show True shape? --- ***TV***
4. Which side will be vertical? -------- ***any side.***

Hence begin with TV, draw pentagon below X-Y line, taking one side vertical.



Problem 5:

A regular pentagon of 30 mm sides is resting on HP on one of it's sides while it's opposite vertex (corner) is 30 mm above HP.
Draw projections when side in HP is 30^0 inclined to VP.

Read problem and answer following questions

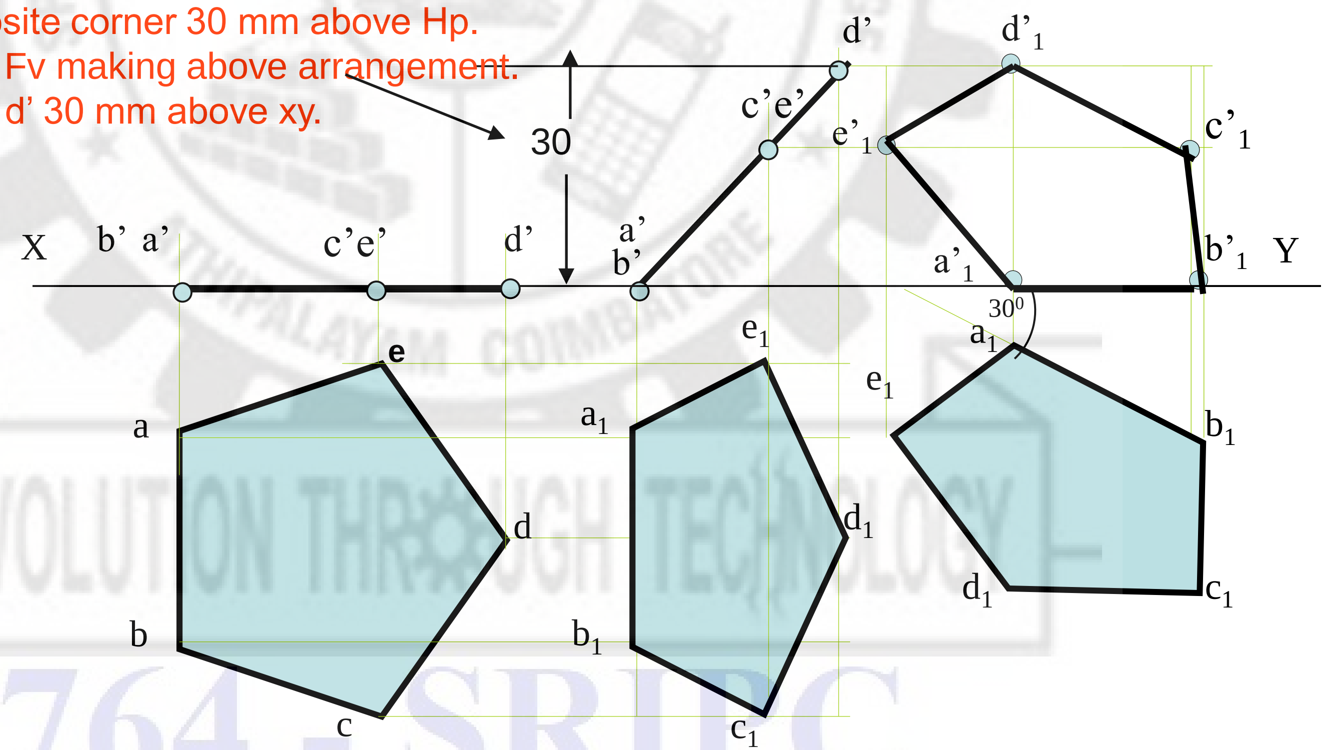
1. Surface inclined to which plane? ------- ***HP***
2. Assumption for initial position? ------ ***// to HP***
3. So which view will show True shape? --- ***TV***
4. Which side will be vertical? --------***any side.***

Hence begin with TV,draw pentagon below

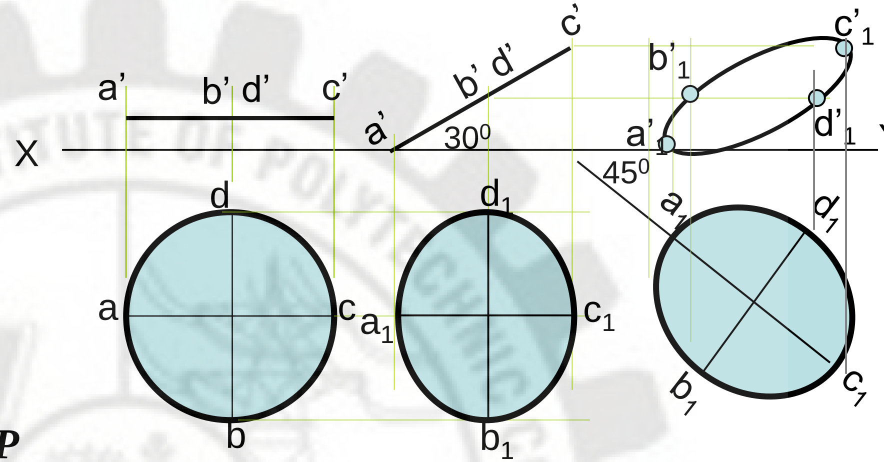
X-Y line, taking one side vertical.

SURFACE INCLINATION INDIRECTLY GIVEN
SIDE INCLINATION DIRECTLY GIVEN:

ONLY CHANGE is
the manner in which surface inclination is described:
One side on Hp & it's opposite corner 30 mm above Hp.
Hence redraw 1st Fv as a 2nd Fv making above arrangement.
Keep a'b' on xy & d' 30 mm above xy.



Problem 8: A circle of 50 mm diameter is resting on Hp on end A of it's diameter AC which is 30^0 inclined to Hp while it's Tv is 45^0 inclined to Vp.Draw it's projections.



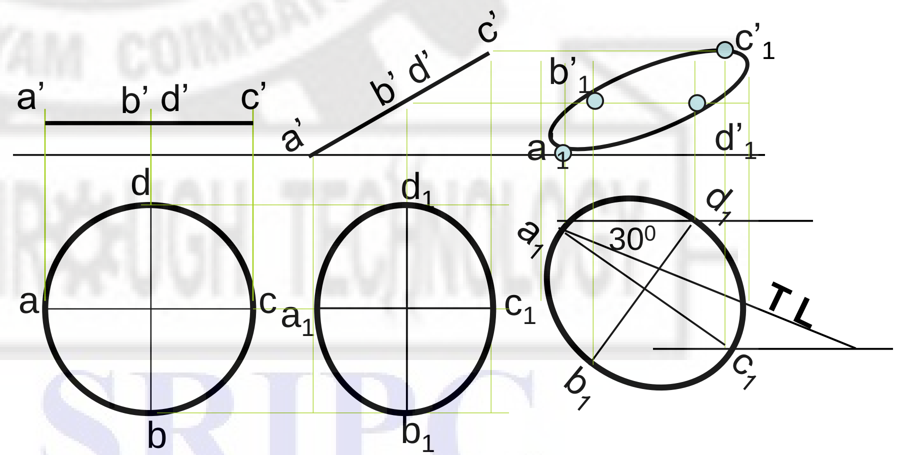
Read problem and answer following questions

1. Surface inclined to which plane? ------- ***HP***
2. Assumption for initial position? ------ ***// to HP***
3. So which view will show True shape? --- ***TV***
4. Which diameter horizontal? ---------- ***AC***

Hence begin with TV,draw rhombus below X-Y line, taking longer diagonal // to X-Y

The difference in these two problems is in step 3 only.
In problem no.8 inclination of Tv of that AC is given,It could be drawn directly as shown in 3rd step.
While in no.9 angle of AC itself i.e. it's TL, is given. Hence here angle of TL is taken,locus of c_1 Is drawn and then LTV I.e. a_1 c_1 is marked and final TV was completed.Study illustration carefully.

Problem 9: A circle of 50 mm diameter is resting on Hp on end A of it's diameter AC which is 30^0 inclined to Hp while it makes 45^0 inclined to Vp. Draw it's projections.



Note the difference in construction of 3rd step in both solutions.

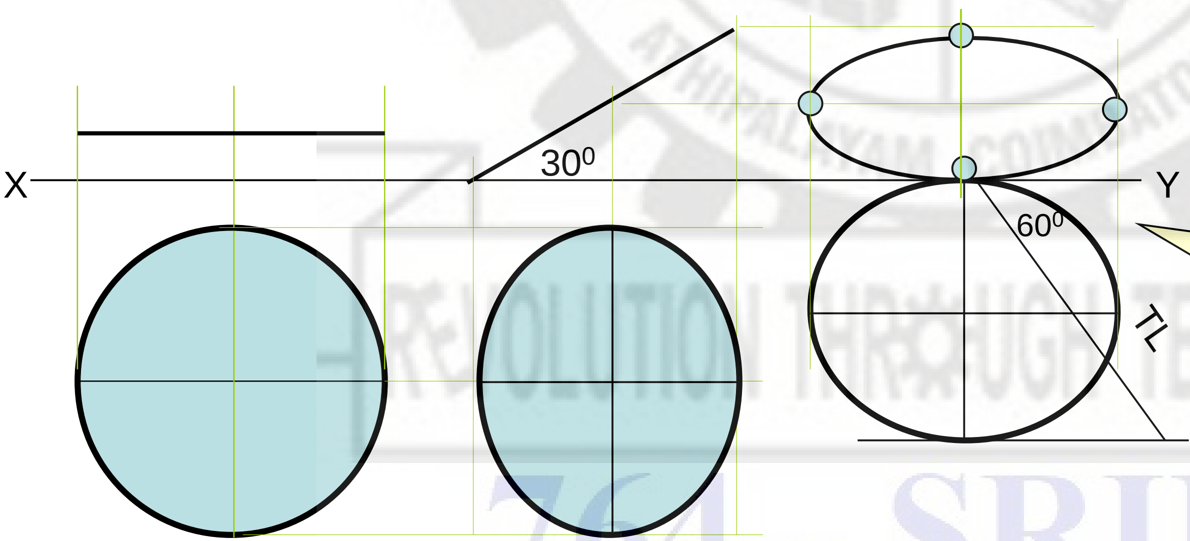
Problem 10: End A of diameter AB of a circle is in HP and end B is in VP.Diameter AB, 50 mm long is 30^0 & 60^0 inclined to HP & VP respectively. Draw projections of circle.

Read problem and answer following questions

1. Surface inclined to which plane? ------- ***HP***
2. Assumption for initial position? ------ ***// to HP***
3. So which view will show True shape? --- ***TV***
4. Which diameter horizontal? ---------- ***AB***

Hence begin with TV,draw CIRCLE below X-Y line, taking DIA. AB // to X-Y

The problem is similar to previous problem of circle – no.9.
But in the 3rd step there is one more change.
Like 9th problem True Length inclination of dia.AB is definitely expected but if you carefully note - the the SUM of it's inclinations with HP & VP is 90^0.
Means Line AB lies in a Profile Plane.
Hence it's both Tv & Fv must arrive on one single projector.
So do the construction accordingly AND ***note the case carefully***..



SOLVE SEPARATELY
ON DRAWING SHEET
GIVING NAMES TO VARIOUS
POINTS AS USUAL,
AS THE CASE IS IMPORTANT

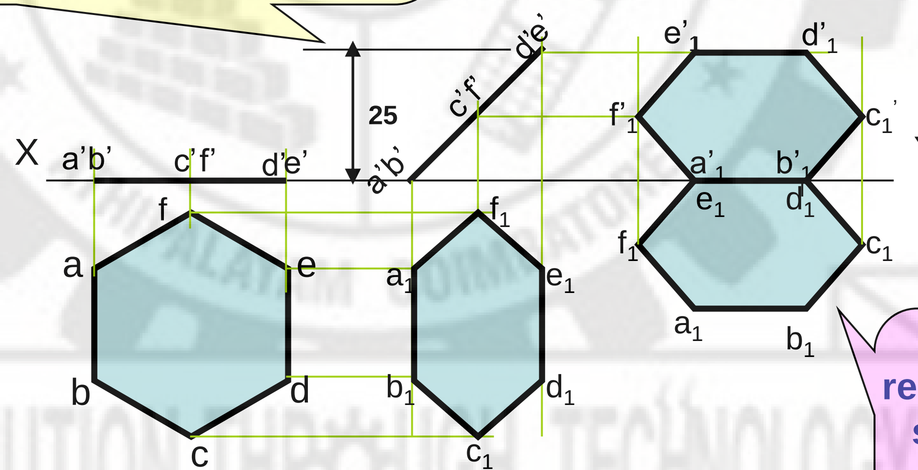
Problem 11:

A hexagonal lamina has its one side in HP and Its apposite parallel side is 25mm above Hp and In Vp. Draw it's projections.
Take side of hexagon 30 mm long.

Read problem and answer following questions
1. Surface inclined to which plane? ------- ***HP***
2. Assumption for initial position? ------ ***// to HP***
3. So which view will show True shape? --- ***TV***
4. Which diameter horizontal? ---------- ***AC***

Hence begin with TV,draw rhombus below X-Y line, taking longer diagonal // to X-Y

ONLY CHANGE is the manner in which surface inclination is described:
One side on Hp & it's opposite side 25 mm above Hp.
Hence redraw 1st Fv as a 2nd Fv making above arrangement.
Keep a'b' on xy & d'e' 25 mm above xy.



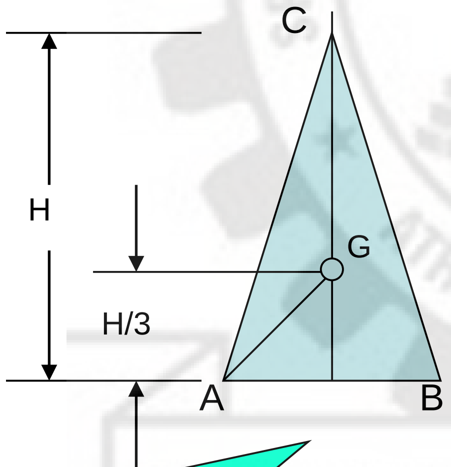
As 3rd step redraw 2nd Tv keeping side DE on xy line. Because it is in VP as said in problem.

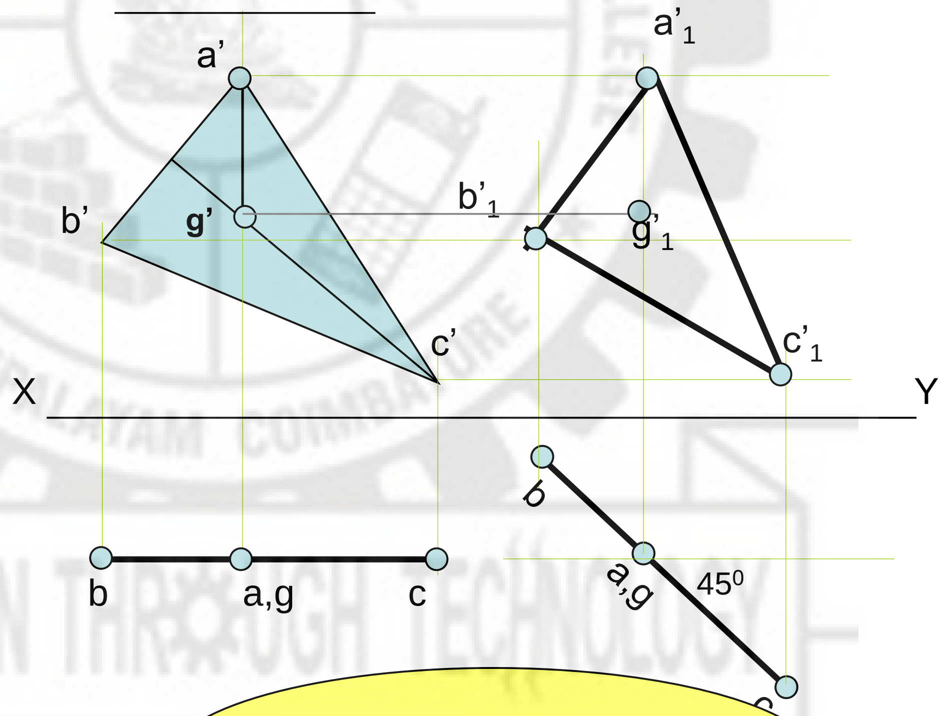
FREELY SUSPENDED CASES.

Problem 12:
An isosceles triangle of 40 mm long base side, 60 mm long altitude Is freely suspended from one corner of Base side.It's plane is 45^0 inclined to Vp. Draw it's projections.

IMPORTANT POINTS

1.In this case the plane of the figure always remains ***perpendicular to Hp***.
2.It may remain parallel or inclined to Vp.
3.Hence ***TV*** in this case will be always a ***LINE view.***
4.Assuming surface // to Vp, draw true shape in suspended position as FV.
(Here keep *line joining* ***point of contact & centroid of fig. vertical***)
5.Always begin with FV as a True Shape but in a suspended position.
AS shown in 1st FV.





First draw a given triangle With given dimensions, Locate it's centroid position And join it with point of suspension.

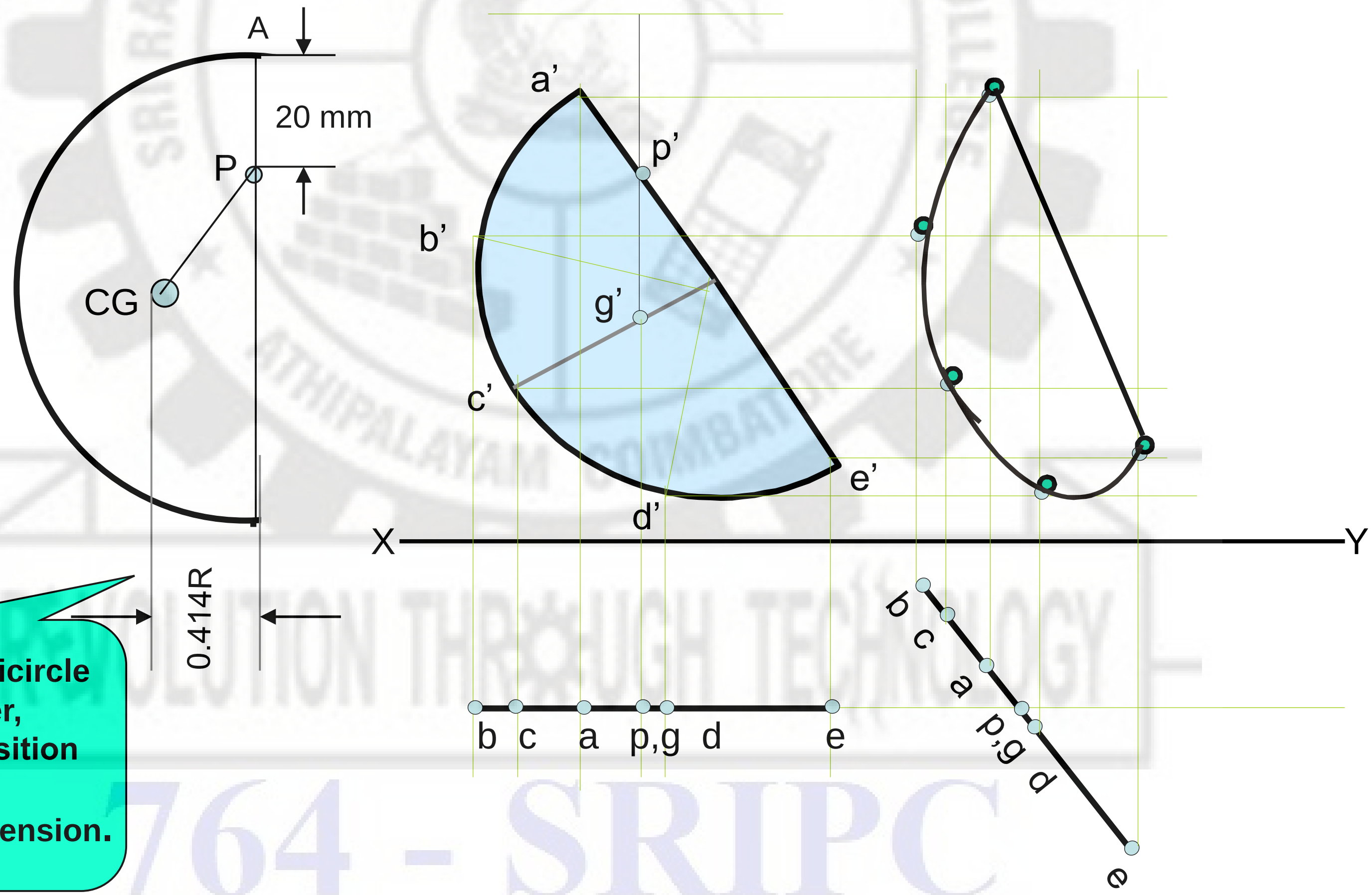
Similarly solve next problem of Semi-circle

IMPORTANT POINTS

1. In this case the plane of the figure always remains ***perpendicular to Hp***.
2. It may remain parallel or inclined to Vp.
3. Hence ***TV*** in this case will be always a ***LINE view.***
4. Assuming surface // to Vp, draw true shape in suspended position as FV.
   (Here keep *line joining* ***point of contact & centroid of fig. vertical***)
5. Always begin with FV as a True Shape but in a suspended position.
   AS shown in 1st FV.

Problem 13

:A semicircle of 100 mm diameter is suspended from a point on its straight edge 30 mm from the midpoint of that edge so that the surface makes an angle of 45^0 with VP. Draw its projections.



First draw a given semicircle
With given diameter,
Locate it's centroid position
And
join it with point of suspension.

To determine true shape of plane figure when it's projections are given.
BY USING AUXILIARY PLANE METHOD

WHAT WILL BE THE PROBLEM?
Description of final Fv & Tv will be given.
You are supposed to determine true shape of that plane figure.

Follow the below given steps:

1. Draw the given Fv & Tv as per the given information in problem.
2. Then among all lines of Fv & Tv select a line showing True Length (T.L.) (It's other view must be // to xy)
3. Draw x_1-y_1 perpendicular to this line showing T.L.
4. Project view on x_1-y_1 (it must be a line view)
5. Draw x_2-y_2 // to this line view & project new view on it.

It will be the required answer i.e. True Shape.

The facts you must know:-
If you carefully study and observe the solutions of all previous problems,
You will find
IF ONE VIEW IS A LINE VIEW & THAT TOO PARALLEL TO XY LINE,
THEN AND THEN IT'S OTHER VIEW WILL SHOW TRUE SHAPE:

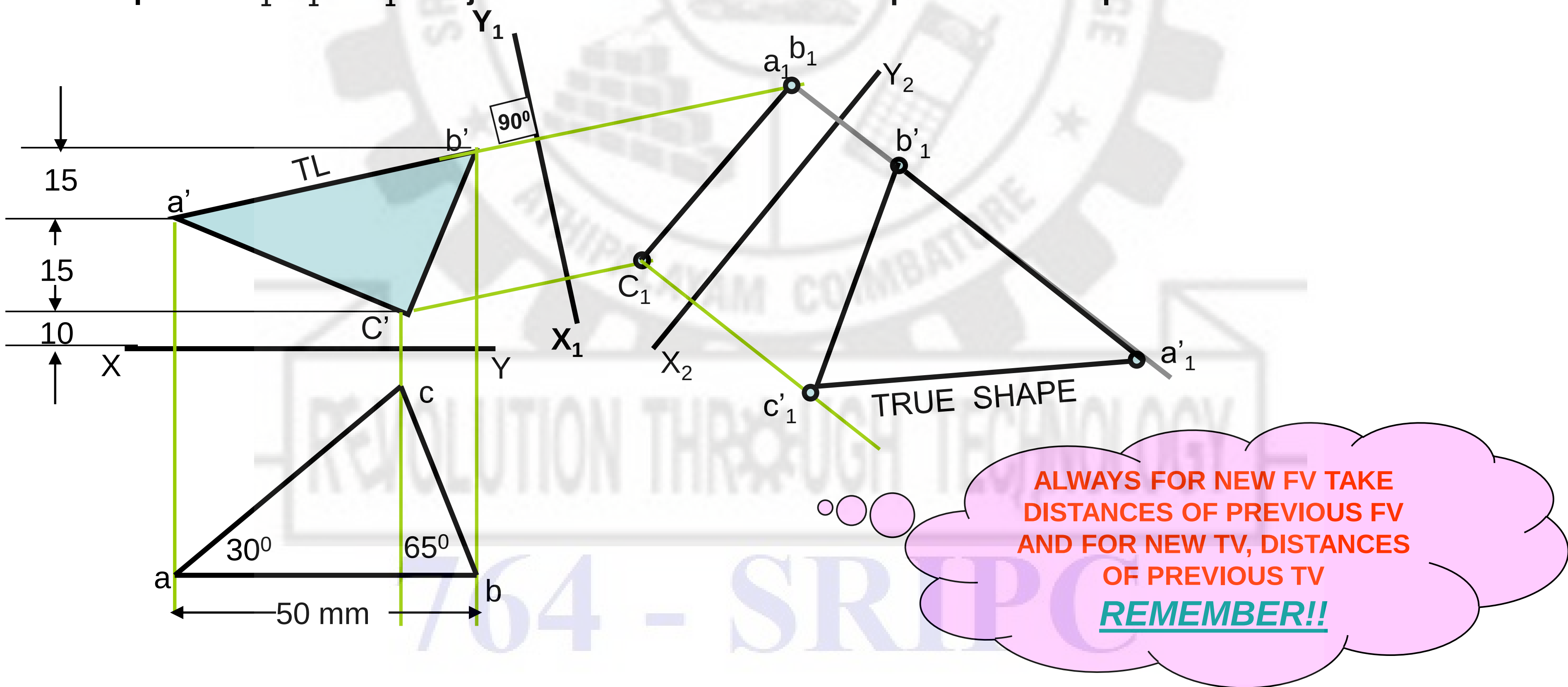
NOW FINAL VIEWS ARE ALWAYS SOME SHAPE, NOT LINE VIEWS:
SO APPLYING ABOVE METHOD:
WE FIRST CONVERT ONE VIEW IN INCLINED LINE VIEW .(By using x1y1 aux.plane)
THEN BY MAKING IT // TO X2-Y2 WE GET TRUE SHAPE.

Study Next Four Cases

Problem 14 Tv is a triangle abc. Ab is 50 mm long, angle cab is 300 and angle cba is 650. a’b’c’ is a Fv. a’ is 25 mm, b’ is 40 mm and c’ is 10 mm above Hp respectively. Draw projections of that figure and find it’s true shape.

As per the procedure-

1. First draw Fv & Tv as per the data.
2. In Tv line ab is // to xy hence it’s other view a’b’ is TL. So draw x_1y_1 perpendicular to it.
3. Project view on x1y1.
   a) First draw projectors from a’b’ & c’ on x_1y_1.
   b) from xy take distances of a,b & c(Tv) mark on these projectors from x_1y_1. Name points a1b1 & c1.
   c) This line view is an Aux.Tv. Draw x_2y_2 // to this line view and project Aux. Fv on it.
   for that from x_1y_1 take distances of a’b’ & c’ and mark from x_2y= on new projectors.
4. Name points a'_1 b'_1 & c'_1 and join them. This will be the required true shape.

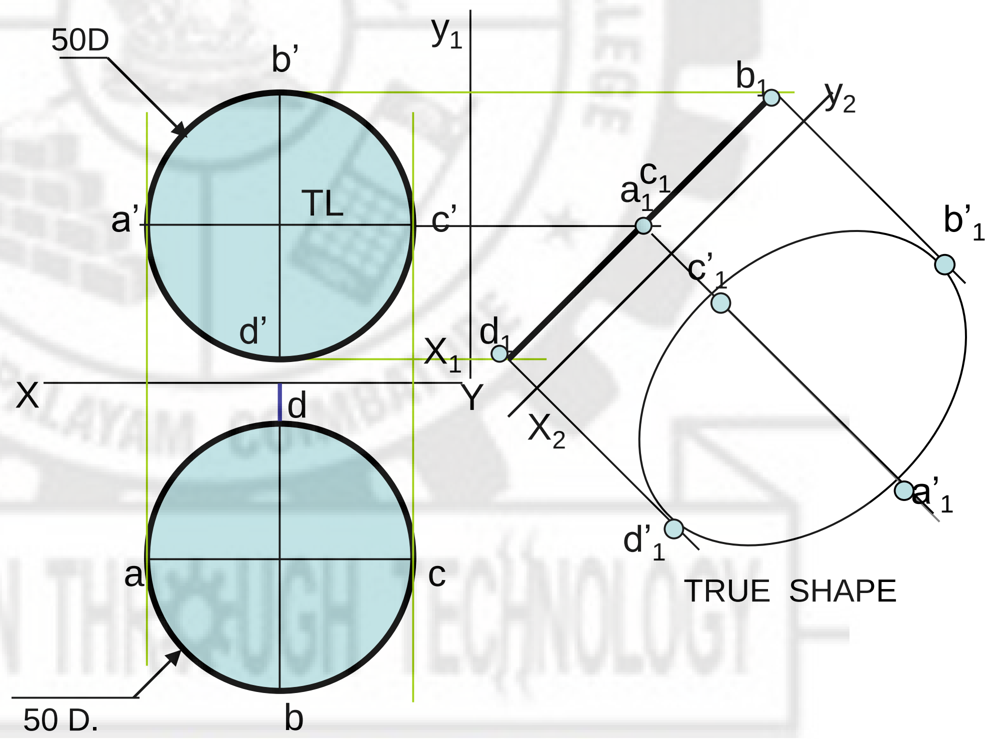


PROBLEM 15: Fv & Tv both are circles of 50 mm diameter. Determine true shape of an elliptical plate.

ADOPT SAME PROCEDURE.
a c is considered as line // to xy.
Then a'c' becomes TL for the purpose.
Using steps properly true shape can be Easily determined.

Study the illustration.

ALWAYS, FOR NEW FV TAKE DISTANCES OF PREVIOUS FV AND FOR NEW TV, DISTANCES OF PREVIOUS TV
REMEMBER!!

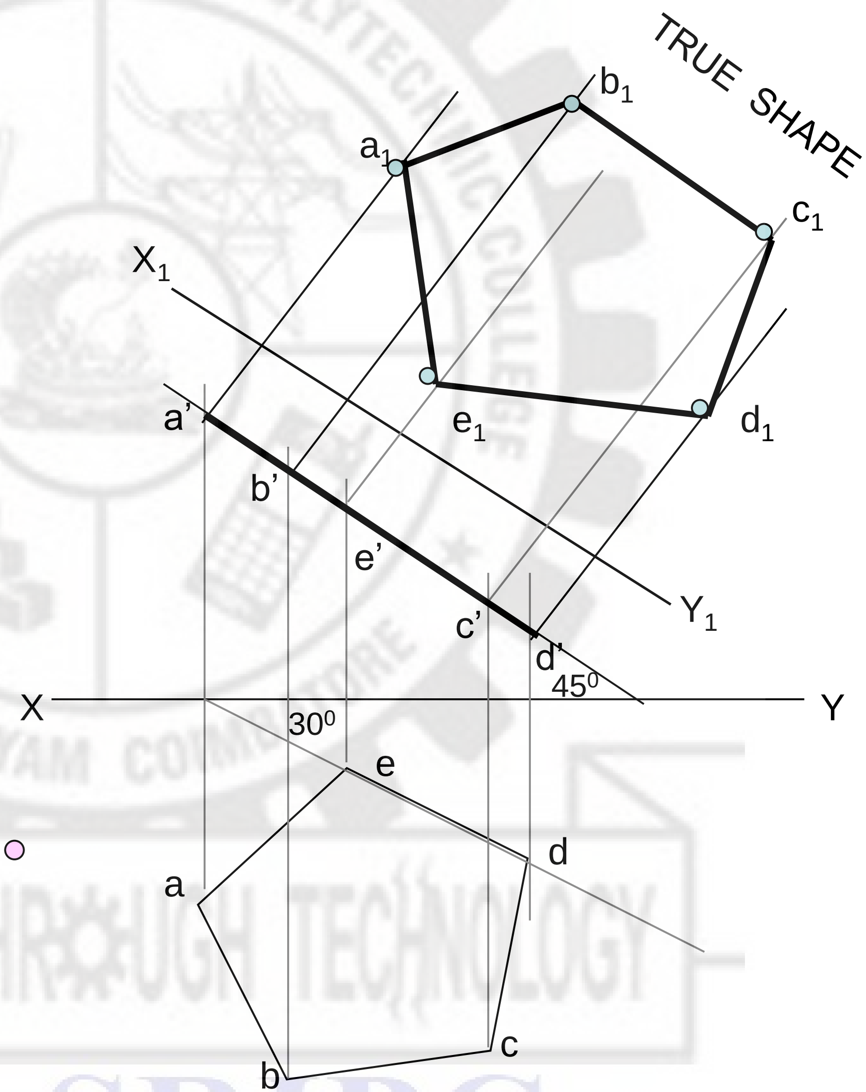


Problem 16 : Draw a regular pentagon of 30 mm sides with one side 30^0 inclined to xy. This figure is Tv of some plane whose Fv is A line 45^0 inclined to xy. Determine it's true shape.

IN THIS CASE ALSO TRUE LENGTH IS NOT AVAILABLE IN ANY VIEW.

BUT ACTUALLY WE DONOT REQUIRE TL TO FIND IT'S TRUE SHAPE, AS ONE VIEW (FV) IS ALREADY A LINE VIEW. SO JUST BY DRAWING X1Y1 // TO THIS VIEW WE CAN PROJECT VIEW ON IT AND GET TRUE SHAPE:

STUDY THE ILLUSTRATION..



ALWAYS FOR NEW FV TAKE DISTANCES OF PREVIOUS FV AND FOR NEW TV, DISTANCES OF PREVIOUS TV

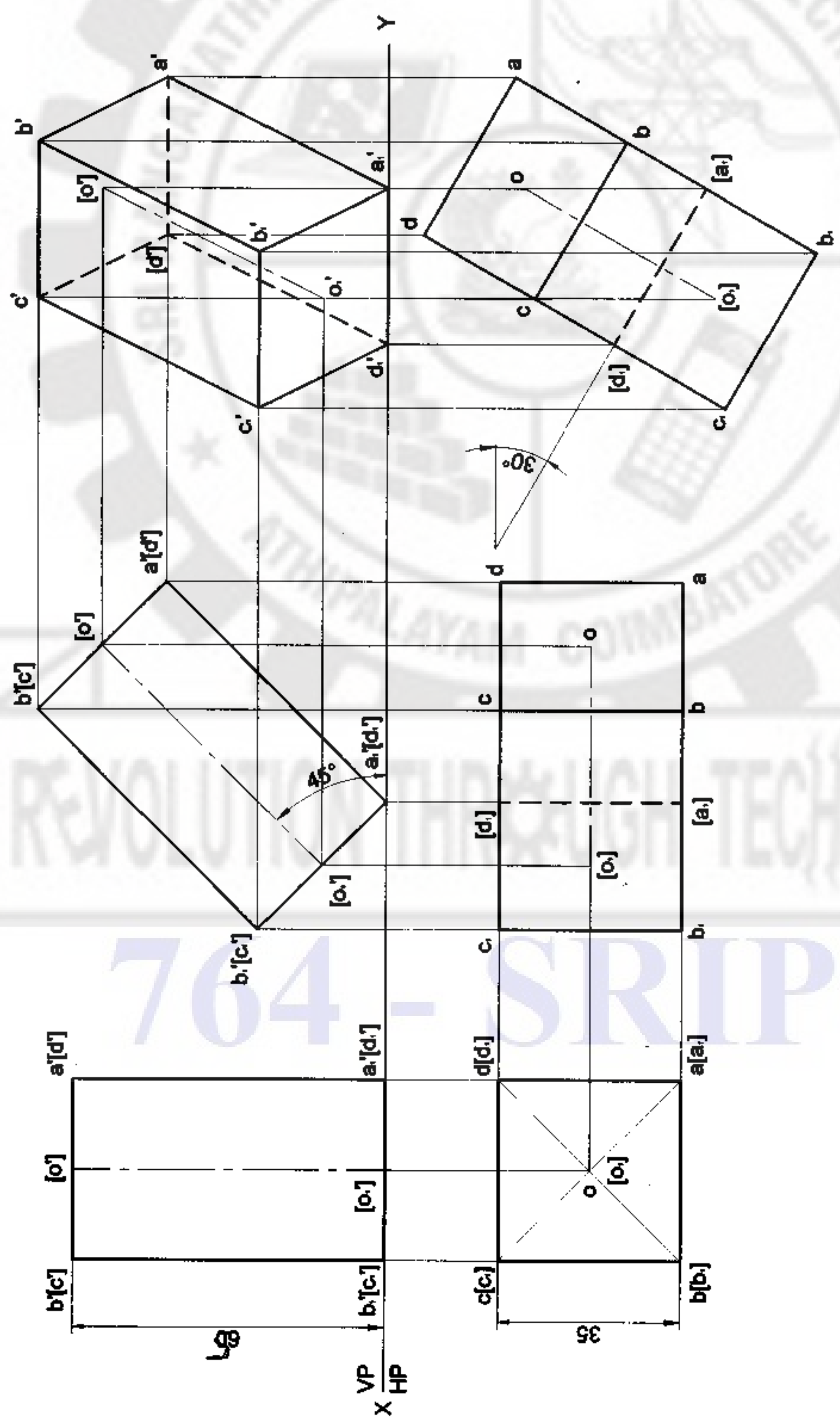
REMEMBER!!

CHAPTER 4

PROJECTIONS OF SOLIDS

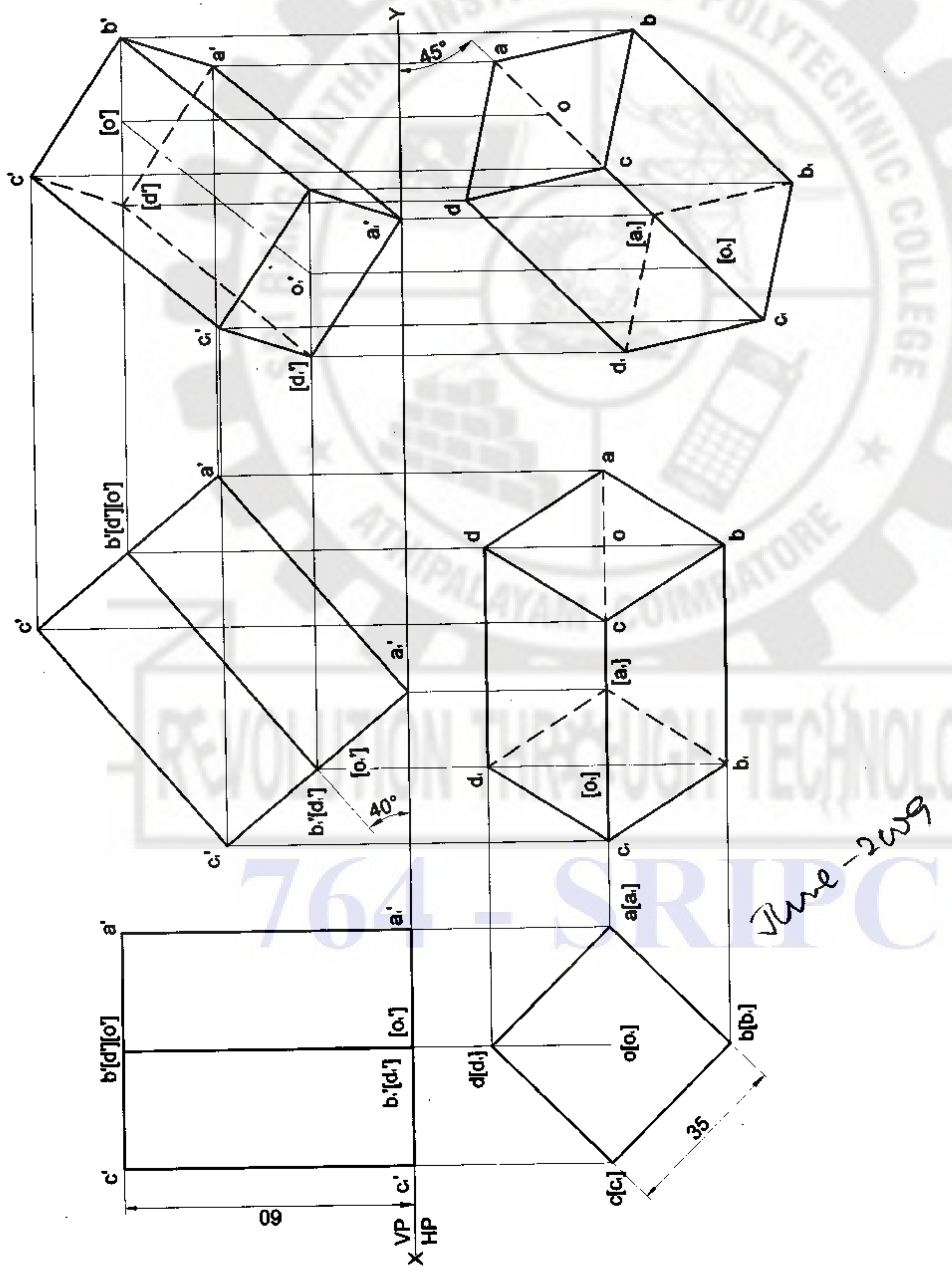
Problem 1 A square prism 35 mm sides of base and 65 mm axis length rests on HP on one of its edges of the base which is inclined to VP at 30º. Draw the projections of the prism when the axis is inclined to HP at 45º.

Solution



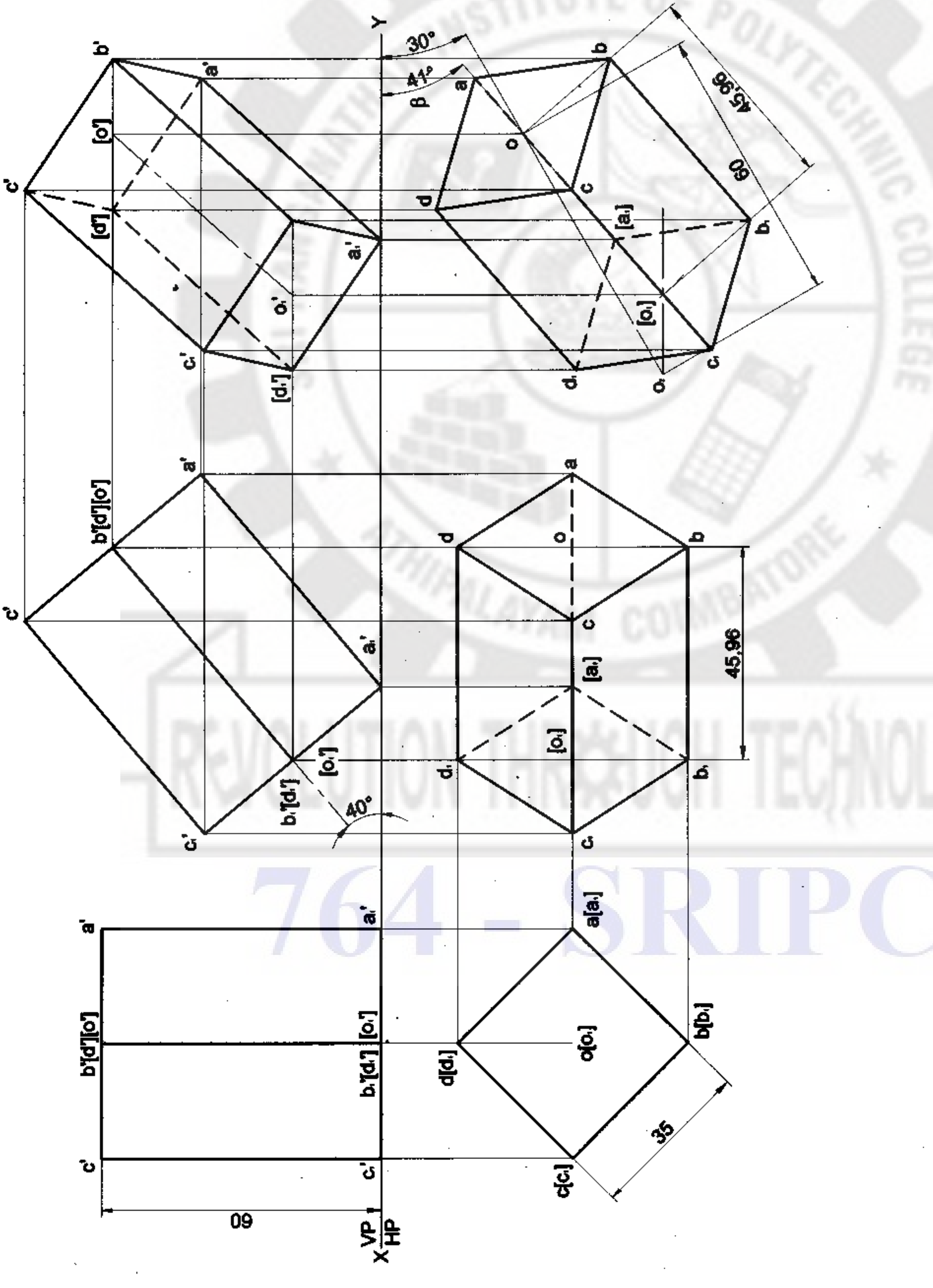
Problem 2 A square prism 35 mm sides of base and 60 mm axis length rests on HP on one of its corners of the base such that the two base edges containing the corner on which it rests make equal inclinations with HP. Draw the projections of the prism when the axis of the prism is inclined to HP at 40º and appears to be inclined to VP at 45º.

Solution



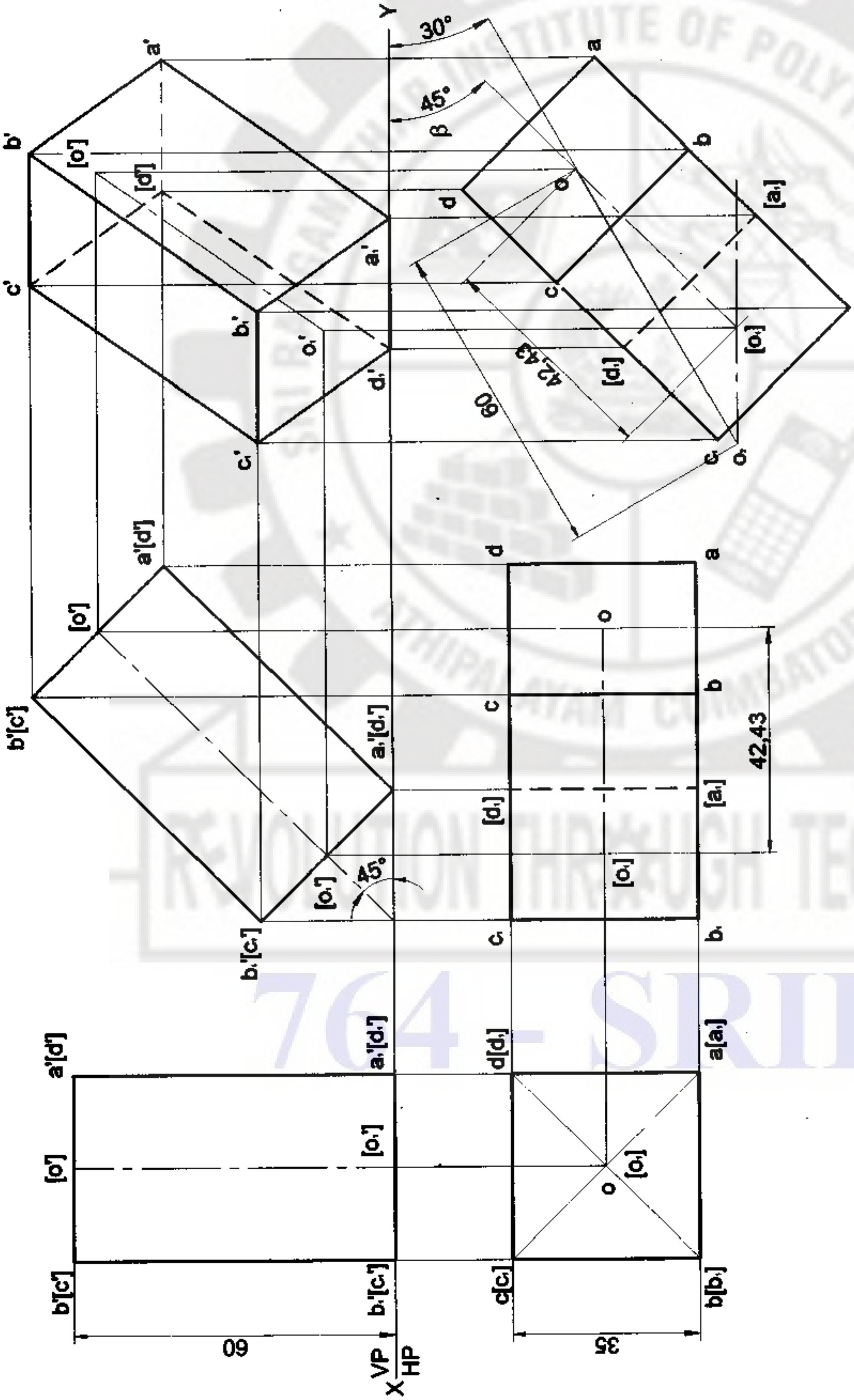
Problem 3 A square prism 35 mm sides of base and 60 mm axis length rests on HP on one of its corners of the base such that the two base edges containing the corner on which it rests make equal inclinations with HP. Draw the projections of the prism when the axis of the prism is inclined to HP at 40º and to VP at 30º.

Solution



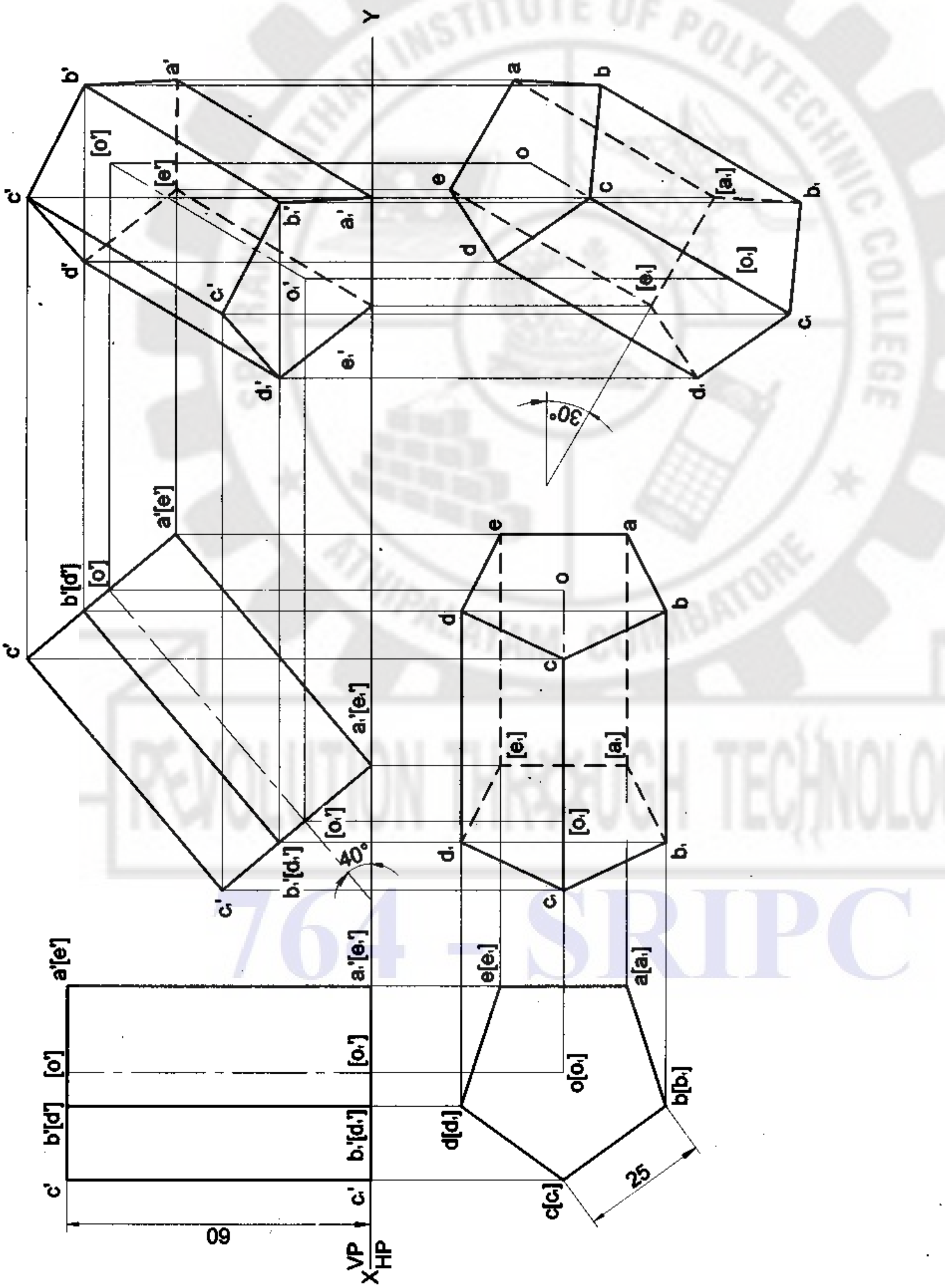
Problem 4 A square prism 35 mm sides of base and 60 mm axis length rests on HP on one of its edges of the base. Draw the projections of the prism when the axis is inclined to HP at 45º and VP at 30º.

Solution



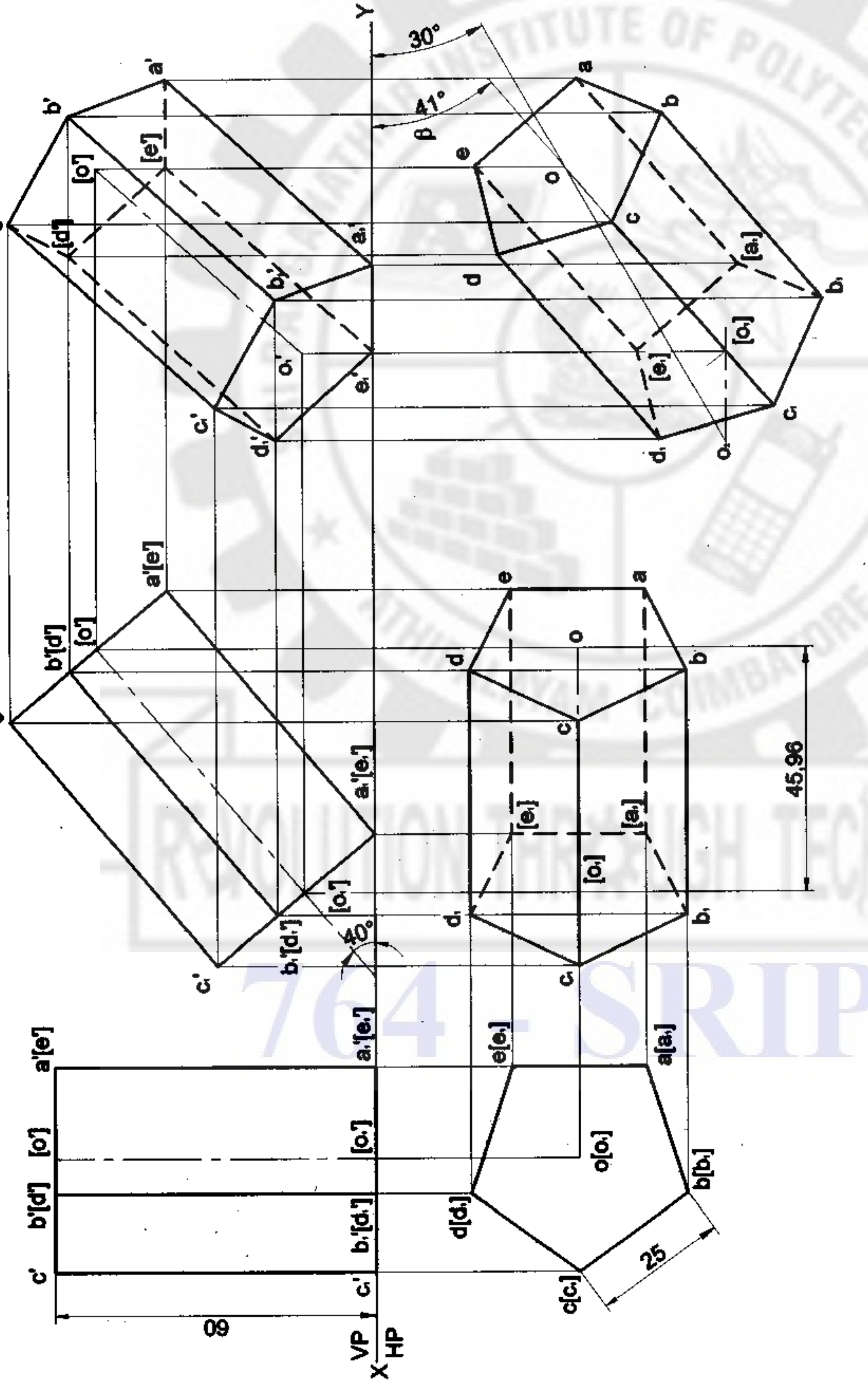
Problem 5 A pentagonal prism 25 mm sides of base and 60 mm axis length rests on HP on one of its edges of the base which is inclined to VP at 30º. Draw the projections of the prism when the axis is inclined to HP at 40º.

Solution



Problem 6 A pentagonal prism 25 mm sides of base and 60 mm axis length rests on HP on one of its edges of the base. Draw the projections of the prism when the axis is inclined to HP at 40º and VP at 30º.

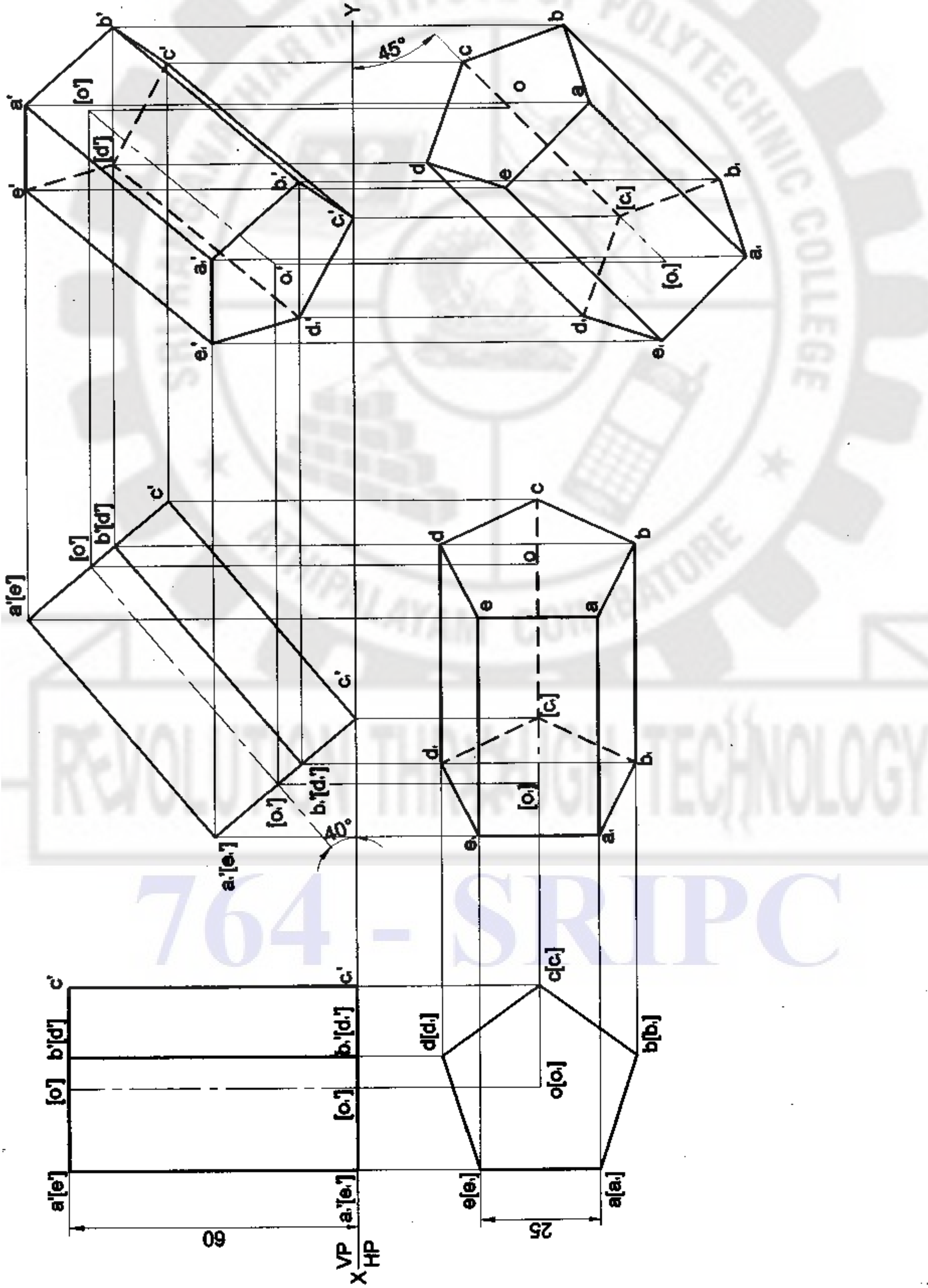
Solution



Problem 7 A pentagonal prism 25 mm sides of base and 50 mm axis length rests on HP on one of its corners of the base such that the two base edges containing the corner on which it rests make equal inclinations with HP. Draw the projections of the prism when the axis of the prism is inclined to HP at 40º and appears to be inclined to VP at 45º.

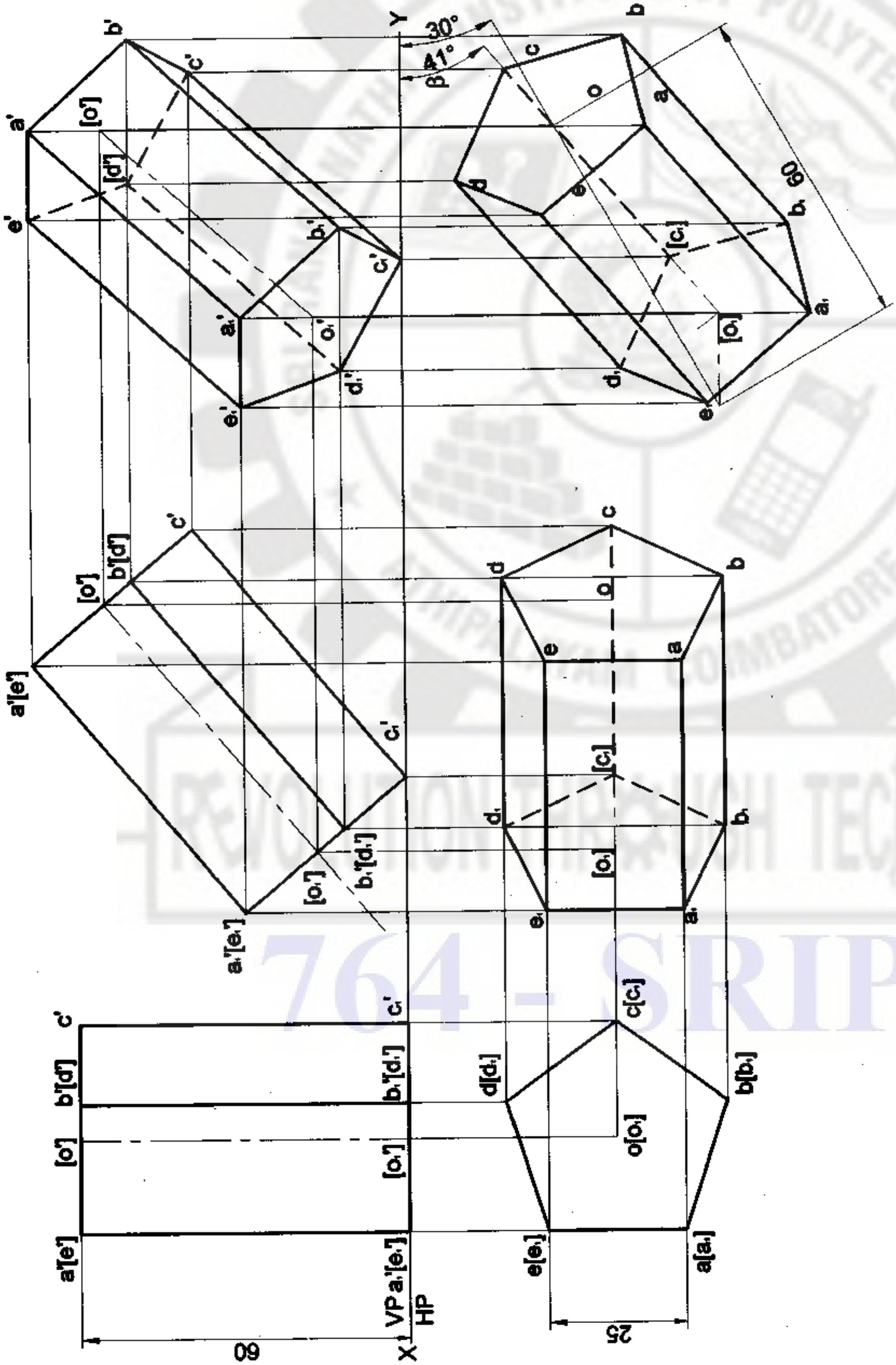
Solution

1



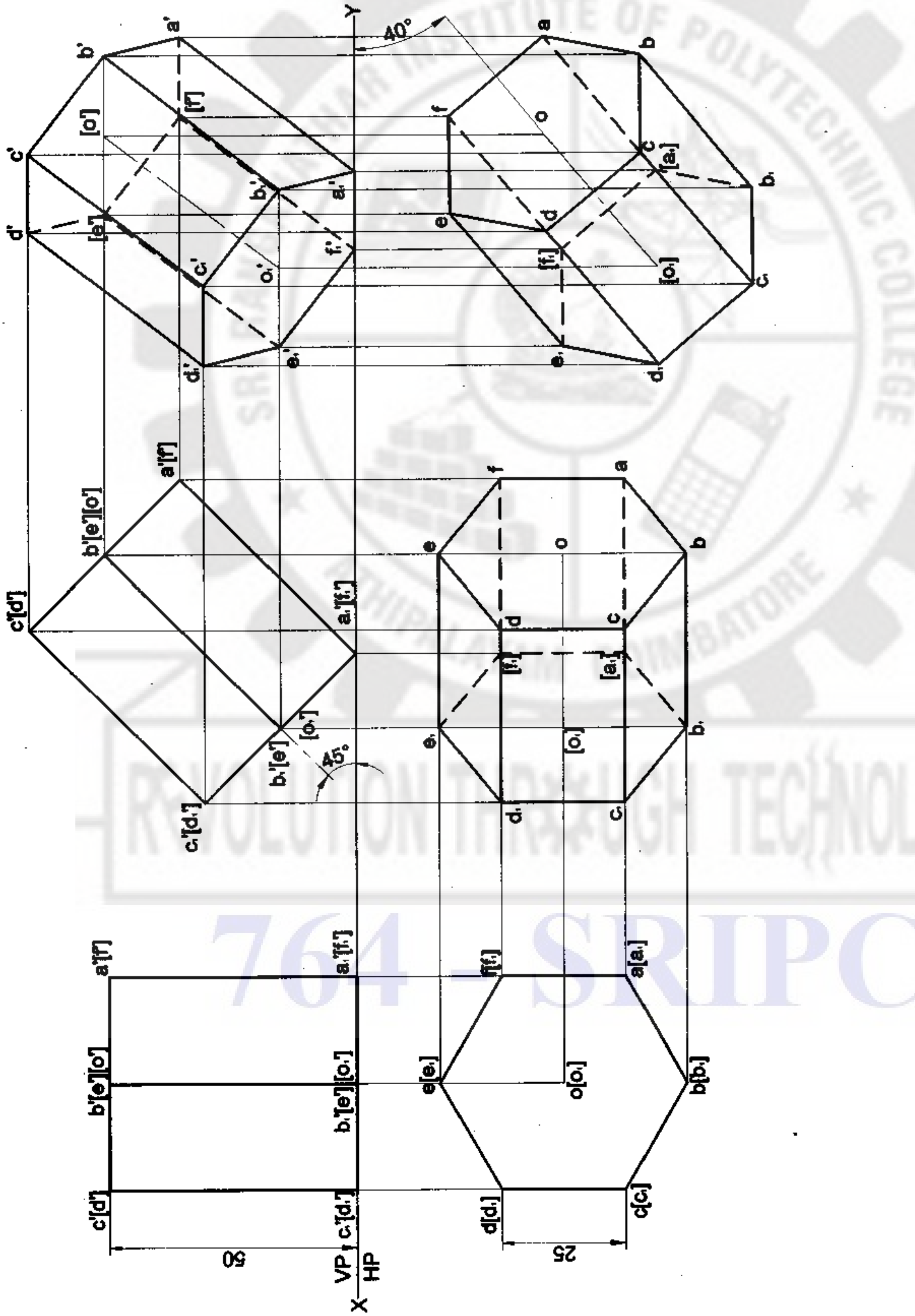
Problem 8 A pentagonal prism 25 mm sides of base and 50 mm axis length rests on HP on one of its corners of the base such that the two base edges containing the corner on which it rests make equal inclinations with HP. Draw the projections of the prism when the axis of the prism is inclined to HP at 40º and to VP at 30º.

Solution



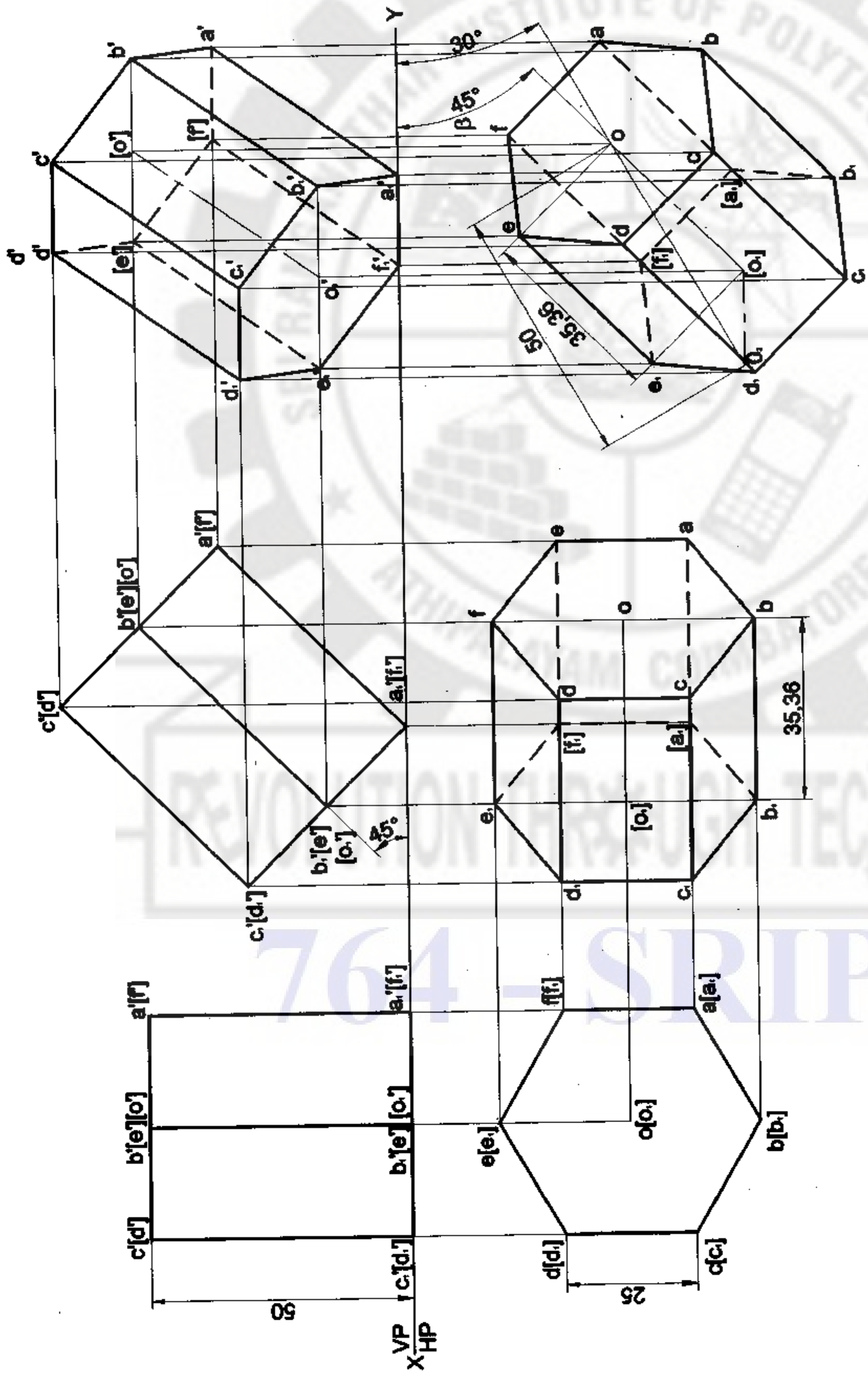
Problem 9 A hexagonal prism 25 mm sides of base and 50 mm axis length rests on HP on one of its edges. Draw the projections of the prism when the axis is inclined to HP at 45º and appears to be inclined to VP 40⁰.

Solution



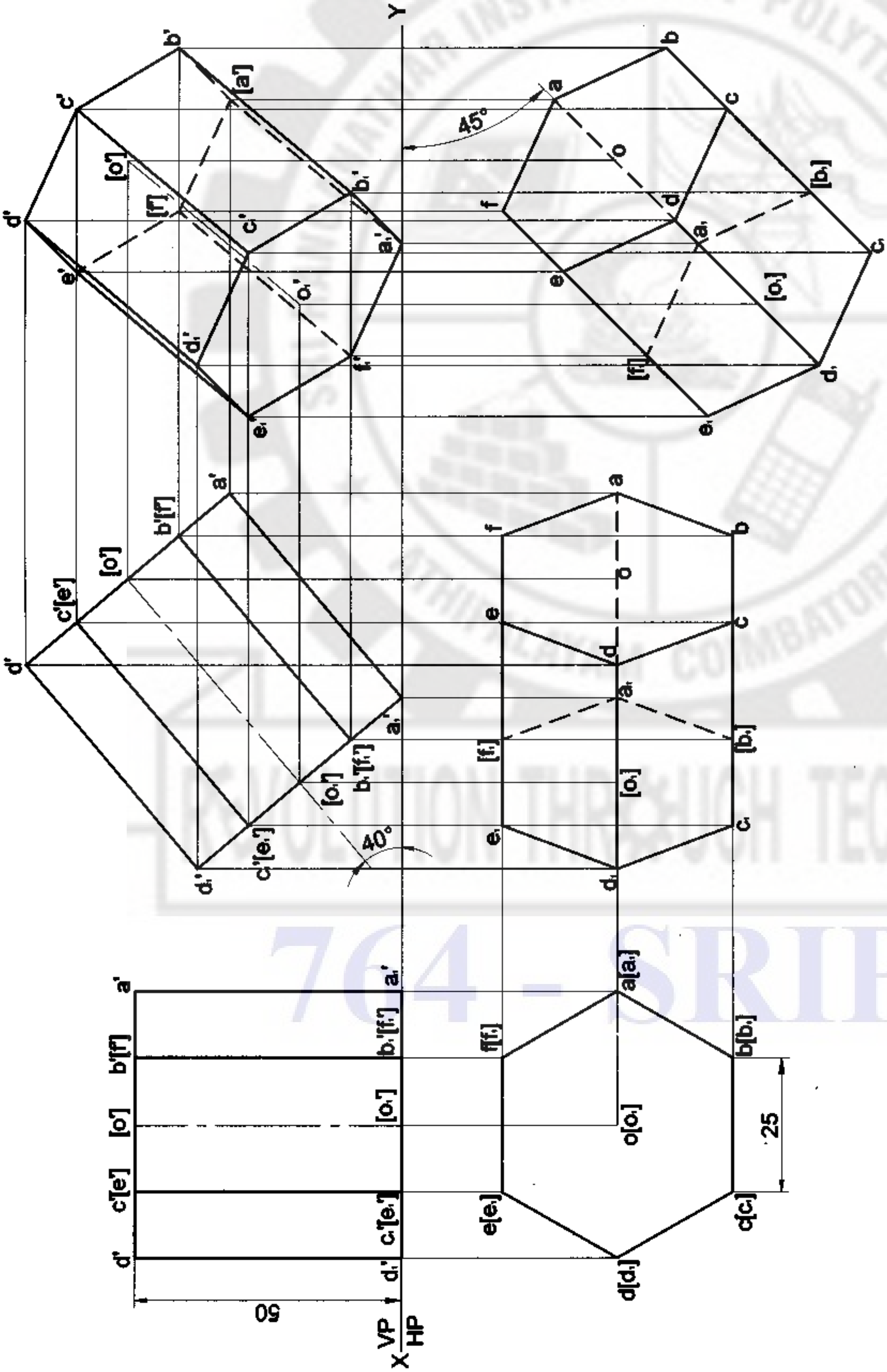
Problem 10 A hexagonal prism 25 mm sides of base and 50 mm axis length rests on HP on one of its edges of the base. Draw the projections of the prism when the axis is inclined to HP at 45º and VP at 30º.

Solution



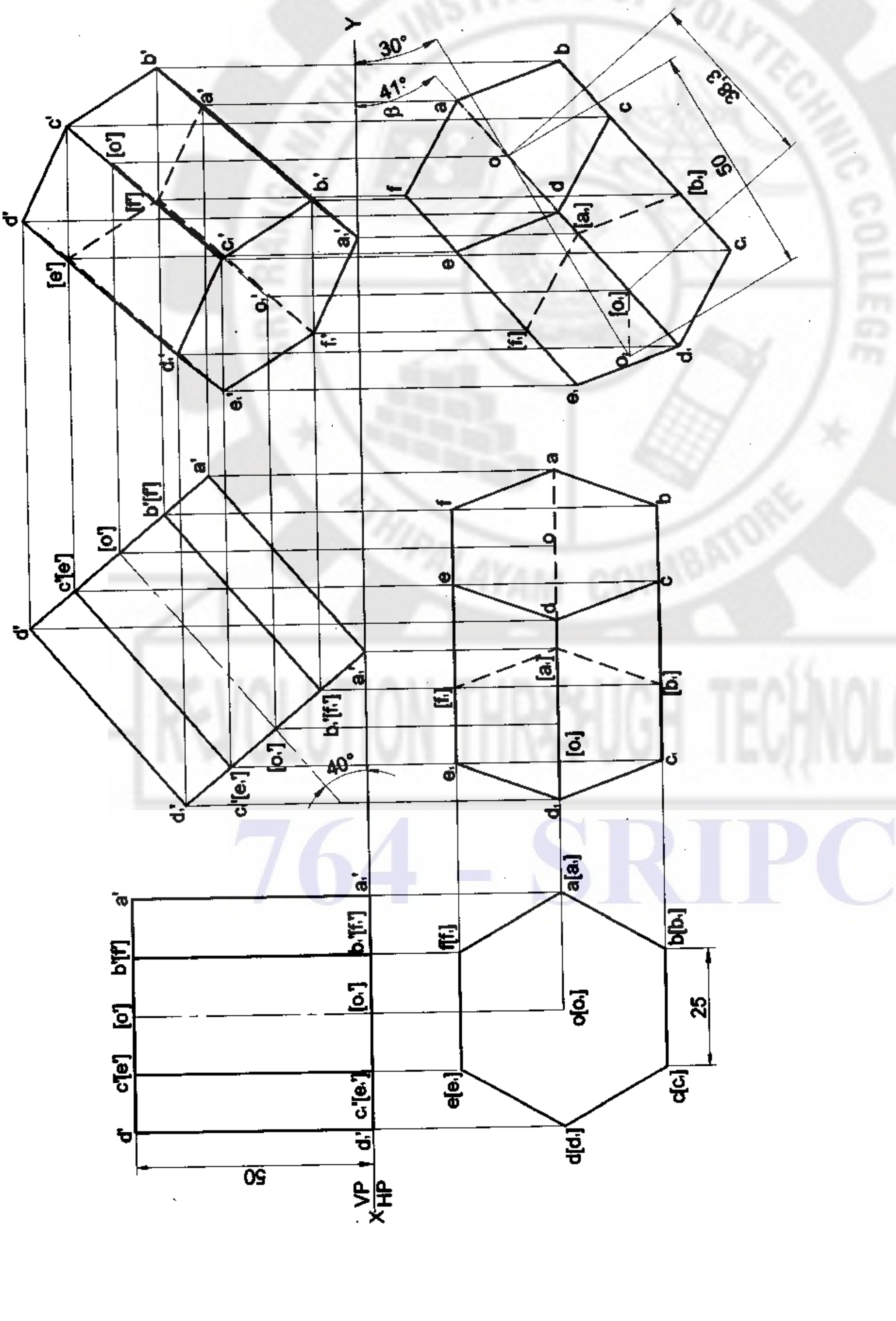
Problem 11 A hexagonal prism 25 mm sides of base and 50 mm axis length rests on HP on one of its corners of the base such that the two base edges containing the corner on which it rests make equal inclinations with HP. Draw the projections of the prism when the axis of the prism is inclined to HP at 40º and appears to be inclined to VP at 45º.

Solution



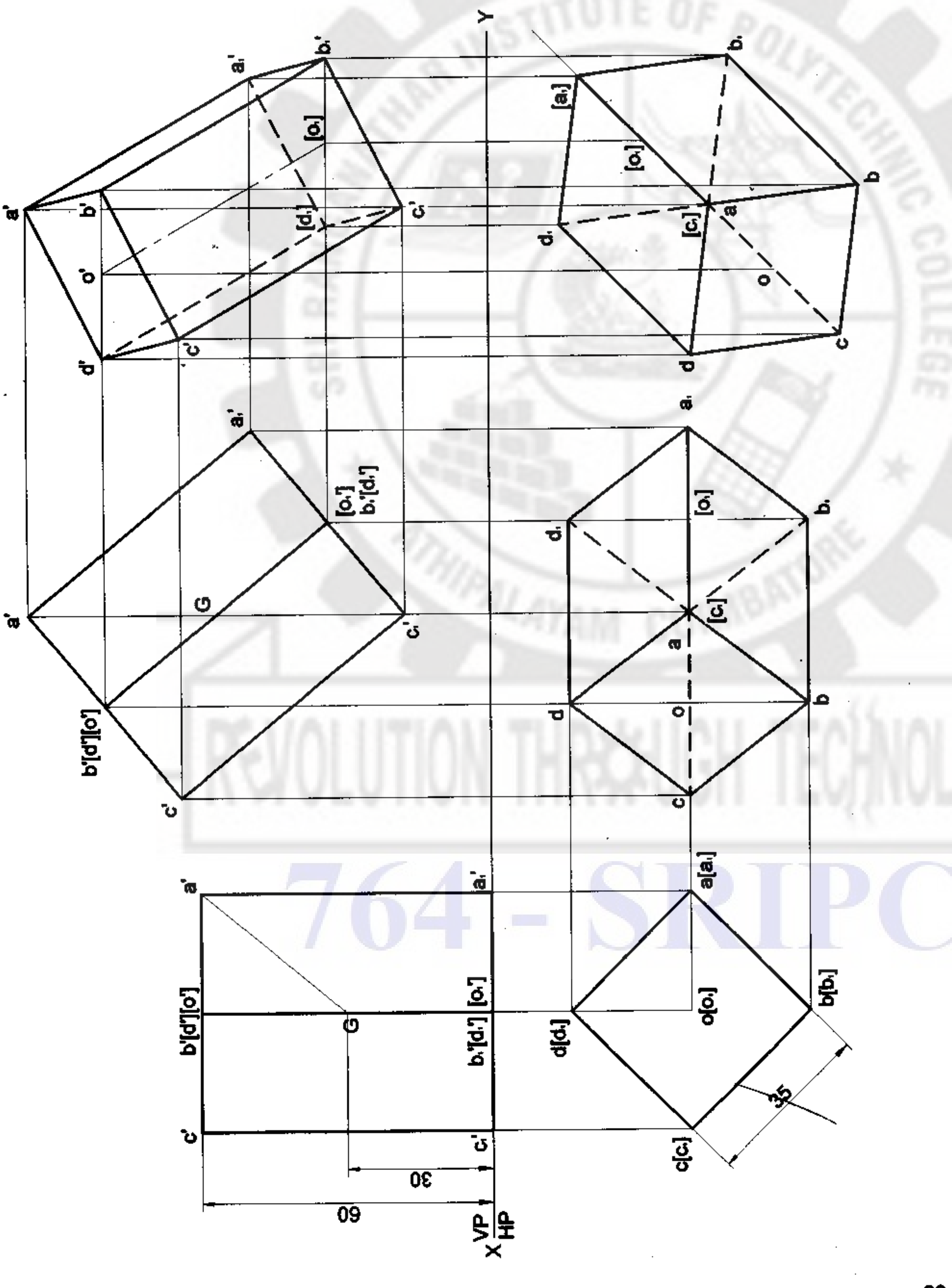
Problem 12 A hexagonal prism 25 mm sides of base and 50 mm axis length rests on HP on one of its corners of the base such that the two base edges containing the corner on which it rests make equal inclinations with HP. Draw the projections of the prism when the axis of the prism is inclined to HP at 40º and to VP at 30º.

Solution



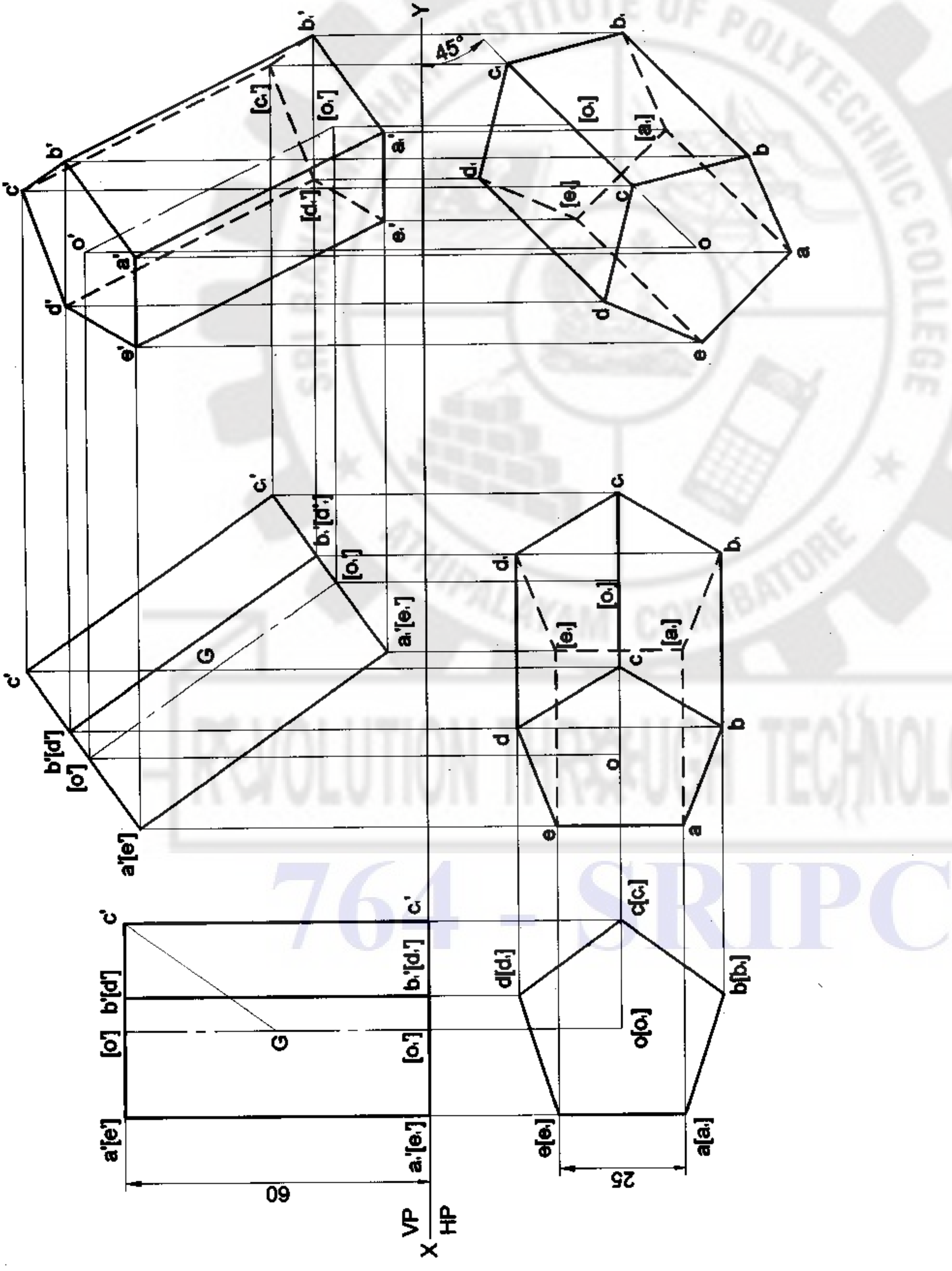
Problem 13 A square prism 35 mm sides of base and 60 mm axis length is suspended freely from a corner of its base. Draw the projections of the prism when the axis appears to be inclined to VP at 45º.

Solution



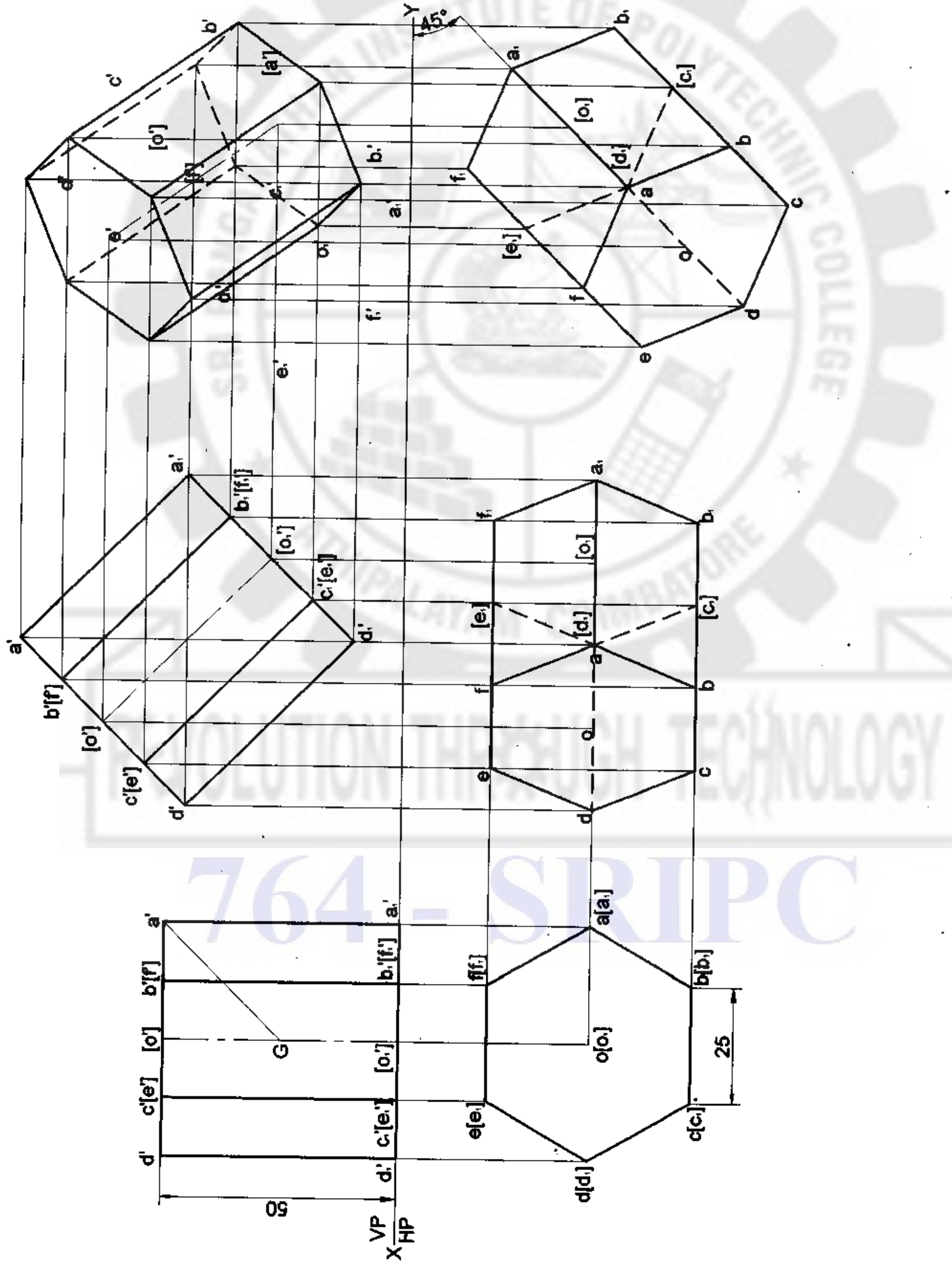
Problem 14 A pentagonal prism 25 mm sides of base and 50 mm axis length is suspended freely from a corner of its base. Draw the projections of the prism when the axis appears to be inclined to VP at 45º.

Solution



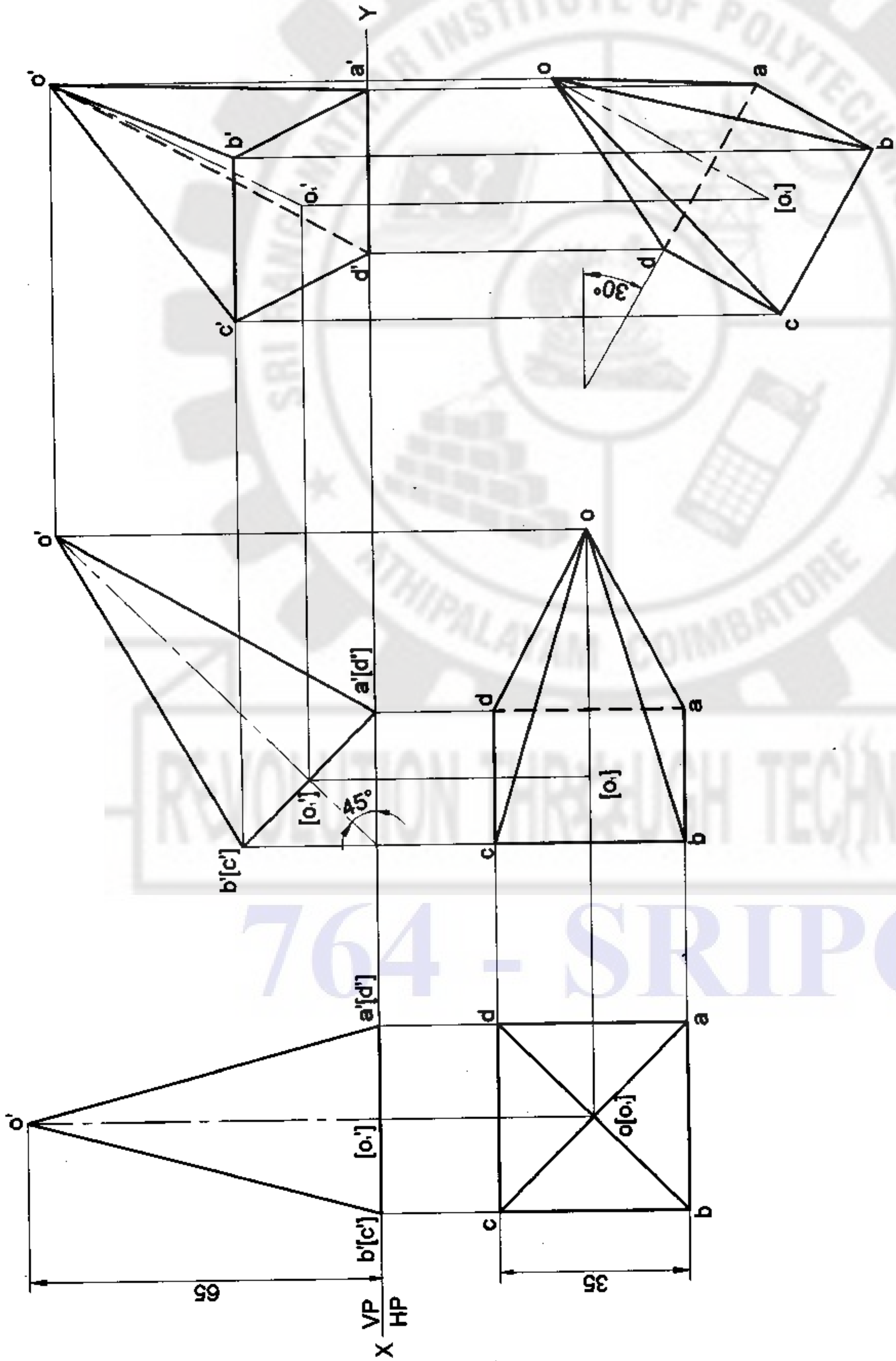
Problem 15 A hexagonal prism 25 mm sides of base and 50 mm axis length is suspended freely from a corner of its base. Draw the projections of the prism when the axis appears to be inclined to VP at 45º.

Solution



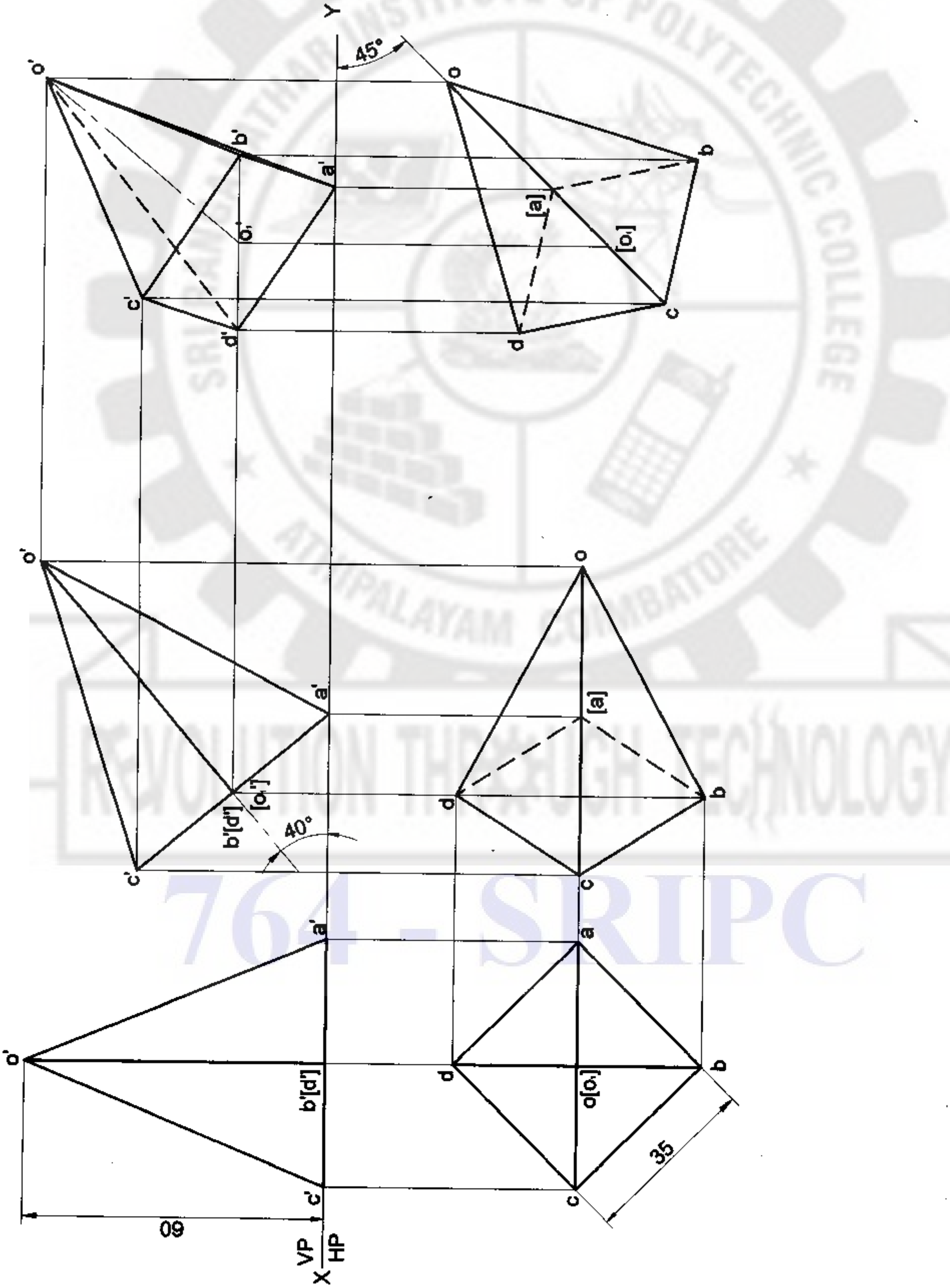
Problem 16 A square pyramid 35 mm sides of base and 65 mm axis length rests on HP on one of its edges of the base which is inclined to VP at 30º. Draw the projections of the pyramid when the axis is inclined to HP at 45º.

Solution



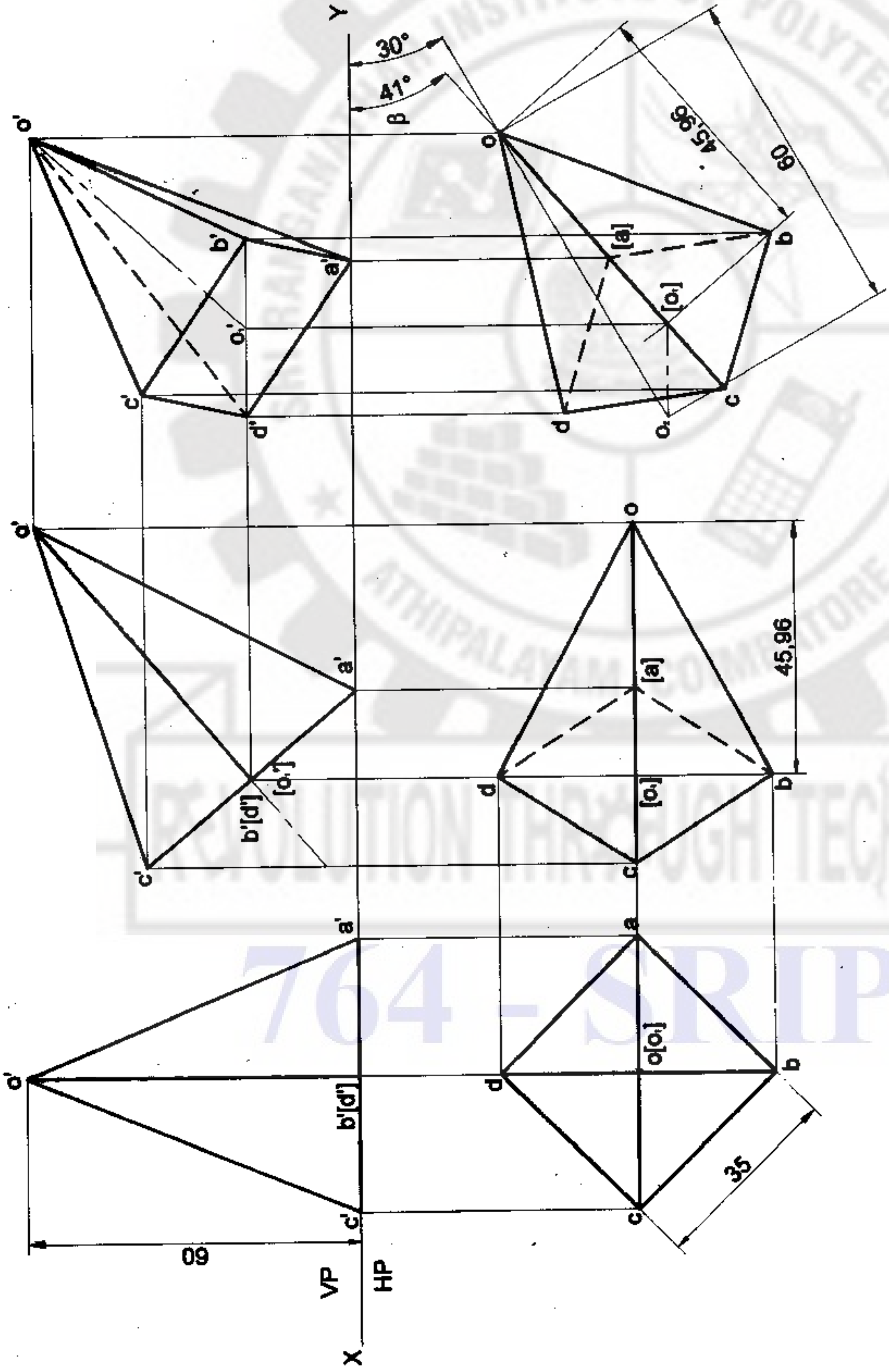
Problem 17 A square pyramid 35 mm sides of base and 60 mm axis length rests on HP on one of its corners of the base such that the two base edges containing the corner on which it rests make equal inclinations with HP. Draw the projections of the pyramid when the axis of the pyramid is inclined to HP at 40º and appears to be inclined to VP at 45º.

Solution



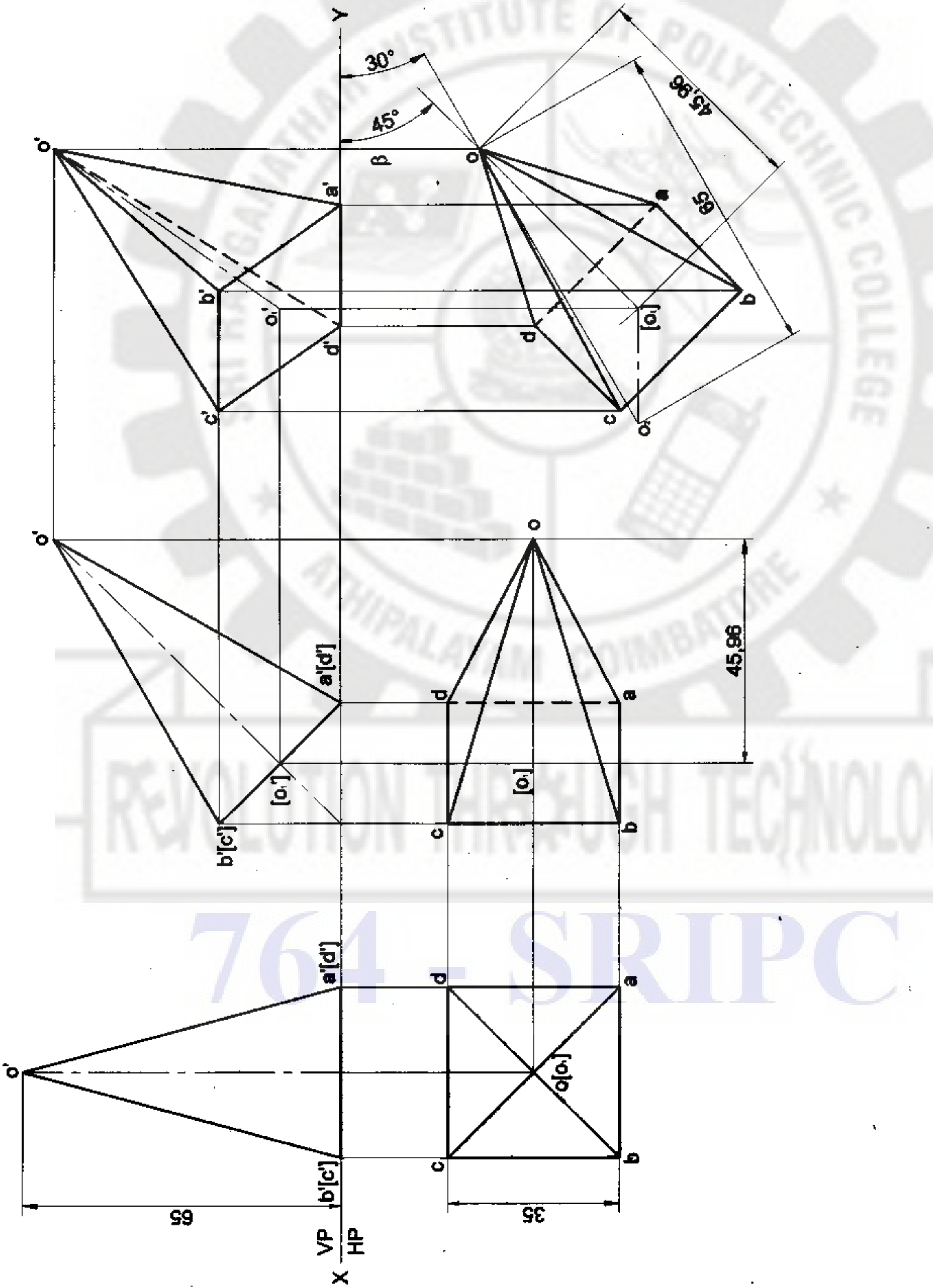
Problem 19 A square-pyramid 35 mm sides of base and 60 mm axis length rests on HP on one of its corners of the base such that the two base edges containing the corner on which it rests make equal inclinations with HP. Draw the projections of the pyramid when the axis of the pyramid is inclined to HP at 40º and to VP at 30º.

Solution



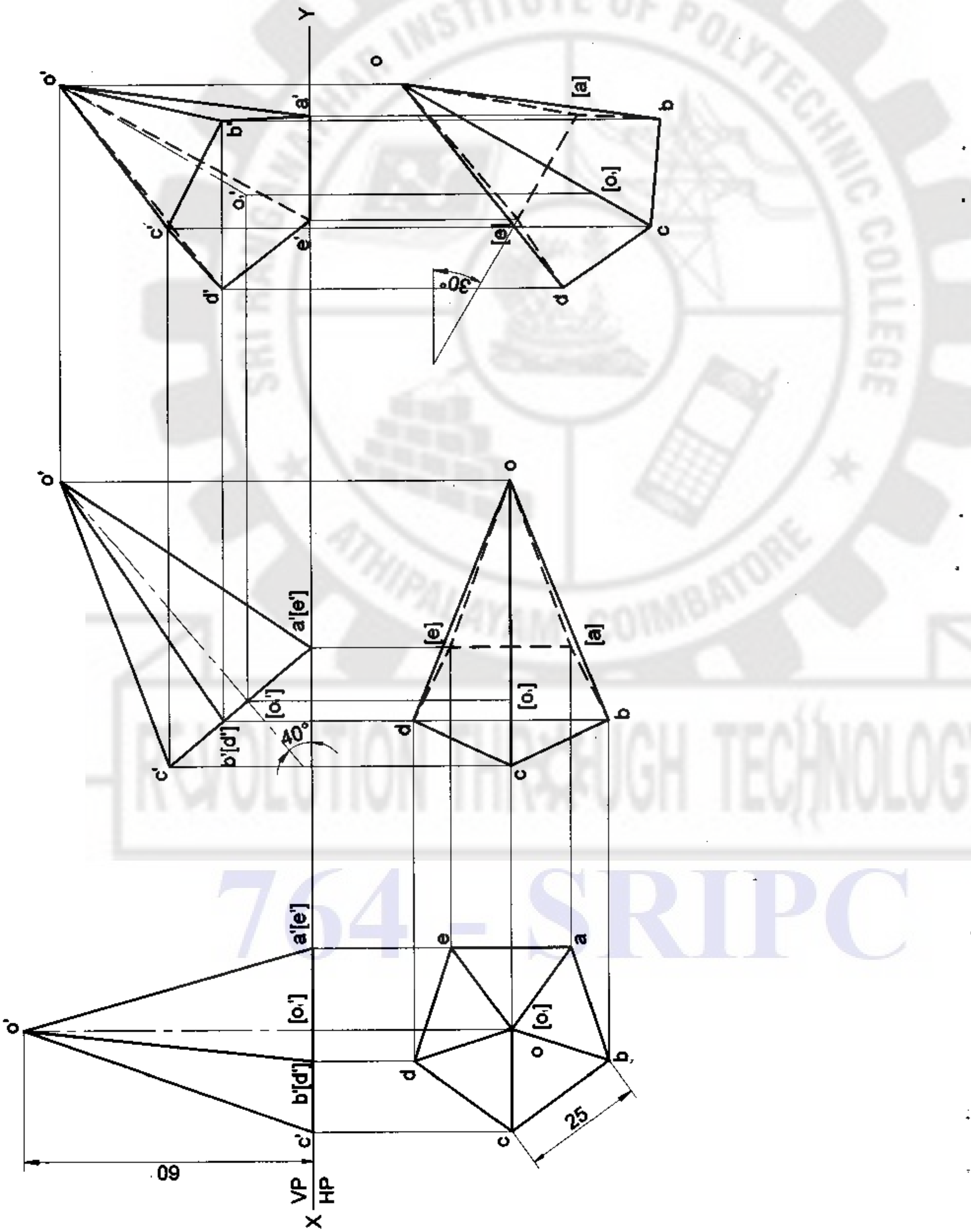
Problem 19 A square pyramid 35 mm sides of base and 60 mm axis length rests on HP on one of its edges of the base. Draw the projections of the pyramid when the axis is inclined to HP at 45º and VP at 30º.

Solution



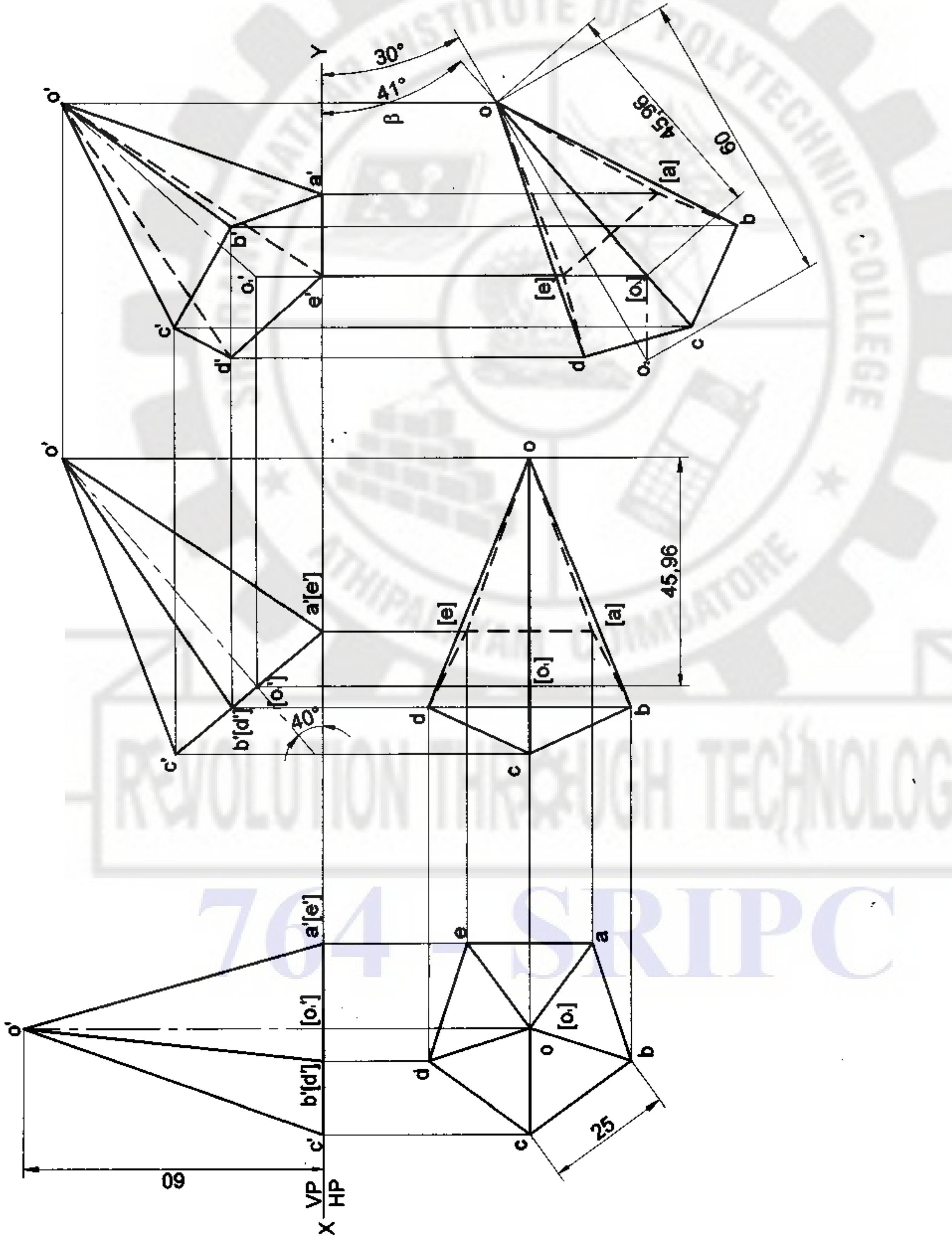
Problem 20 A pentagonal pyramid 25 mm sides of base and 60 mm axis length rests on HP on one of its edges of the base which is inclined to VP at 30º. Draw the projections of the pyramid when the axis is inclined to HP at 40º.

Solution



Problem 21 A pentagonal pyramid 25 mm sides of base and 50 mm axis length rests on HP on one of its edges of the base. Draw the projections of the pyramid when the axis is inclined to HP at 45º and VP at 30º.

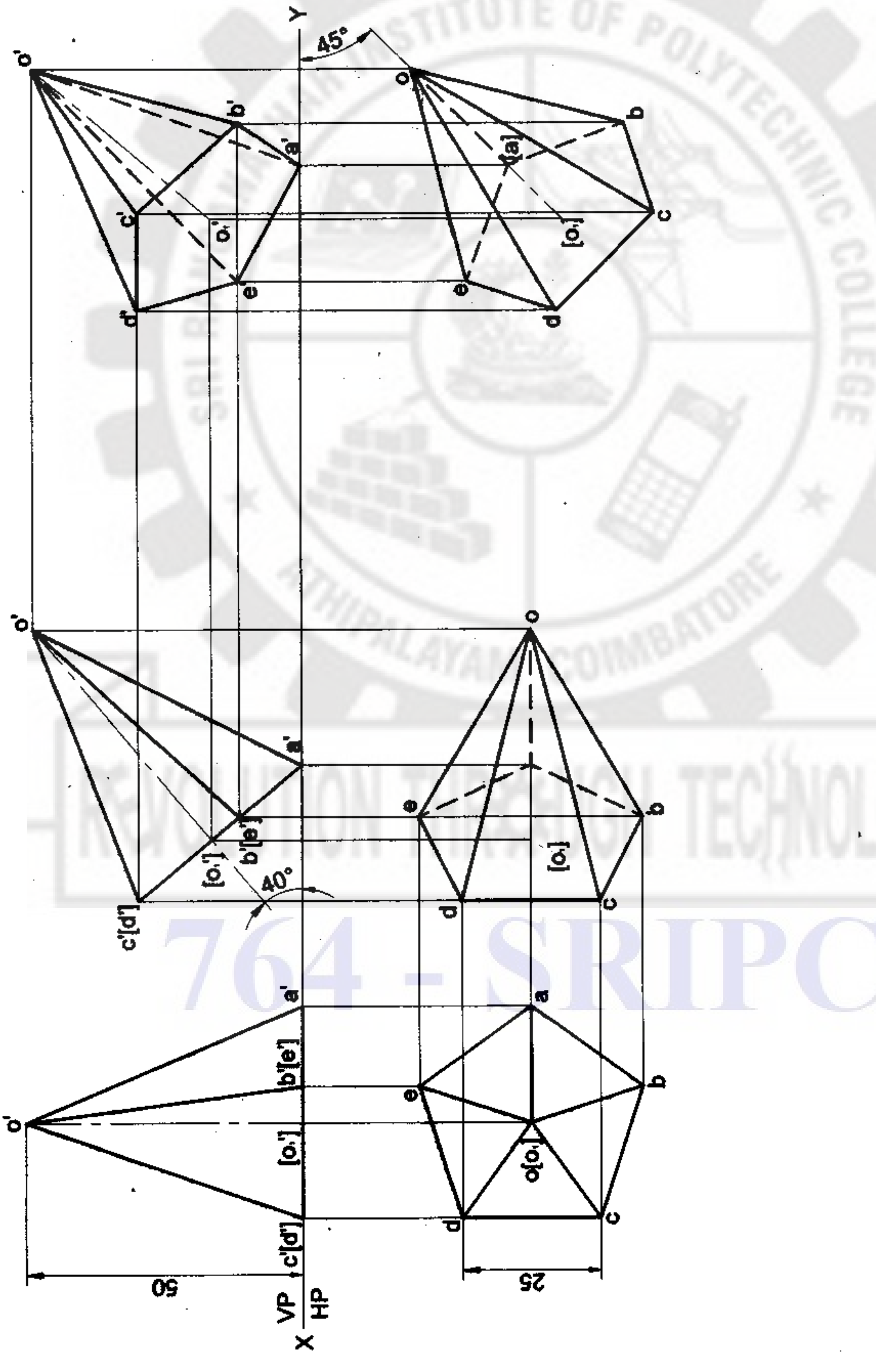
Solution



Problem 22 A pentagonal pyramid 25 mm sides of base and 50 mm axis length rests on HP on one of its corners of the base such that the two base edges containing the corner on which it rests make equal inclinations with HP. Draw the projections of the pyramid when the axis of the pyramid is inclined to HP at 40º and appears to be inclined to VP at 45º.

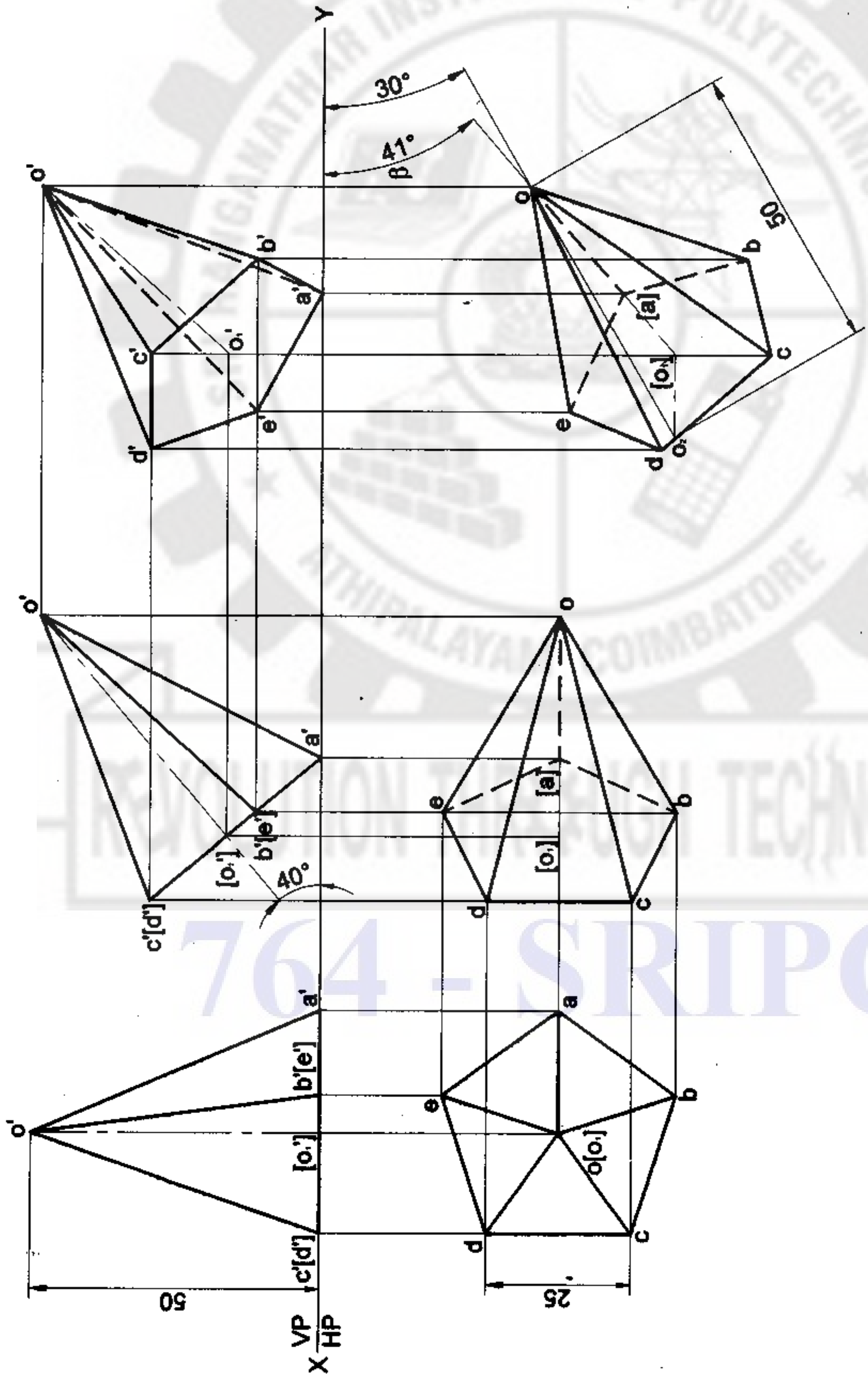
Solution

2



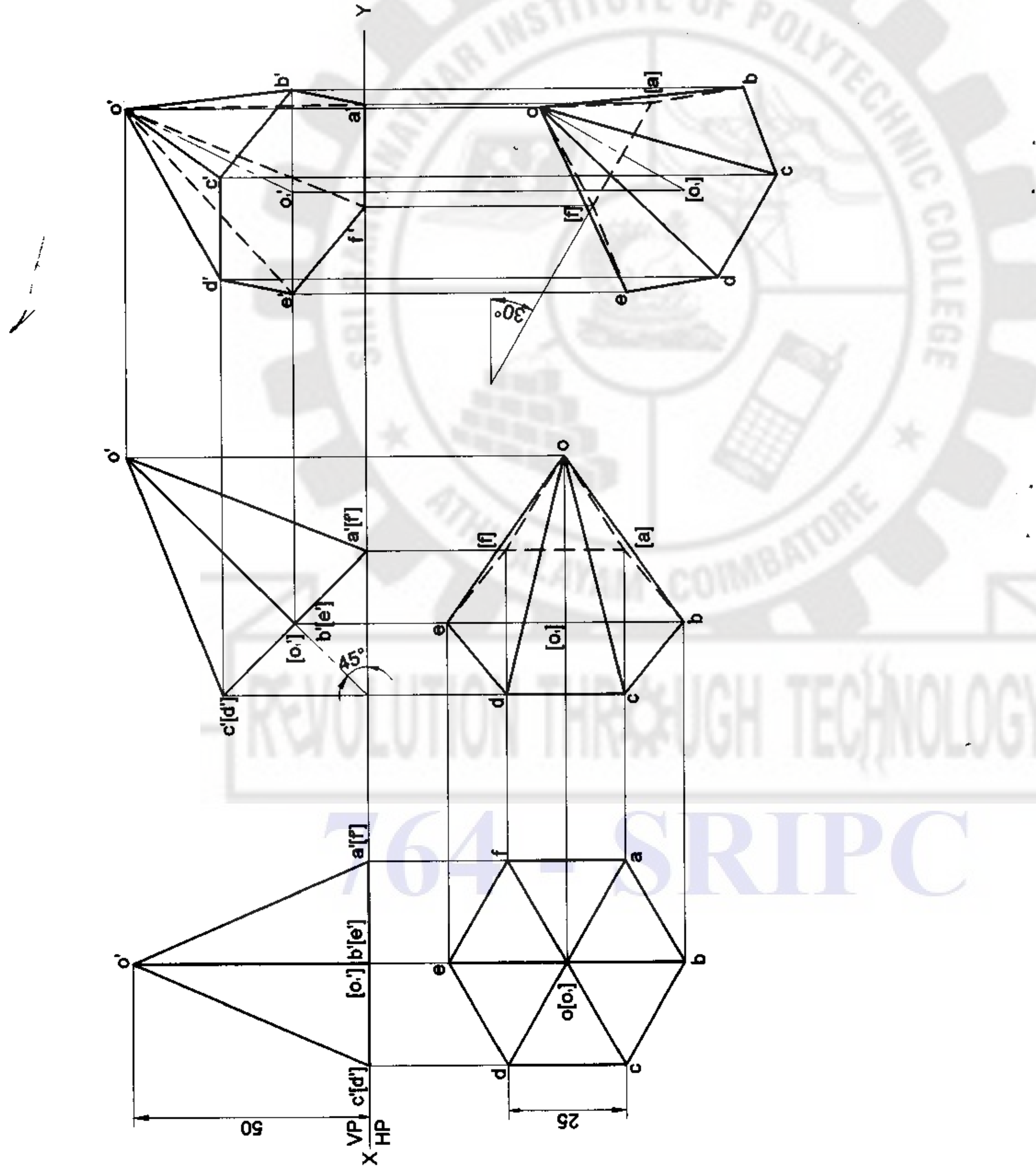
Problem 23 A pentagonal pyramid 25 mm sides of base and 50 mm axis length rests on HP on one of its corners of the base such that the two base edges containing the corner on which it rests make equal inclinations with HP. Draw the projections of the pyramid when the axis of the pyramid is inclined to HP at 40º and to VP at 30º.

Solution



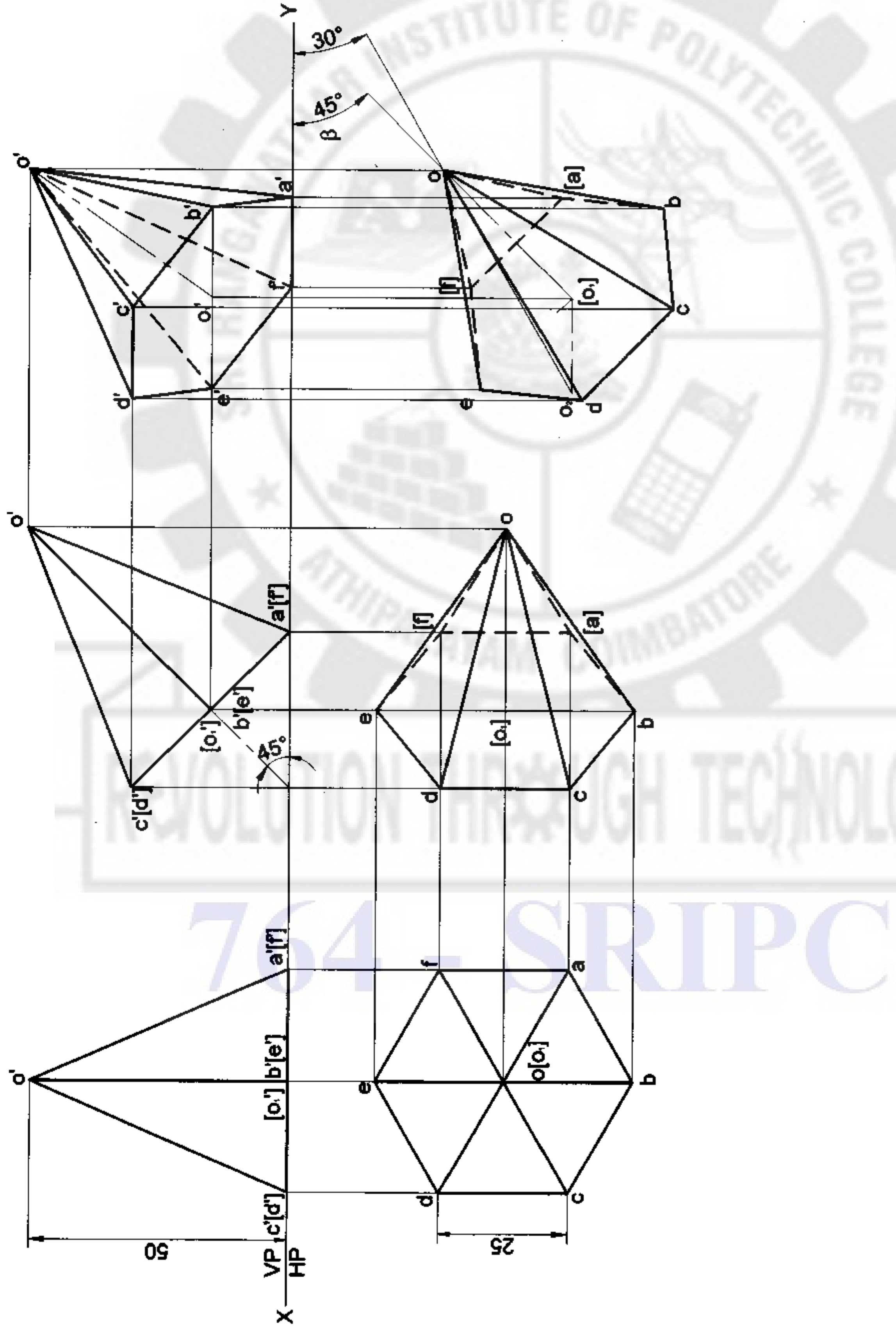
Problem 24 A hexagonal pyramid 25 mm sides of base and 50 mm axis length rests on HP on one of its edges of the base which is inclined to VP at 30º. Draw the projections of the pyramid when the axis is inclined to HP at 45º.

Solution



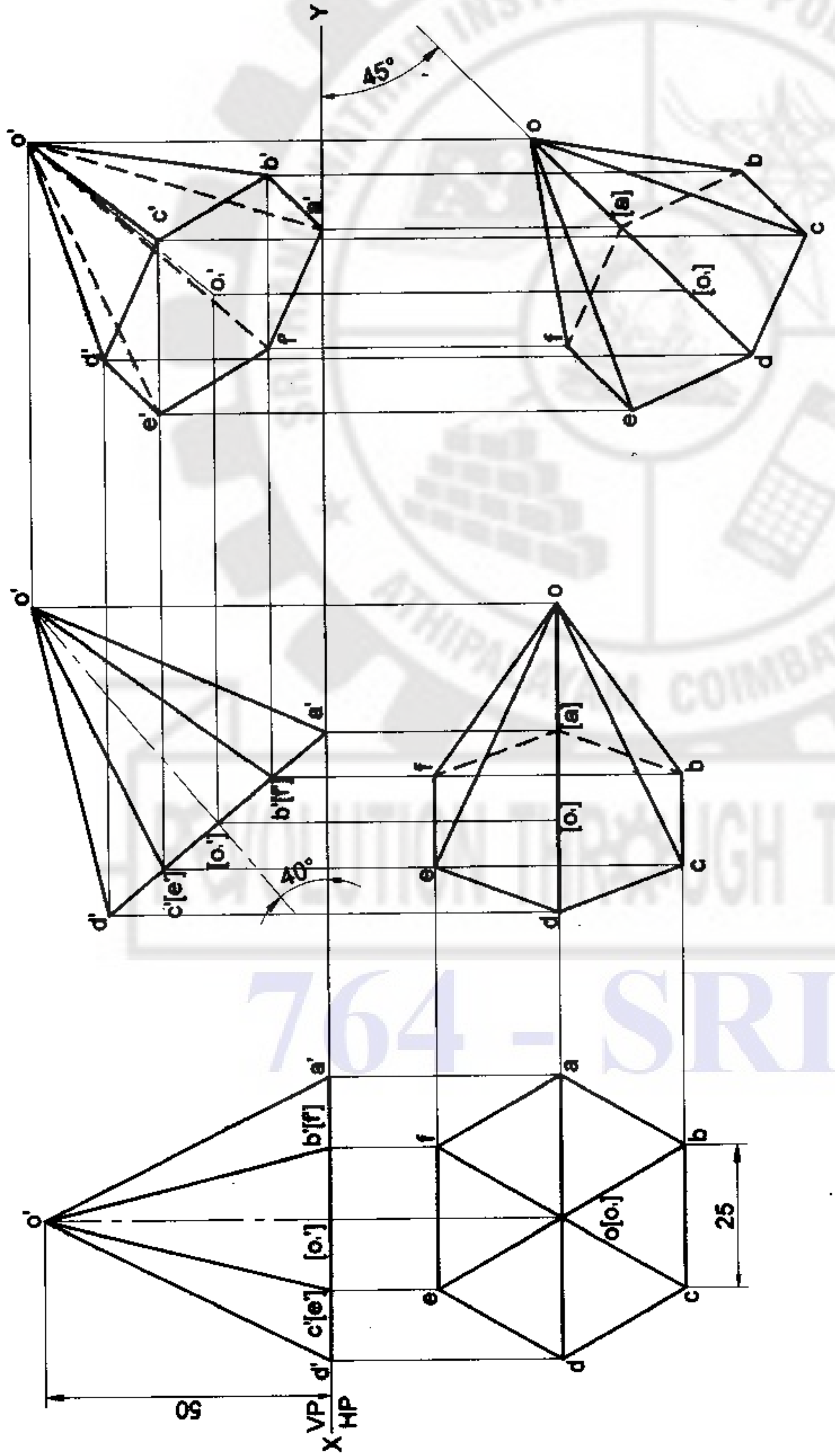
Problem 25 A hexagonal pyramid 25 mm sides of base and 50 mm axis length rests on HP on one of its edges of the base. Draw the projections of the pyramid when the axis is inclined to HP at 45º and VP at 30º.

Solution



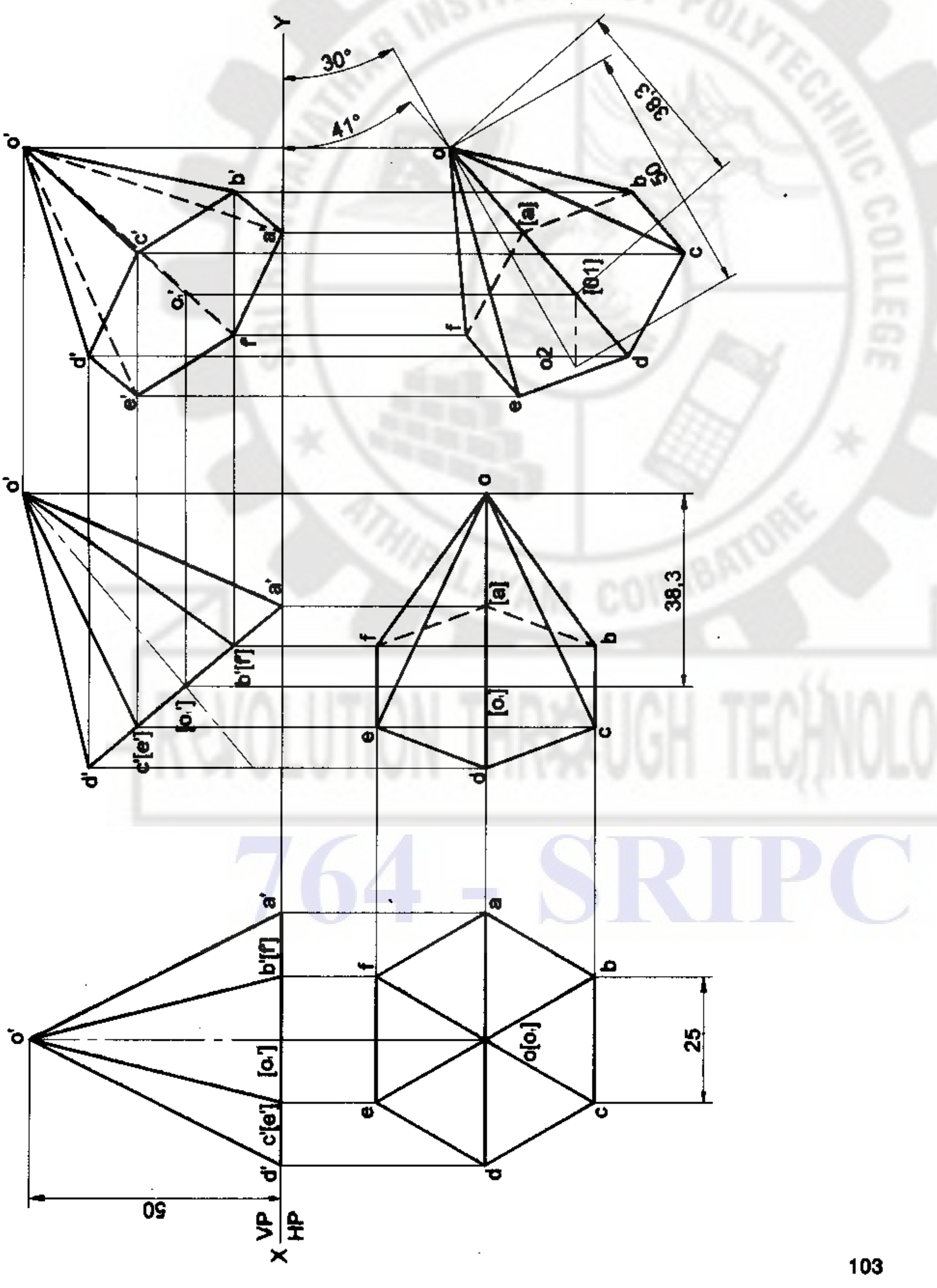
Problem 26 A hexagonal pyramid 25 mm sides of base and 50 mm axis length rests on HP on one of its corners of the base such that the two base edges containing the corner on which it rests make equal inclinations with HP. Draw the projections of the pyramid when the axis of the pyramid is inclined to HP at 40º and appears to be inclined to VP at 45º.

Solution



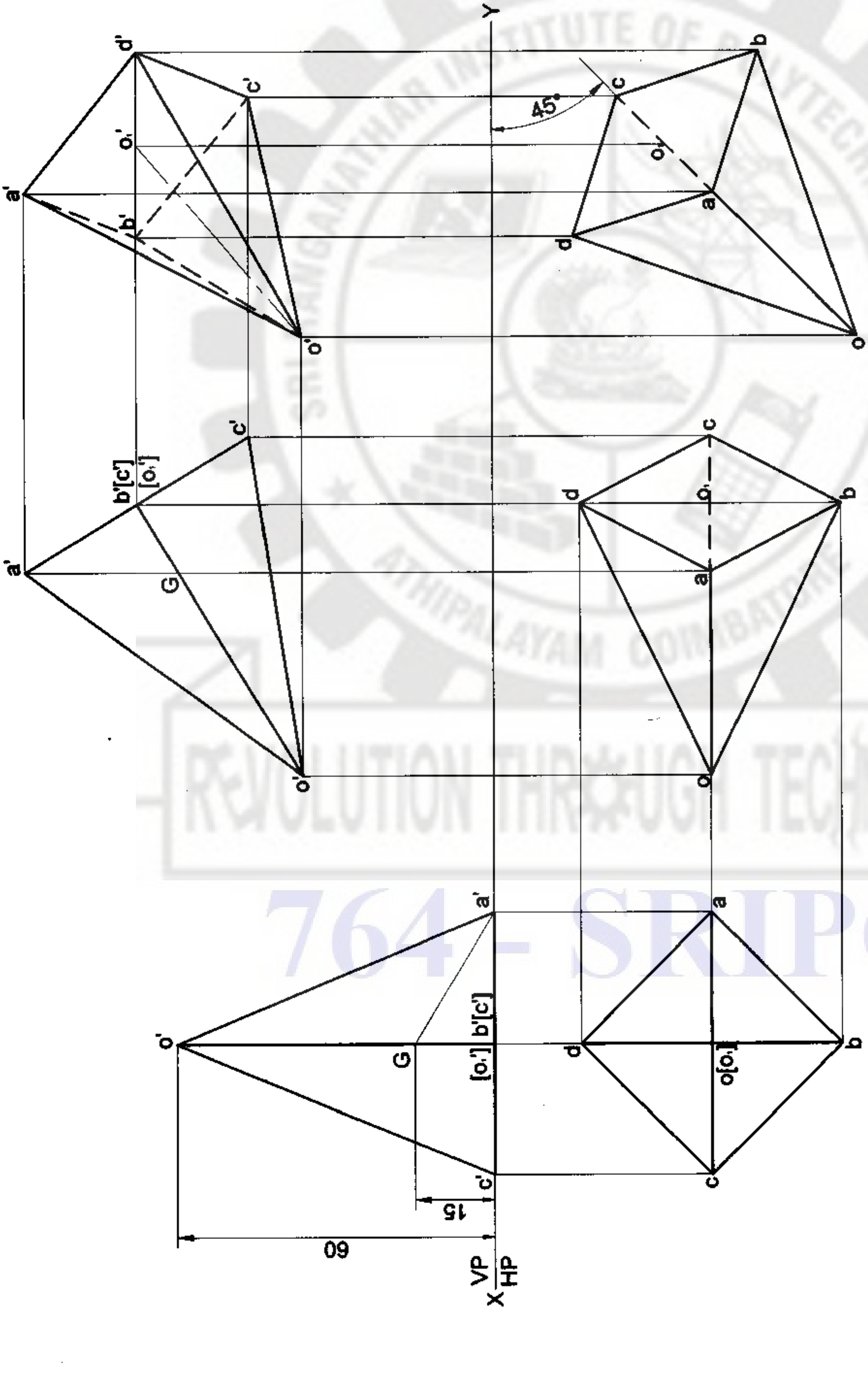
Problem 27 A hexagonal pyramid 25 mm sides of base and 50 mm axis length rests on HP on one of its corners of the base such that the two base edges containing the corner on which it rests make equal inclinations with HP. Draw the projections of the pyramid when the axis of the pyramid is inclined to HP at 40º and to VP at 30º.

Solution



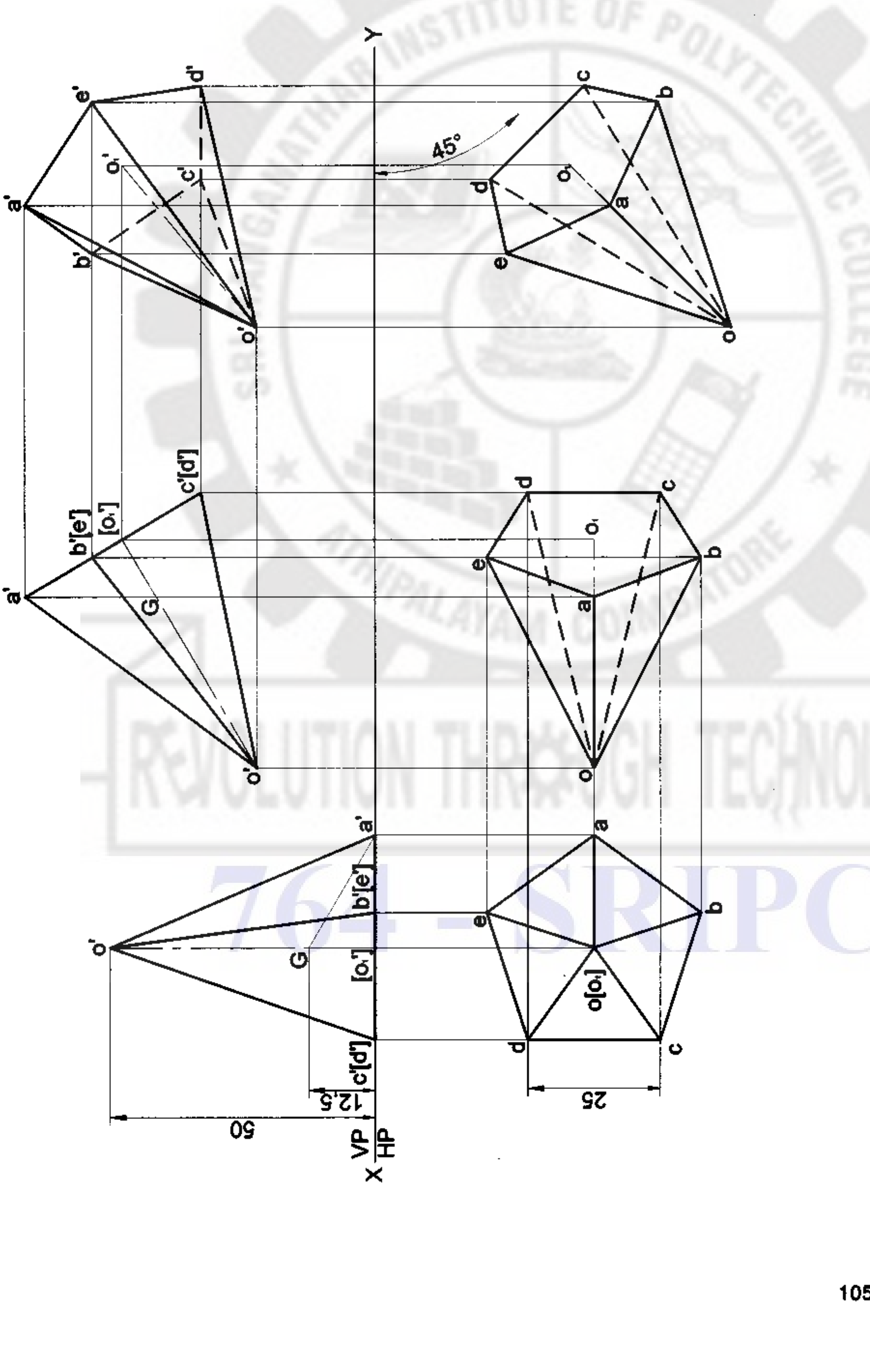
Problem 28 A square pyramid 35 mm sides of base and 60 mm axis length is suspended freely from a corner of its base. Draw the projections of the pyramid when the axis appears to be inclined to VP at 45º.

Solution



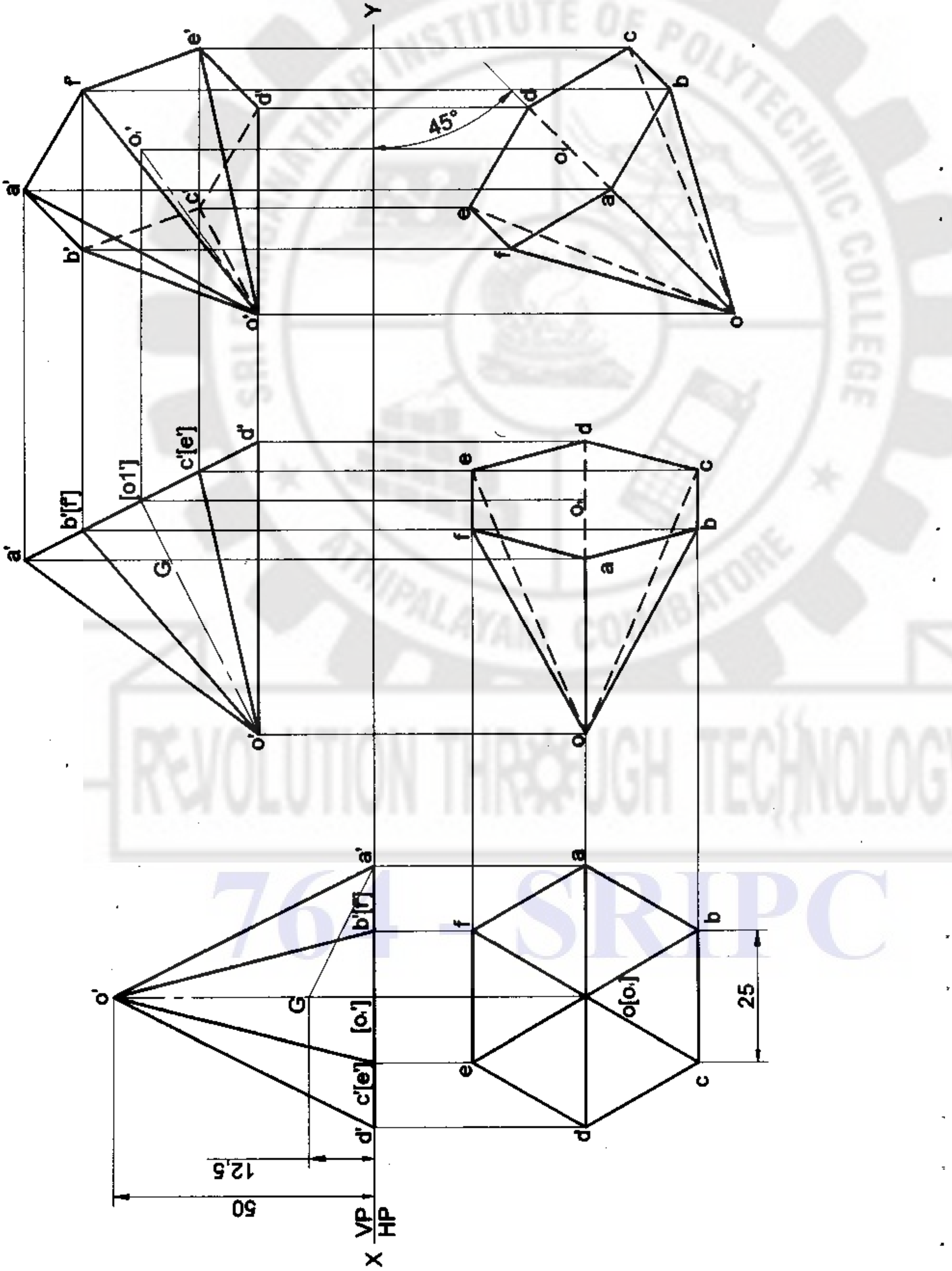
Problem 29 A pentagonal pyramid 25 mm sides of base and 50 mm axis length is suspended freely from a corner of its base. Draw the projections of the pyramid when the axis appears to be inclined to VP at 45º.

Solution



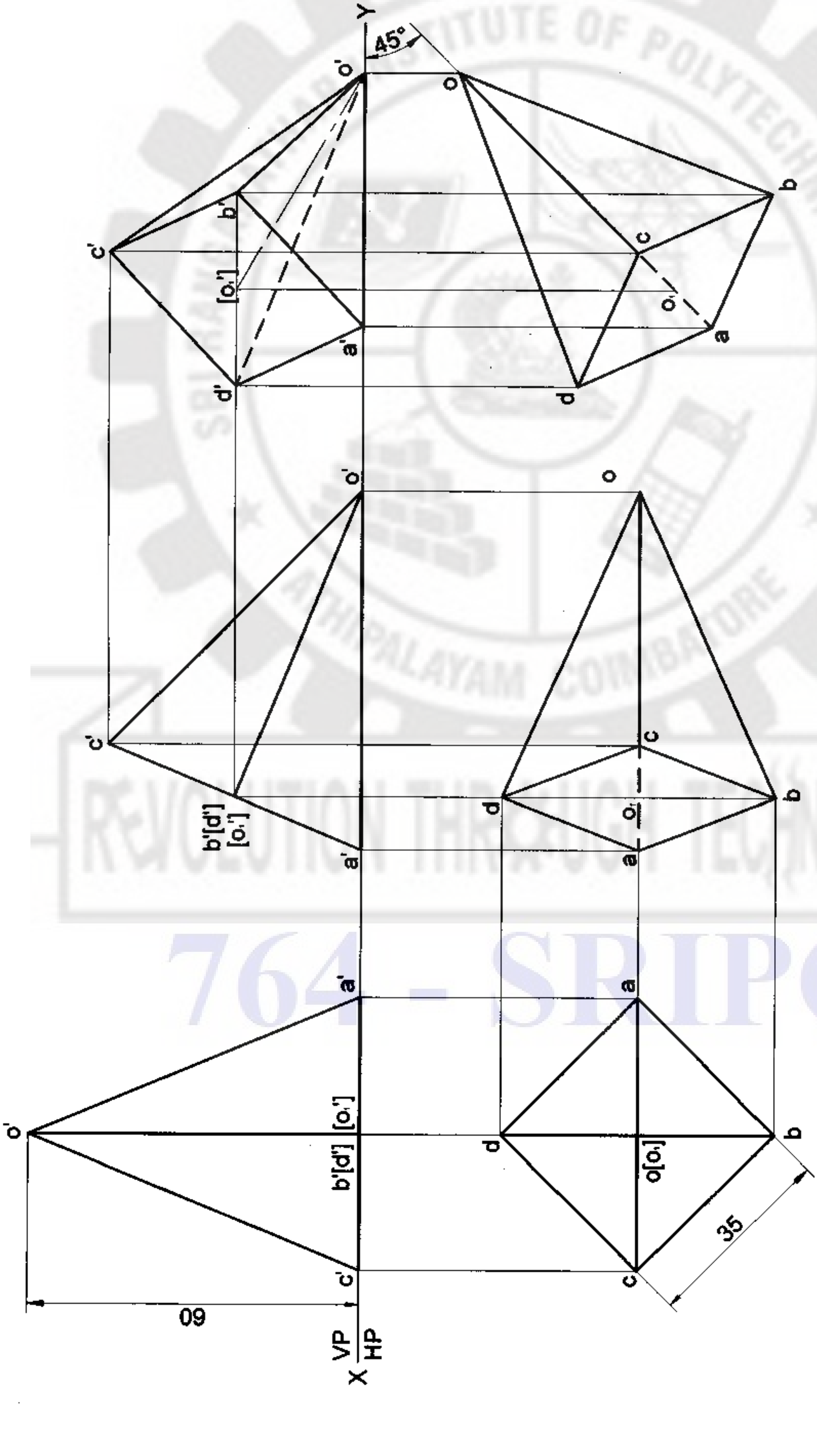
Problem 30 A hexagonal pyramid 25 mm sides of base and 50 mm axis length is suspended freely from a corner of its base. Draw the projections of the pyramid when the axis appears to be inclined to VP at 45º.

Solution



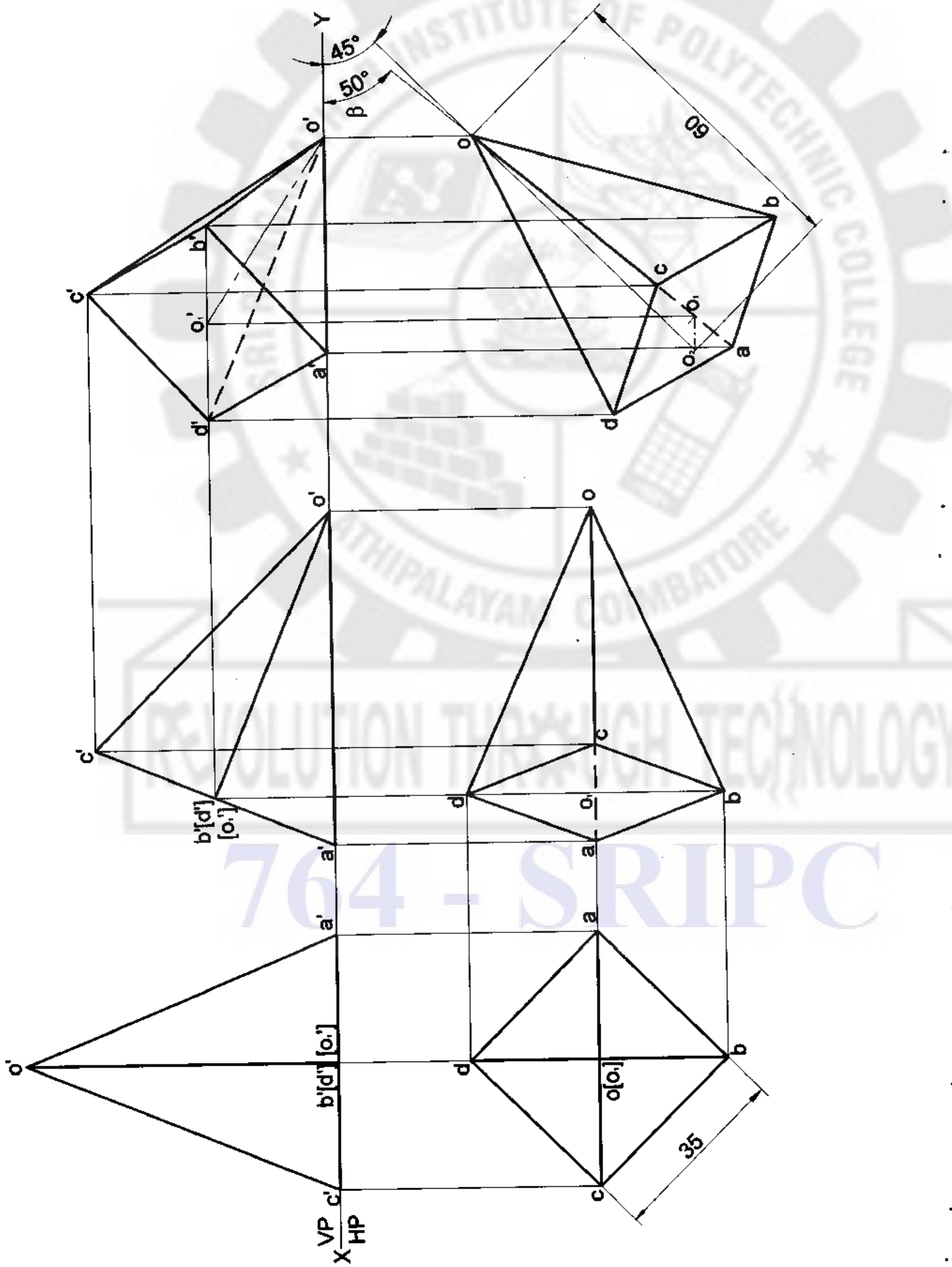
Problem 31 A square pyramid 35 mm sides of base and 60 mm axis length rests on HP on one of its slant edges. Draw the projections of the pyramid when the axis appears to be inclined to VP at 45º.

Solution



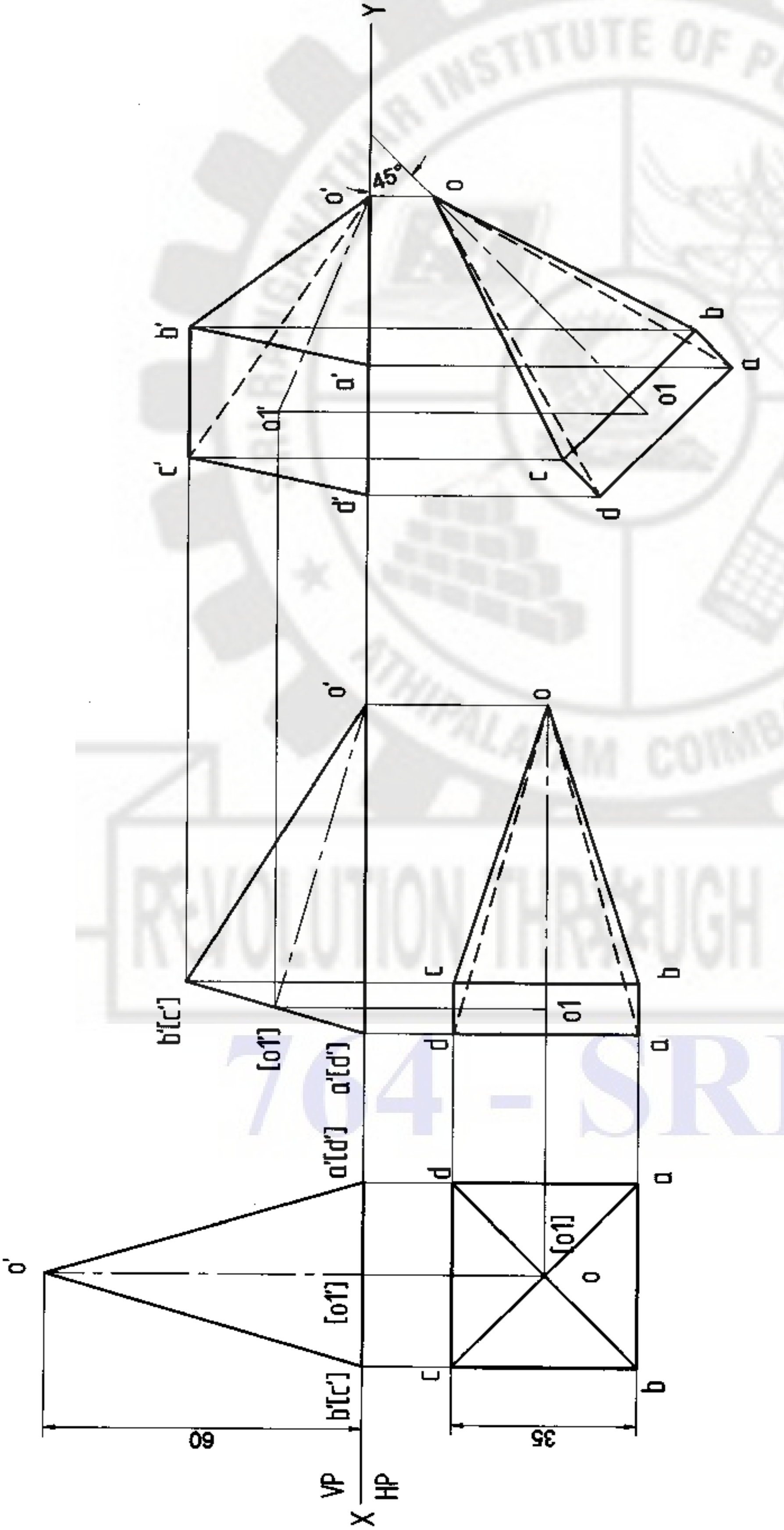
Problem 32 A square pyramid 35 mm sides of base and 60 mm axis length rests on HP on one of its slant edges. Draw the projections of the pyramid when the axis is inclined to VP at 45º.

Solution



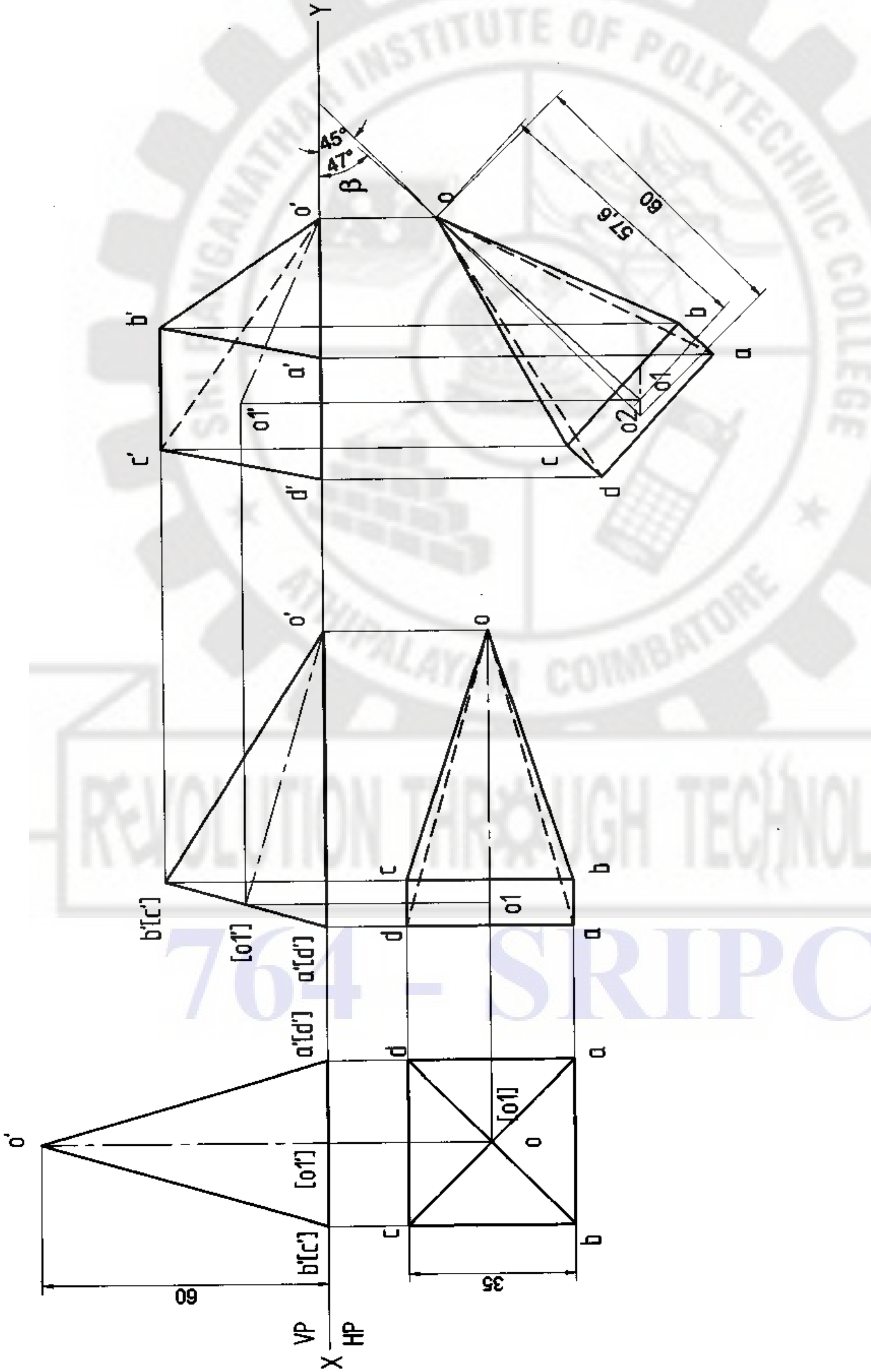
Problem 33 A square pyramid 35 mm sides of base and 60 mm axis length rests on HP on one of its slant triangular faces. Draw the projections of the pyramid when the axis appears to be inclined to VP at 45º.

Solution



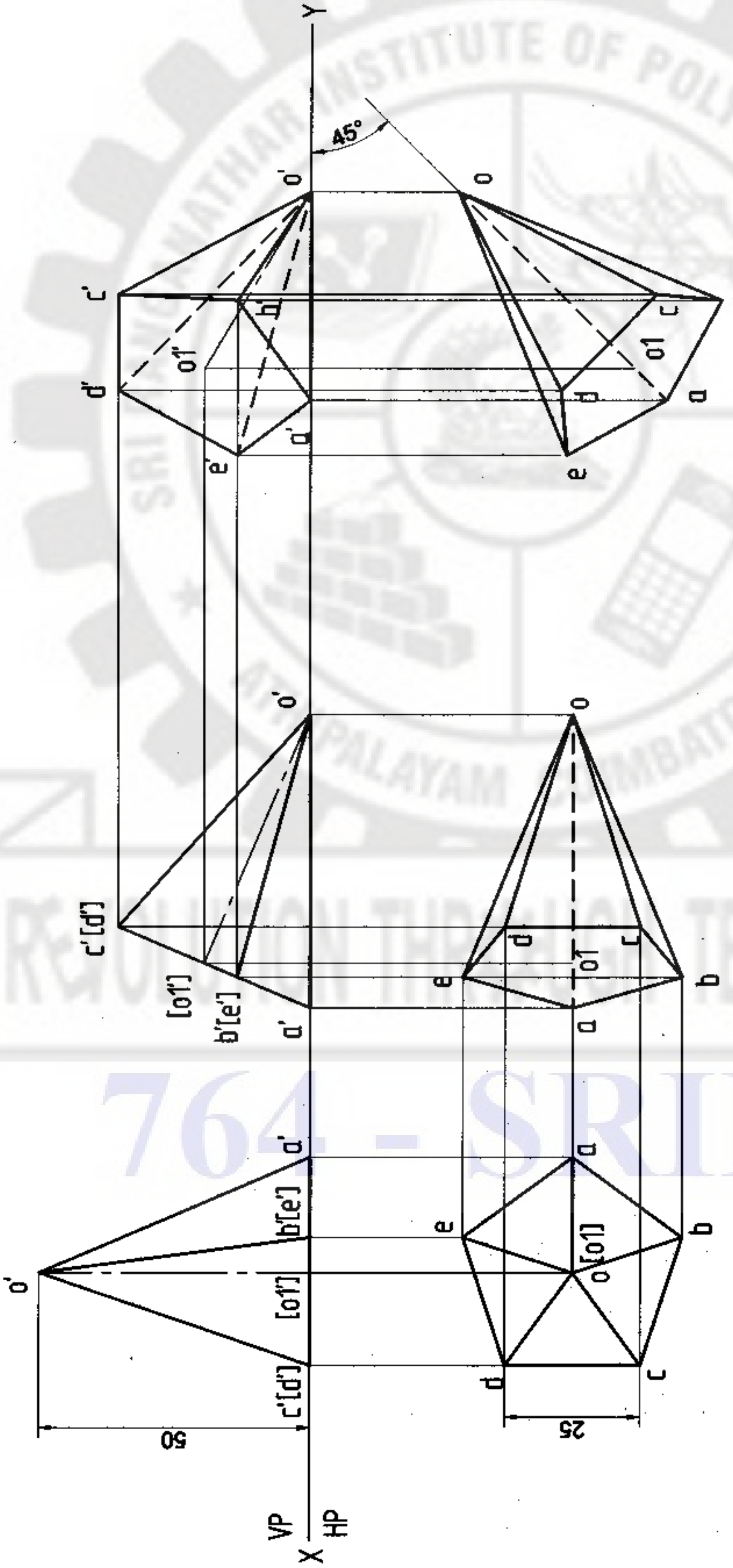
Problem 34 A square pyramid 35 mm sides of base and 60 mm axis length rests on HP on one of its slant triangular faces. Draw the projections of the pyramid when the axis is inclined to VP at 45º.

Solution



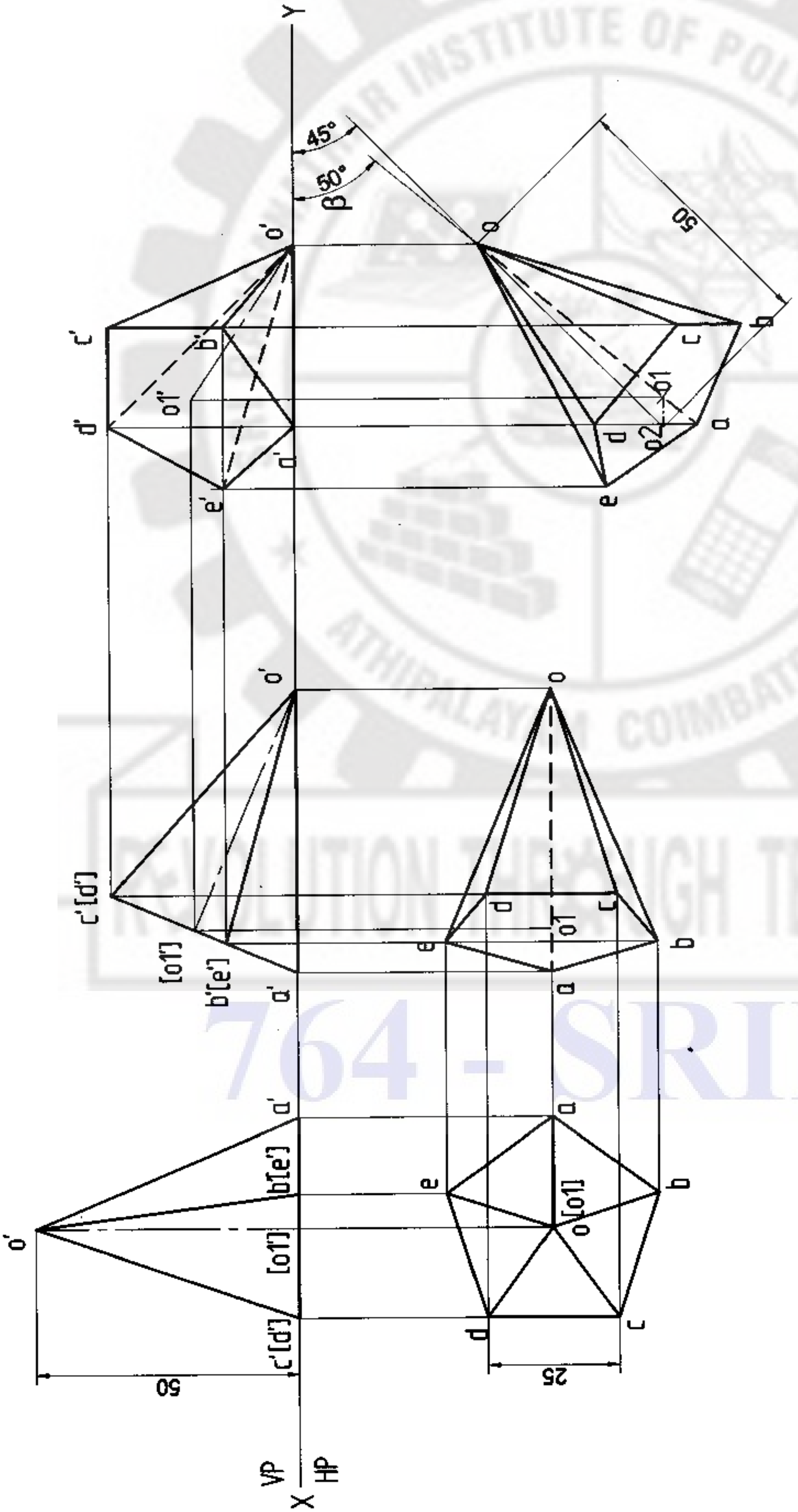
Problem 35 A pentagonal pyramid 25 mm sides of base and 50 mm axis length rests on HP on one of its slant edges. Draw the projections of the pyramid when the axis appears to be inclined to VP at 45º.

Solution



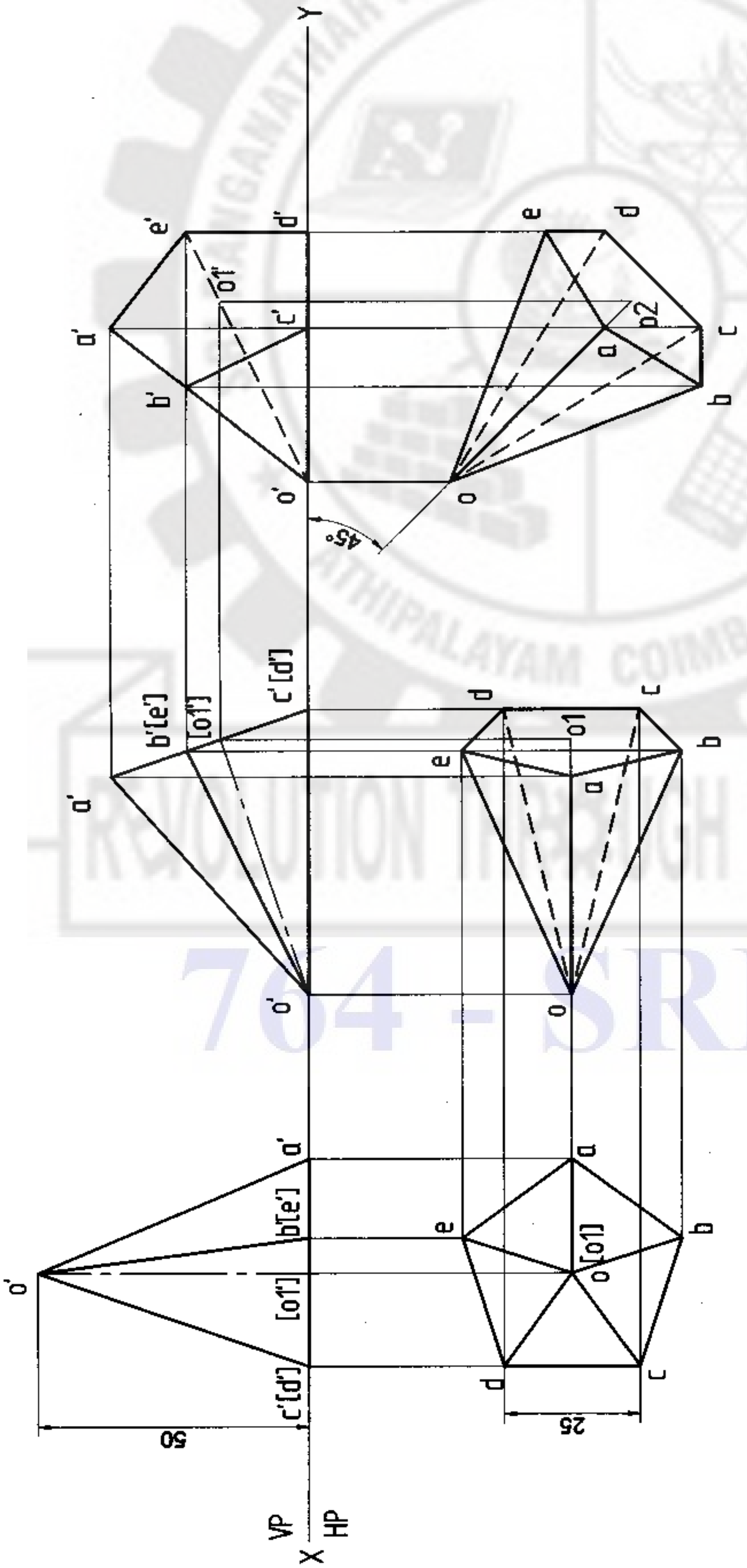
Problem 36 A pentagonal pyramid 25 mm sides of base and 50 mm axis length rests on HP on one of its slant edges. Draw the projections of the pyramid when the axis is inclined to VP at 45º.

Solution



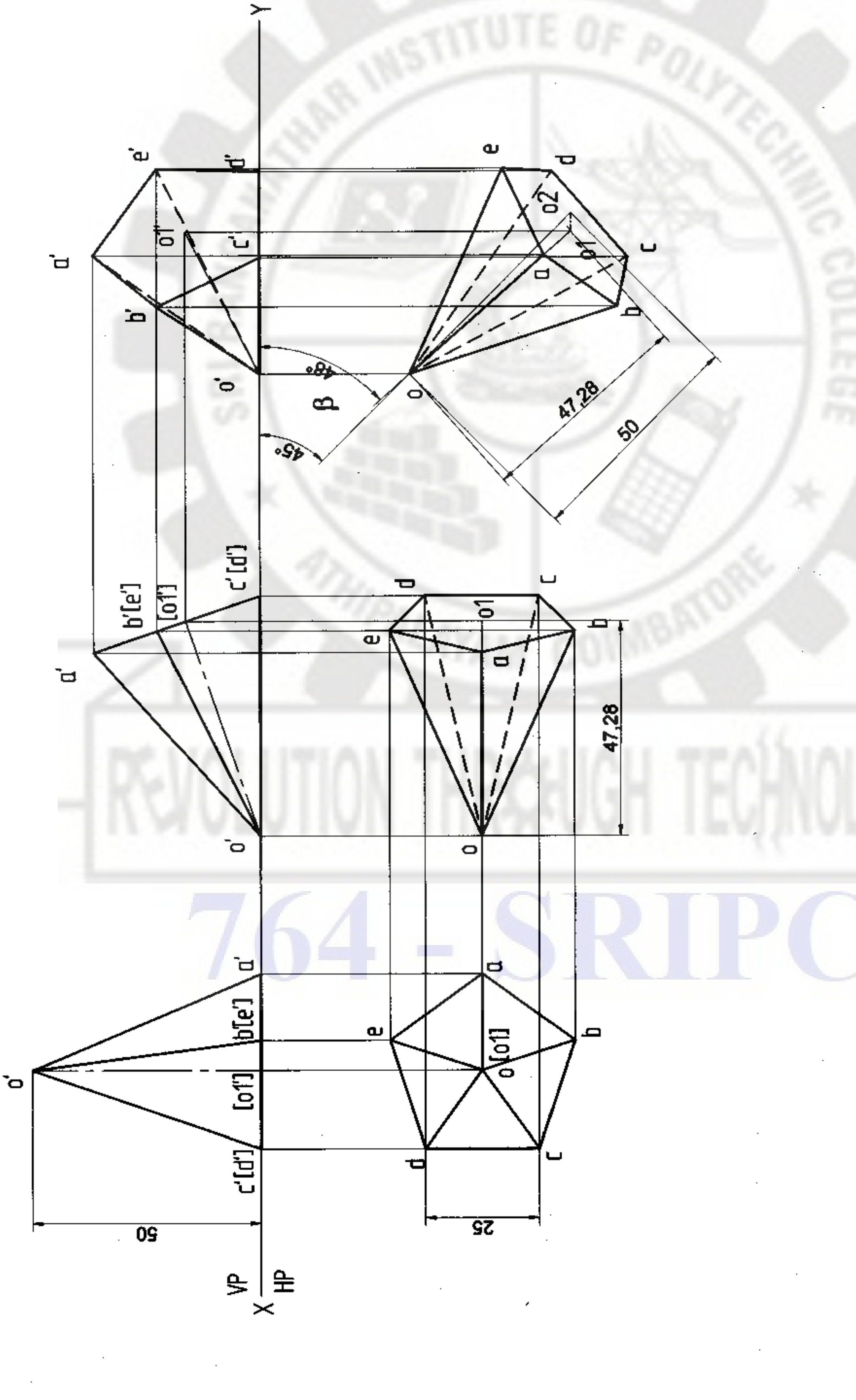
Problem 37 A pentagonal pyramid 25 mm sides of base and 50 mm axis length rests on HP on one of its slant triangular faces. Draw the projections of the pyramid when the axis appears to be inclined to VP at 45º.

Solution



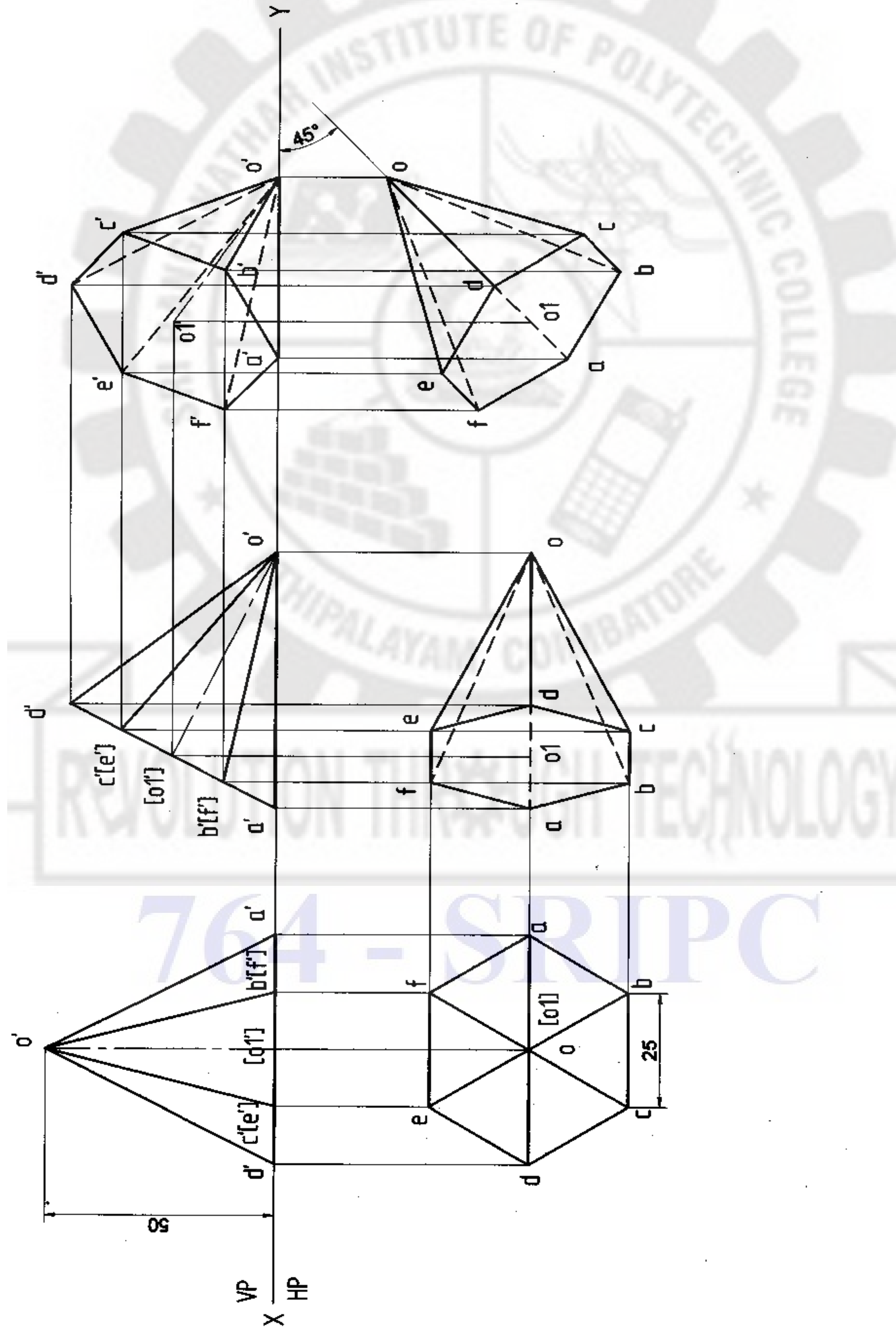
Problem 38 A pentagonal pyramid 25 mm sides of base and 50 mm axis length rests on HP on one of its slant triangular faces. Draw the projections of the pyramid when the axis is inclined to VP at 45º.

Solution



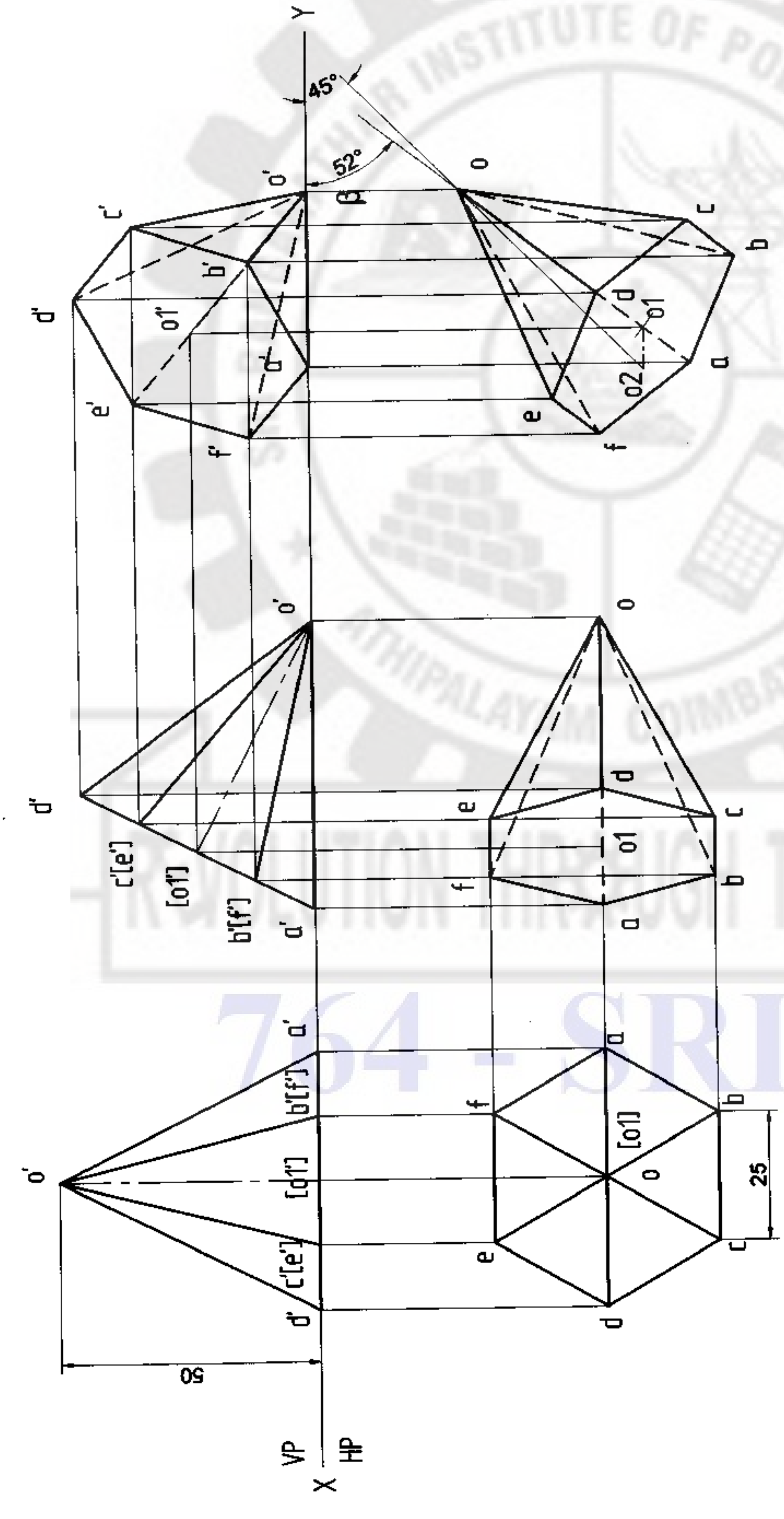
Problem 39 A hexagonal pyramid 25 mm sides of base and 50 mm axis length rests on HP on one of its slant edges. Draw the projections of the pyramid when the axis appears to be inclined to VP at 45º.

Solution



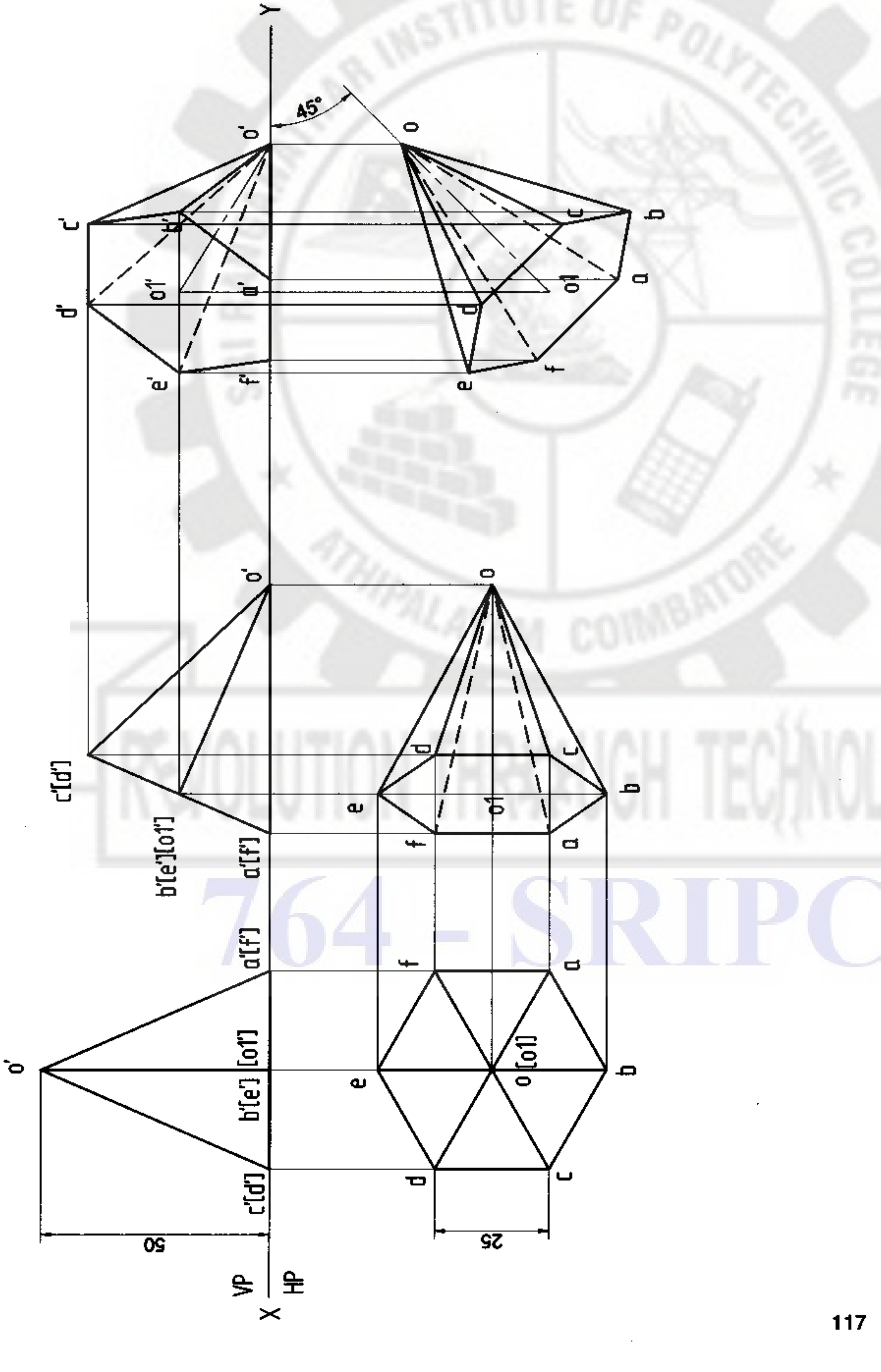
Problem 40 A hexagonal pyramid 25 mm sides of base and 50 mm axis length rests on HP on one of its slant edges. Draw the projections of the pyramid when the axis is inclined to VP at 45º.

Solution



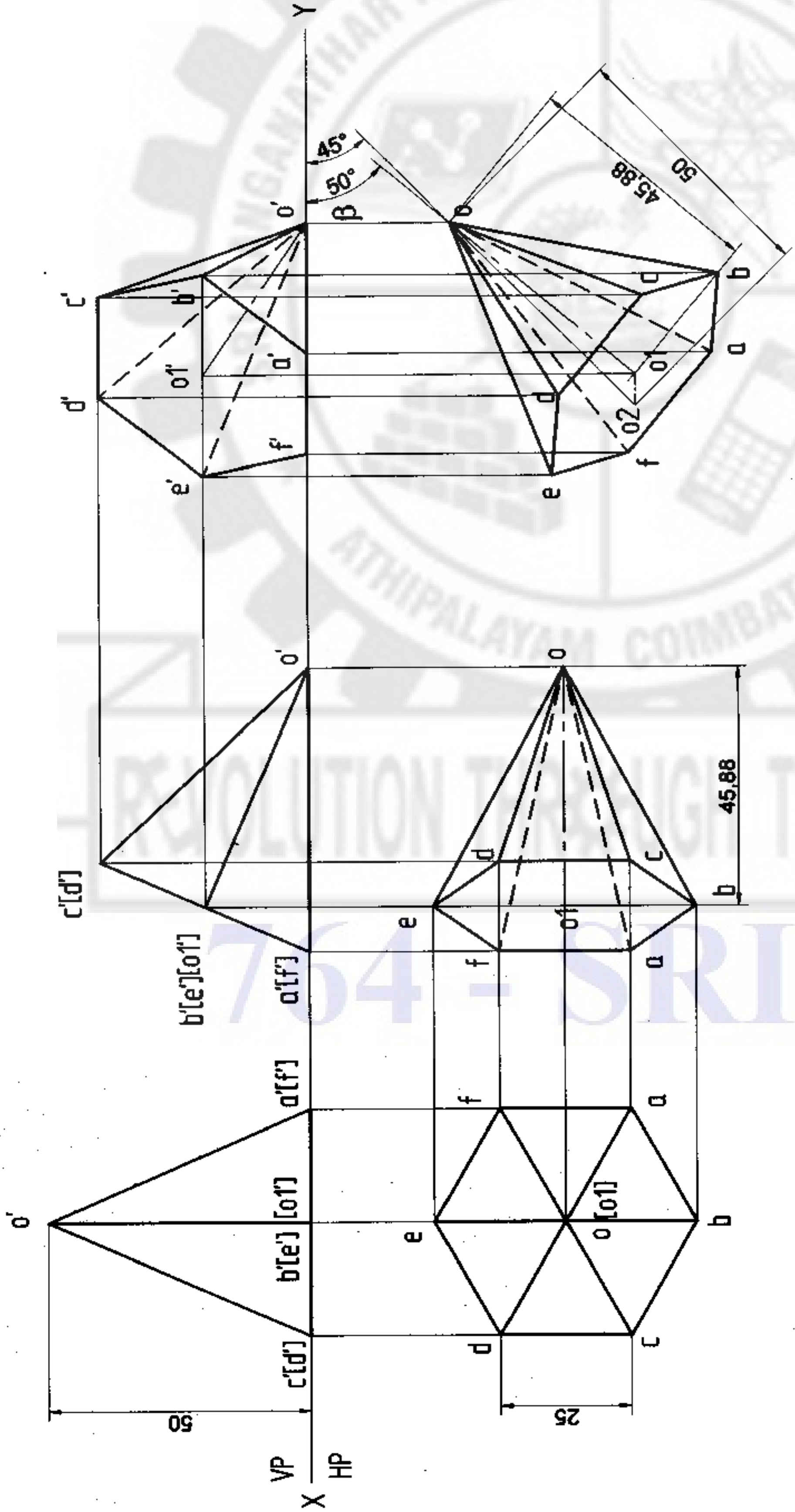
Problem 41 A hexagonal pyramid 25 mm sides of base and 50 mm axis length rests on HP on one of its slant triangular faces. Draw the projections of the pyramid when the axis appears to be inclined to VP at 45º.

Solution



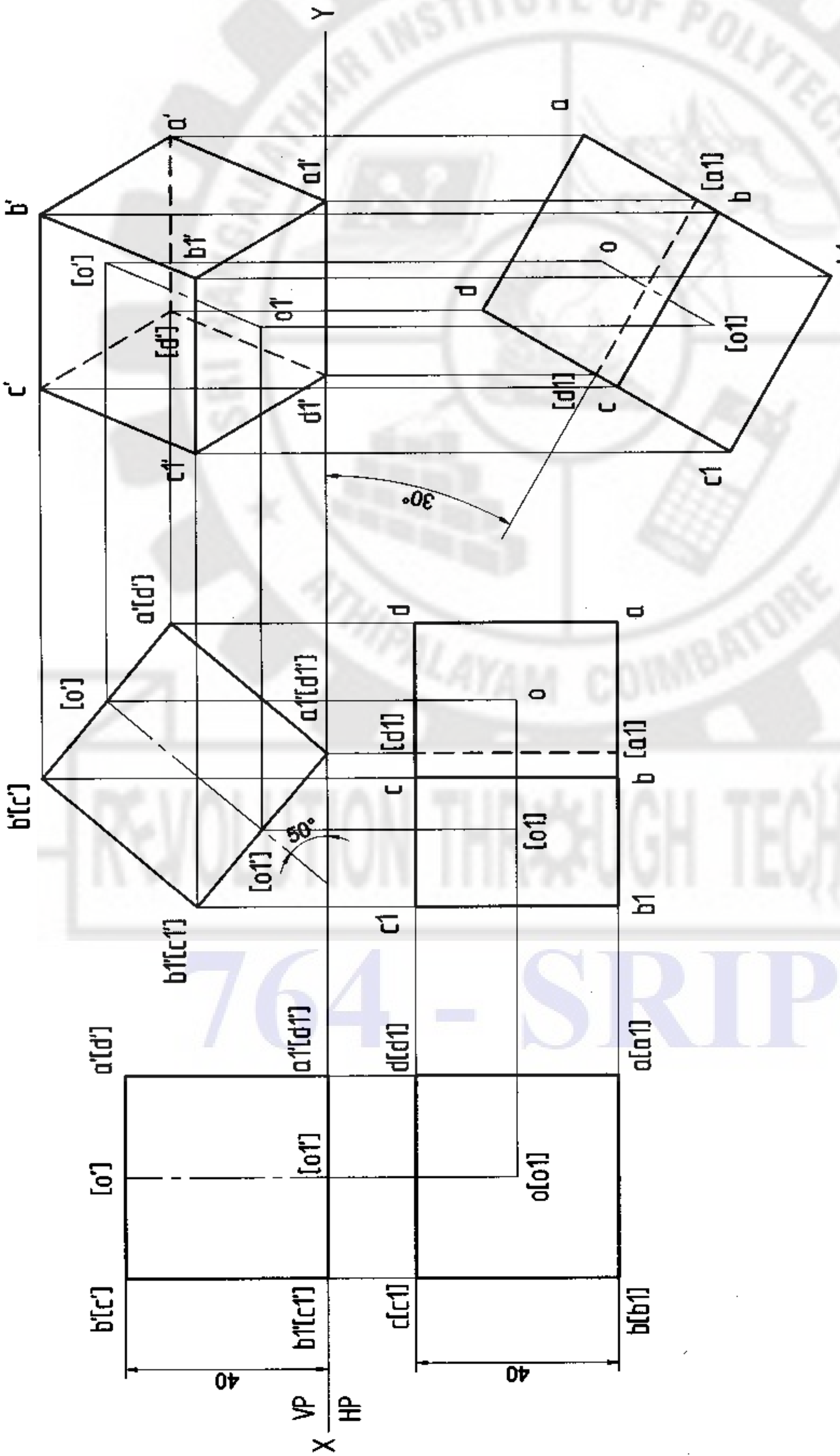
Problem 42 A hexagonal pyramid 25 mm sides of base and 50 mm axis length rests on HP on one of its slant triangular faces. Draw the projections of the pyramid when the axis is inclined to VP at 45º.

Solution



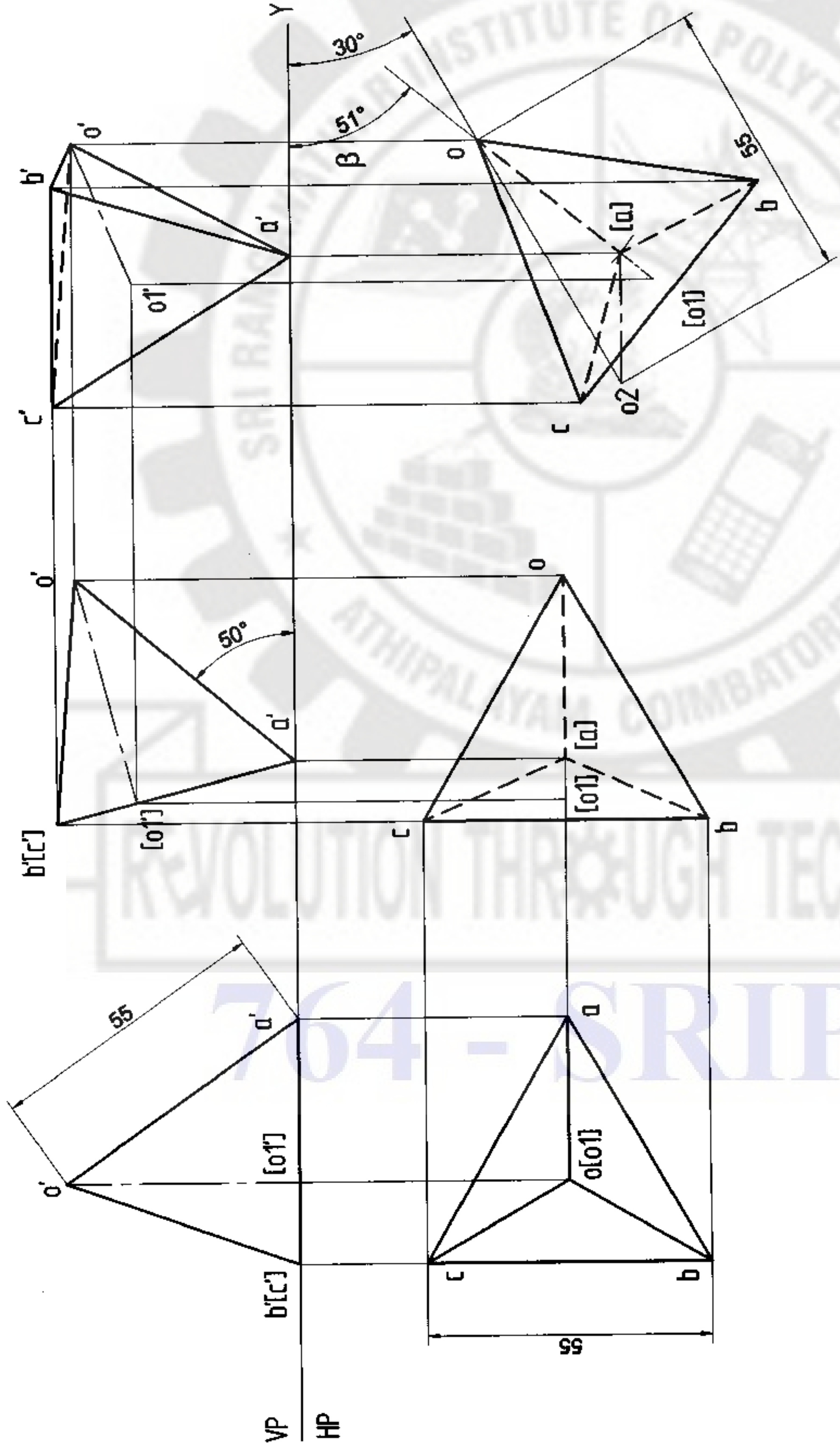
Problem 43 A cube of 40 mm sides rests on HP on an edge which is inclined to VP at 30º. Draw the projections when the lateral square face containing the edge on which it rests makes an angle of 50º to HP.

Solution



Problem 44 A tetrahedron of 55 mm sides rests on one of its corners such that an edge containing that corner is inclined to HP at 50º and VP at 30º. Draw its projections.

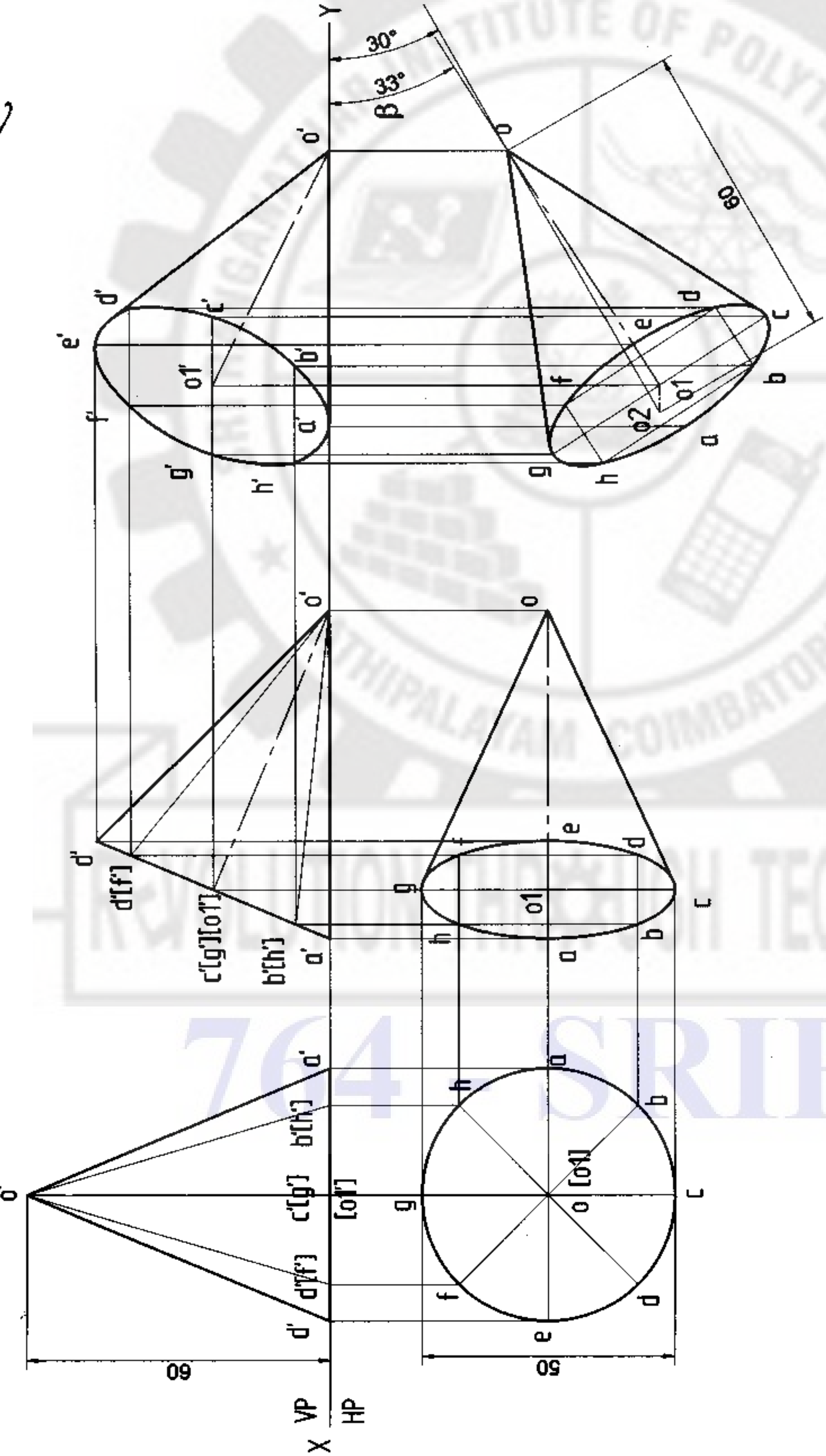
Solution



Problem 45 A cone of 50 mm base diameter and 60 mm axis length rests on HP on one of its generators. Draw its projections when the axis is inclined to VP at 30º.

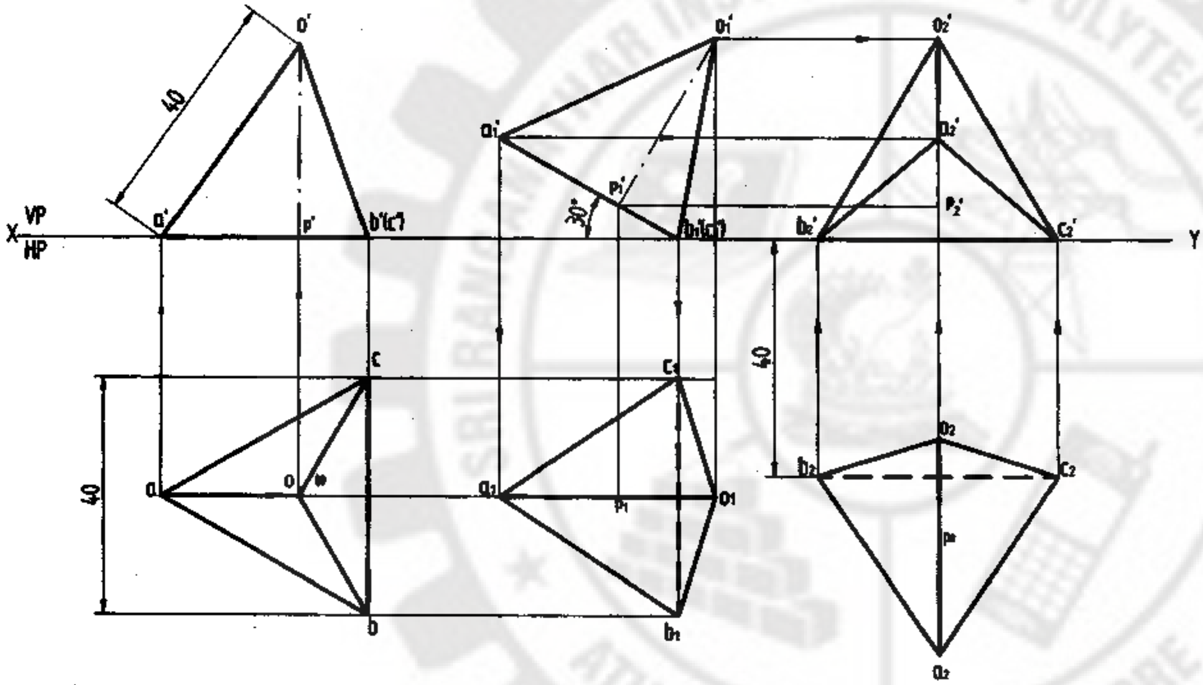
Solution

June 09



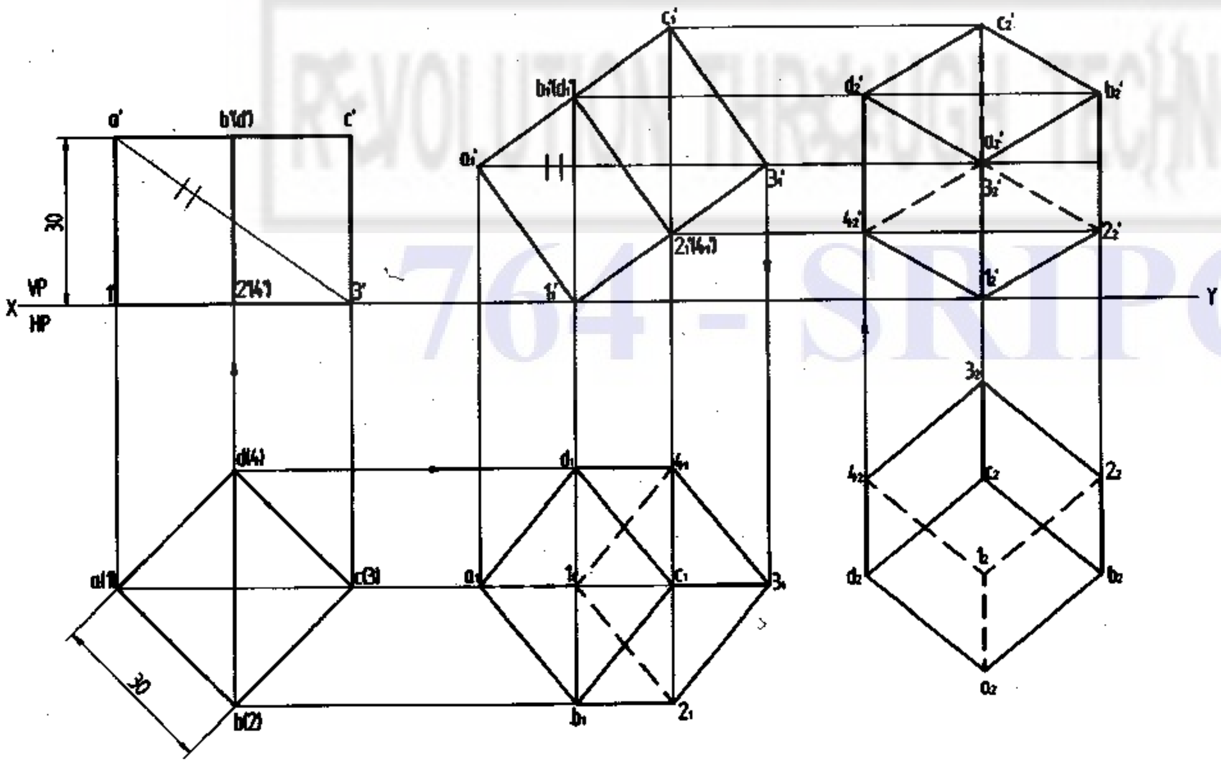
Problem 46 A tetrahedron of sides 40 mm is resting on one of its sides on HP. This side is parallel to VP and 40 mm away from it. It is tilted about resting side such that the base containing this edge is inclined at 30° to HP. Draw the projections of the solid.

Solution



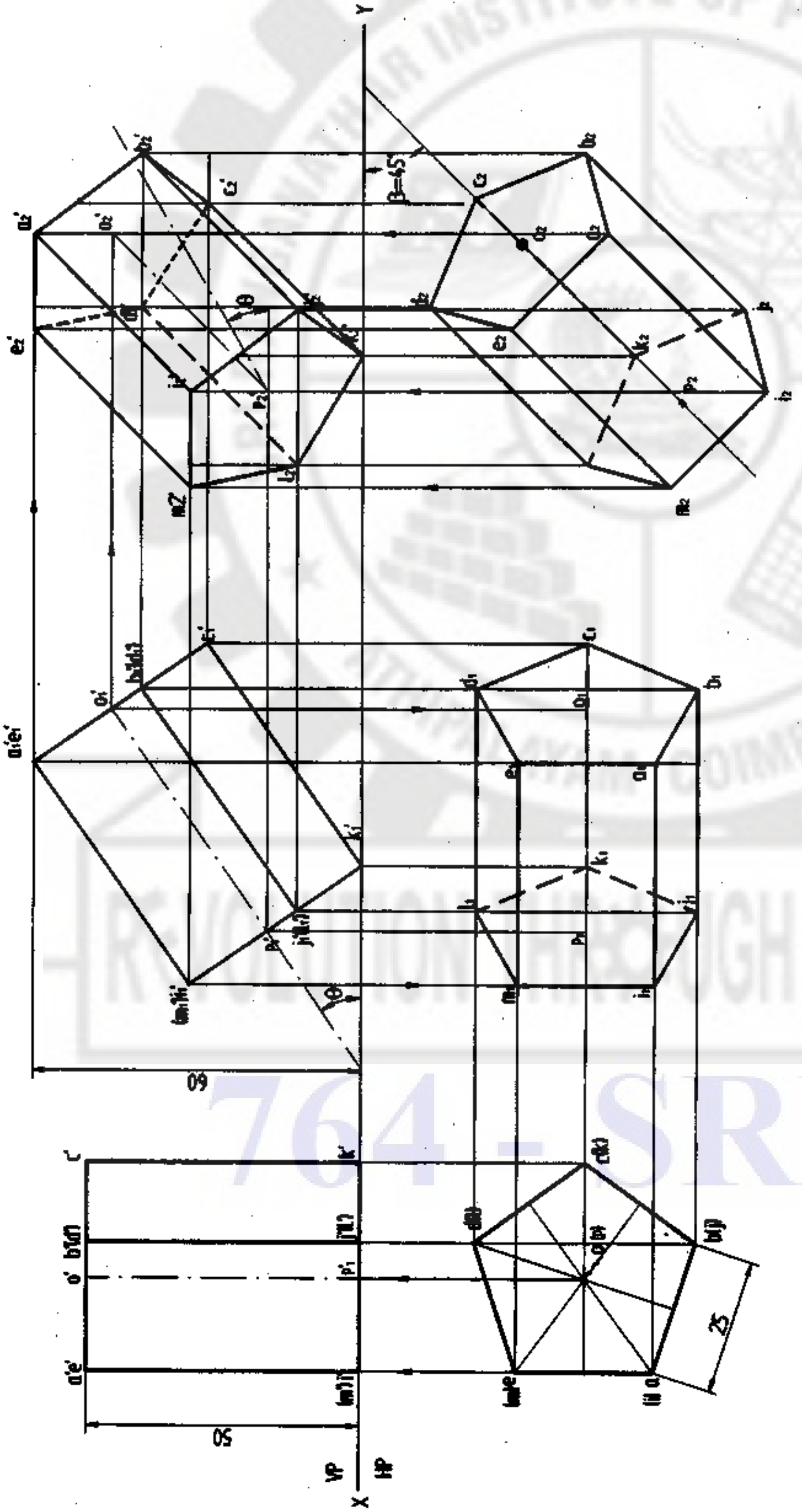
Problem 47 A Hexahedron of 30 mm sides is resting on one of its corners on HP such that one of its solid diagonals is perpendicular to VP. Draw the projections of the solid.

Solution



Problem 48 A pentagonal prism of base side 25 mm and height 50 mm is resting on HP on one of its base corners such that the top most edge is at a distance of 60 mm above HP. Draw its projections, when its top view of the axis is inclined at 45° to VP. Also, determine the inclination of the longer edge of the prism to HP which contains the resting corner.

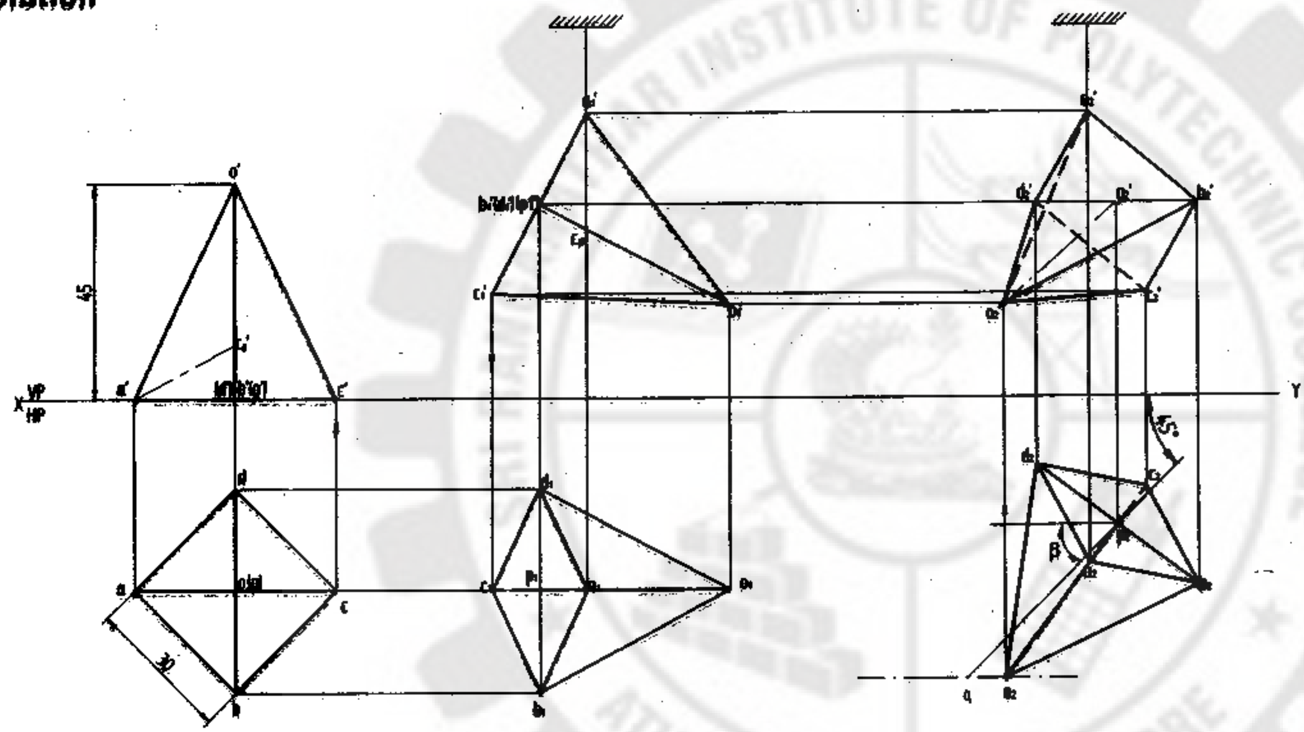
Solution



ANSWER
θ=35°

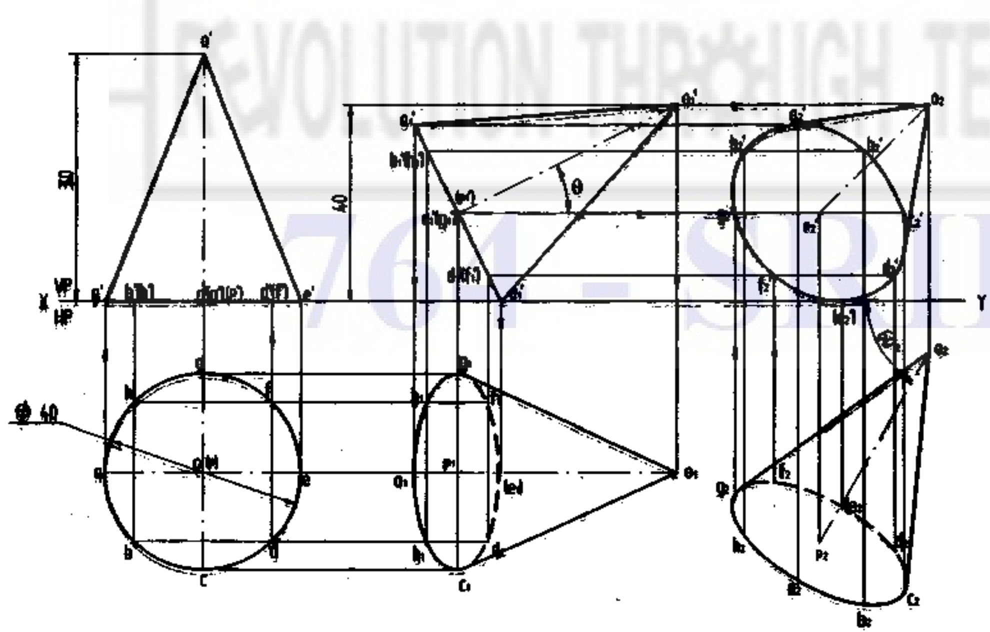
Problem 49 A square pyramid of base sides 30 mm and height 60 mm is suspended by a thread tied to one of the corners of its base. It is then tilted such that the axis makes an angle of 45° with respect to the VP. Considering the apex of the solid to be nearer to the observer, draw the projections of the solid.

Solution



Problem 50 A cone of base dia. 40 mm and axis length 50 mm is resting on HP on a point on the circumference of its base such that its apex is at 40 mm above the HP and its top view of the axis is inclined at 60° to VP. Draw the top and front views of the solid. Also, determine the inclinations of the axis when the base is nearer to the observer.

Solution



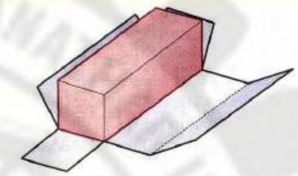
ANSWERS $\theta = 26°$

$\phi = 51°$

ME 111: Engineering Drawing

Lecture # 14 (10/10/2011)

Development of Surfaces



http://www.iitg.ernet.in/arindam.dey/me111.htm
http://www.iitg.ernet.in/rkbc/me111.htm
http://shilloi.iitg.ernet.in/~psr/

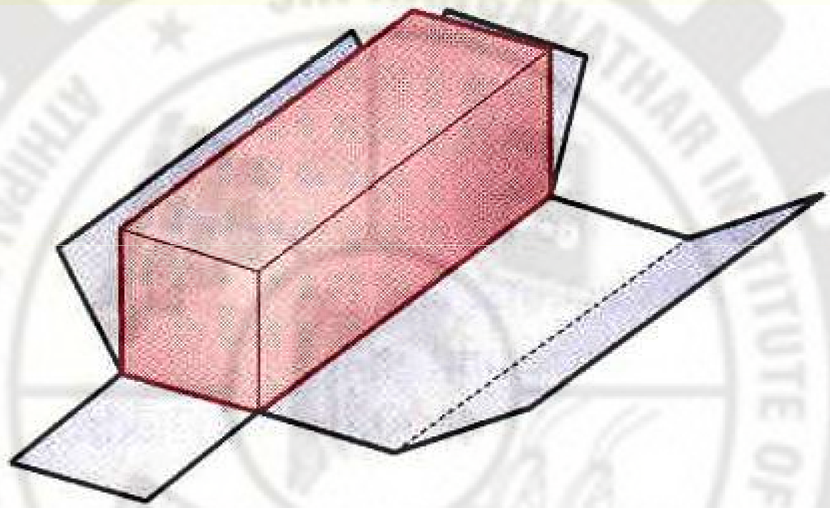
Indian Institute of Technology Guwahati
Guwahati – 781039

Development of surfaces

A development is the unfold/unrolled flat / plane figure of a 3-D object.

Called also a pattern, the plane may show the true size of each area of the object.

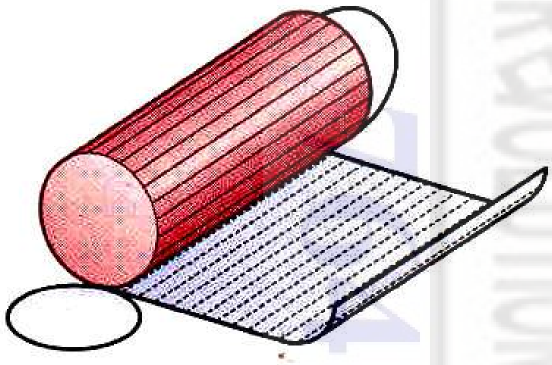
When the pattern is cut, it can be rolled or folded back into the original object.



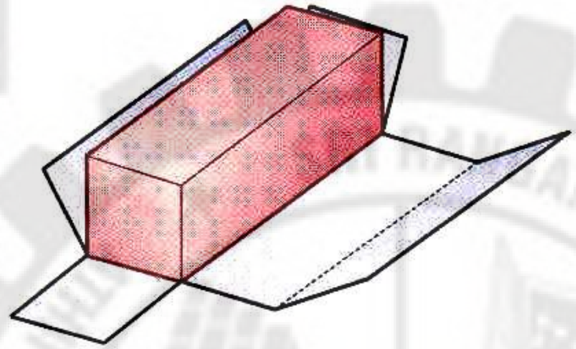
Methods of development of surfaces are:

- **Parallel line development**
- **Radial line development**
- **Triangulation development**
- **Approximate development**

- **Parallel line development** uses parallel lines to construct the expanded pattern of each three-dimensional shape. The method divides the surface into a series of parallel lines to determine the shape of a pattern. **Example: Prism, Cylinder.**

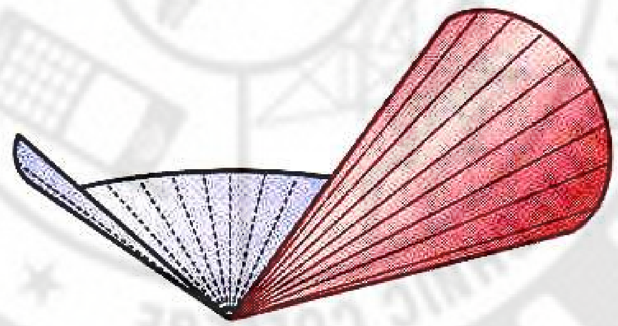


(B) Cylinder
(Parallel line development)



(A) Prism
(Parallel line development)

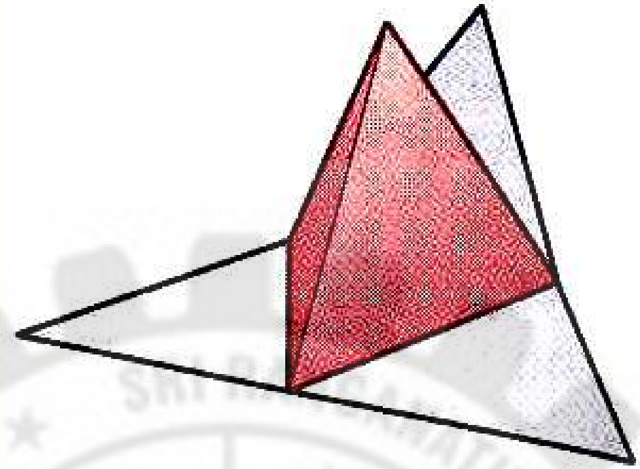
- **Radial line development** uses lines radiating from a central point to construct the expanded pattern of each three-dimensional shape. **Example: Cone, Pyramid.**



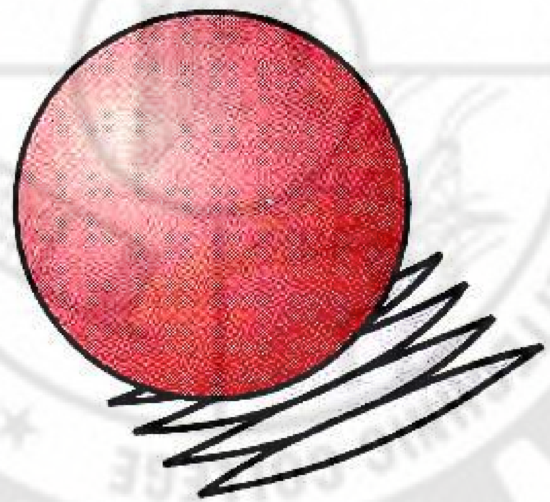
(D) Cone
(Radial line development)

- **Triangulation developments are made from polyhedrons, single-curved surfaces, and wrapped surfaces. Example: Tetrahedron and other polyhedrons.**

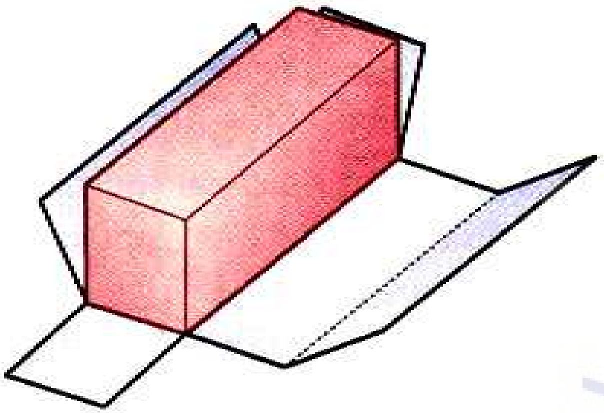
- **In approximate development, the shape obtained is only approximate. After joining, the part is stretched or distorted to obtain the final shape. Example: Sphere.**



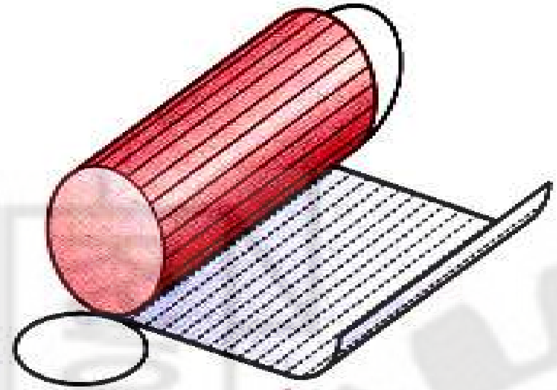
(F) Tetrahedron
(Triangulation development)



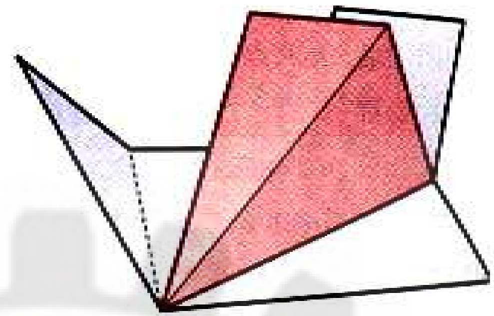
(E) Sphere
(Approximate development)



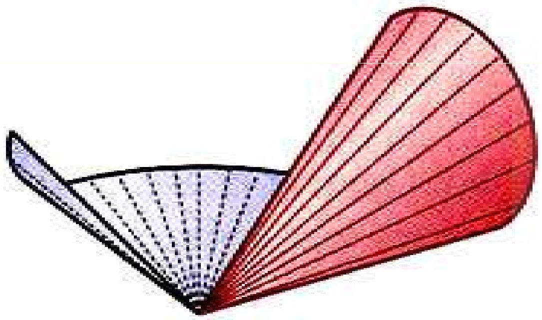
(A) Prism
(Parallel line development)



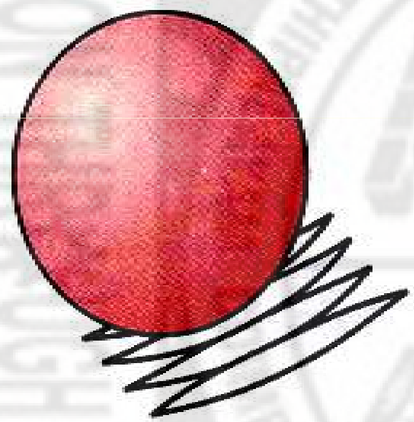
(B) Cylinder
(Parallel line development)



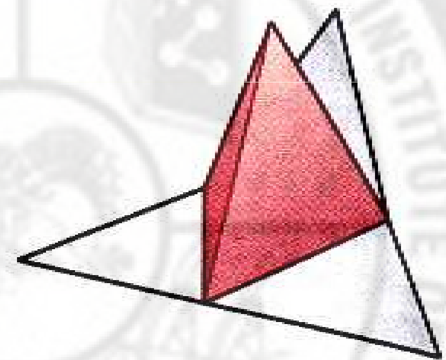
(C) Pyramid
(Radial line development)



(D) Cone
(Radial line development)



(E) Sphere
(Approximate development)



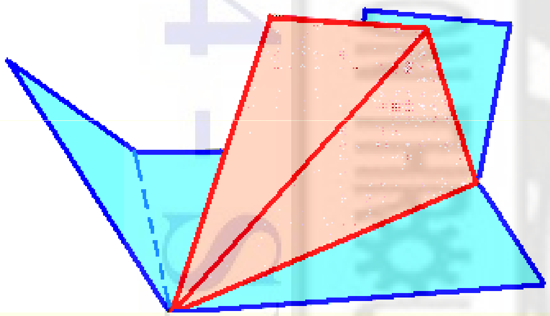
(F) Tetrahedron
(Triangulation development)

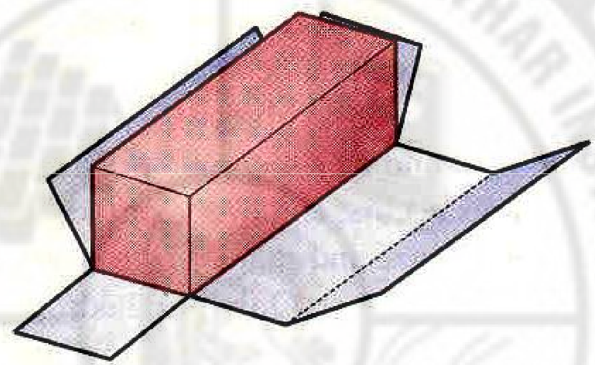
Examples of Developments

A **true development** is one in which no stretching or distortion of the surfaces occurs and every surface of the development is the same size and shape as the corresponding surface on the 3-D object.

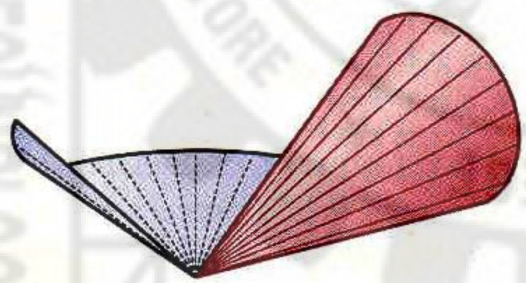
e.g. polyhedrons and single curved surfaces

Polyhedrons are composed entirely of plane surfaces that can be flattened true size onto a plane in a connected sequence.





Single curved surfaces are composed of consecutive pairs of straight-line elements in the same plane.



An **approximate development** is one in which stretching or distortion occurs in the process of creating the development.

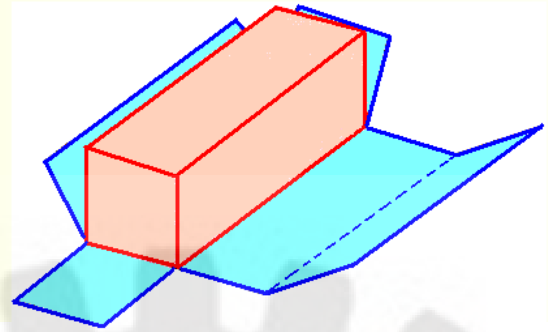
The resulting flat surfaces are not the same size and shape as the corresponding surfaces on the 3-D object.

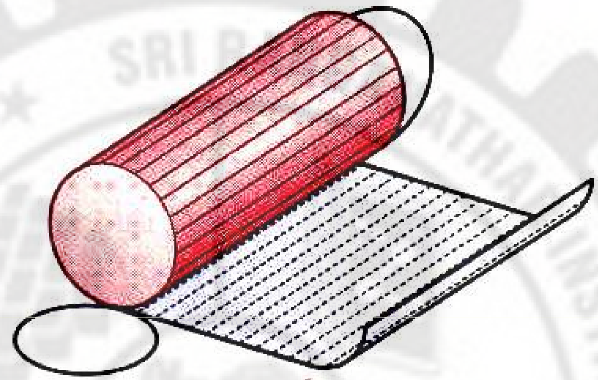
Wrapped surfaces do not produce true developments, because pairs of consecutive straight-line elements do not form a plane.

Also double-curved surfaces, such as a sphere do not produce true developments, because they do not contain any straight lines.

1. **Parallel-line developments** are made from common solids that are composed of parallel lateral edges or elements.

e.g. Prisms and cylinders





The cylinder is positioned such that one element lies on the development plane.

The cylinder is then unrolled until it is flat on the development plane.

The base and top of the cylinder are circles, with a circumference equal to the length of the development.

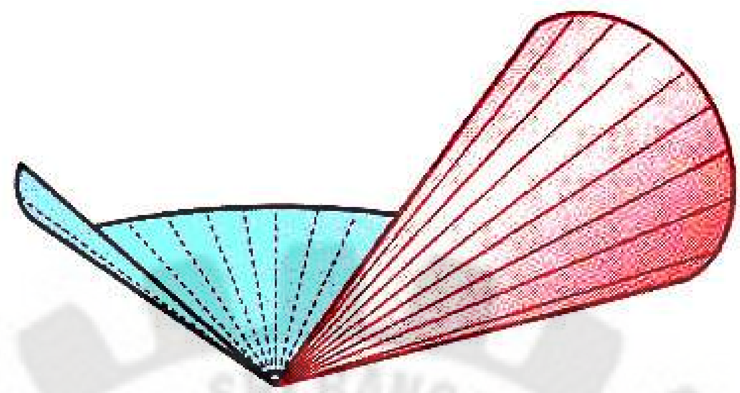
All elements of the cylinder are parallel and are perpendicular to the base and the top.

When cylinders are developed, all elements are parallel and any perpendicular section appears as a stretch-out line that is perpendicular to the elements.

2. Radial-line development

Radial-line developments are made from figures such as cones and pyramids.

In the development, all the elements of the figure become radial lines that have the vertex as their origin.



The cone is positioned such that one element lies on the development plane.

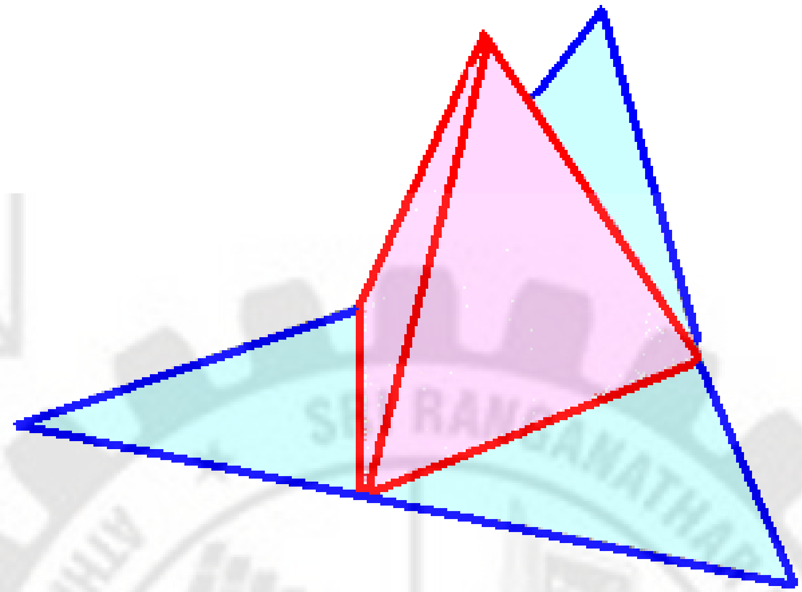
The cone is then unrolled until it is flat on the development plane.

One end of all the elements is at the vertex of the cone. The other ends describe a curved line.

The base of the cone is a circle, with a circumference equal to the length of the curved line.

3. Triangulation developments:

Made from polyhedrons, single-curved surfaces, and wrapped surfaces.



The development involve subdividing any ruled surface into a series of triangular areas.

If each side of every triangle is true length, any number of triangles can be connected into a flat plane to form a development

Triangulation for single curved surfaces increases in accuracy through the use of smaller and more numerous triangles.

Triangulation developments of wrapped surfaces produces only approximate of those surfaces.

4. Approximate developments

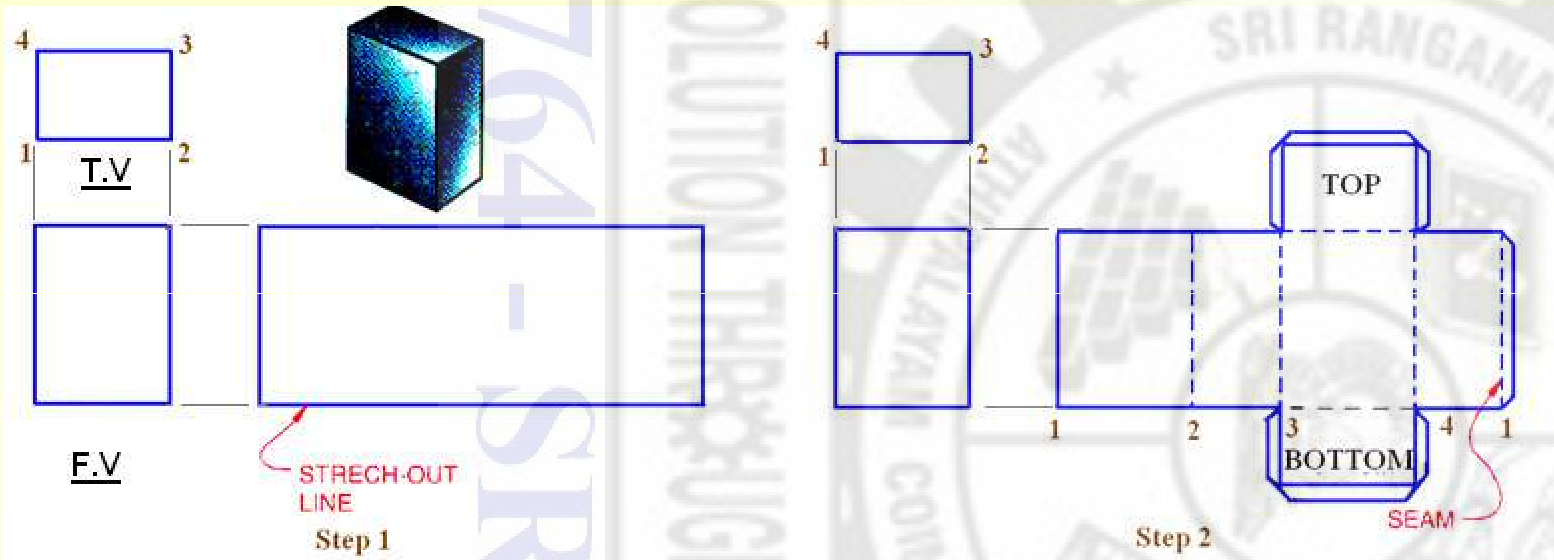
Approximate developments are used for double curved surfaces, such as spheres.

Approximate developments are constructed through the use of conical sections of the object.

The material of the object is then stretched through various machine applications to produce the development of the object.

Parallel-line developments

Developments of objects with parallel elements or parallel lateral edges begins by constructing a stretch-out line that is parallel to a right section of the object and is therefore, perpendicular to the elements or lateral edges.

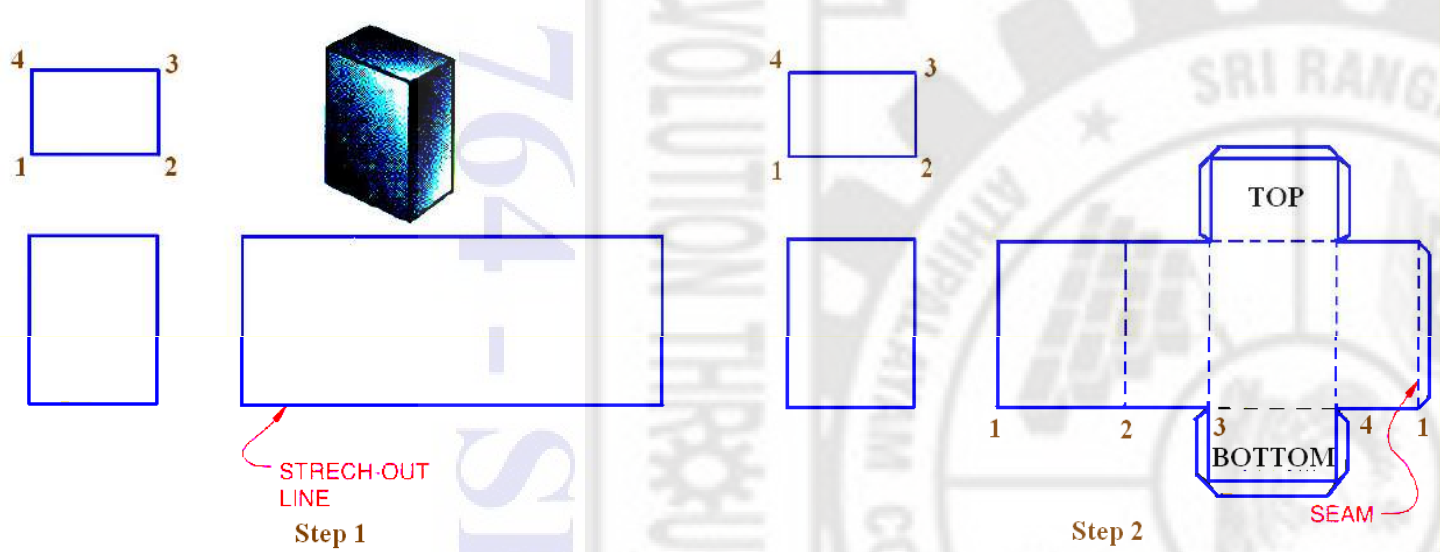


In the front view, all lateral edges of the prism appear parallel to each other and are true length. The lateral edges are also true length in the development. The length, or the stretch-out, of the development is equal to the true distance around a right section of the object.

***Step* 1.** To start the development, draw the stretch-out line in the front view, along the base of the prism and equal in length to the perimeter of the prism.

Draw another line in the front view along the top of the prism and equal in length to the stretch-out line.

Draw vertical lines between the ends of the two lines, to create the rectangular pattern of the prism.



***Step* 2.** **Locate the fold line on the pattern by transferring distances along the stretch-out line in length to the sides of the prism, 1-2, 2-3, 3-4, 4-1.**

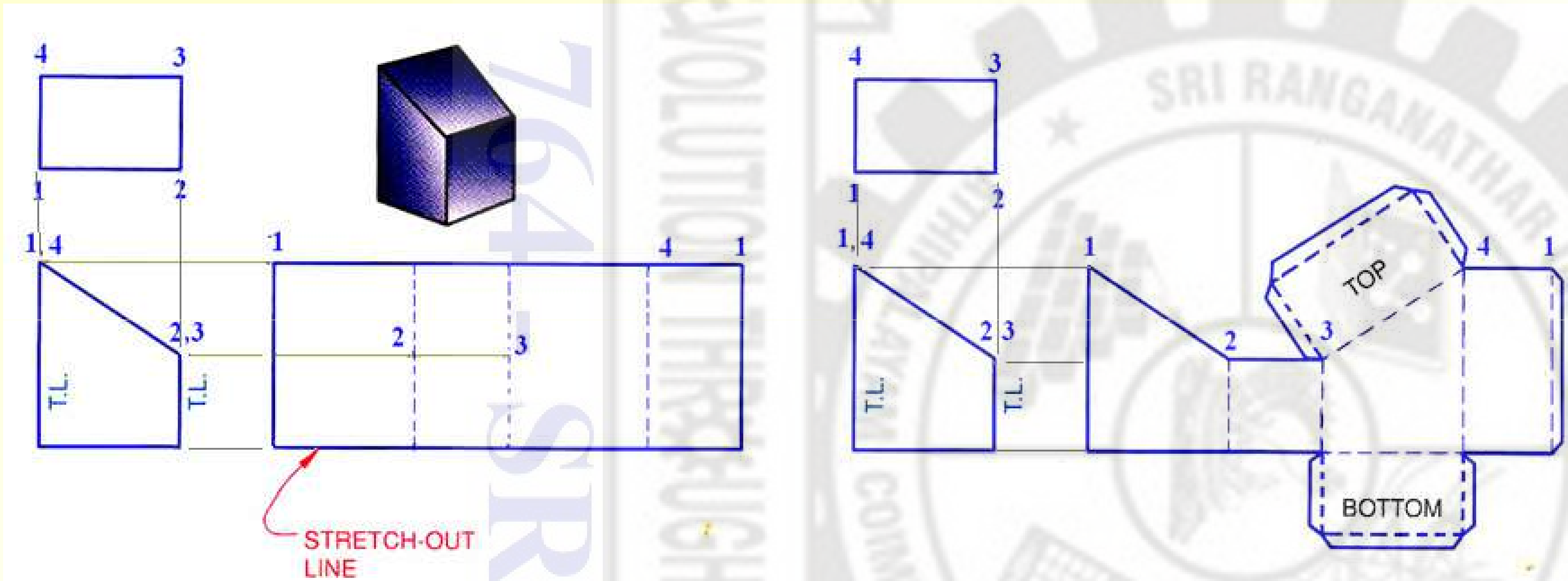
Draw thin, dashed vertical lines from points 2, 3, and 4 to represent the fold lines.

Add the bottom and top surfaces of the prism to the development, taking measurements from the top view. Add the seam to one end of the development and the bottom and top.

Development of a truncated prism

Step 1: Draw the stretch-out line in the front view, along the base of the prism and equal in length to the perimeter of the prism.

Locate the fold lines on the pattern along the stretch-out line equal in length to the sides of the prism, 1-2, 2-3, 3-4, and 4-1.



Draw perpendicular construction lines at each of these points.

Project the points 1, 2, 3, and 4 from the front view

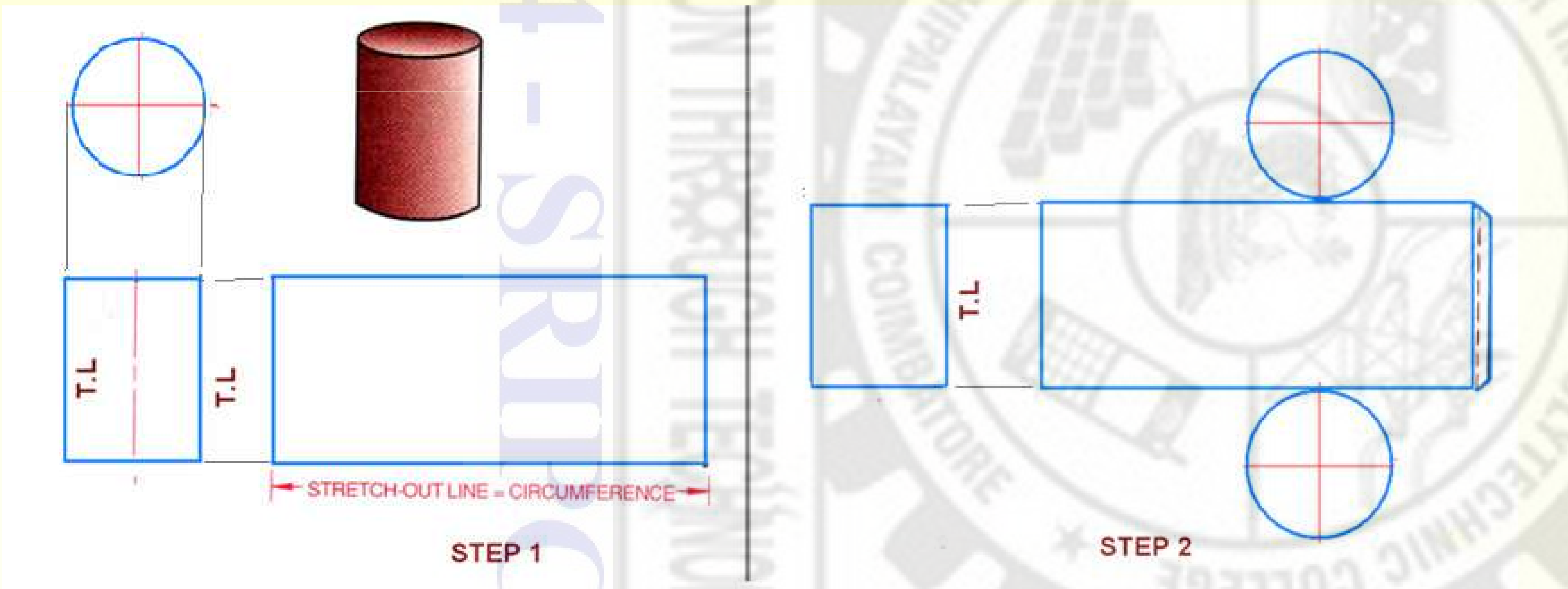
Step 2: Darken lines 1-2-3 and 4-1. Construct the bottom and top, as shown and add the seam to one end of the development and the top and bottom

Development of a right circular cylinder

***Step* 1**. **In the front view, draw the stretch-out line aligned with the base of the cylinder and equal in length to the circumference of the base circle.**

At each end of this line, construct vertical lines equal in length to the height of the cylinder.

***Step* 2**. **Add the seam to the right end of the development, and add the bottom and top circles.**



Development of a truncated right circular cylinder

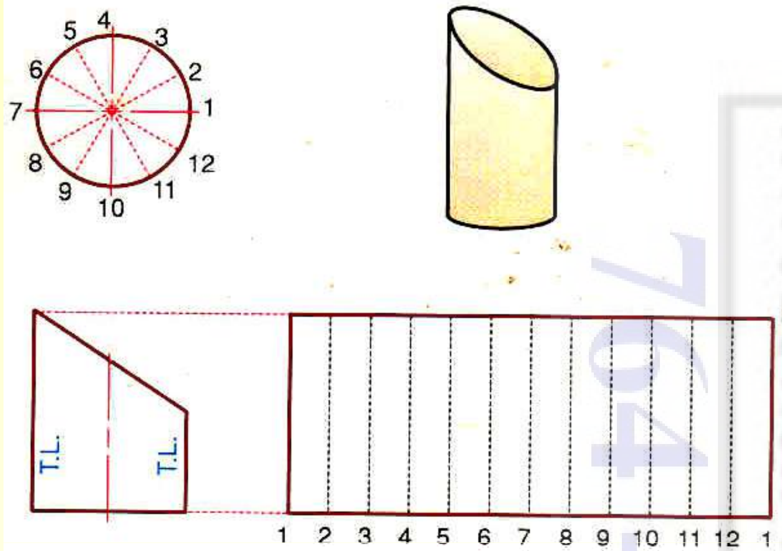
The top circular view of the cylinder is divided into a number of equal parts, e.g 12.

The stretch-out line, equal in length to the circumference of the circle, is aligned with the base in the F.V. view and is divided into 12 equal parts from which vertical lines are constructed.

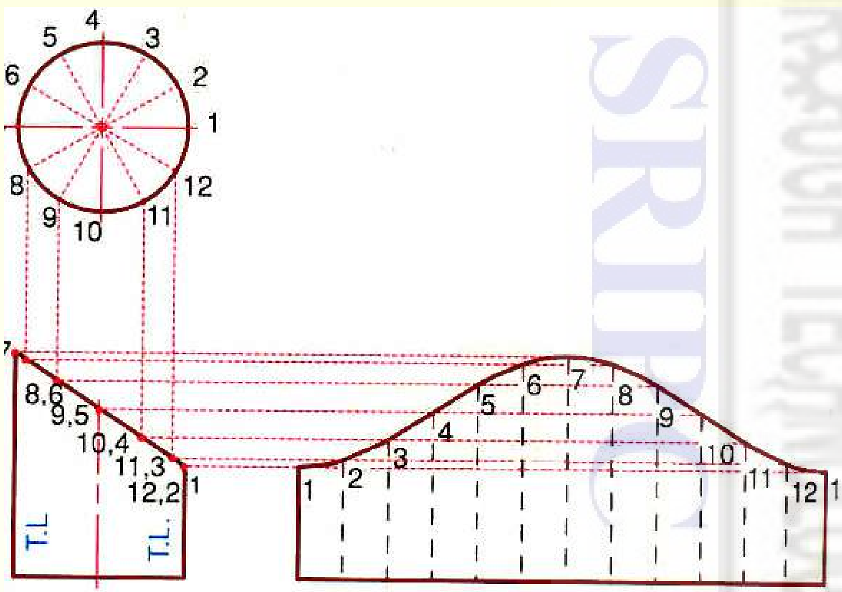
The intersection points in the T.V. are projected into the F.V. , where the projected lines intersect the angled edge view of the truncated surface of the cylinder. These intersection points are in turn projected into the development.

The intersections between these projections and the vertical lines constructed from the stretch-out line are points along the curve representing the top line of the truncated cylinder.

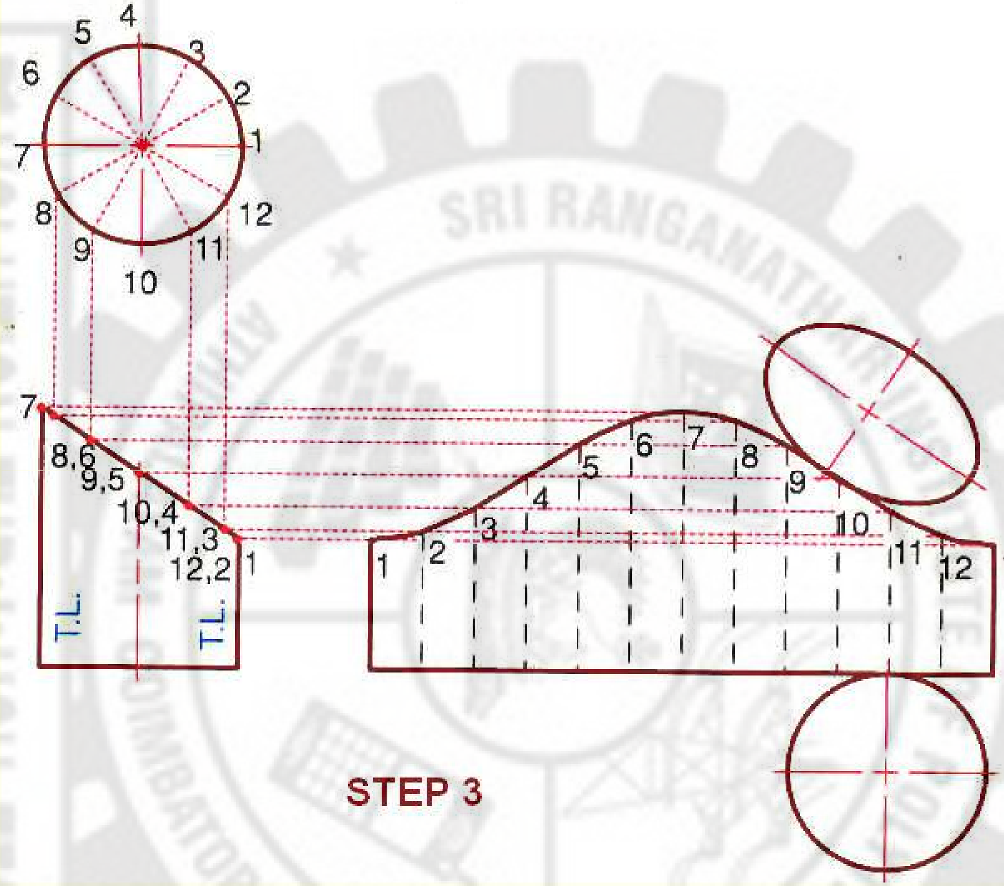
Development of a truncated right circular cylinder



STEP 1



STEP 2



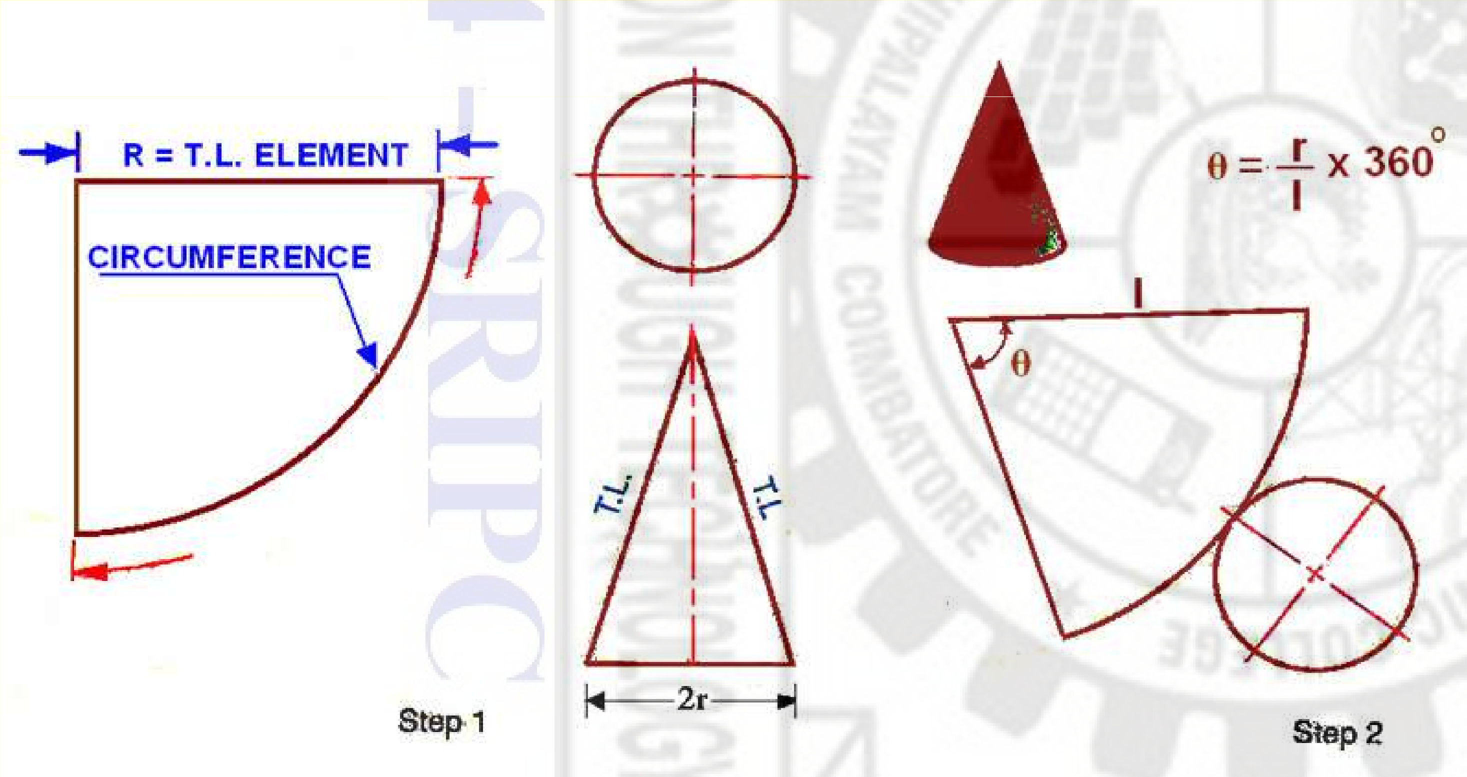
STEP 3

Development of a right circular cone

To begin this development, use a true-length element of the cone as the radius for an arc and as one side of the development.

A true- length element of a right circular cone is the limiting element of the cone in the front view. Draw an arc whose length is equal to the circumference of the base of the cone.

Draw another line from the end of the arc to the apex and draw the circular base to complete the development.



Question:

A cone of base diameter 40 mm and slant height 60 mm is kept on the ground on its base. An AIP inclined at 45° to the HP cuts the cone through the midpoint of the axis. Draw the development.

Solution   Refer Fig. 16.10.

1. Draw FV and TV as shown. Locate the AIP.

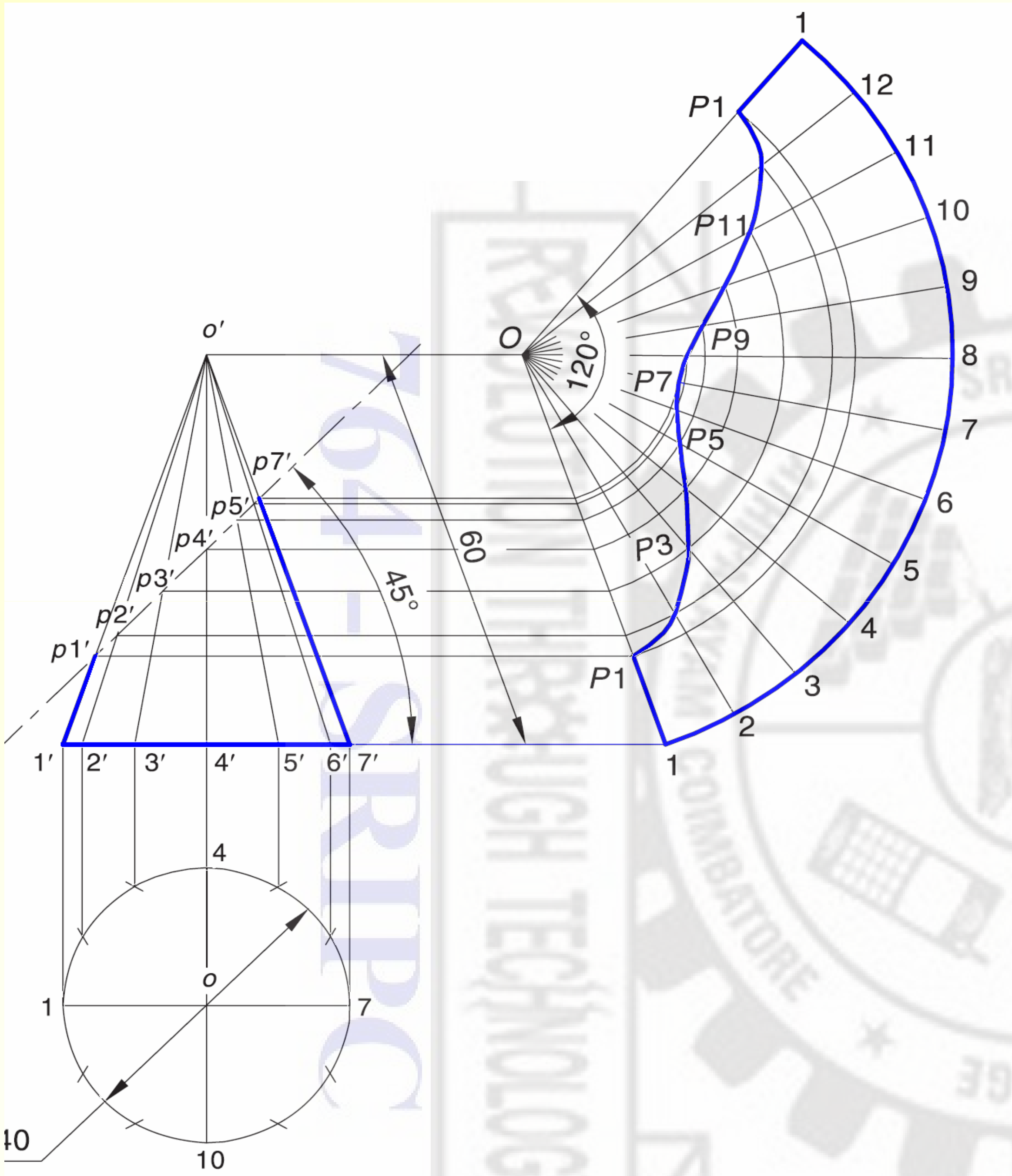
2. Divide the TV into 12 equal parts and draw the corresponding lateral lines (i.e., generators) in FV. Mark points p1', p2', p3', …, p12' at the points of intersections of the AIP with generators of the cone.

3. Obtain the included angle of the sector. θ = (20/60)* 360 = 120°.

4. Draw O–1 parallel and equal to o'–7. Then draw sector O–1–1– O with O as a centre and included angle 120°.

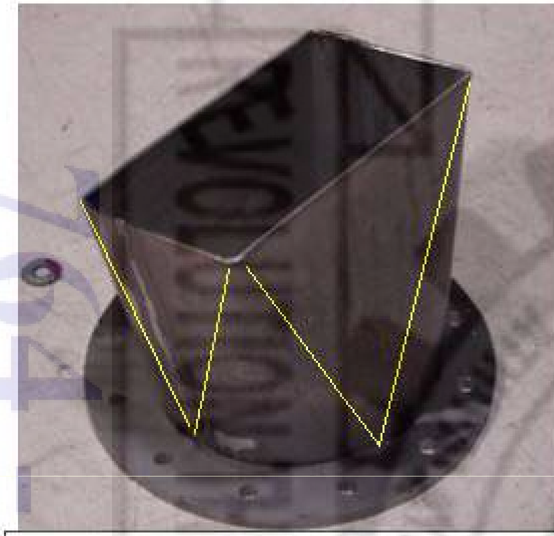
5. Divide the sector into 12 equal parts (i.e., 10° each). Draw lines O–2, O–3, O–4, …, O–12.

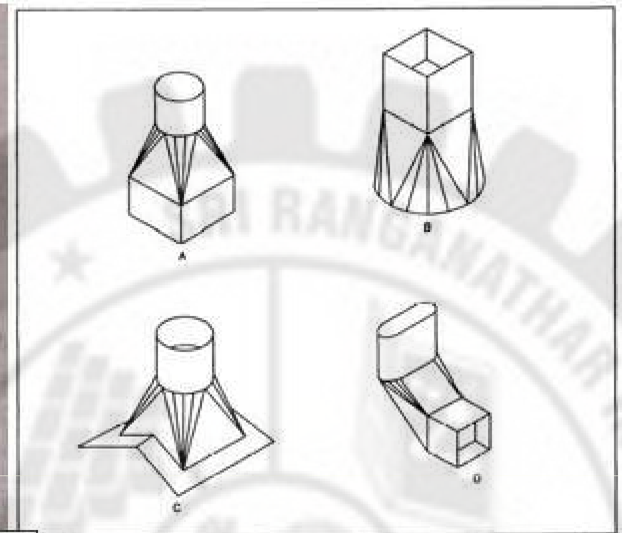
6. Project points p1', p2', p3', …, p12' from FV to corresponding lines in development and mark points P1, P2, P3, …, P12 respectively. Join all these points by a smooth freehand curve.

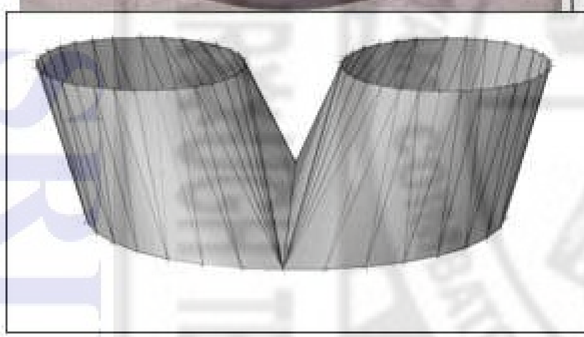


o′
O
120°
60
45°
p1′
p2′
p3′
p4′
p5′
p7′
1′
2′
3′
4′
5′
6′
7′
o
1
4
7
10
40
P1
P3
P5
P7
P9
P11
1
2
3
4
5
6
7
8
9
10
11
12

Development of Transition pieces used in industry







Source : Internet

Triangulation development

Employed to obtain the development of Transition Pieces

Transition pieces are the sheet metal objects used for connecting pipes or openings either of different shapes of cross sections or of same cross sections but not arranged in identical positions.

1. **Transition pieces joining a curved cross section to a non curved cross section (e,g, Square to round, hexagon to round , square to ellipse, etc.)**
2. **Joining two non-curved cross sections (e.g. square to hexagon, square to rectangle, square to square in un-identical positions)**
3. **Joining only two curve sections (e.g. Circle to oval, circle to an ellipse, etc)**

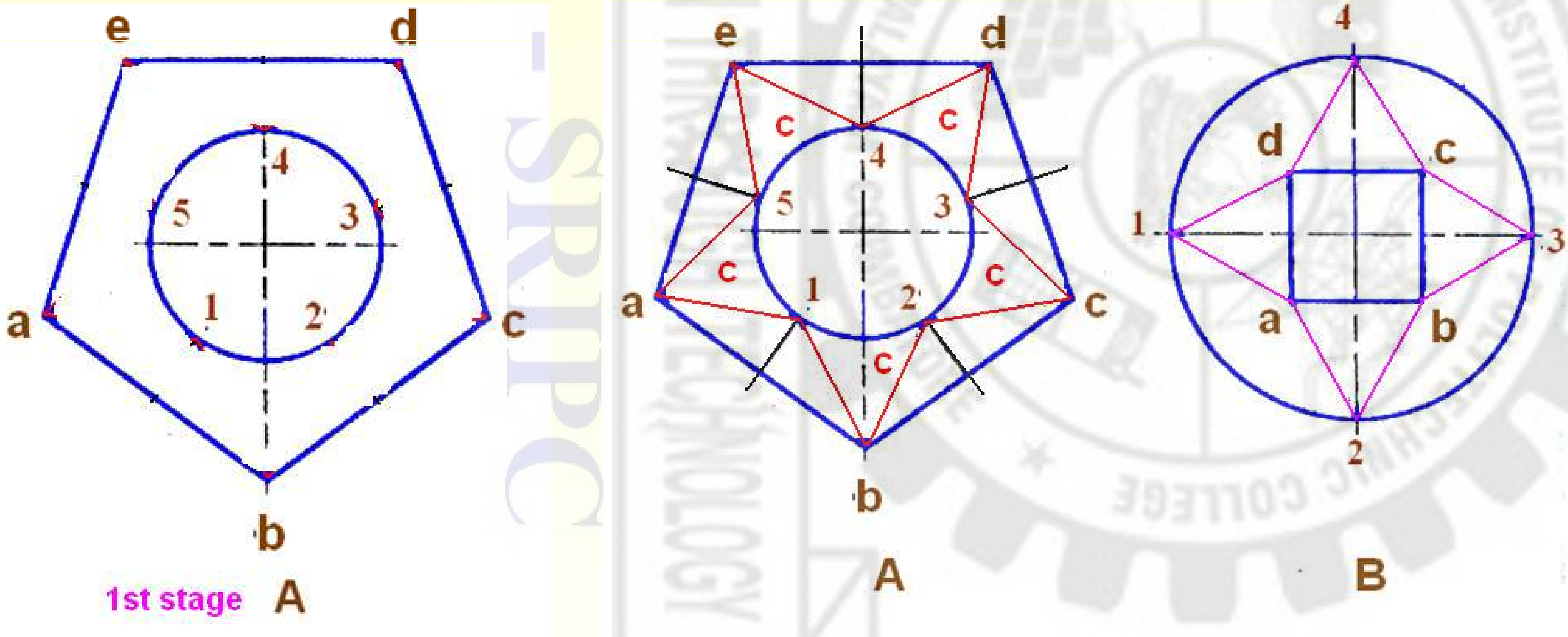
In this method, the lateral surfaces of the transition pieces are divided in to a number of triangles.

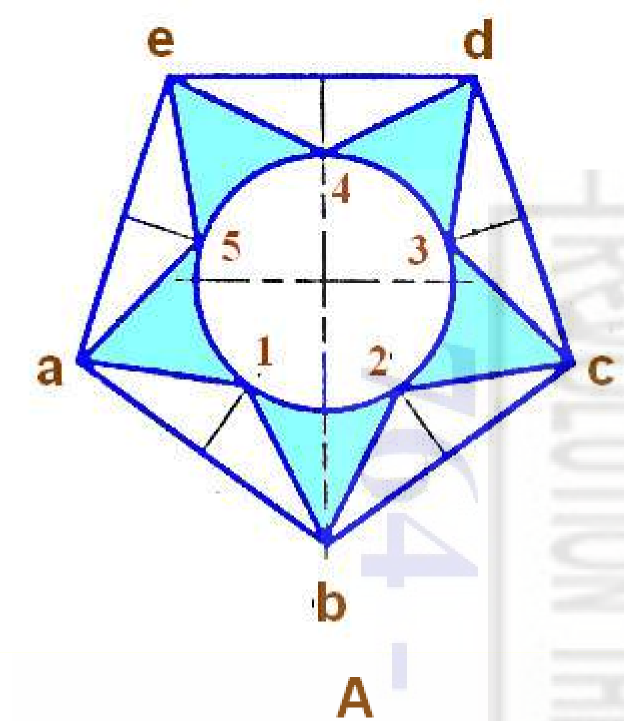
By finding the true lengths of the sides of each triangle, the development is drawn by laying each one of the triangles in their true shapes adjoining each other.

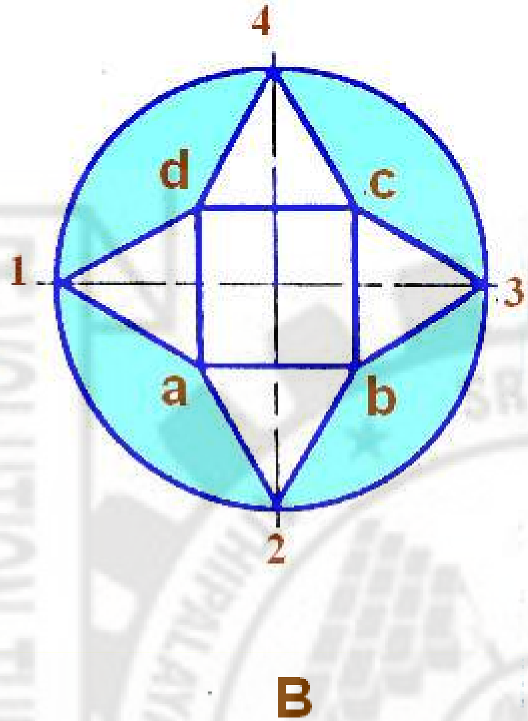
Transition pieces joining curved to Non-curved cross sections

The lateral surface must be divided into curved and non-curved triangles. Divide the curved cross section into a number of equal parts equal to the number of sides of non-curved cross-section.

Division points on the curved cross section are obtained by drawing bisectors of each side of the non-curved cross section.



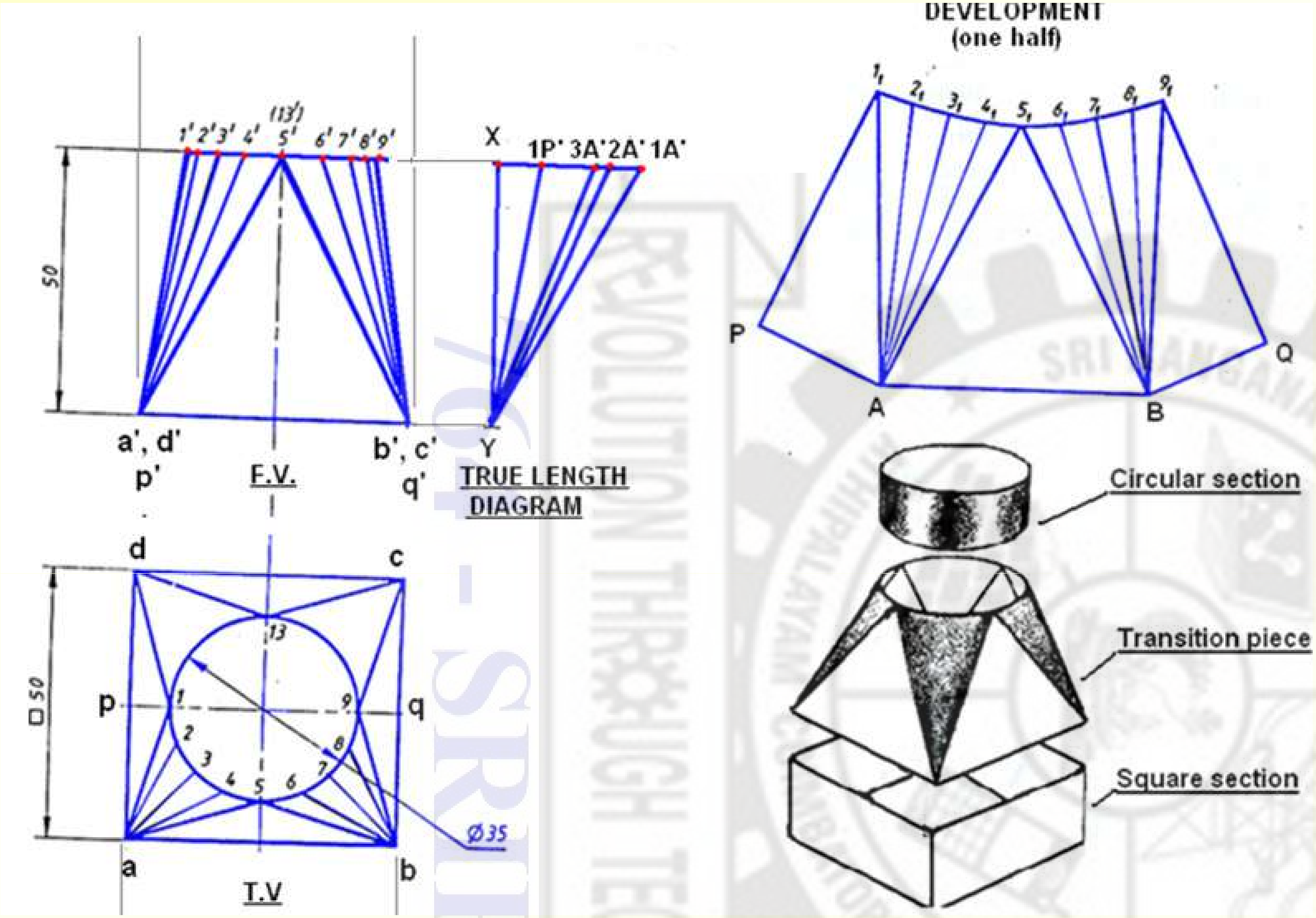




The division points thus obtained when connected to the ends of the respective sides of the non-curved cross-section produces plane triangles

In between two plane triangles there lies a curved triangle

After dividing in to a number of triangles, the development is drawn by triangulation method.

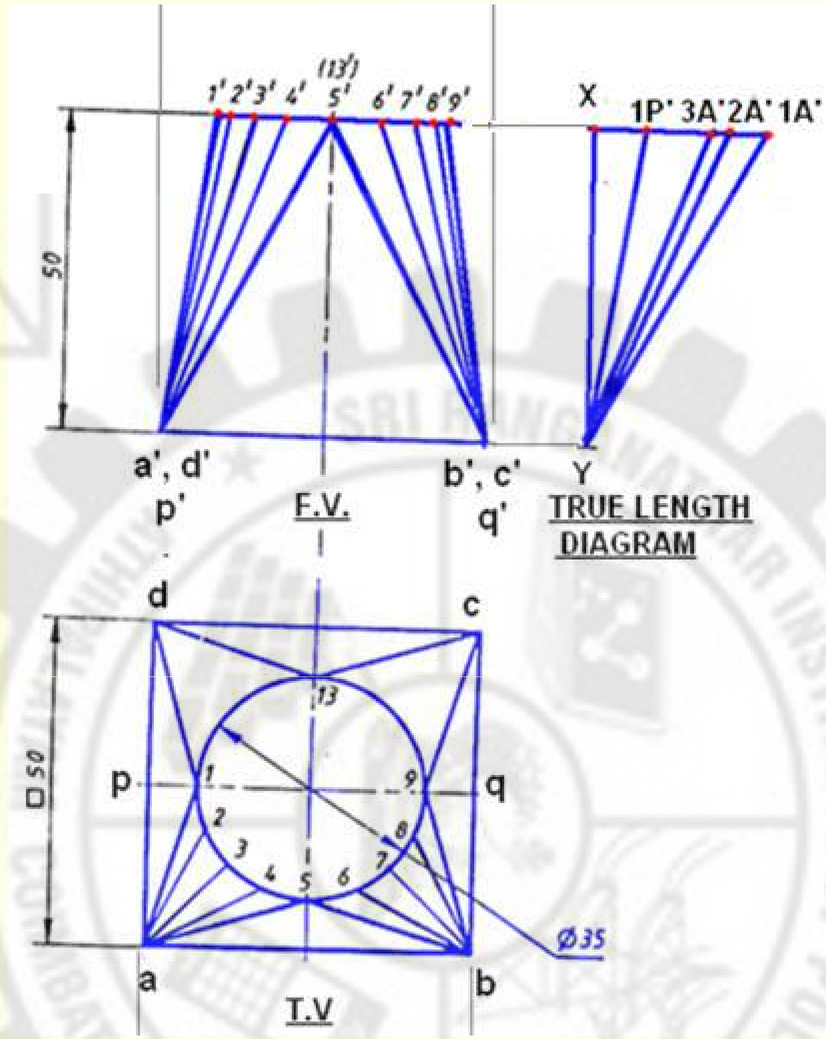


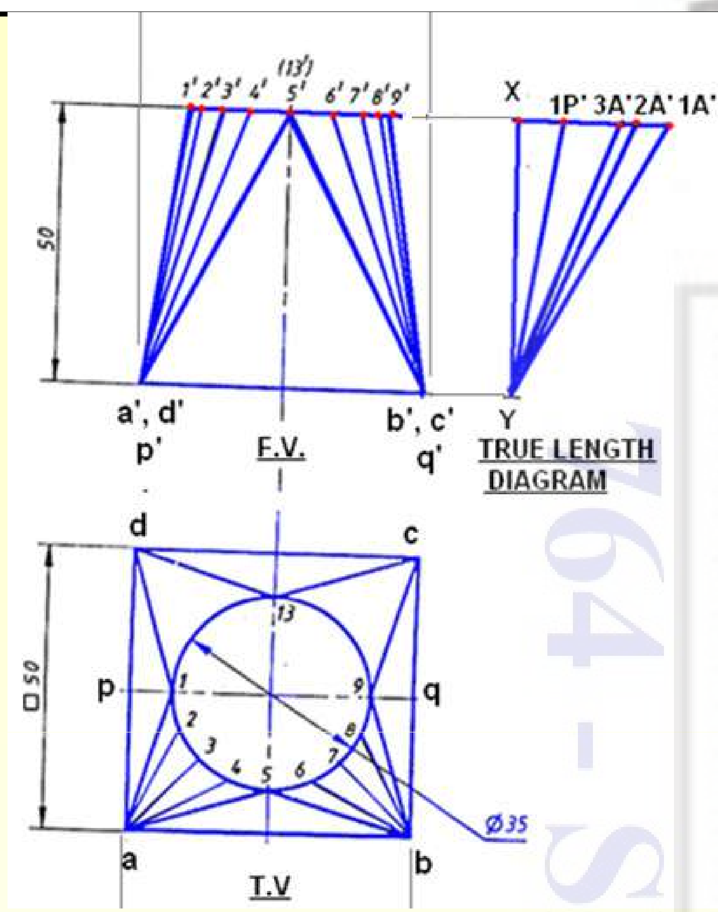
The transition piece consists of 4 plane and 4 curved triangles
1da, 5ab, 9bc, and 13cd are plane triangles and
1a5, 5b9, 9c13 and 13d1 are curved triangles.

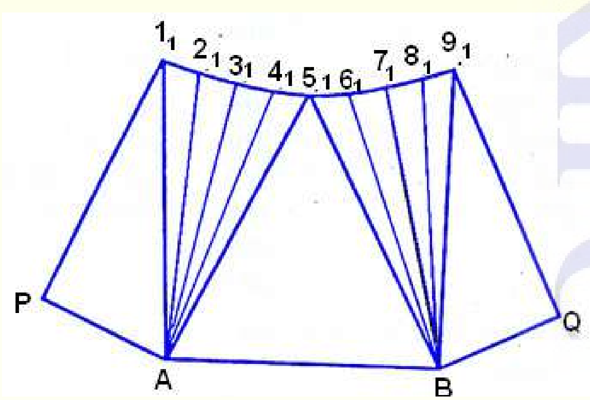
Since the transition piece is symmetrical about the horizontal axis **pq** in the top view, the development is drawn only for one half of the transition piece. The front semicircle in the top view is divided into eight equal parts 1,2,3,4, etc. Connect points 1,2,3,4 and 5 to point a.

Project points 1,2,3,etc to the front view to 1',2',3'. etc.

Connect 1', 2', 3' etc to a' and 5', 6', 7', 8' 9' to b'.







Development

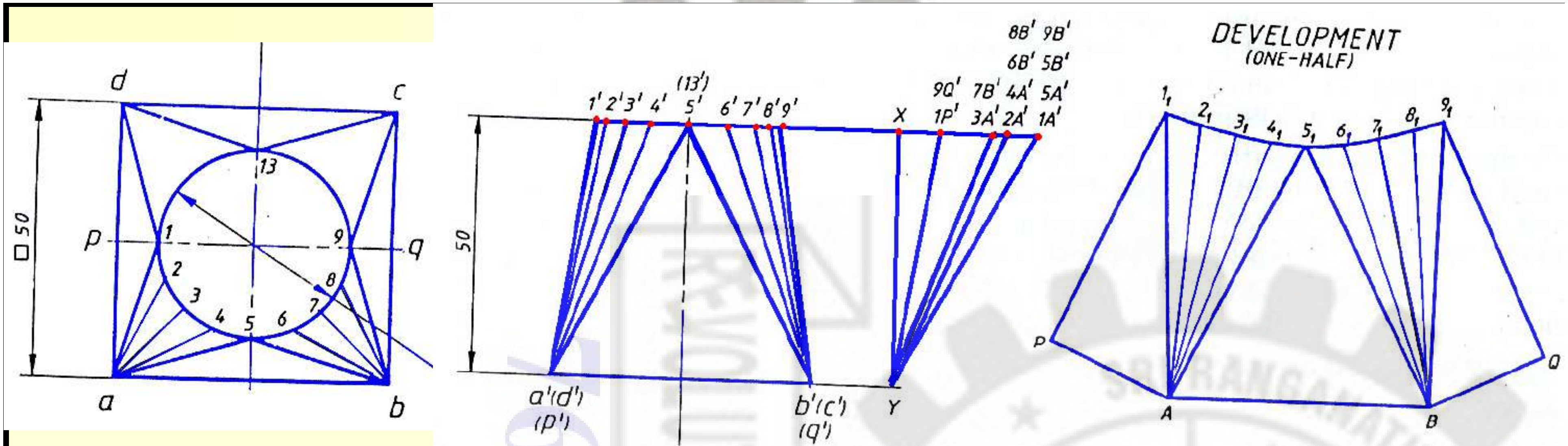
Draw vertical line **XY**. The first triangle to be drawn is **1pa**

The true length of sides **1p** and **1a** are found from the true length diagram. To obtain true length of sides **1p** and **1a**, step off the distances **1p** and **1a** on the horizontal drawn through **X** to get the point **1P'** and **1A'**. Connect these two points to **Y**. The length **Y-1P'** and **Y-1A'** are the true lengths of the sides **1p** and **1a** respectively.

DEVELOPMENT

Draw a line 1_1P = Y-1P'.

Draw another line with center 1_1 and radius Y-1A'. With P as center and radius pa, as measured from the top view, draw an arc to cut the line 1_1-A to meet at A.



With A as center and radius equal to true length of the line 2a (i.e Y-2A'), draw an arc.

With 1_1 as center and radius equal to 1-2 (T.V), draw another arc intersecting the pervious arc at 2_1.

Similarly determine the points 3_1, 4_1 and 5_1.

A -1_1-2_1-3_1- 4_1- 5_1 is the development of the curved triangle 1-a-5.

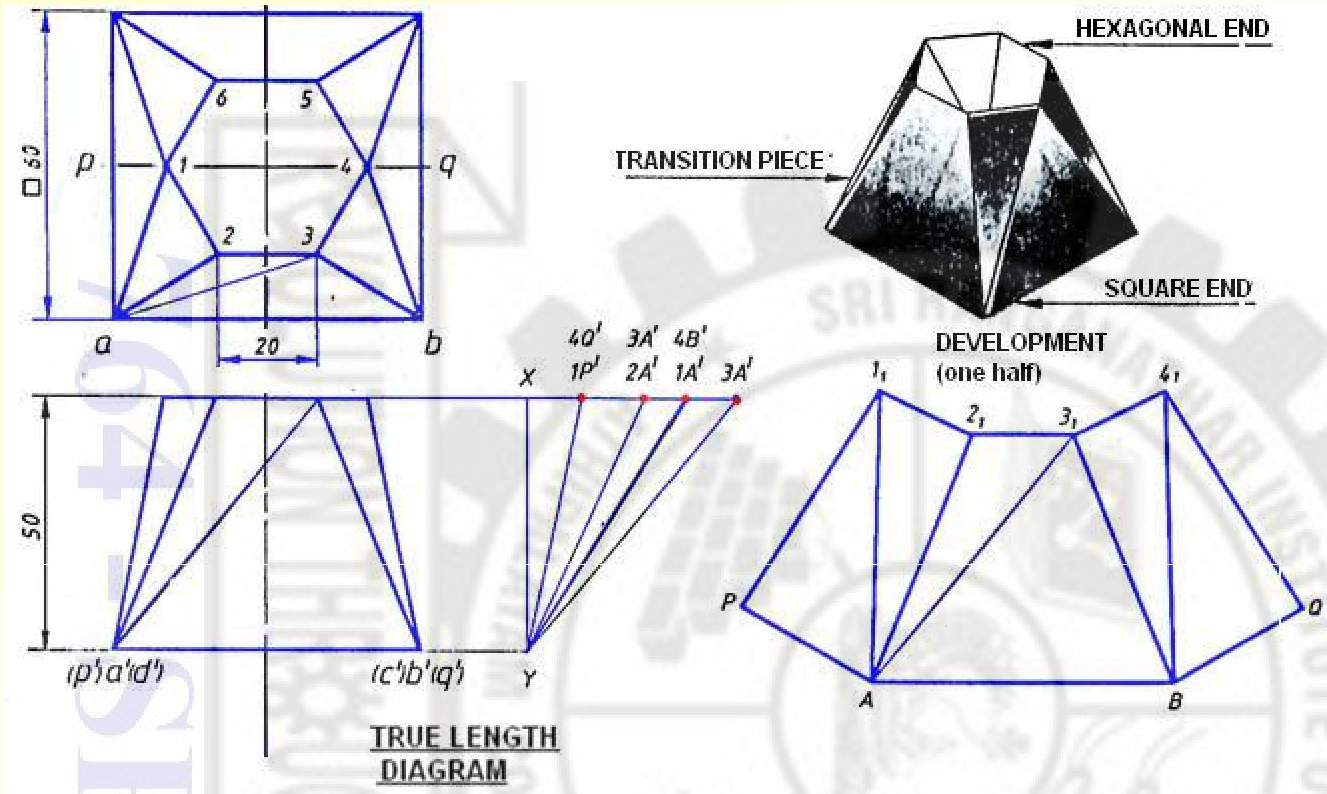
AB is the true length of the plain triangle a-5-b.

Similar procedure is repeated for the other three curved triangles and plain triangles.

Square to hexagon transition

The transition piece is assumed to cut along PQ.

Triangles 1pa and 1a2 and trapezium a23b are obtained.



To develop the lateral surface a23b, it is divided into two triangles by connecting either a3 or 2b and completed by triangulation method.

True length diagram is drawn and development obtained by the previous method.

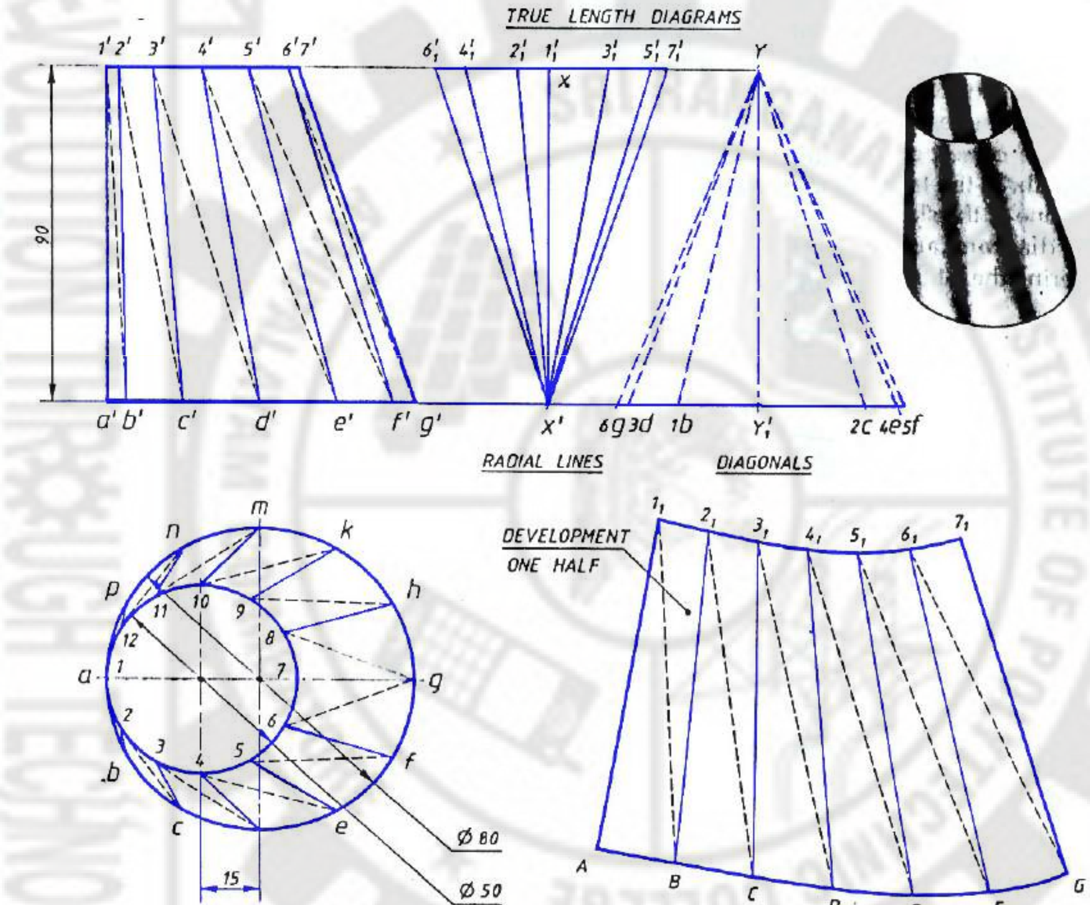
Transition pieces joining two curved surfaces

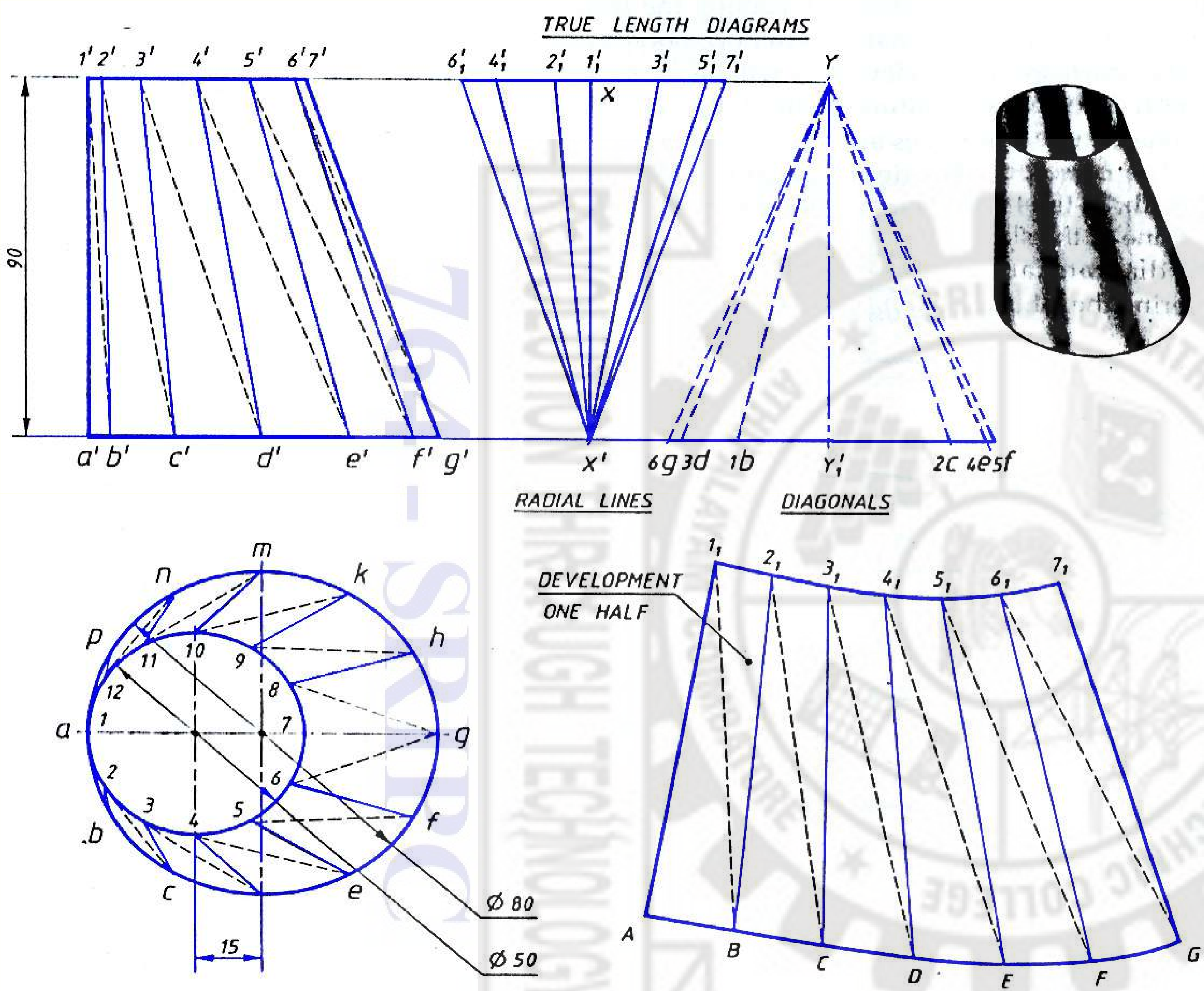
Draw TV and FV of conical reducing pieces

Divide the two circles into twelve equal parts. Connect point 1a, 2b, 3c, etc in the TV and 1’a’, 2’b’,etc in the FV. These lines are called radial lines

The radial lines divide the lateral surface into a number of equal quadrilaterals. Their diagonals are connected (dashed lines) forming a number of triangles. The true length diagram are drawn separately for radial and diagonal lines.

Conical reducing piece to connect two circular holes of diameters 80 mm and 50 mm. The holes are 90 mm apart and center offset by 15 mm.




TRUE LENGTH DIAGRAMS
1' 2' 3' 4' 5' 6' 7'
a' b' c' d' e' f' g'
90
6'1 4'1 2'1 1'1 3'1 5'1 7'1
X
X'
Y
Y'1
6g 3d 1b
2c 4e5f
RADIAL LINES
DIAGONALS
a b c e f g h k m n p
1 2 3 4 5 6 7 8 9 10 11 12
15
Ø 80
Ø 50
DEVELOPMENT
ONE HALF
11 21 31 41 51 61 71
A B C D E F G

True length diagram for radial lines

For the radial line 7-g`.

Draw XX` equal to vertical height (90mm).

With X as center and radius = 7g (from the top view), draw a horizontal offset line from X (in the true length diagram) to obtain point 7_1`. Join $7_1$` and X`, which is the true length of radial line 7g.

Similarly we can obtain true lengths for all the radial lines. For drawing convenience, the offset points are drawn on both sides of the line XX`

Similarly true length diagram for the diagonal lines can be obtained.

THANK YOU

Acknowledgement

- **Main contributors** of Engineering Drawing lecture slides preparation and modification as well as lab/tutorial questions preparation are:
  - Prof. S.C. Mishra, IIT Guwahati
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  - Prof. P.S. Robi, IIT Guwahati
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  - Dr. Sujit Dash, IIT Guwahati
- This is to acknowledge that some slides are downloaded from internet.
- Thanks to Dr. Rajib Bhattacharjya and Dr. Arindam Dey for uploading the final lecture slides in internet.
- Thanks to all other colleagues and academic staff members, whose name I missed to mention in this page.

ME 111: Engineering Drawing

Date: 17/10/2011

Lecture 15

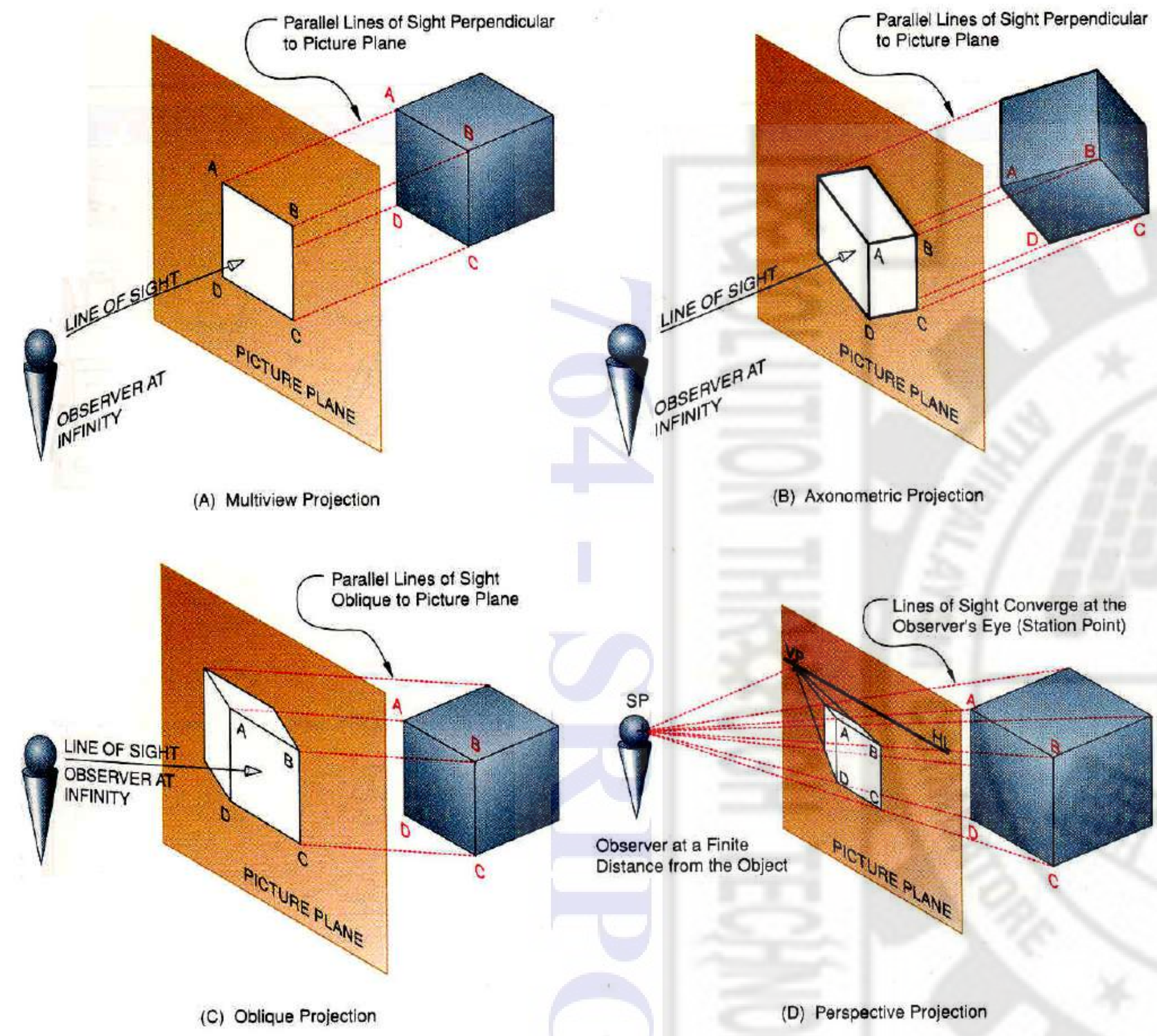
Isometric Projections

Indian Institute of Technology Guwahati
Guwahati – 781039

Announcement

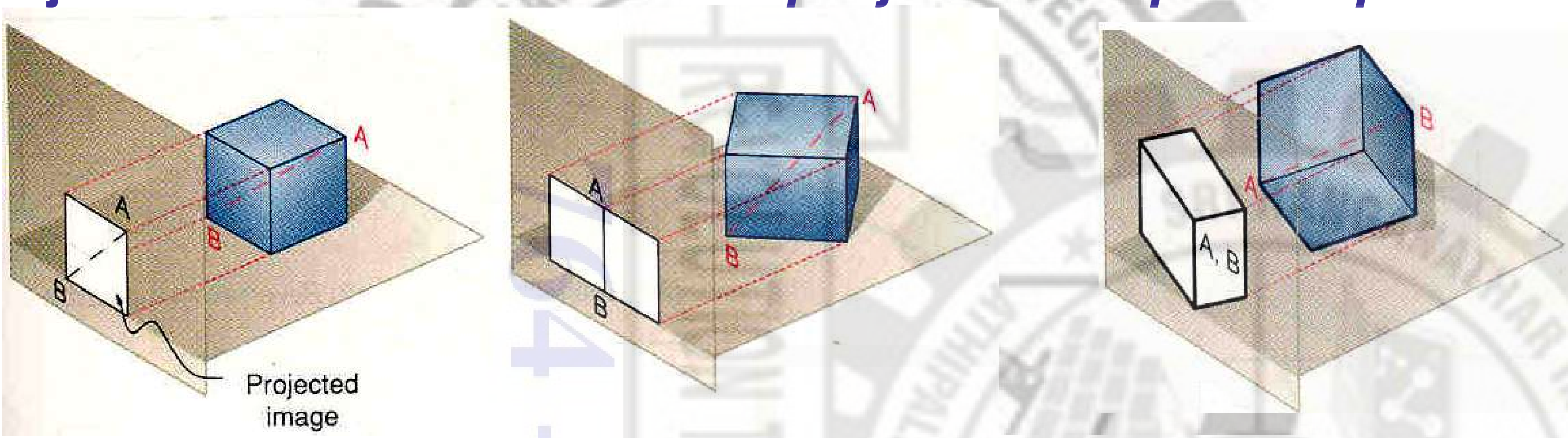
- Makeup lab class (Lab 12):
  - Inform the respective Tutor one week before lab 12 or during lab 11, about the lab (only one) you want to perform as makeup class.
  - Give Your Name, Roll No., Group No. and Lab details

- End semester examination:
  - 19th Nov. 2011 (Saturday), and
  - 20th Nov. 2011 (Sunday)



The axonometric projection is produced by multiple parallel lines of sight perpendicular to the plane of projection, with the observer at infinity and the object rotated about an axis to produce a pictorial view

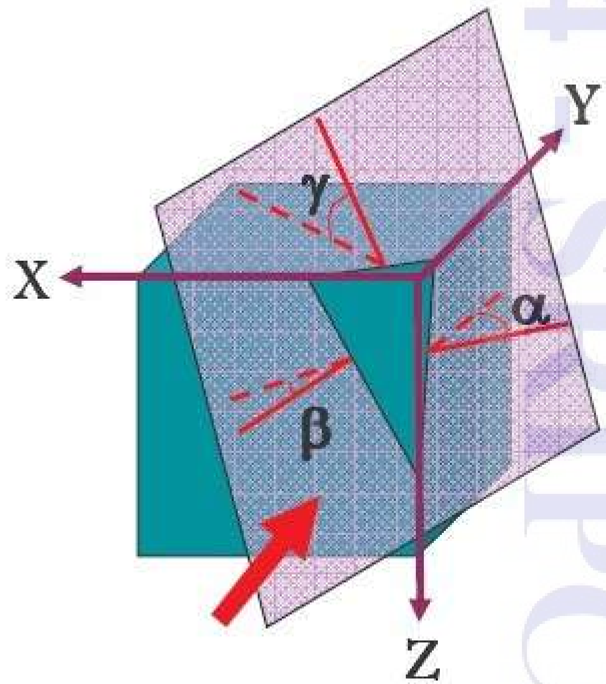
Axonometric projection - is a parallel projection technique used to create a pictorial drawing of an object by rotating the object on an axis relative to a *projection* or *picture plane.*



The differences between a multiview drawing and an axonometric drawing are that, in a multiview, only two dimensions of an object are visible in each view and more than one view is required to define the object; whereas, in an axonometric drawing, the object is rotated about an axis to display all three dimensions, and only one view is required.

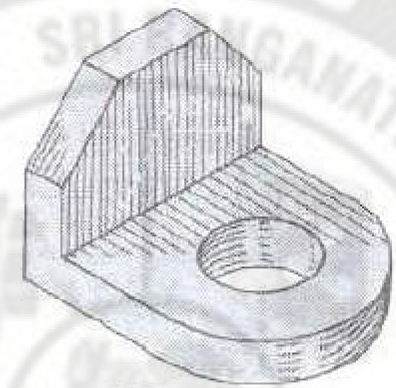
Viewing Planes

- Axonometric Projections
  - Viewing plane NORMAL to viewing/projection lines



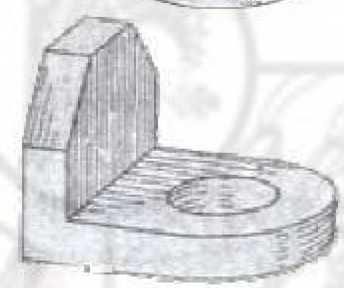
Isometric

$\alpha = \beta = \gamma$



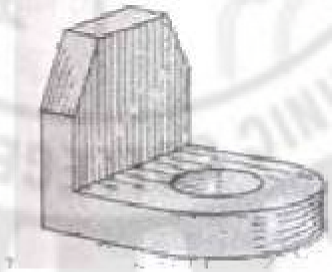
Dimetric

$\alpha = \beta \neq \gamma$

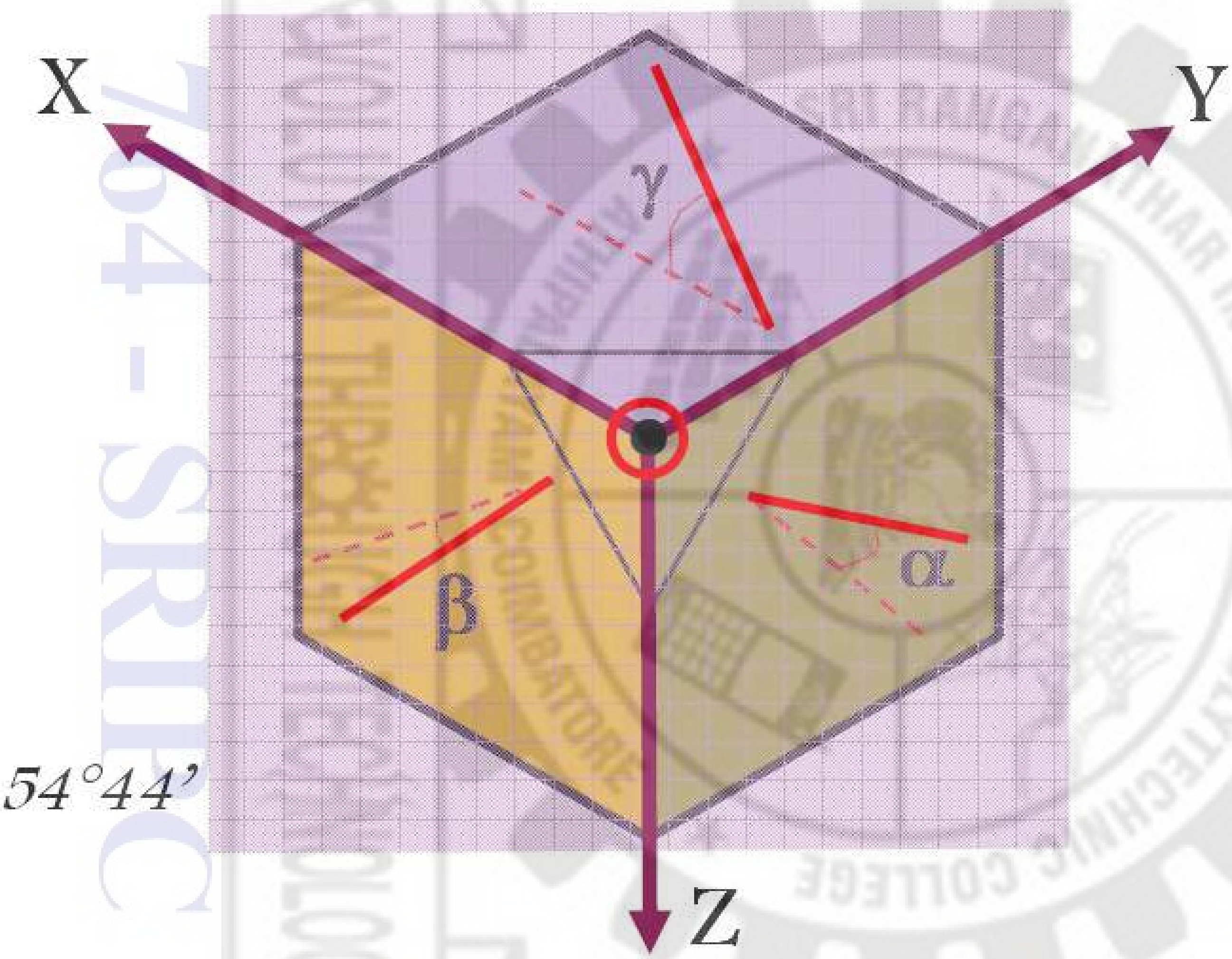


Trimetric

$\alpha \neq \beta \neq \gamma$

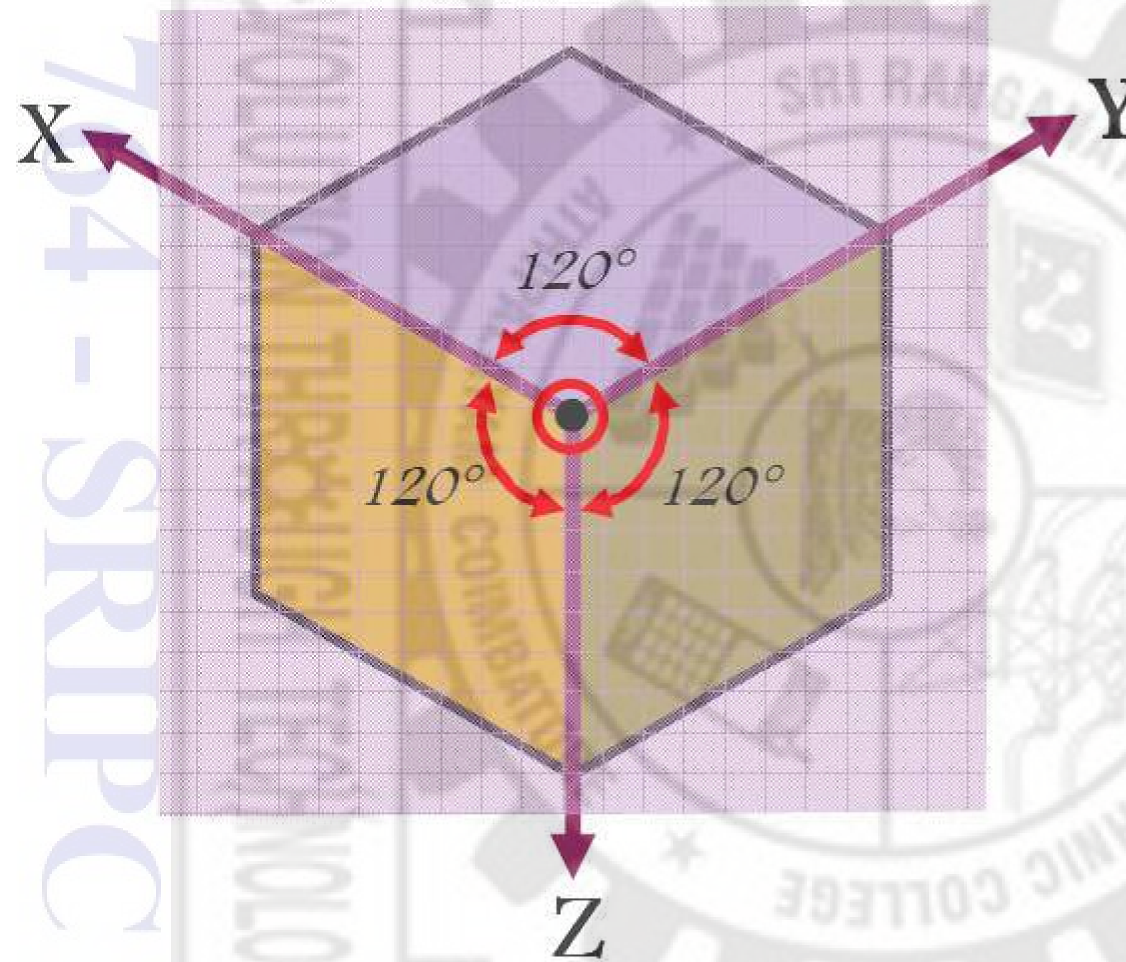


- Cube in Isometric View



$\alpha = \beta = \gamma = 54°44'$

- Cube in Isometric View



Isometric axes can be positioned in a number of ways to create different views of the same object.

Figure *A* is a regular isometric, in which the viewpoint is looking down on the top of the object.

In a regular isometric, the axes at 30° to the horizontal are drawn upward from the horizontal.

For the reversed axis isometric, the viewpoint is looking up on the bottom of the object, and the 30° axes are drawn downward from the horizontal.

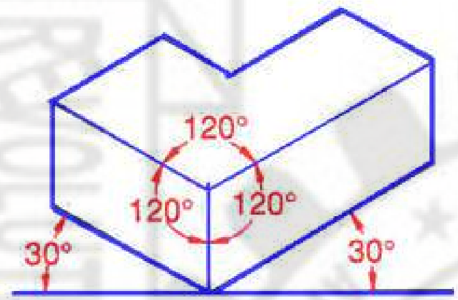


Figure A Regular Isometric

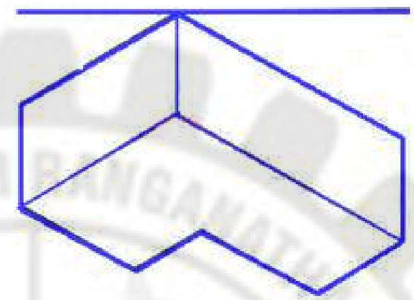


Figure B Reversed Axis isometric

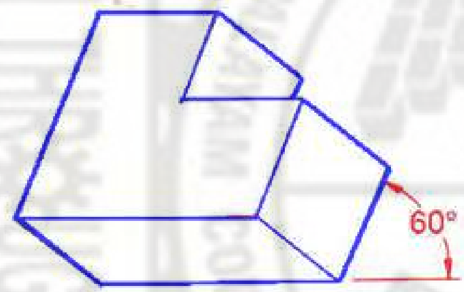


Figure C Long axis isometric

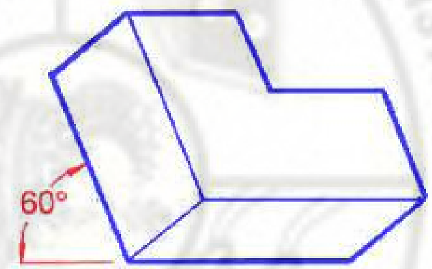
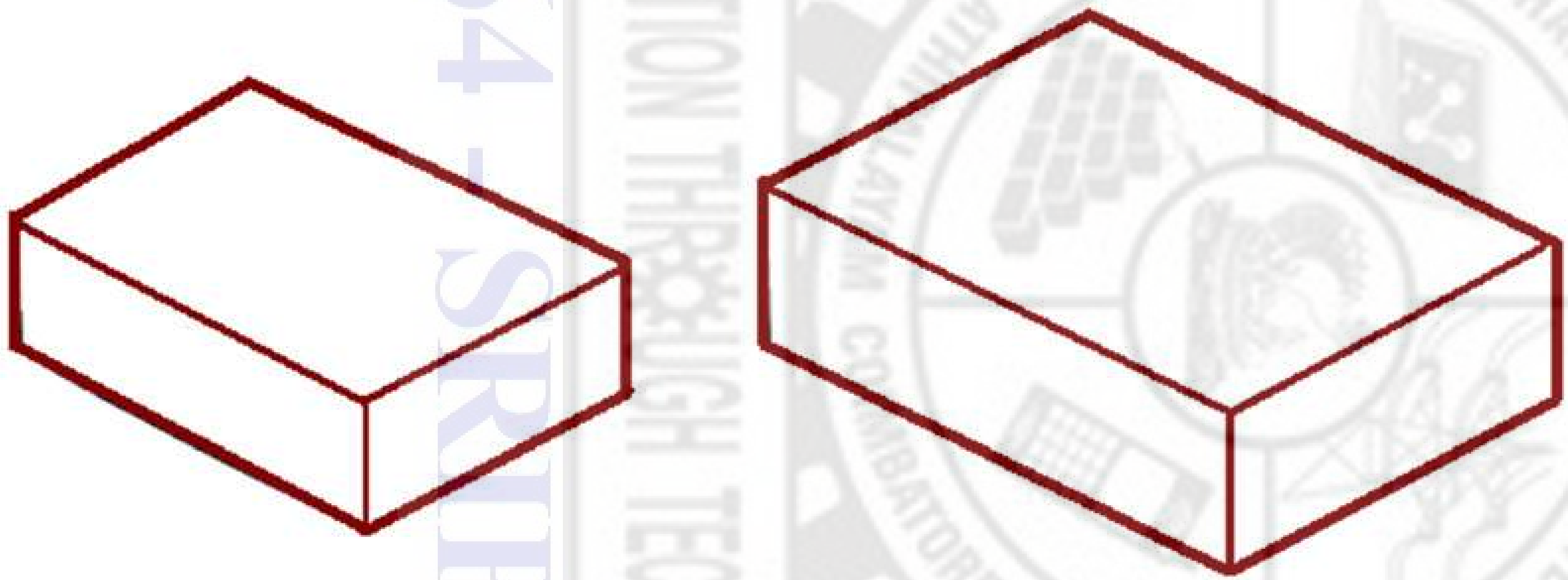


Figure D Long axis isometric

For the long axis isometric, the viewpoint is looking from the right or from the left of the object, and one axis is drawn at 60 ° to the horizontal.

ISOMETRIC PROJECTION and ISOMETRIC DRAWING

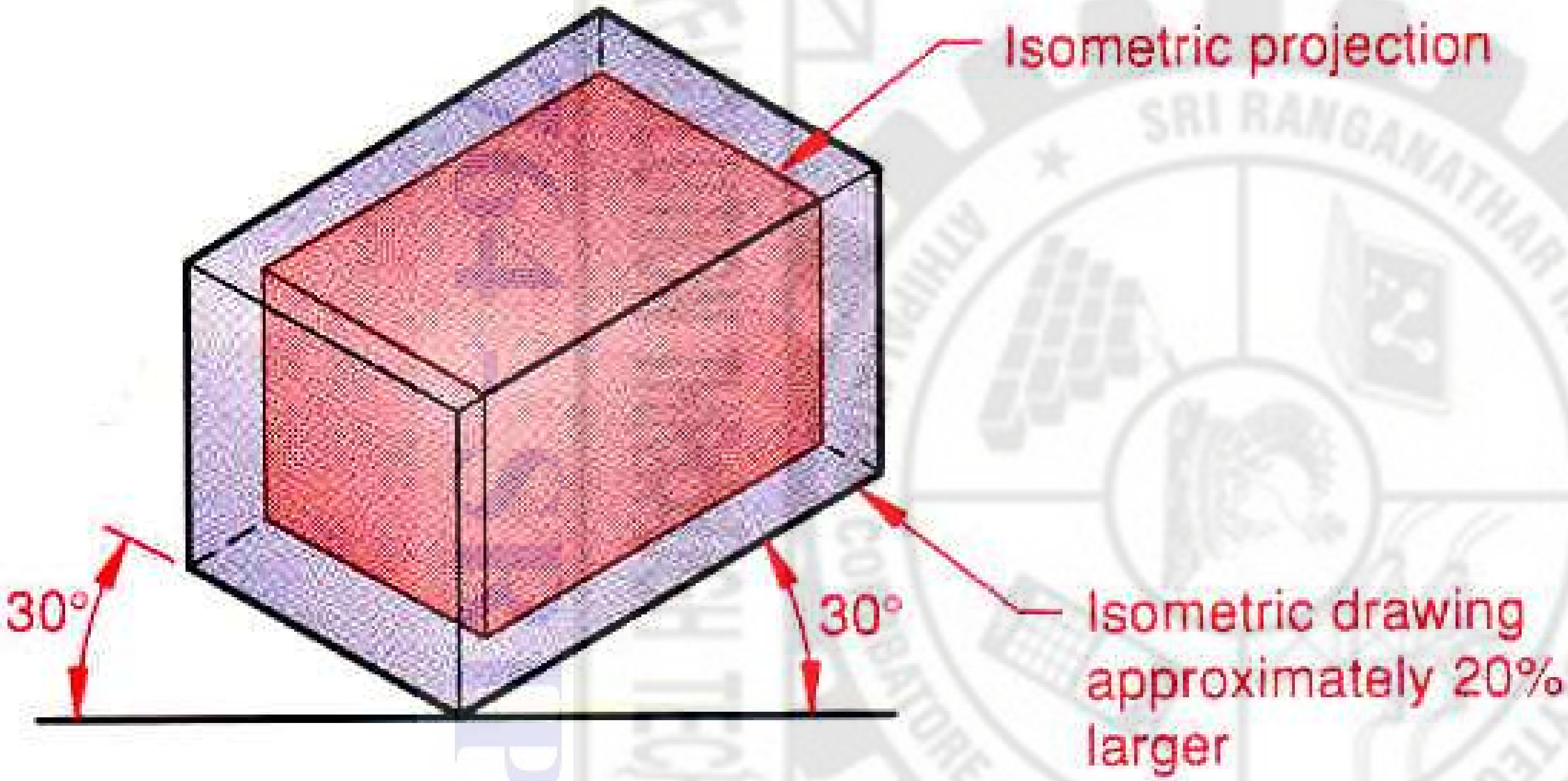
Isometric drawings are almost always preferred over isometric projection for engineering drawings, because they are easier to produce.



isometric projection
82% of ful scale

Full scale Isometric drawing

An *isometric drawing* is an axonometric pictorial drawing for which the angle between each axis equals 120° and the scale used is full scale.

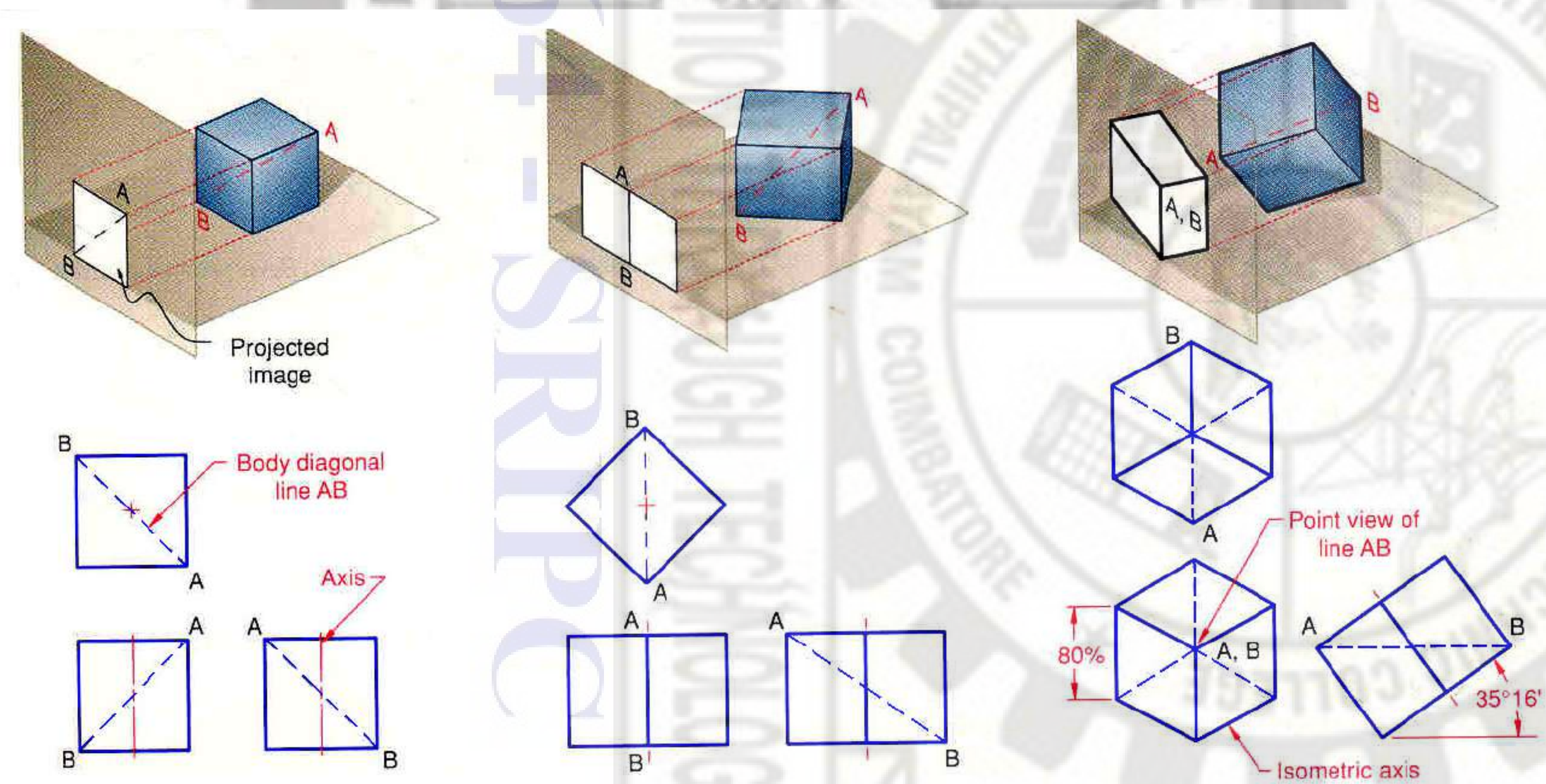


Size comparison of Isometric Drawing and True Isometric Projection

Isometric Axonometric Projections

An isometric projection is a true representation of the isometric view of an object.

An isometric view of an object is created by rotating the object 45° about a vertical axis, then tilting the object (see figure - in this case, a cube) forward until the body diagonal (AB) appears as a point in the front view



(A) Orthographic views of a cube.

(B) Cube rotated 45° clockwise about axis.

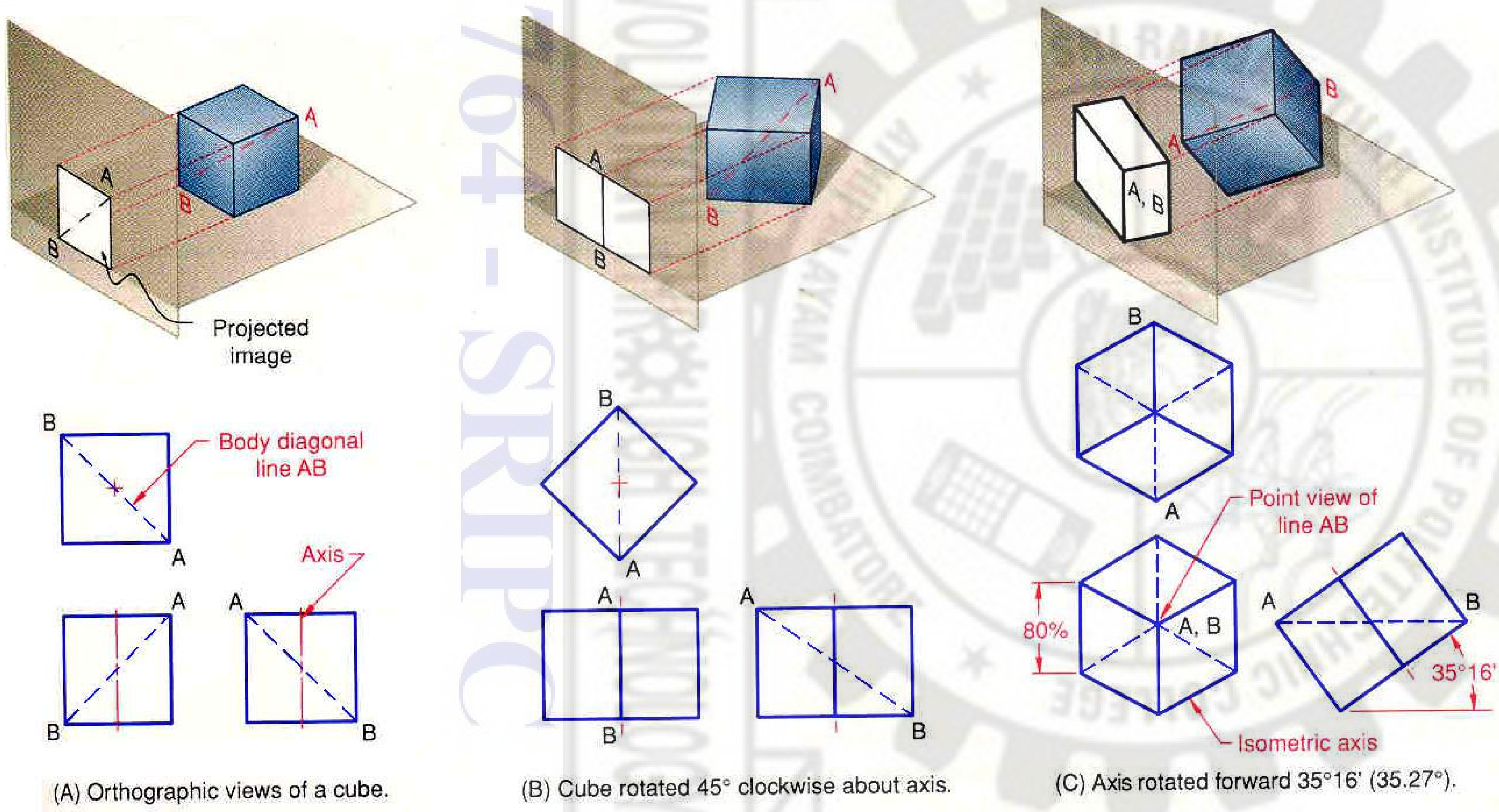
(C) Axis rotated forward 35°16' (35.27°).

The angle the cube is tilted forward is 35° 16'. The 3 axes that meet at A, B form equal angles of 120° and are called the isometric axes.

Each edge of the cube is parallel to one of the isometric axes.

Line parallel to one of the legs of the isometric axis is an isometric line.

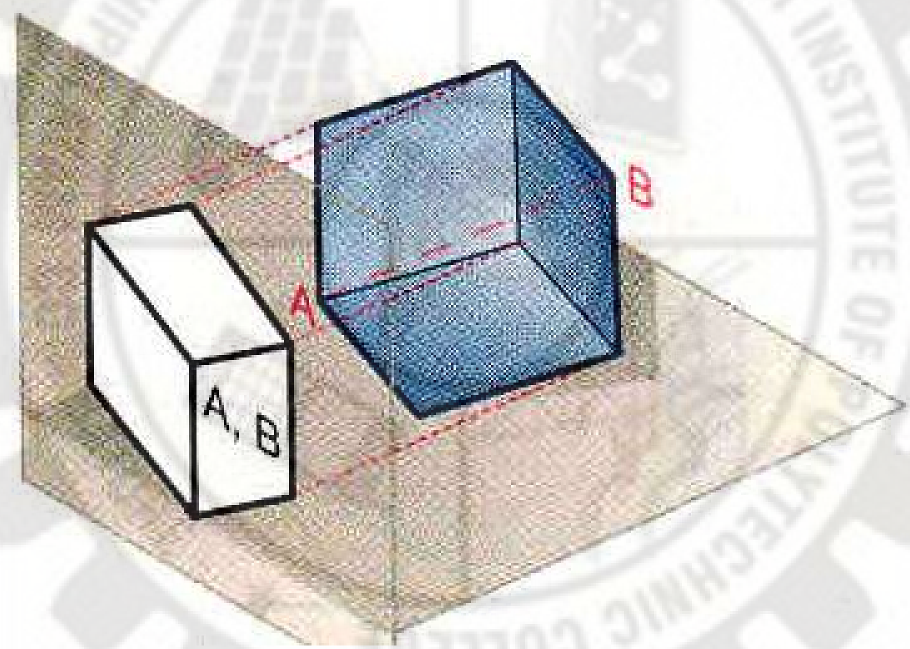
Planes of the cube faces & all planes parallel to them are isometric planes



The forward tilt of the cube causes the edges and planes of the cube to become shortened as it is projected onto the picture plane.

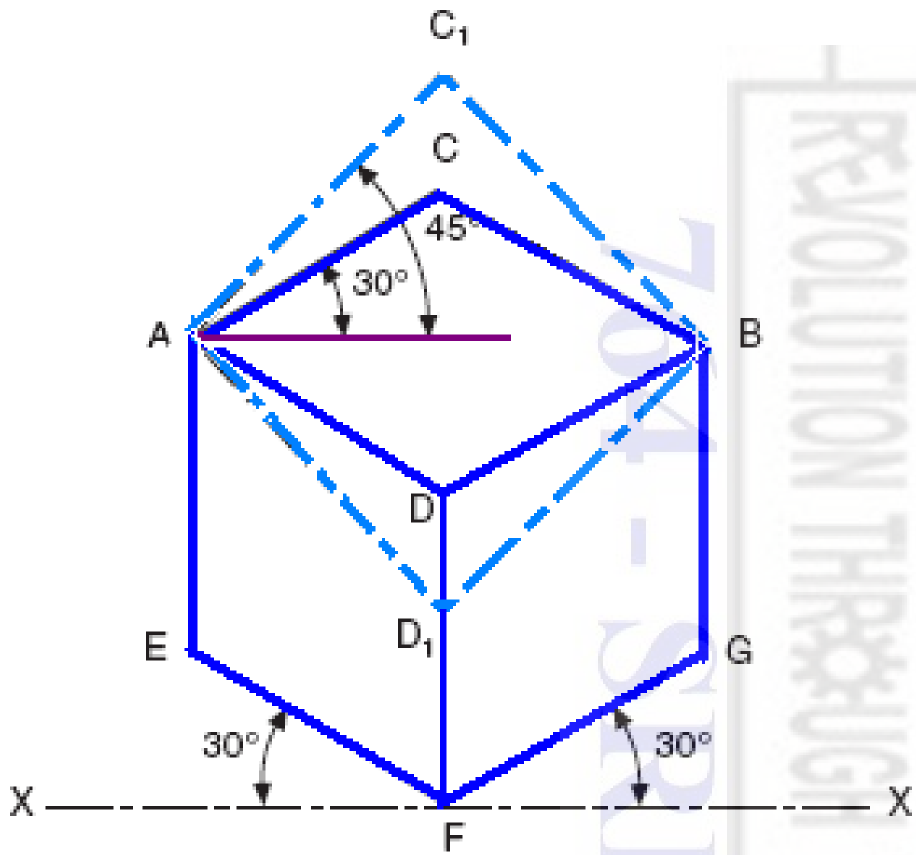
The lengths of the projected lines are equal to the cosine of 35° 16’, or 0.81647 times the true length. In other words, the projected lengths are approximately 82% of the true lengths.

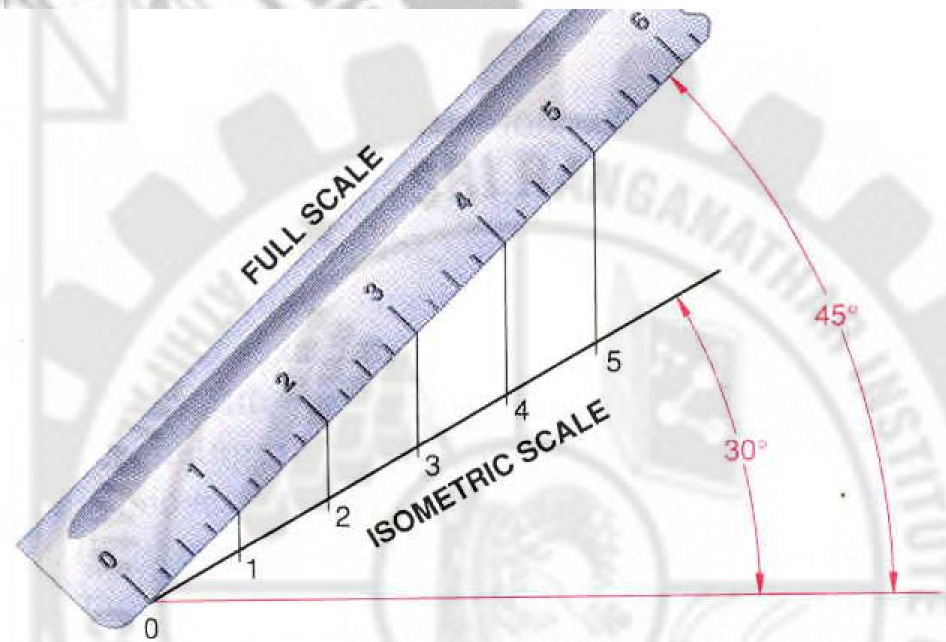
A drawing produced using a scale of 0.816 is called an ***isometric projection*** and is a true representation of the object.



However, if the drawing is produced using full scale, it is called an ***isometric drawing***, which is the same proportion as an isometric projection, but is larger by a factor of 1.23 to 1.

Isometric scale is produced by positioning a regular scale at 45 ° to the horizontal and projecting lines vertically to a 30° line.





$$\text{Isometric scale} = (\text{Isometric length/True length}) = \frac{\cos 45^\circ}{\cos 30^\circ} = \frac{1}{\sqrt{2}} \div \frac{\sqrt{3}}{2} = \frac{\sqrt{2}}{\sqrt{3}} = 0.8165$$

$$= 82\% \text{ (approximately)}$$

$$\boxed{\text{Isometric length} = 0.82^{*}\ \text{True length}}$$

In an isometric drawing, true length distances can only be measured along isometric lines, that is, lines that run parallel to any of the isometric axes. Any line that does not run parallel to an isometric axis is called a non-isometric line.

Non-isometric lines include inclined and oblique lines and can not be measured directly. Instead they must be created by locating two end points.

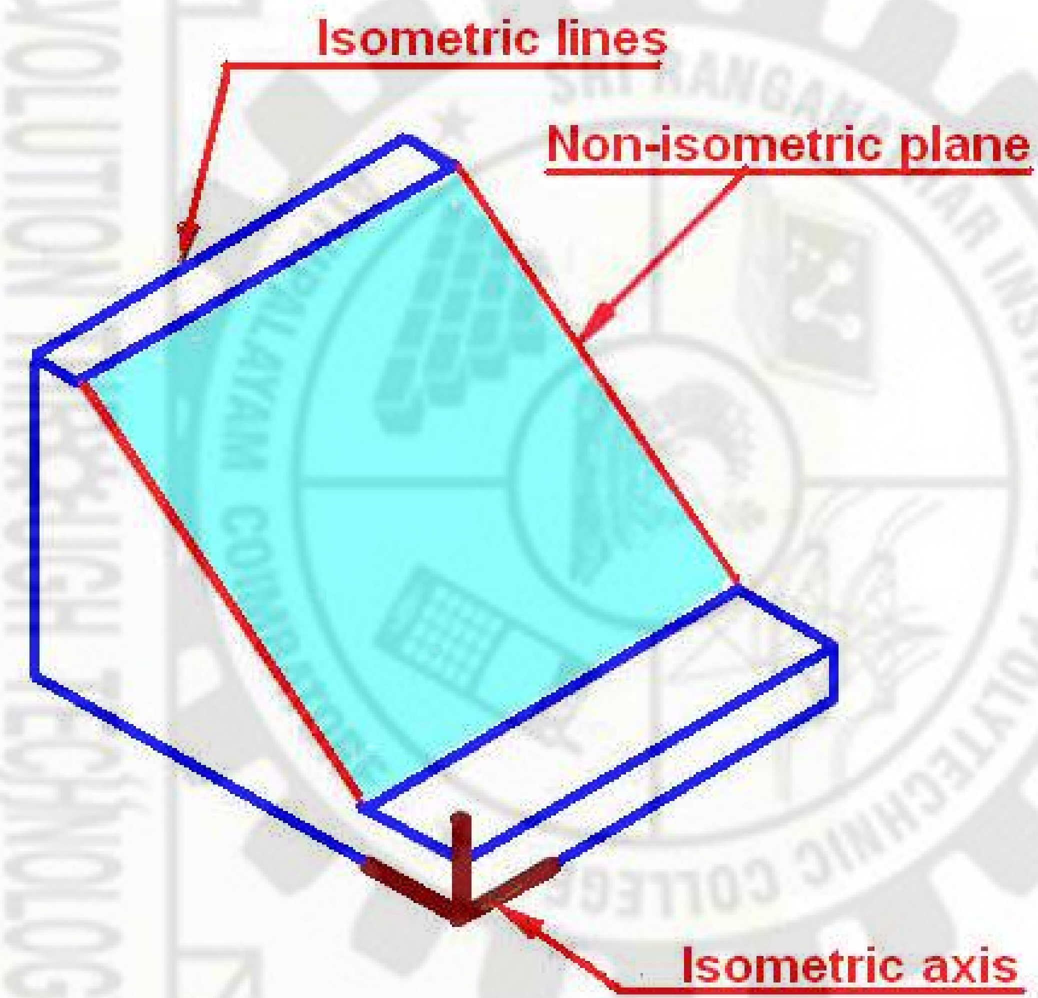


Figure A is an isometric drawing of a cube. The three faces of the isometric cube are isometric planes, because they are parallel to the isometric surfaces formed by any two adjacent isometric axes.

Planes that are not parallel to any isometric plane are called non-isometric planes (Figure B)

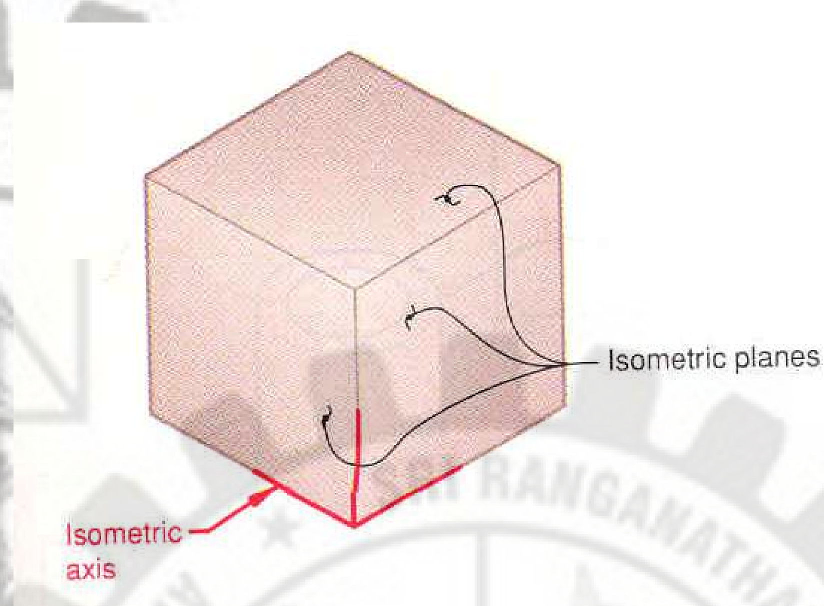


Figure A: Isometric planes relative to isometric axes

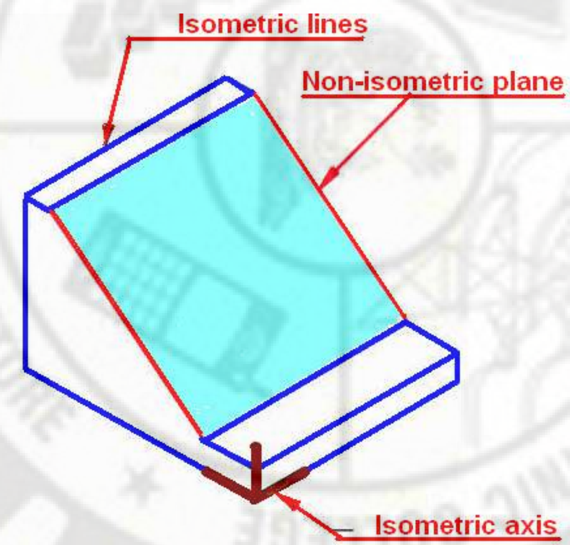
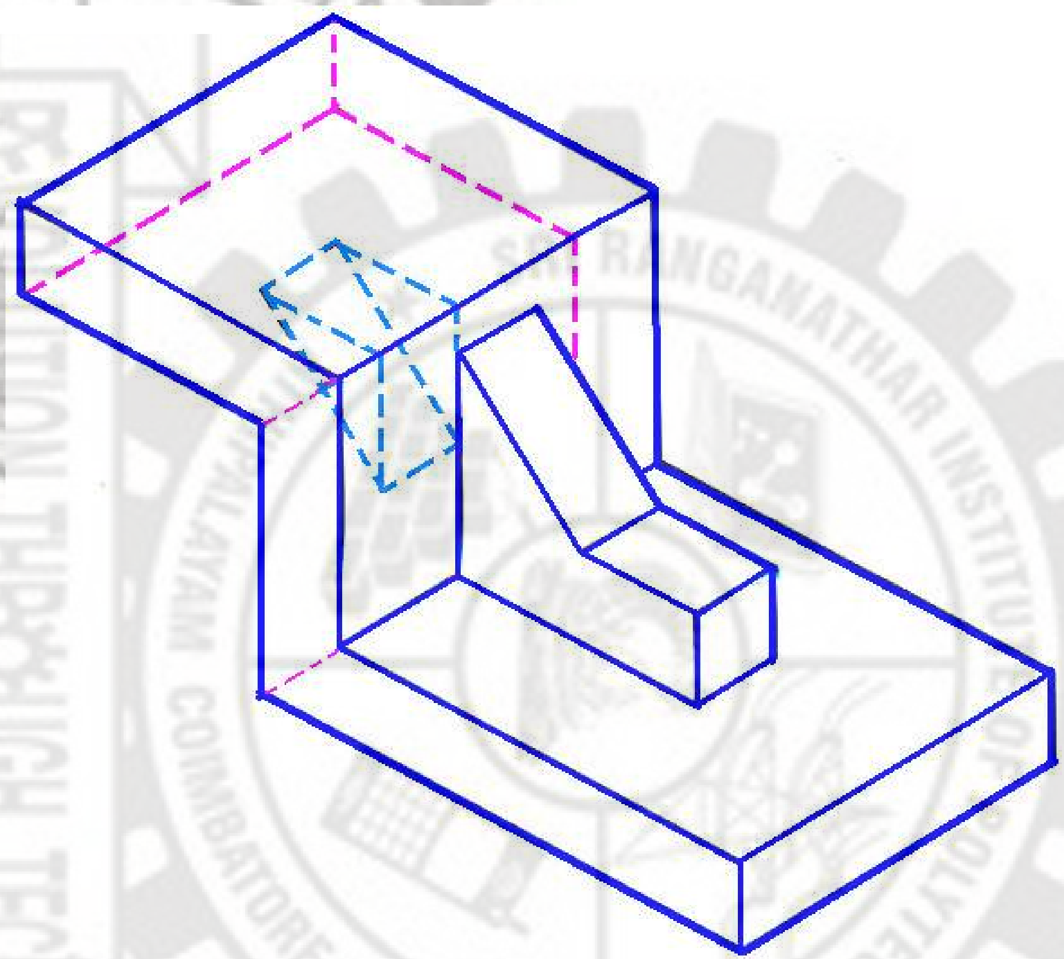


Figure B: Non-isometric plane

Standards for Hidden Lines, Center Lines and Dimensions

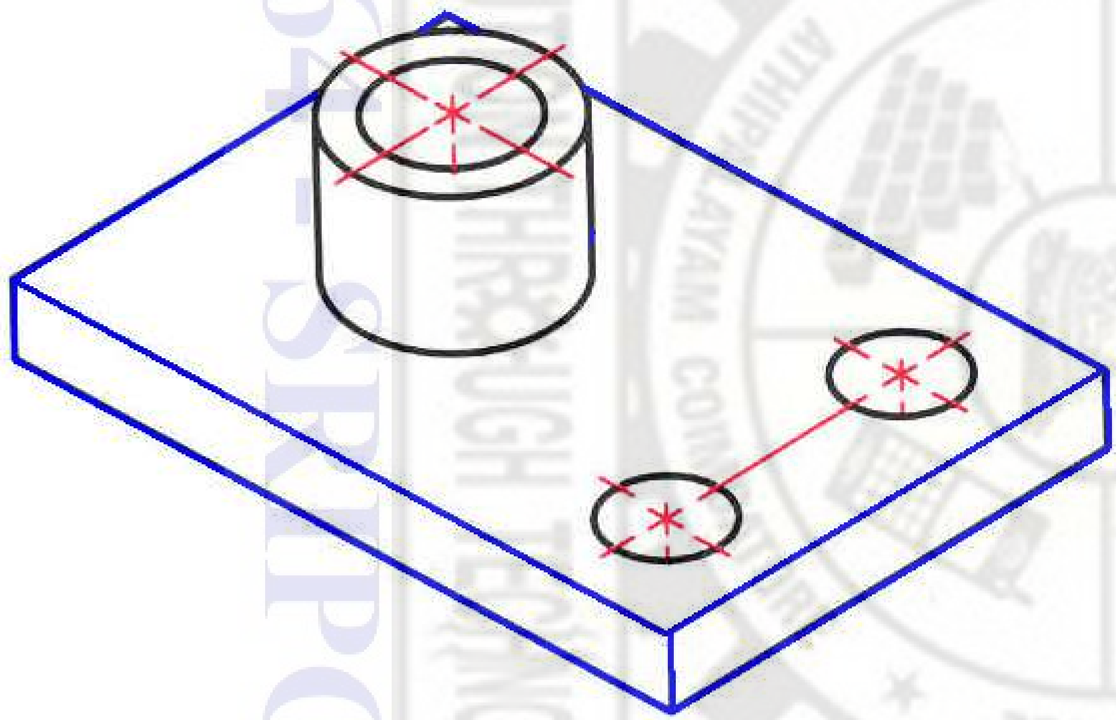
In isometric drawings, hidden lines are omitted unless they are absolutely necessary to completely describe the object. Most isometric drawings will not have hidden lines.



To avoid using hidden lines, choose the most descriptive viewpoint.

However, if an isometric viewpoint cannot be found that clearly depicts all the major features, hidden lines may be used.

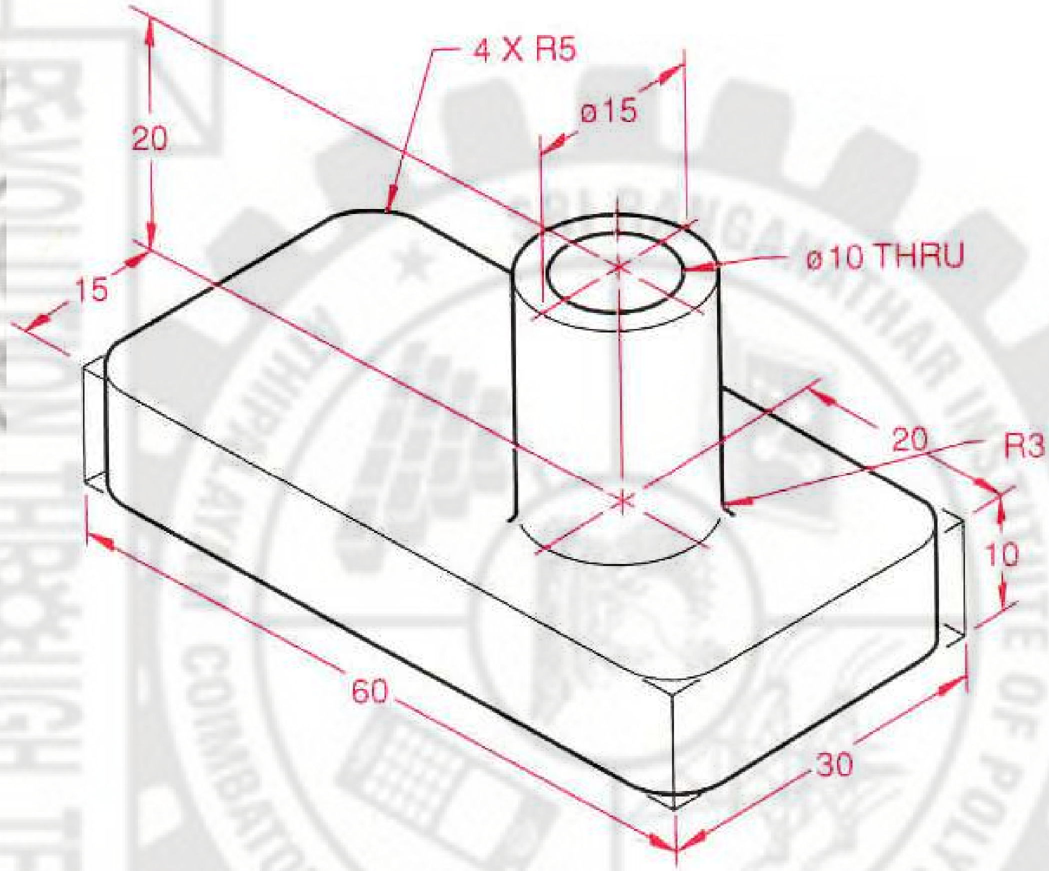
Centerlines are drawn only for showing symmetry or for dimensioning. Normally, centerlines are not shown, because many isometric drawings are used to communicate to non-technical people and not for engineering purposes.



As per the Standards:

Dimension lines, extension lines, and lines being dimensioned shall lie in the same plane.

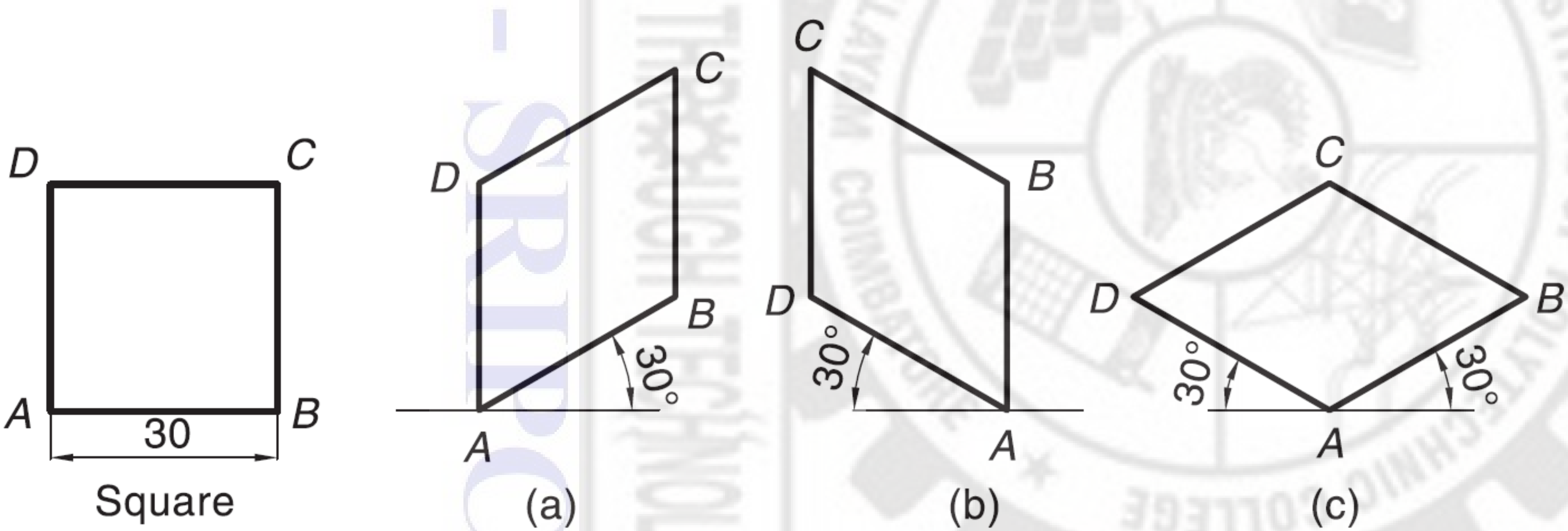
All dimensions and notes should be unidirectional, reading from the bottom of the drawing upward and should be located outside the view whenever possible. The texts is read from the bottom, using horizontal guidelines.



ISOMETRIC VIEWS OF STANDARD SHAPES

Square

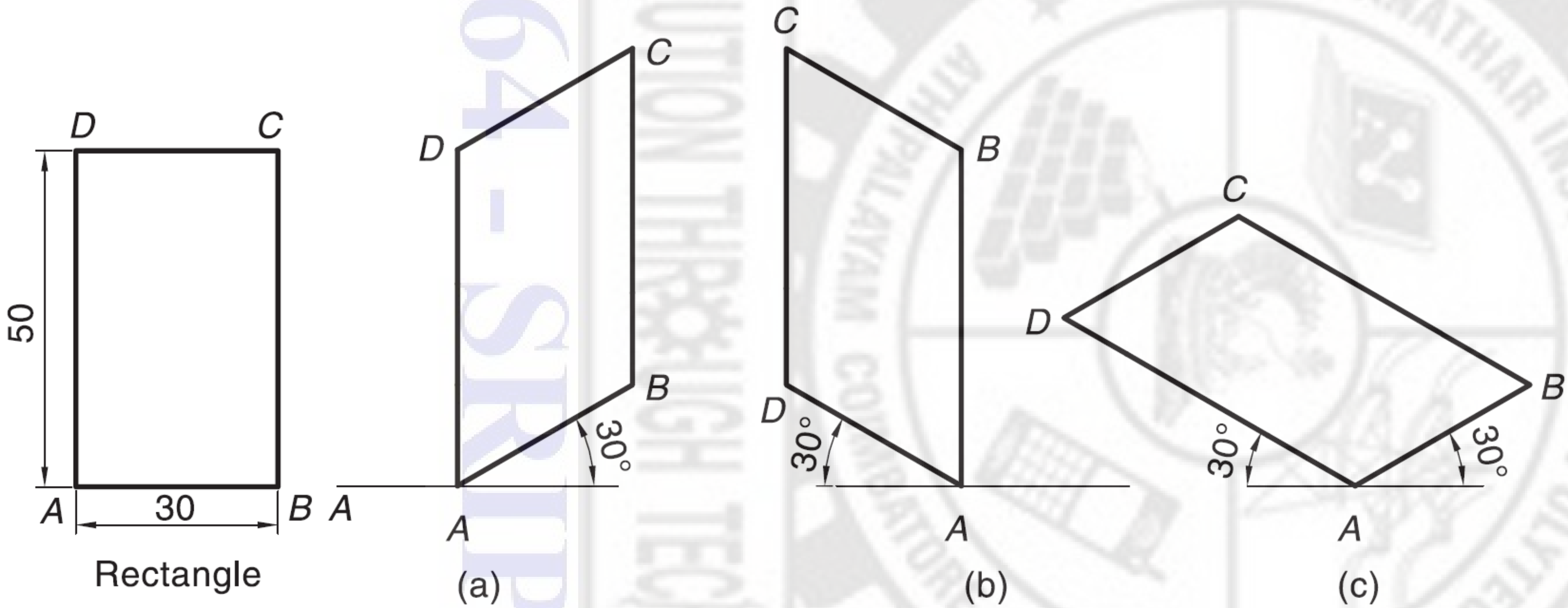
Consider a square *ABCD* with a 30 mm side shown in Fig. If the square lies in the vertical plane, it will appear as a rhombus with a 30 mm side in isometric view as shown in Fig. (a) or (b), depending on its orientation, i.e., right-hand vertical face or left-hand vertical face. If the square lies in the horizontal plane (like the top face of a cube), it will appear as in Fig.(c). The sides *AB* and *AD*, both, are inclined to the horizontal reference line at 30°.



Taken from Dhananjay A Jolhe, Engg. Drawing, MGH

Rectangle

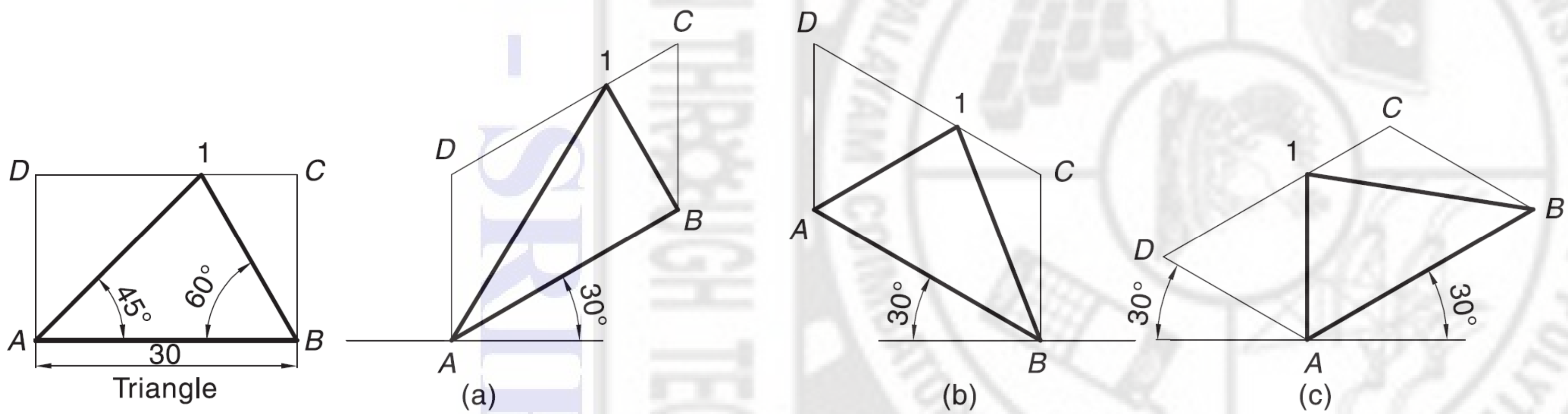
A rectangle appears as a parallelogram in isometric view. Three versions are possible depending on the orientation of the rectangle, i.e., right-hand vertical face, left-hand vertical face or horizontal face.



Taken from Dhananjay A Jolhe, Engg. Drawing, MGH

Triangle

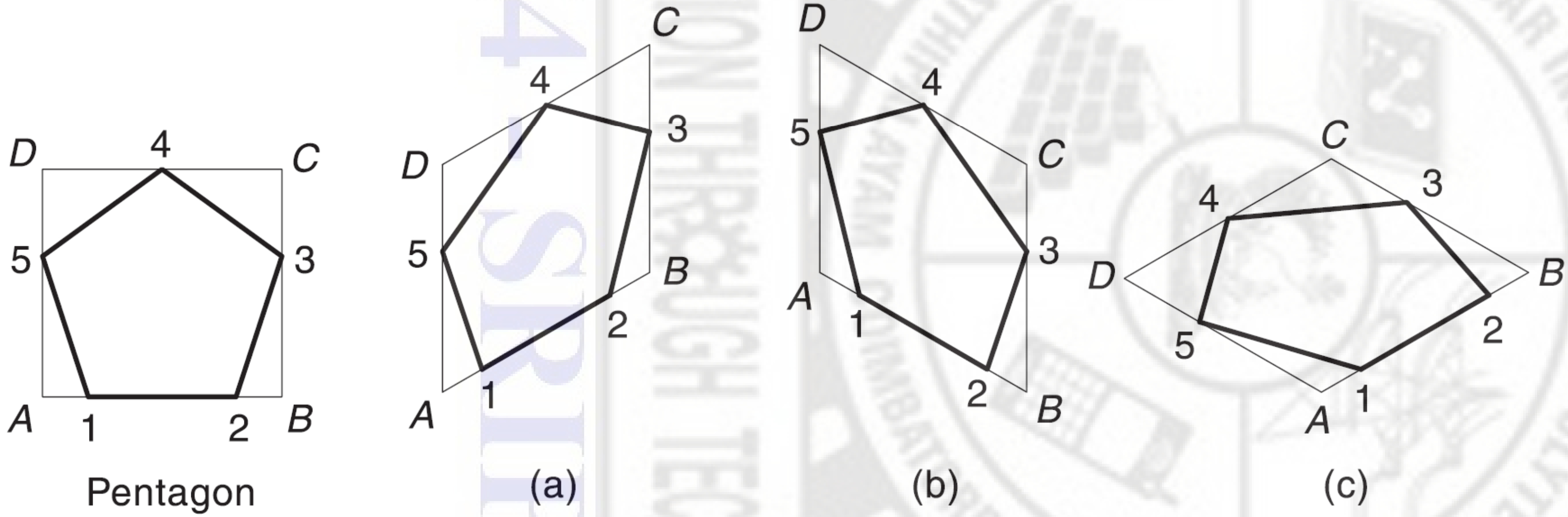
A triangle of any type can be easily obtained in isometric view as explained below. First enclose the triangle in rectangle *ABCD*. Obtain parallelogram *ABCD* for the rectangle as shown in Fig. (a) or (b) or (c). Then locate point 1 in the parallelogram such that *C*–1 in the parallelogram is equal to *C*–1 in the rectangle. *A*–*B*–1 represents the isometric view of the triangle.



Taken from Dhananjay A Jolhe, Engg. Drawing, MGH

Pentagon

Enclose the given pentagon in a rectangle and obtain the parallelogram as in Fig. 18.9(a) or (b) or (c). Locate points 1, 2, 3, 4 and 5 on the rectangle and mark them on the parallelogram. The distances *A*–1, *B*–2, *C*–3, *C*–4 and *D*–5 in isometric drawing are same as the corresponding distances on the pentagon enclosed in the rectangle.

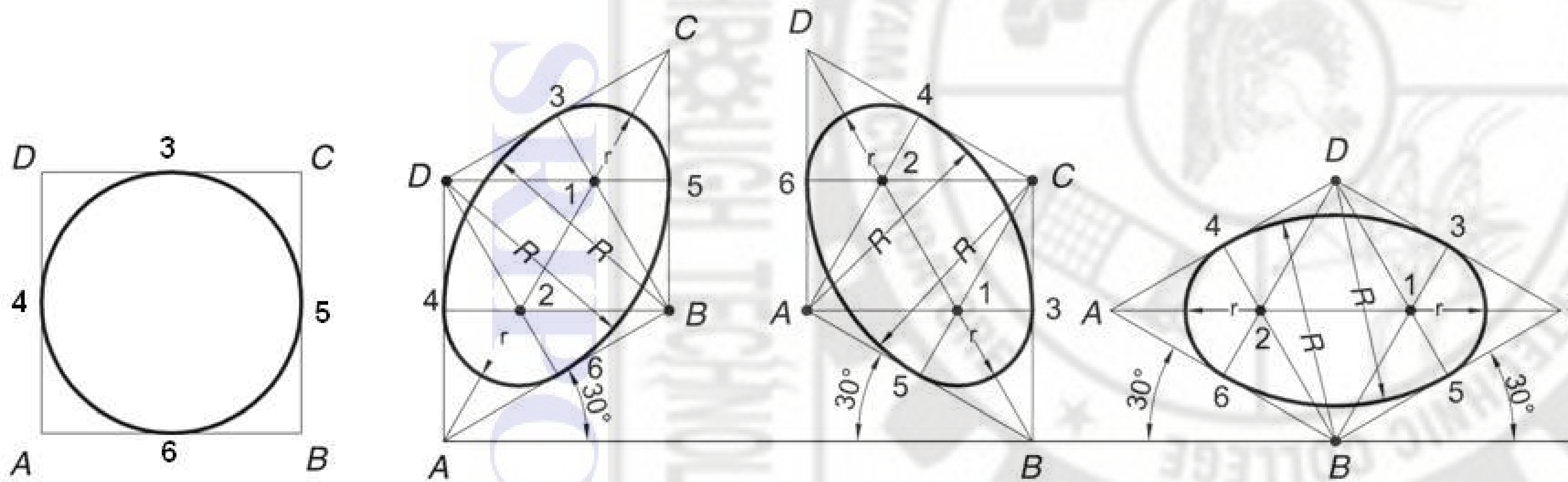


Taken from Dhananjay A Jolhe, Engg. Drawing, MGH

Circle

The isometric view or isometric projection of a circle is an ellipse. It is obtained by using four-centre method explained below.

<u>Four-Centre Method</u> **: First, enclose the given circle into a square *ABCD*. Draw rhombus *ABCD* as an isometric view of the square. Join the farthest corners of the rhombus, i.e., *A* and *C*. Obtain midpoints 3 and 4 of sides *CD* and *AD* respectively. Locate points 1 and 2 at the intersection of *AC* with *B*–3 and *B*–4 respectively. Now with 1 as a centre and radius 1–3, draw a small arc 3–5. Draw another arc 4–6 with same radius but 2 as a centre. With *B* as a centre and radius *B*–3, draw an arc 3–4. Draw another arc 5–6 with same radius but with *D* as a centre.**

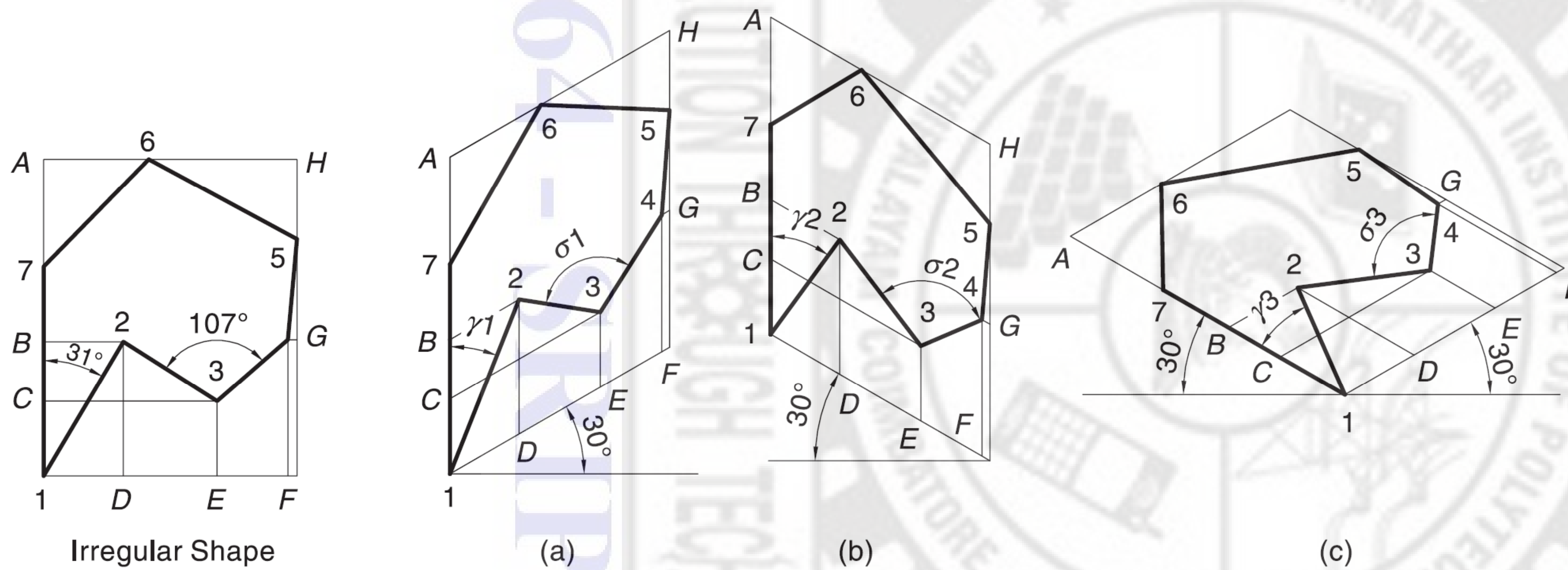


Circle (a) (b) (c)

Taken from Dhananjay A Jolhe, Engg. Drawing, MGH

Any irregular Shape

Any irregular shape 1–2–3–4–5–6–7 can be drawn in isometric view as follows: The figure is enclosed in a rectangle first. The parallelogram is obtained in isometric for the rectangle as shown. The isolines *B*–2, *D*–2, *C*–3, *E*–3, *G*–4, *F*–4, *H*–5, *H*–6 and *A*–7 has the same length as in original shape, e.g., *B*–2 in isometric = *B*–2 in irregular shape.



Taken from Dhananjay A Jolhe, Engg. Drawing, MGH

Isometric views for solids

The Boxing-in Method

The four basic steps for creating an isometric drawing are:

Determine the isometric viewpoint that clearly depicts the features of the object, then draw the isometric axes which will produce that view-point.

Construct isometric planes, using the overall width (W), height (H), and depth (D) of the object, such that the object will be totally enclosed in a box.

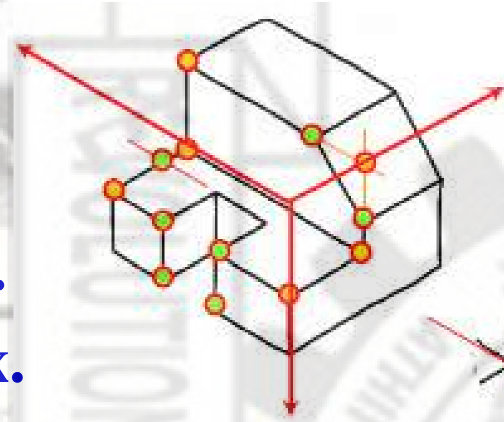
Locate details on the isometric planes.

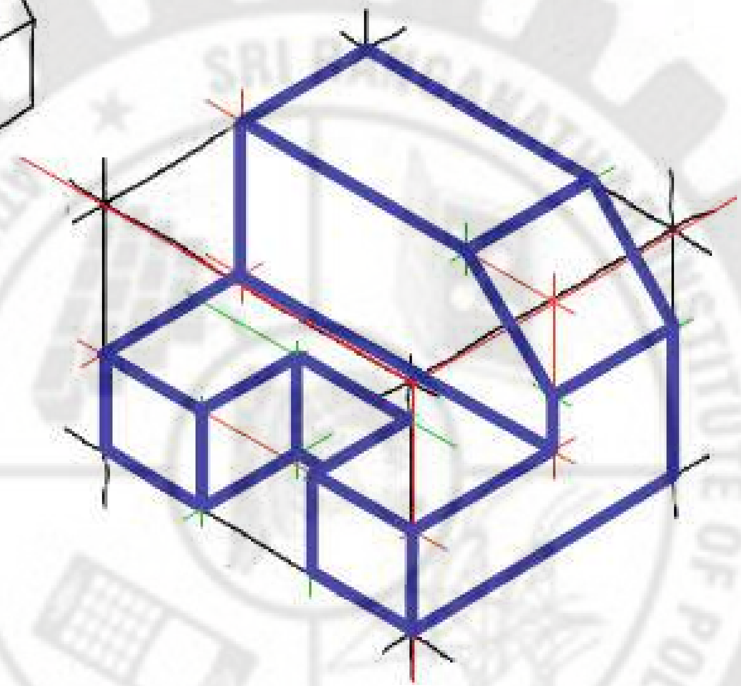
Darken all visible lines, and eliminate hidden lines unless absolutely necessary to describe the object.

Sketch from an actual object

STEPS

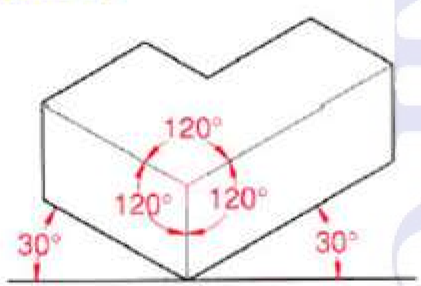
1. **Positioning object.**
2. **Select isometric axis.**
3. **Sketch enclosing box.**
4. **Add details.**
5. **Darken visible lines.**



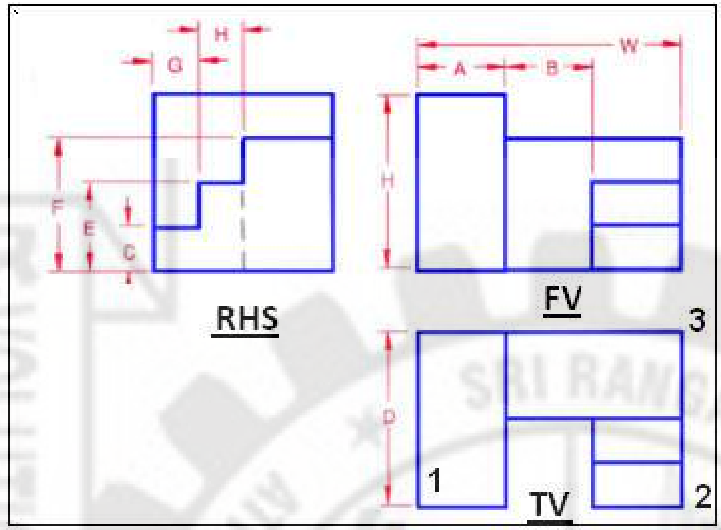


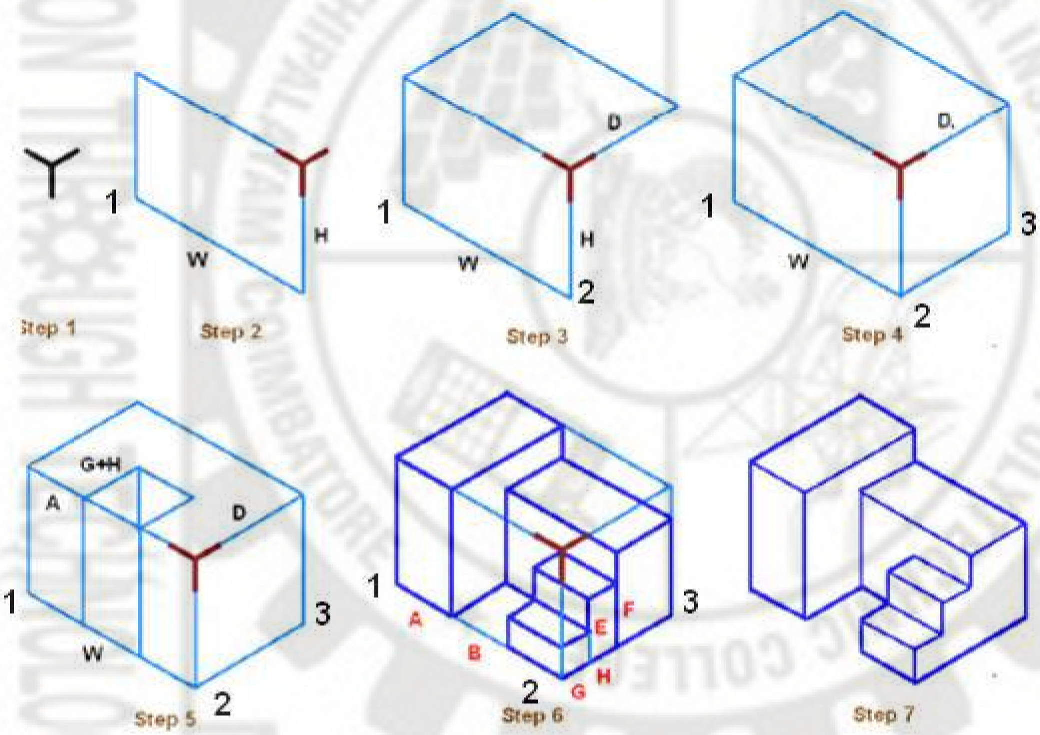
Note In isometric sketch/drawing), hidden lines are *omitted* unless they are absolutely necessary to completely describe the object.**Sketch from an actual object**

Step 1. Determine the desired view of the object, then draw the isometric axis. For this example, it is determined that the object will be viewed from above (regular isometric) and axis shown in Fig A is used.



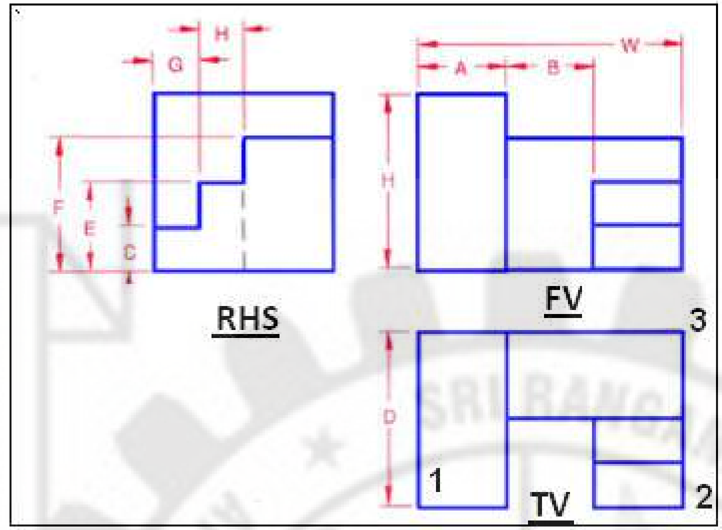
(A) Regular Isometric

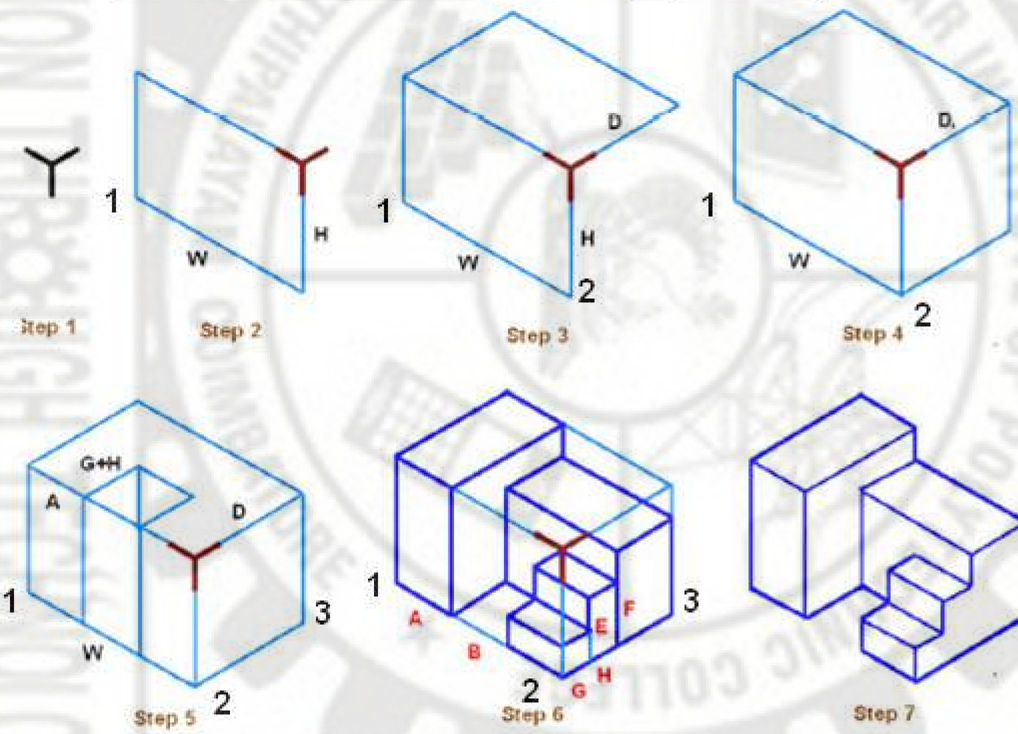




***Step* 2.** Construct the front isometric plane using **W** and **H** dimensions. **Width** dimensions are drawn along 30-degree lines from the horizontal. **Height** dimensions are drawn as vertical lines.

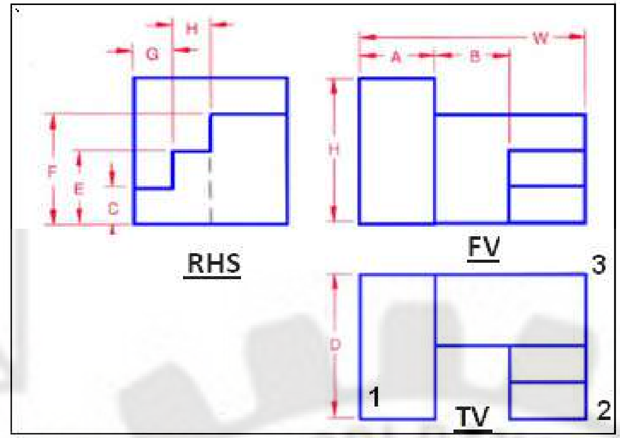
***Step* 3.** Construct the top isometric plane using the **W** and **D** dimensions. Both **W** and **D** dimensions are drawn along 3o-degree lines from the horizontal.

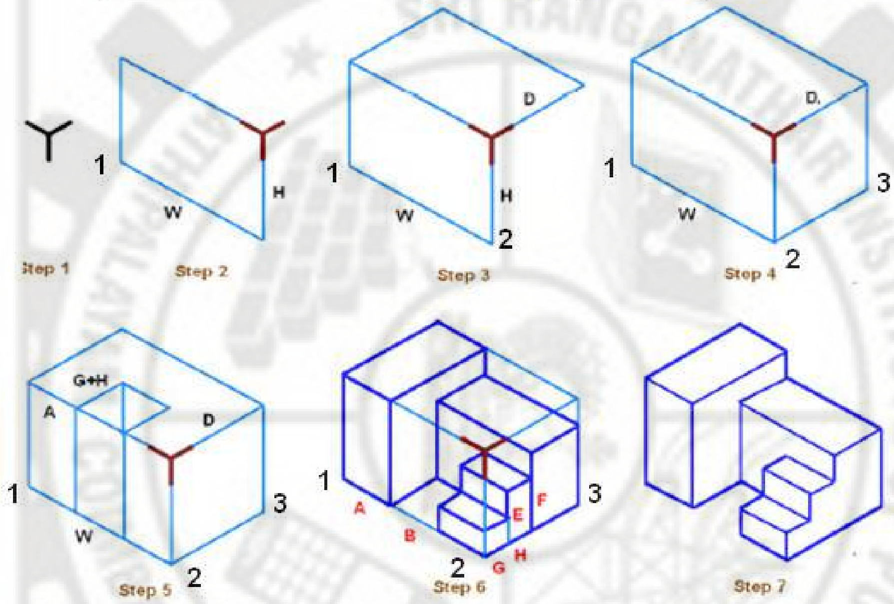




Step 4. Construct the right side isometric plane using **D** and **H** dimensions. Depth dimensions are drawn along 30-degree lines and height dimensions are drawn as vertical lines.

Step 5. Transfer some distances for the various features from the multiview drawing to the isometric lines that make up the isometric rectangle. on the front and top planes of the isometric box.

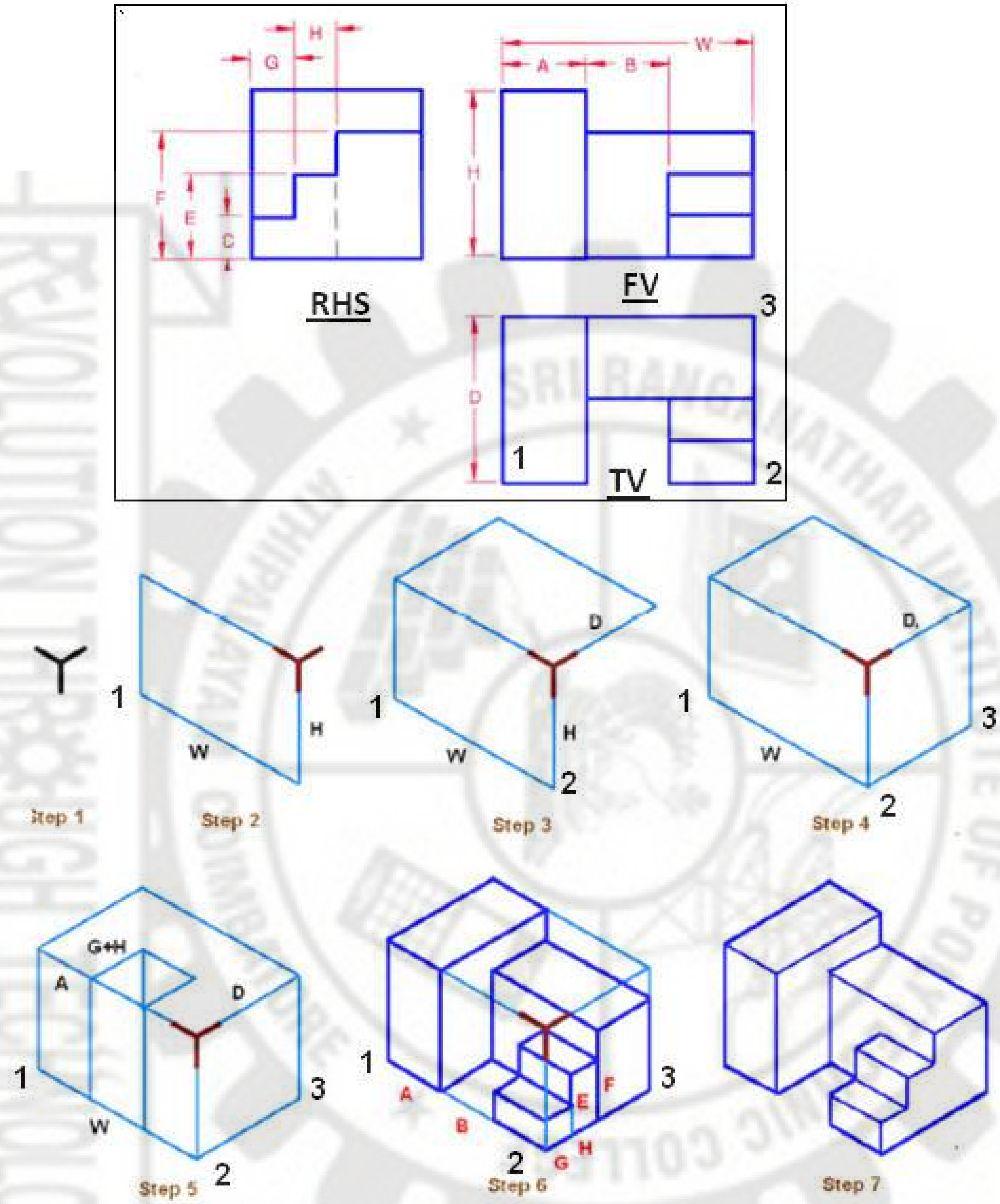




For example, distance **A** is measured in the multiview drawing, then transferred to a width line in the front plane of the isometric rectangle. Begin drawing details of the block by drawing isometric lines between the points transferred from the multiview drawing. For example, a notch is taken out of the block by locating its position on the front and the top planes of the isometric box.

Step 6. Transfer the remaining features from the multi-view drawing to the isometric drawing. Block in the details by connecting endpoints of the measurements taken from the multiview drawing.

Step 7. Darken all visible lines and erase or lighten the construction lines to complete the isometric drawing of the object



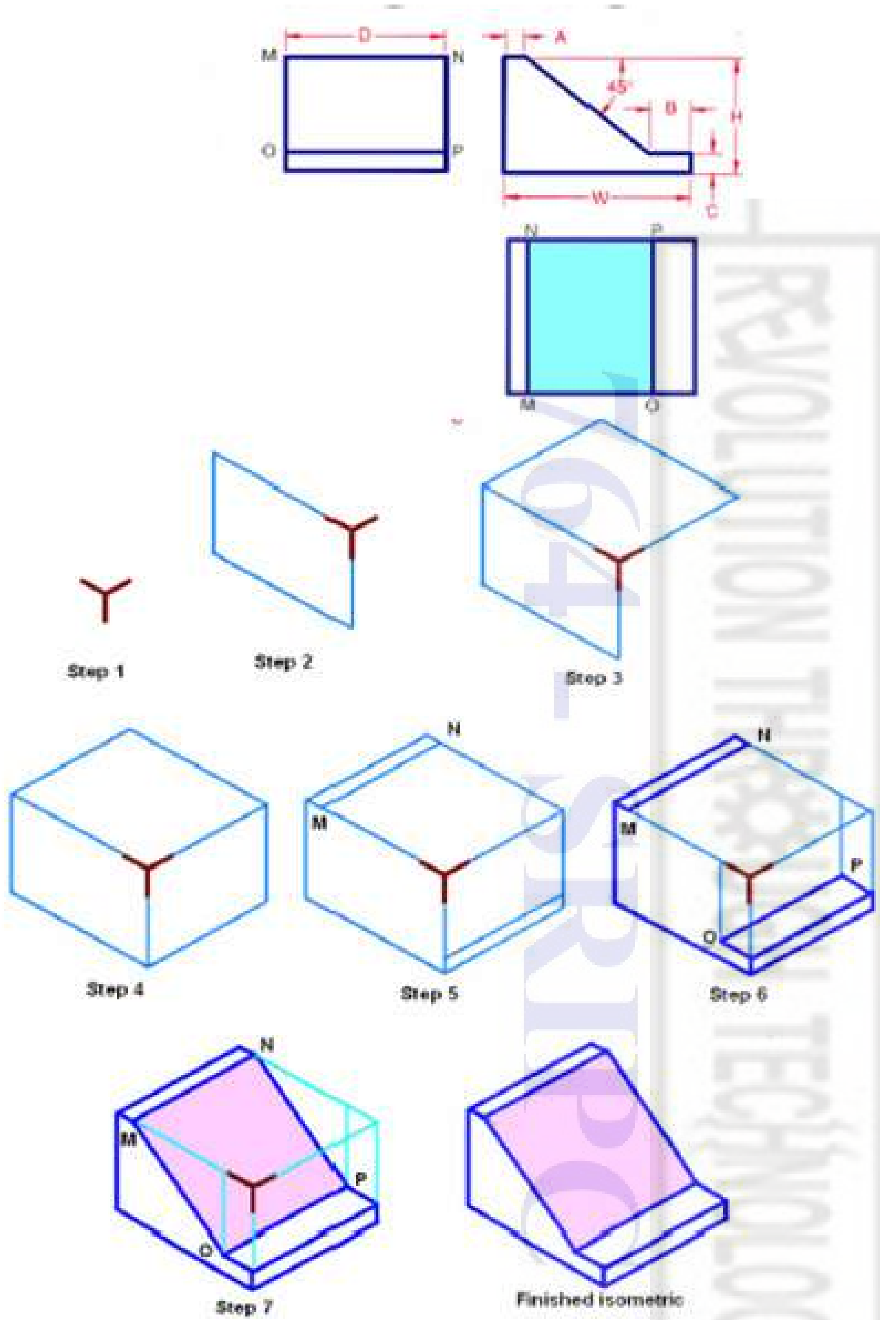
Non-Isometric Lines

Normally, non-isometric lines will be the edges of inclined or oblique planes of an object as represented in a multiview drawing.

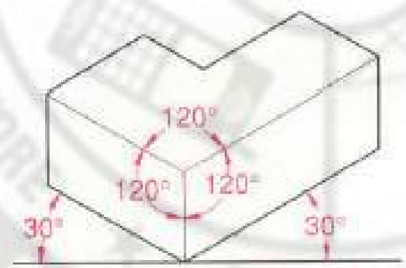
It is not possible to measure the length or angle of an inclined or oblique line in a multiview drawing and then use that measurement to draw the line in an isometric drawing.

Instead, non-isometric lines must be drawn by locating the two end points, then connecting the end points with a line.

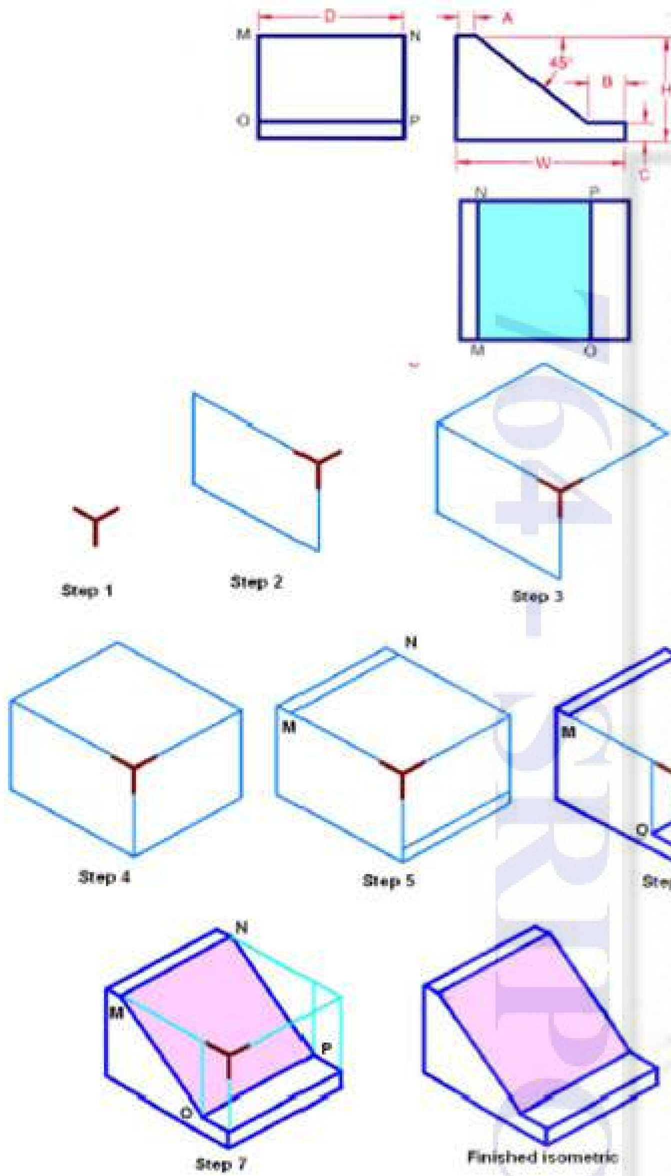
The process used is called offset measurement, which is a method of locating one point by projecting another point.



Step 1. Determine the desired view of the object, then draw the isometric axes. For this example, it is determined that the object will be viewed from above, and the axis shown in Figure A is used.



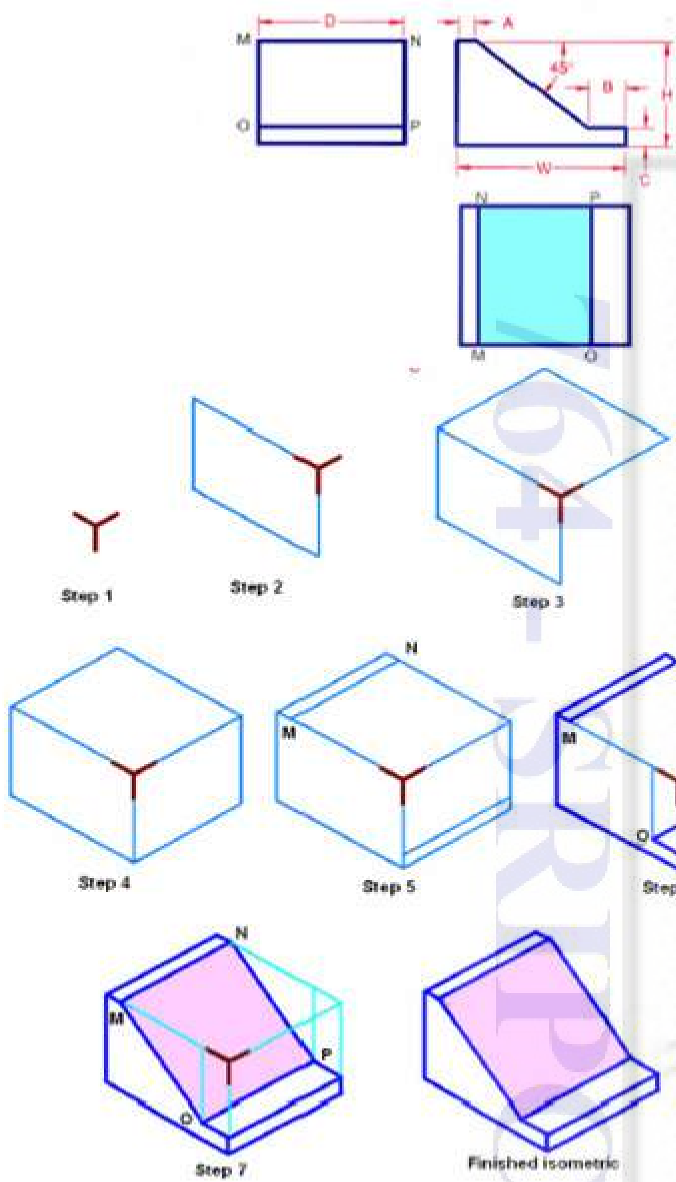
(A) Regular Isometric



Step 2. Construct the front isometric plane using **W** and **H** dimensions.

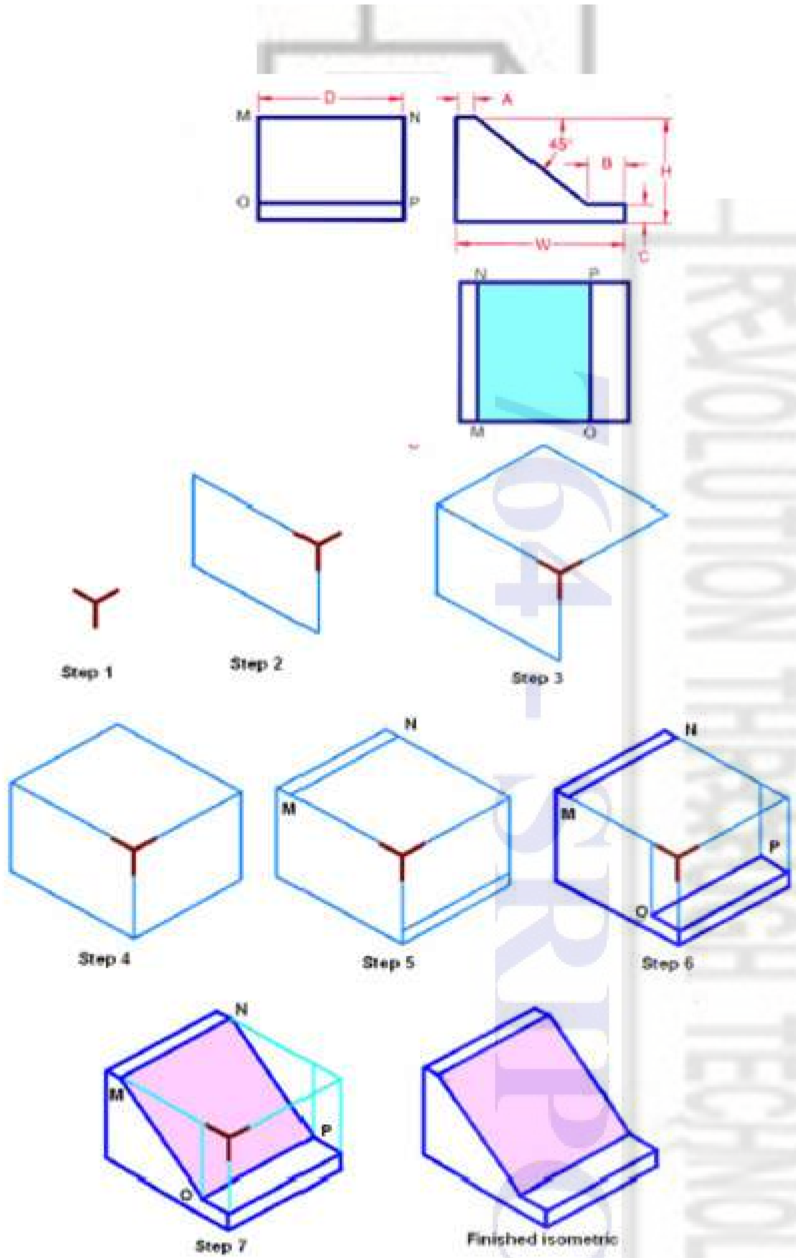
Step 3. Construct the top isometric plane using the **W** and **D** dimensions.

Step 4. Construct the right side isometric plane using **D** and **H** dimensions.



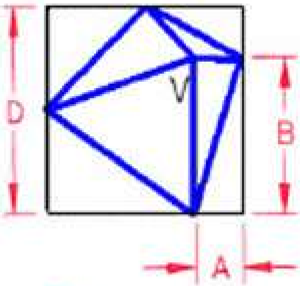
Step **5.** Transfer the distances for **C** and **A** from the multi-view drawing to the top and right side isometric rectangles.

Draw line **MN** across the top face of the isometric box. Draw an isometric construction line from the endpoint marked for distance **C**. This, in effect, projects distance **C** along the width of the box.

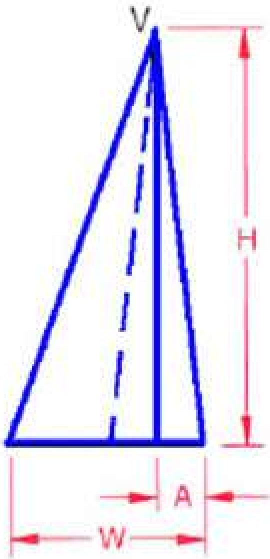


***Step* 6**. Along these isometric construction lines, mark off the distance **B**, thus locating points **0** and **P**. Connect points **OP**.

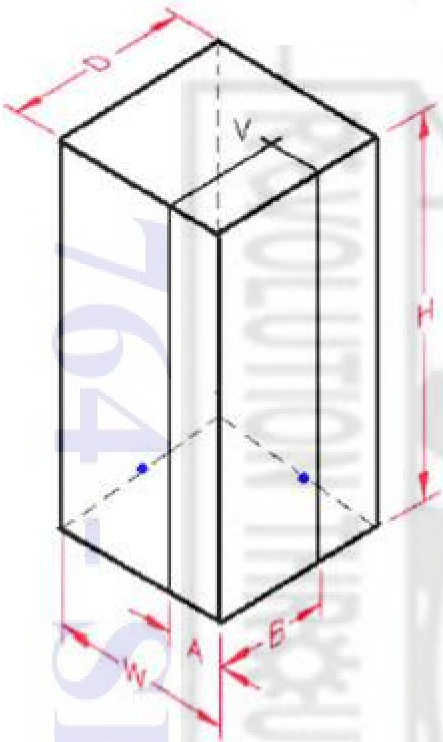
***Step* 7.** Connect points **MO** and **NP** to draw the non-isometric lines.



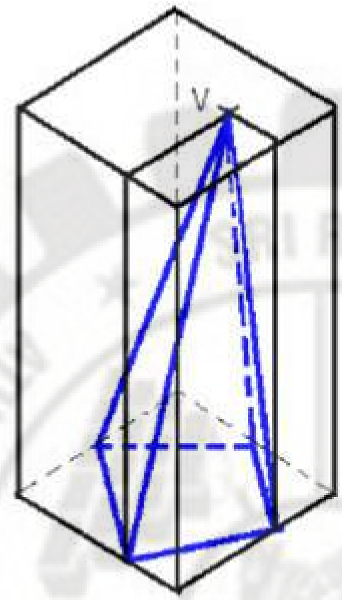
T.V.



F.V.



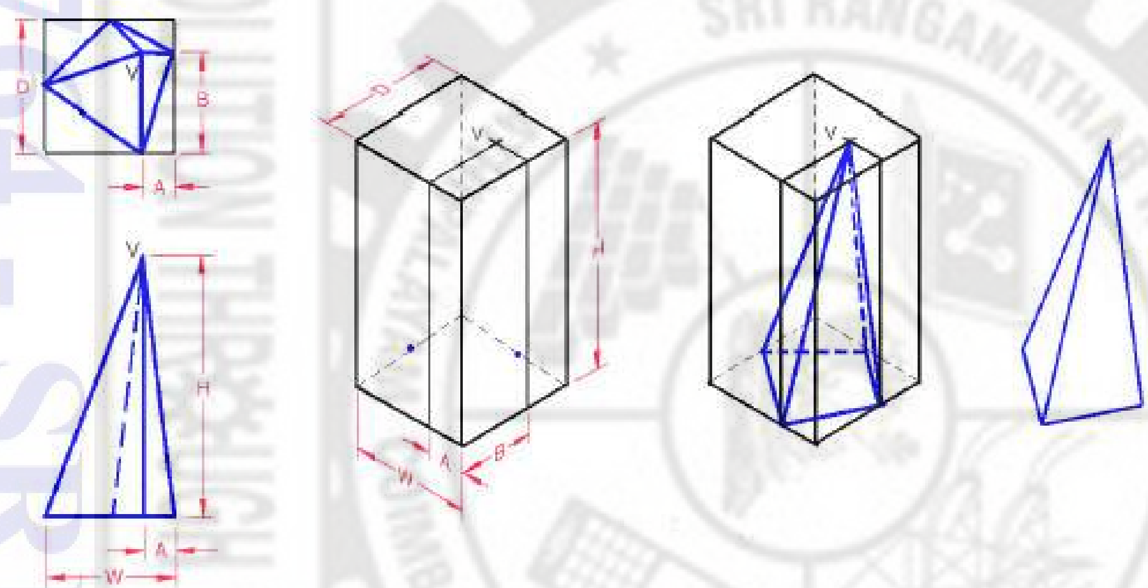
Box



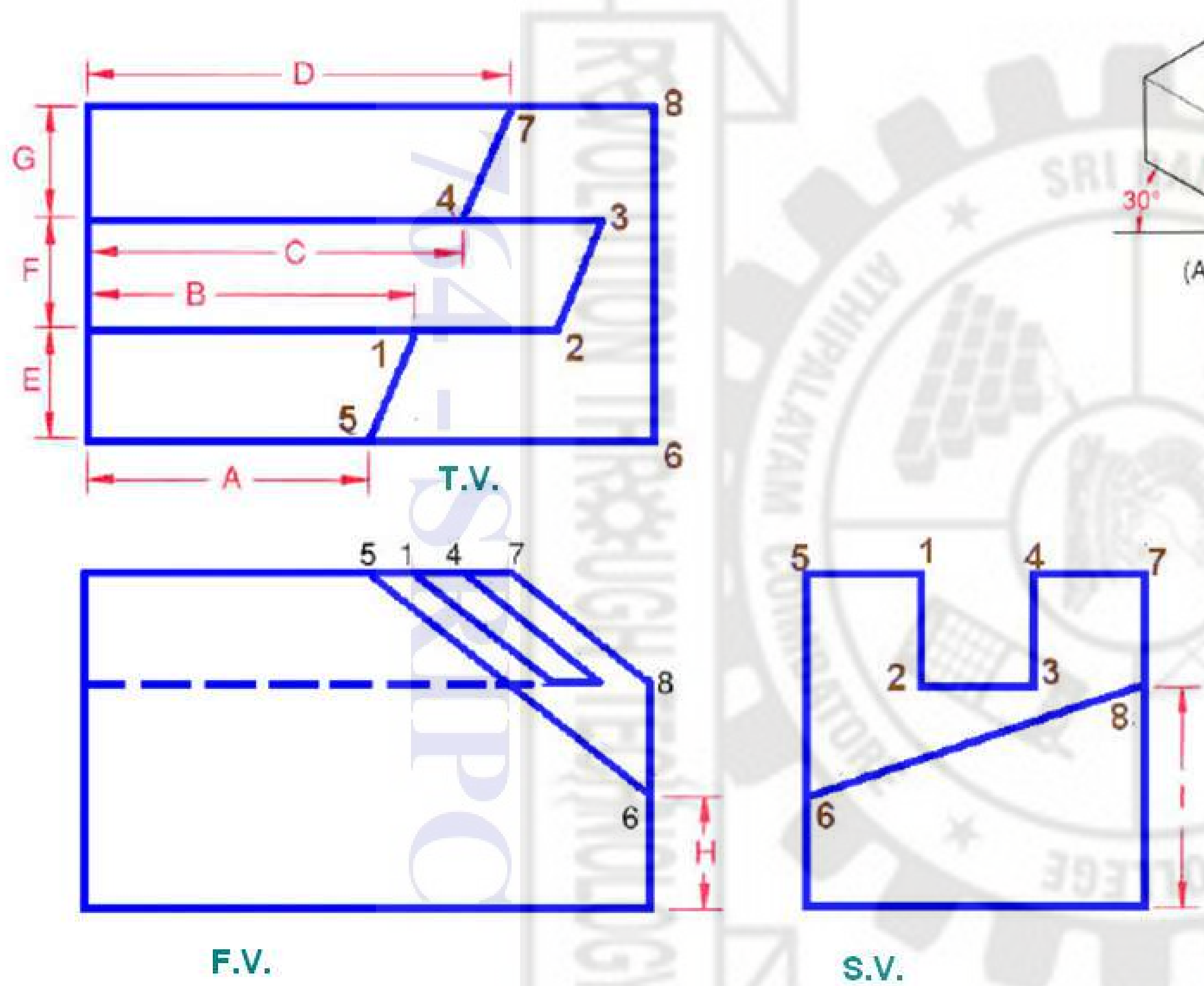
An example of how to locate points to make an isometric drawing of an irregular object

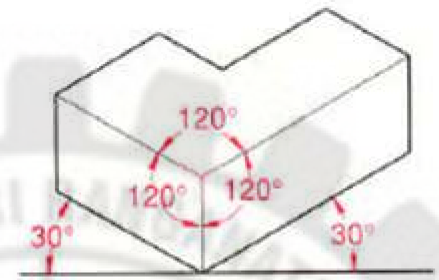
Determine dimensions A and B in the multi-view drawing. Construct an isometric box equal to the dimensions W, H and D as measured in the multi-view drawing. Locate dimensions A and B along the base of the isometric box, then project them along the faces to the edge of the top face, using vertical lines..

Project the points of intersection across the top face using isometric lines. Point V is located at the intersection of these last two projections. Locate the remaining points around the base and draw the figure.



Step 1: Determine the desired view of the object, then draw the isometric axes. For this example it is determined that the object will be viewed from above and the axis will be as shown in Fig. A.





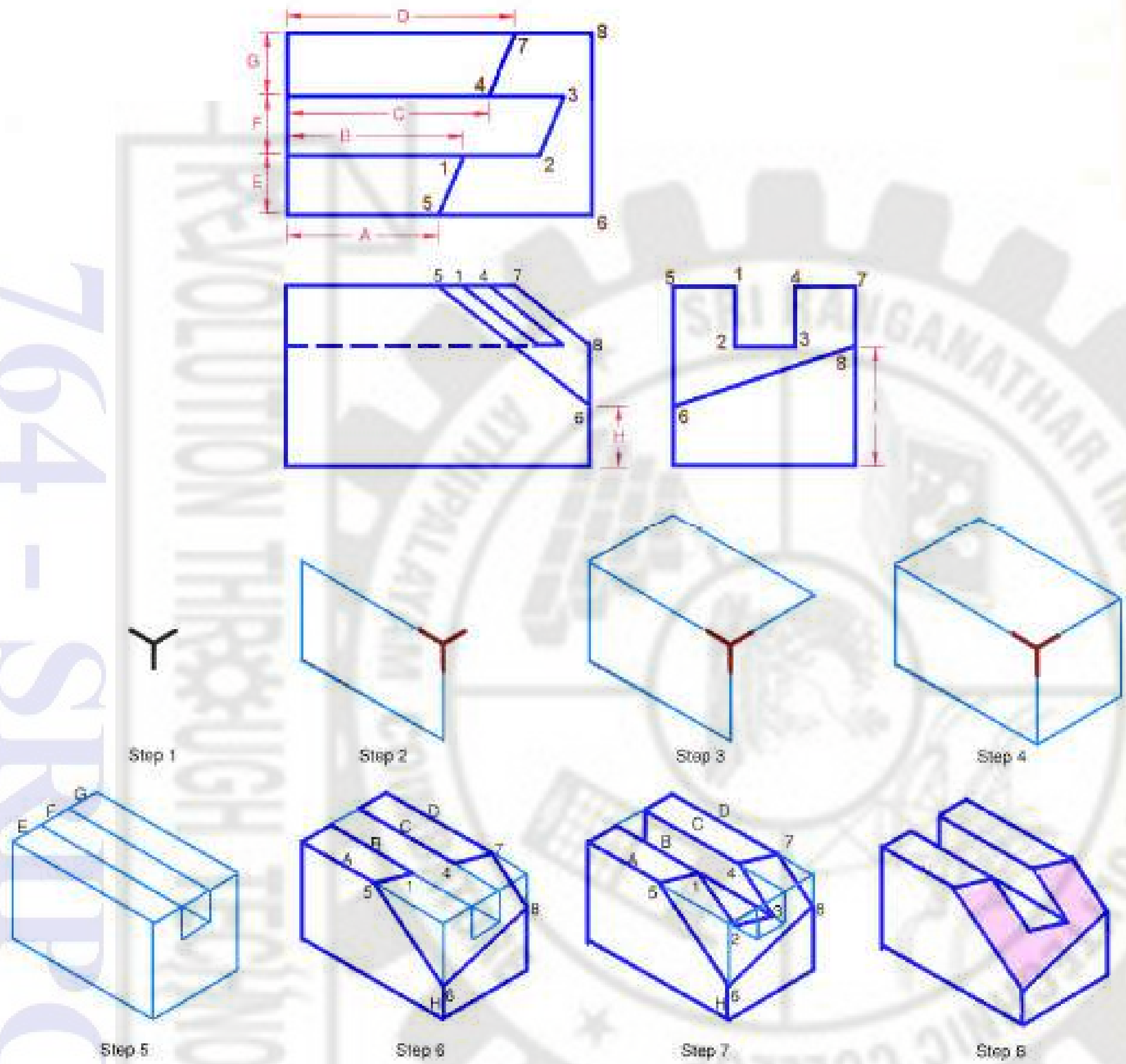
(A) Regular Isometric

Step 2. Construct the front isometric plane using **W** and **H** dimensions.

Step 3. Construct the top isometric plane using the **W** and **D** dimensions.

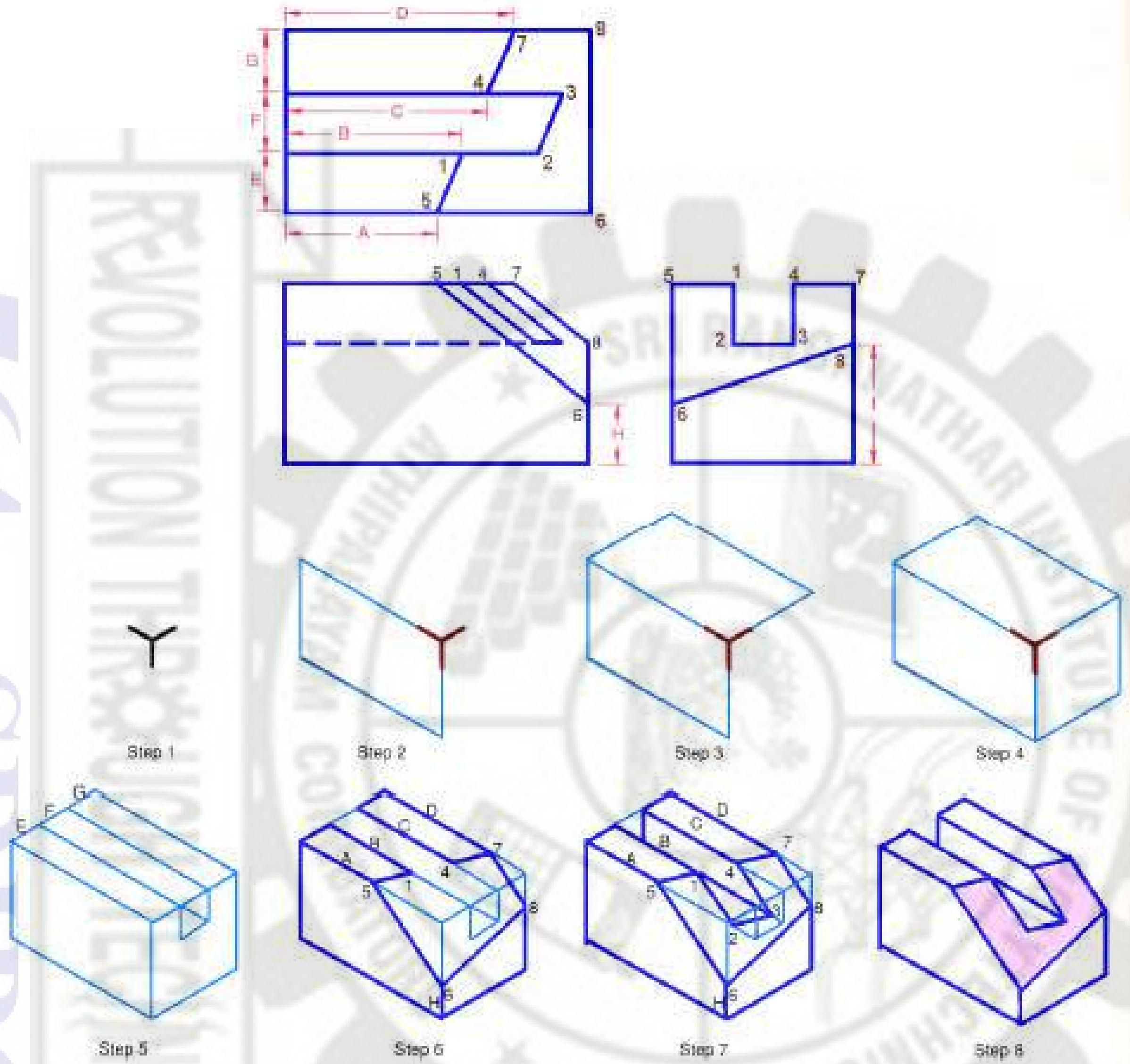
Step 4. Construct the right side isometric plane using **D** and **H** dimensions.

Step 5. Locate the slot across the top plane by measuring distances **E, F**, and **G** along isometric lines.



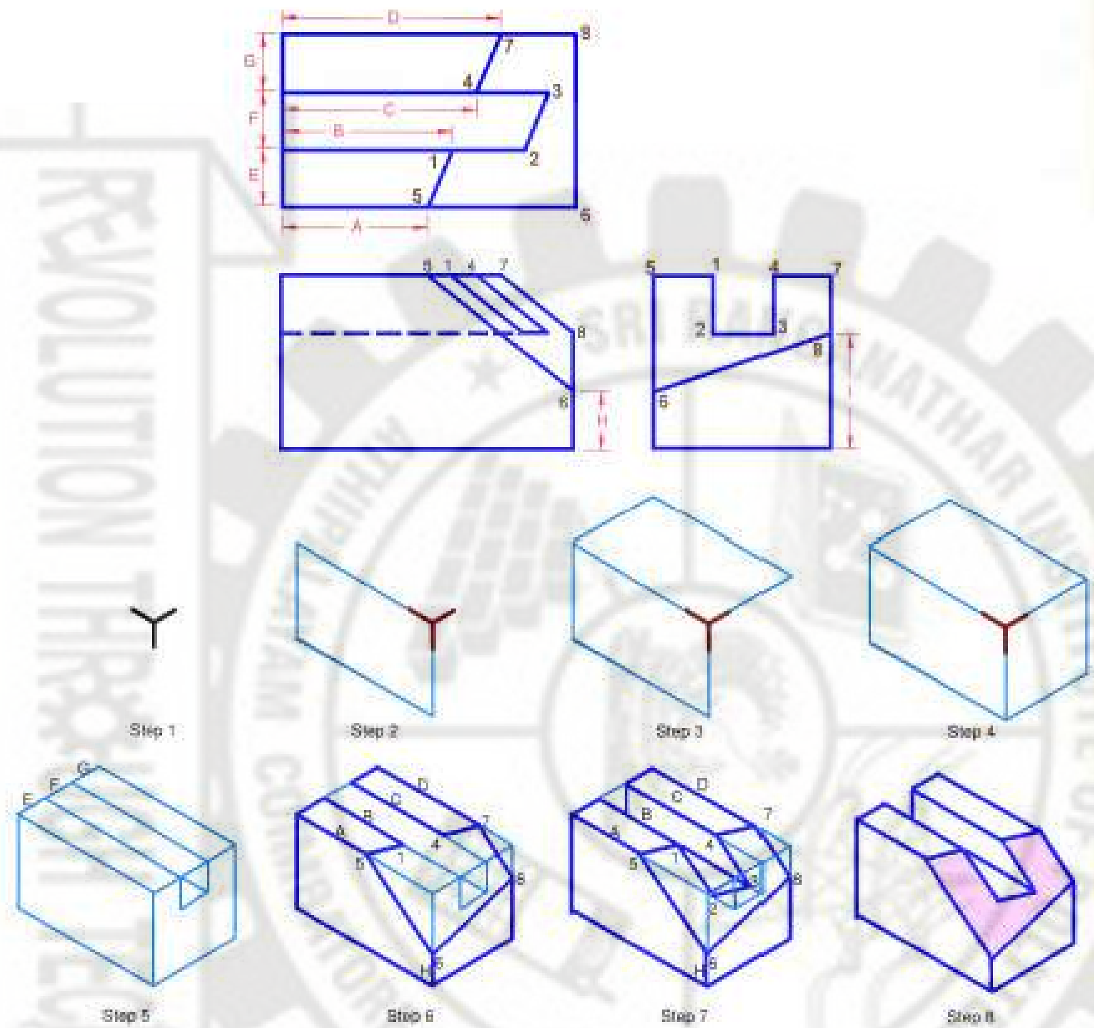
***Step* 6.** Locate the endpoints of the oblique plane in the top plane by locating distances **A, B, C,** and **D** along the lines created for the slot in Step **5.** Label the end-point of line **A** as **5**, line **B** as **1**, line **C** as **4**, and lire **D** as **7**.

Locate distance **H** along the vertical isometric line in the front plane of the isometric box and label the end point **6**. Then locate distance **I** along the isometric line in the profile isometric plane and label the end point **8**. Connect endpoints **5-7** and endpoint **6-8**. Connect points **5-6** and **7-8**.



***Step* 7.** Draw a line from point **4** parallel to line **7**. This new line should intersect at point **3**. Locate point **2** by drawing a line from point **3** parallel to line **4** and equal in length to the distance between points **1** and **4**. Draw a line from point **1** parallel to line **5-6**. This new line should intersect point **2.**

***Step* 8.** Darken lines **4-3**, **3-2**, and **2-1** to complete the isometric view of the object.



Irregular Curves - Irregular curves are drawn in isometric by constructing points along the curve in the multi-view drawing, locating those points in the isometric view, and then connecting the points using a drawing instrument such as a French curve.

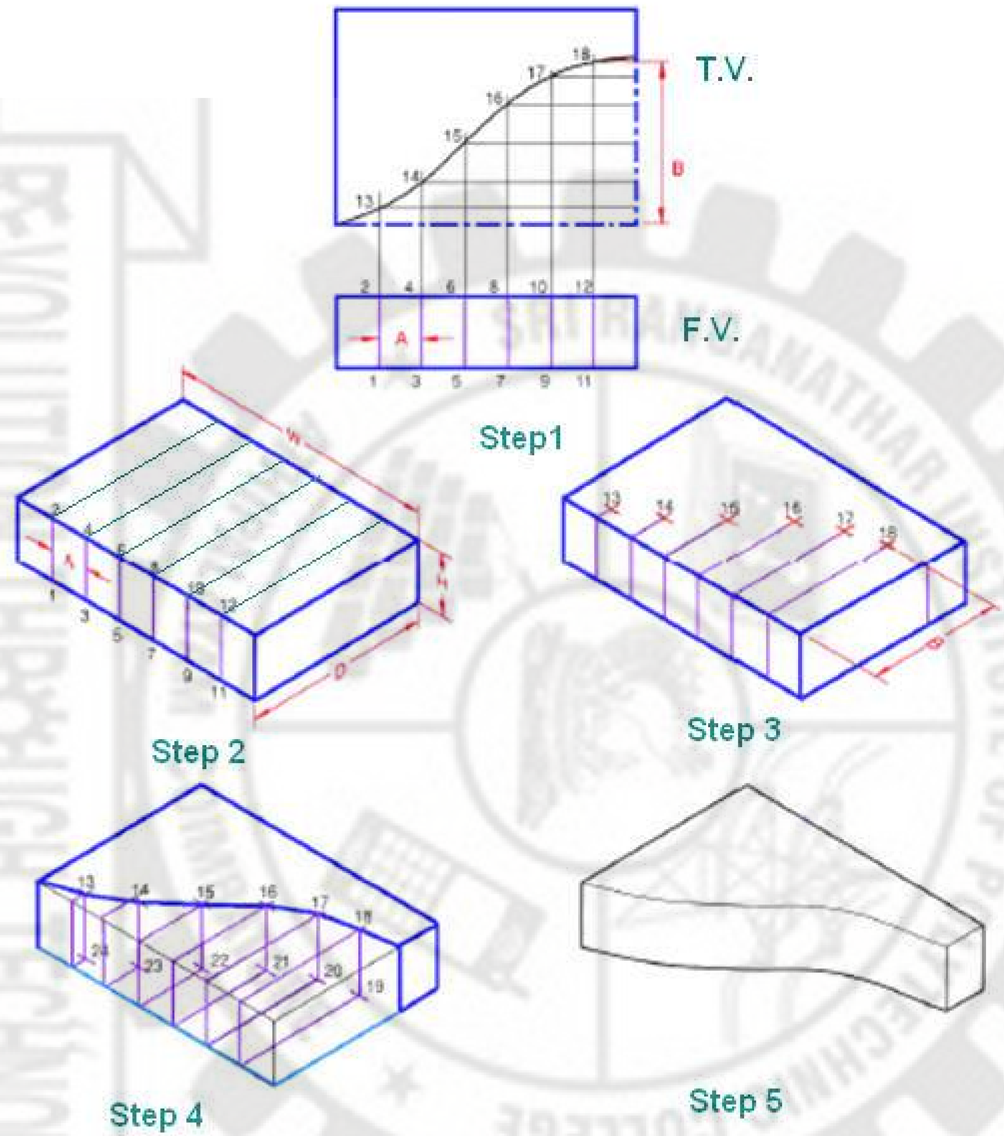
The multi-view drawing of the curve is divided into a number of segments by creating a grid of lines and reconstructing the grid in the isometric drawing.

The more segments chosen, the longer the curve takes to draw, but the curve will be more accurately represented in the isometric view.

***Step* 1**. On the front view of the multi-view drawing of the curve, construct parallel lines and label the points **1-12.**

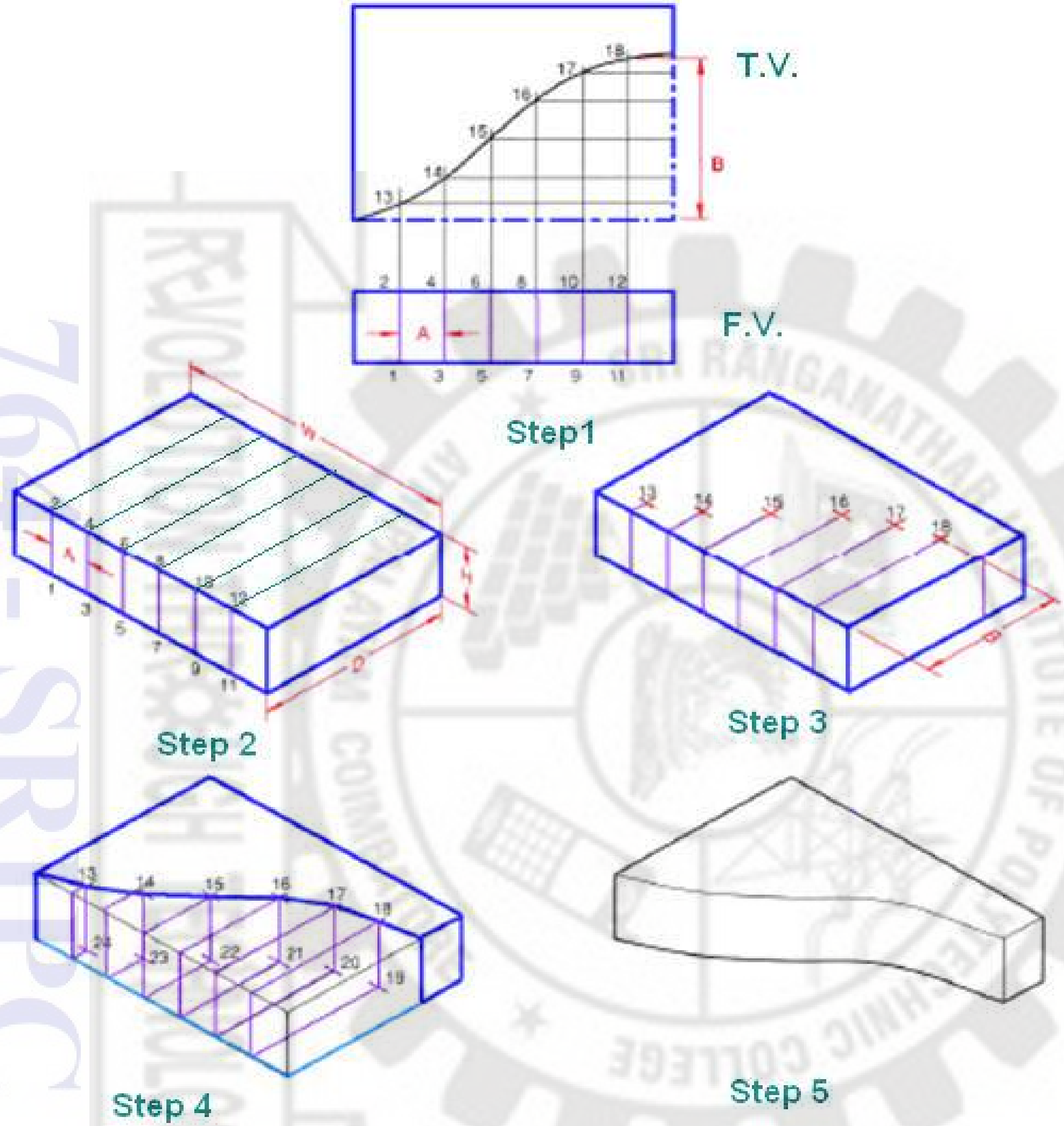
Project these lines into the top view until they intersect the curve.

Label these points of intersection **13-18**, as shown in the Figure. Draw horizontal lines through each point of intersection, to create a grid of lines.



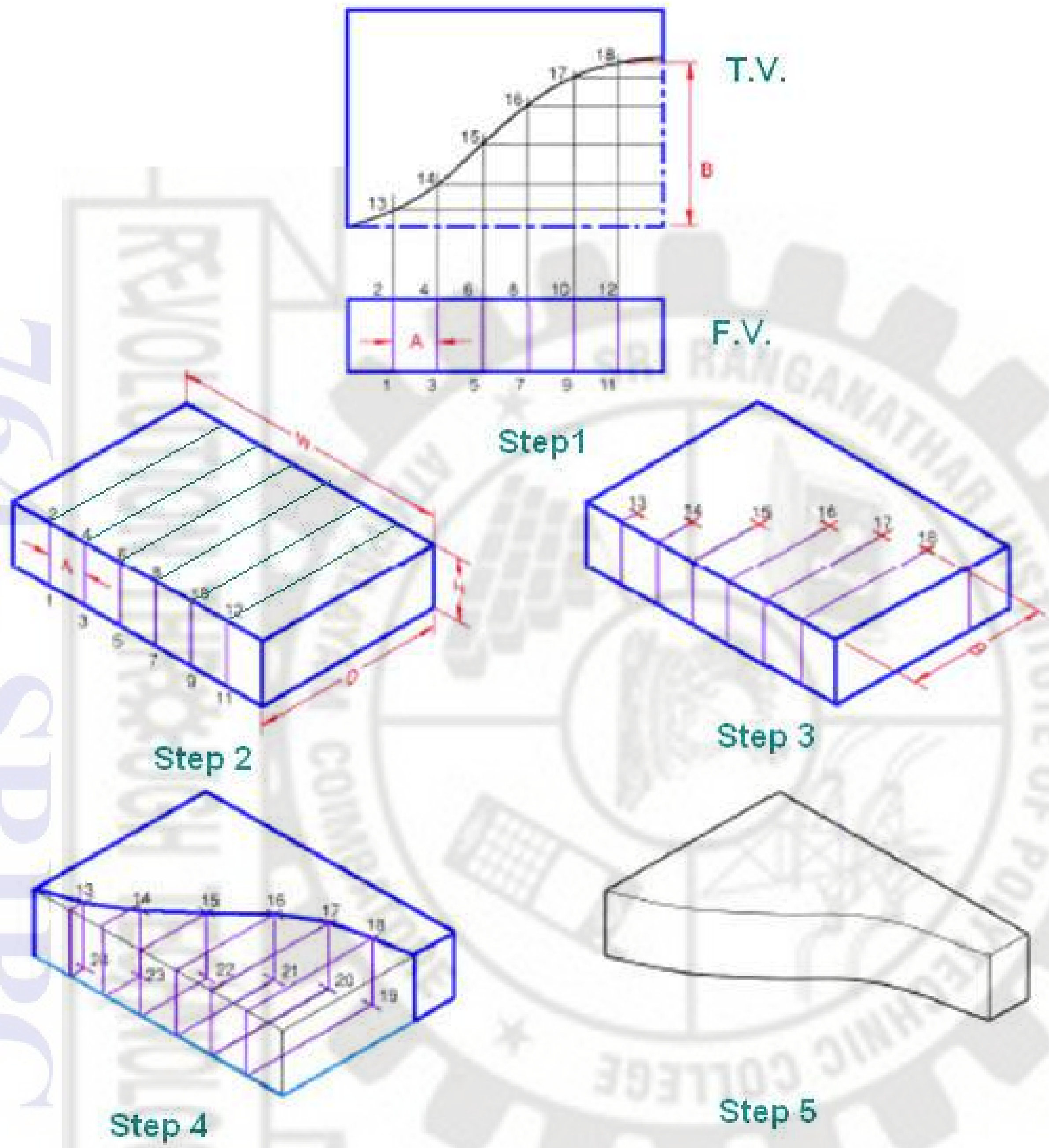
***Step* 2**. Use the **W**, **H**, and **D** dimensions from the multi-view drawing to create the isometric box for the curve.

Along the front face of the isometric box, transfer dimension **A** to locate and draw lines **1-2**, **3-4**, **5-6**, **7-8**, **9-10**, and **11-12**.



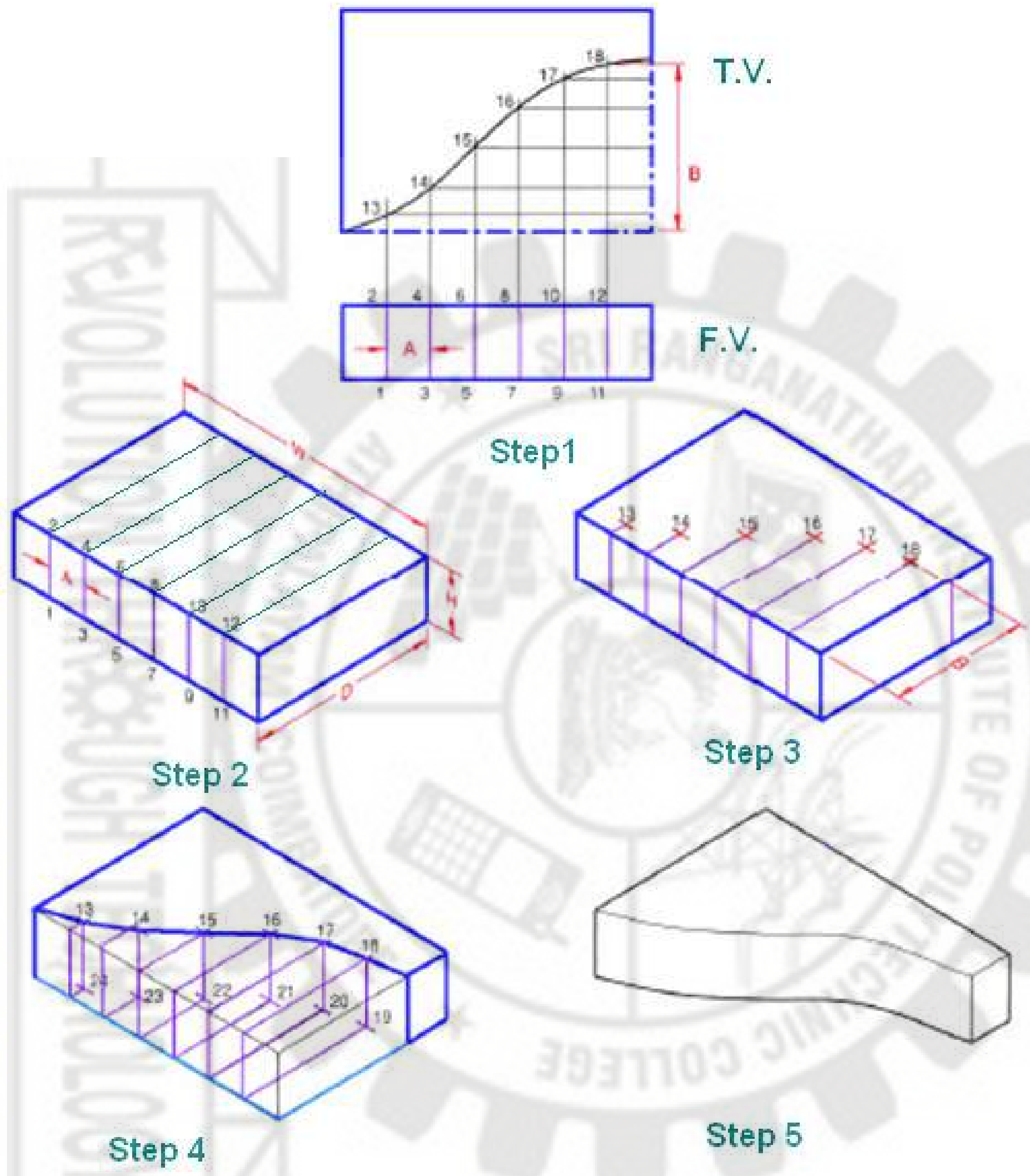
***Step* 3**. From points **2, 4, 6, 8, 10**, and **12**, draw isometric lines on the top face parallel to the **D** line.

Then, measure the horizontal spacing between each of the grid lines in the top multi-view as shown for dimension **B**, and transfer those distances along isometric lines. parallel to the **W** line. The intersections of the lines will locate points **13-18**.



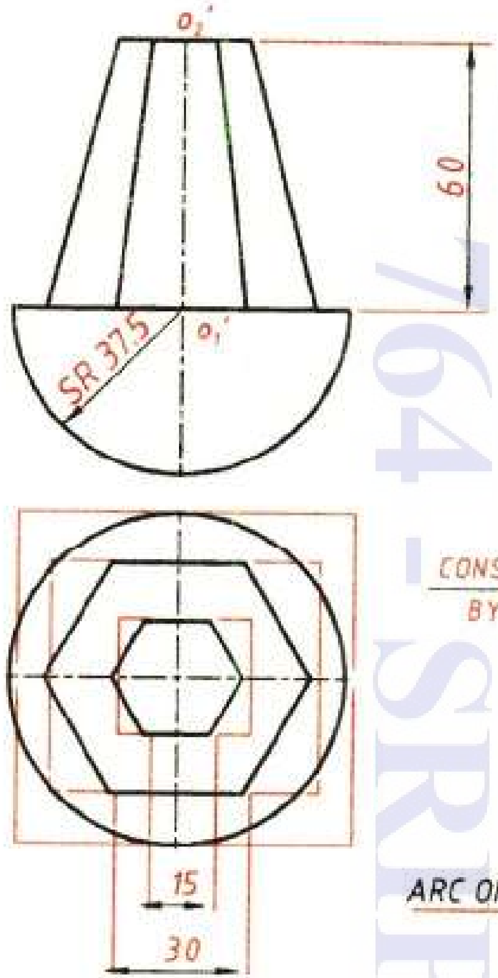
***Step* 4**. Draw the curve through points **13-18**, using an irregular curve. From points **13-18**, drop vertical isometric lines equal to dimension **H**. From points **1, 3, 5, 7, 9**, and **11**, construct isometric lines across the bottom face to intersect with the vertical lines dropped from the top face to locate points **19-24**. Connect points **19-24** with an irregular curve.

***Step* 5.** Erase or lighten all construction lines to complete the view

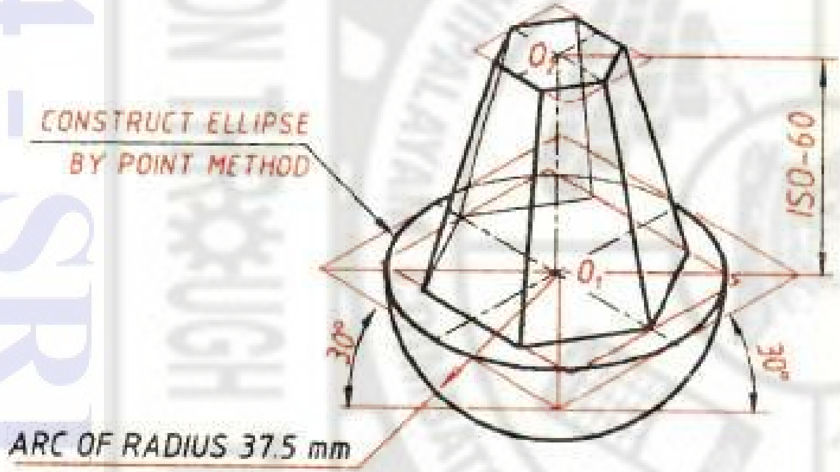


Combinations of solids

Isometric projection of sphere & hexagonal pyramid



A
Orthographic Views



B
Isometric Projection

Taken for K.R. Gopalakrishna, Engineering Graphics, Subash stores

THANK YOU