21MES102L
Engineering Graphics and Design
School of Mechanical Engineering

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Disclaimer

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21MES102L
Engineering Graphic and Design

E4 a.Projection of Straight lines Inclined to Both Planes
b. Projection of Planes Inclined to One Plane

Topics Covered

- Projection of Straight Lines Inclined to Both Planes by using Rotating Line method
- Projection of Plane Surfaces Perpendicular to one Plane and Parallel to other Plane
- Projection of Plane Surfaces Inclined to one Plane and Perpendicular to other Plane

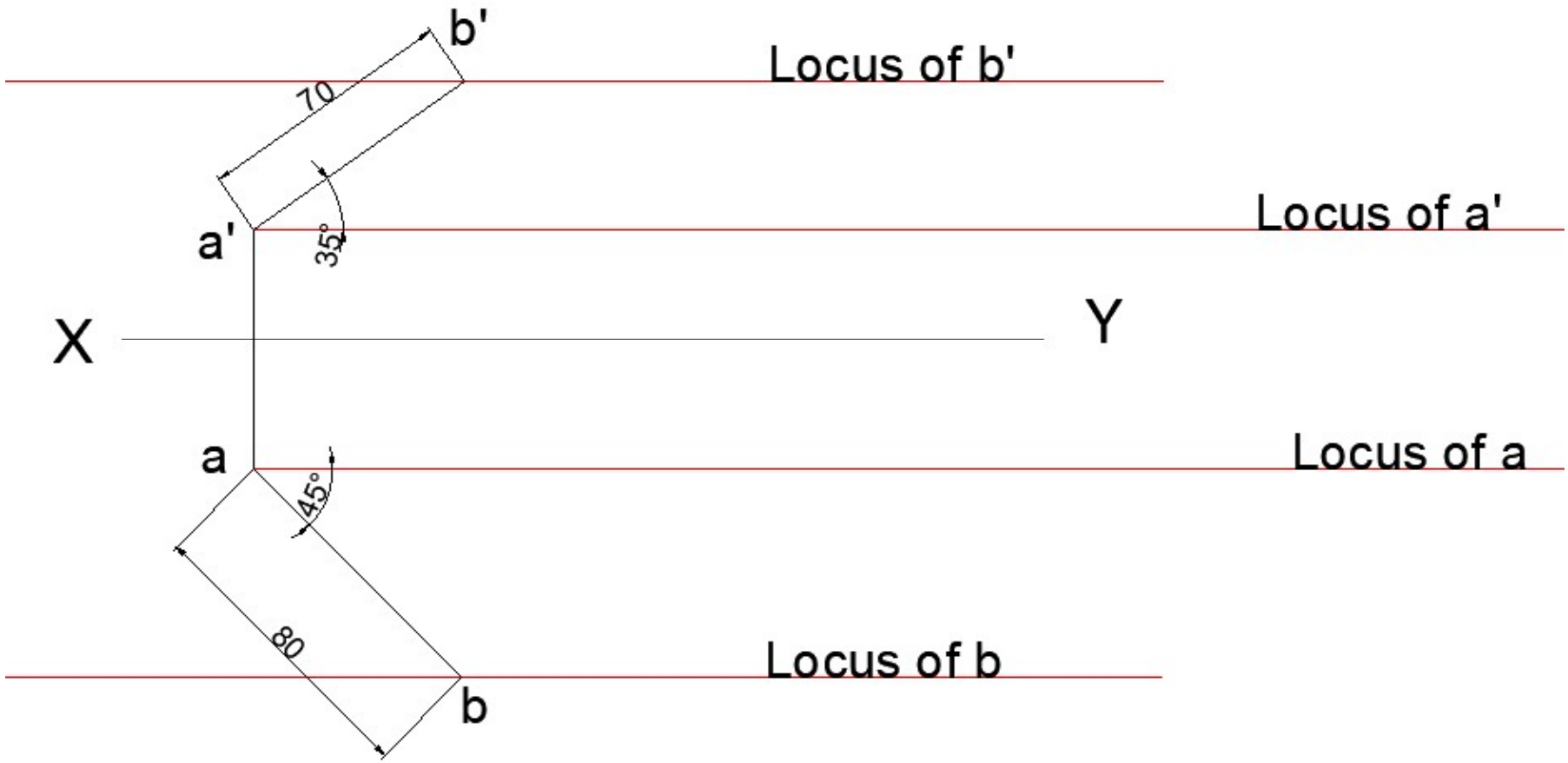
Determination of True Length for the line Inclined to both the Planes

- Initial setup of workspace **Drafting & Annotation** Mode
  - Type UN or **UNITS**
  - Set the Precision for **0**
  - Set the Units in Millimeters
- Type **LIMITS** Press Enter
  - Specify the Lower Left Corner as **0,0** Press Enter
  - Specify the Upper Right Corner as **210,297** Press Enter
- Type **ZOOM** Press Enter
- Type **ALL** Press Enter

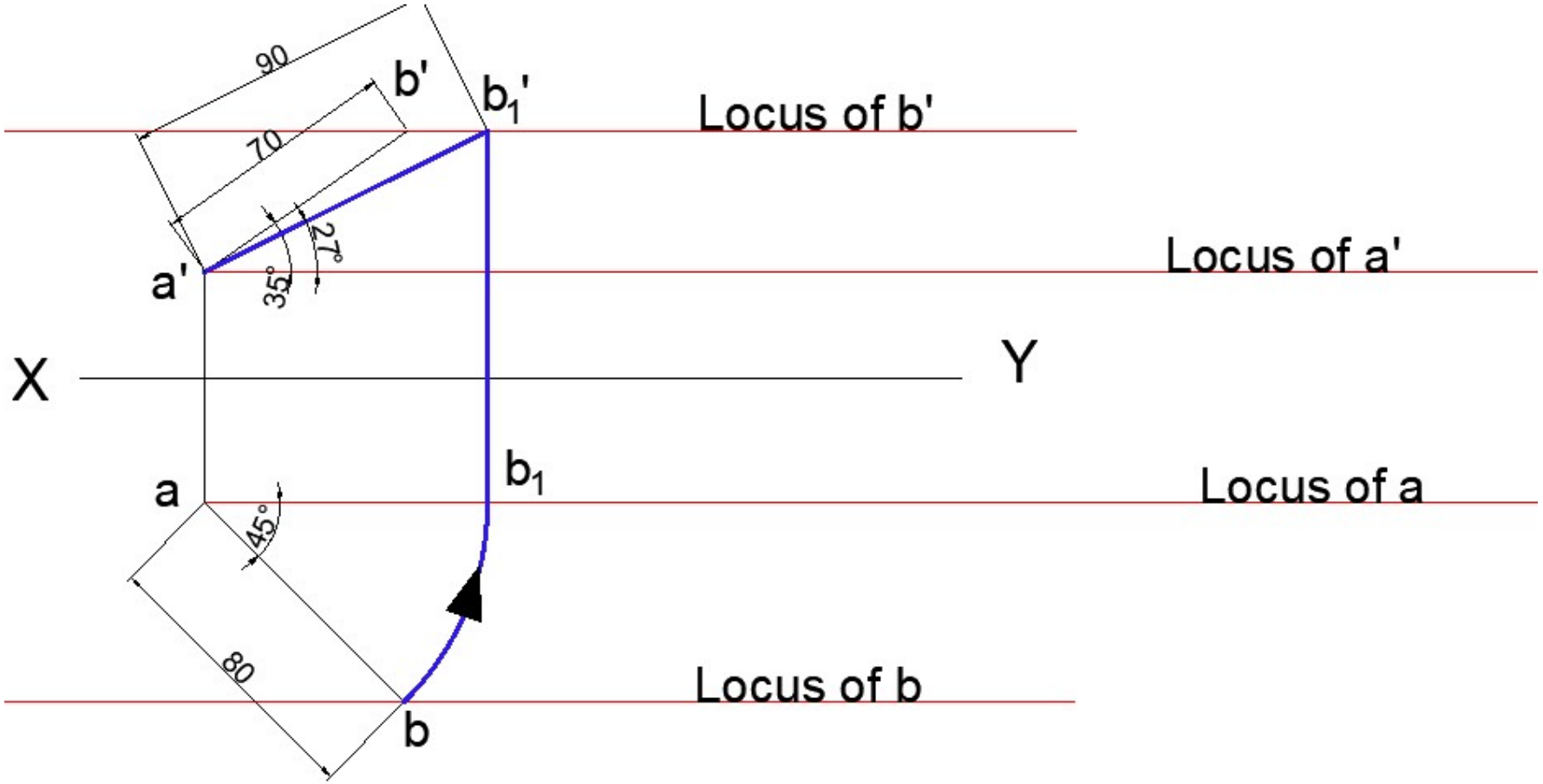
- Use **LINE** command (**ORTHO ON**) draw the Reference line **XY**.
- Use **POINT** command to locate the **a'** & **a** **ABOVE** & **BELOW** the Reference line **XY**.
- Use **LINE** command (**ORTHO ON**) to draw a horizontal line from **a'** (Locus of **a'**) & draw a horizontal line from **a** (**Locus of a**) .

- Use **LINE** command (**ORTHO OFF**) From **a'** draw a line for a given inclination angle with **HP** & name the end point as **b'**.[**a' b'** is called as **FRONT VIEW (FV)**]
- Use **LINE** command (**ORTHO OFF**) from **a** draw a line for a given inclination angle with **VP** & name the end point as **b** [**a b** is called as **TOP VIEW (T V)]**
- Use **LINE** command (**ORTHO ON**) to draw a horizontal line from **b'** (**Locus of b'**) & from **b** draw a horizontal line (**Locus of b**) .

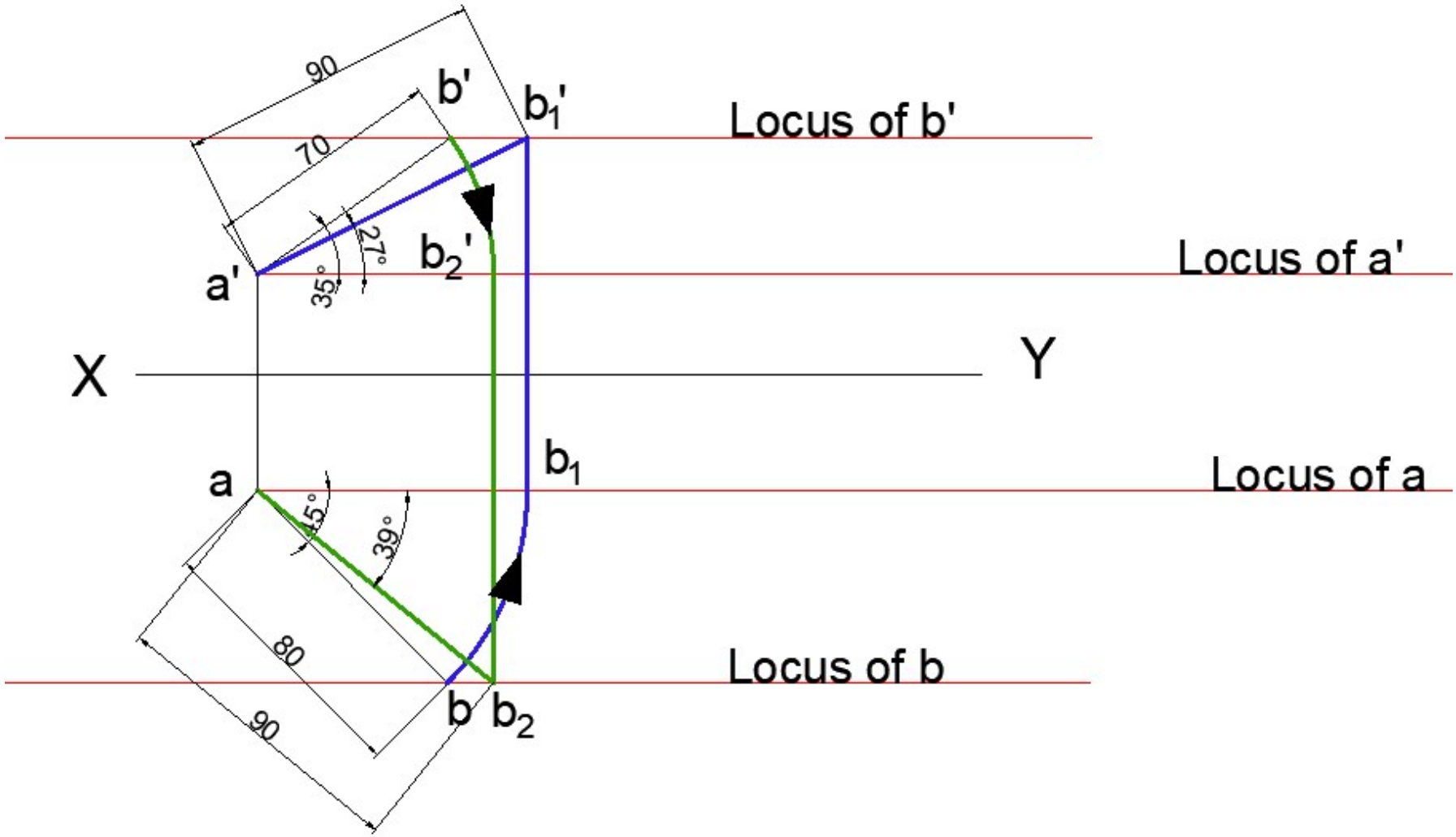
Determination of True Length for the line Inclined to both the Planes



- Use **ARC** command (**Center Start End**) draw an arc from **b** to intersect the **Locus of a** & name the intersecting point as **b_1**.
- Use **LINE** command (**ORTHO ON**) to draw a vertical line from **b_1** to intersect the **locus of b'** & name the intersecting point as **b_1'**
- Use **LINE** command (**ORTHO OFF**) draw a line from **a'** to **b_1'** [**$a'b_1'$** is called as **TRUE LENGTH (TL)]** of the straight line in **HP**.


90
b'
b1'
Locus of b'
70
27°
35°
a'
Locus of a'
X
Y
a
b1
Locus of a
45°
80
Locus of b
b

- Use **ARC** command (**Center Start End**) draw an arc from **b'** to intersect the Locus of **a'** & name the intersecting point as **b_2'**.
- Use **LINE** command (**ORTHO ON**) to draw a vertical line from **b_2'** to intersect the locus of **b** & name the intersecting point as **b_2**
- Use **LINE** command (**ORTHO OFF**) draw a line from **a** to **b_2** [**a b_2** is called as **TRUE LENGTH (TL)**] of the straight line in **VP**.
- Use **ANNOTATION** Tool bar (**DIM TOOL**) & Mark all the required dimensions.


90
b'
b1'
Locus of b'
70
27°
35°
b2'
a'
Locus of a'
X
Y
b1
a
Locus of a
45°
39°
80
Locus of b
90
b
b2

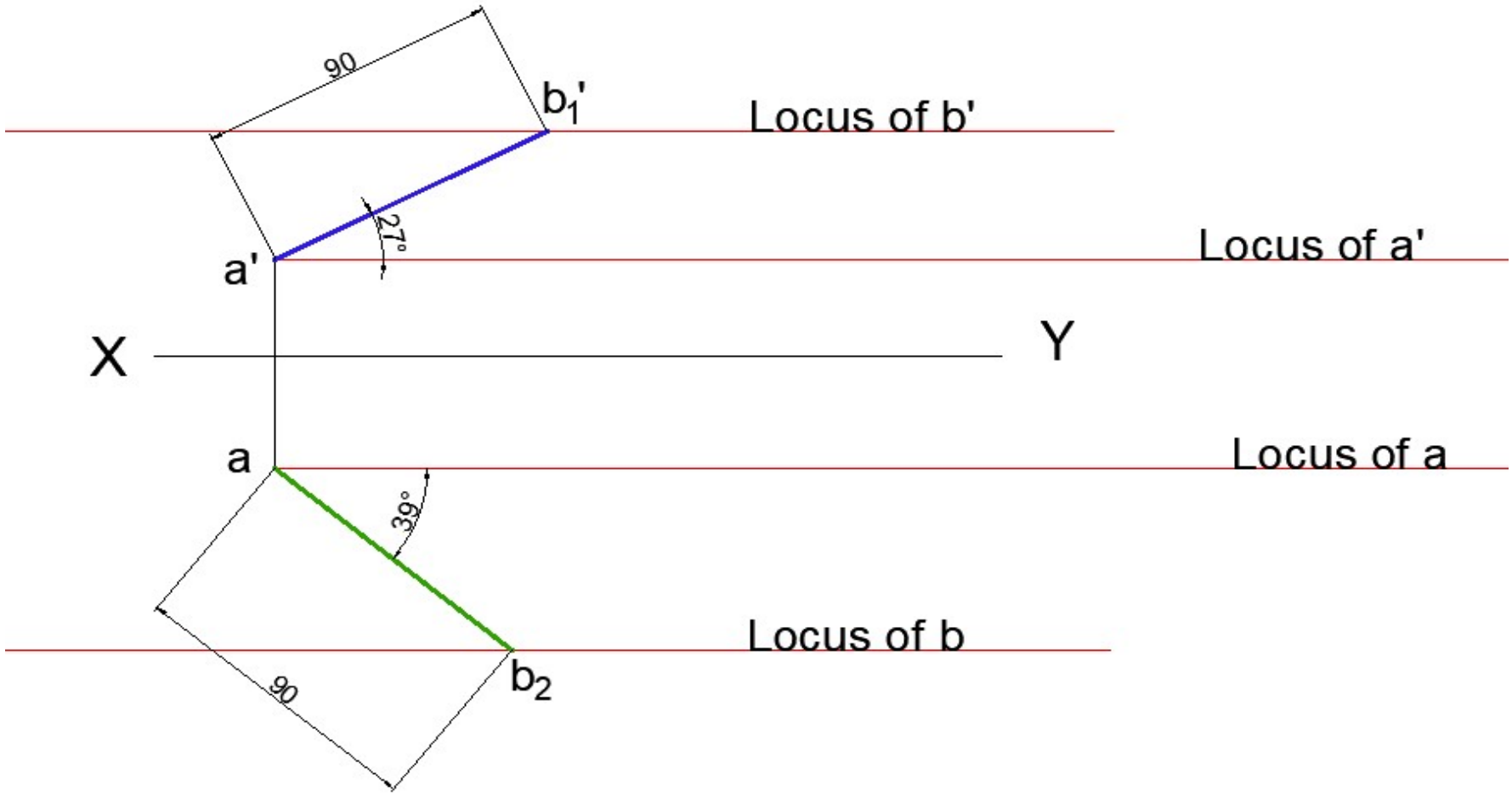
Determination of Front View & Top View for the line Inclined to both the Planes

- Initial setup of workspace **Drafting & Annotation** Mode
  - Type UN or **UNITS**
  - Set the Precision for **0**
  - Set the Units in Millimeters
- Type **LIMITS** Press Enter
  - Specify the Lower Left Corner as **0,0** Press Enter
  - Specify the Upper Right Corner as **210,297** Press Enter
- Type **ZOOM** Press Enter
- Type **ALL** Press Enter

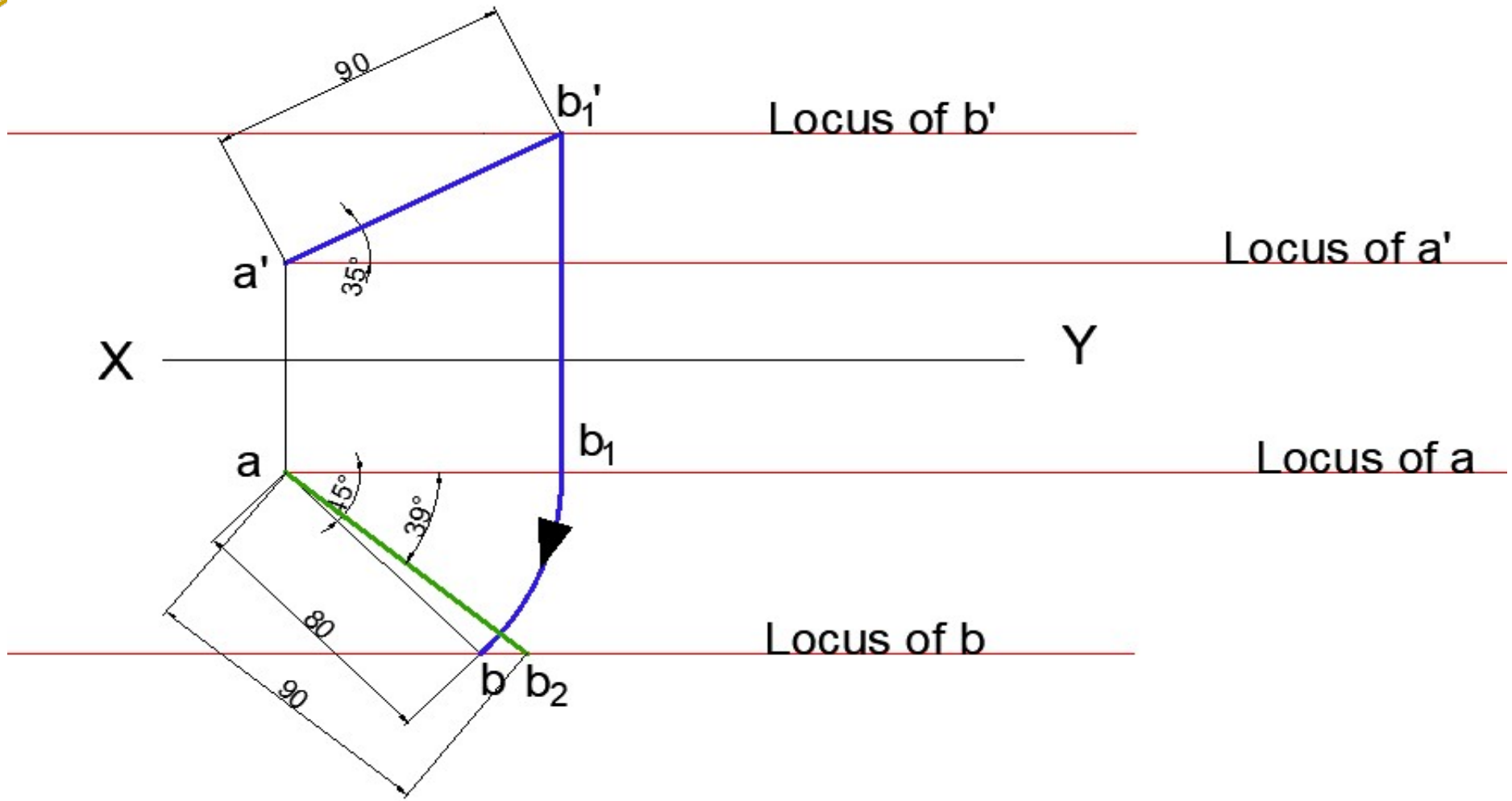
- Use **LINE** command (**ORTHO ON**) draw the Reference line **XY**.
- Use **POINT** command to locate the **a'** & **a** **ABOVE** & **BELOW** the Reference line **XY**.
- Use **LINE** command (**ORTHO ON**) to draw a horizontal line from **a'** (**Locus of a')** & from **a** draw a horizontal line (**Locus of a**) .
- Use **LINE** command (**ORTHO OFF**) From **a'** draw a line for a given True Length (**TL**) & inclination angle with **HP** & name the end point as **b_1'.** [**a'b_1'** is True length of line in **Front View**]

- Use **LINE** command (**ORTHO OFF**) from **a** draw a line for a given True Length (**TL**) & inclination angle with **VP** & name the end point as **b_2** [**a b_2** is True length of line in **Top View**]
- Use **LINE** command (**ORTHO ON**) to draw a horizontal line from **b_1'** (**Locus of b'**) & from **b_2** draw a horizontal line (**Locus of b**) .

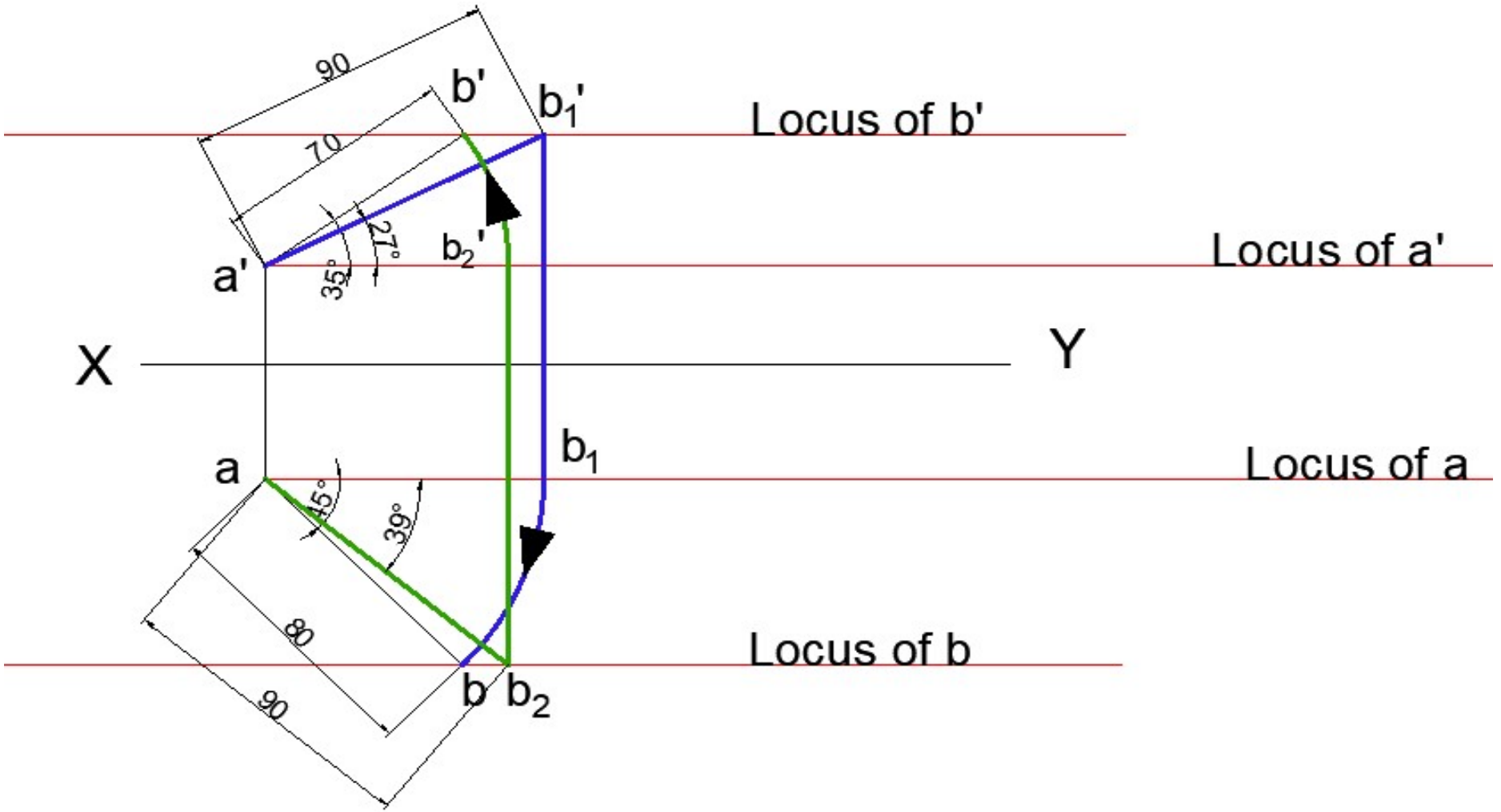
Determination of Front View & Top View for the line Inclined to both the Planes



- Use **LINE** command (**ORTHO ON**) to draw a vertical line downward from **b_1'** to intersect the locus of **a** & name the intersecting point as **b_1**
- Use **ARC** command (**Center Start End**) draw an arc from **b_1** to intersect the Locus of **b** & name the intersecting point as **b**.
- Use **LINE** command (**ORTHO OFF**) draw a line from **a** to **b** [**a b** is called as **TOP VIEW** (**TV**) of the straight line.]

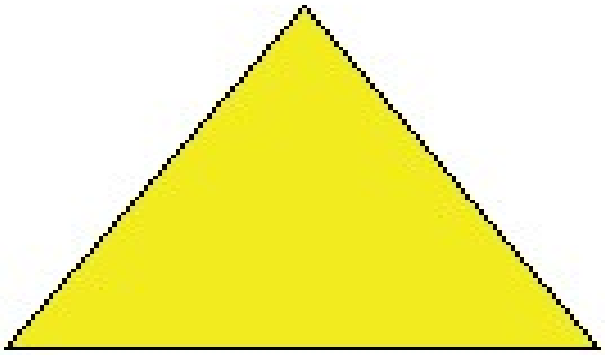

90
b1'
Locus of b'
a'
35°
Locus of a'
X
Y
a
b1
45°
39°
Locus of a
80
Locus of b
90
b
b2

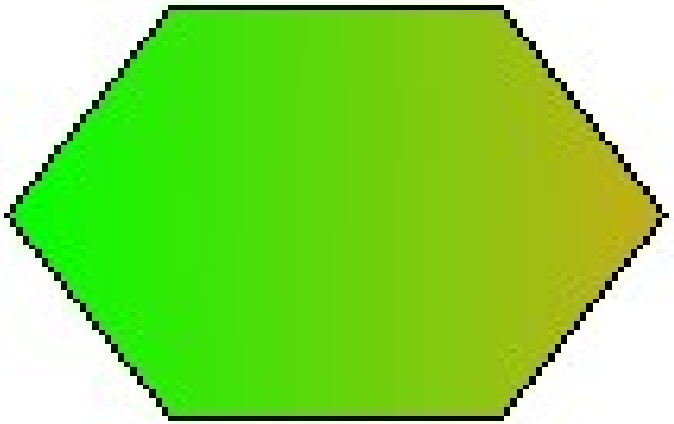
- Use **LINE** command (**ORTHO ON**) to draw a vertical line upwards from **b_2** to intersect the locus of **a'** & name the intersecting point as **b_2'**
- Use **ARC** command (**Center Start End**) draw an arc from **b_2'** to intersect the Locus of **b'** & name the intersecting point as **b'**.
- Use **LINE** command (**ORTHO OFF**) draw a line from **a'** to **b'** [**a' b'** is called as **FRONT VIEW** (**FV**) of the straight line in **VP**.]
- Use **ANNOTATION** Tool bar (**DIM TOOL**) & Mark all the required dimensions.


90
b'
b1'
Locus of b'
70
27°
b2'
Locus of a'
35°
a'
X
Y
b1
a
Locus of a
45°
39°
80
Locus of b
90
b
b2

PROJECTION OF PLANES

- A **Plane** figure has two dimensions, the **Length** and the **Breadth**.
- It may be of any **Regular shape** such as **Triangular**, **Square**, **Pentagonal**, **Hexagonal**, **Circular** etc.

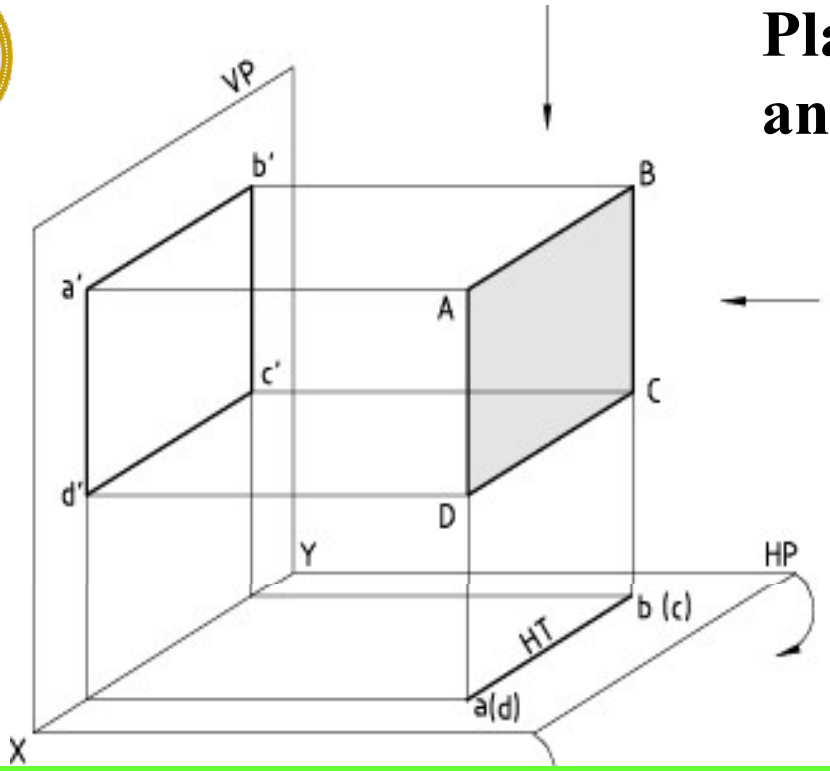


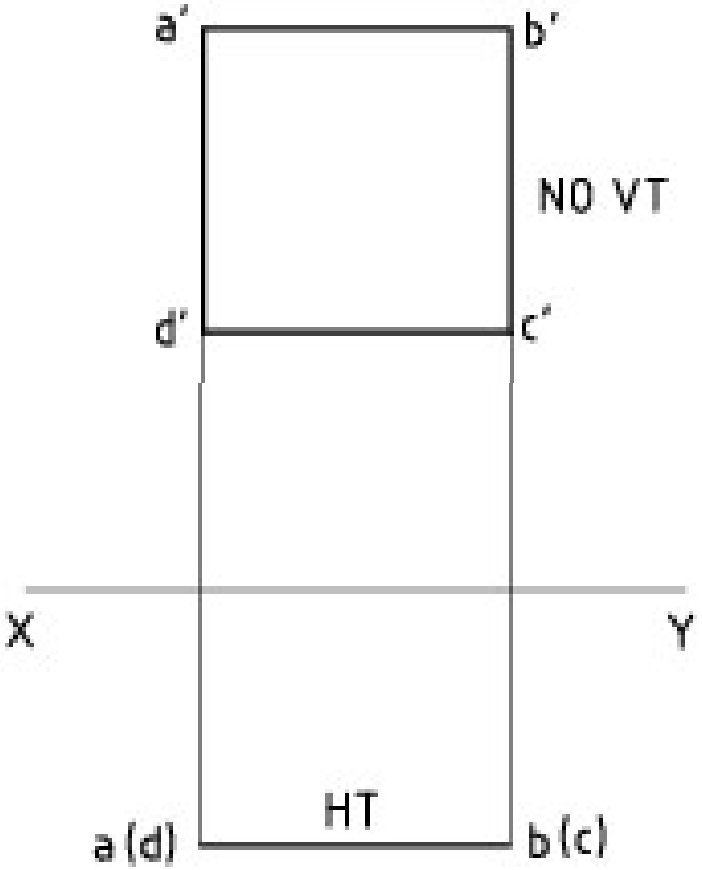


Possible Locations of the Planes with respect to the Wall & Floor

- Plane parallel to wall and perpendicular to the floor.
- Plane parallel to floor and perpendicular to the wall.
- Plane perpendicular to both wall and floor.
- Plane inclined to wall and perpendicular to the floor.
- Plane inclined to floor and perpendicular to the wall.
- Plane inclined to both wall and floor.

Plane Perpendicular to the floor (HP) and Parallel to the wall (VP).



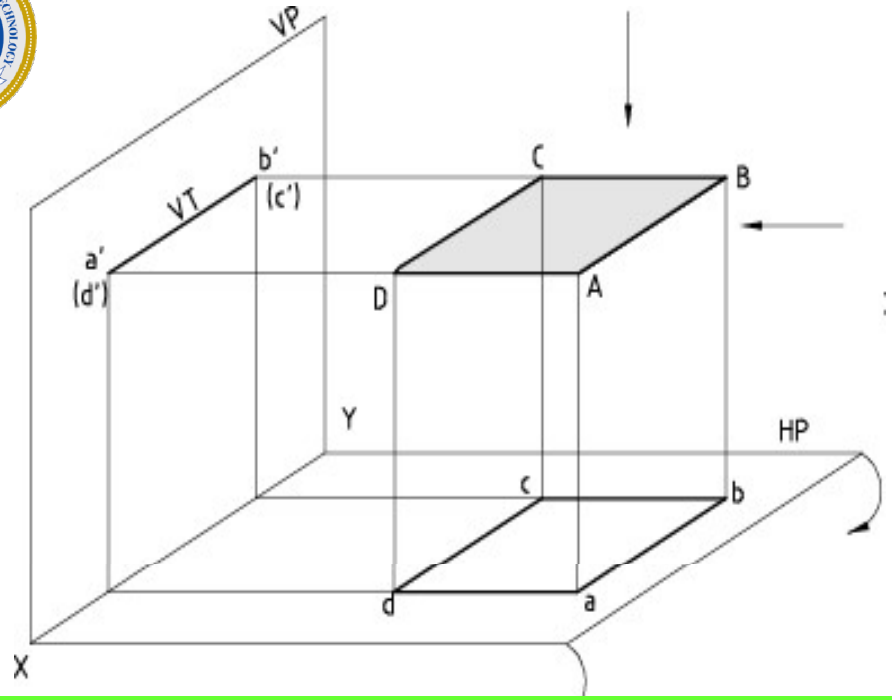


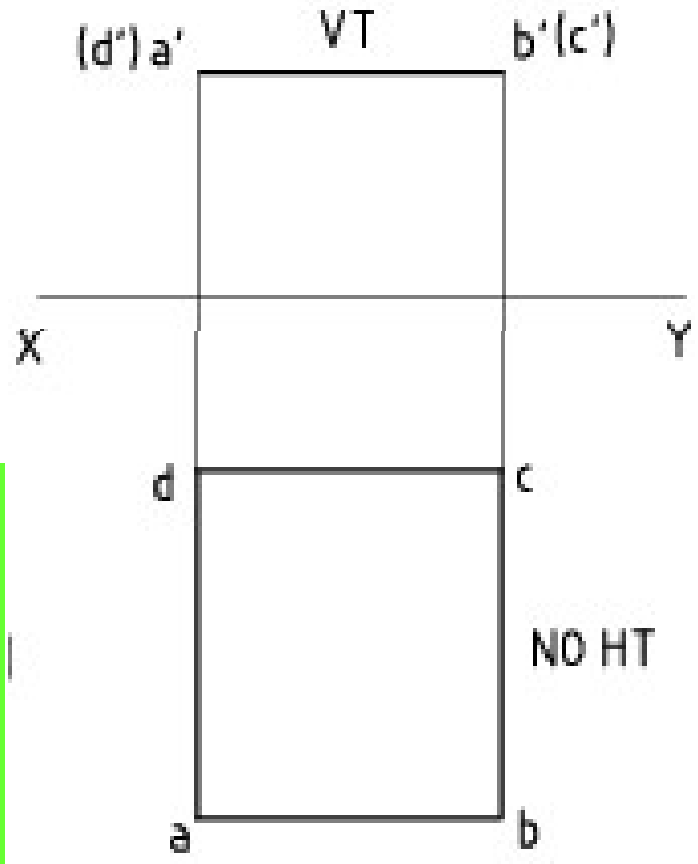
- A Square Plane **ABCD** having its Surface Perpendicular to **HP** and Parallel to **VP**.
- Front view is a Square having True Shape and Size

  Top view is a line.

- Use **LINE** command **ORTHO ON** to draw the reference line **XY**
- Start with Front view use **LINE** command **ORTHO ON** to draw the Square for the given dimensions
- Use **TEXT** command for naming the corners **a'** , **b'** , **c'** & **d'**
- Use LINE command **ORTHO ON** to draw vertical projection lines from corners of square **d'** & **c'** upto **XY** line
- Extend the line downwards from **XY** for **d** mm given distance
- Draw line between the projected lines & name the end points as **a(d)** & **b(c)**
- Use **ANNOTATION** tool bar for marking the required dimensions.

Plane Perpendicular to the Wall (VP) and Parallel to the Floor (HP)



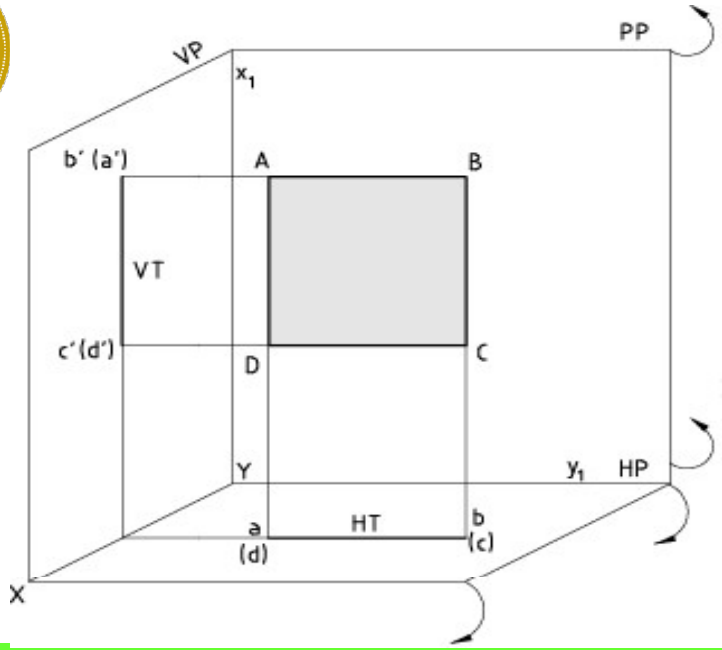


- A Square Plane **ABCD** having its Surface Perpendicular to **VP** and Parallel to **HP**.
- Top view is a Square having true Shape and Size Front view is a line.

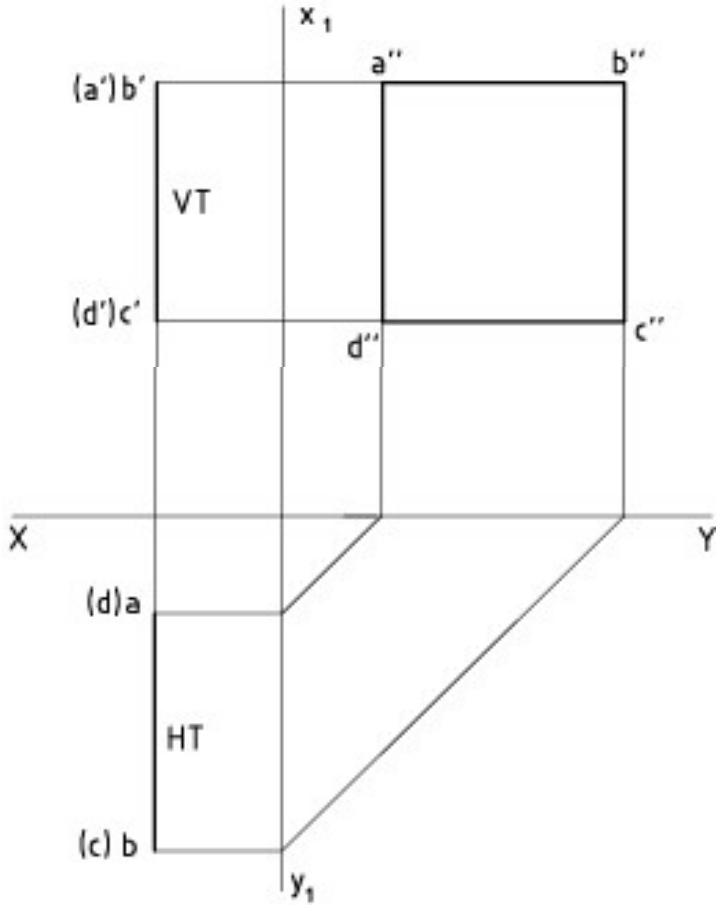
- Initial setup of workspace **Drafting & Annotation** Mode
  - Type UN or **UNITS**
  - Set the Precision for **0**
  - Set the Units in Millimeters
- Type **LIMITS** Press Enter
  - Specify the Lower Left Corner as **0,0** Press Enter
  - Specify the Upper Right Corner as **210,297** Press Enter
- Type **ZOOM** Press Enter
- Type **ALL** Press Enter

- Use **LINE** command **ORTHO ON** to draw the reference line **XY**
- Start with **Top view** use **LINE** command **ORTHO ON** to draw the Square for the given dimensions
- Use **TEXT** command for naming the corners **a** , **b** , **c** & **d**
- Use **LINE** command **ORTHO ON** to draw vertical projection lines from corners of square **d** & **c** upto **XY** line
- Extend the line upwards from **XY** for **h** mm given distance
- Draw line between the projected lines & name the end points as **a'(d')** & **b'(c')** & use **ANNOTATION** tool bar for marking the required dimensions.

Plane Perpendicular to both the wall (VP) and to the floor (HP) .



- A Square Plane **ABCD** having its Surface Perpendicular to both **HP** and **VP**.
- Side view of the Plane is a Square having True Shape and Size. Top and Front views are lines.

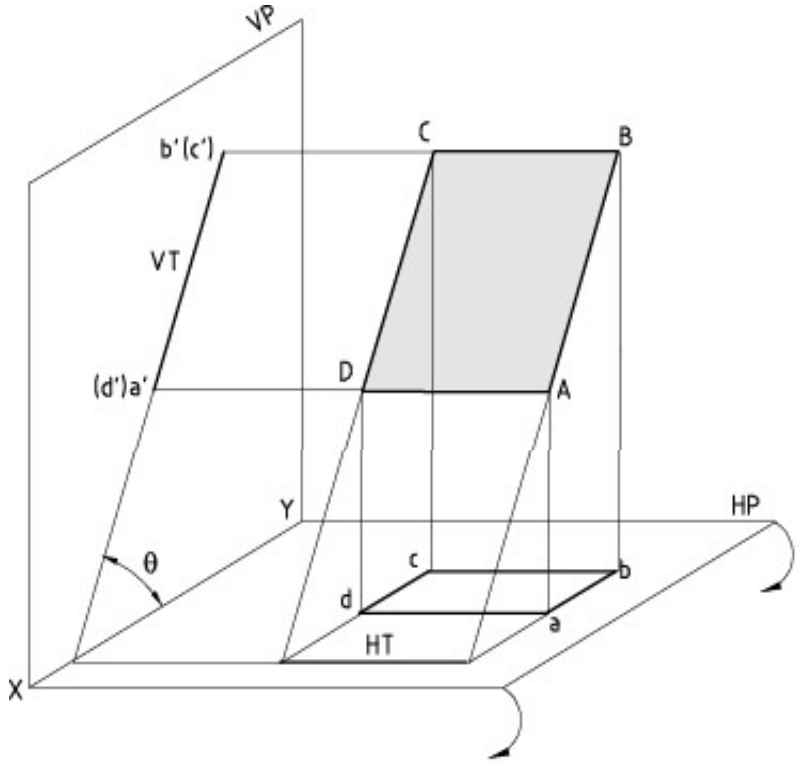


- Initial setup of workspace **Drafting & Annotation** Mode
  - Type UN or **UNITS**
  - Set the Precision for **0**
  - Set the Units in Millimeters
- Type **LIMITS** Press Enter
  - Specify the Lower Left Corner as **0,0** Press Enter
  - Specify the Upper Right Corner as **210,297** Press Enter
- Type **ZOOM** Press Enter
- Type **ALL** Press Enter

- Use **LINE** command **ORTHO ON** to draw the horizontal & vertical reference lines **XY** & $\mathbf{X_1 Y_1}$
- Start with Side view use **LINE** command **ORTHO ON** to draw the Square for the given dimensions
- Use **TEXT** command for naming the corners **a”**, **b”**, **c”** & **d”**
- Use **LINE** command **ORTHO ON** to draw vertical projection lines upto **XY** line from corners of square **d”** & **c”** & draw horizontal projection lines upto $\mathbf{X_1 Y_1}$ line from corners of square **d”** & **a”**

- Use **ARC** command (**Center Start End**) to draw arc from the Extended line **XY** to $\mathbf{X_1Y_1}$ & use line command to extend the line from arc end for **p** distance
- Draw line between the projected lines & name the end points as **a (d)** & **b (c)**
- Use the **LINE** command to Project the lines from corners of square **d"** & **a"** upto $\mathbf{X_1Y_1}$ & Extend for **p** mm distance from $\mathbf{X_1Y_1}$
- Draw the line between the projected lines & name the end points as **(a') b'** & **(d') c'**
- Use **ANNOTATION** tool bar for marking the required dimensions.

Plane Inclined to Floor (HP) and Perpendicular to the Wall (VP).

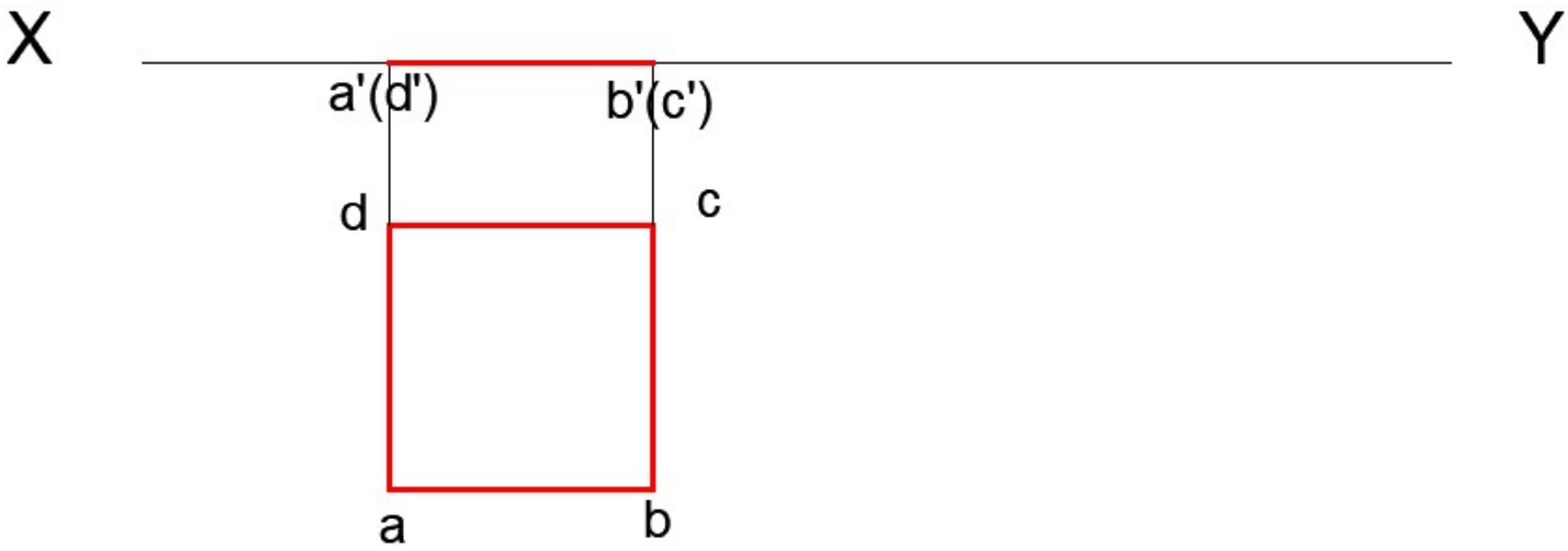


- A Square Plane **ABCD** having its Surface Inclined to **HP** and Perpendicular to **VP** .
- Front view is an Inclined line at **θ** & Top view is Smaller in Size

- Initial setup of workspace **Drafting & Annotation** Mode
  - Type UN or **UNITS**
  - Set the Precision for **0**
  - Set the Units in Millimeters
- Type **LIMITS** Press Enter
  - Specify the Lower Left Corner as **0,0** Press Enter
  - Specify the Upper Right Corner as **210,297** Press Enter
- Type **ZOOM** Press Enter
- Type **ALL** Press Enter

- Use **LINE** command **ORTHO ON** to draw the horizontal reference lines **XY**
- Use **LINE** command from **DRAW TOOL** bar & (**ORTHO ON**) Start with Top view to get the True shape & draw the Square for the given side length .
- Use **TEXT** command for naming the corners of the Square **a, b, c,** & **d .**
- Use **LINE** command **ORTHO ON** & from Top view draw projection lines from corners of the Square **c** & **d** upto reference line **XY**.
- Use **LINE** command **ORTHO ON** & draw lines connecting the projection & the points as **(d') a'** & **b'(c')** & this line is the Front view of the square lying on the floor.

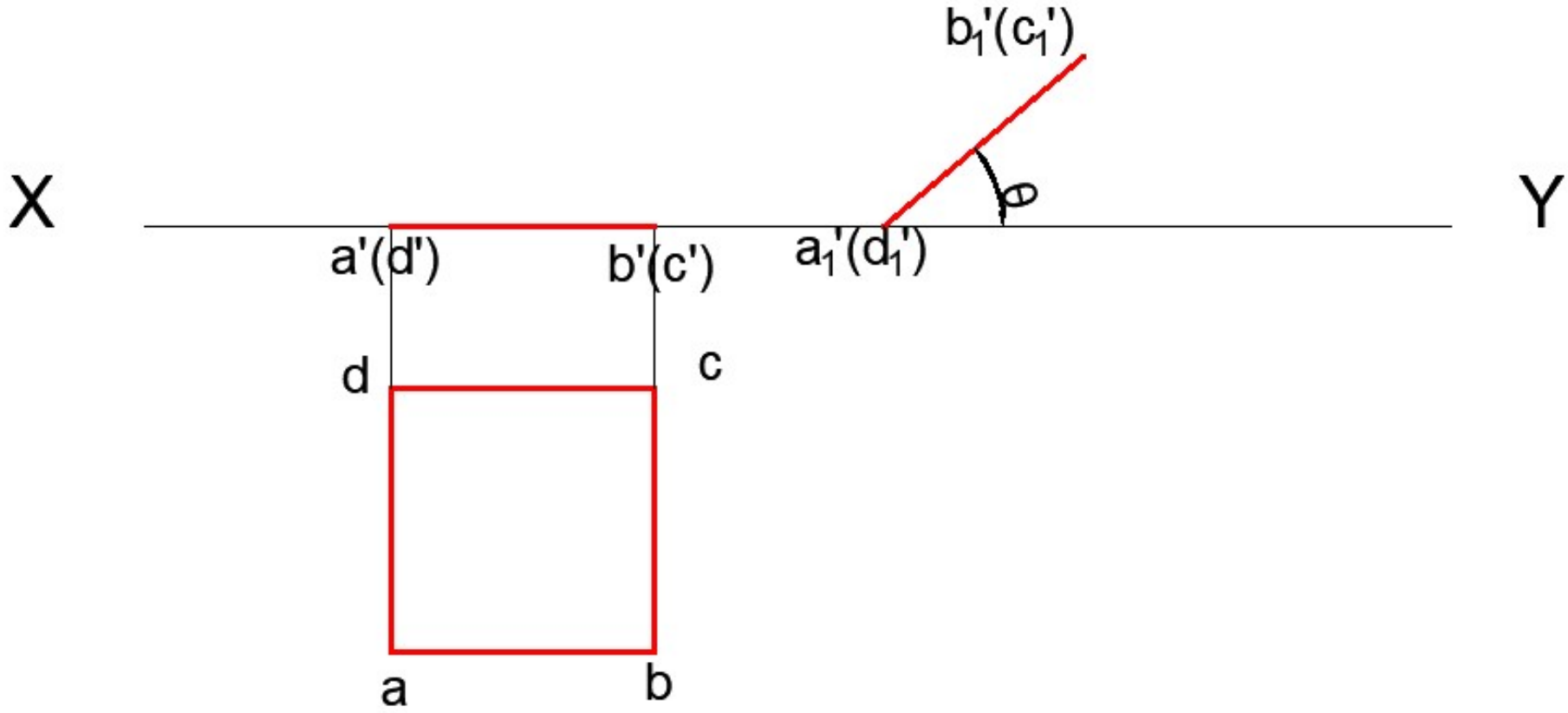
Plane Inclined to Floor (HP) and Perpendicular to the Wall (VP).

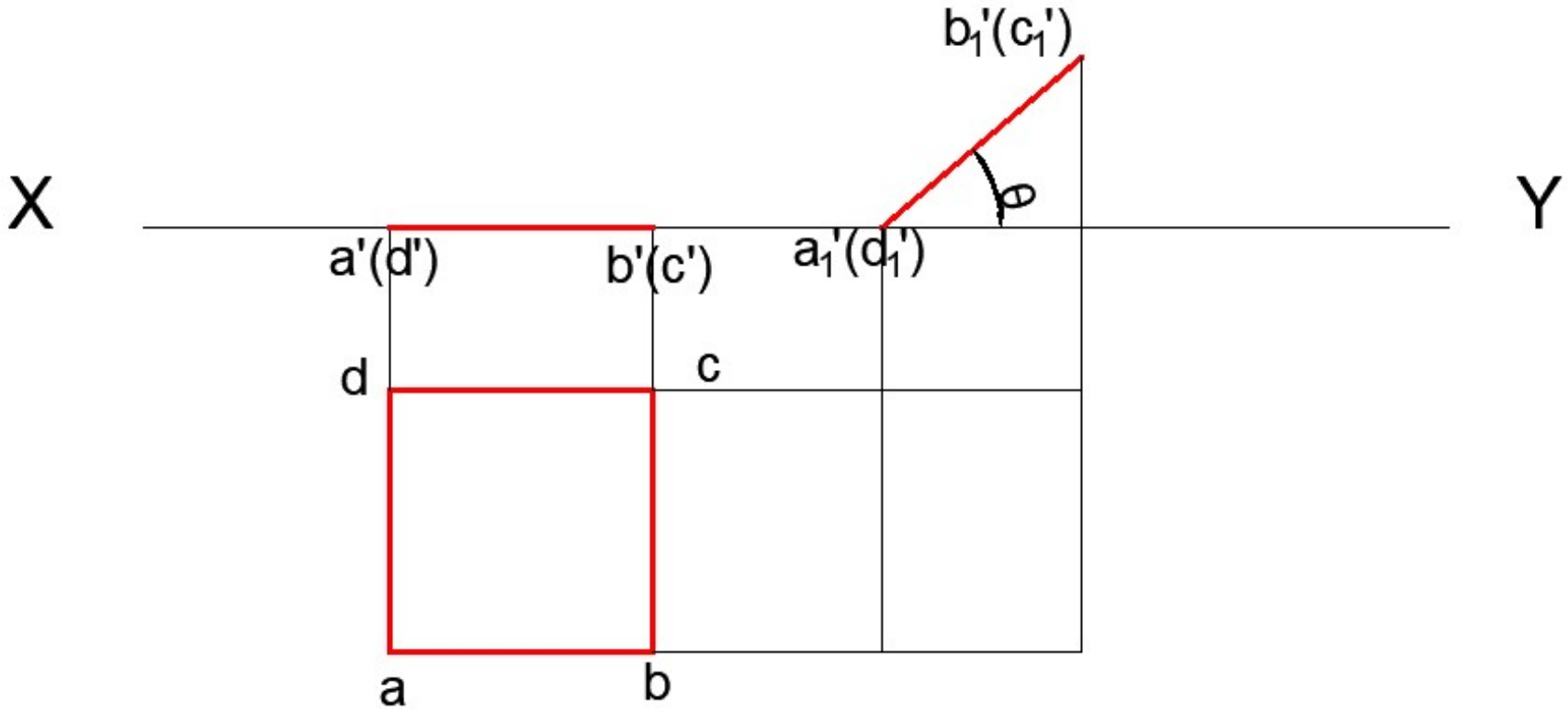


- Use C**OPY** command from **MODIFY** tool bar & copy the front view line & place right adjacent to the **FRONT** view.
- Use **TEXT** command from **ANNOTATION** tool bar & name the points as

a_1'(d_1') & **b_1'(c_1')**

- Use **ROTATE** command from **MODIFY** tool bar & rotate the copied front view line for given inclination angle with respect to **HP**


X
Y
b1'(c1')
Φ
a'(d')
b'(c')
a1'(d1')
d
c
a
b

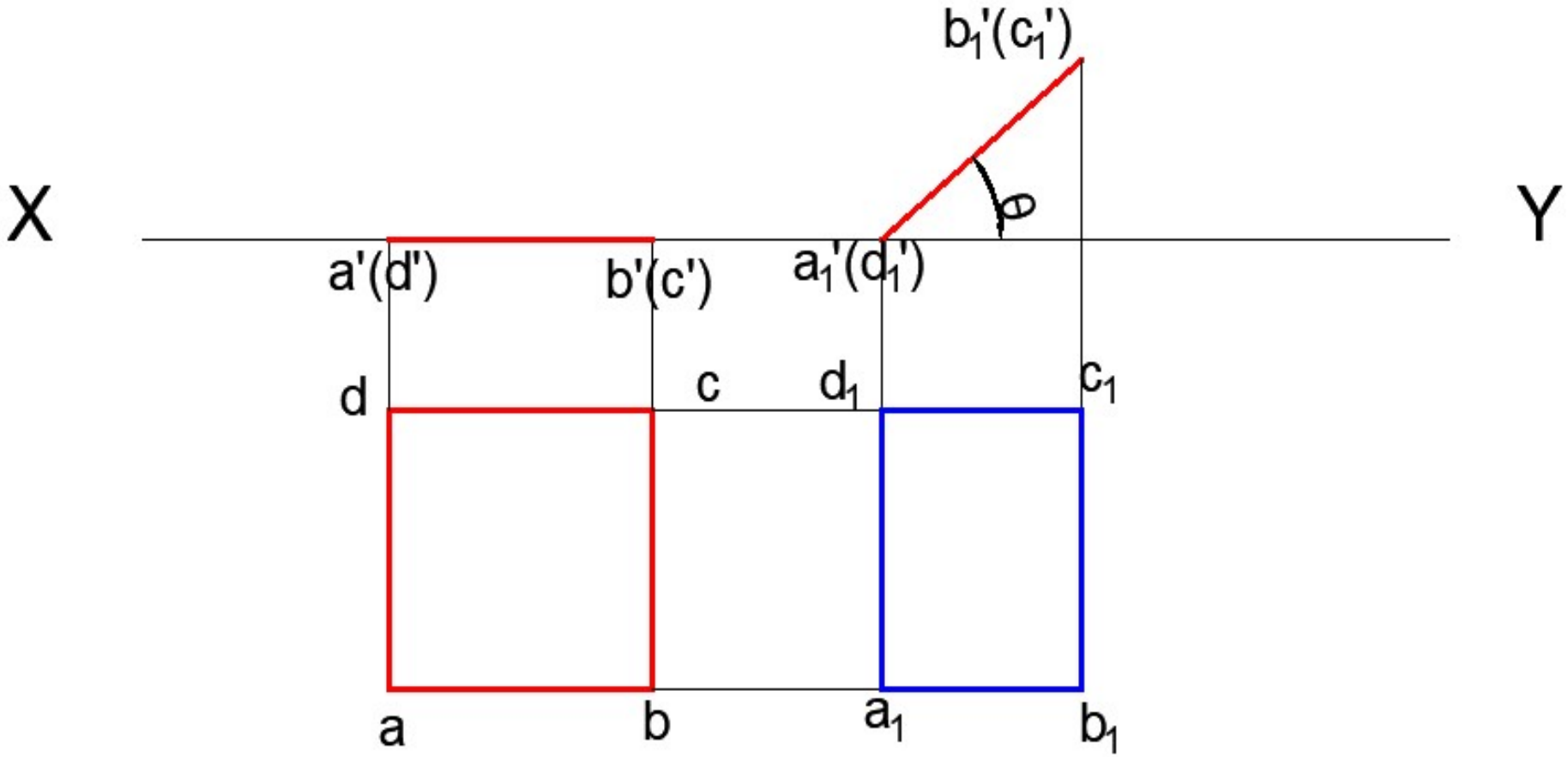


Use **LINE** command **ORTHO ON** & project the lines from front view & top view.

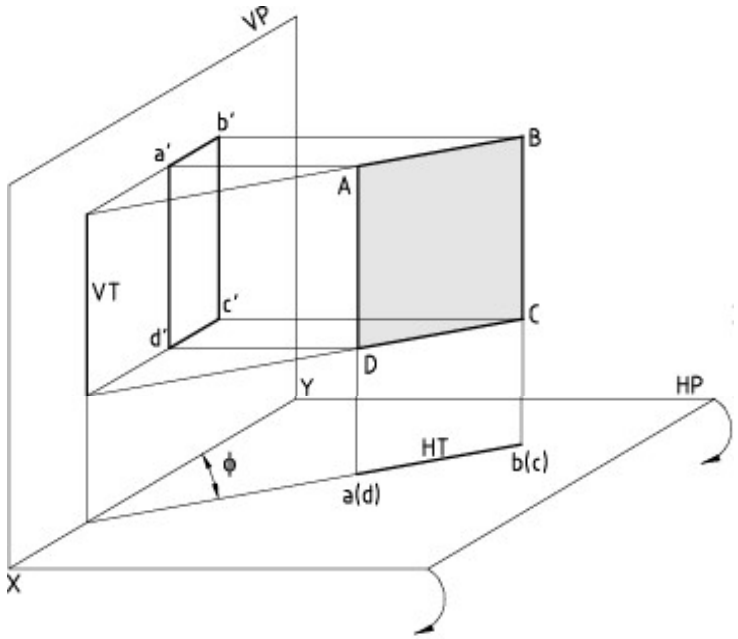
- Use **LINE** command **ORTHO OFF** connect the intersecting points by mapping the points name to get the **APPARENT** shape of the square inclined for given angle with respect to **HP**.
- Use **TEXT** command from **ANNOTATION** tool bar & name the points as

a_1, b_1, c_1 & **d_1**

- Use **ANNOTATION** tool bar for marking the required dimensions

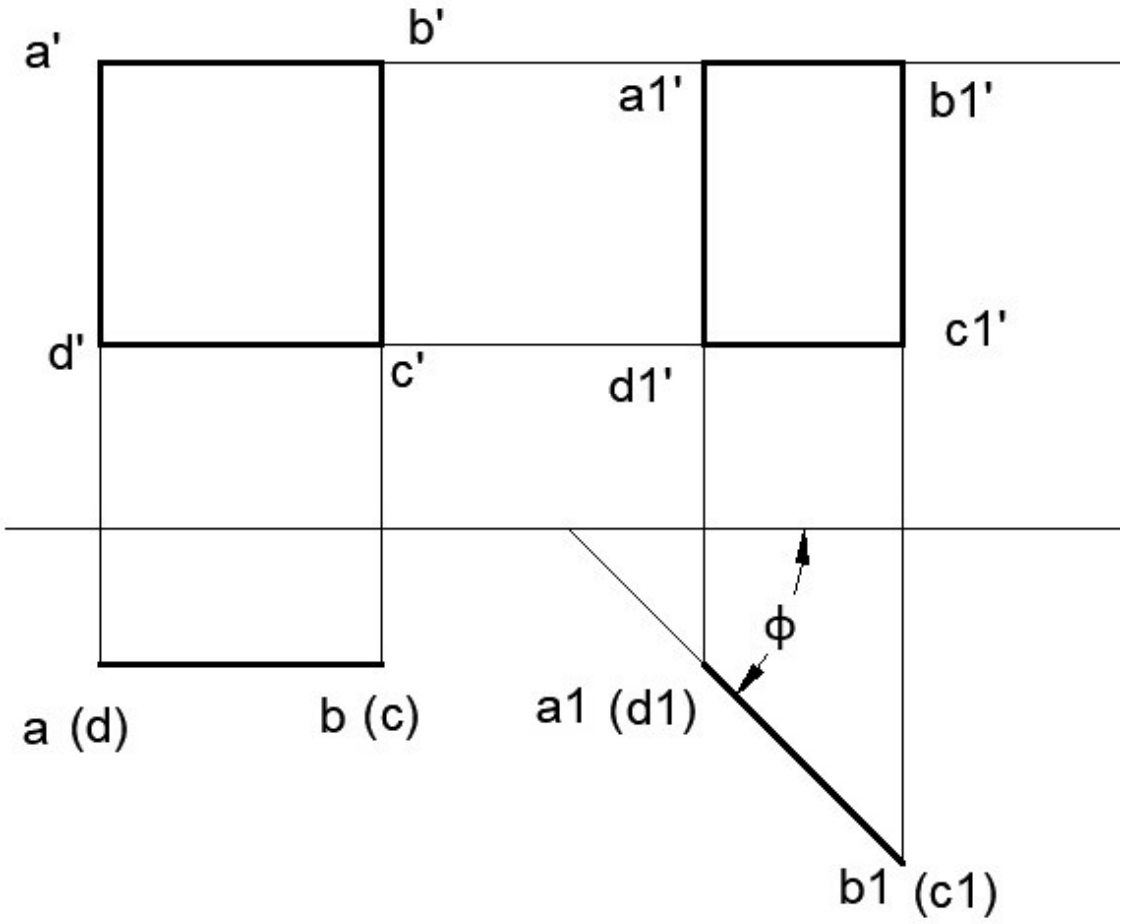

X
Y
b1'(c1')
ϕ
a'(d')
b'(c')
a1'(d1')
d
c
d1
c1
a
b
a1
b1

Plane Inclined to Wall (VP) and Perpendicular to the Floor (HP) .



- A square plane **ABCD** having its surface Inclined to **VP** and Perpendicular to **HP.**
- Top view is an inclined line at **Φ** & Front view is smaller in size.

Plane Inclined to Wall (VP) and Perpendicular to the Floor (HP) .



- Use **LINE** command **ORTHO ON** to draw the horizontal reference lines **XY**
- Use **LINE** command from **DRAW TOOL** bar & (**ORTHO ON**) Start with Front view to get the True shape & draw the Square for the given side length .
- Use **TEXT** command for naming the corners of the Square **a', b', c',** & **d'.**
- Use **LINE** command **ORTHO ON** & from Front view draw projection lines from corners of the Square **c'** & **d'** upto reference line **XY**.

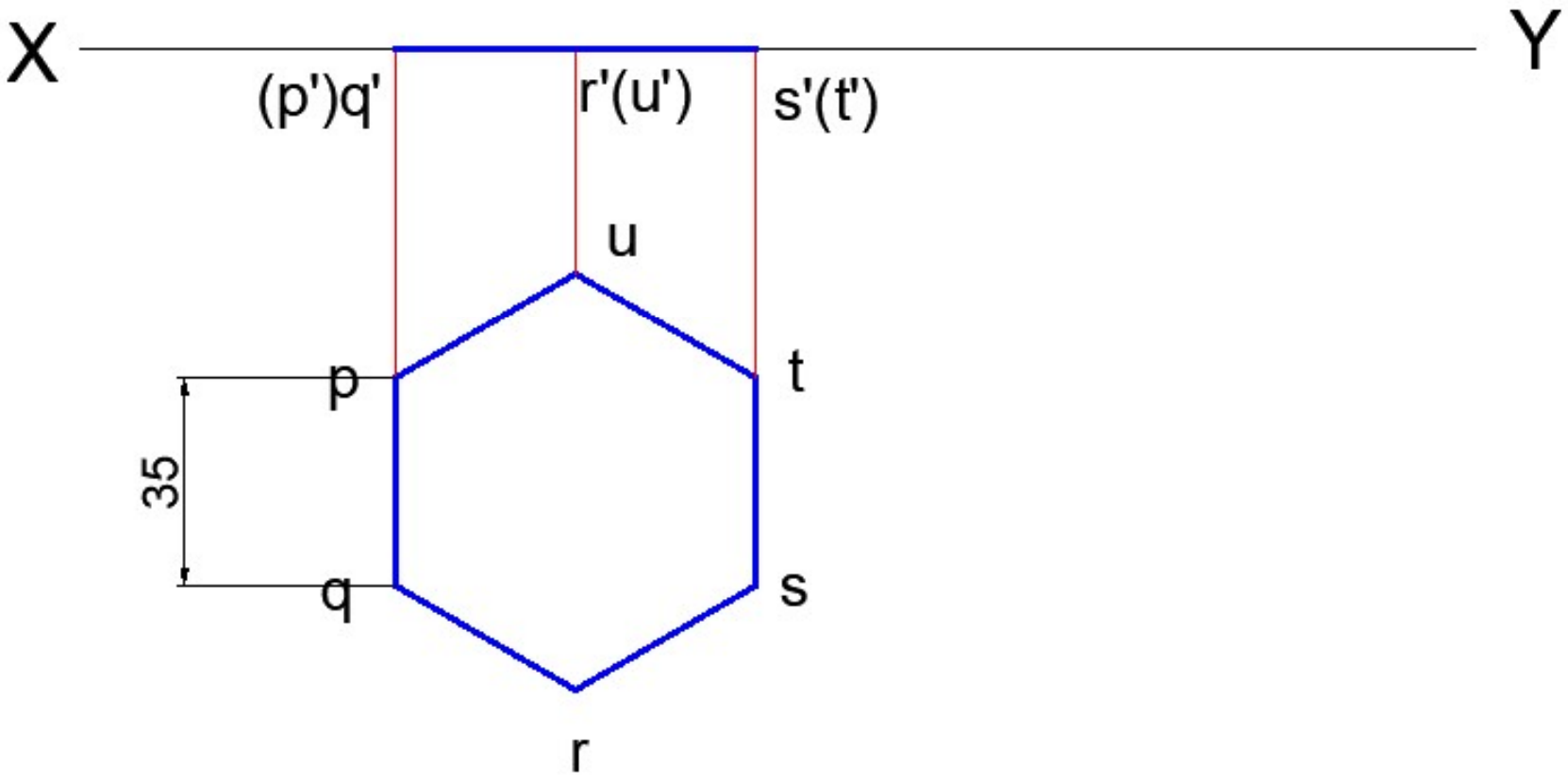
- Use **LINE** command **ORTHO ON** & draw lines connecting the projection & the points as **a(d)** & **b(c)** & this line is the Top view of the square lying on the floor.
- Use **COPY** command from **MODIFY** tool bar & copy the Top view line & place right adjacent to the Top view.
- Use **TEXT** command from **ANNOTATION** tool bar & name the points as **$a_1(d_1)$** & **$b_1(c_1)$**
- Use **ROTATE** command from **MODIFY** tool bar & rotate the copied Top view line for given inclination angle with respect to **VP**

- Use **LINE** command **ORTHO ON** & project the lines from Front view & Top view.
- Use **LINE** command **ORTHO OFF** connect the intersecting points by mapping the points name to get the **APPARENT** shape of the square inclined for given angle with respect to **VP**.
- Use **TEXT** command from **ANNOTATION** tool bar & name the points as **a_1'**, **b_1'**, **c_1'** & **d_1'**
- Use **ANNOTATION** tool bar for marking the required dimensions

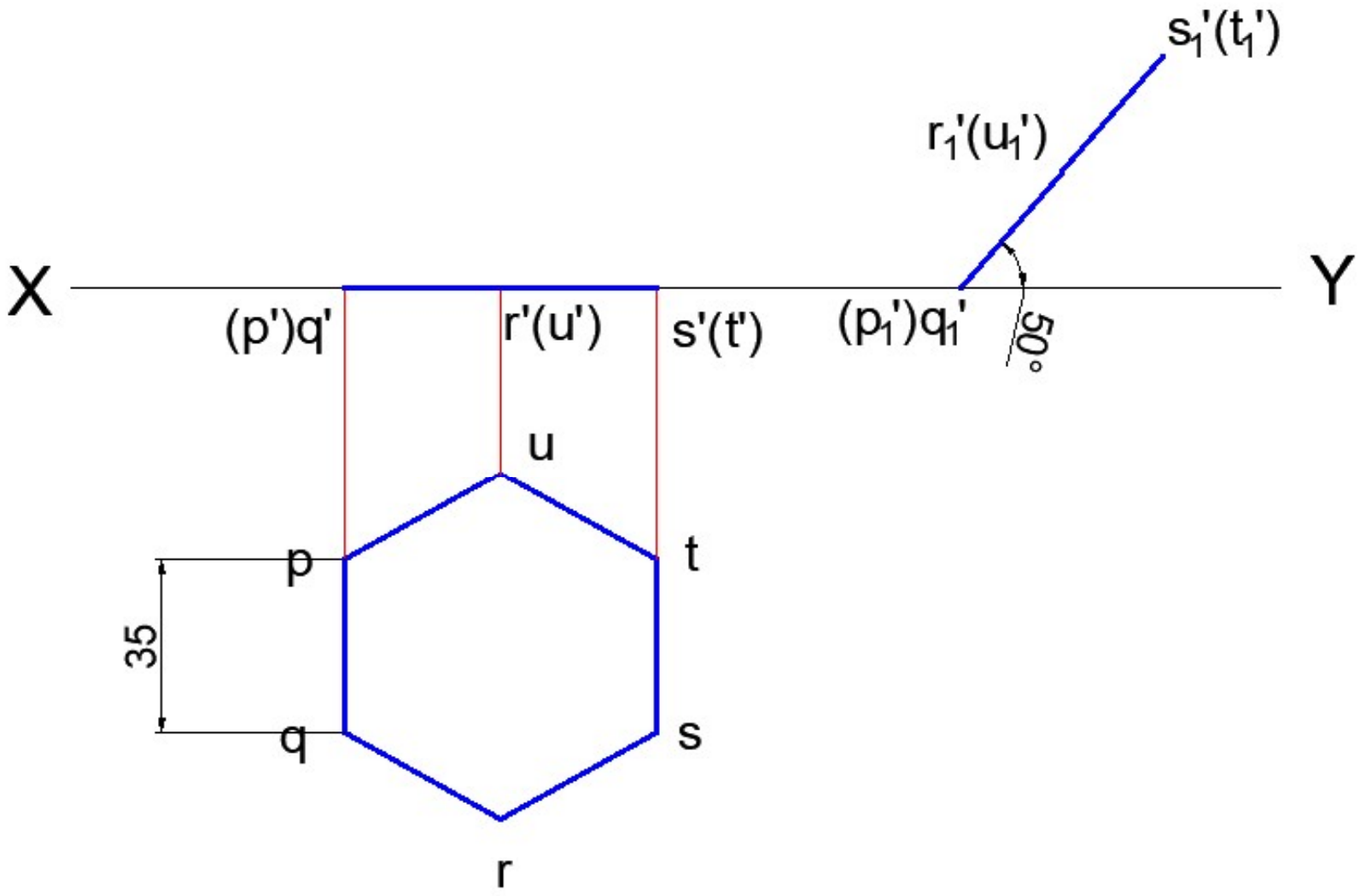
Hexagonal Plane Inclined to floor (HP) and Perpendicular to the wall (VP).

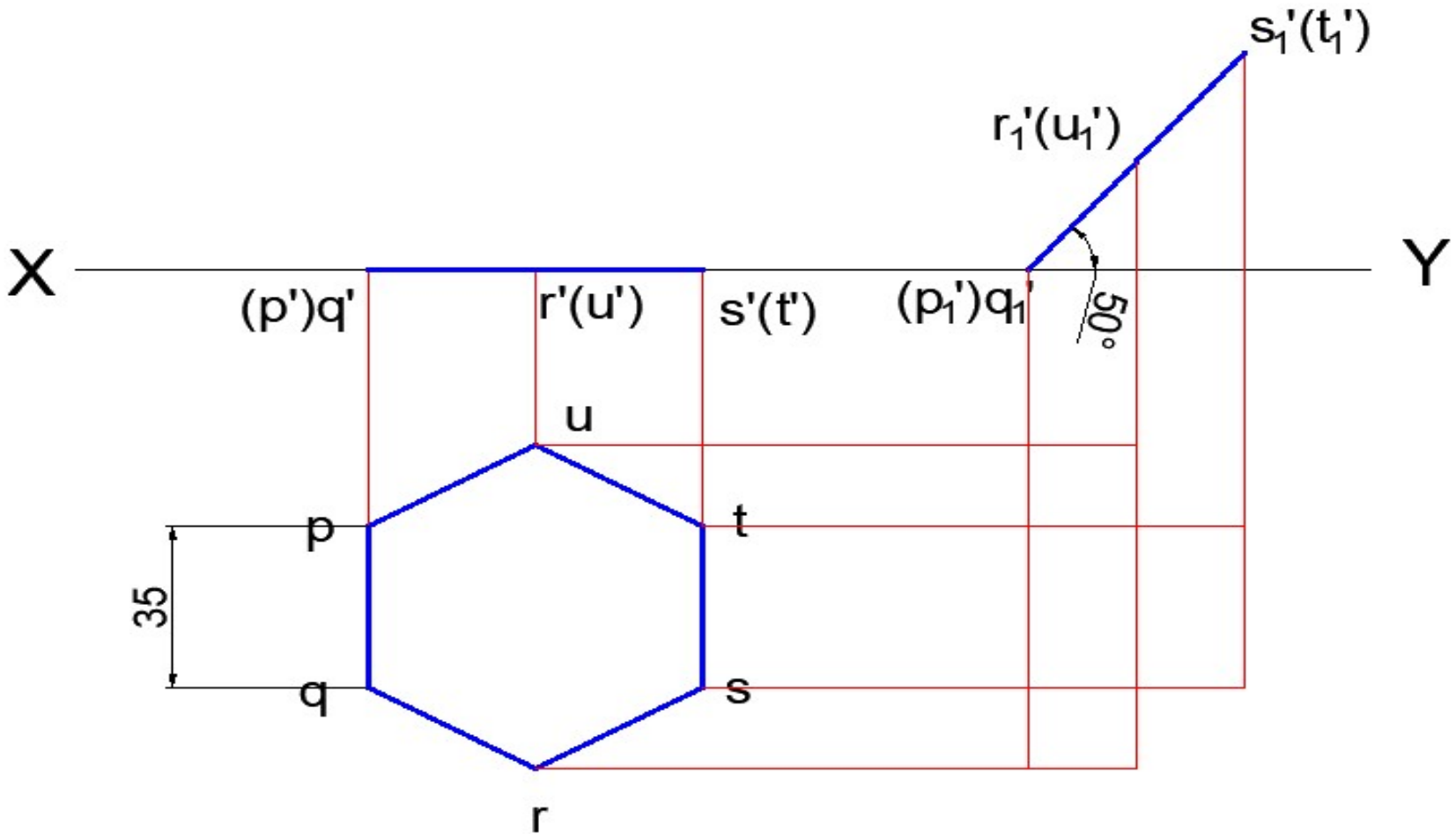
- Initial setup of workspace **Drafting & Annotation** Mode
  - Type UN or **UNITS**
  - Set the Precision for **0**
  - Set the Units in Millimeters
- Type **LIMITS** Press Enter
  - Specify the Lower Left Corner as **0,0** Press Enter
  - Specify the Upper Right Corner as **210,297** Press Enter
- Type **ZOOM** Press Enter
- Type **ALL** Press Enter

- Use **LINE** command **ORTHO ON** to draw the horizontal reference lines **XY**
- Use **POLYGON** command from **DRAW TOOL** bar & (**ORTHO ON**) Start with Top view to get the true shape & draw the Hexagonal polygon for the given side length .
- Use **TEXT** command for naming the corners of the polygon **p** ,**q**, **r**, **s**, **t** & **u.**
- Use **LINE** command **ORTHO ON** & from Top view draw projection lines from corners of the polygon **p**, **u** & **t** upto reference line **XY**.
- Use **LINE** command **ORTHO ON** & draw lines connecting the projection & the points as **(p') q'** , **r'(u')** & **s'(t')** & this line is the Front view of the polygon lying on the floor.


X
Y
(p')q'
r'(u')
s'(t')
u
p
t
35
q
s
r

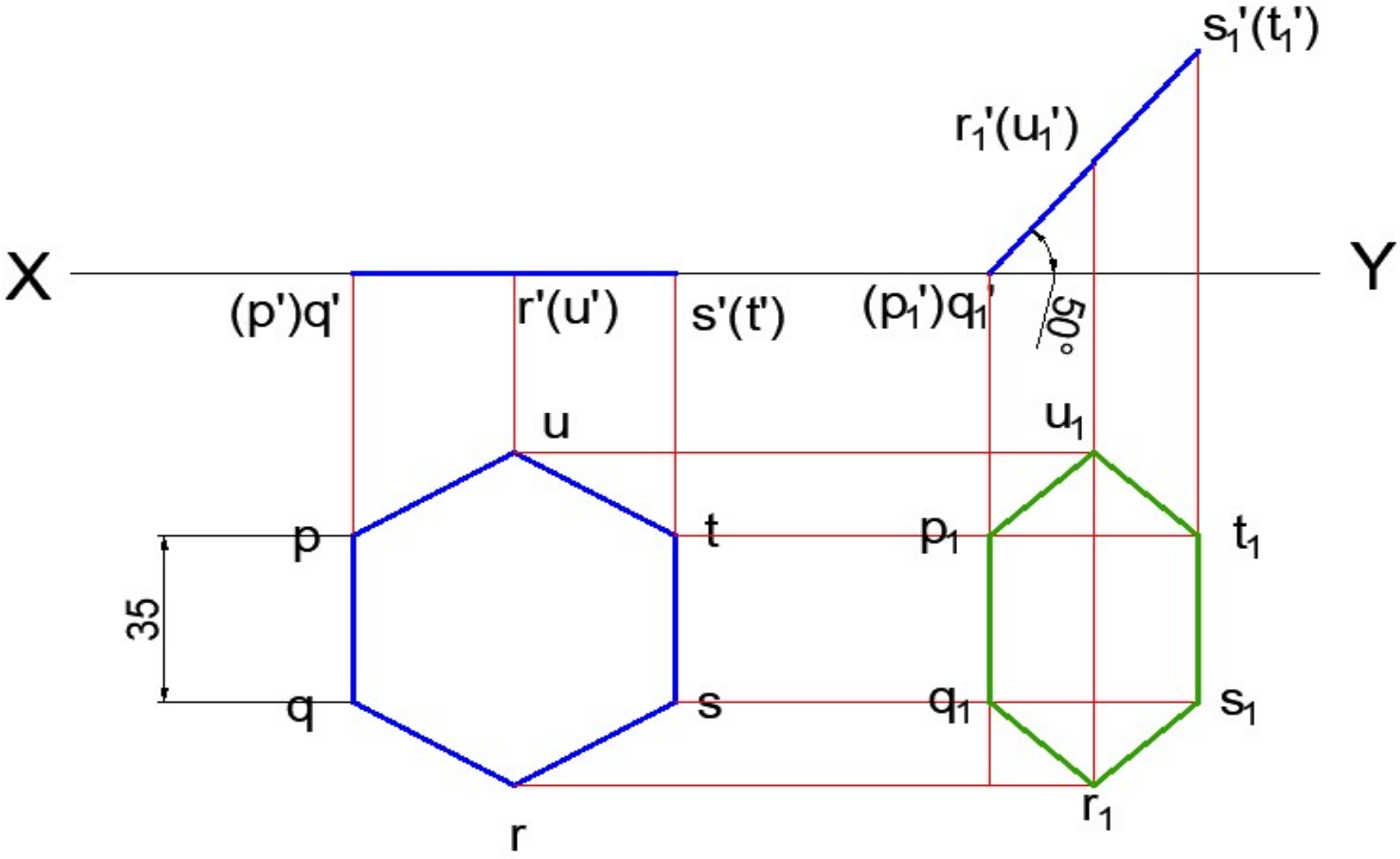
- Use **COPY** command from **MODIFY** tool bar & copy the front view line & place right adjacent to the **FRONT** view.
- Use **TEXT** command from **ANNOTATION** tool bar & name the points as **(p_1') q_1'** , **r_1'(u_1')** & **s_1'(t_1')**
- Use **ROTATE** command from **MODIFY** tool bar & rotate the copied front view line for given inclination angle with respect to **HP**


X
Y
(p')q'
r'(u')
s'(t')
(p1')q1'
60°
s1'(t1')
r1'(u1')
u
p
t
35
q
s
r



➢Use **LINE** command **ORTHO ON** & project the lines from **(p_1') q_1'** , **r_1'(u_1')** **s_1'(t_1')** & Top view.

- Use **LINE** command **ORTHO OFF** connect the intersecting points by mapping the points name to get the **APPARENT** shape of the polygon resting on the floor with **p q** edge tilted for given angle with respect to **HP**.
- Use **TEXT** command from **ANNOTATION** tool bar & name the points as **p_1 q_1 r_1 s_1 t_1** & **u_1**
- Use **ANNOTATION** tool bar for marking the required dimensions


X
Y
(p')q'
r'(u')
s'(t')
(p1')q1'
60°
s1'(t1')
r1'(u1')
u
u1
p
t
p1
t1
35
q
s
q1
s1
r
r1

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- K.V.NATARAJAN, “Engineering Graphics”, 2015, Dhanalakshmi Publishers.