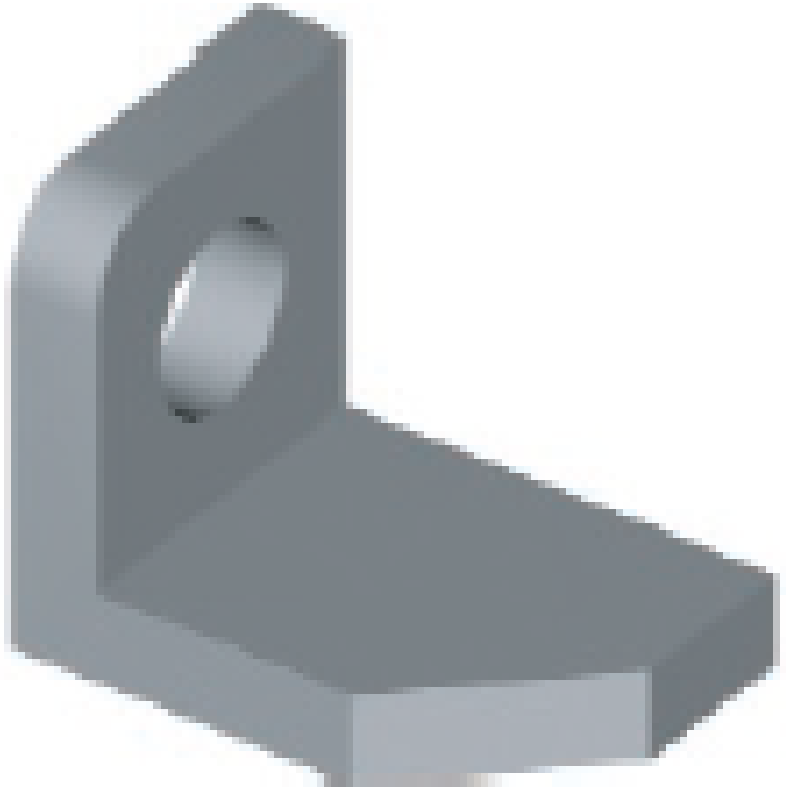
# Introduction
# to
# Orthographic Projections

# Multiview Projections vs. Pictorials

## Pictorial for clarity





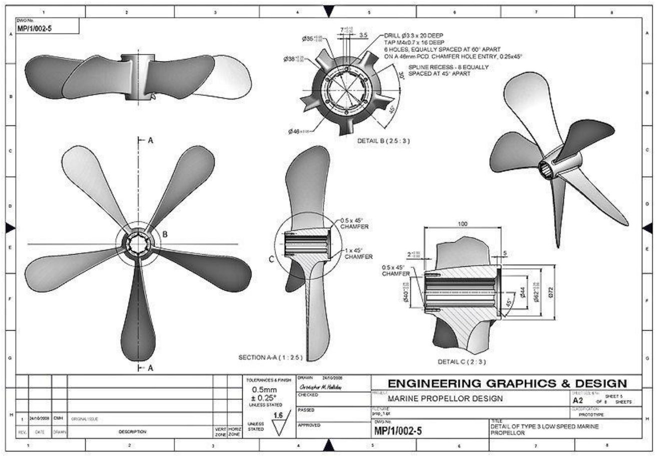
If I hand over the 3d pictorial will two different manufacturer make the same exact part!

1. Does this drawing have all the dimensions?
2. Is it a circular or elliptical hole?
3. ...

# Why Do We Need Engineering Drawing ?

- □ **Designers and manufacturers/fabricators communicate via Engineering Drawing.**
  - ► **Enables teamwork.**
  - ► **Helps preserve design for future.**
- □ **Good Engineering Drawing skills do not require artistic temperament/skills.**

► **Procedures are completely based on concepts related to geometry.**



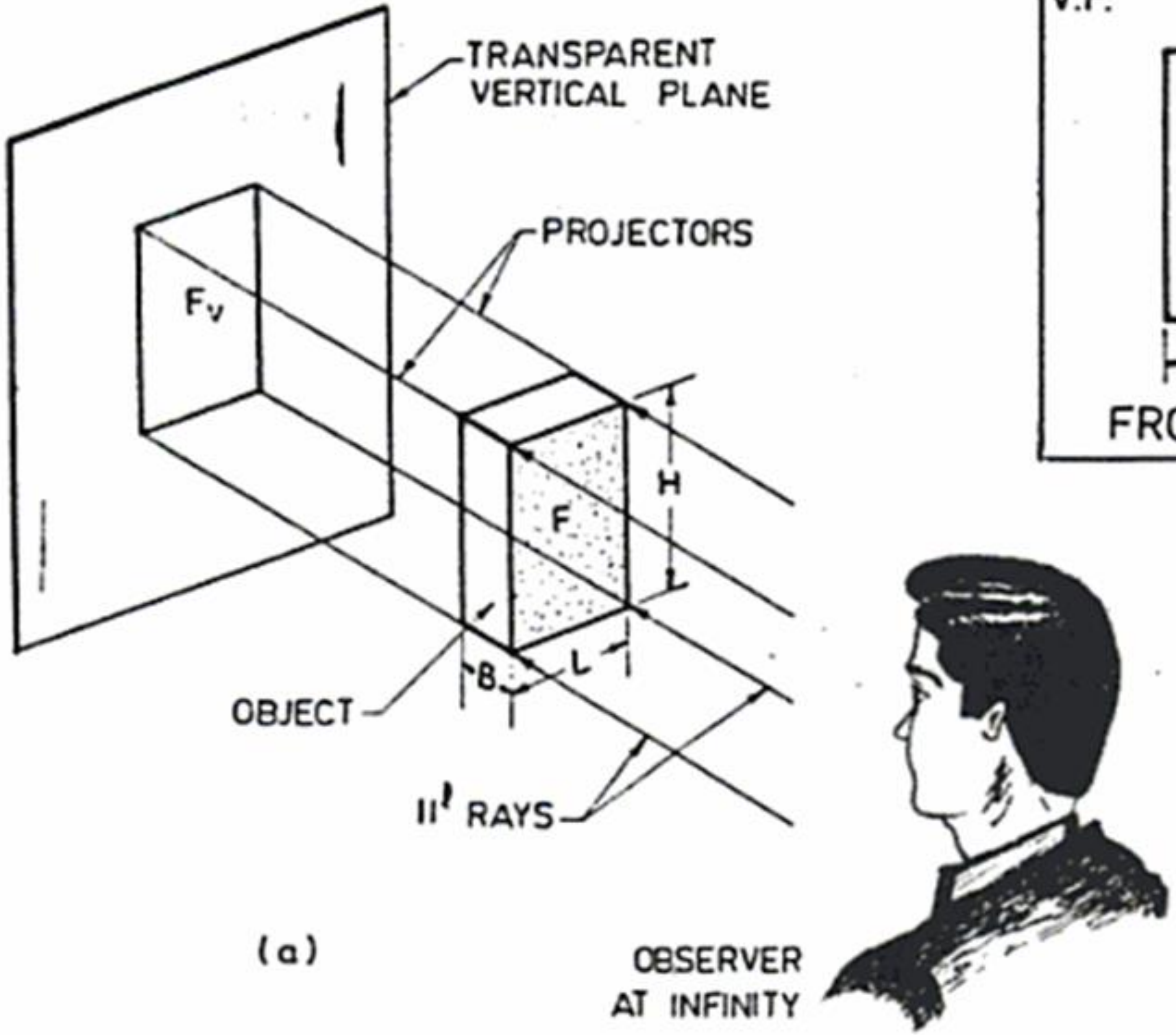
# Orthographic Projections

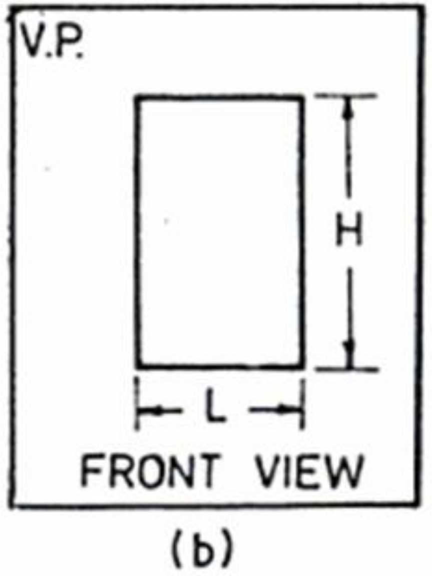
**Ortho** – right angle

Orthographic – right angled drawing

When the projectors are perpendicular to the plane on which the projection is obtained, it is known as orthographic projection

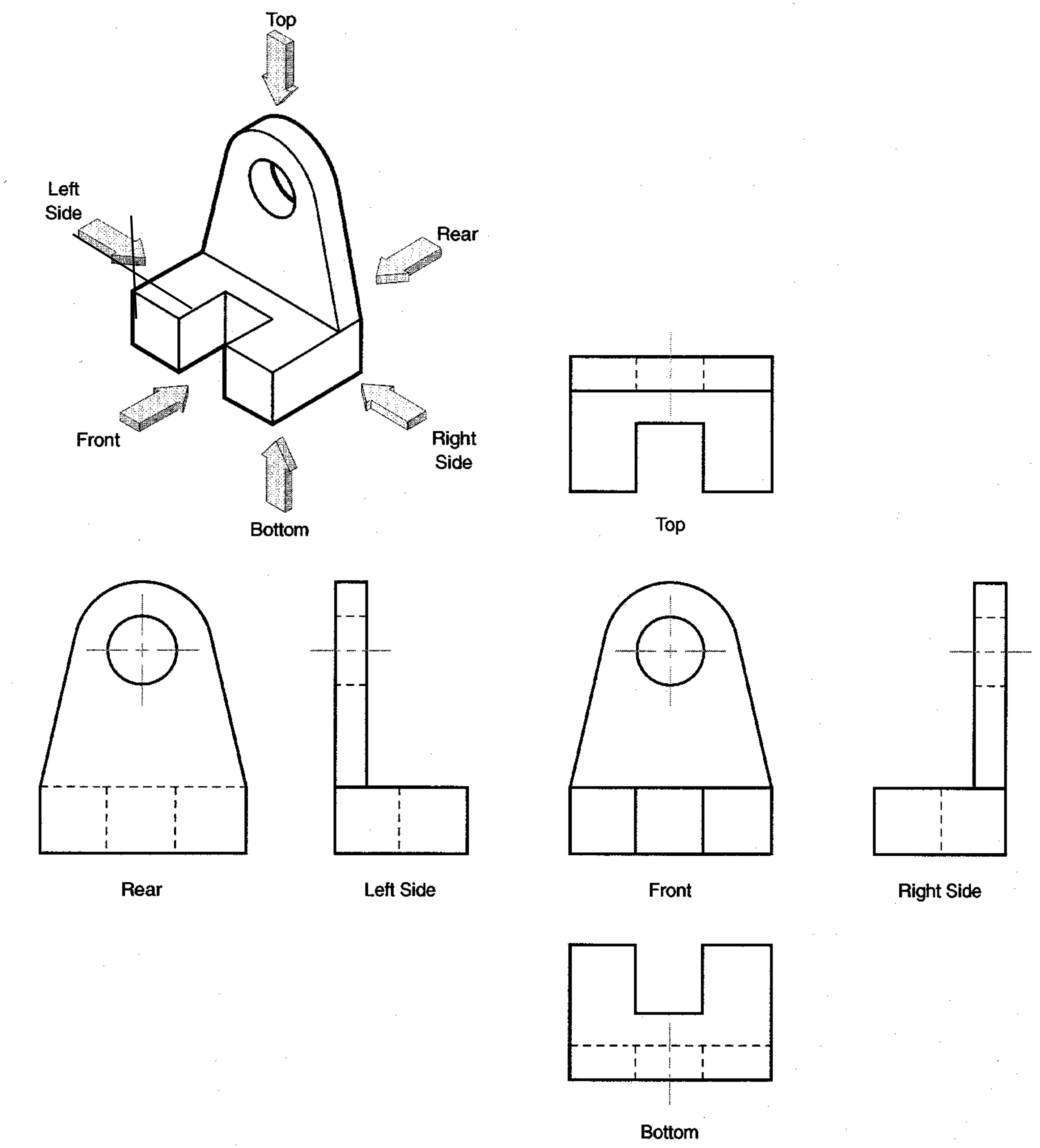
V.P. – vertical plane



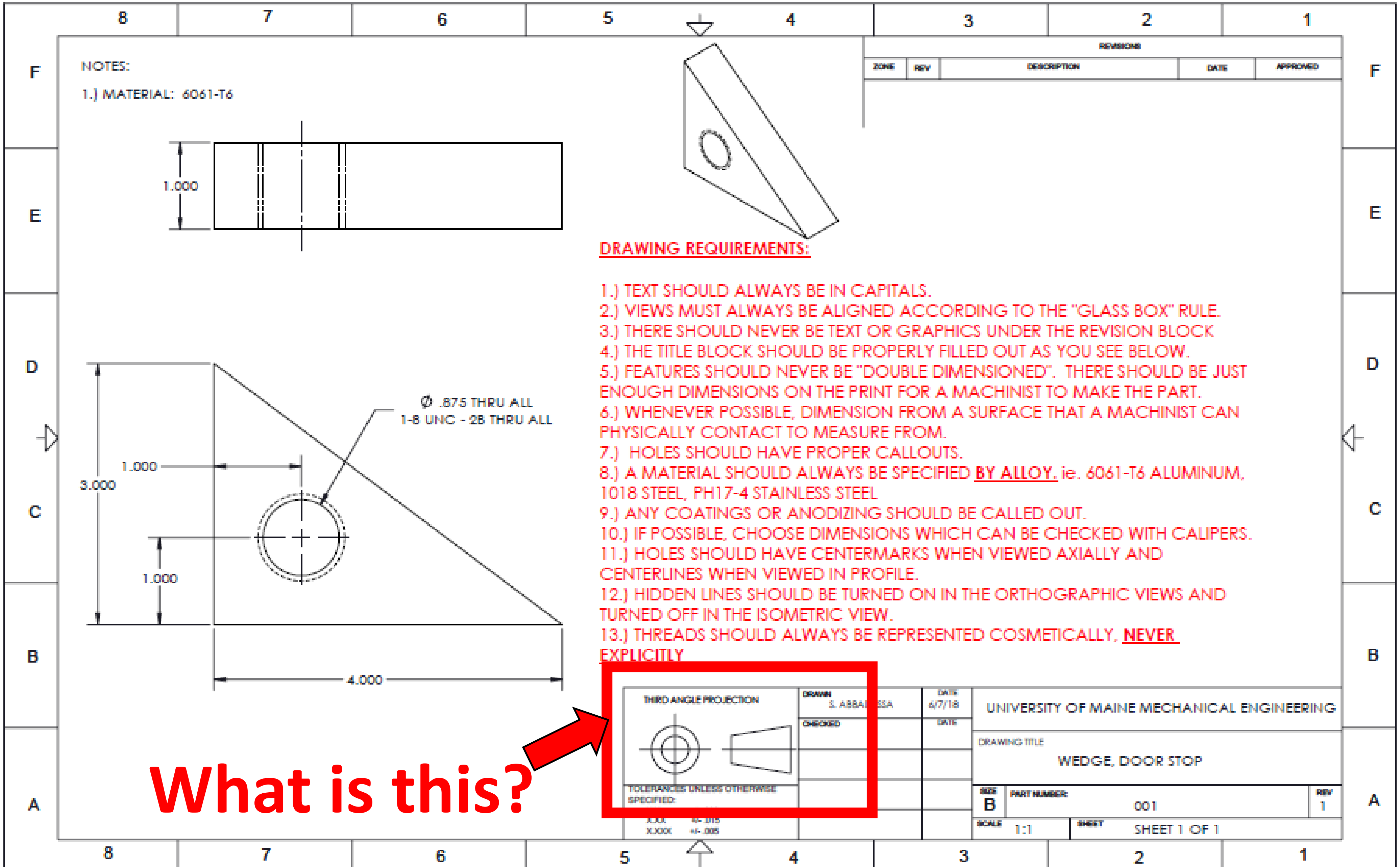



# Orthographic Projection Fundamentals

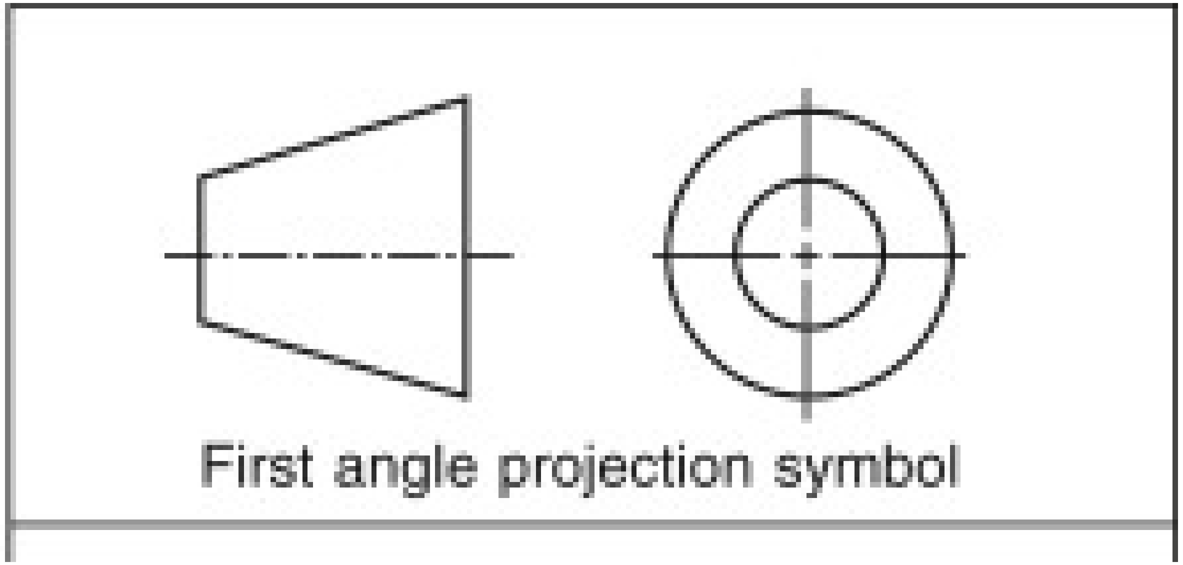
## Defining Six Principal Views or Orthographic Views



# Example Assembly Drawing




What is this?

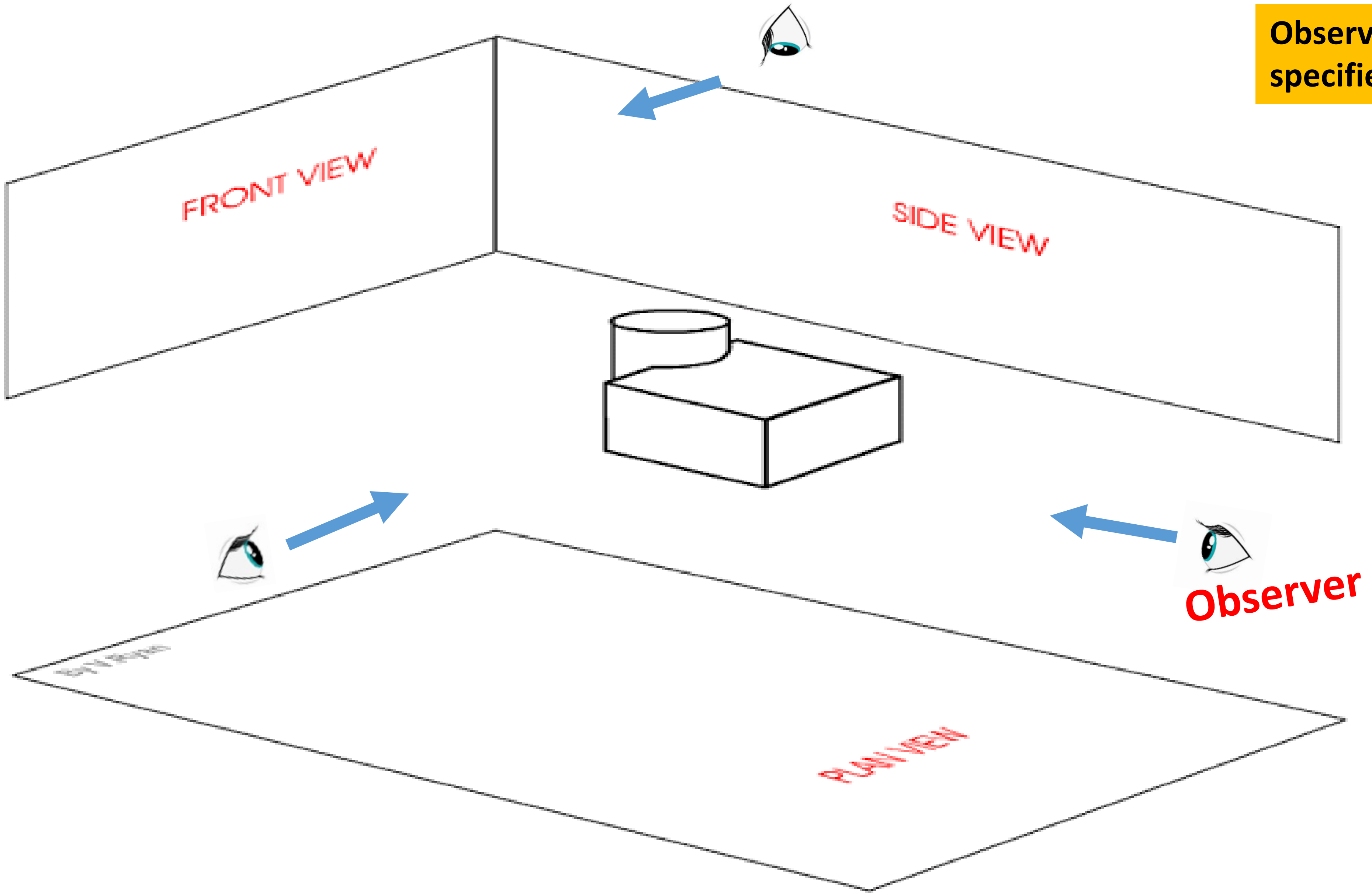



# First Angle Projection

First angle projection is a widely used method for creating technical drawings in Europe and India. Adopts ISO standard

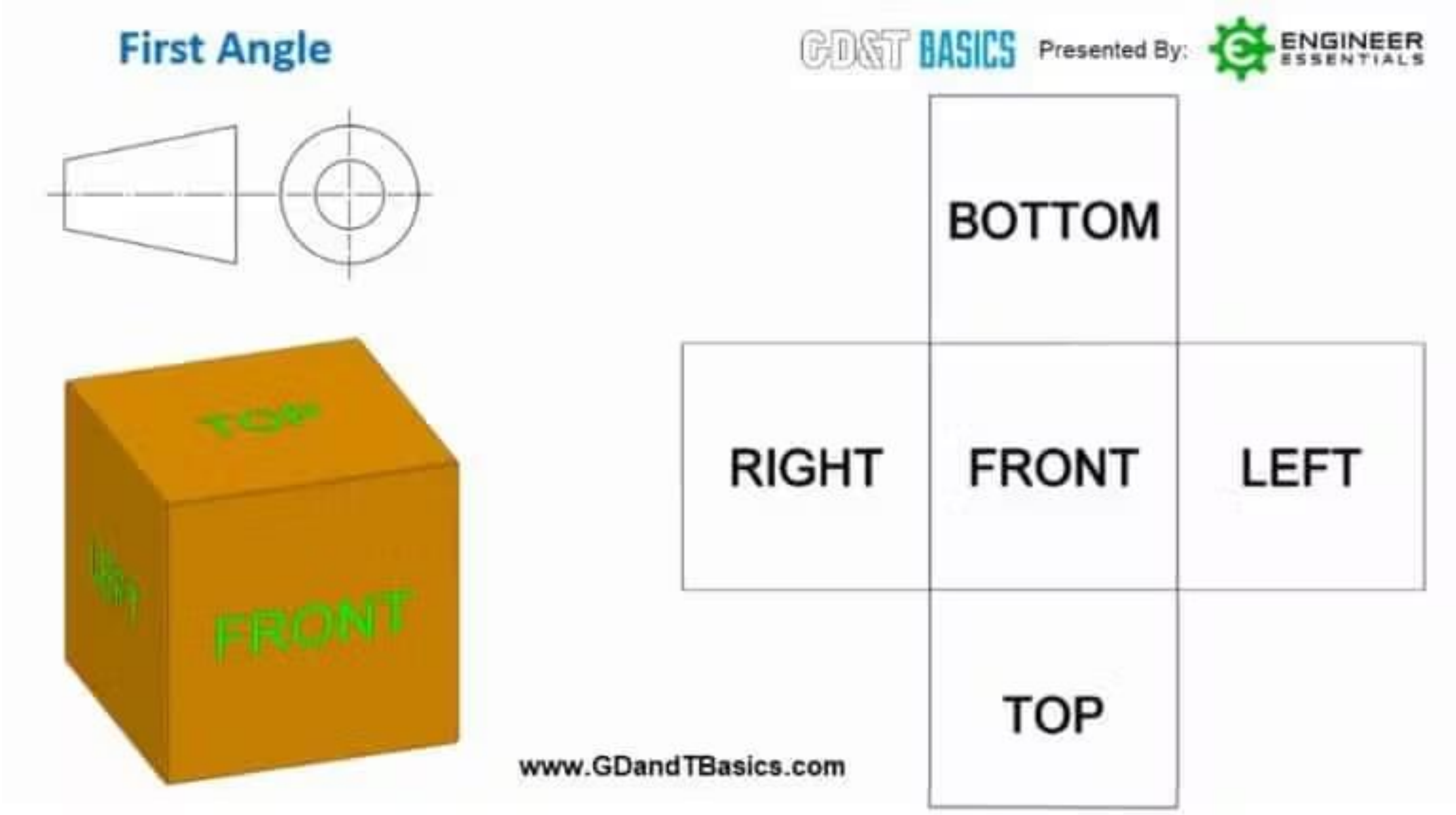
# FIRST ANGLE PROJECTION

Observer needs to be specified!

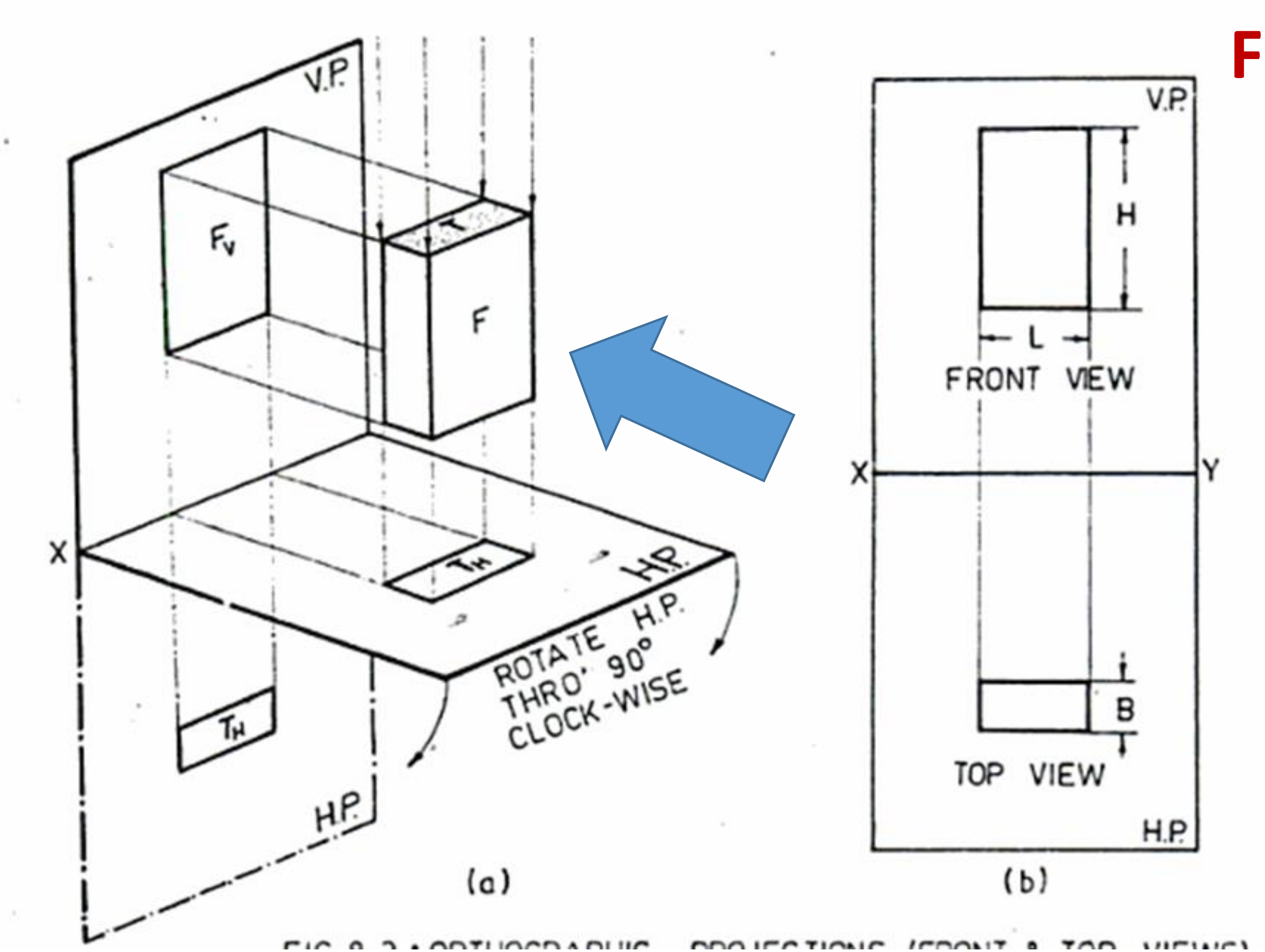



Object lies between projection plane and observer

# Projection Planes



# First Angle Projection

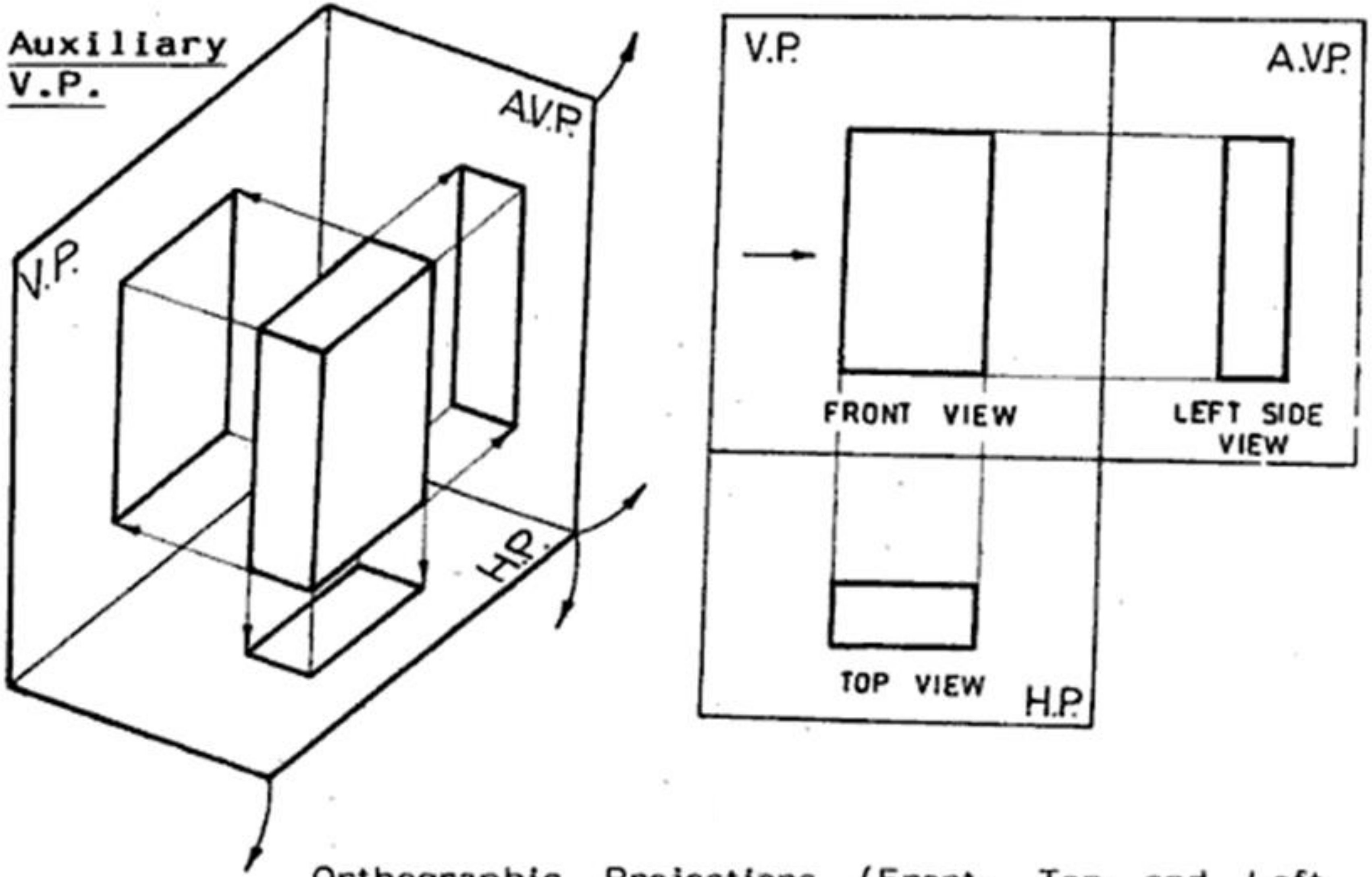



V.P. – Vertical Plane
H.P. – Horizontal Plane
V.P. and H .P – Principal planes of projection

Projection on V.P. – FRONT VIEW
Projection on H.P. – TOP VIEW

**OBJECT IS BETWEEN THE OBSERVER AND THE PROJECTION PLANE**

Main direction of observation (arrow) needs to be specified to decide the front view

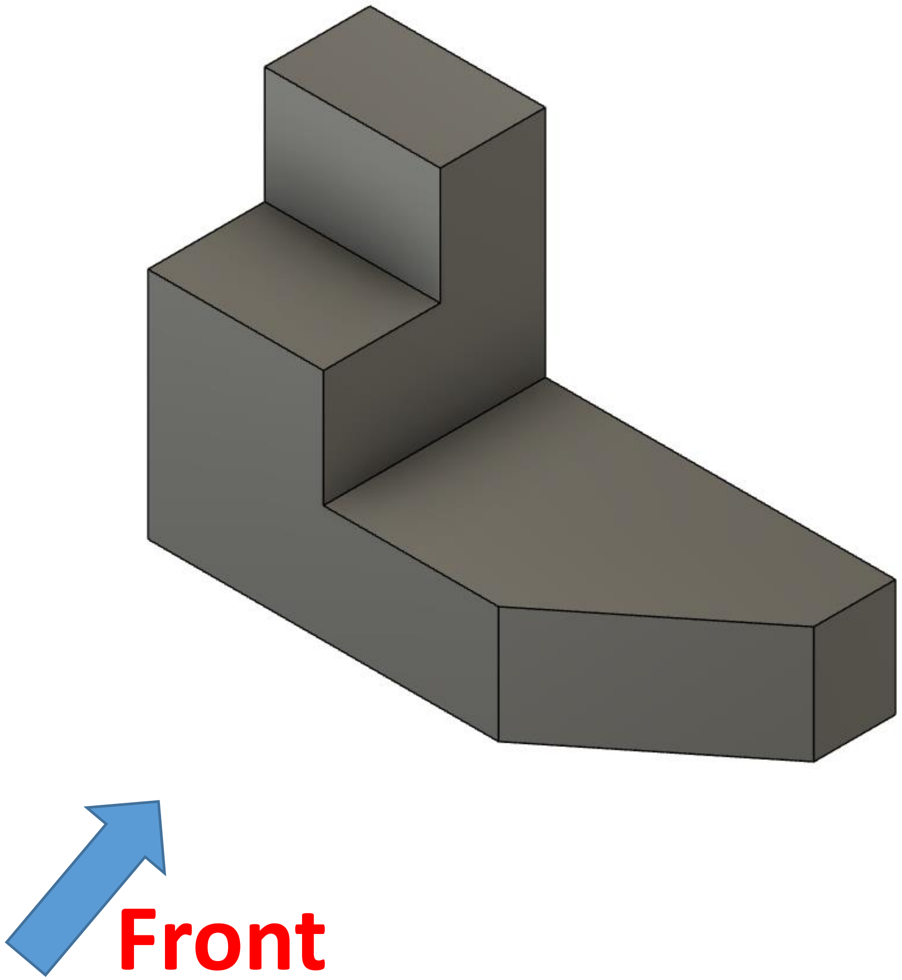


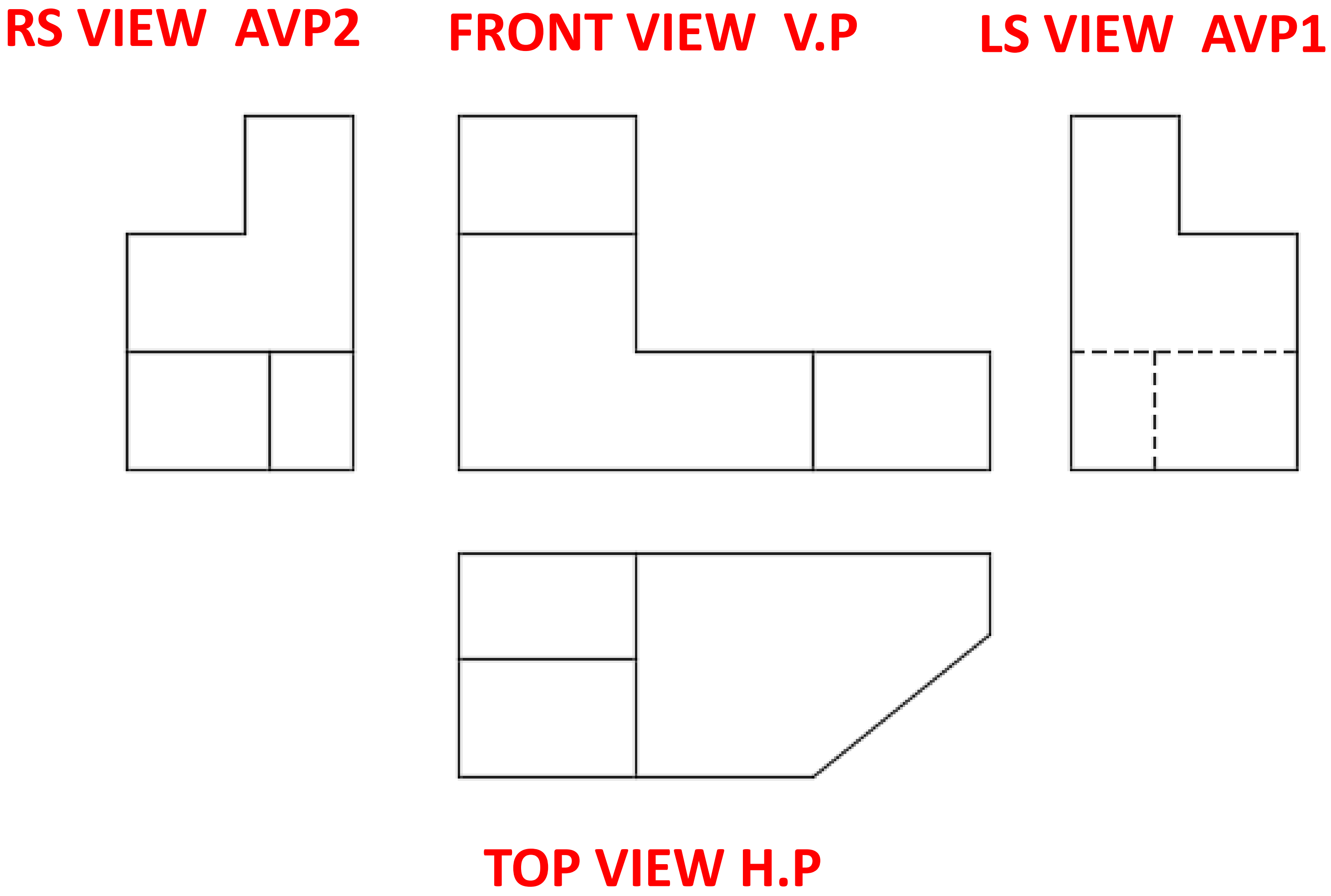

Orthographic Projections (Front, Top and Left side views)

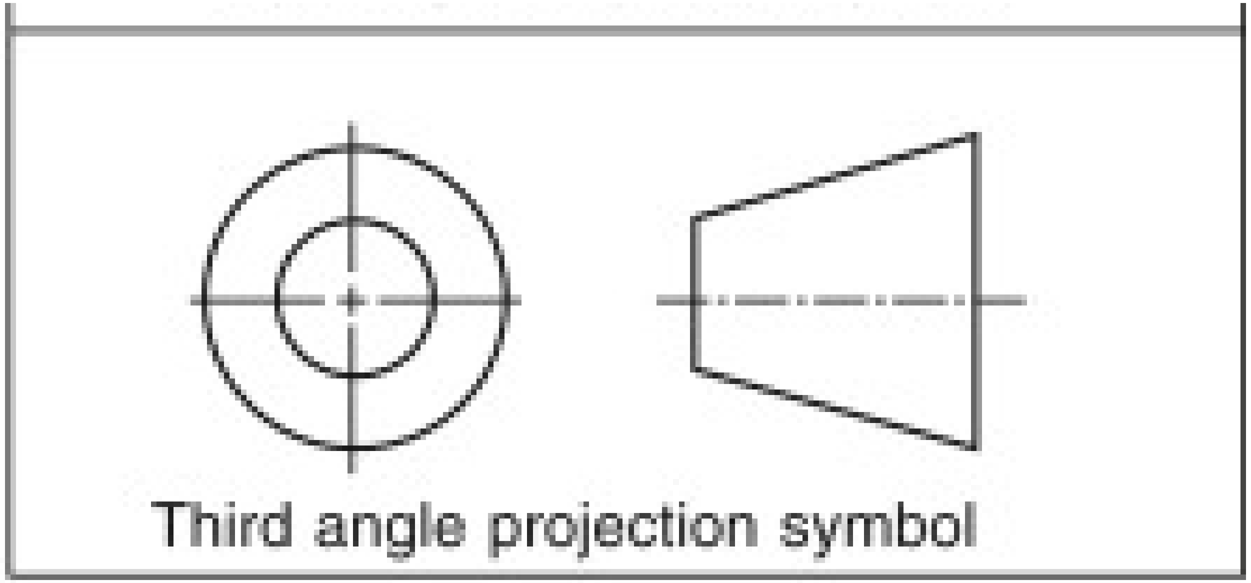
**AVP is positioned on the right side of the VP to obtain the left side view**

**AVP is positioned on the left side of the VP to obtain the right side view**

# First Angle Projection



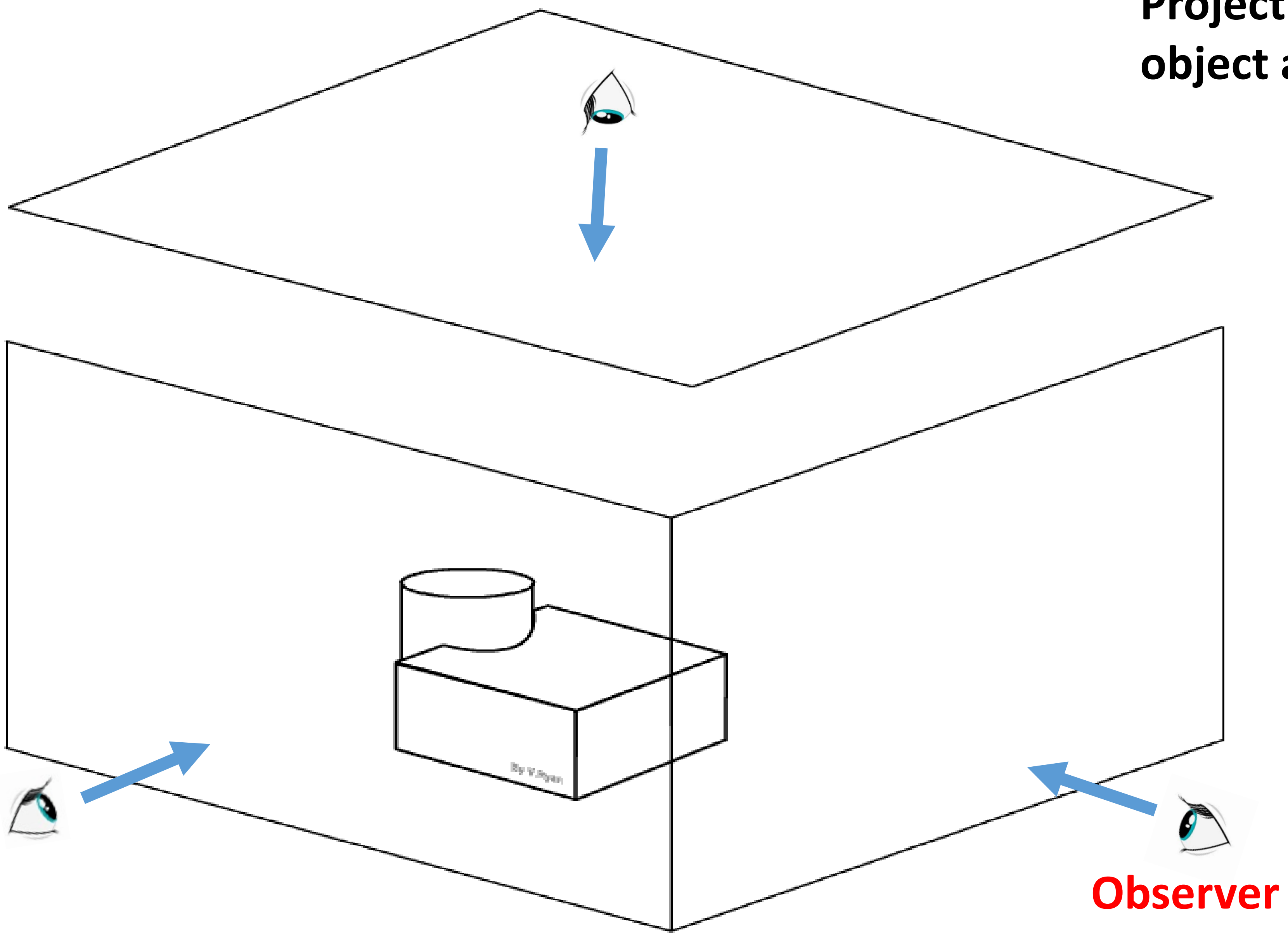



# Third Angle Projection

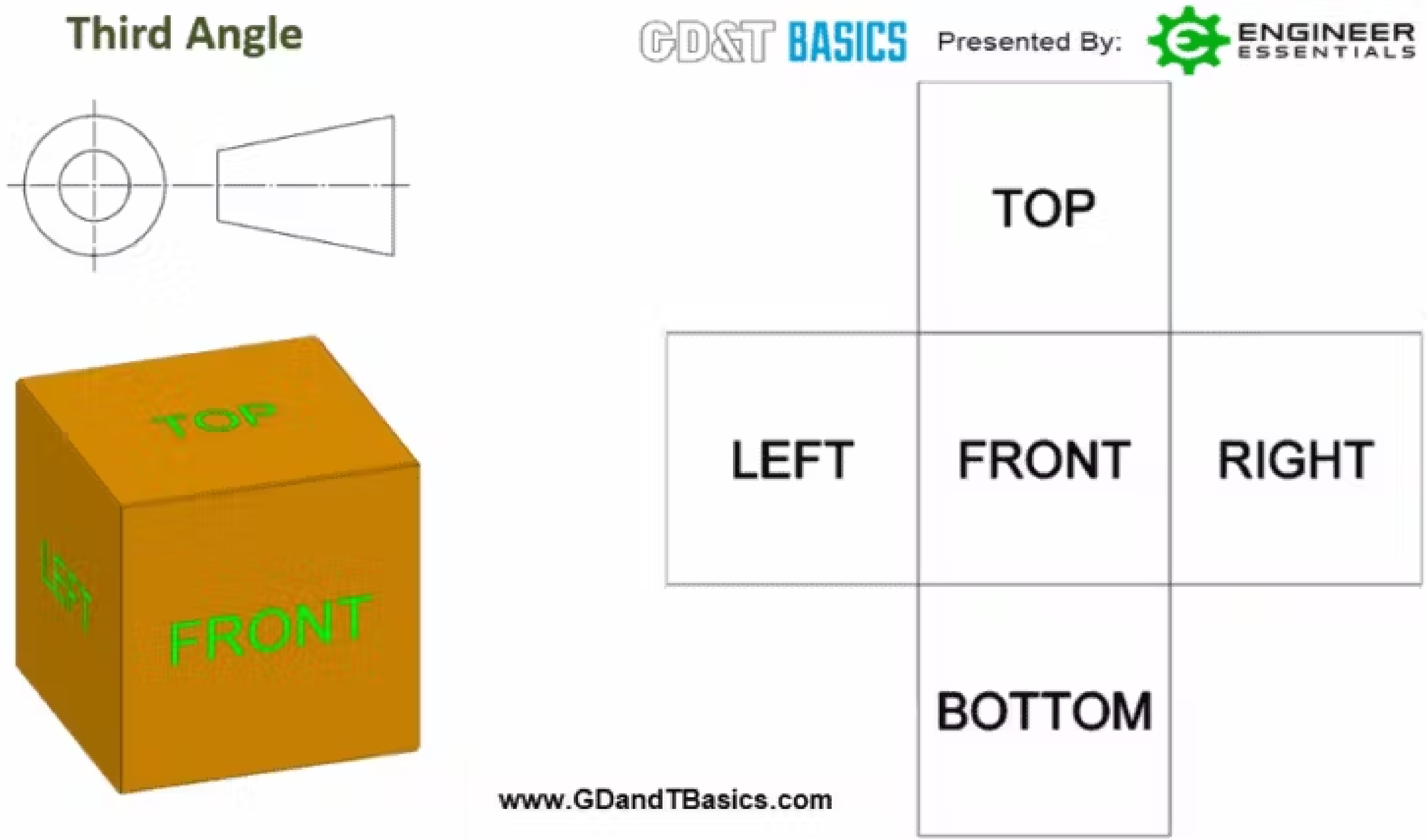
Third-angle projection is a method of orthographic projection that is the default projection system in the United States and Canada. Adopts ANSI standard. Also, referred as ASME format.

# Third Angle Projection

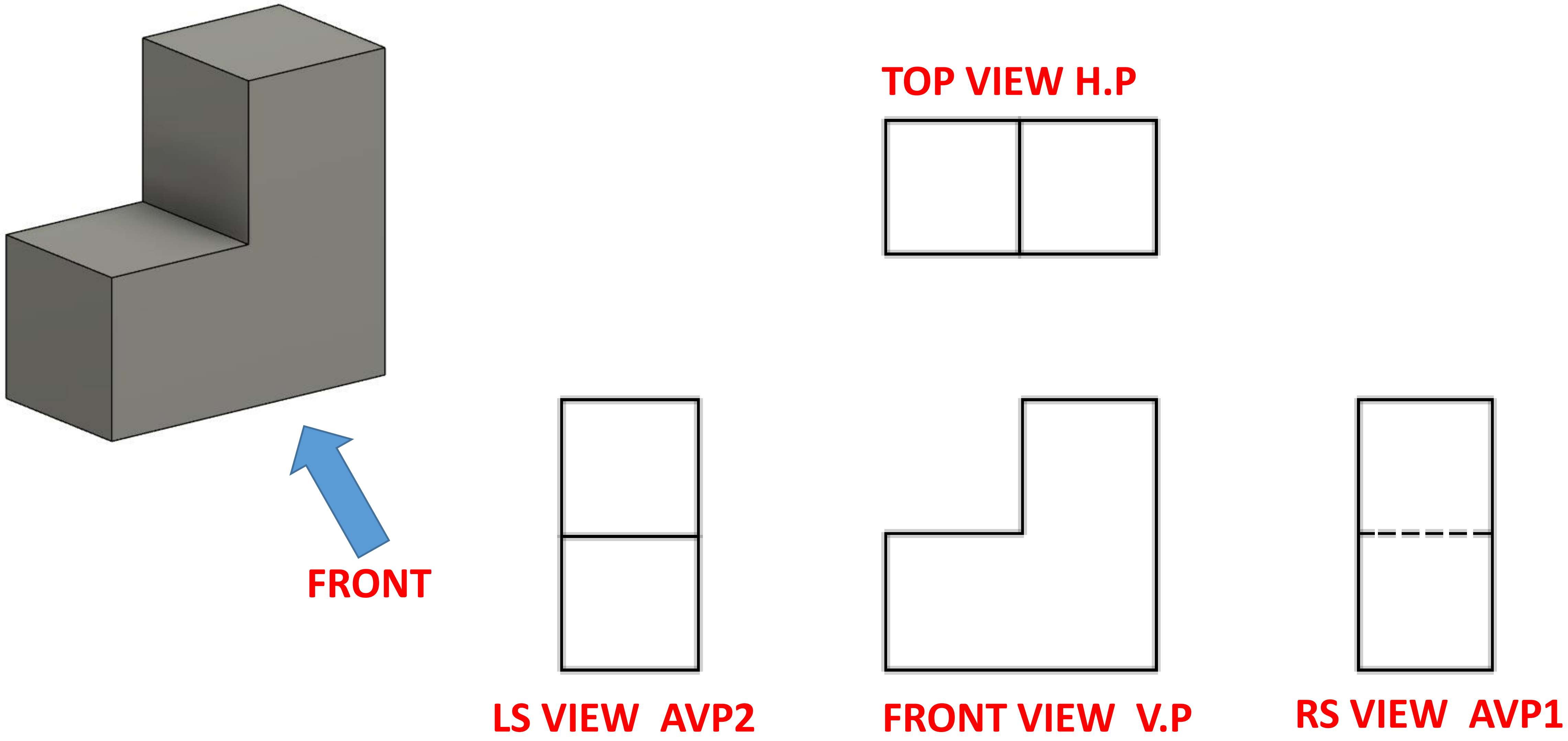
**Projection plane lies between object and observer**



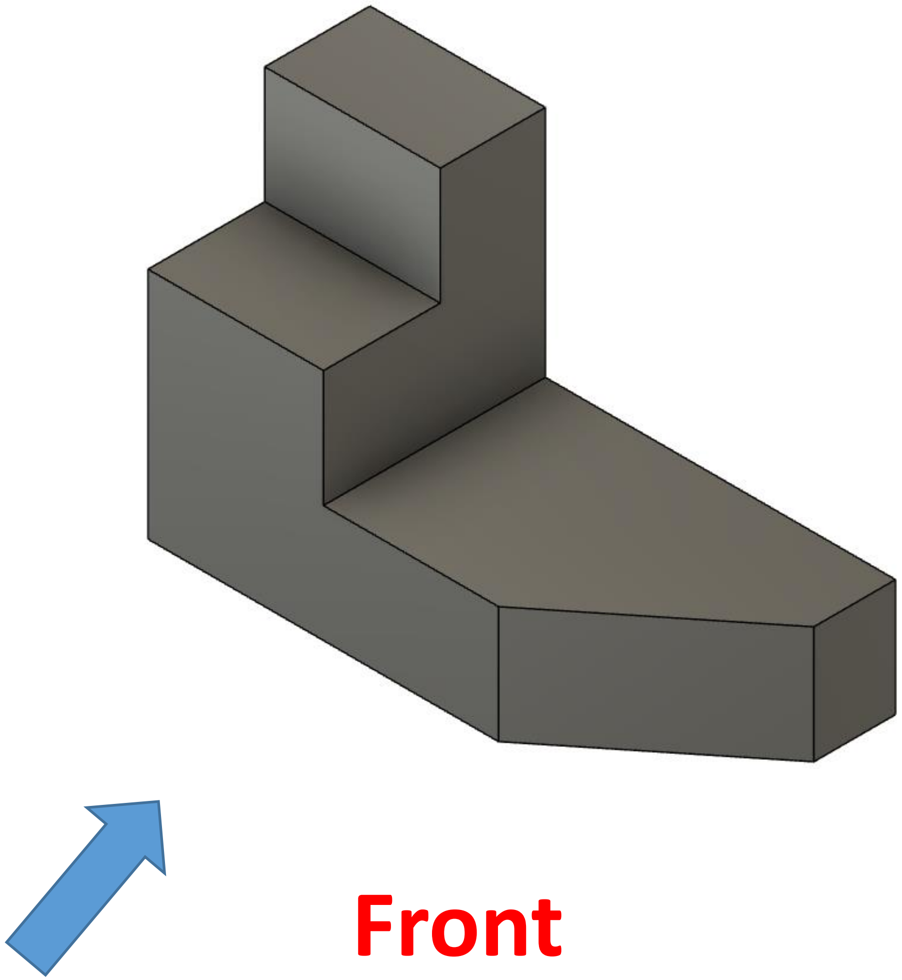
# Projection Planes



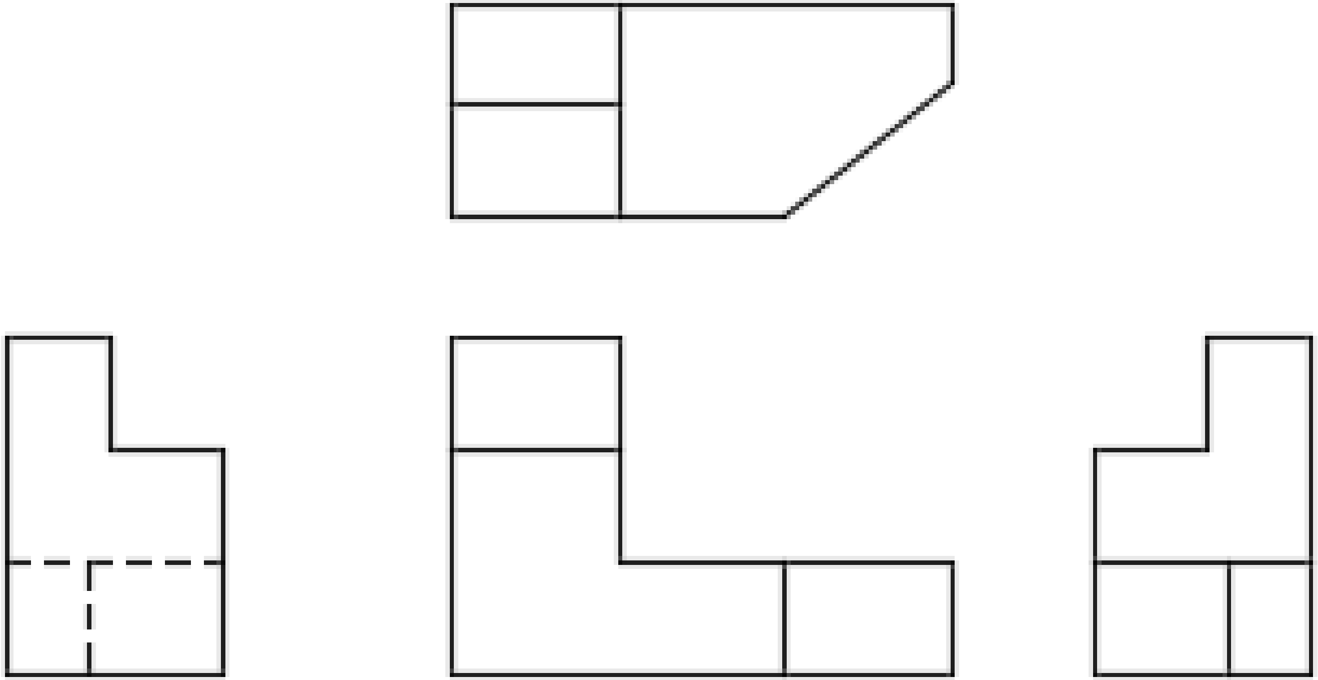
# Third Angle Projection



# Third Angle Projection

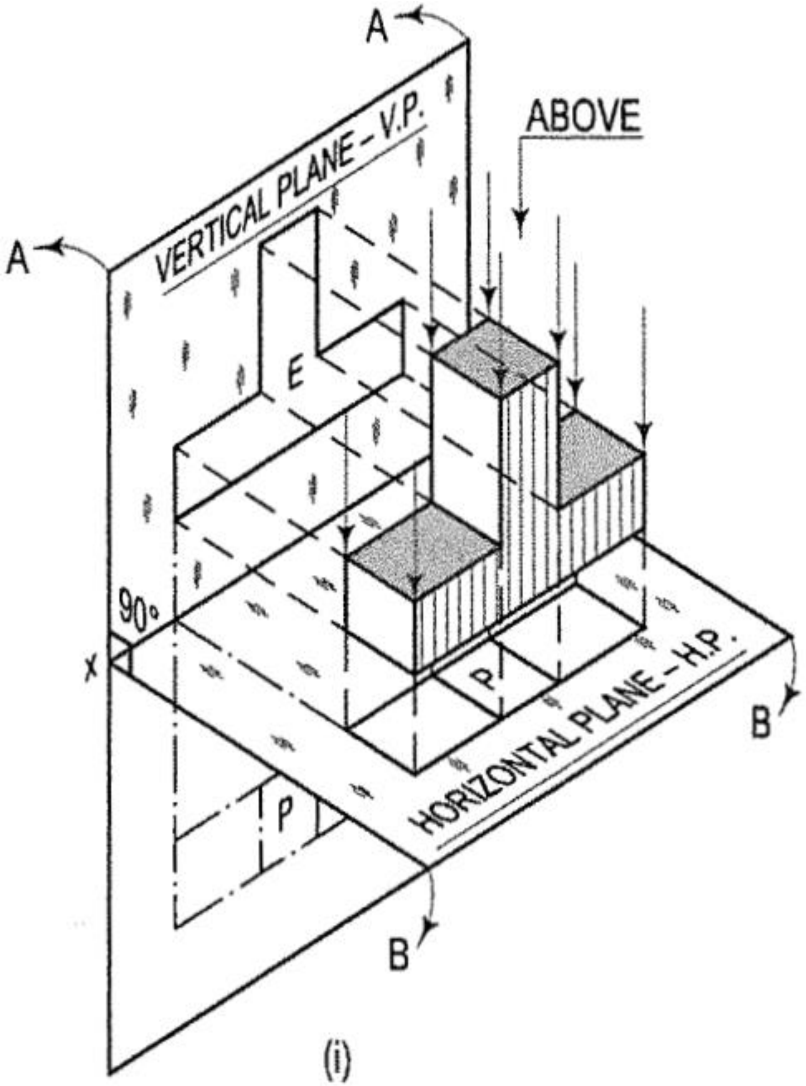


Front

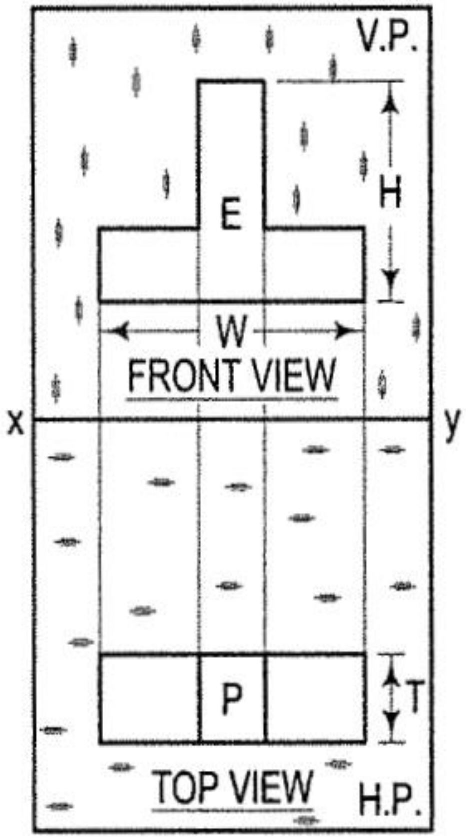


# FIRST ANGLE PROJECTION

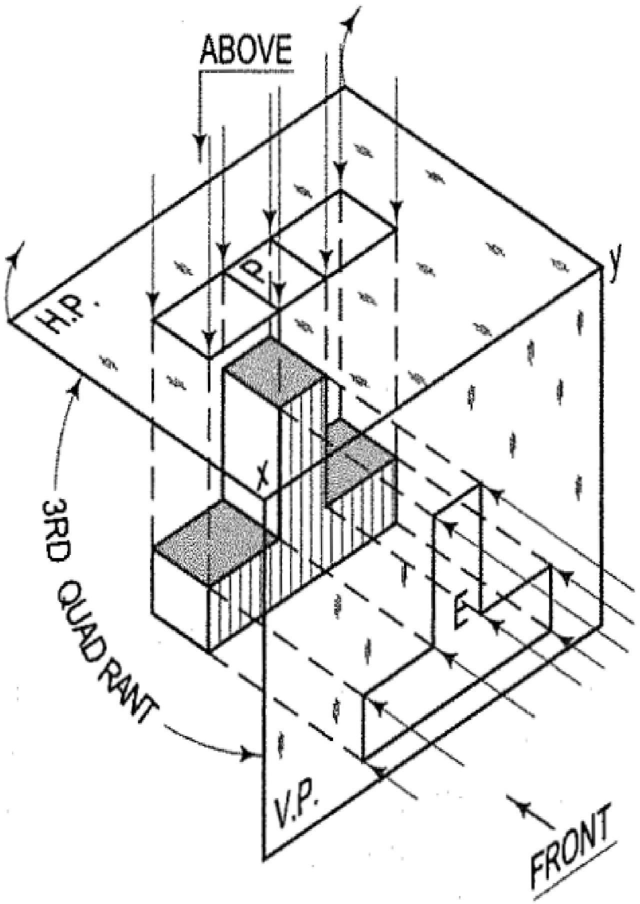
# THIRD ANGLE PROJECTION

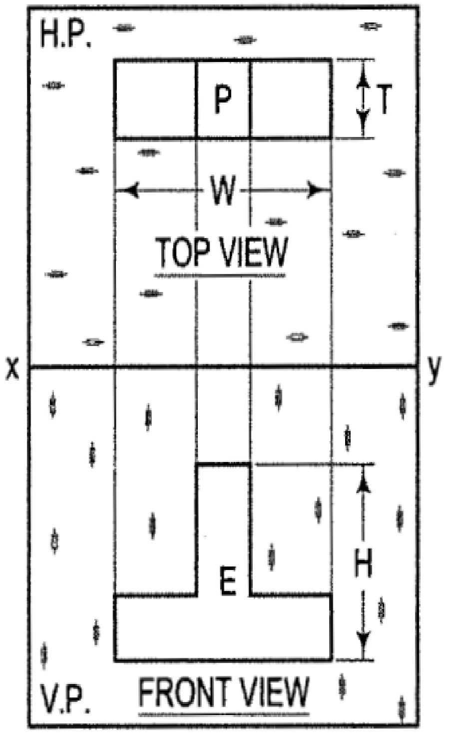



(i)




(ii)



# Glass Box Concept

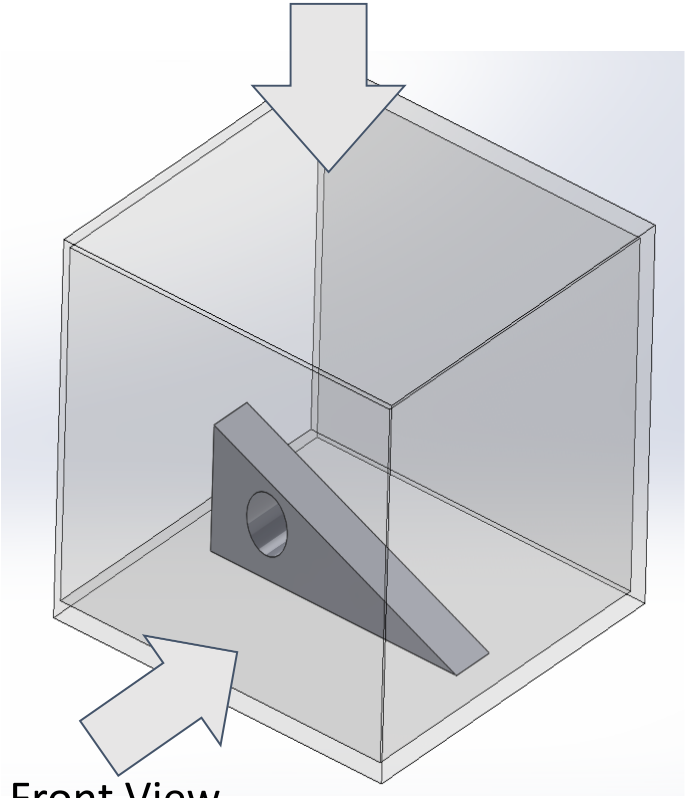
## Applicable only to third angle projection

## The Glass Box Concept:

The way we interpret the 2D prints is by considering the actual object to be in a glass box. The faces and edges of the object are projected onto the glass and the box is then "unfolded" and laid flat.

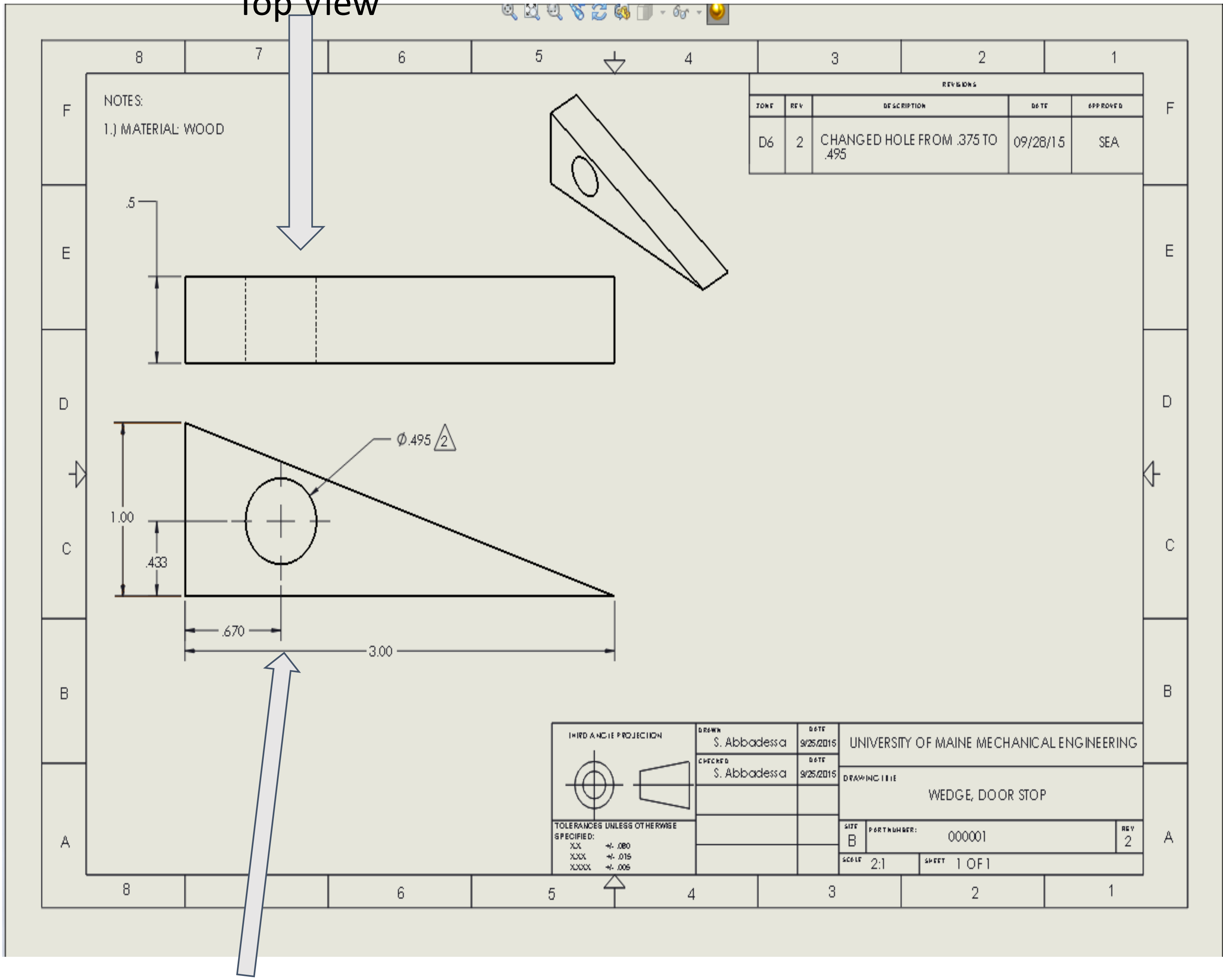
This box becomes this print:

Top View



Front View

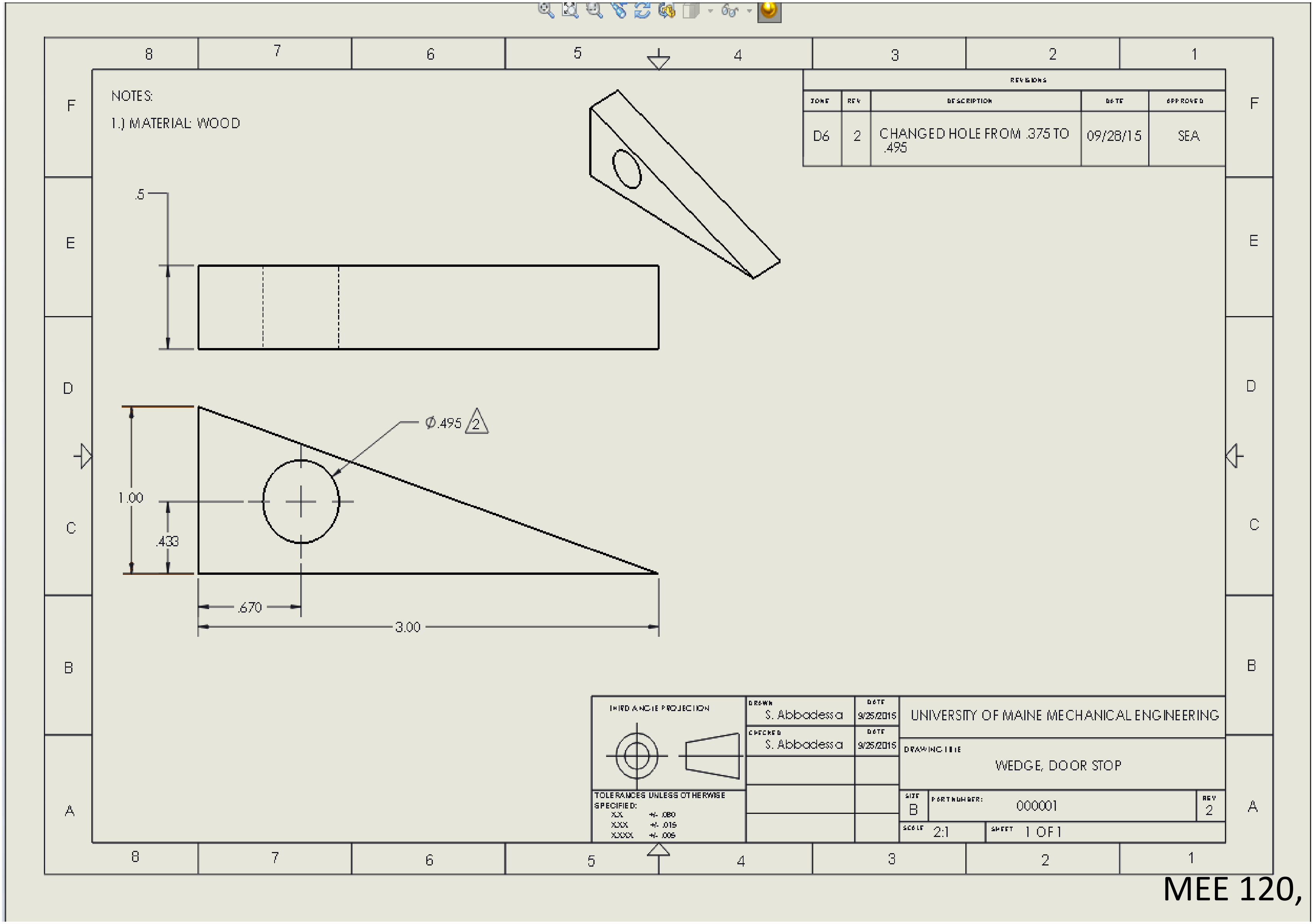
Top View



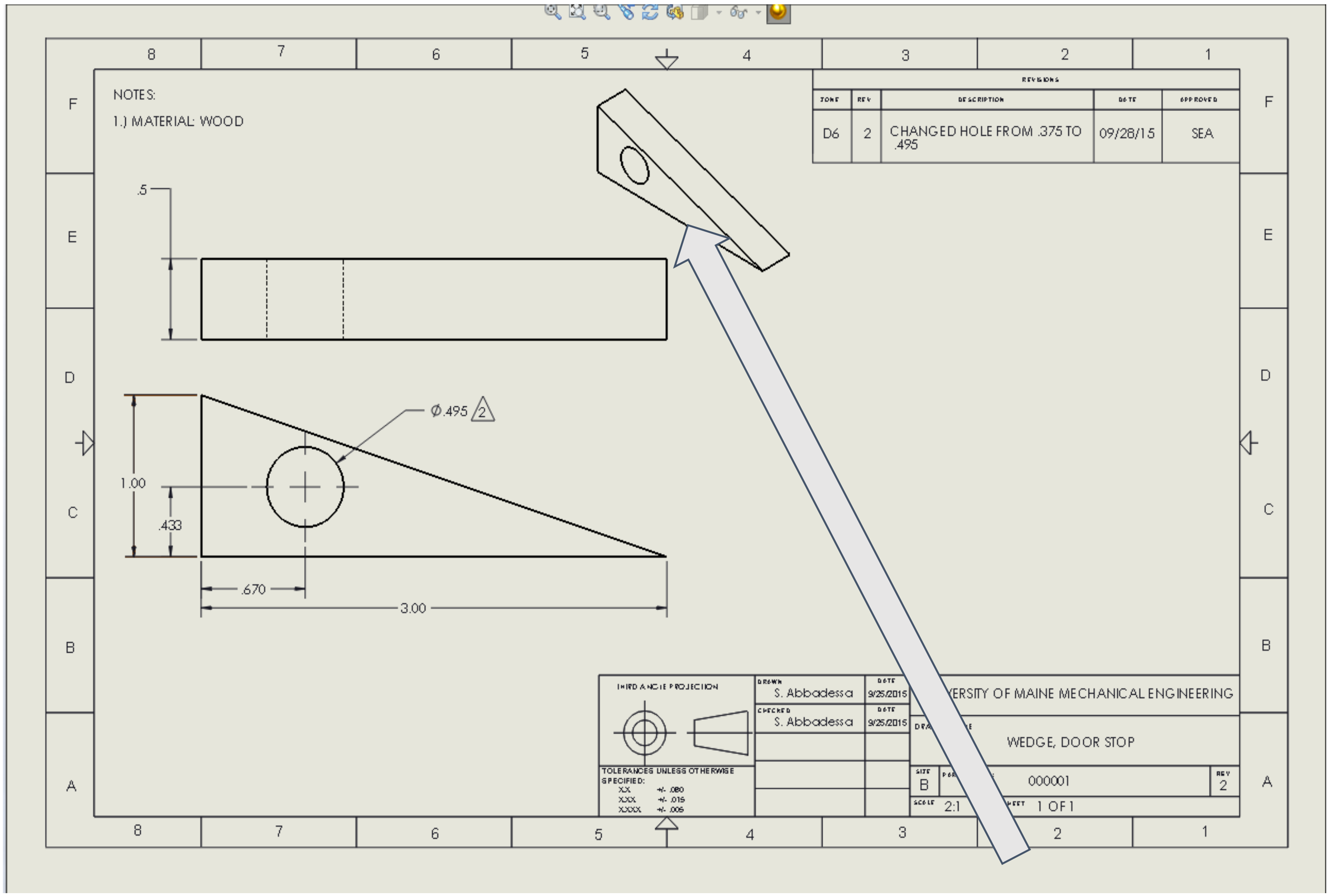

Front View

Internal or unseen edges get projected as dotted lines.

The “fold lines” of the glass box are not shown on a blueprint and are simply assumed to be there.



Not all of the six sides of the box need to be shown if the geometry can be fully described with fewer views.

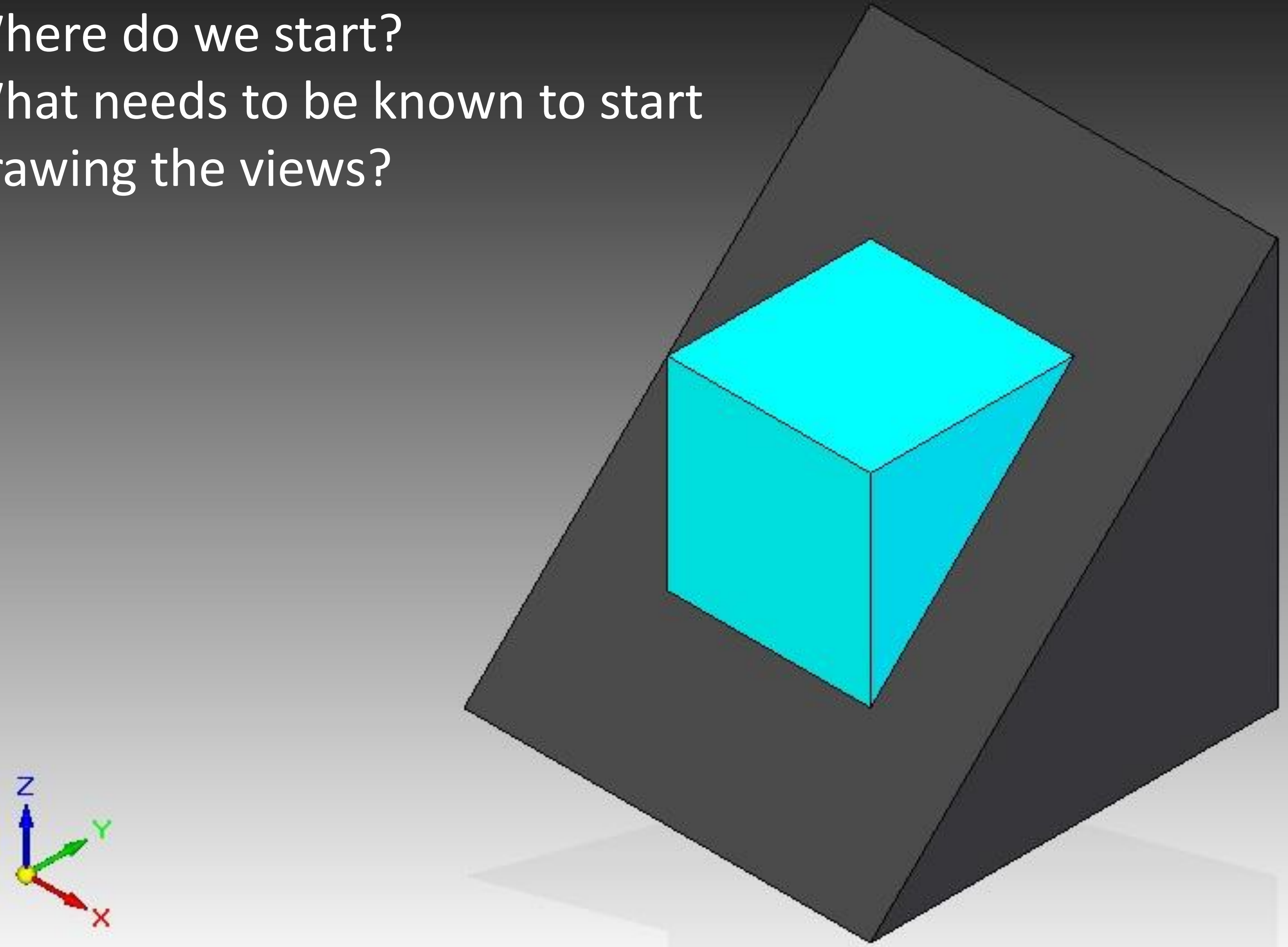



The isometric is generally added as just a visualization aid.

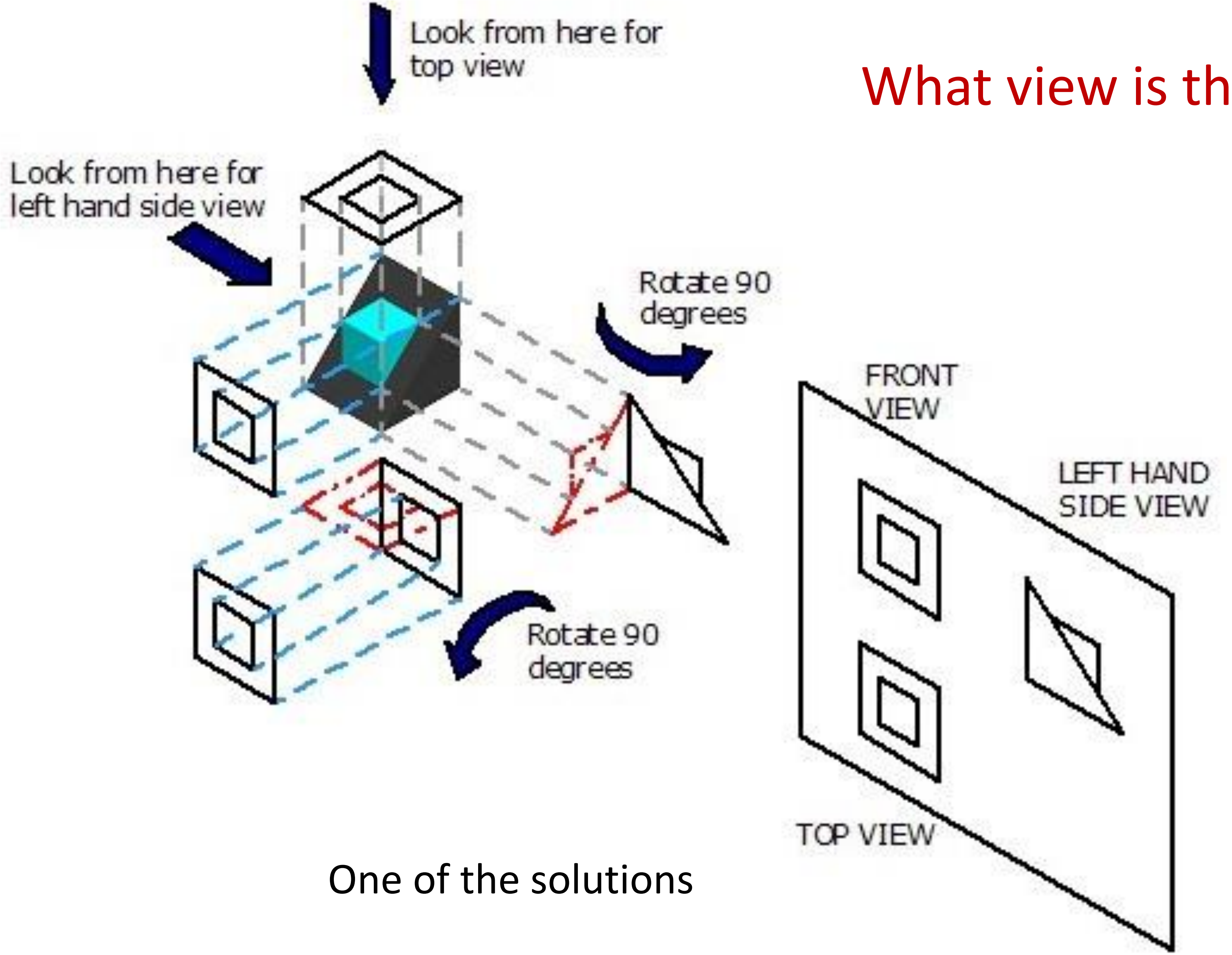
https://www.youtube.com/watch?app=desktop&v=aV3kHWu6JFE

# Examples

Where do we start?
What needs to be known to start drawing the views?

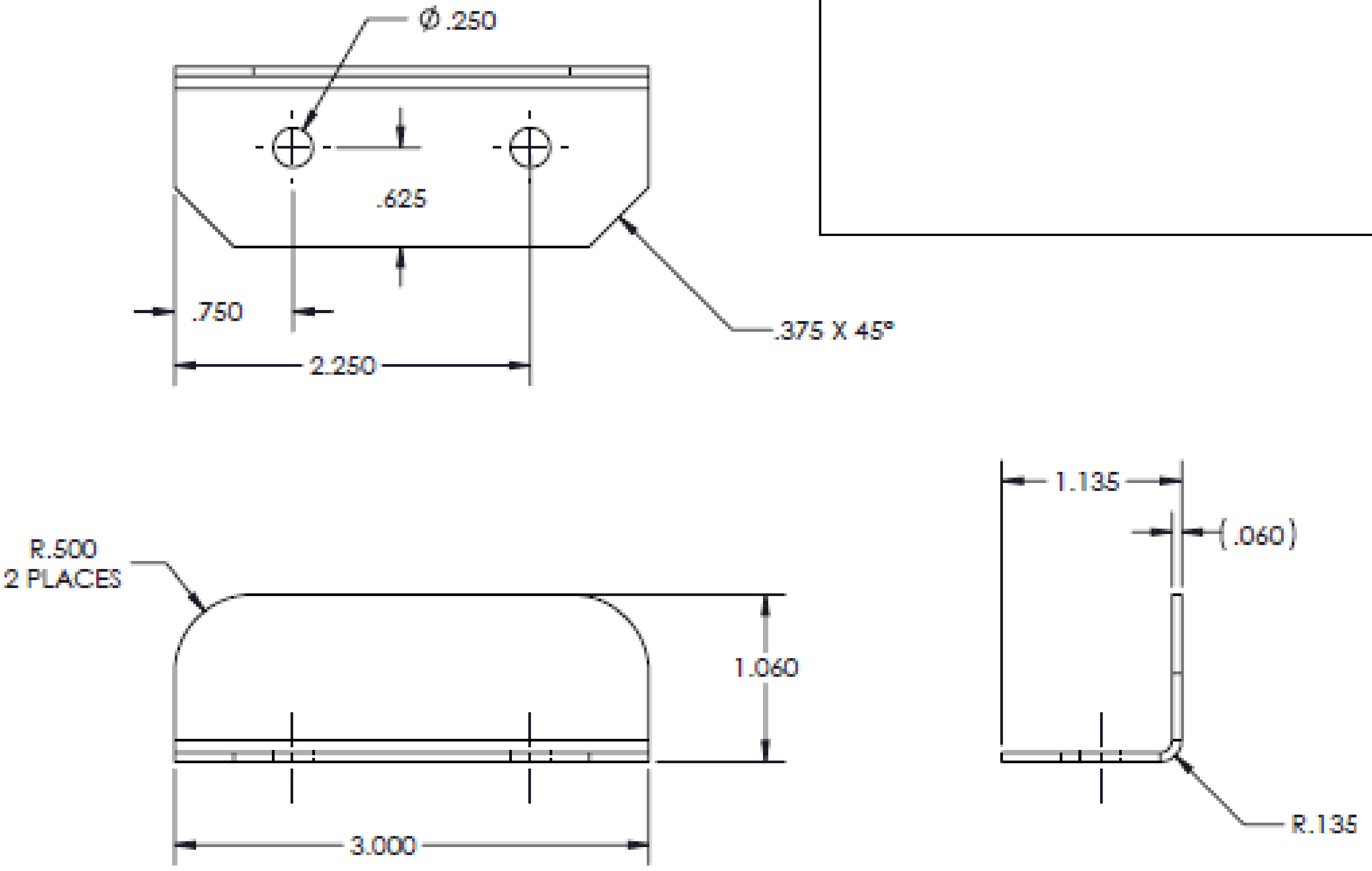


# What view is this?



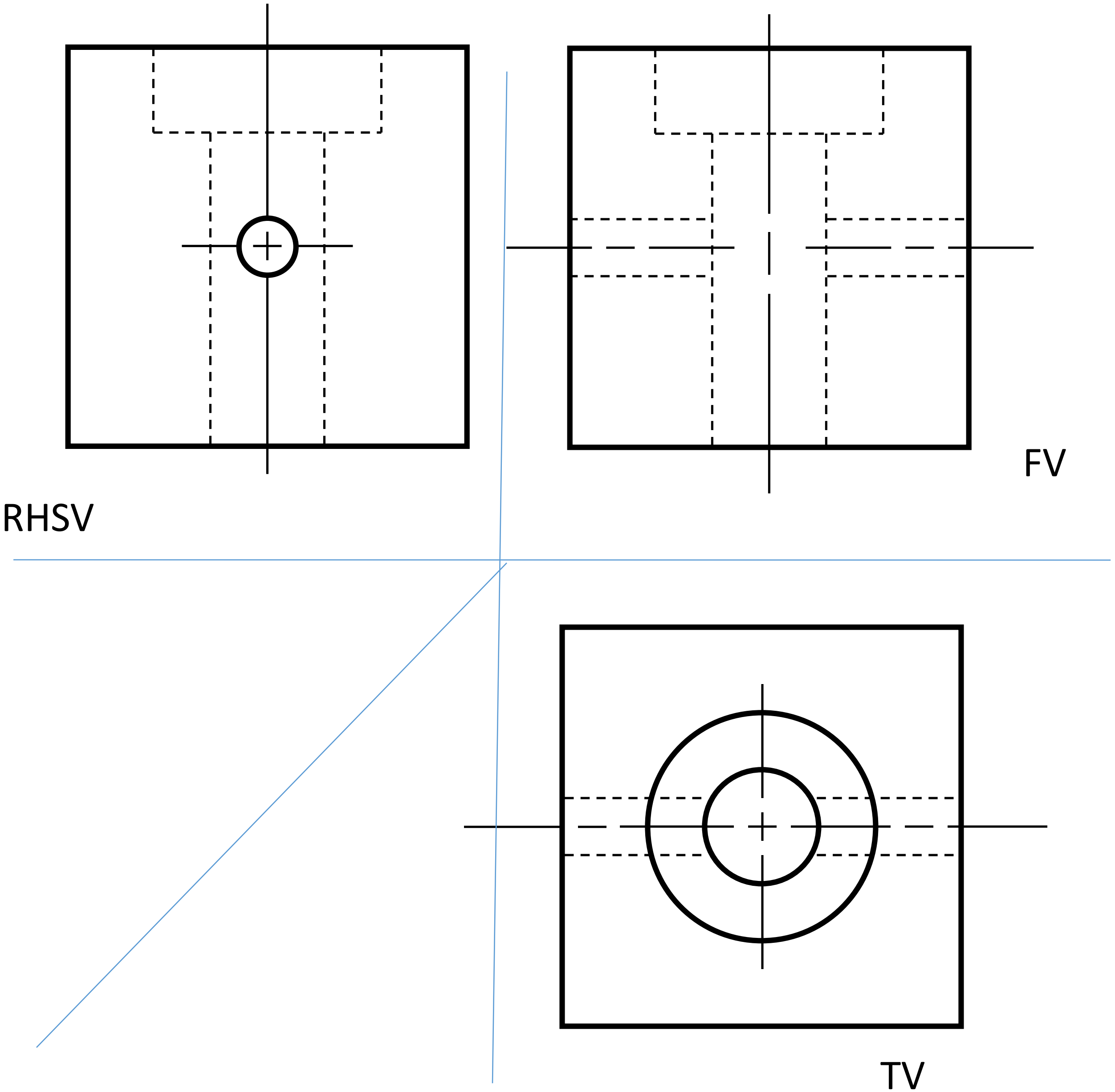

One of the solutions

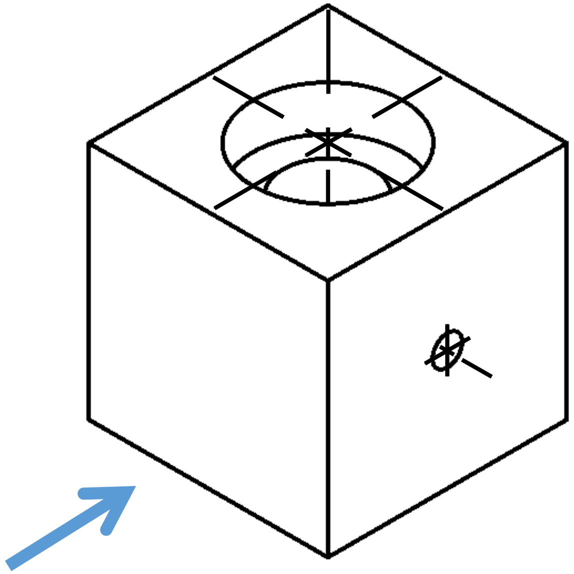
# Guess this one!




Univ of Maine, MEE 120

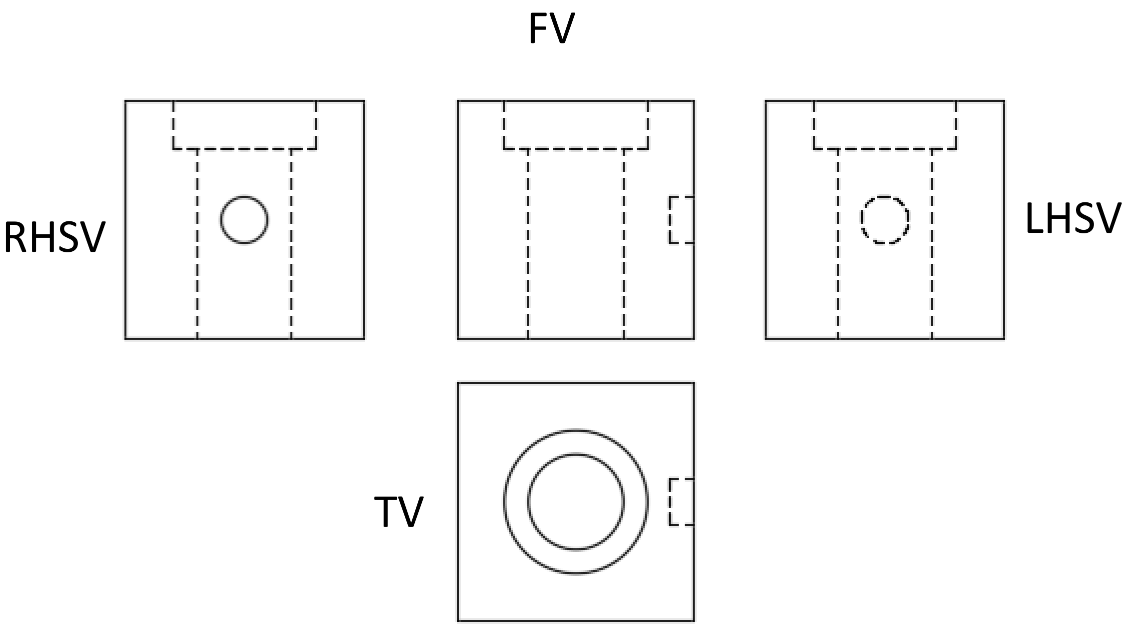
# Example



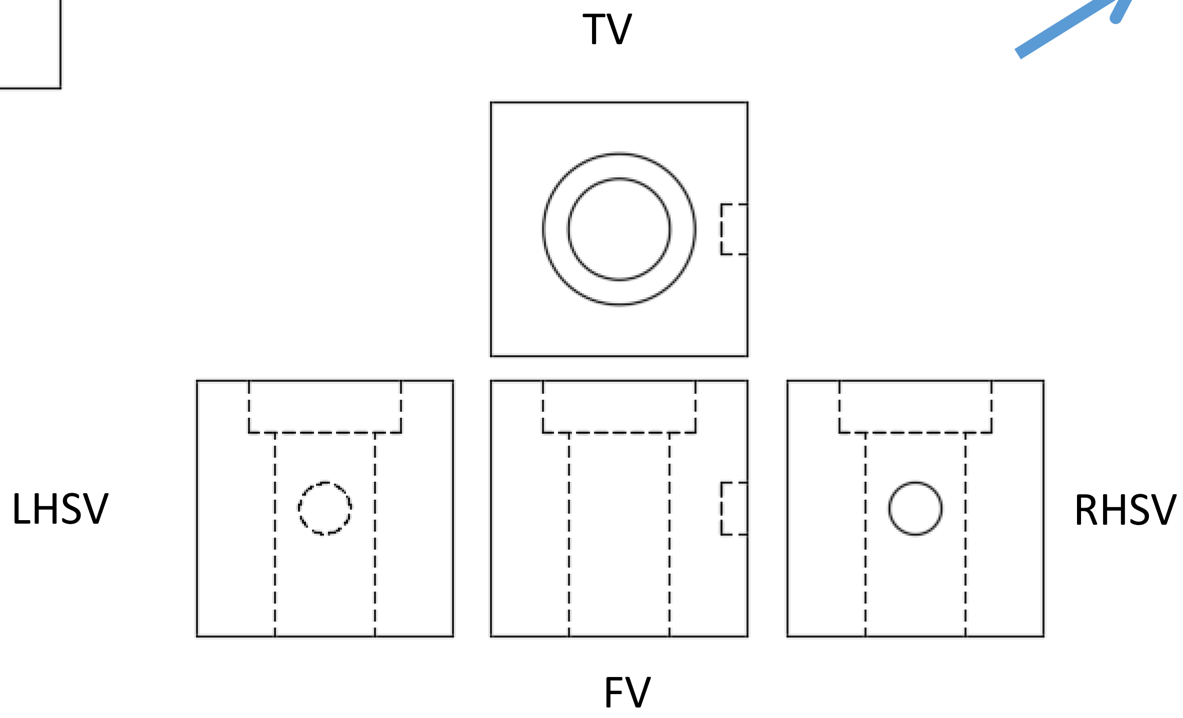



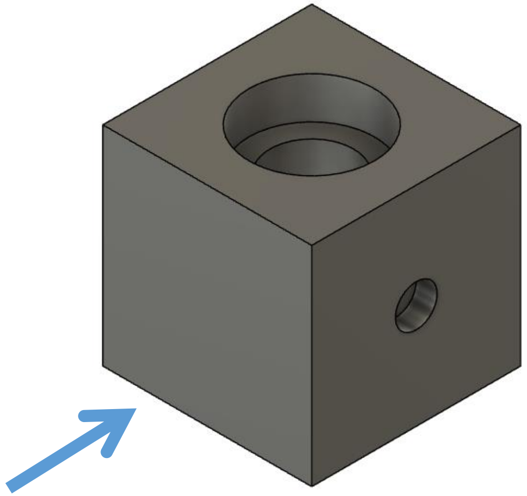
1. **Visible**
2. **Hidden**
3. **Center**

# First Angle Projection



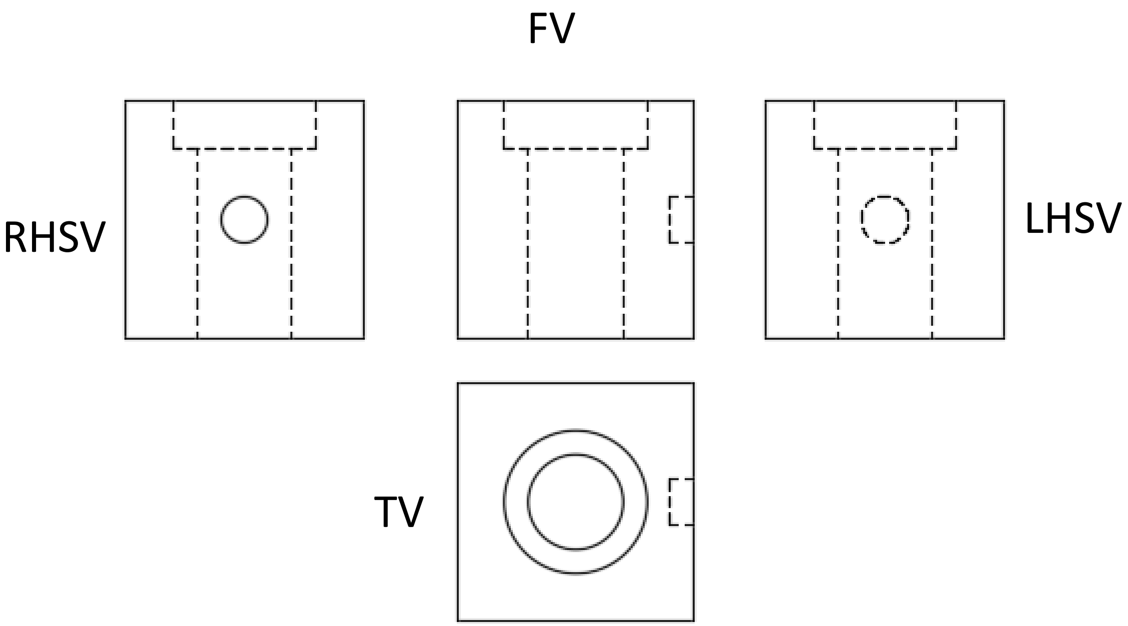

## What is wrong here?

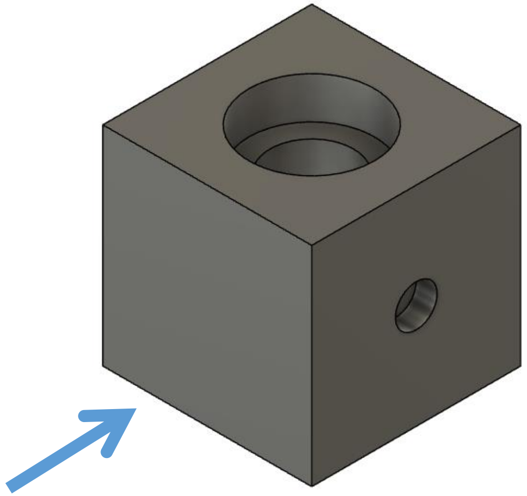


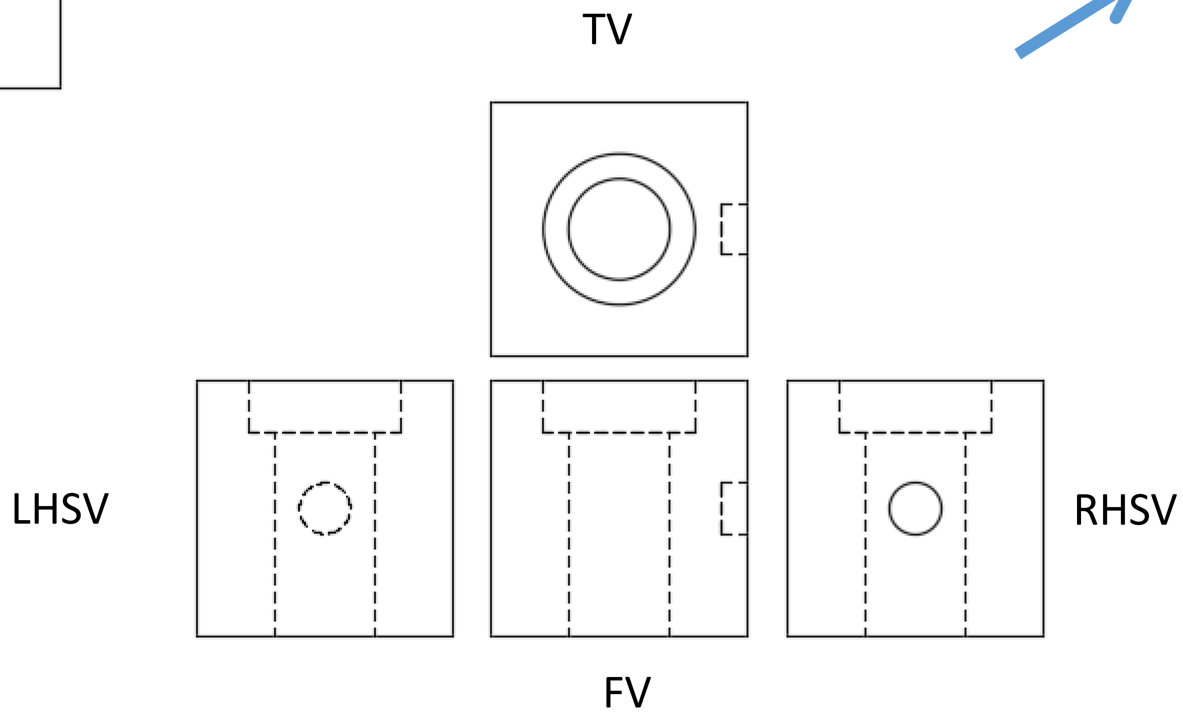



# First Angle Projection

# First Angle Projection






# Third Angle Projection

# Line Styles and Dimensioning

**LINES on an engineering drawing signify more than just the geometry of the object and it is important that the appropriate line type is used.**

**Line Thickness For most engineering drawings you will require two thickness', a thick and thin line. The general recommendation are that thick lines are twice as thick as thin lines.**

## LINE STYLES

| | |
|---|---|
| ▬▬▬▬▬▬ | **A thick continuous line is used for visible edges and outlines.** |
| ______________ | A thin line is used for hatching, leader lines, short centre lines, dimensions and projections. |

**Other line styles used to clarify important features on drawings are:**

| | |
|---|---|
| _._._._._._._._._._._ | Thin chain lines are a common feature on engineering drawings used to indicate centre lines. Centre lines are used to identify the centre of a circle, cylindrical features, or a line of symmetry. |
| ------------------ | Dashed lines are used to show important hidden detail for example wall thickness and holes |

# Precedence of Lines

- Visible lines takes precedence over all other lines

0.6 mm

- Hidden lines and cutting plane lines

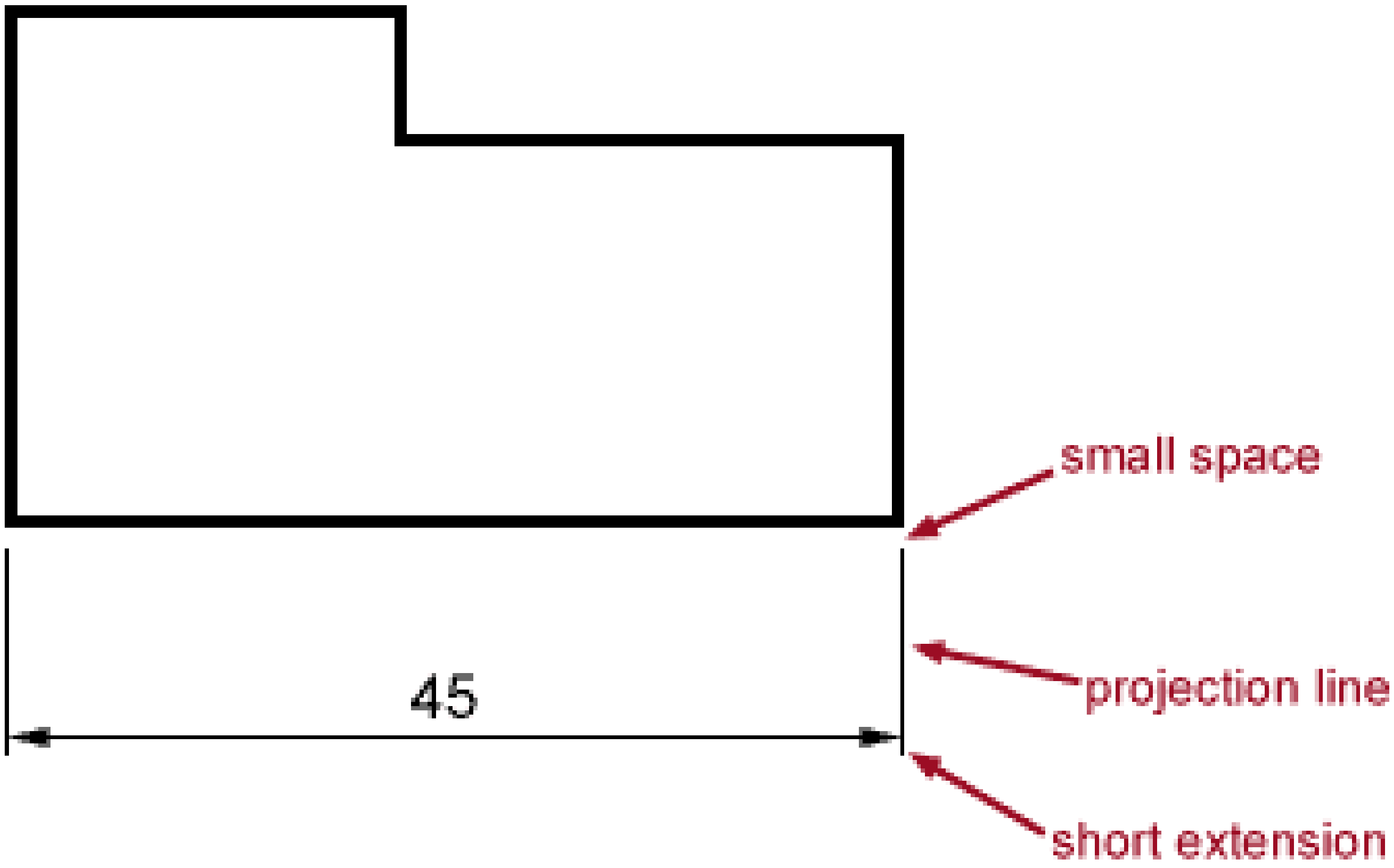
0.3 mm

- Center lines

- Centermark

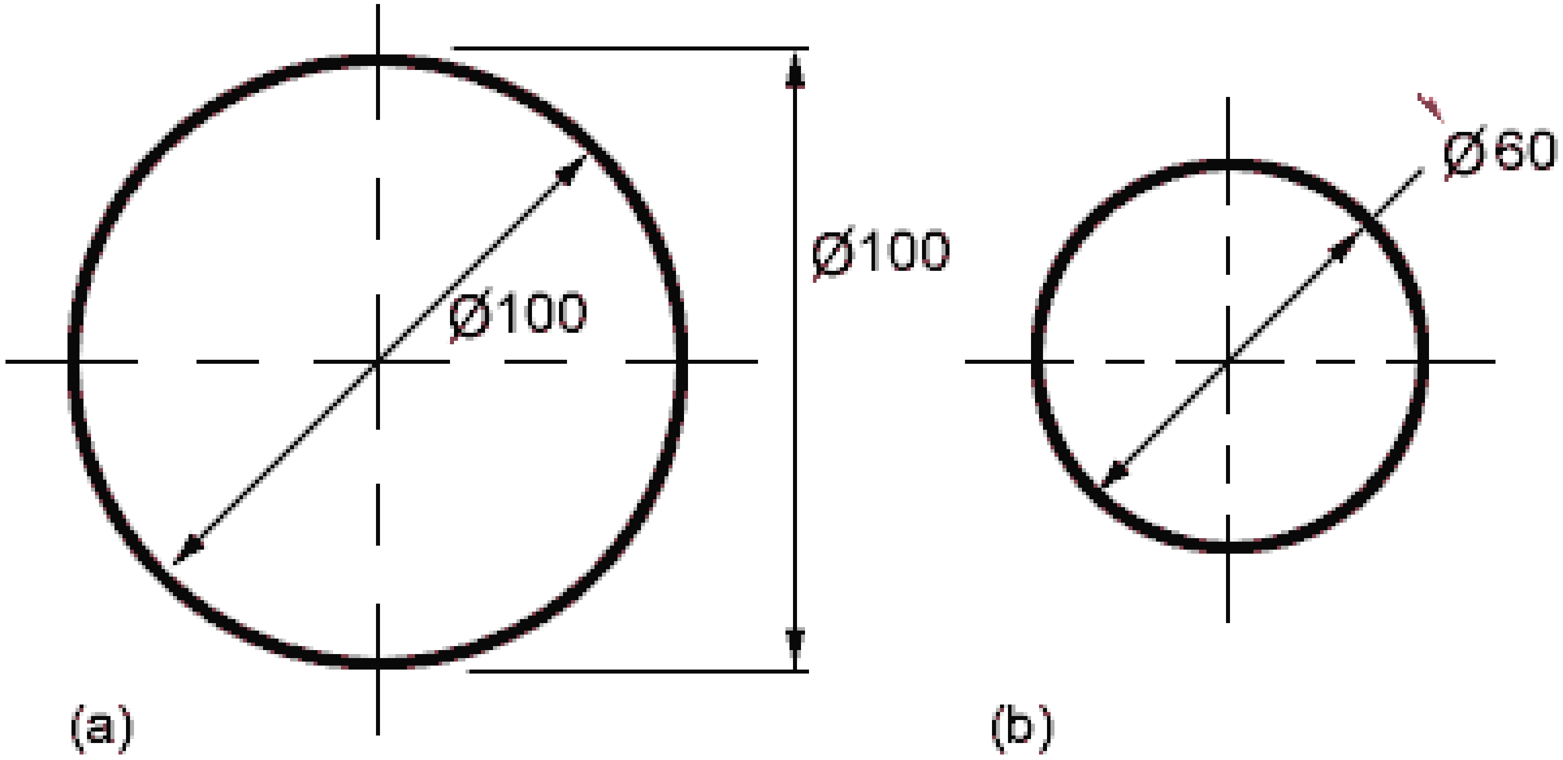
# Dimensioning

A dimensioned drawing should provide all the information necessary for a finished product or part to be manufactured.




- Dimensions are always drawn using continuous thin lines.
- Two projection lines indicate where the dimension starts and finishes.
- Projection lines do not touch the object and are drawn perpendicular to the element you are dimensioning.
- All dimensions less than 1 should have a leading zero. i.e. .35 should be written as 0.35

# Dimensioning of Circles

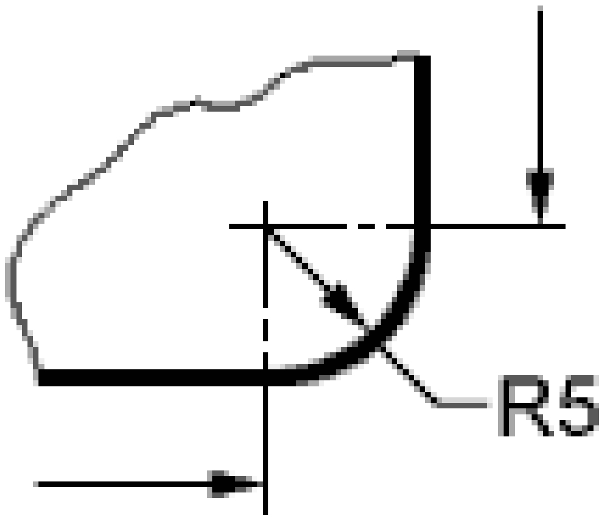



(a) shows two common methods of dimensioning a circle. One method dimensions the circle between two lines projected from two diametrically opposite points. The second method dimensions the circle internally.

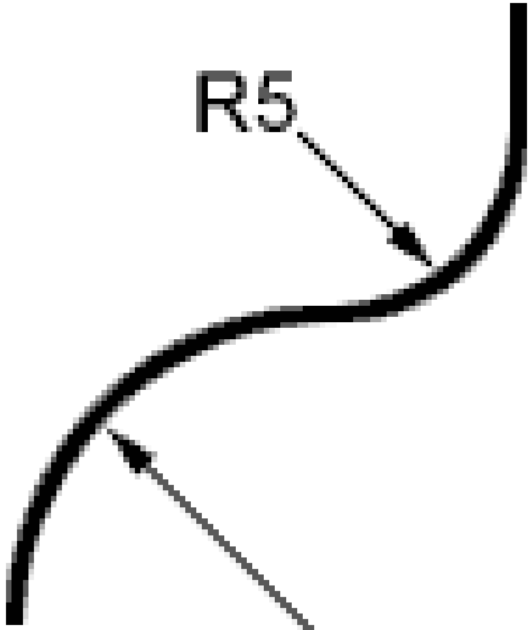
(b) is used when the circle is too small for the dimension to be easily read if it was placed inside the circle.

# Dimensioning Radii

All radial dimensions are proceeded by the capital R.



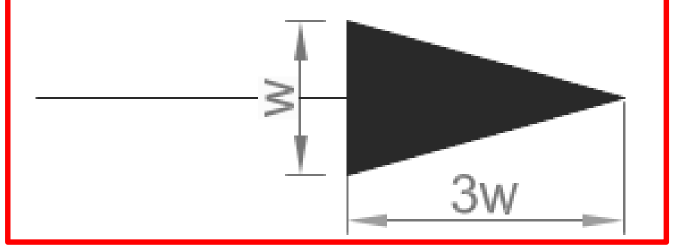

(a)



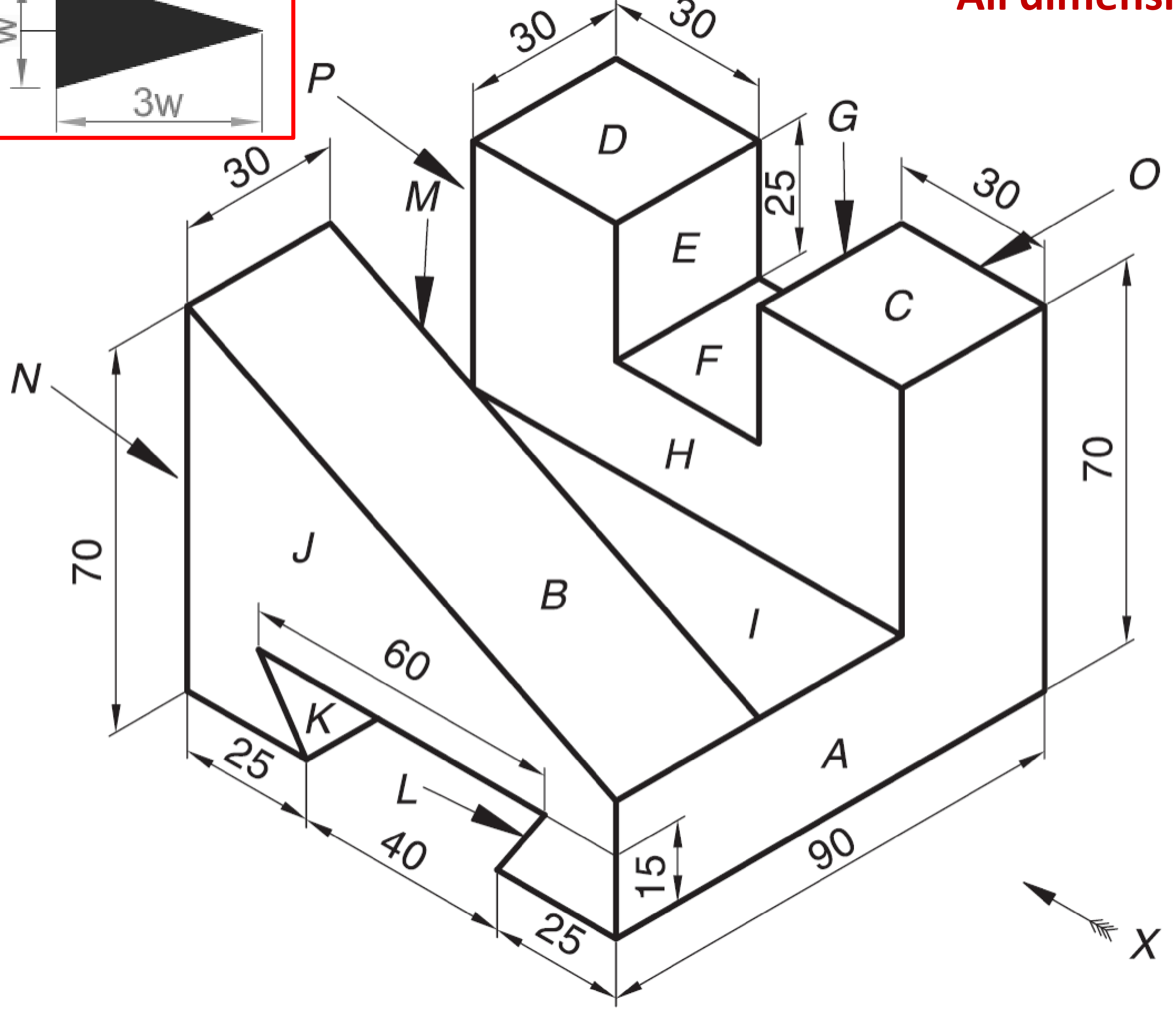

(b)

(a) shows a radius dimensioned with the centre of the radius located on the drawing.

(b) shows how to dimension radii which do not need their centres locating.




All dimensions in mm




Note the method of dimensioning and arrow style

# Autodesk Fusion

# Fusion

- Fusion is a cloud-based CAD/CAM/CAE tool for collaborative product development.

- Fusion combines fast and easy organic modeling with precise solid modeling.

- To help you create manufacturable designs.

# Fusion

## File structure

### Design/Project/Product

- Components, bodies, sketches and joints

### Bodies and Components

- All components exist in the same Fusion file.
- Component groups act like sub-assemblies, and bodies are physical objects that exist either in the global space or in a component.

### Joints

- Joints define the degrees of freedom between parts to show how components move in an assembly.
- They drive motion studies and animations.
- Joints are created between components, but are defined by certain features within the component, like bodies, faces, or edges.

# Sketching

- A Sketch is a geometric profile that forms the foundation of 3D geometry in a design in Fusion.
- Before you can create 3D objects in your design, you first need to create the underlying sketch profile(s) that drive the overall shape of the parametric solid, surface, or T-spline bodies that make up your design.
- Sketches are the backbone of any subsequent parametric modeling. If you create a robust sketch profile, you can improve your workflow and minimize potential downstream issues in your design.

https://help.autodesk.com/view/fusion360/ENU/?guid=SKT-3D-SKETCH

# Fusion

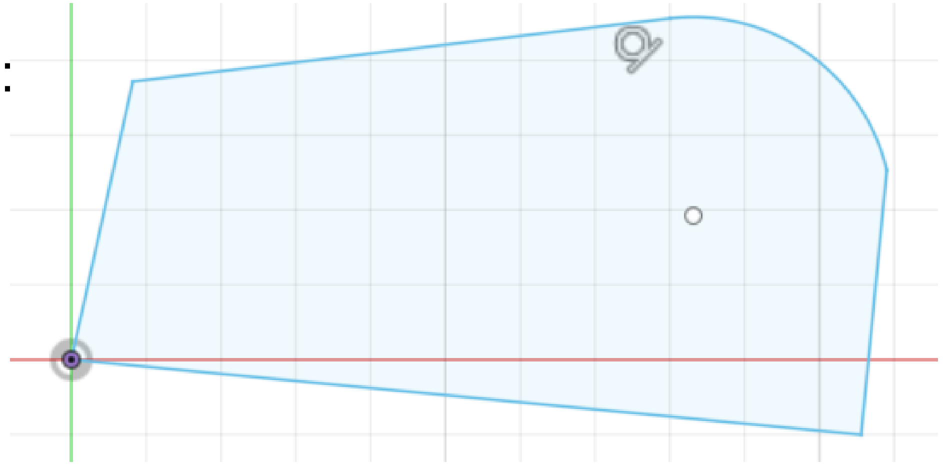
## Fully define and constrain sketches

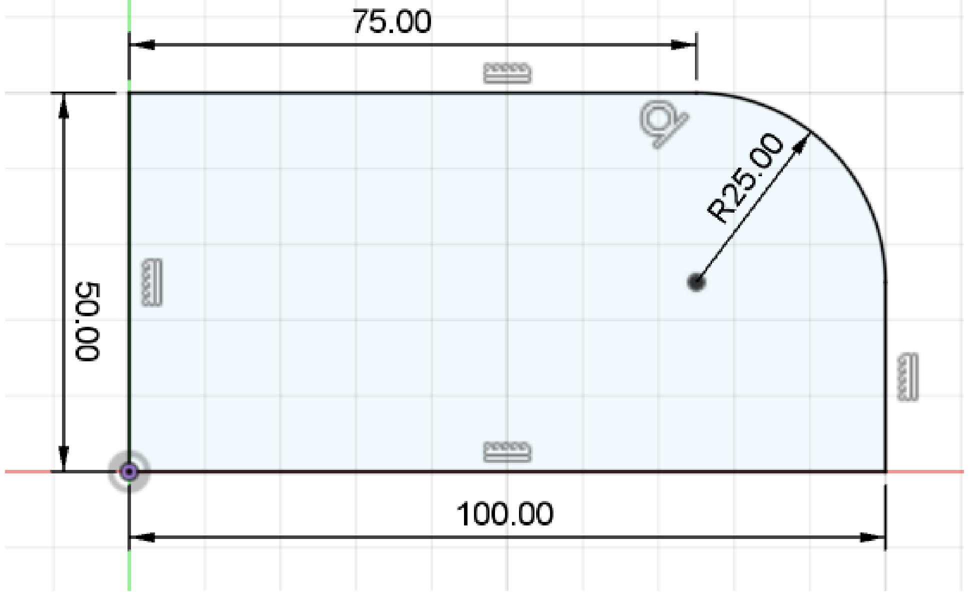
- A sketch is fully constrained when the size and position of all sketch geometry is completely defined.
- This is achieved using a combination of constraints and dimensions.
- No need to fully constrain sketches, but it is often good practice to do so.
- In the Browser, a red lock displays on the icon next to the sketch when it is fully constrained.
- When sketch geometry is fully constrained, it changes from its initial color to black.

# Fusion

## Commands to **constrain** sketches:

- Horizontal/Vertical
- Coincident
- Tangent
- Equal
- Parallel
- Perpendicular
- Fix/UnFix
- Midpoint
- Concentric
- Collinear
- Symmetry
- Curvature





# Fusion

## Commands to constrain sketches:

- Horizontal/Vertical
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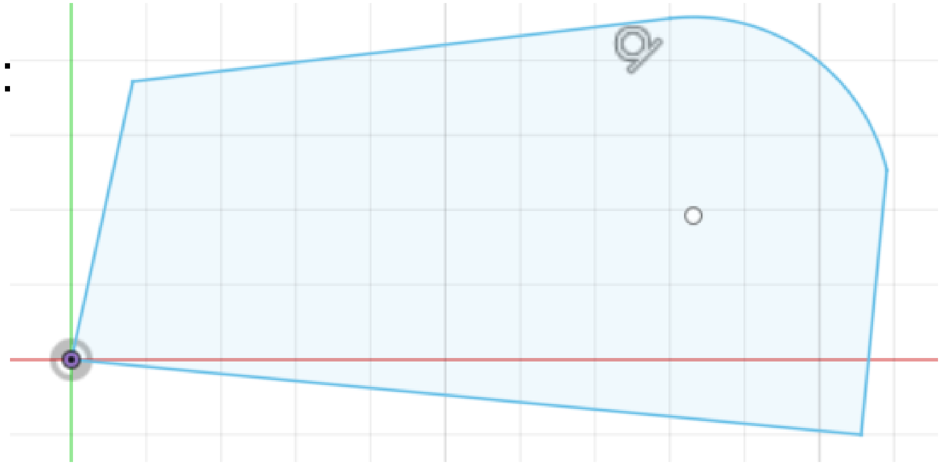
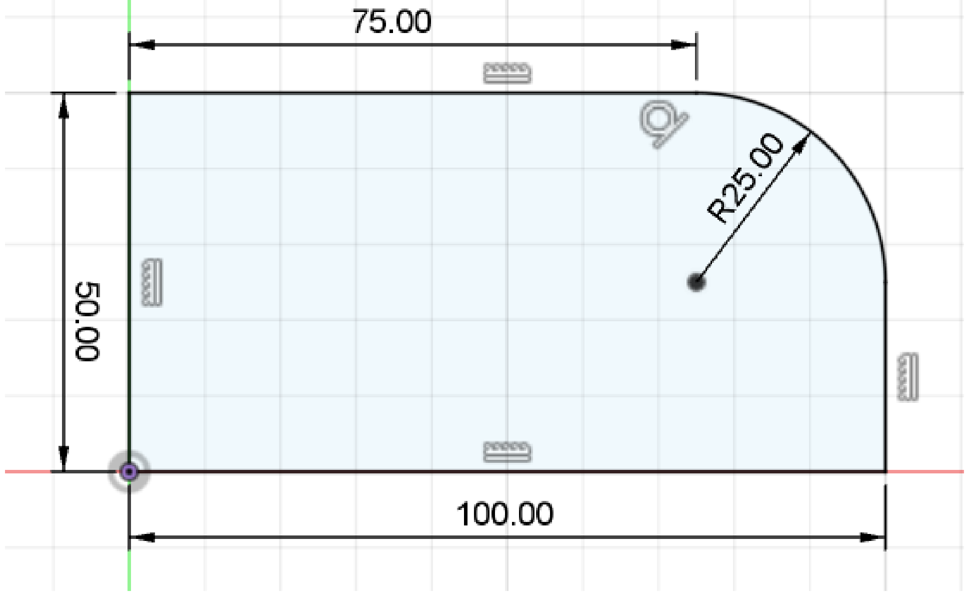
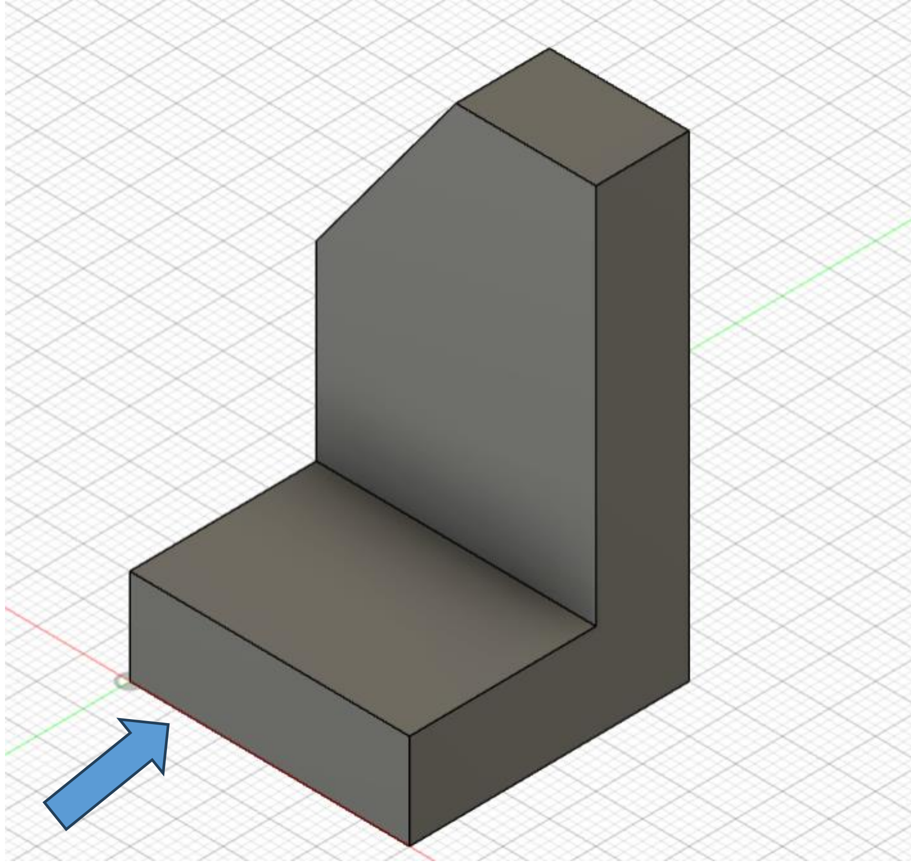
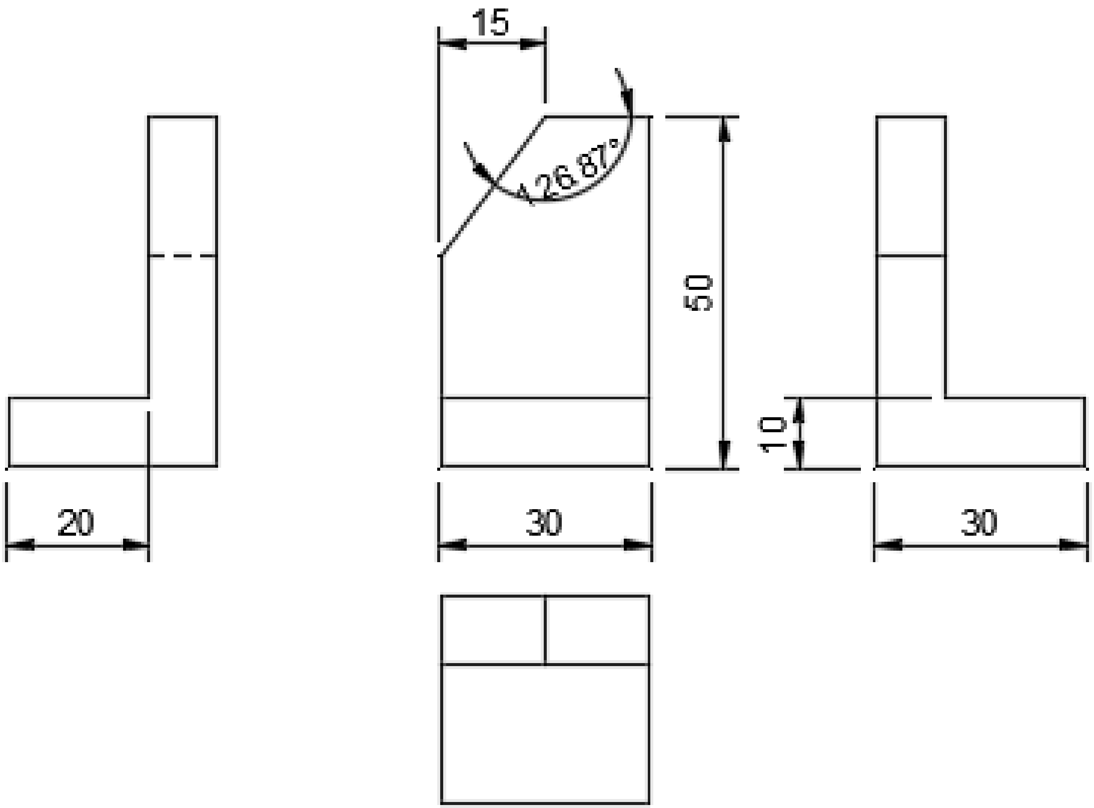




# First angle projections of a 3D object

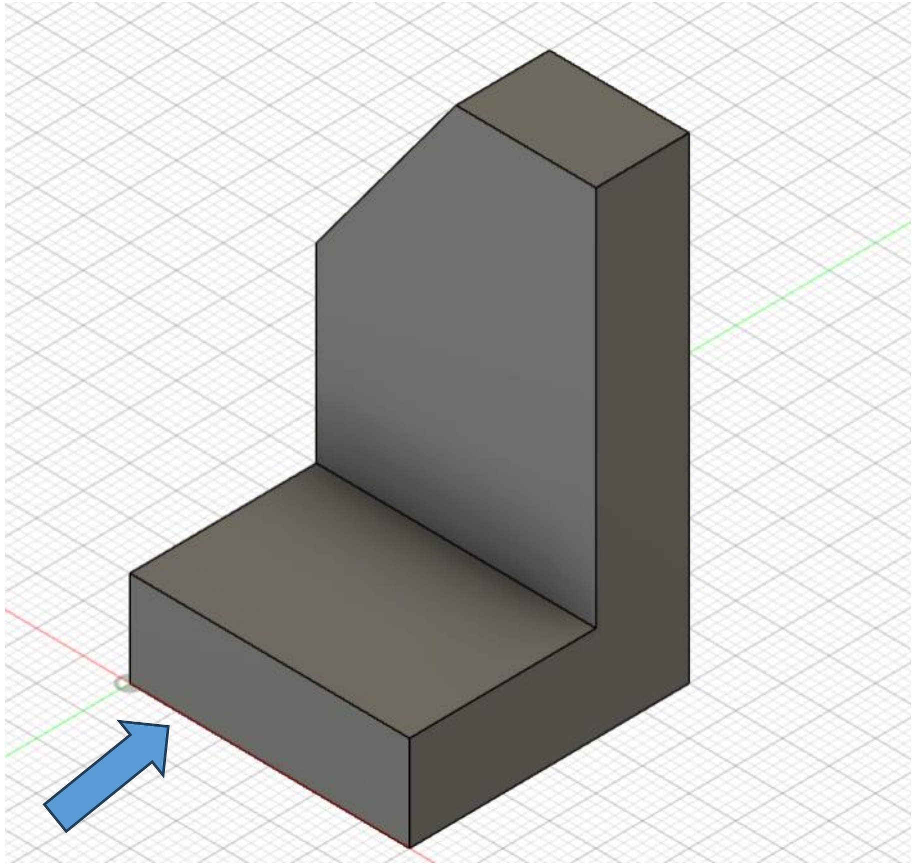


Isometric view

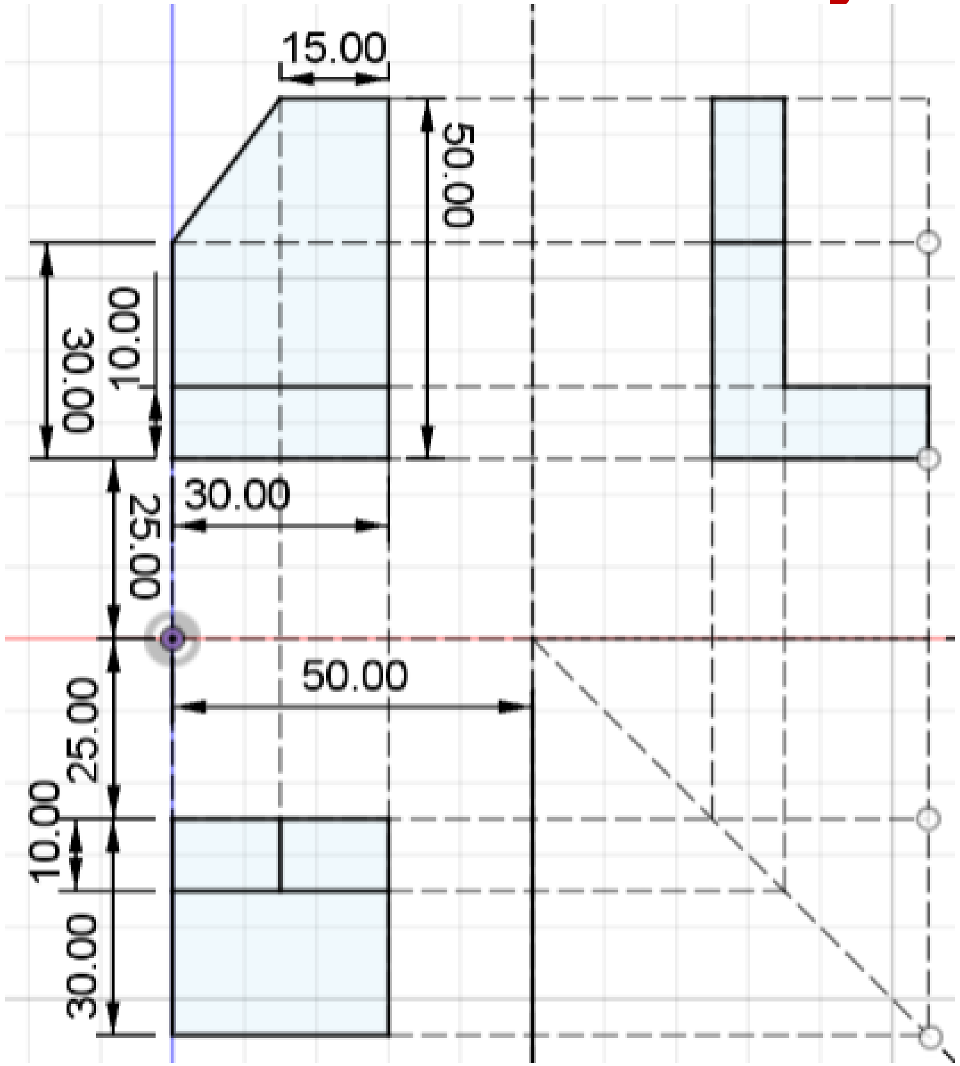



First angle projections

# First angle projections of a 3D object



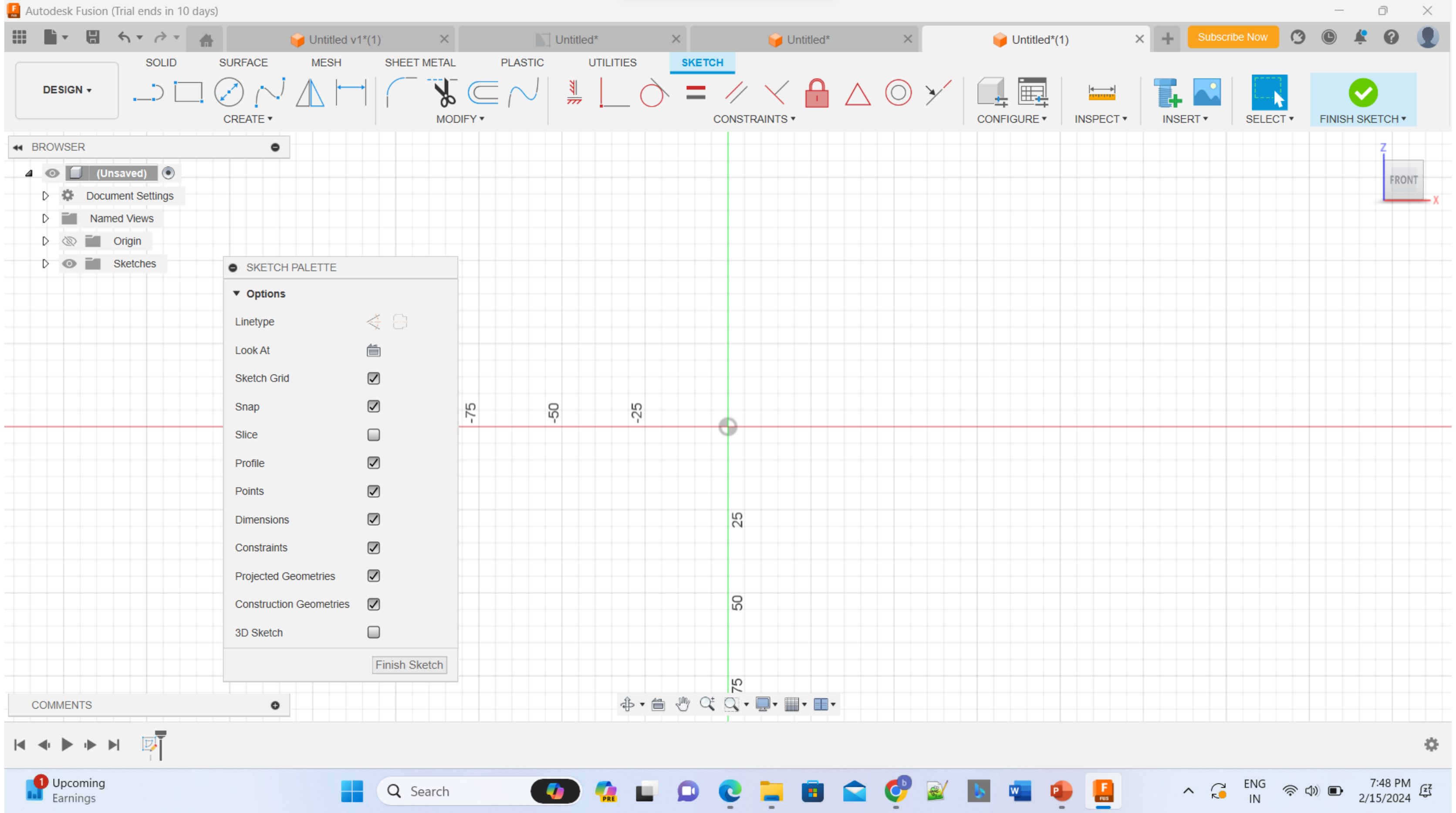
Isometric view




First angle projections

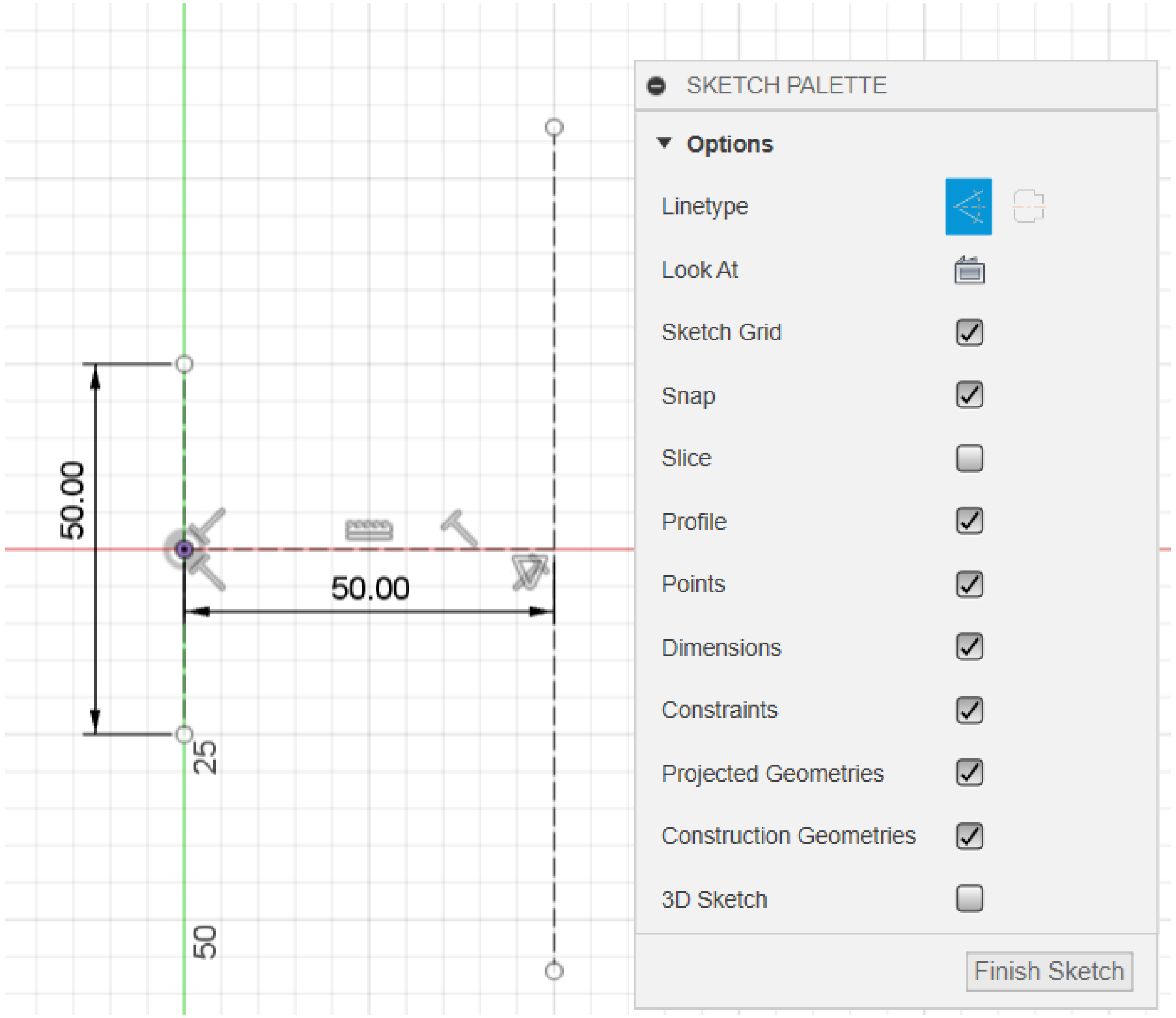
# First angle projections of a 3D object

- Create sketch
- Choose a plane ‘front plane’ for creating the 2D sketch



# First angle projections of a 3D object

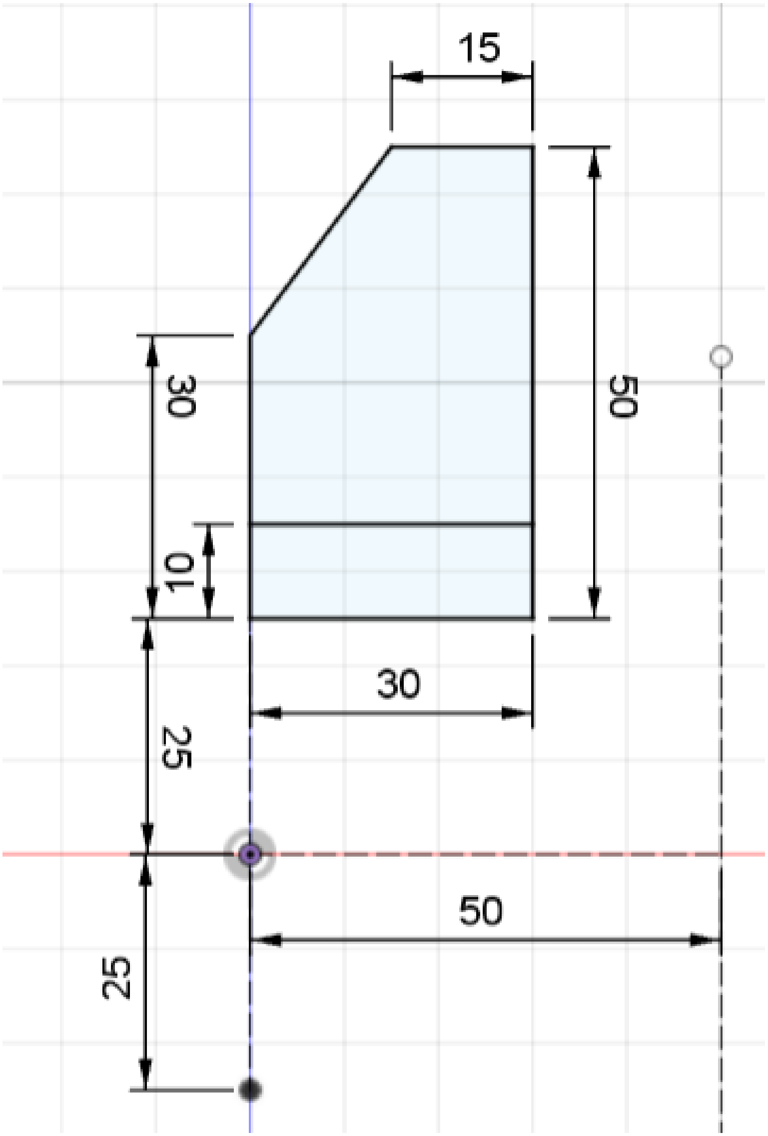
- Line type ‘construction’
- ‘Line’/L to draw line
- Origin as 1st point
- 2nd point, 50 mm horizontal
- Horizontal constraint symbol
- XY line
- Vertical line +25 for front view
- Vertical line -25 for top view
- Vertical line 50 mm away, $X_1Y_1$
- Constraint $X_1Y_1$ with XY(midpoint)



# First angle projections of a 3D object

FV

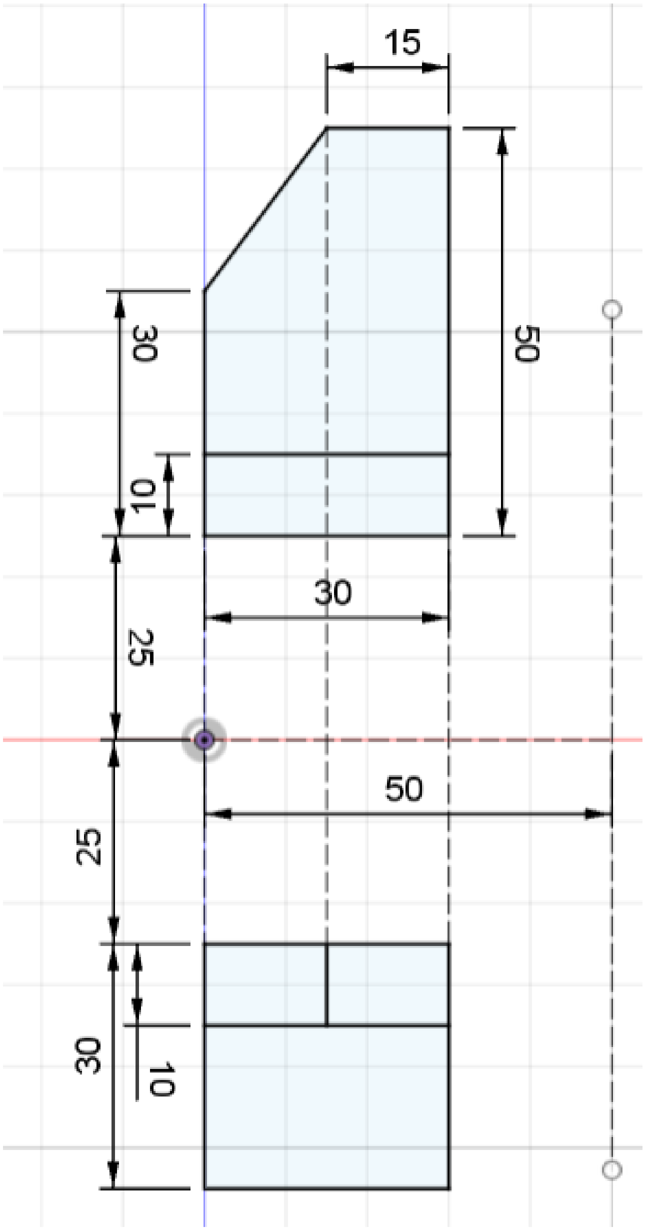
- 30 mm vertical, horizontal from 25 mm above origin.
- 50 mm vertical from horizontal end point.
- 15 mm horizontal from 50 mm vertical end.
- Joint 30 mm vertical and 15 mm horizontal.
- Horizontal from 10 mm above 30 mm horizontal.
- Constraint as the initial point is fixed using construction line from origin.



# First angle projections of a 3D object

FV & TV

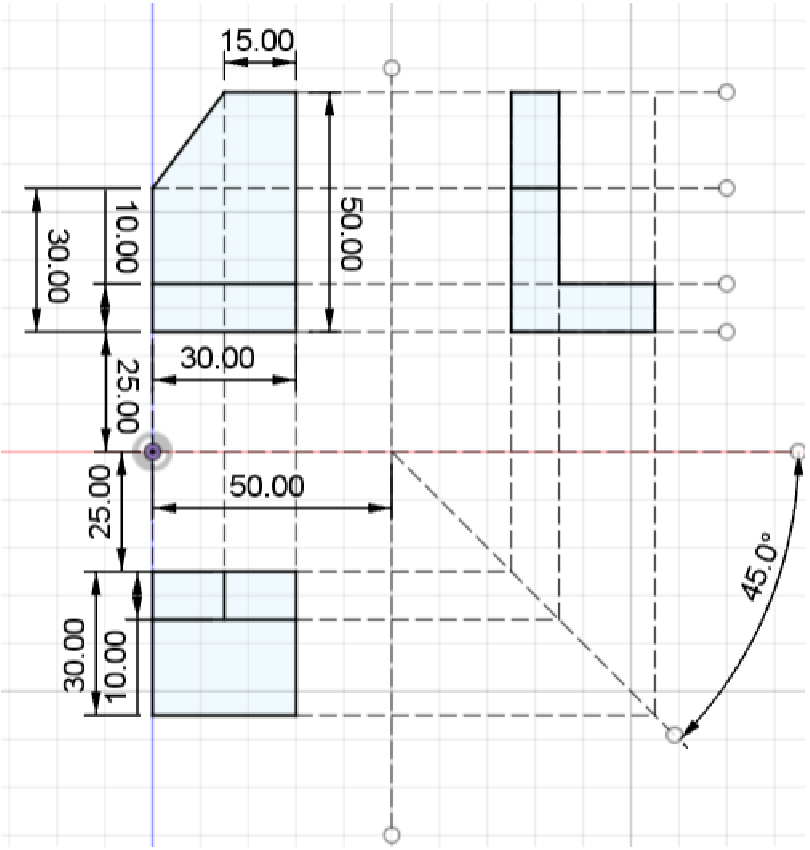
- Draw vertical projectors(construction lines) from the edges of the front view.
- Draw 30 mm vertical, horizontal lines from 25 mm point below the origin.
- Draw horizontal, vertical lines from the end points.
- Draw horizontal line 10 mm below.
- Draw vertical line(10 mm) between midpoints of two horizontal lines.
- Sketch is constrained as the initial point is fixed to the origin.



# First angle projections of a 3D object

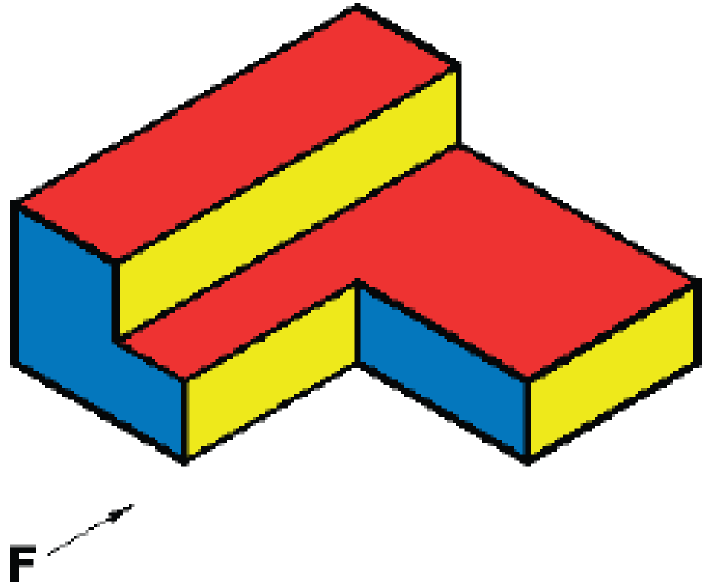
FV, TV & LHSV

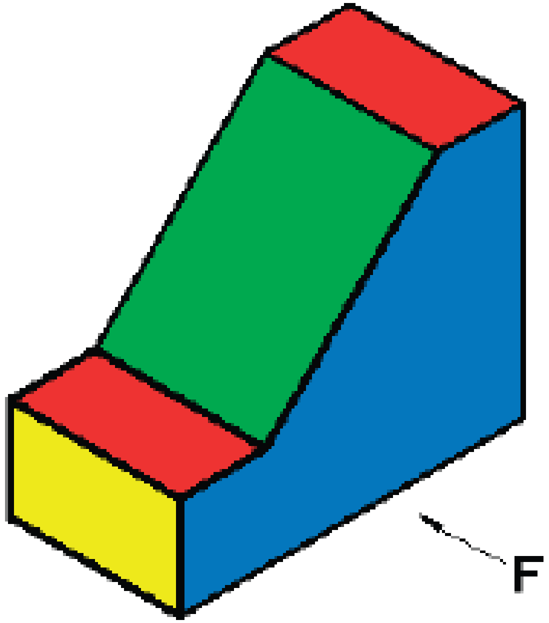
- Construction line from the intersection XY and $X_1Y_1$ at $45^0$.
- Intersection of projectors from TV and FV is used to create the LSV.

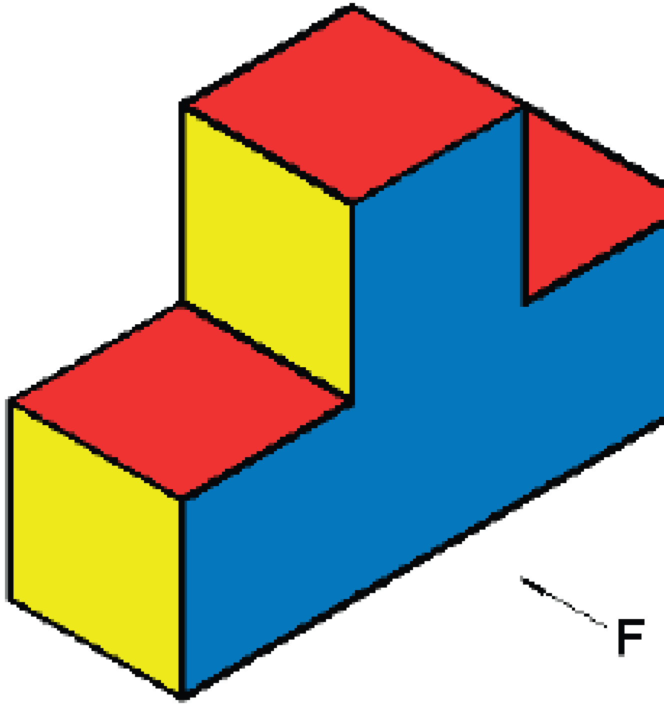


# Additional Study Materials

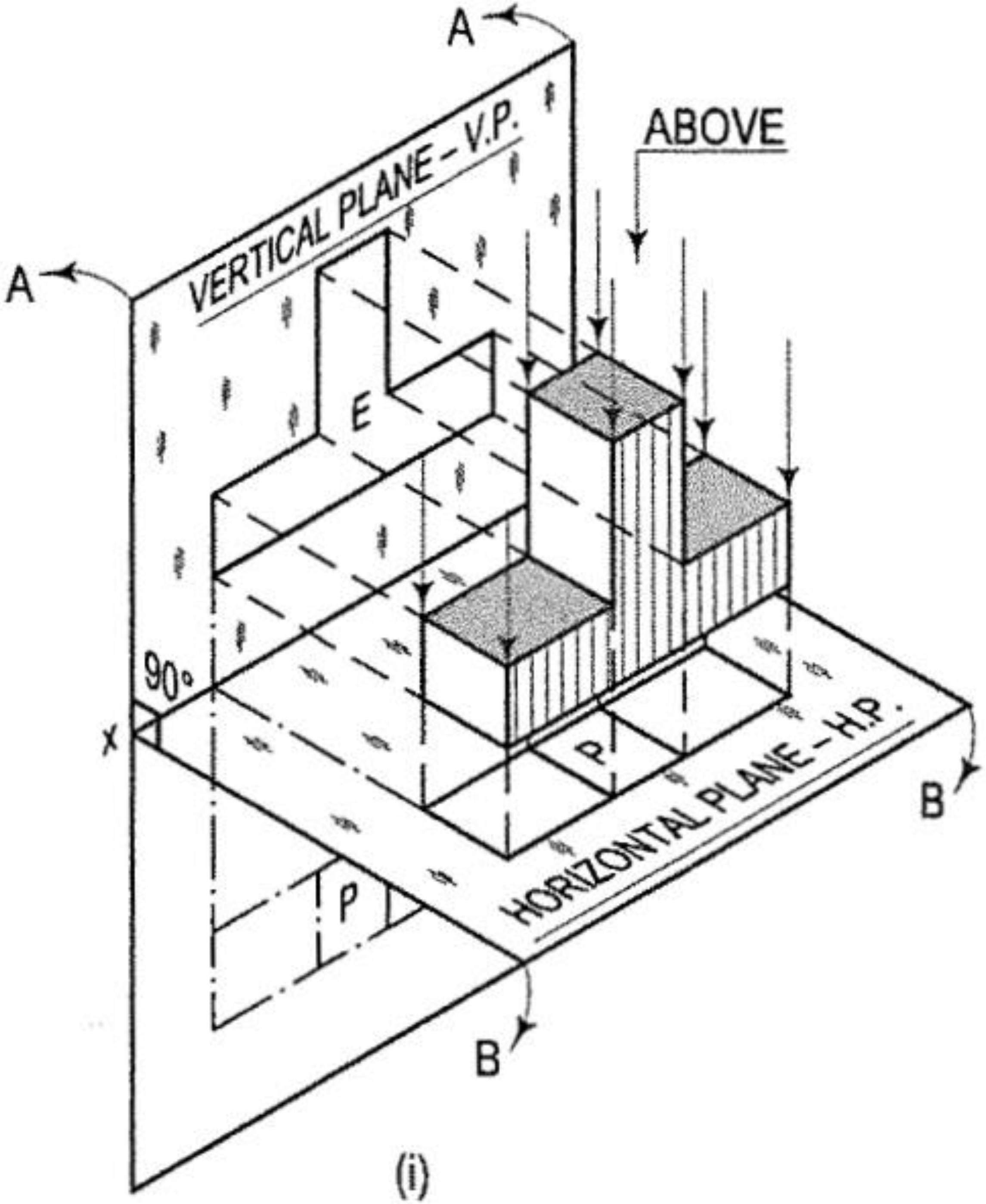
Sketch looking from the direction of arrow
Front View, Top View and side view



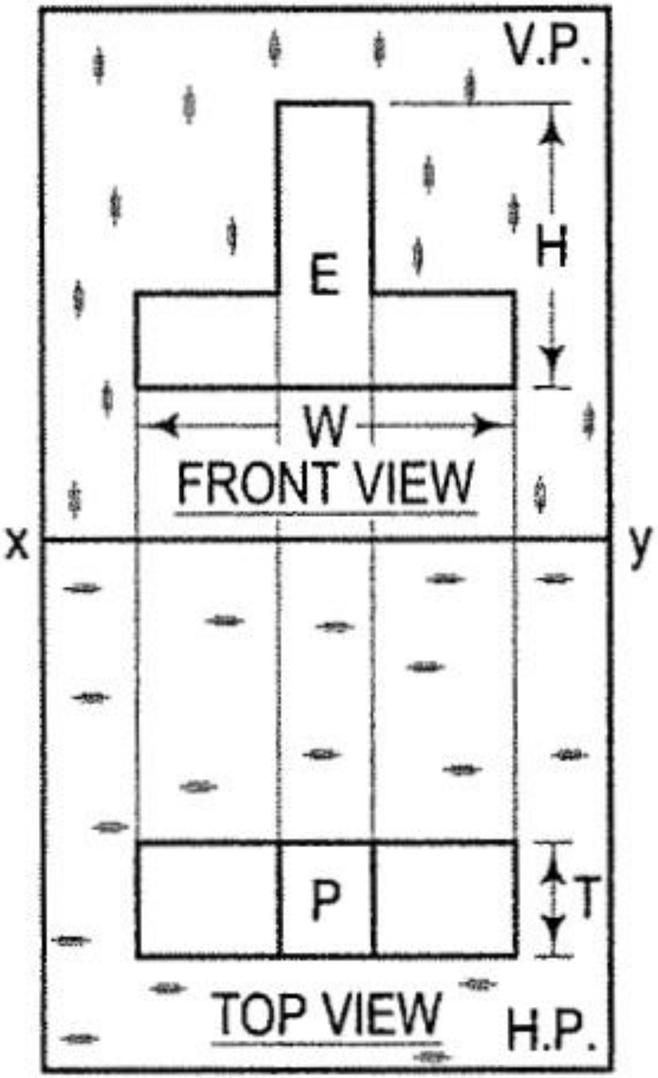



# FIRST ANGLE PROJECTION

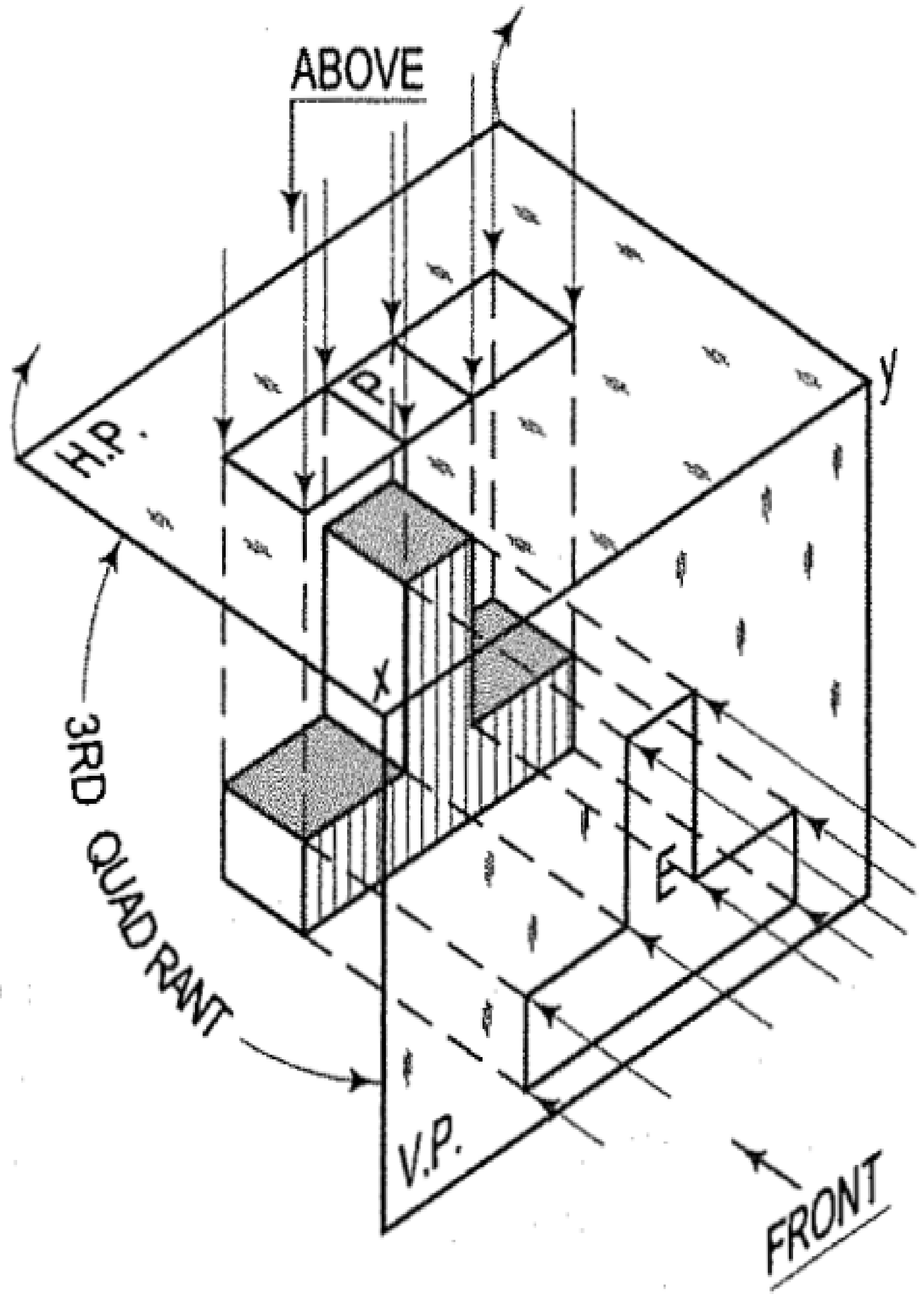


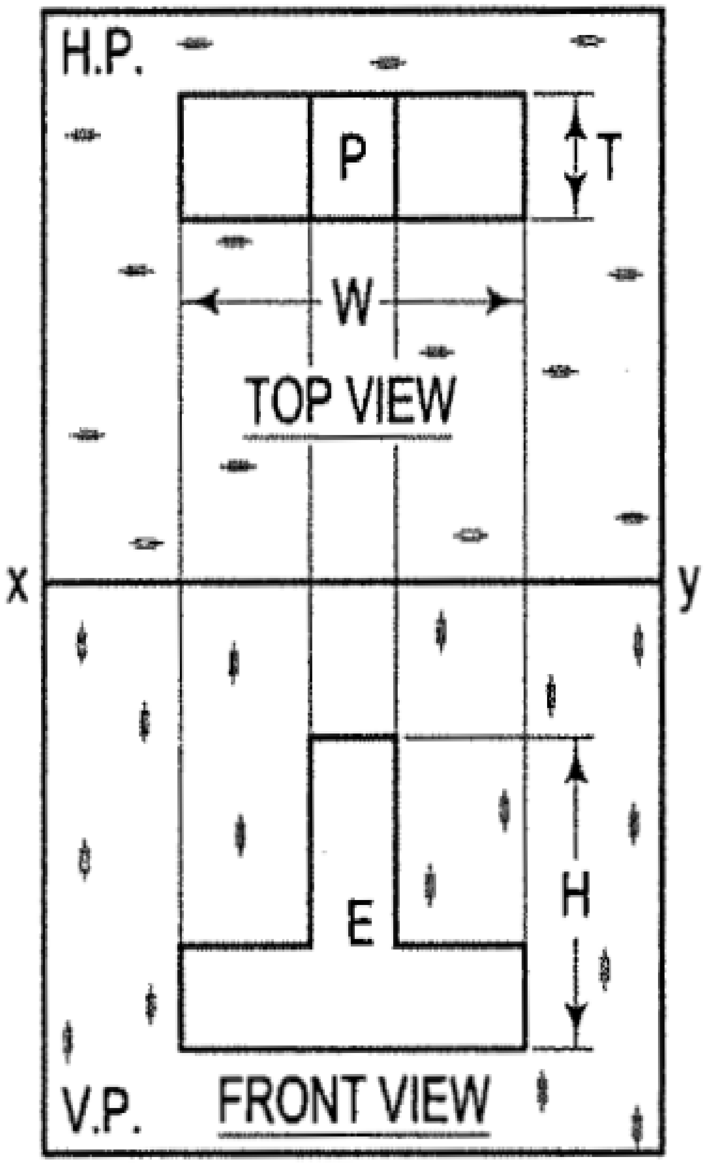

(i)



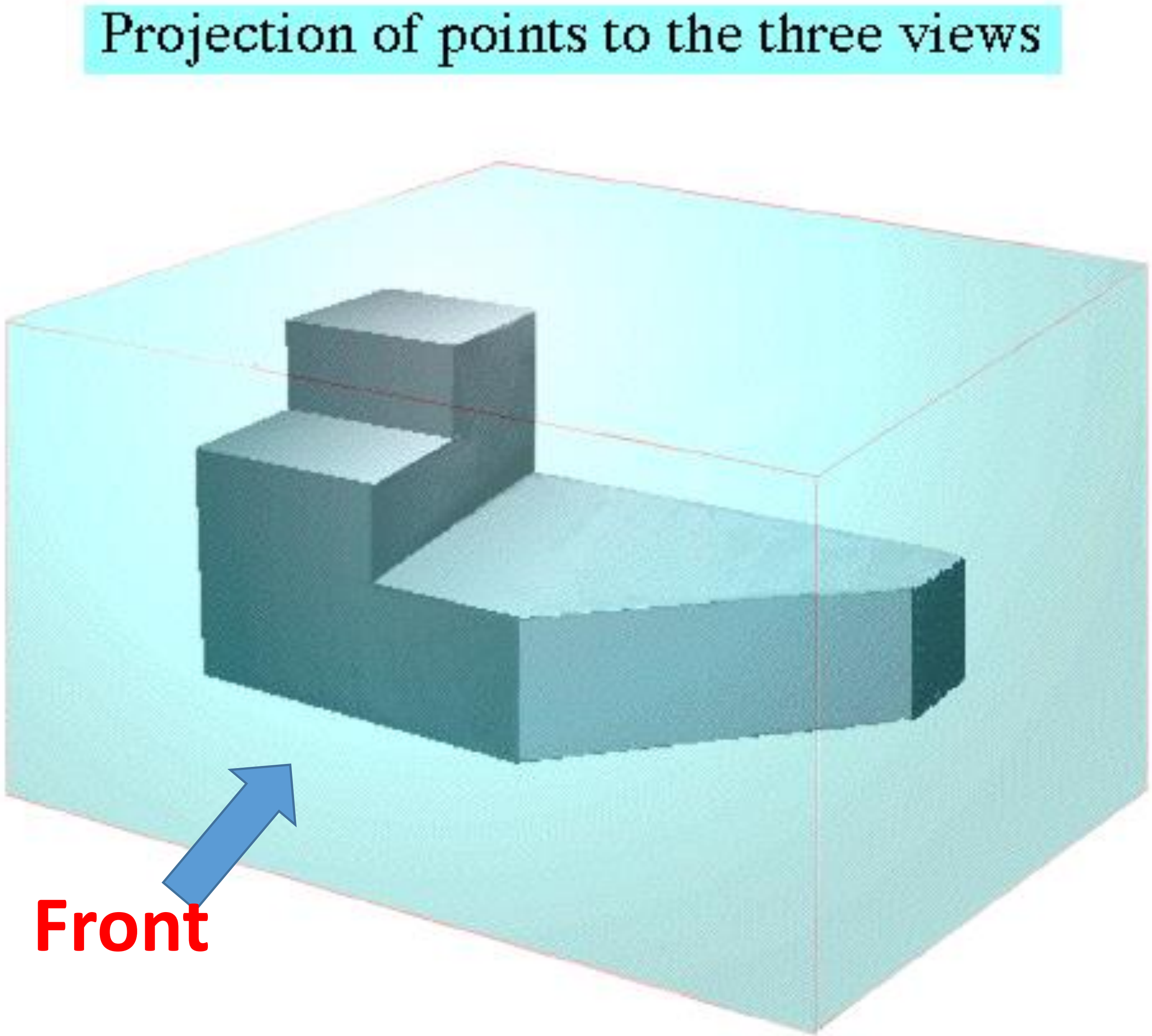

(ii)

# THIRD ANGLE PROJECTION – THIRD QUADRANT



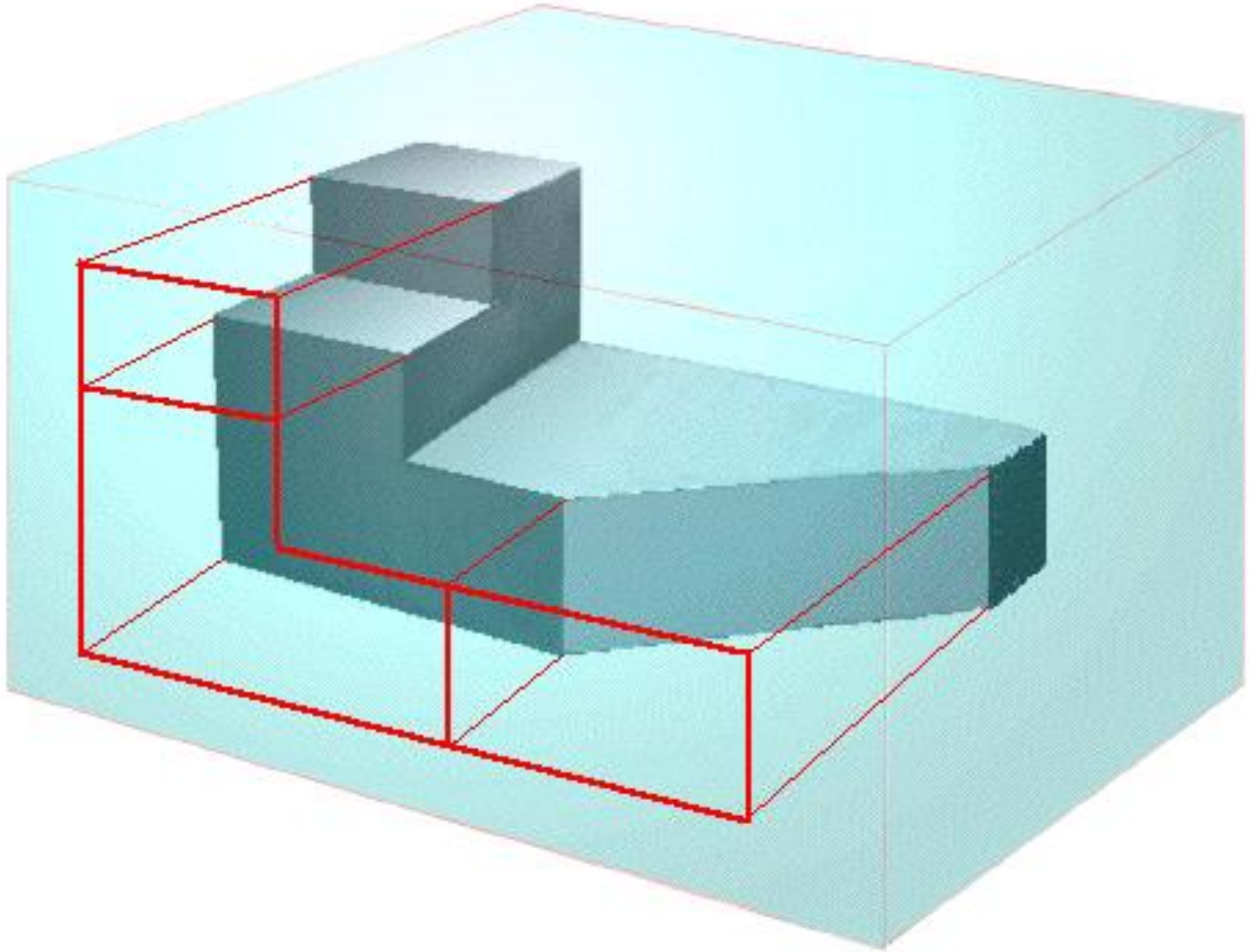



# Glass Box Approach

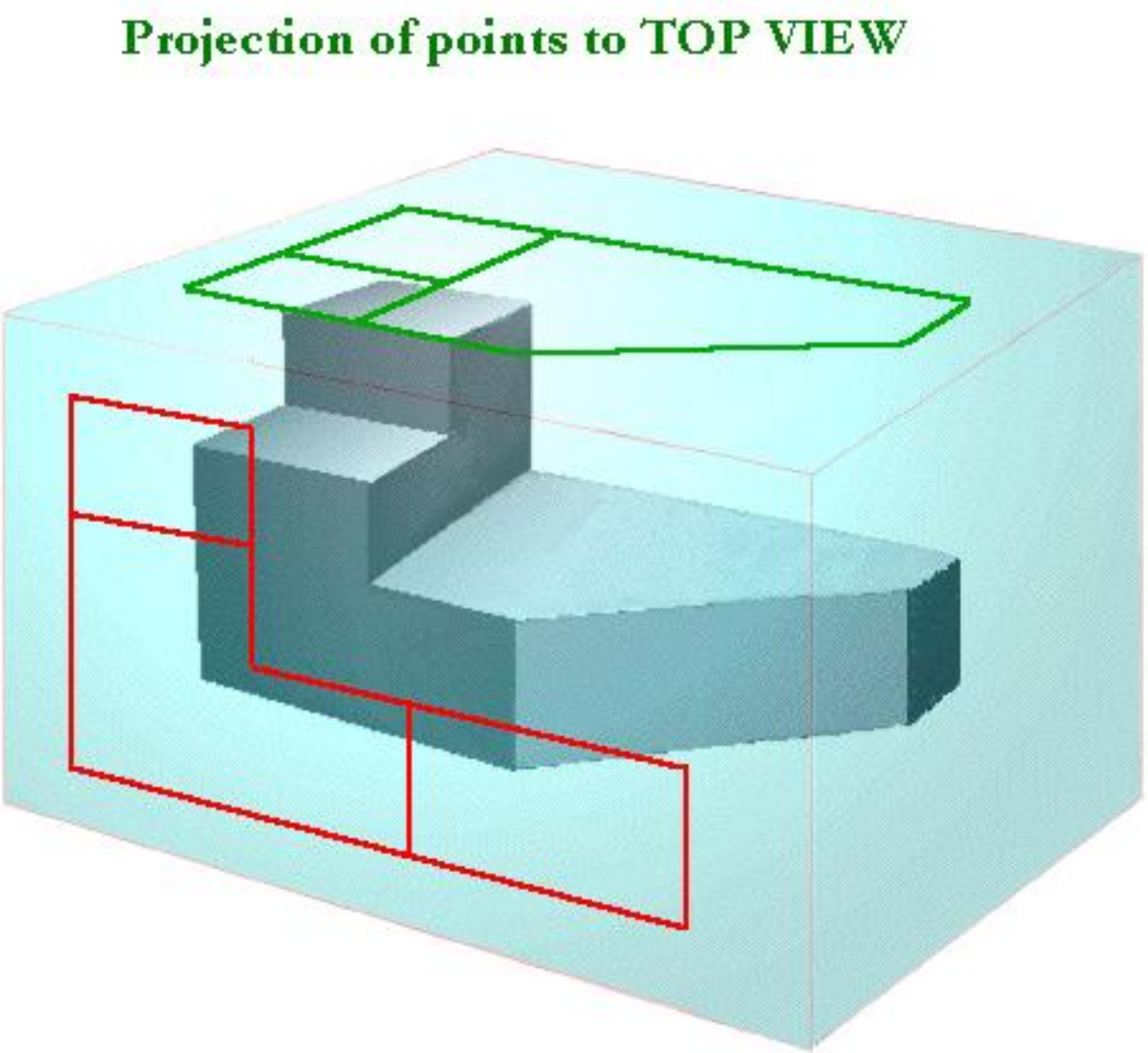


# Glass Box Approach

Projection of points to FRONT VIEW

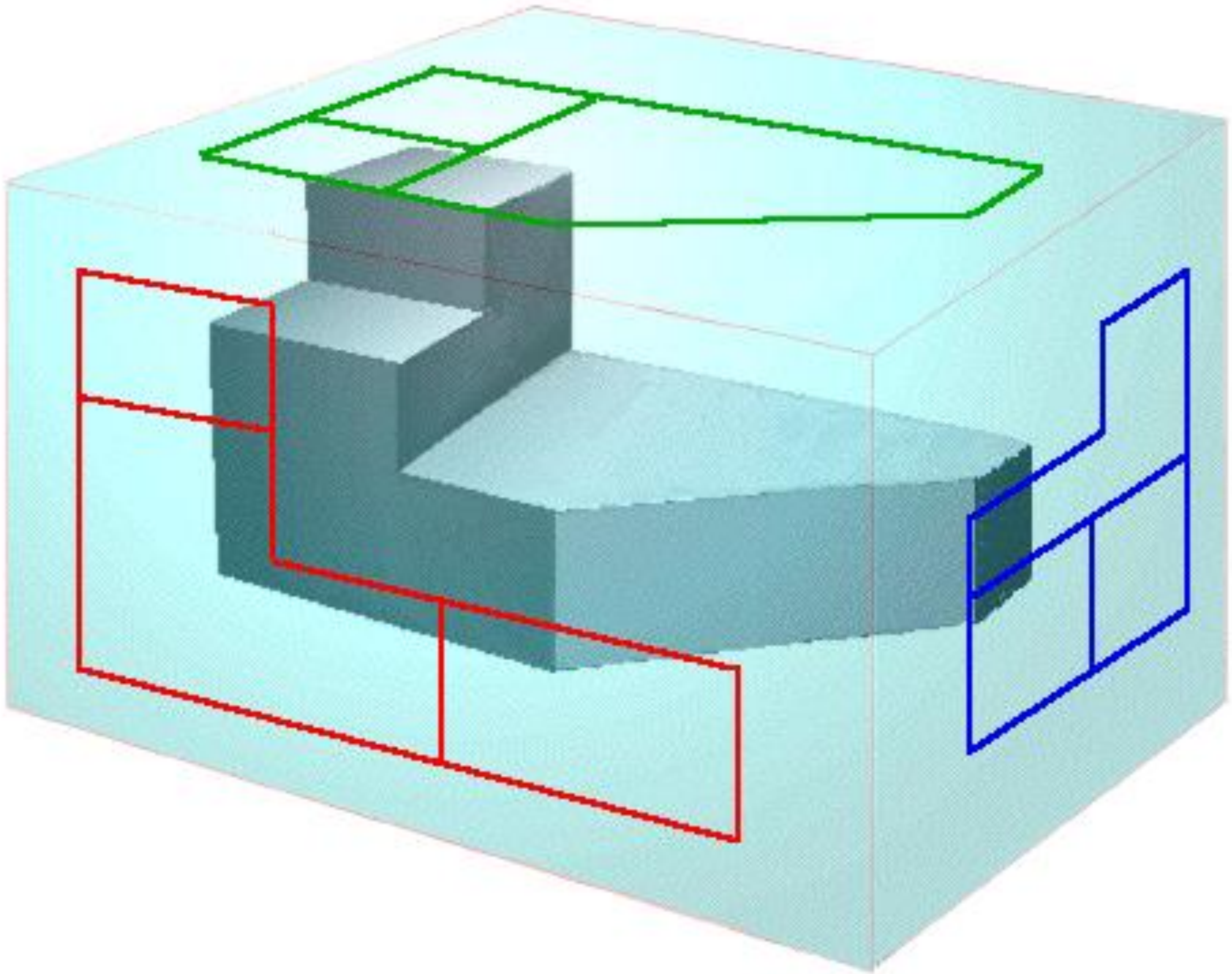


# Glass Box Approach



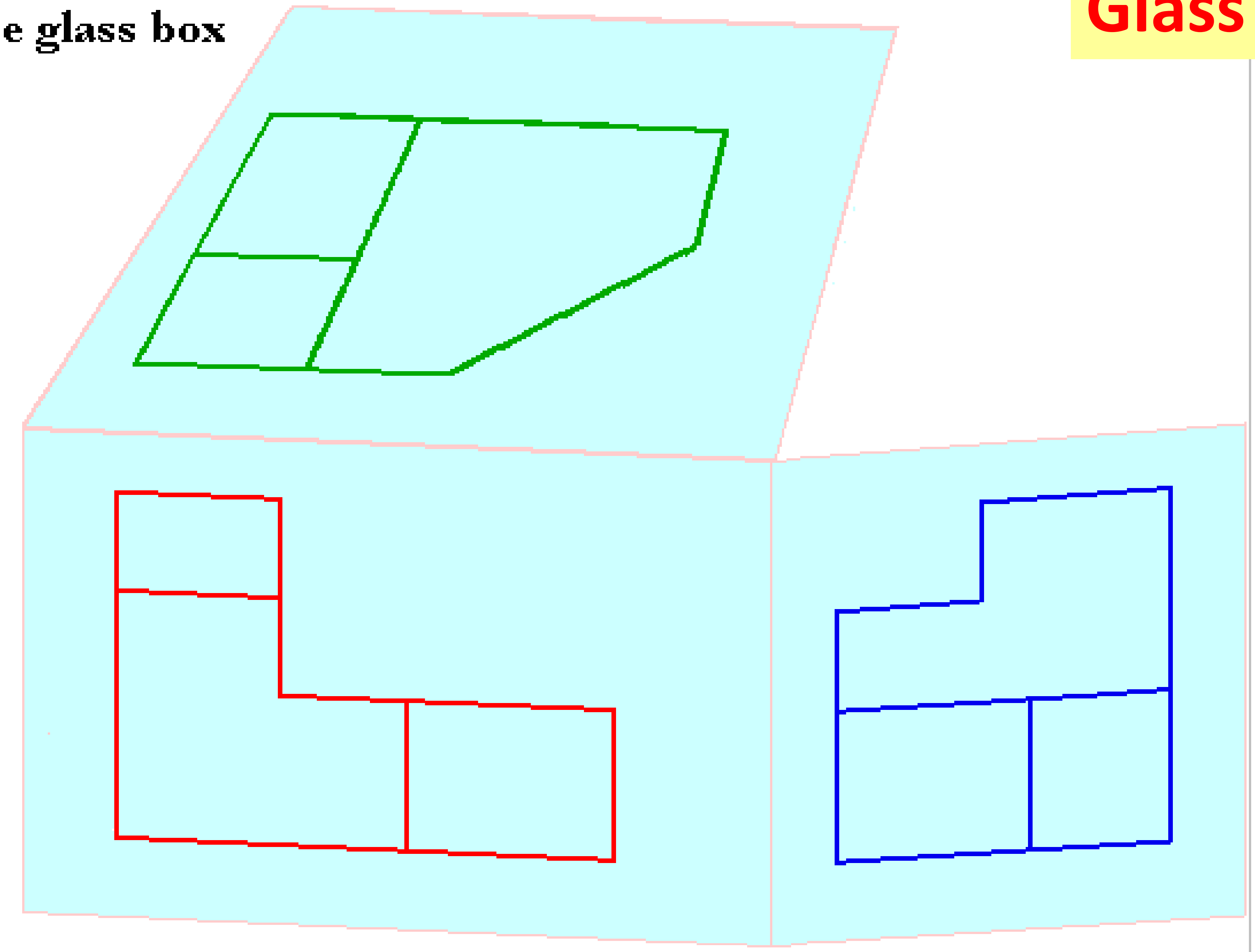
# Glass Box Approach

Projection of points to RIGHT SIDE VIEW

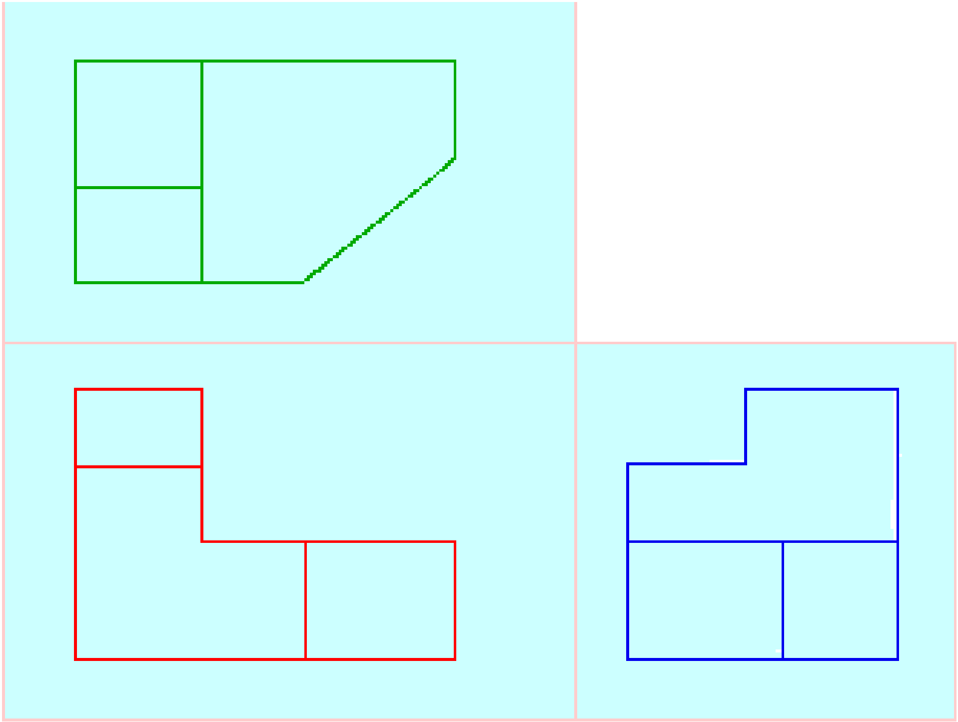


# Glass Box Approach

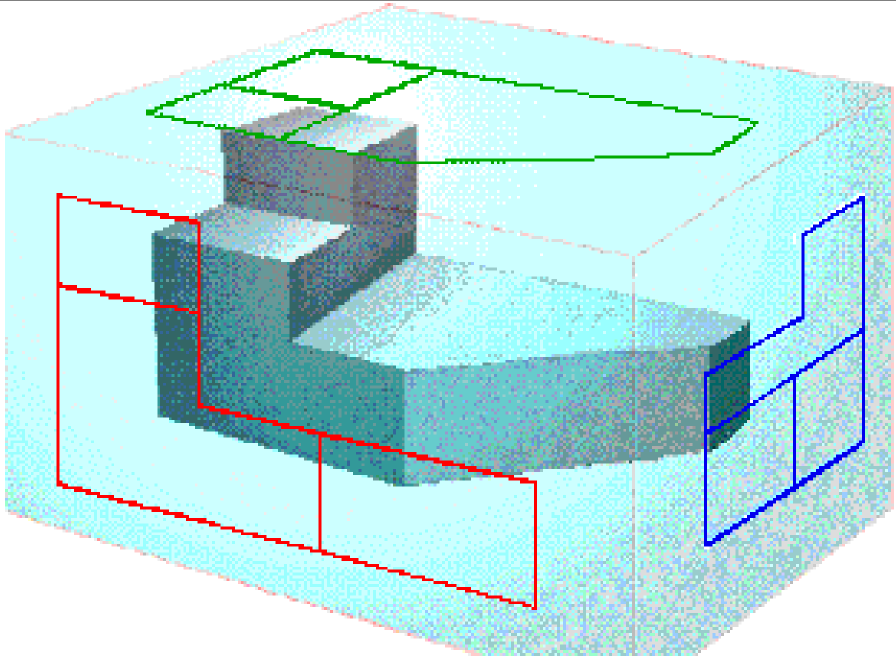
Unfold the glass box



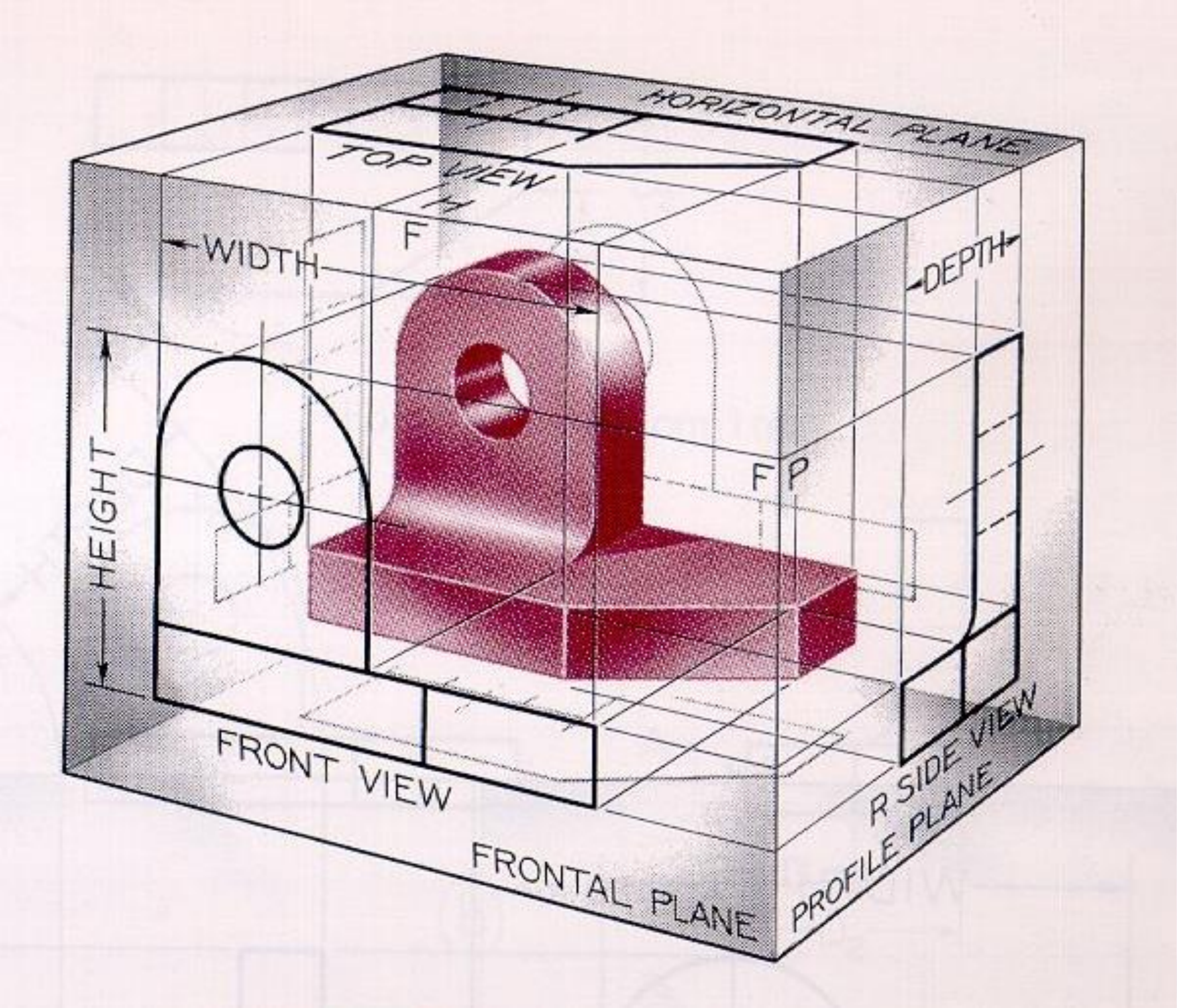
Unfolded glass-box

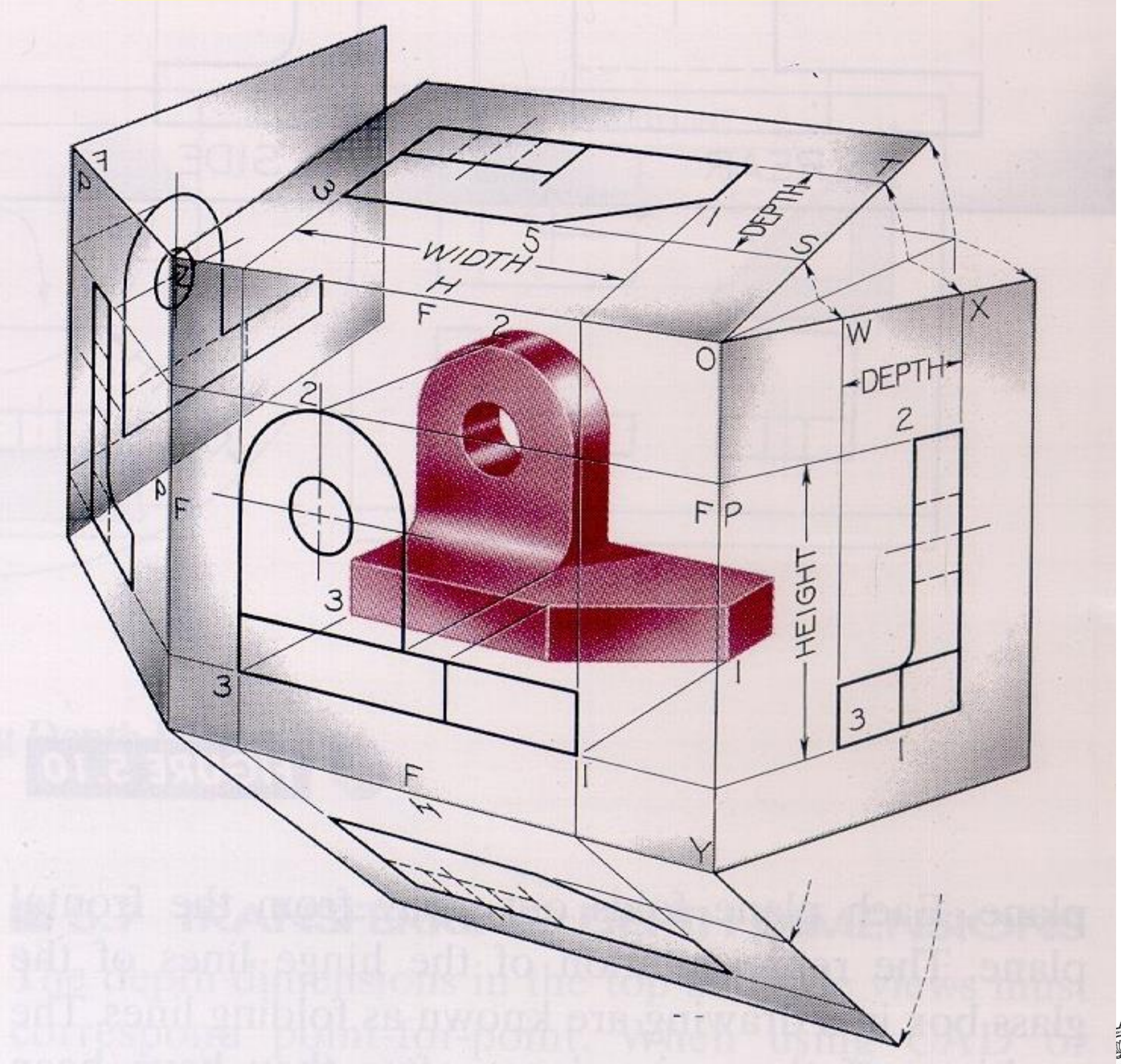


Object in the glass-box



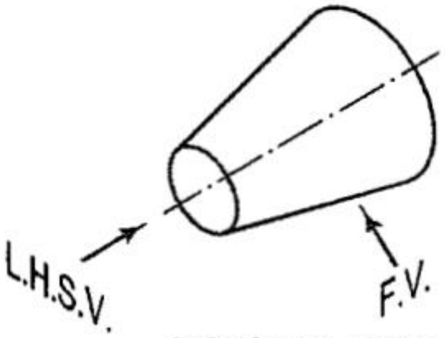
# Unfolding the Glass Box



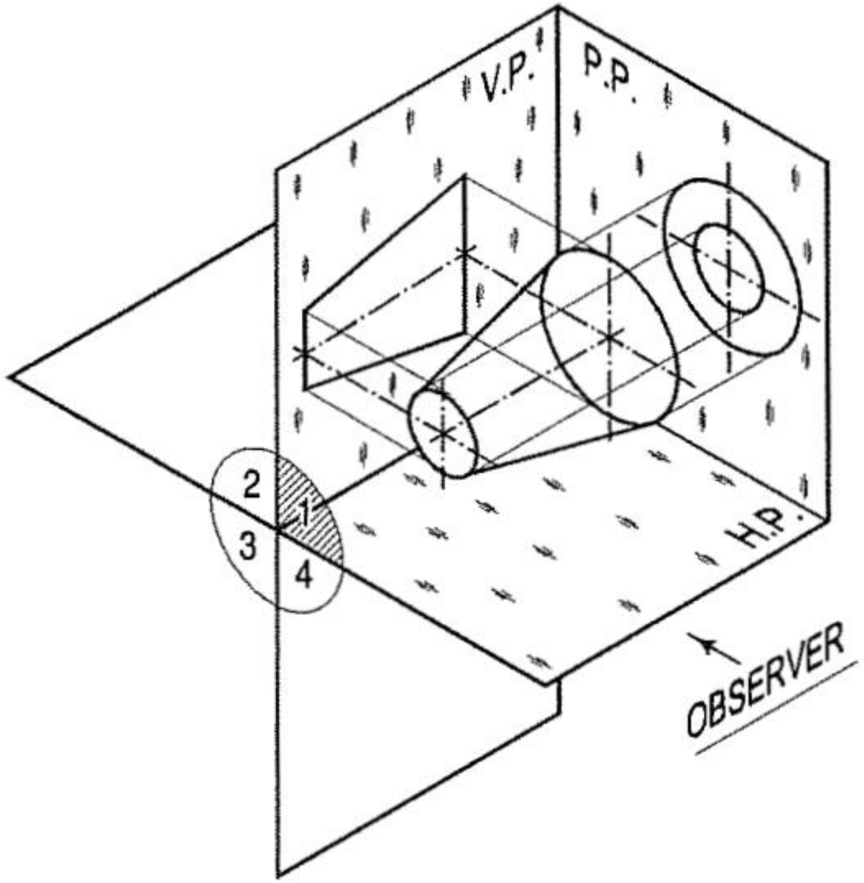




# Glass Box Approach

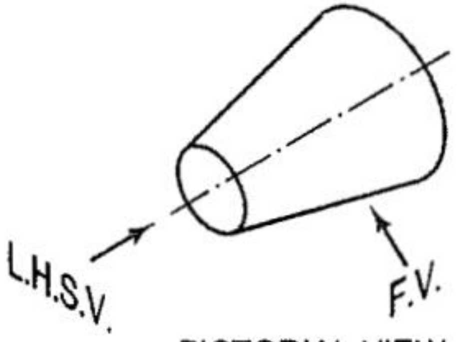
## FIRST ANGLE PROJECTION METHOD



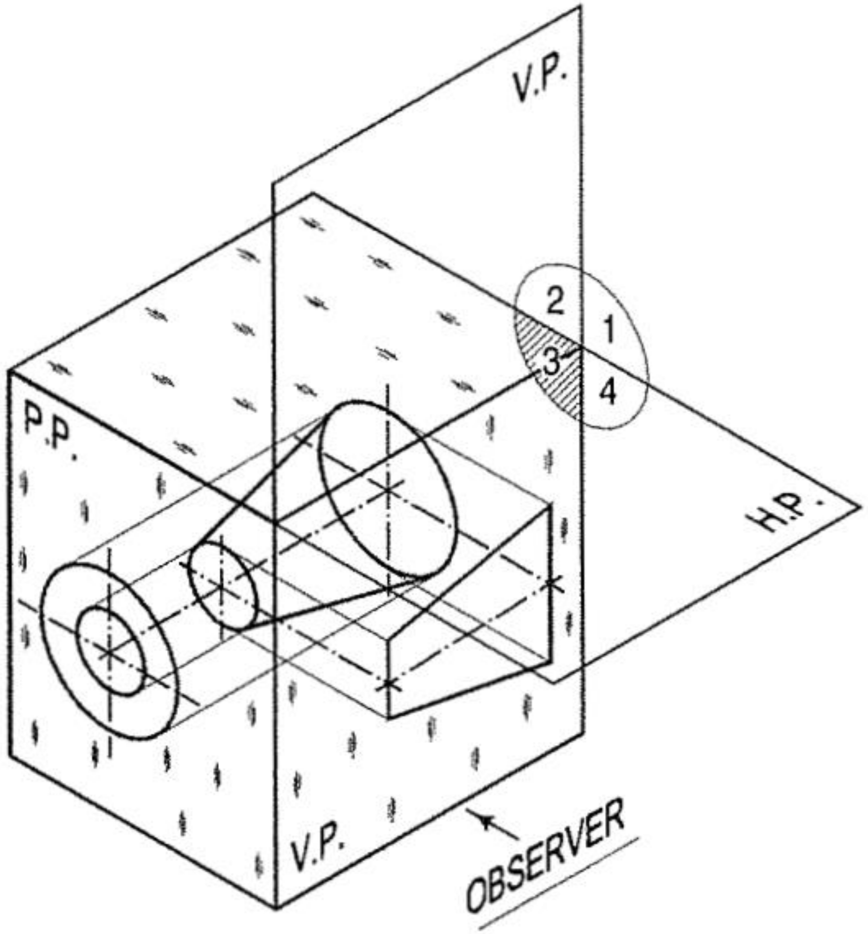

PICTORIAL VIEW

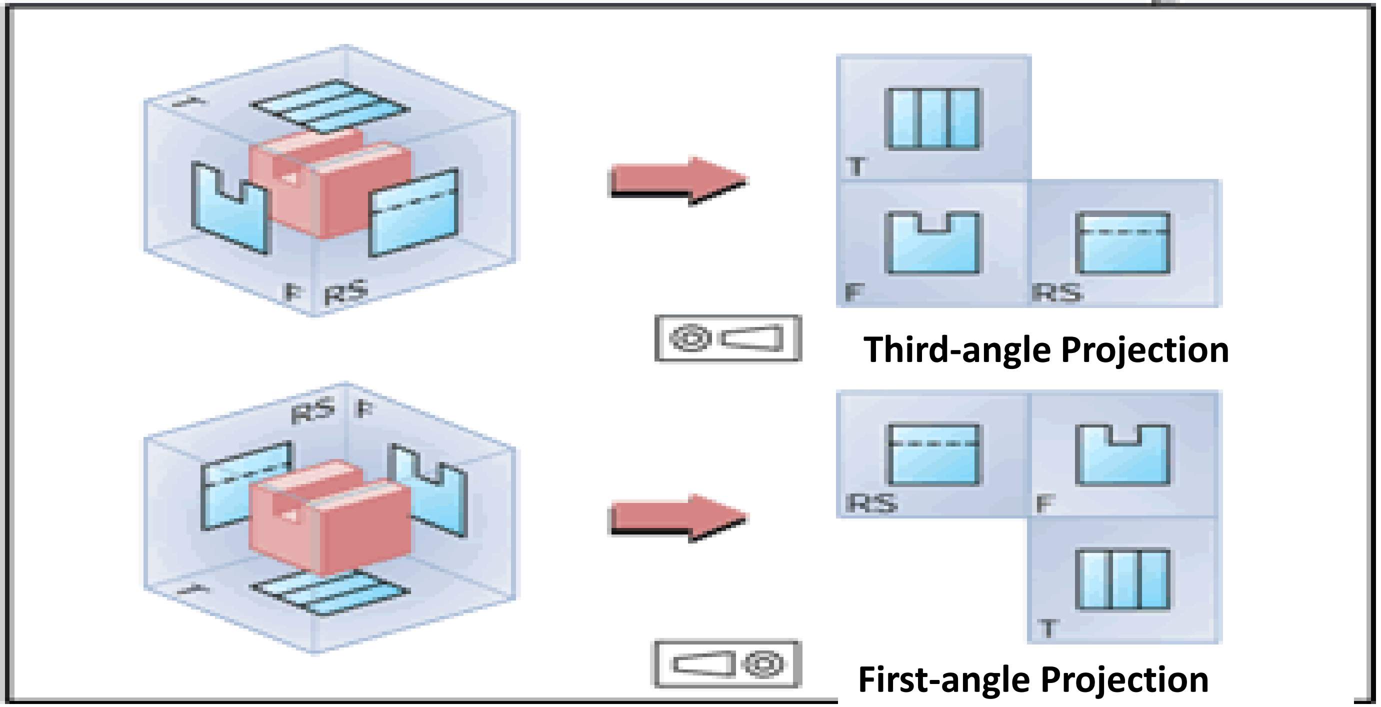



## THIRD ANGLE PROJECTION METHOD




PICTORIAL VIEW



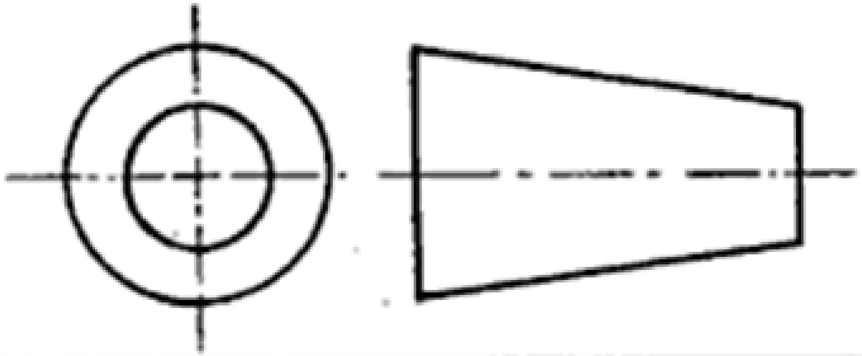



## FIRST ANGLE PROJECTION

Object lies between the observer and the planes of projection

Front view comes above the top view

Object is situated on or above the horizontal plane

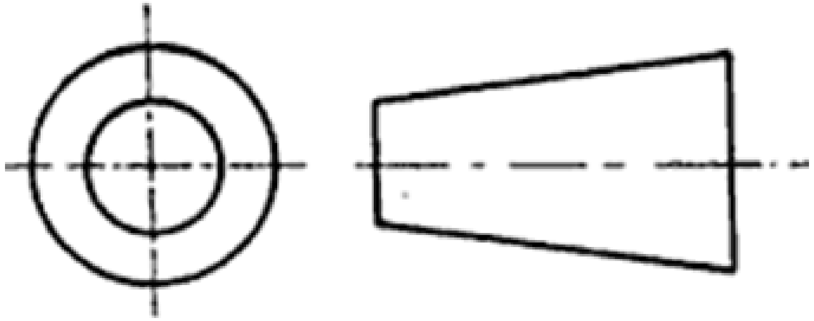


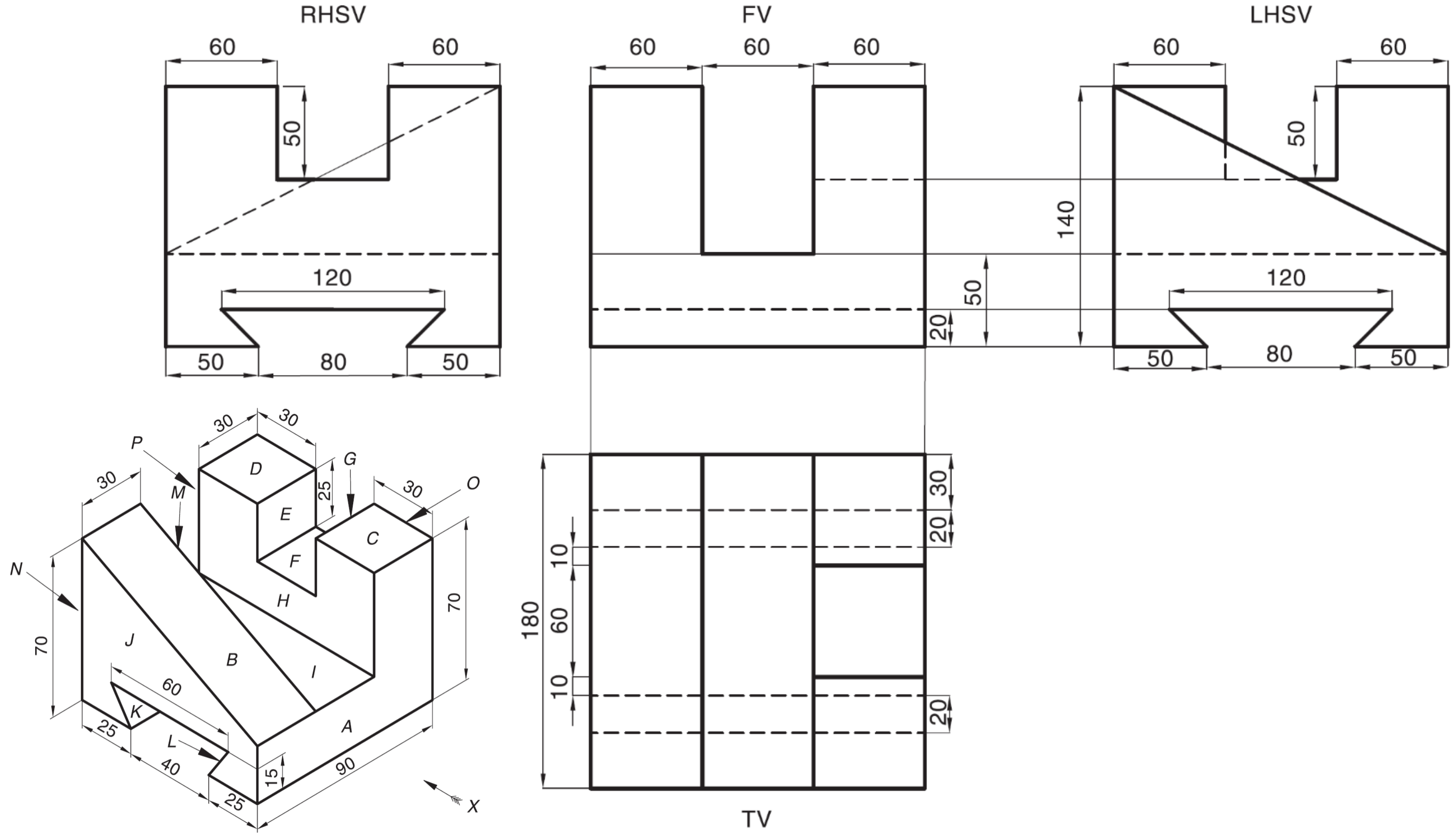
## THIRD ANGLE PROJECTION

Planes of projection lie between the object and observer

Top view comes above the front view

Object is situated on or above the ground




RHSV
FV
LHSV
TV
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60
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50
120
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80
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140
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180
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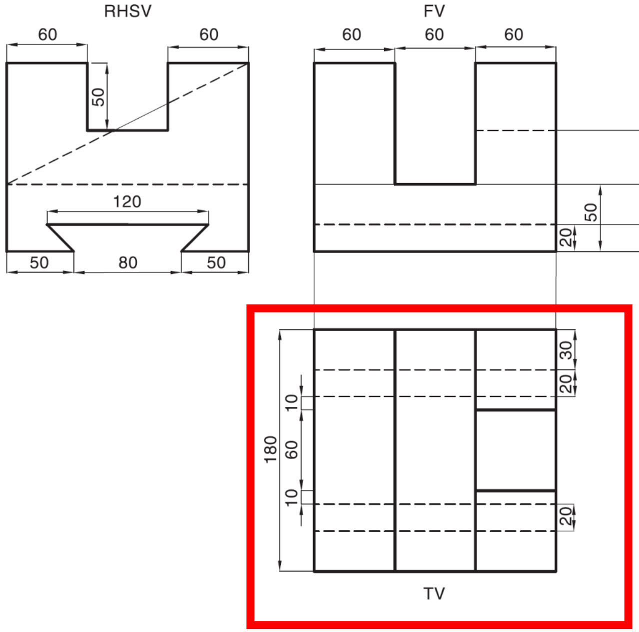
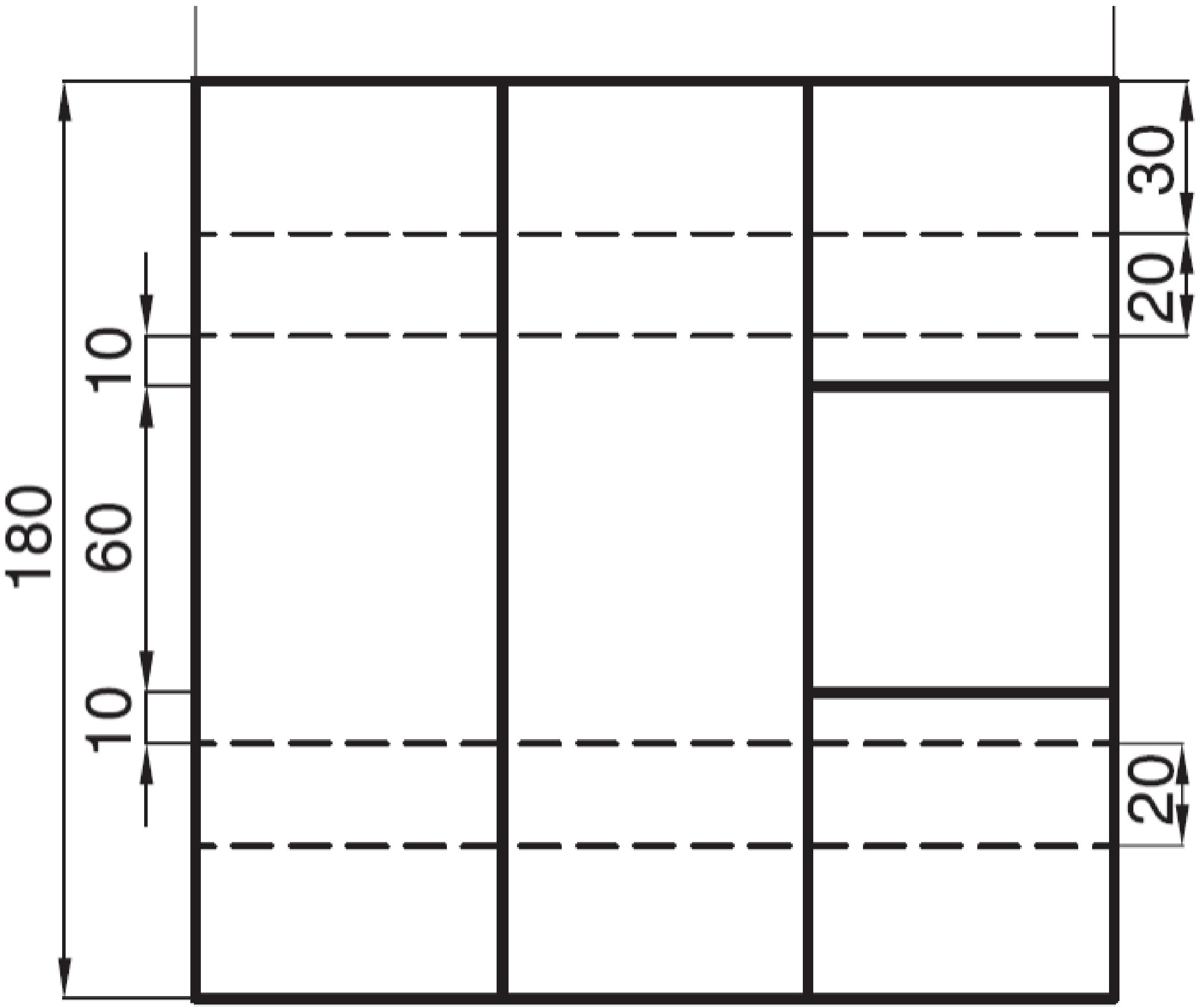
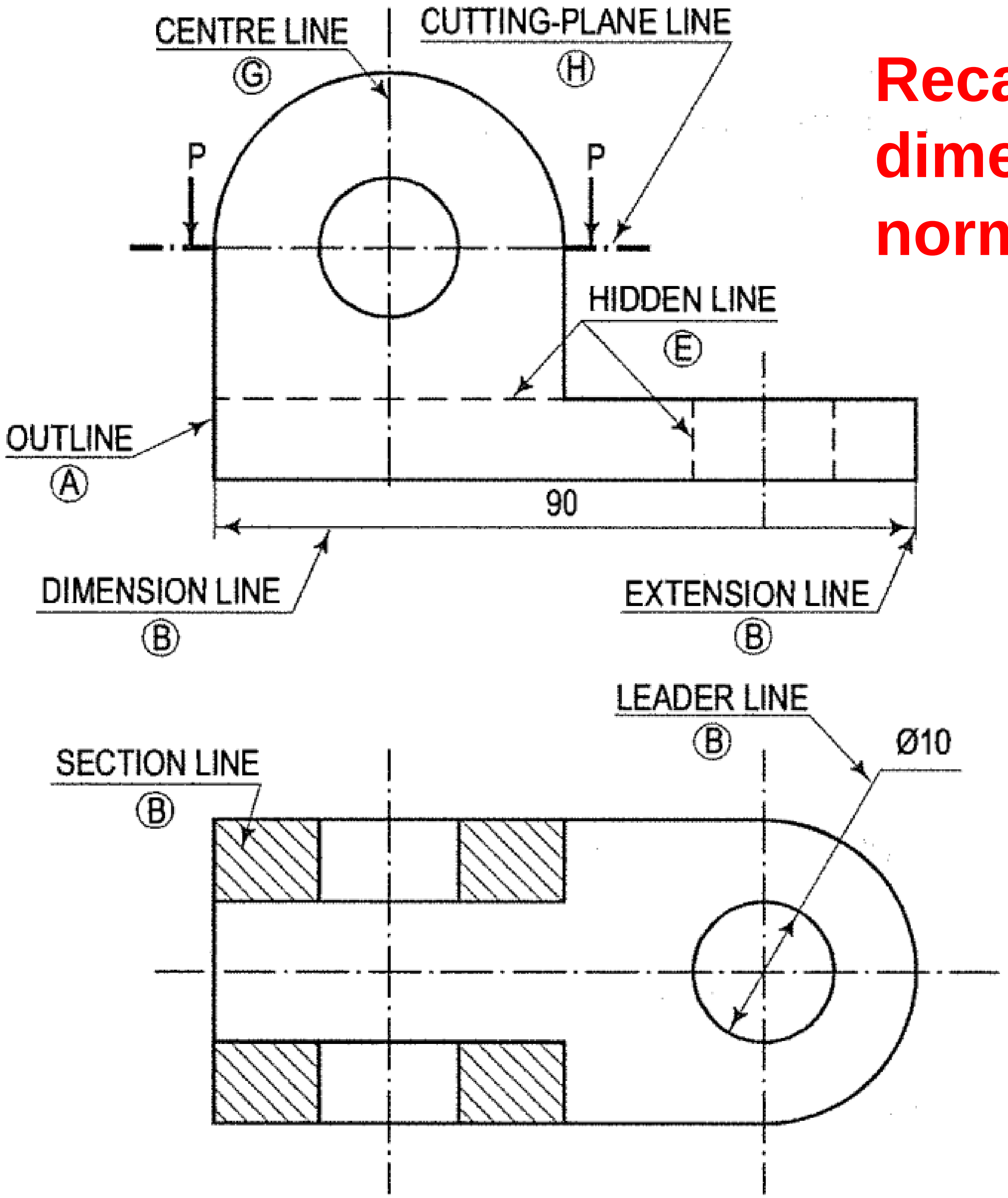
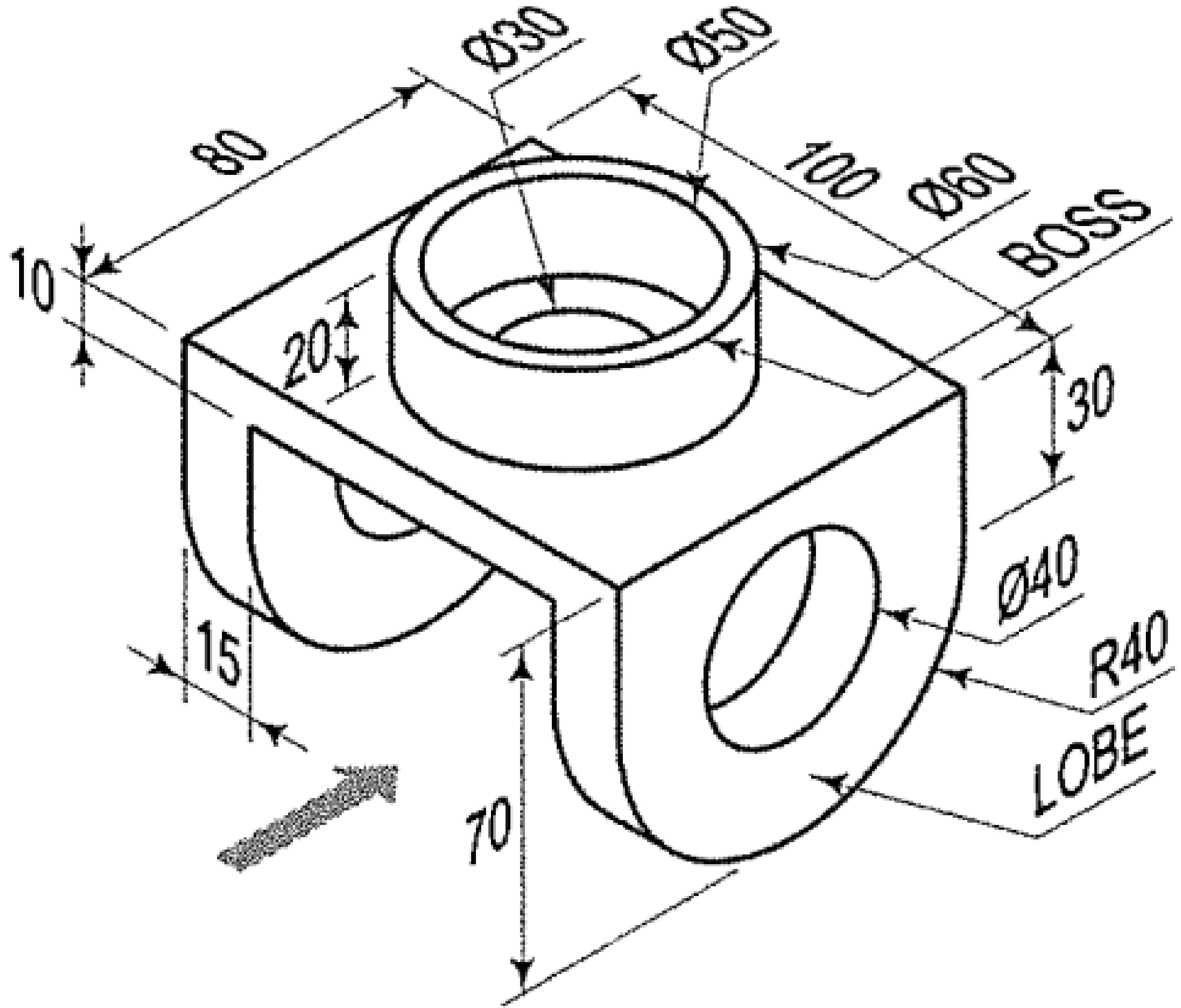


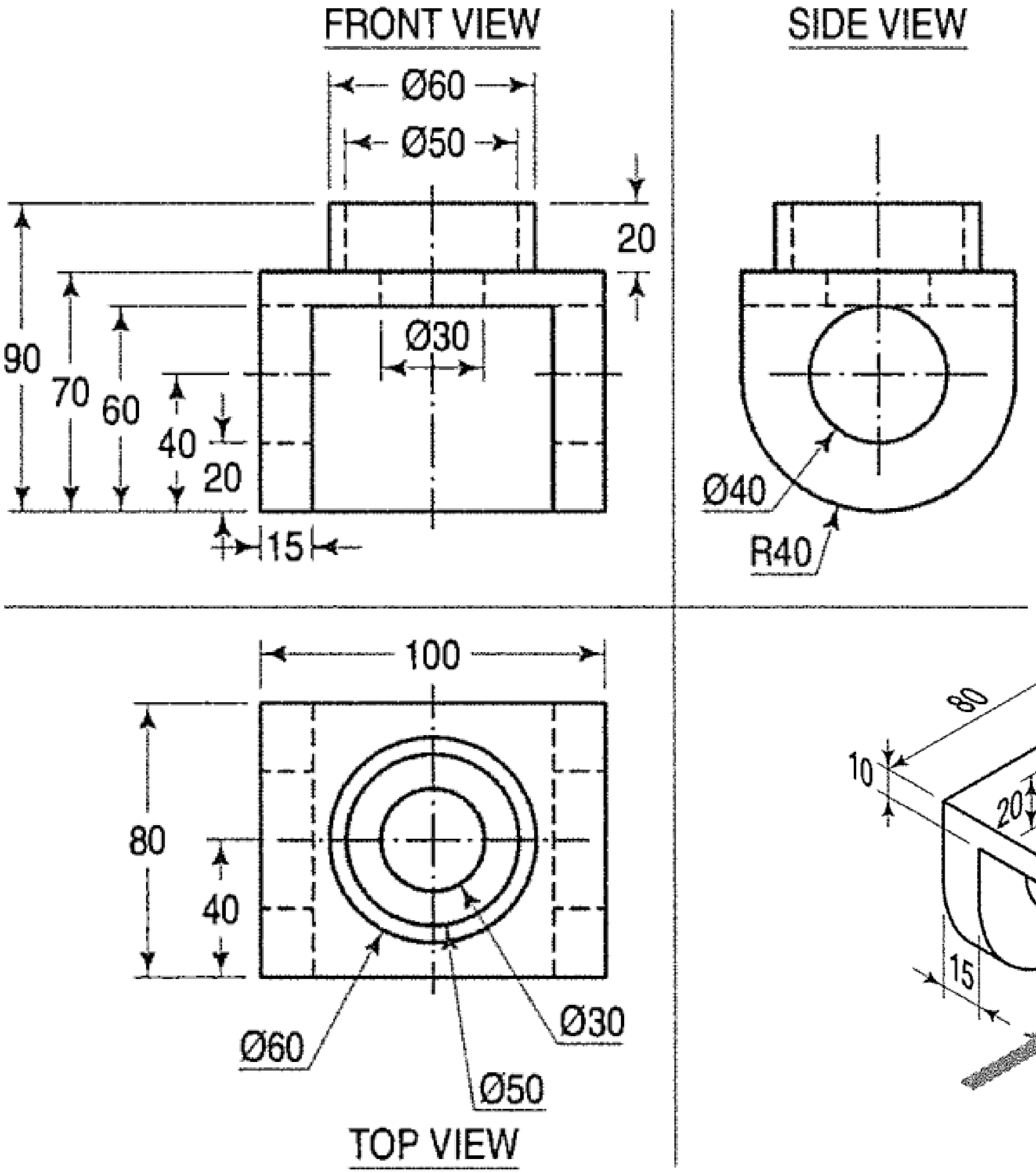



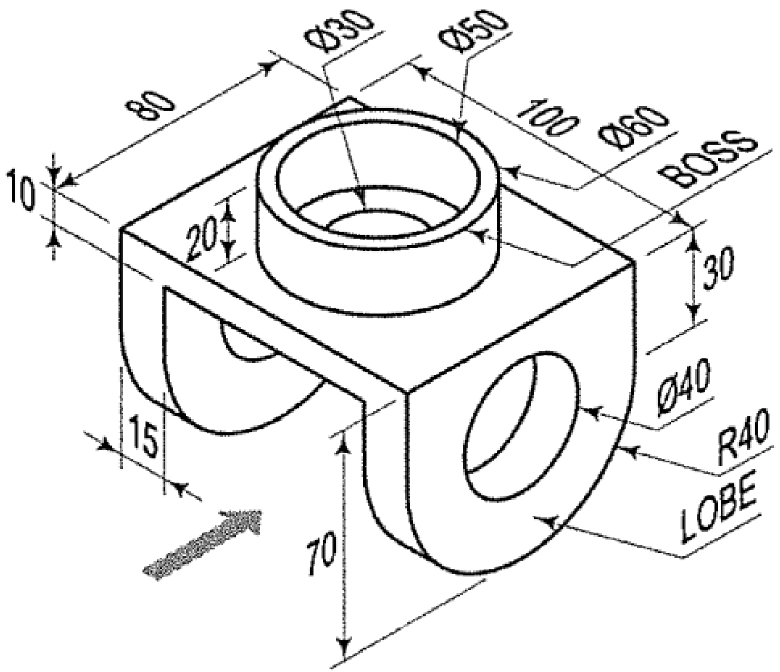

TV

## Recall dimensioning norms



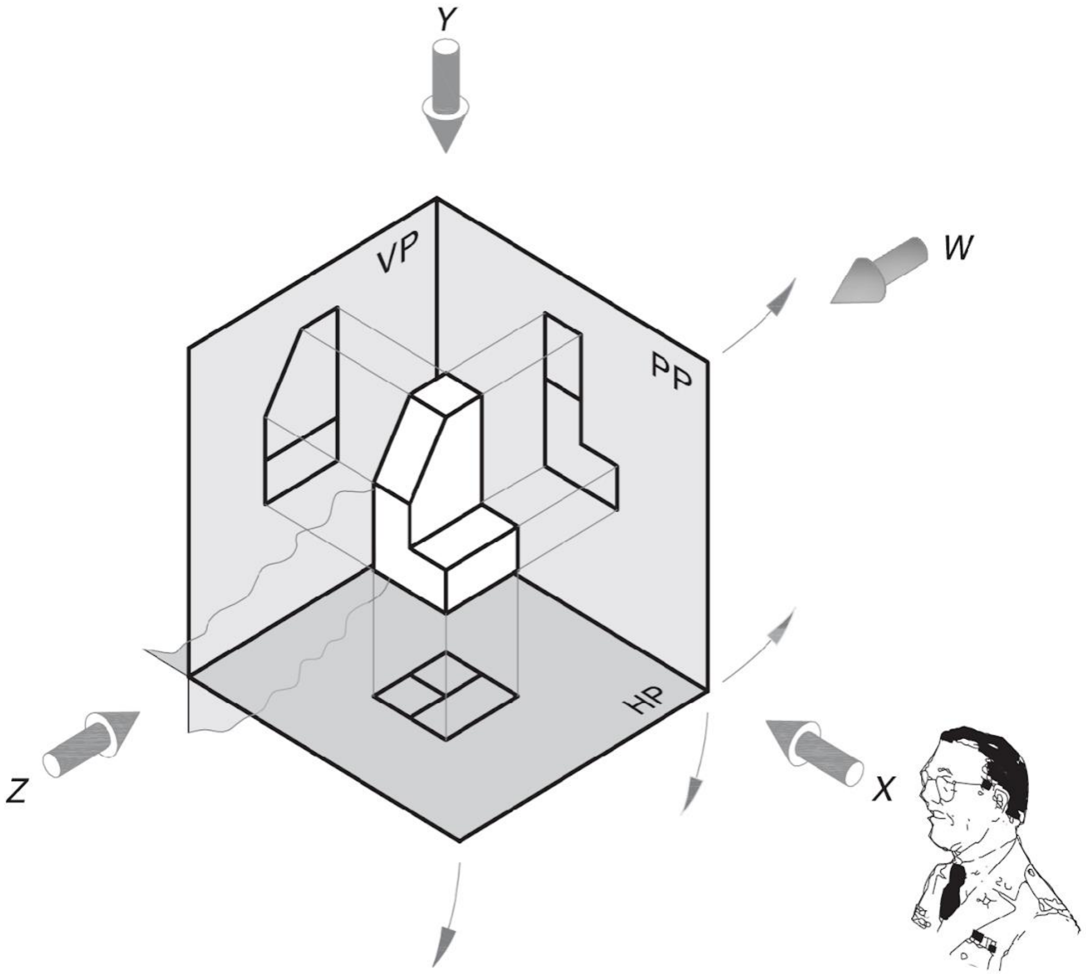

Ø30
Ø50
80
100
Ø60
BOSS
10
20
30
Ø40
R40
LOBE
15
70



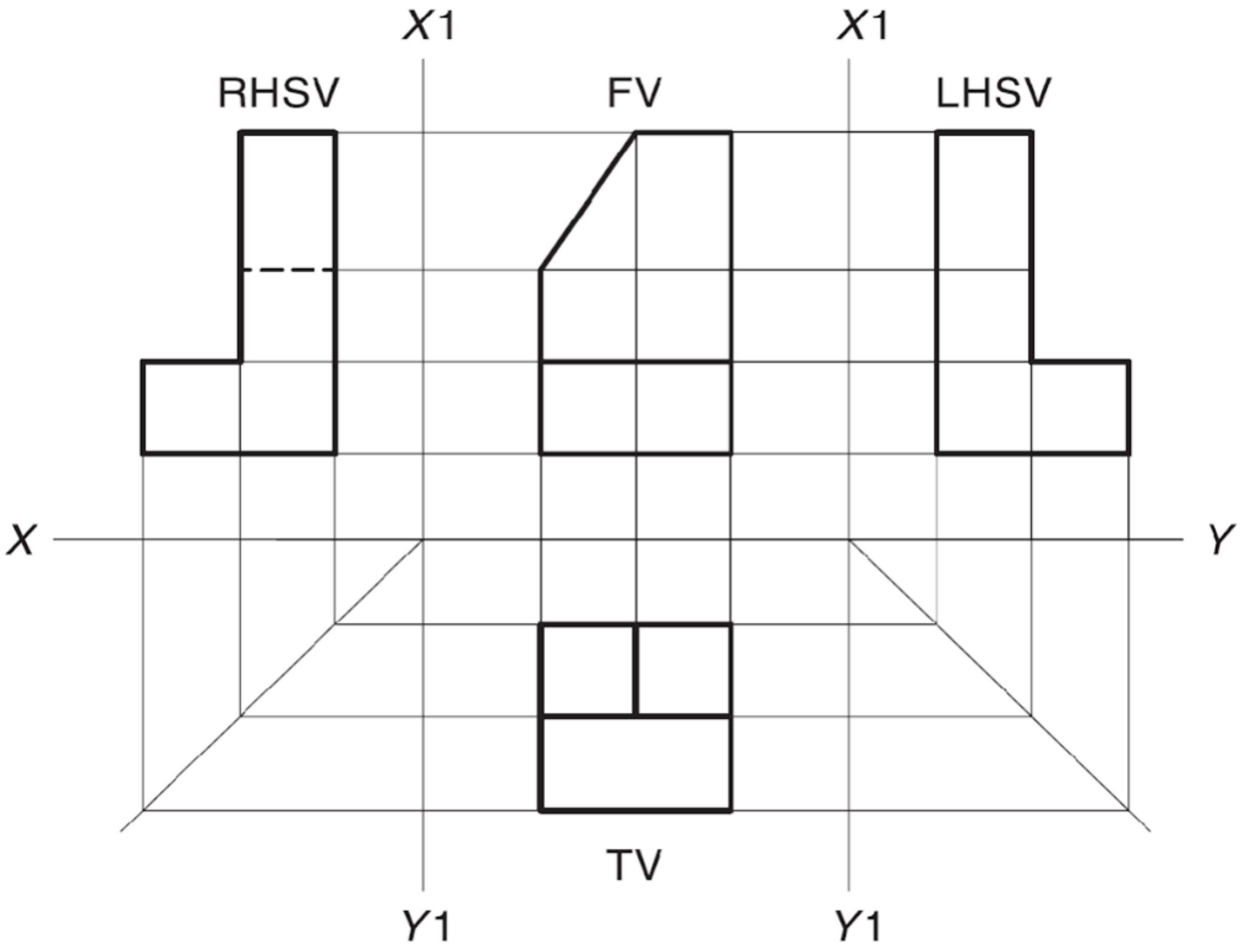




**Note the different method of dimensioning**

Object lies between projection plane and observer



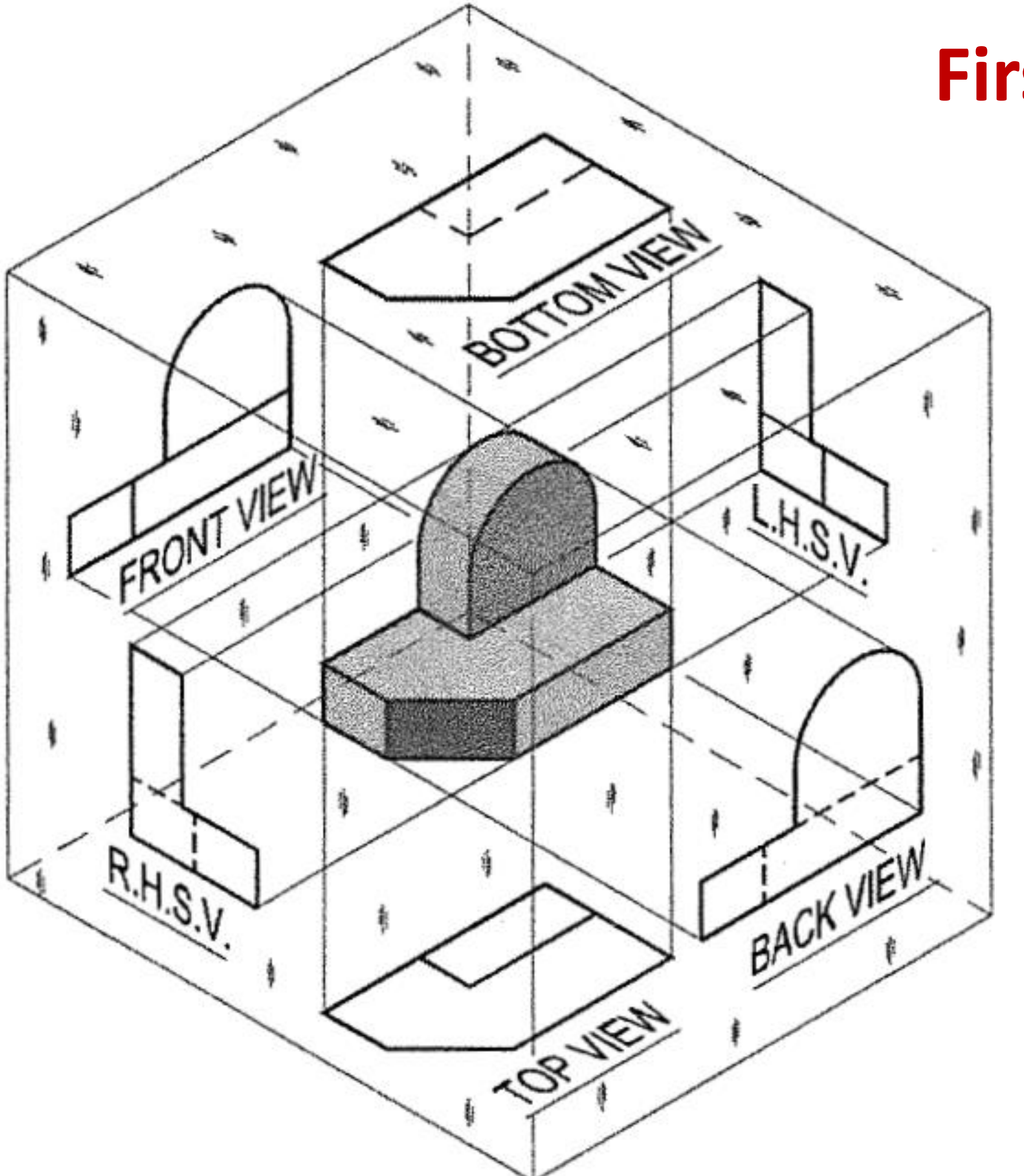

(a) Object in First Angle



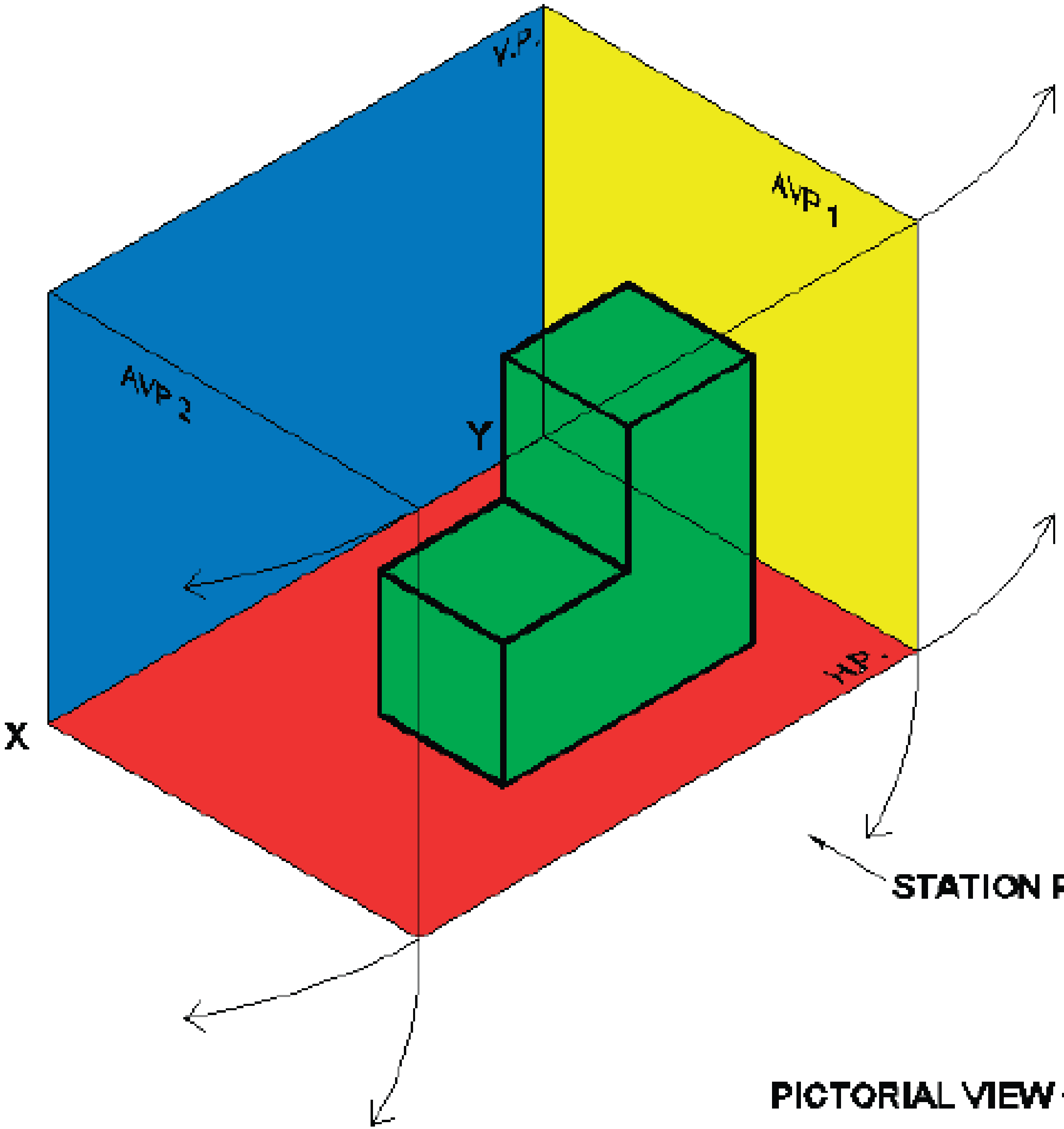

(b) Location of the Principal Views

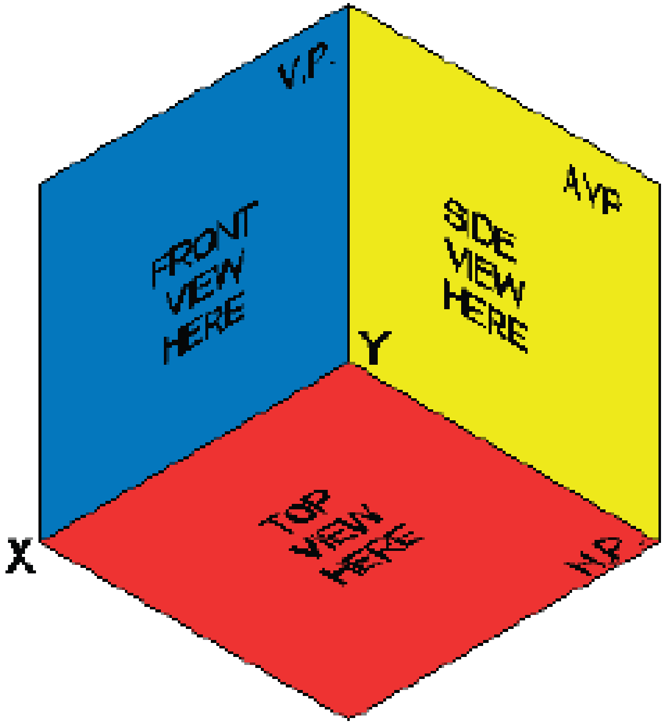
# FIRST ANGLE PROJECTION

# First Angle Projection



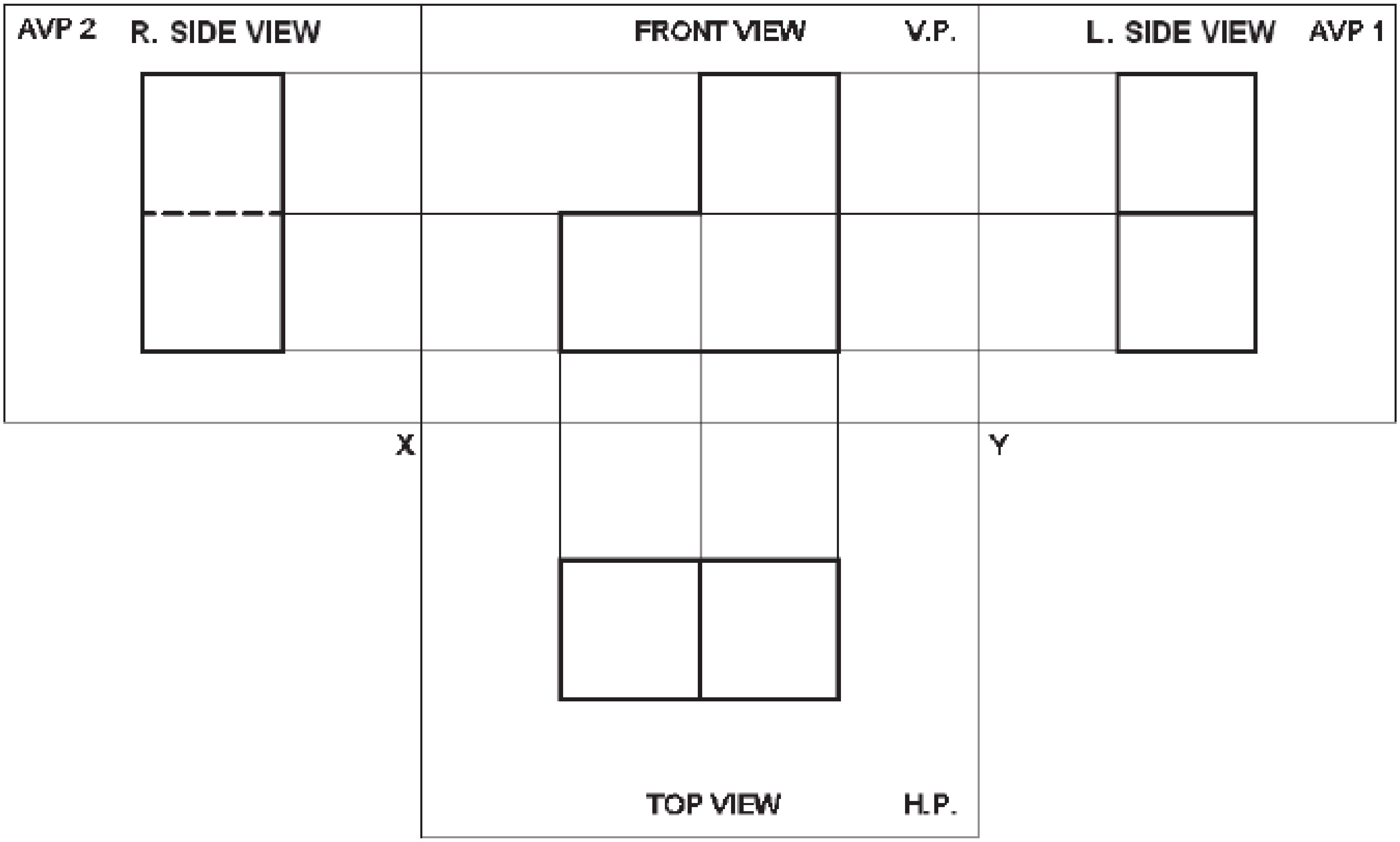
# First Angle Projection



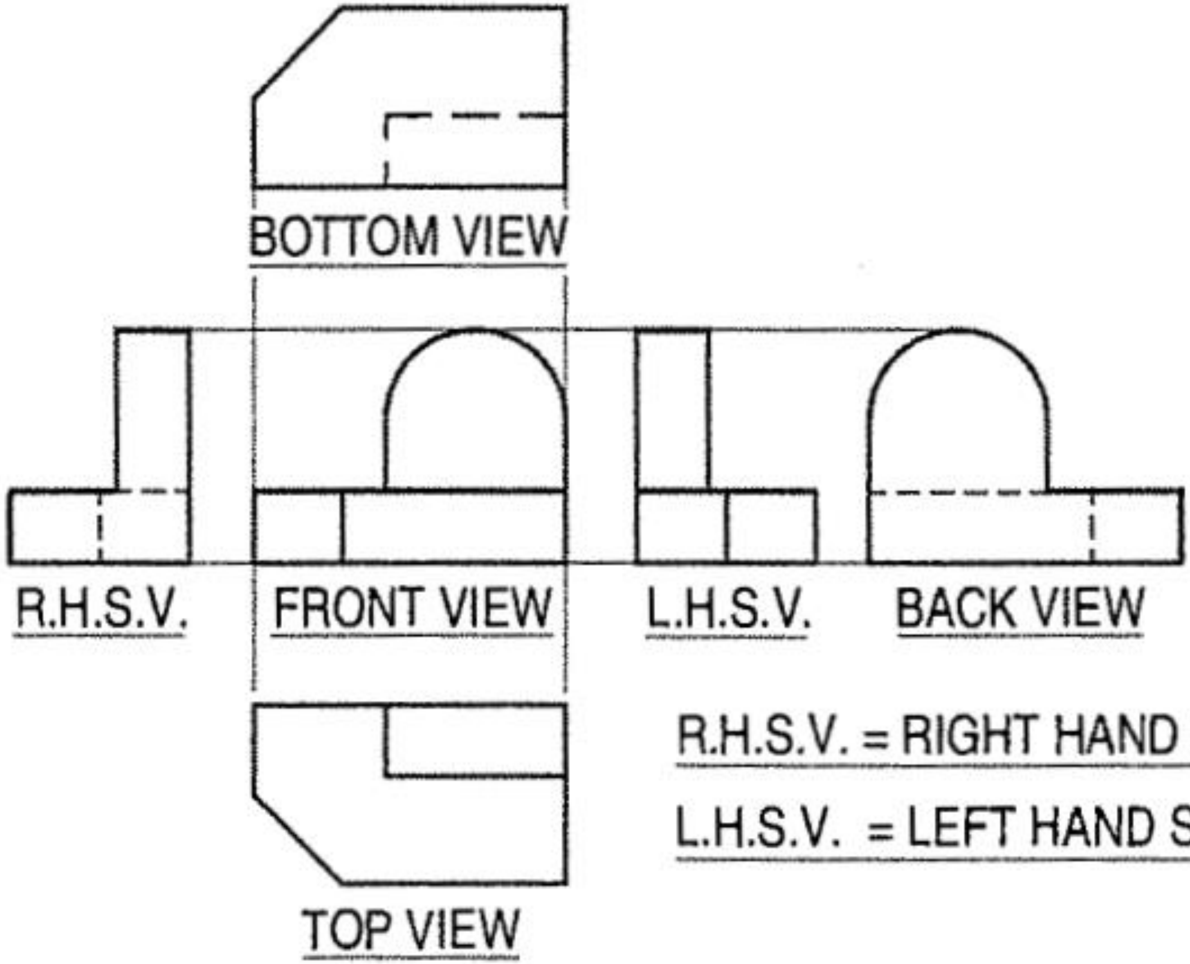

STATION POINT / OBSERVER

PICTORIAL VIEW OF THE OBJECT KEPT IN I QUADRANT




# First Angle Projection

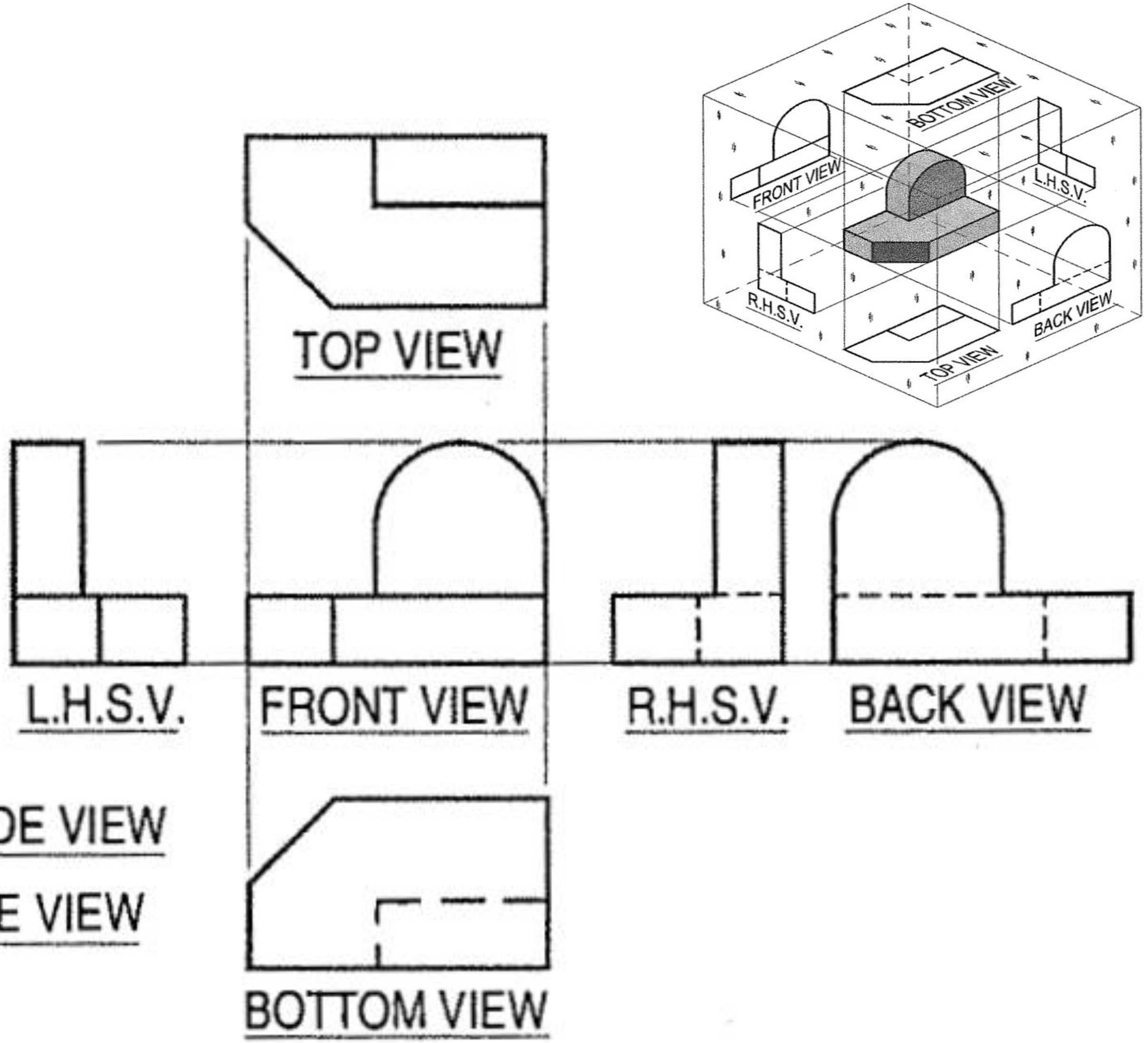
I ANGLE PROJECTION




R.H.S.V. = RIGHT HAND SIDE VIEW

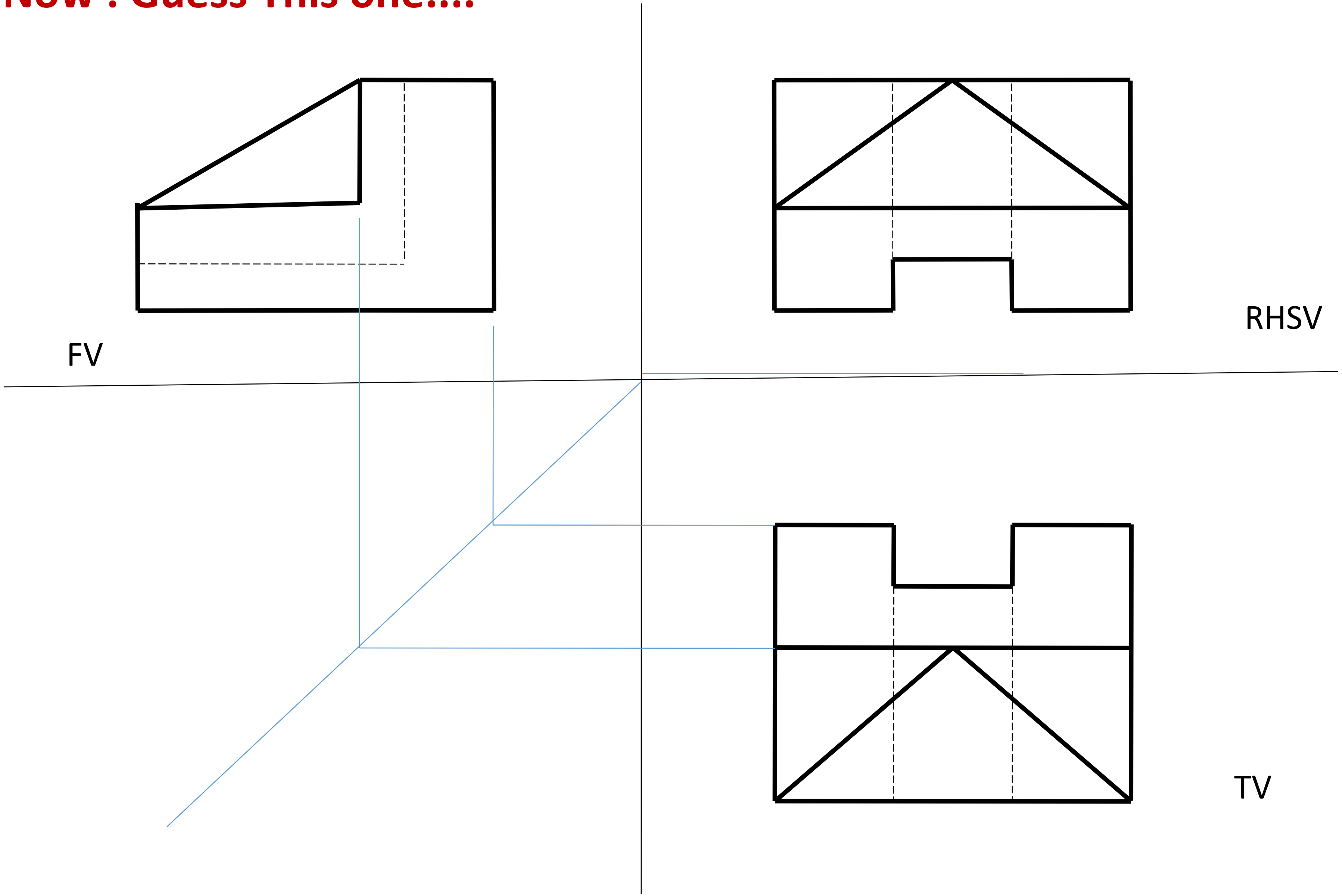
L.H.S.V. = LEFT HAND SIDE VIEW

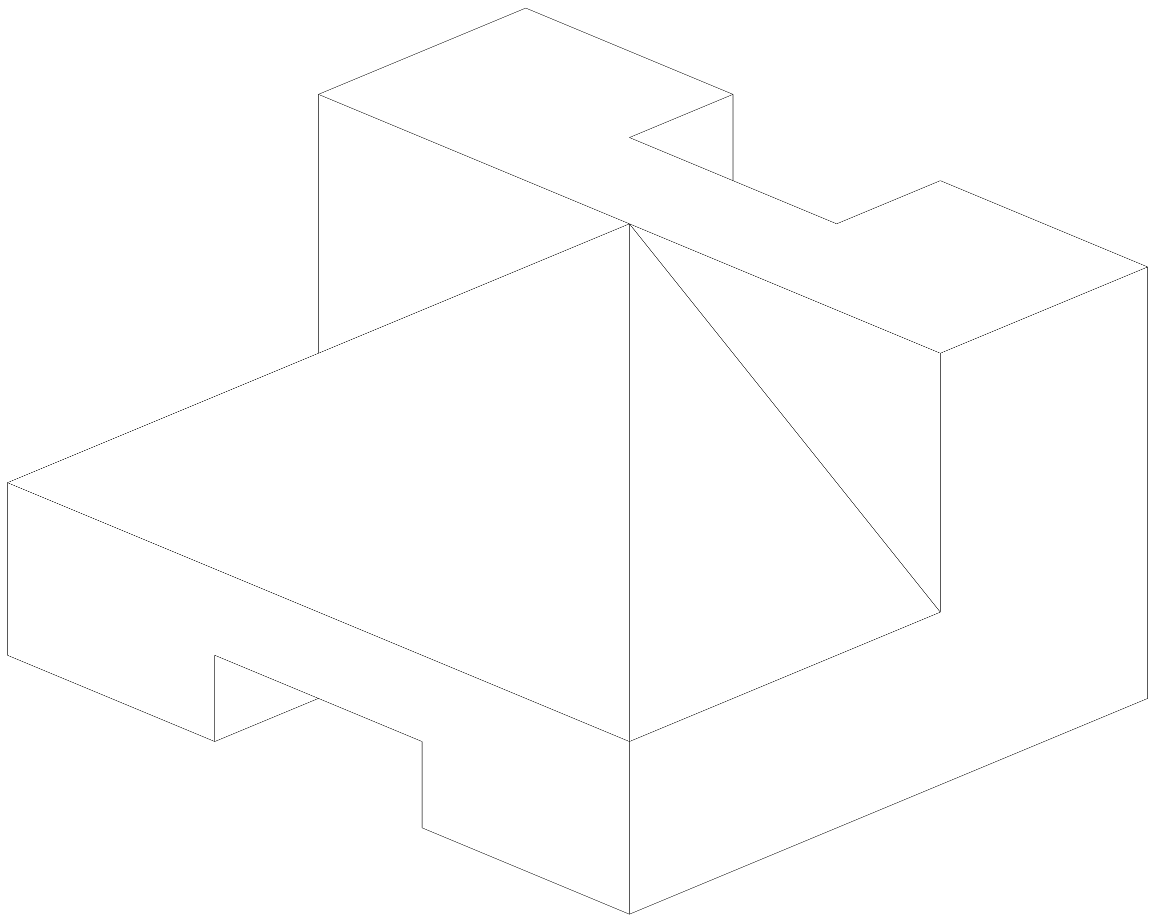
FIRST ANGLE PROJECTION



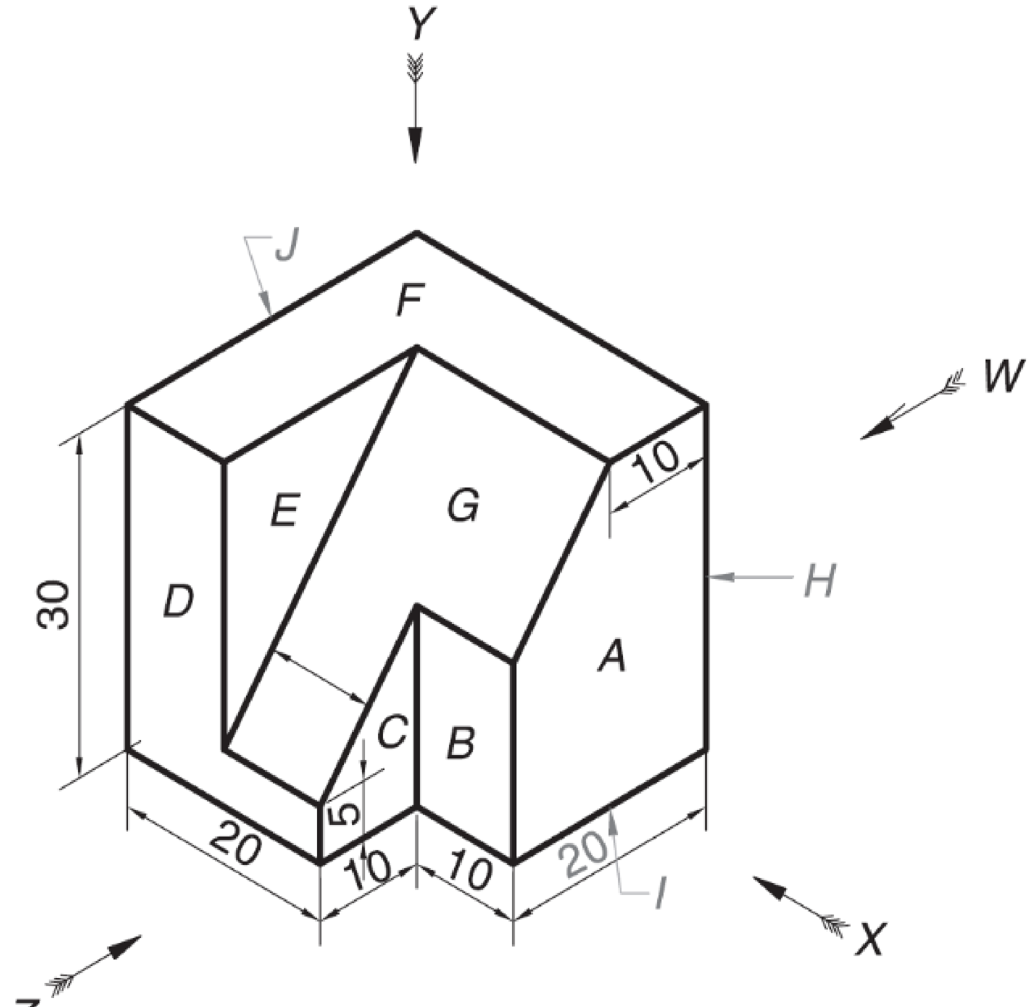

THIRD ANGLE PROJECTION

# Now : Guess This one....

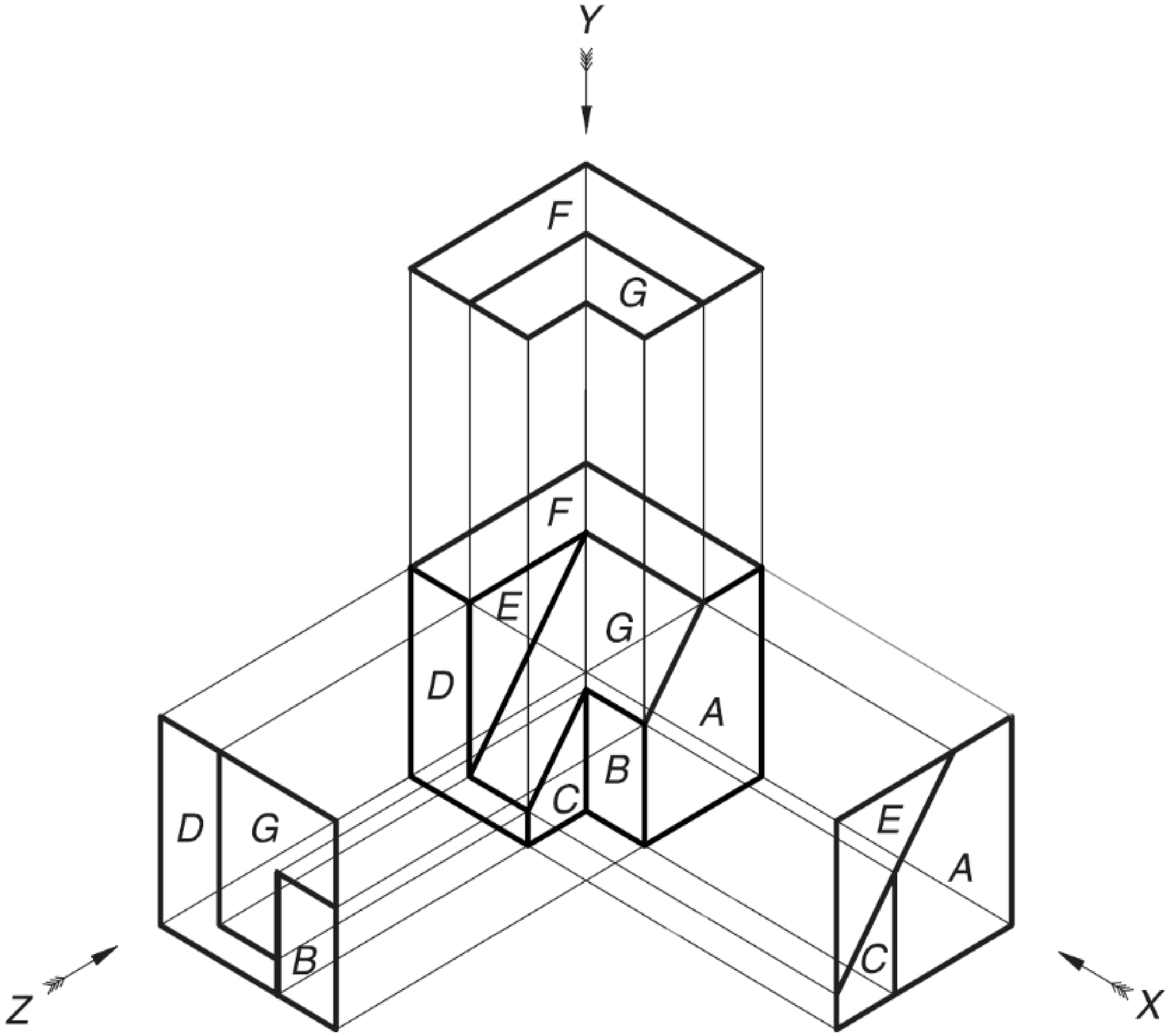




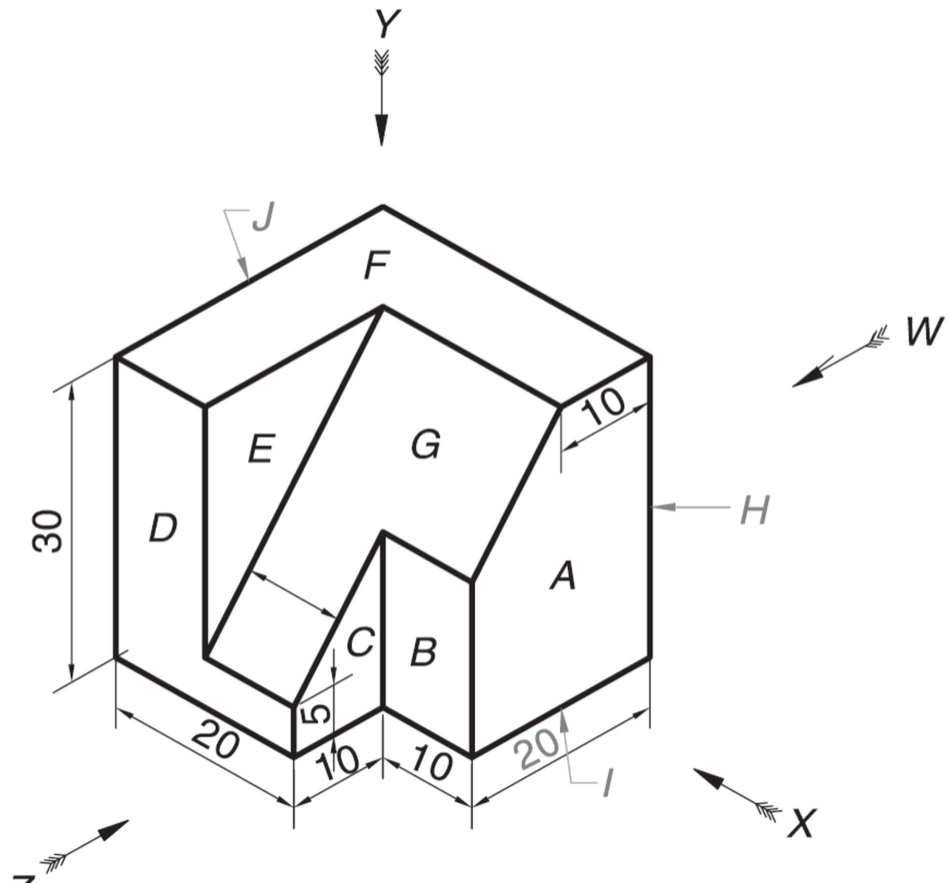
# Line Styles and Dimensioning



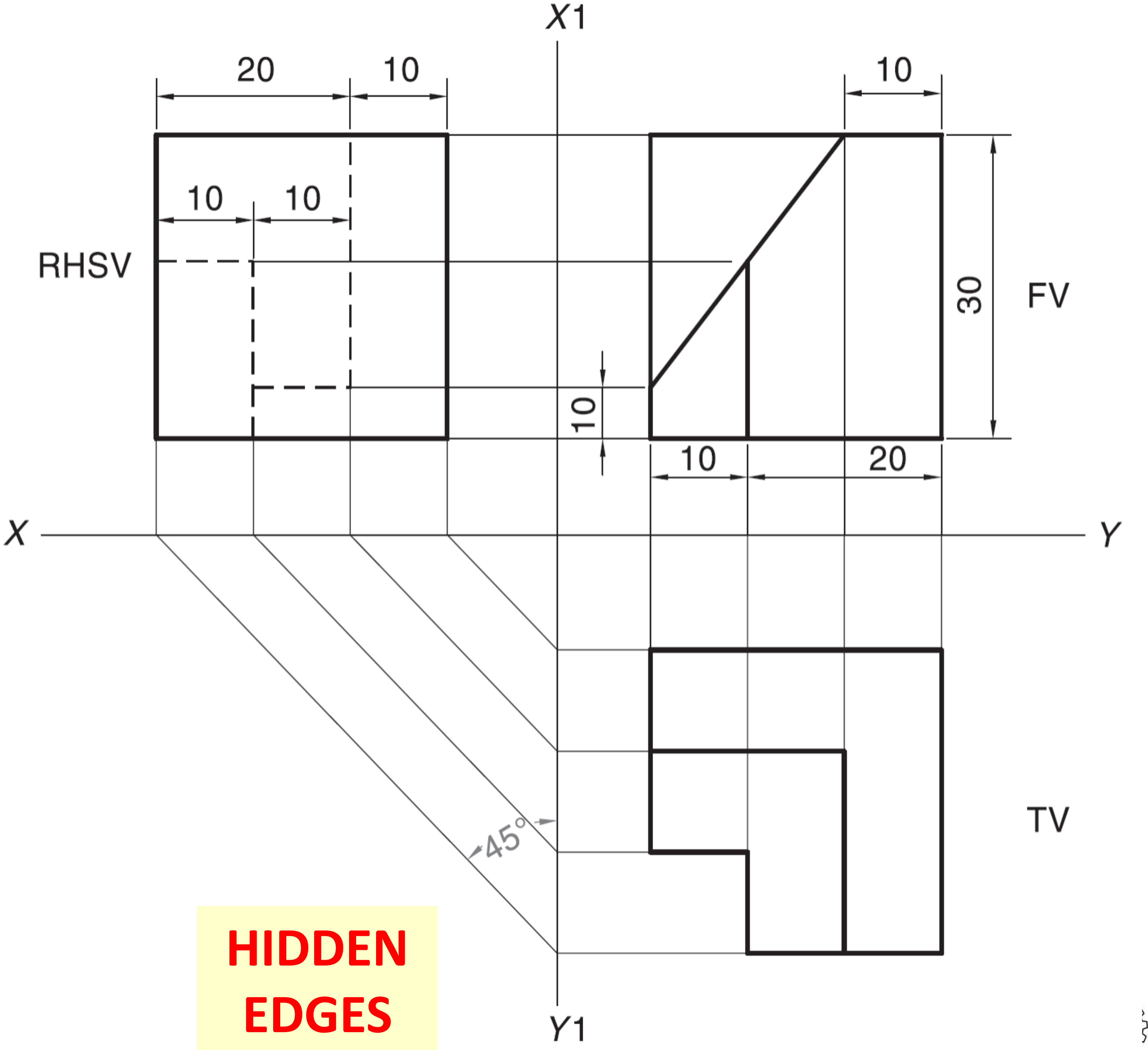

(a)




(b)

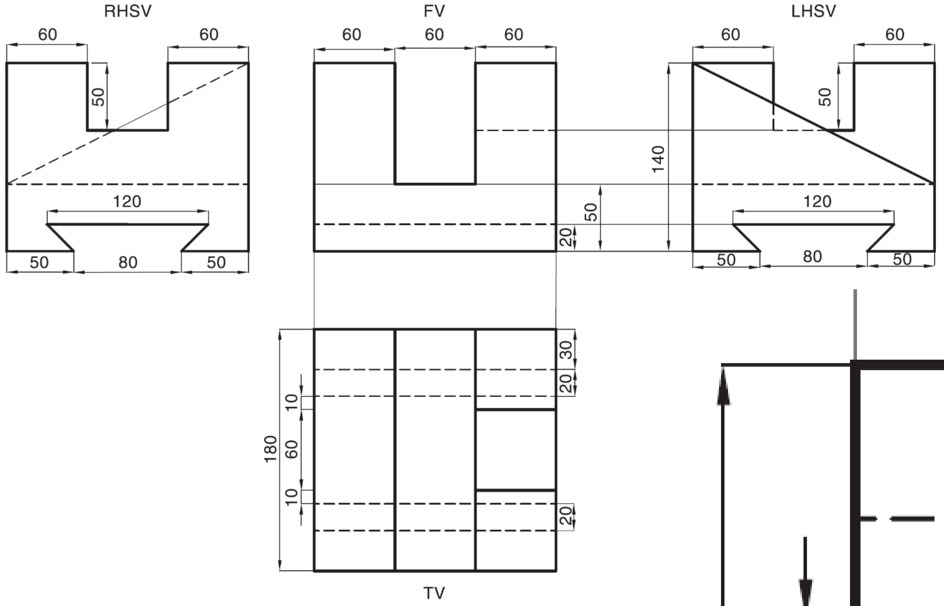



(a)




**Note the method of dimensioning**

**HIDDEN EDGES**


RHSV
FV
LHSV
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120
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180
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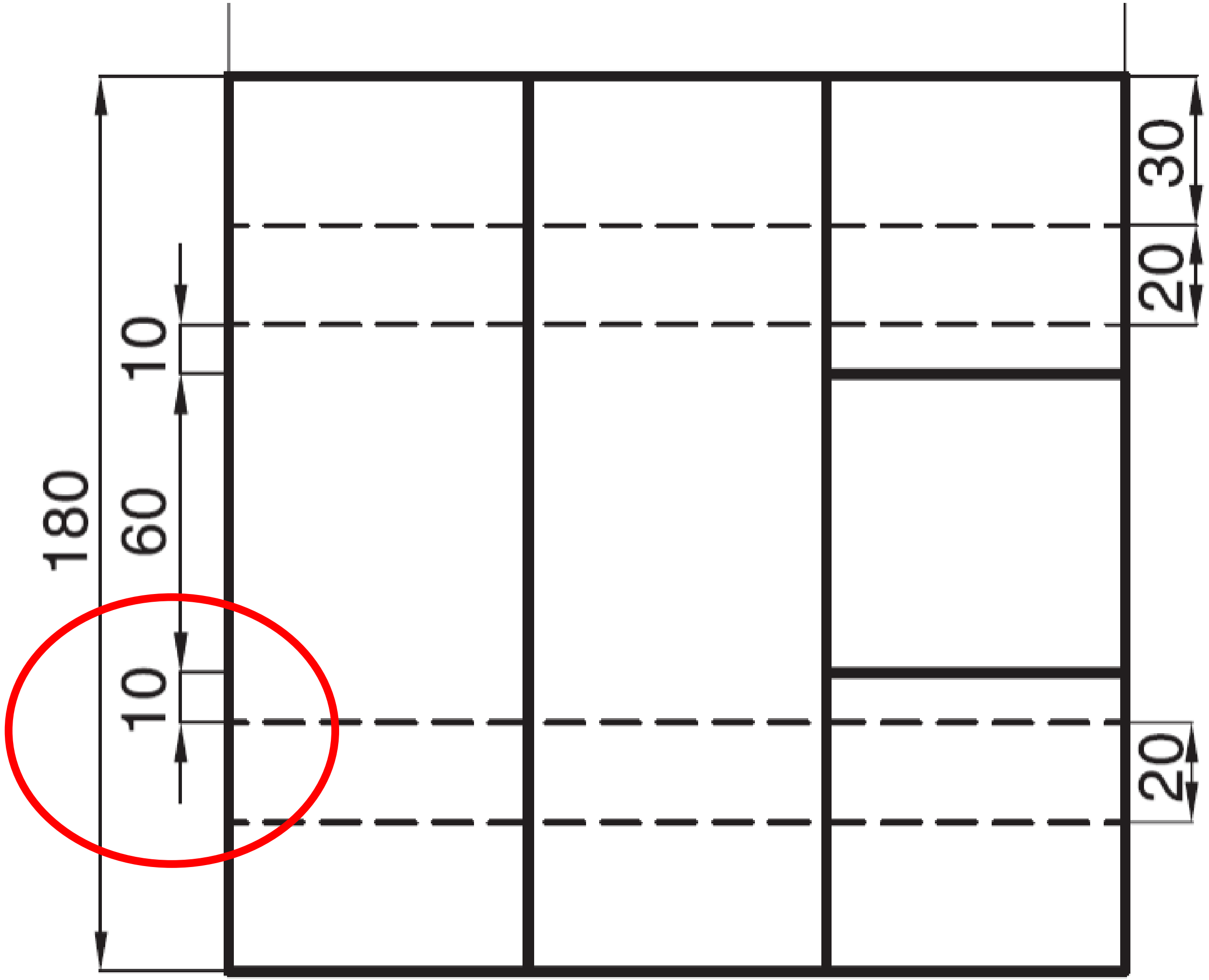
20
TV


180
10
60
10
30
20
20

TV