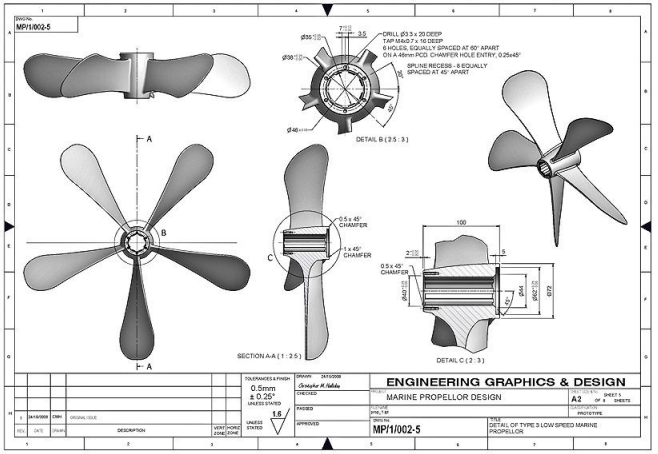
Introduction
to
Orthographic Projections

Why Do We Need Engineering Drawing ?

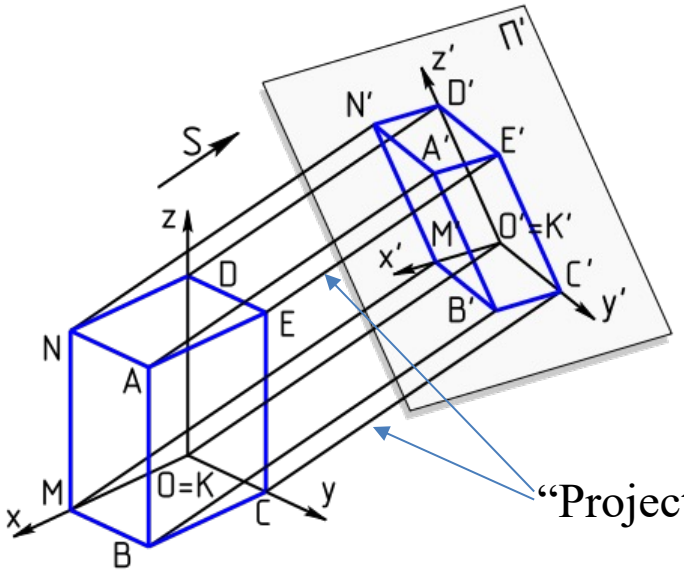
- Designers and manufacturers/fabricators communicate via Engineering Drawing.
  - Enables teamwork.
  - Helps preserve design for future.
- Good Engineering Drawing skills do not require artistic temperament/skills.
  - Procedures are completely based on concepts related to geometry.

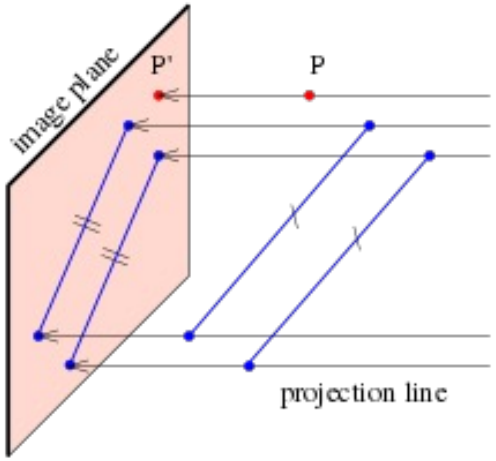


http://www.engd.com.au

Introduction to Projections

- Most drawings are representations of 3D objects on 2D plane.
- **Parallel projection** is a projection of an object in three-dimensional space onto a fixed plane.
  - "Projection lines" or "projectors" are all parallel to each other.
- Projection lines can be perpendicular (**orthographic**) or non-perpendicular (**oblique**) to 2D plane.

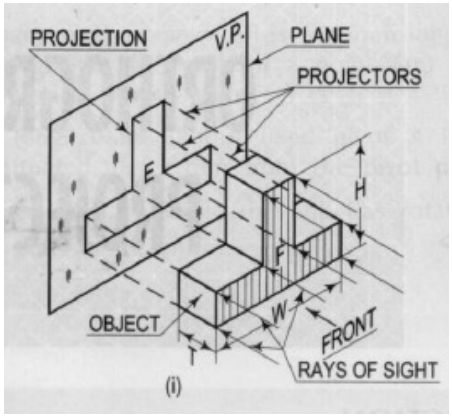


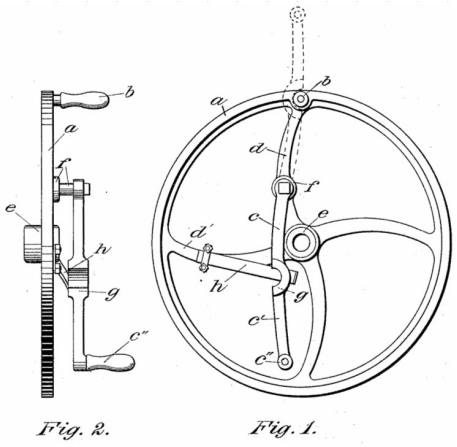


www.wikipedia.org

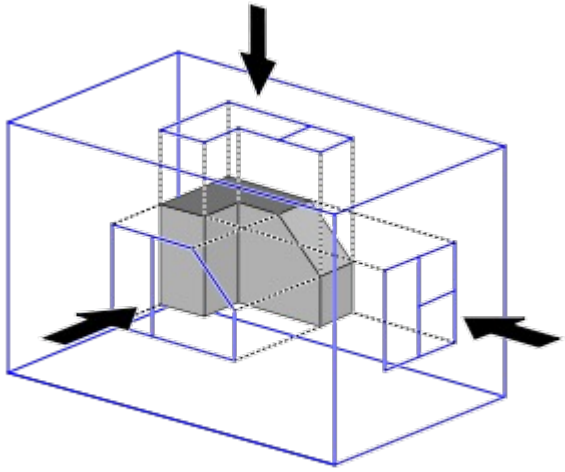
Multiview Orthographic Projections

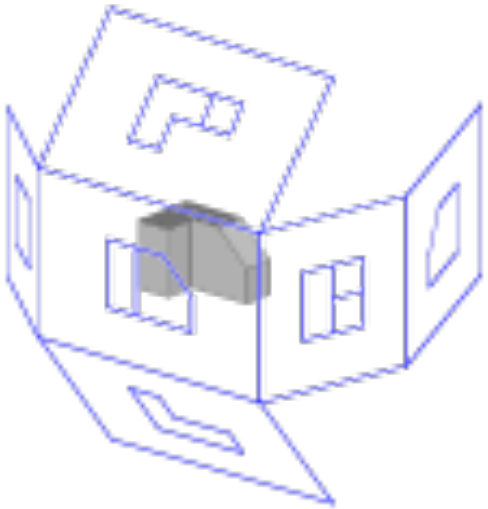
- **Orthographic Projection**: The projectors are perpendicular to the projection plane.

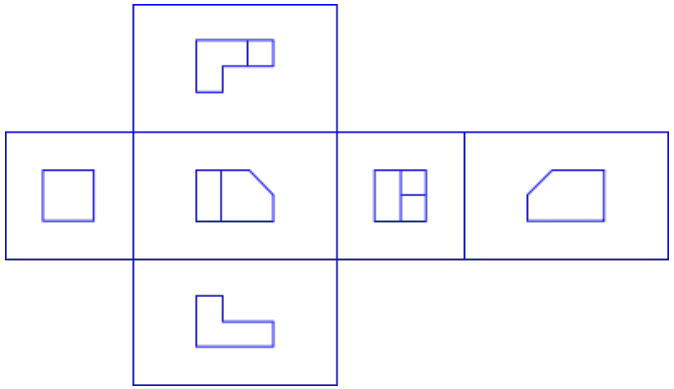




- **Multiview Projection**: More than one view of the object are shown.







Orthographic Projection

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

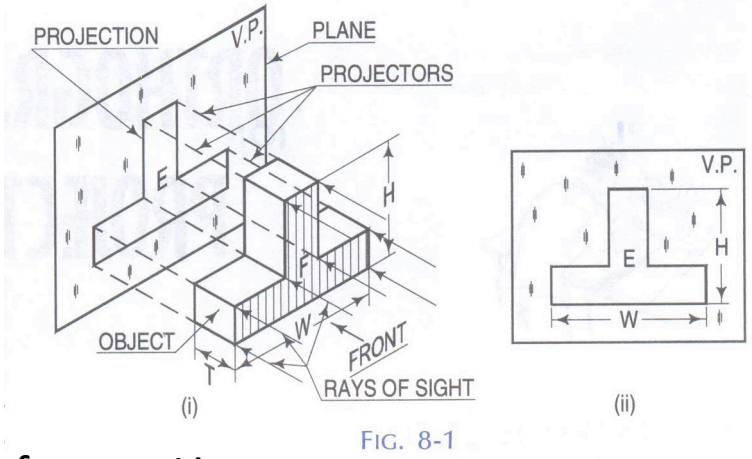


FIG. 8-1

Two major reference or principal planes of projection.
V.P. – vertical (frontal) plane
H.P. – horizontal plane

Projections are drawn from relevant **points.**

- Typically intersection of **edges** in 3D figure.

Reference Line

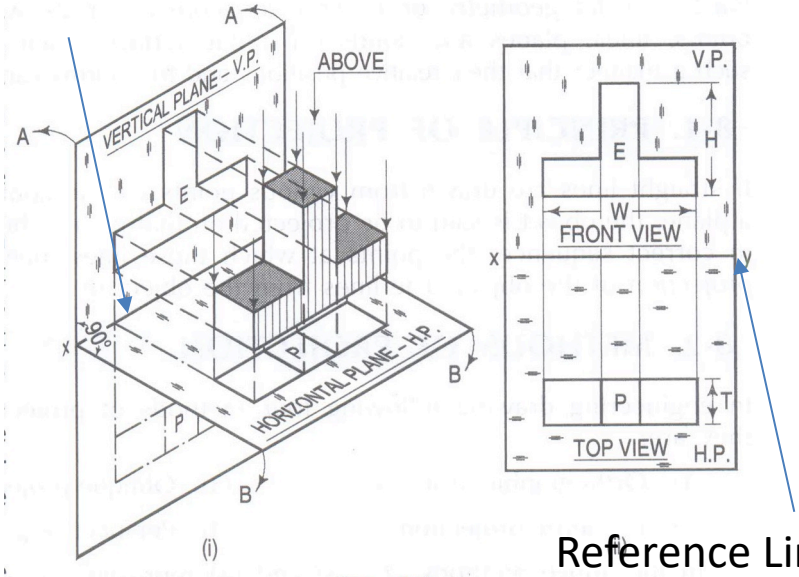


FIG. 8-2

Projection on V.P. – front view or elevation
Projection on H.P. – top view or plan

Intersection of the V.P. and the H.P. is called the reference line and is denoted by xy.

Note: Generally we will also need a side view.

Reference Line

Ref: Engineering Drawing by Bhatt and Panchal.

Orthographic Projection: Additional Points

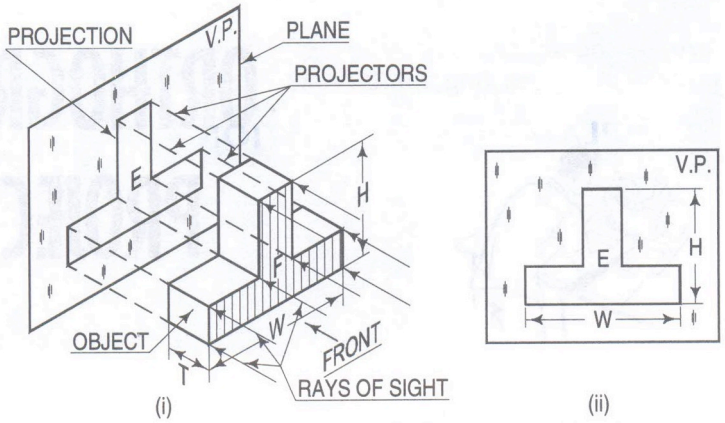


FIG. 8-1

Reference Line

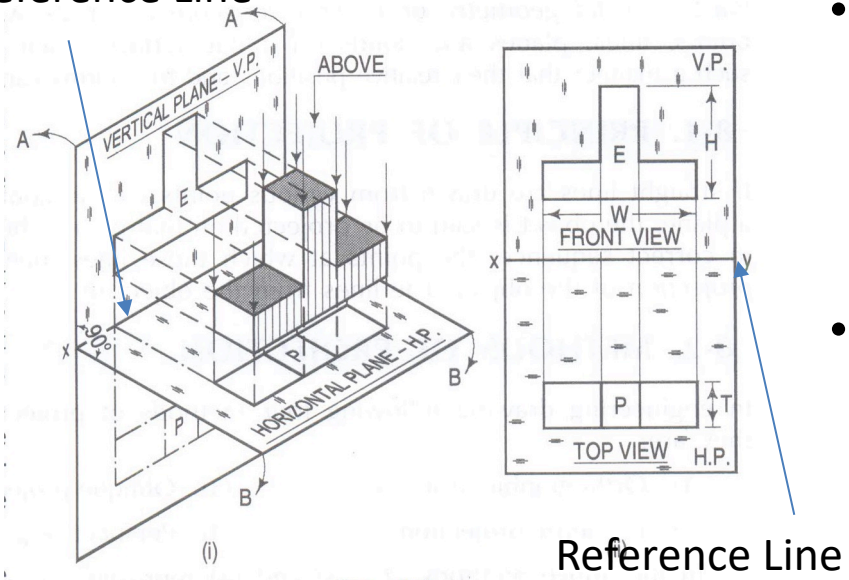


FIG. 8-2

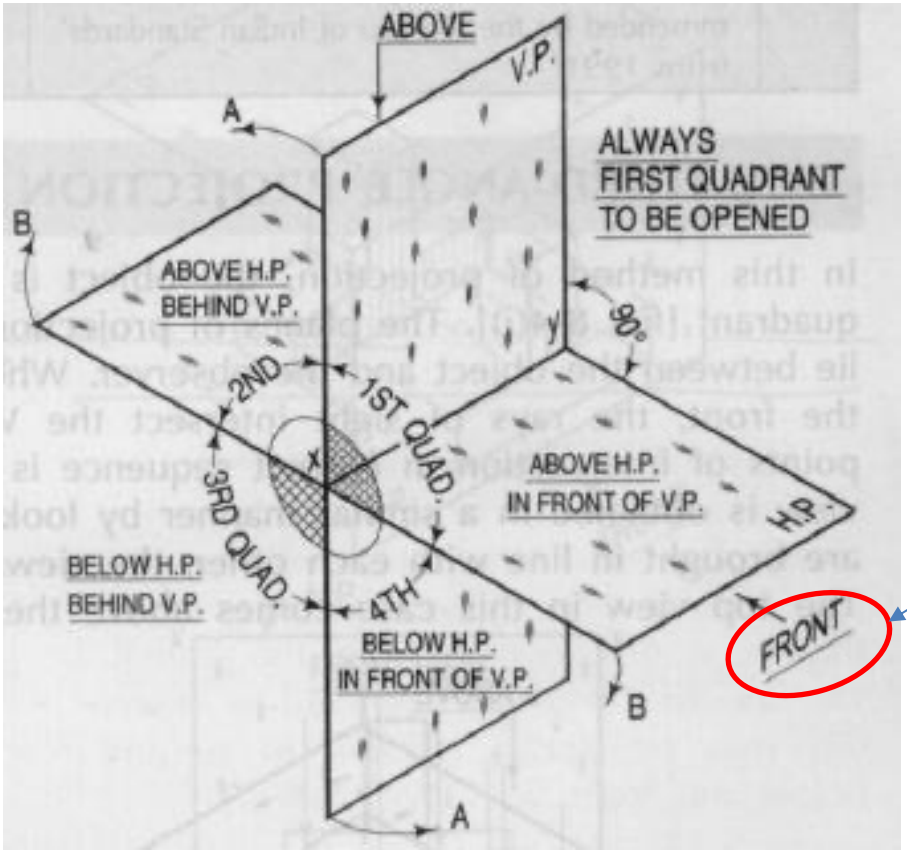
Reference Line

- The HP and VP are **infinite in extent.**
  - They extend to infinity towards both +ve and –ve directions of the respective axes.
- Either AA or BB are opened out to get the multiview drawings on 2D plane.
- Once one of the principal planes is opened out, the "location" of the 3D object is undefined (and irrelevant) on the 2D plane.
- Main **direction of observation (arrow)** needs to be specified.
  - This decides which view is the Front View.

Methods of Orthographic Projections

- First Angle Projection: 3D object placed in 1st quadrant.
- Third Angle Projection: 3D object placed in 3rd quadrant.

Basic Four Quadrants

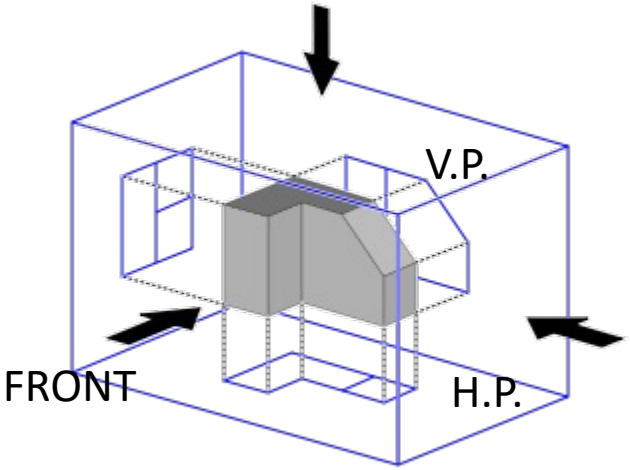


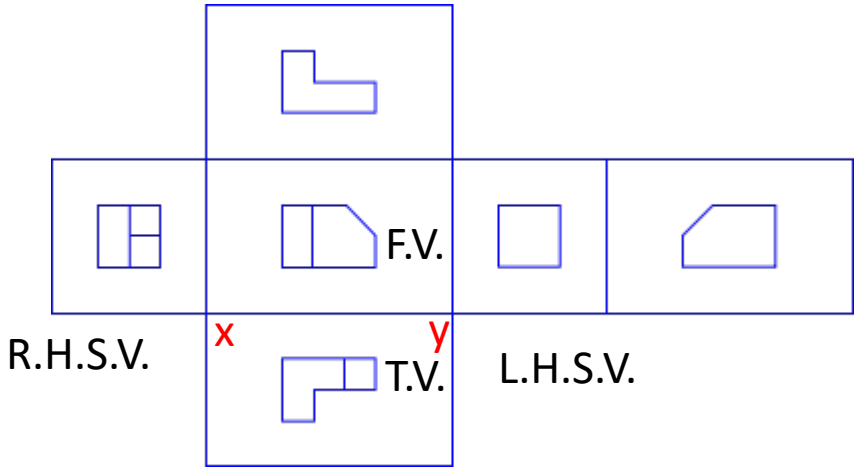
Main direction of observation

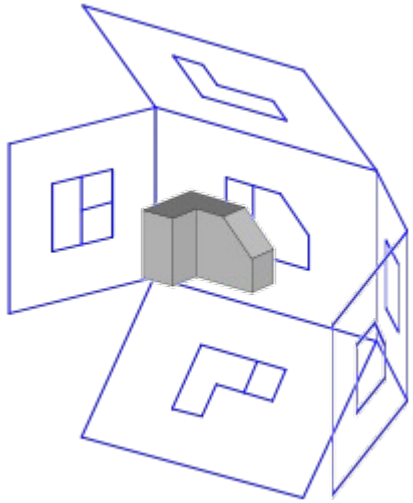
Ref: Engineering Drawing by N. D. Bhatt et. al

First Angle Projection

- **Object** is between **2D plane** (“paper”) and **observer.**
  - Front view (F.V.) is at center.
  - Top view (T.V.) is at bottom.
  - Left hand side view (L.H.S.V.) is on the right.
  - Right hand side view (R.H.S.V.) is on the left.



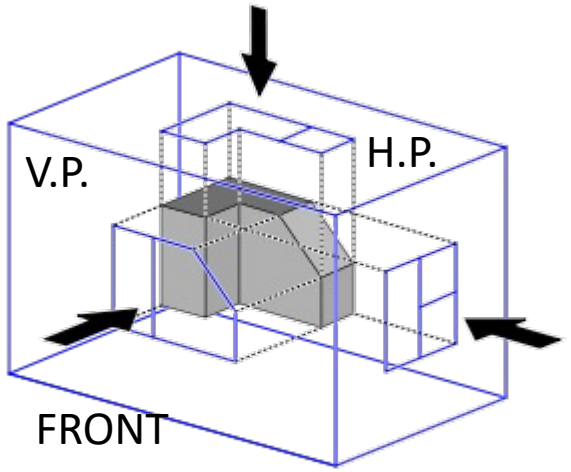


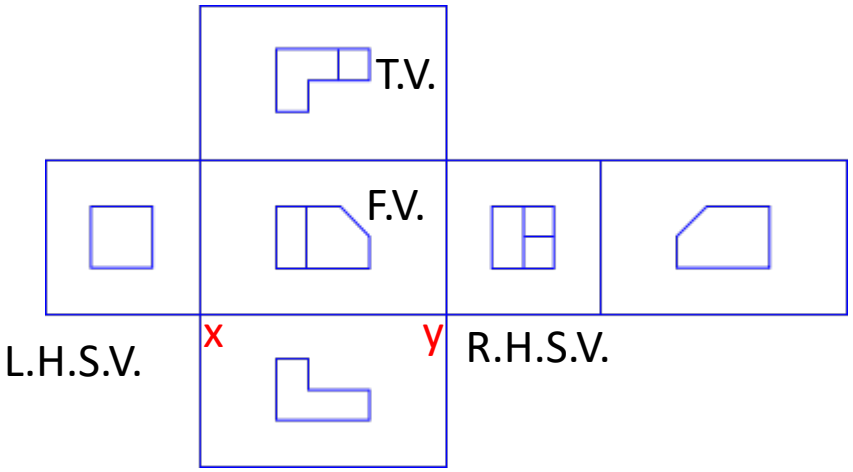


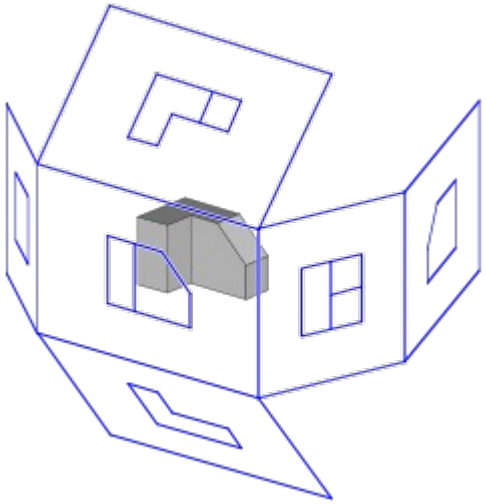
Used In India

Third Angle Projection

- **<u>2D Plane</u>** ("paper") is between **object** and **observer.**
  - Front view (F.V.) is at center.
  - Top view (T.V.) is at top.
  - Left hand side view (L.H.S.V.) is on the left.
  - Right hand side view (R.H.S.V.) is on the right.

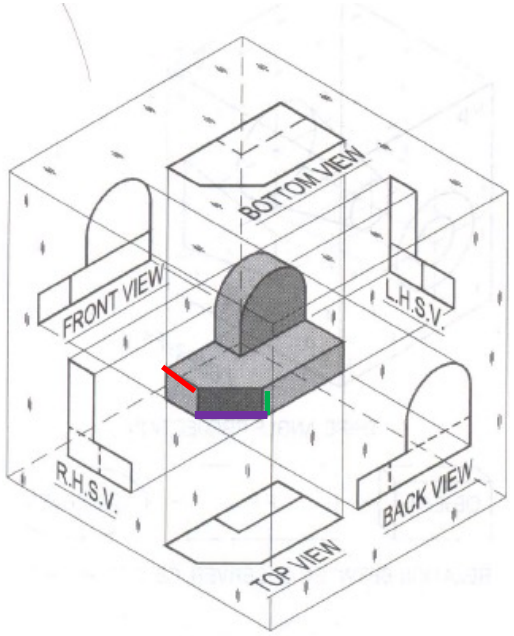


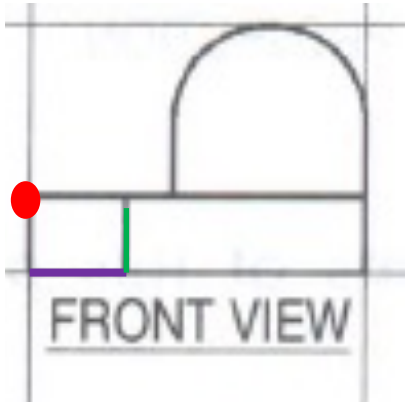




Basic Rules/Procedure

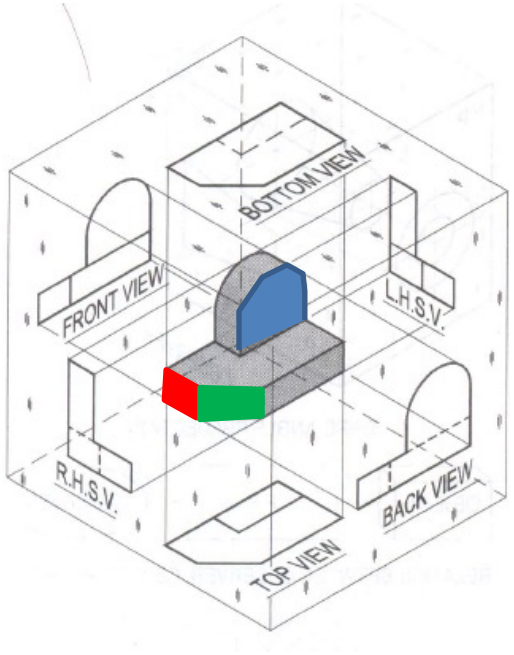
- If line/edge is perpendicular to direction of viewing, its true shape and size is seen in that view (green lines).
- If line/edge is parallel to direction of viewing, you will see a point view (red line and red dot).
- When line/edge is inclined to direction of viewing, we will see its foreshortened view (magenta line).
  - We will need to locate the end points of the inclined edge to make the projections.

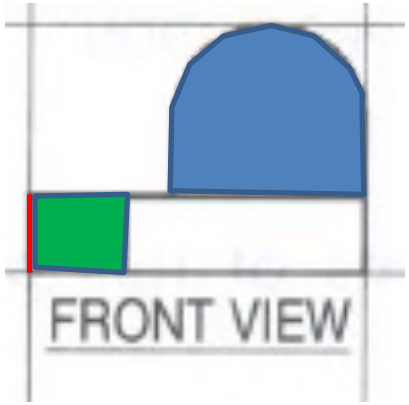




Basic Rules/Procedure

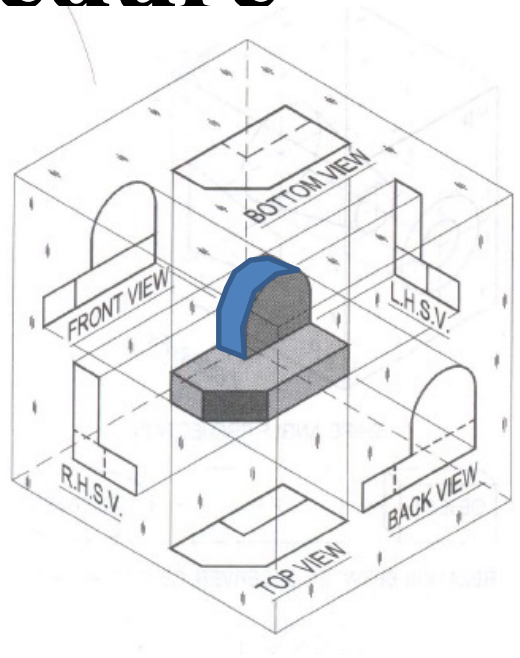
- If face is perpendicular to direction of viewing, it's true shape and size is seen in that view (Blue shade).
- If face is parallel to direction of viewing, you will see the line or edge view of face (Red shading and line).
- For projection of faces with any general orientation, projection of lines/curves bounding the face need to be determined (Green Shading).

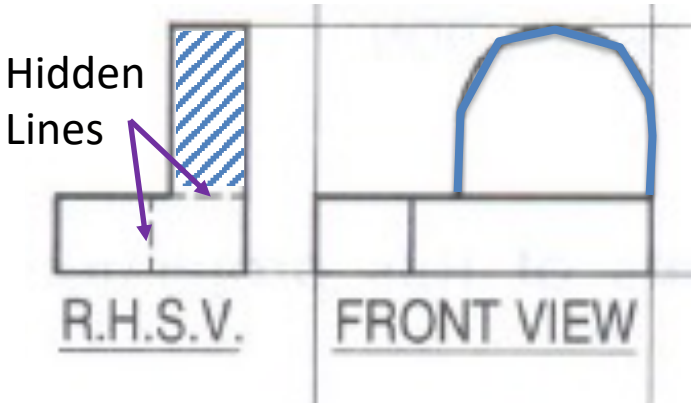




Basic Rules/Procedure

- Cylindrical surface, parallel to direction of viewing appears circular (Blue Shading).
- Cylindrical surface, perpendicular to direction of viewing, appears rectangular (Blue Hatched).
- Edges may not visible in a view should be shown via hidden (dashed) lines.

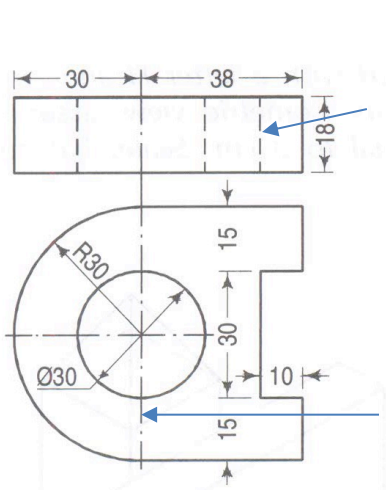




Line Types

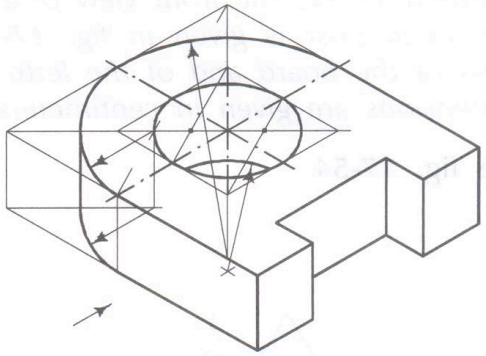
- **Construction lines:** 0.25mm
- **Object lines:** 0.6 mm
- **Borders:** 0.6 mm
- **Hidden lines**: Dashed, 0.3 mm
- **Centerline**: Dot-Dash
- **Dimensioning**: Double-arrow lines

Line	Description
A	Continuous thick or Continuous wide
F	Dashed thin (narrow)
G	Chain thin Long-dashed dotted (narrow)

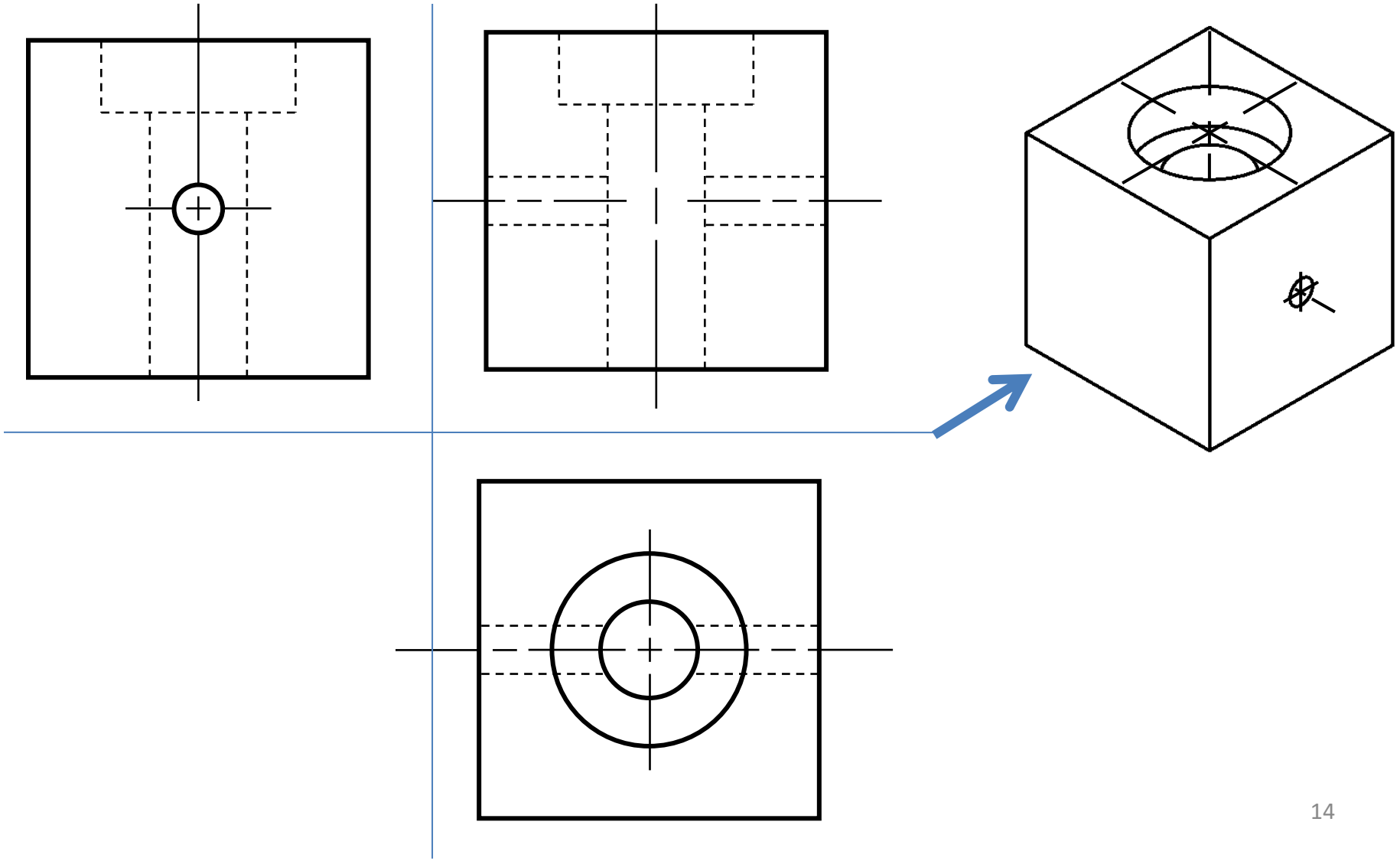


Hidden lines

Center Lines

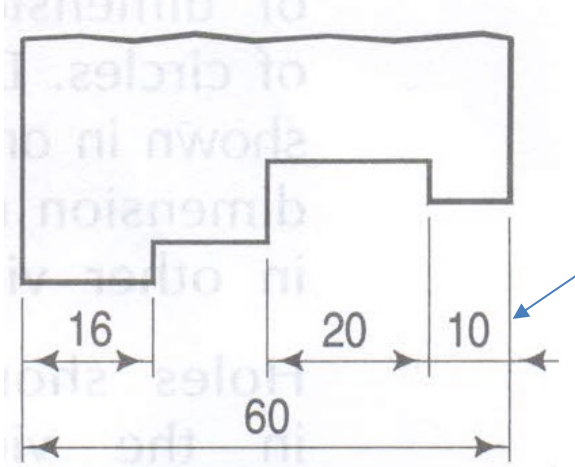


A Simple Example

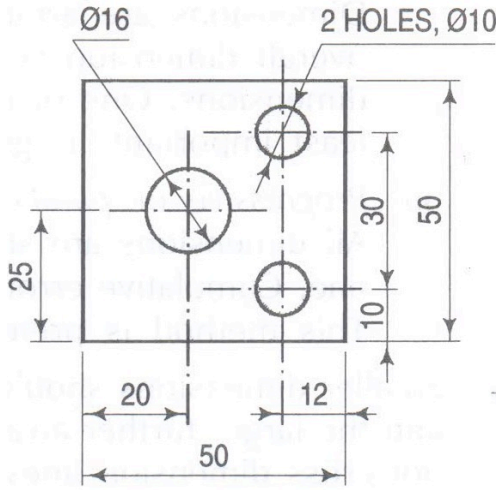


Dimensioning

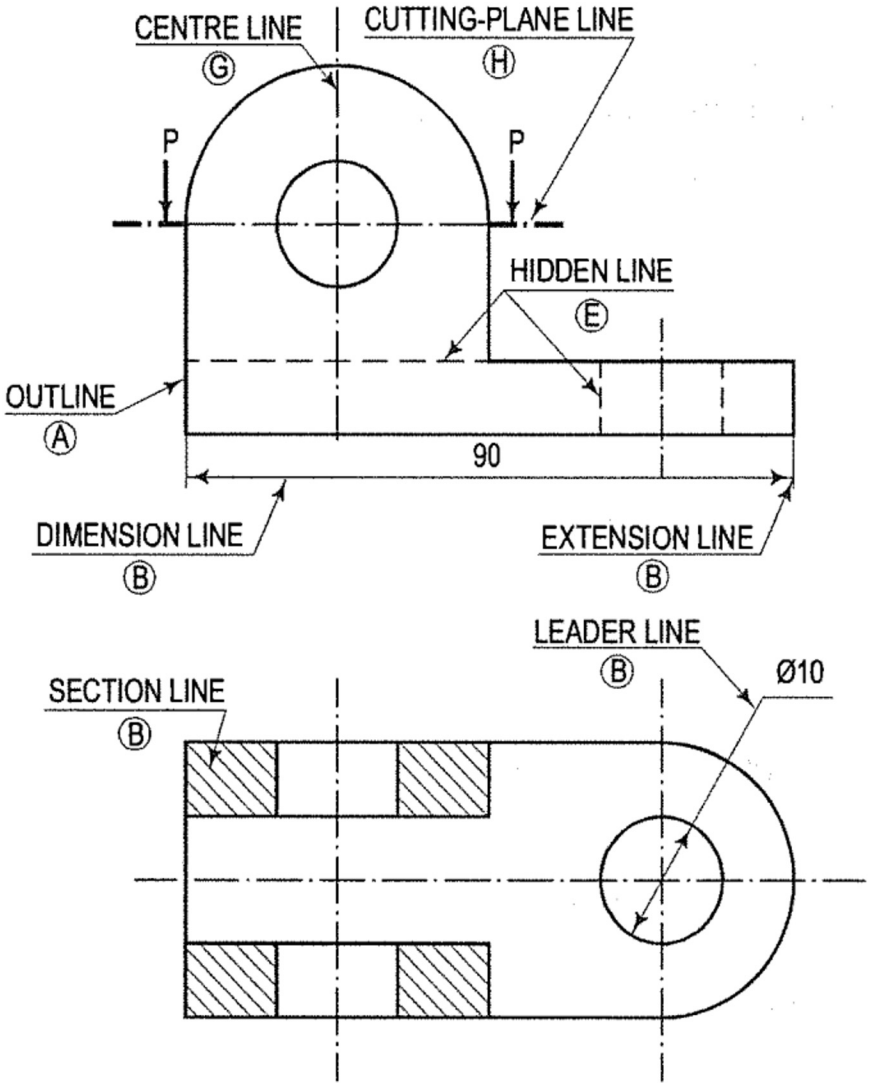
- Use consistent arrow style for all dimensioning lines.
- No dimensioning information should be redundant.
- Dimension lines should not intersect object lines.
- Diameter of holes are denoted by ϕ.
- Units, scale should be mentioned at the bottom of the figure.
  - e.g. “All units in mm”, “Scale 1:10” .



All units in mm
Scale 1:2

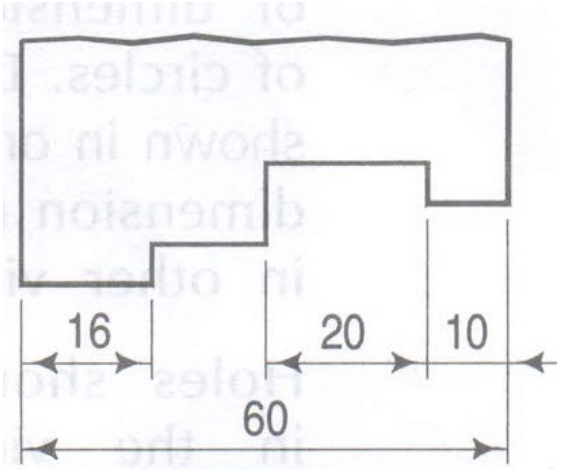


Example (Note P-P, the “Cutting Plane/Section Plane”)



Scales

- May not be always possible to produce full scale drawing i.e. 1:1.
- They are therefore drawn smaller or larger.
- When drawings are drawn smaller than the actual size of the objects, the scale used is said to be a reducing scale, e.g 1:2.
- When drawings are drawn larger than the actual size of the objects, the scale used is said to be a enlarging scale, e.g 2:1.
- E.g. If 1 cm on the drawing represents 1 m of of the object/distance then the scale is mentioned as **SCALE 1:100** under the drawing.

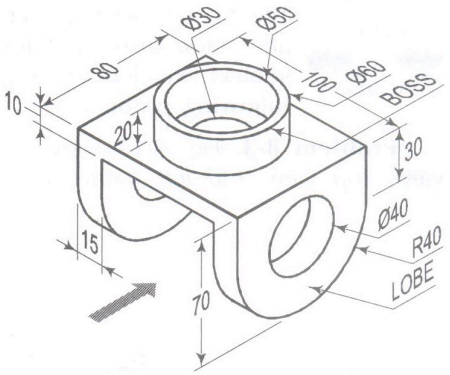


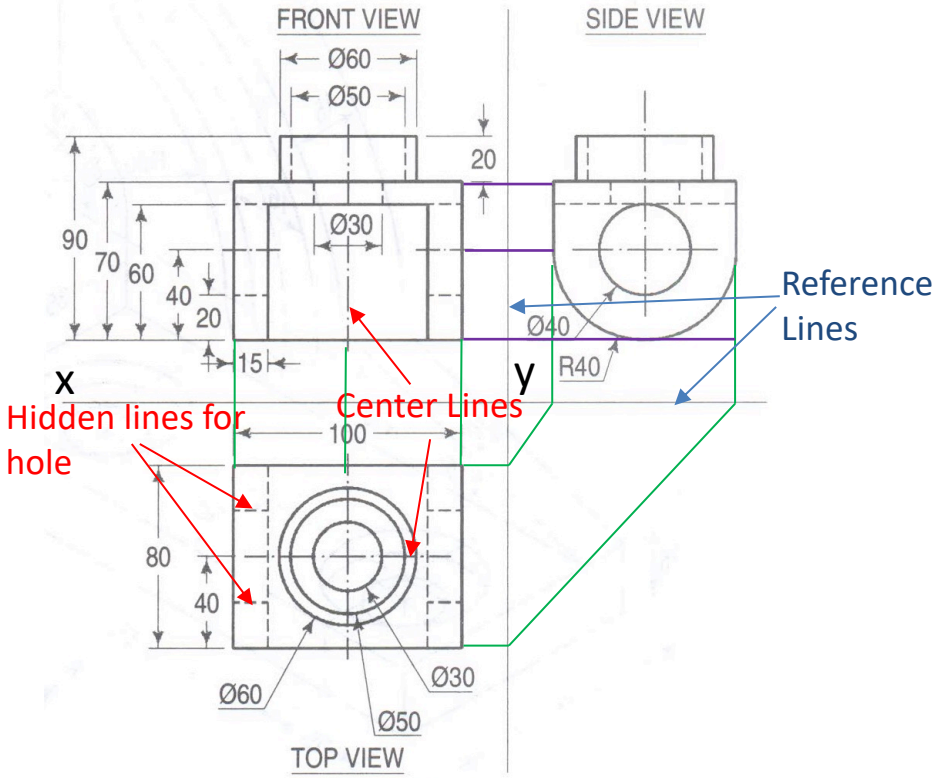
All units in mm
Scale 1:2

Example: First Angle Projection

Isometric (3D) view with dimensions is given. Draw 2D projections.

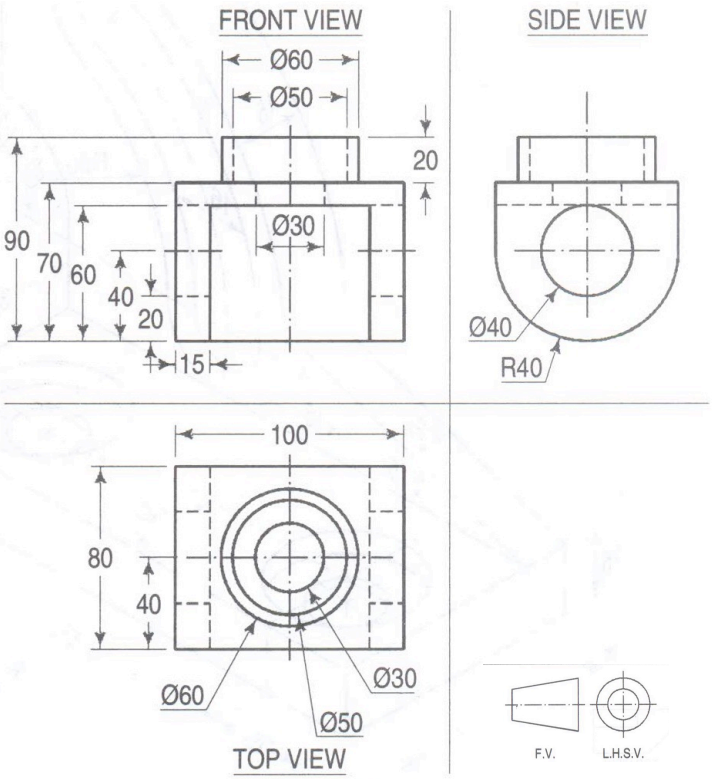
1. Draw the reference lines
2. First draw either F.V. or T.V.
   - In this case we draw T.V. first
3. Use vertical projectors from the TV to locate the vertical F.V. edges (Green Lines)
4. Use horizontal projectors from TV to locate the vertical L.H.S.V. edges (Green Lines)
5. Make F.V., and use horizontal projectors from F.V. to local horizontal L.H.S.V. edges (Magenta Lines)
6. Make L.H.S.V.
7. Make sure hidden edges are shown via dashed hidden lines
8. Make sure center lines are shown via dot-dashed lines





Symbol For 1st & 3rd Angle Projection

It is a good practice to show the truncated frustum to indicate 1st/3rd angle projection



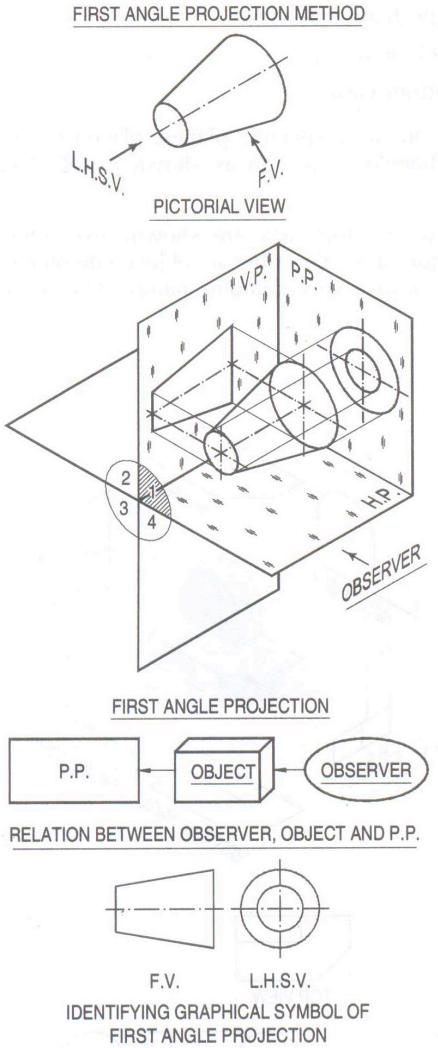


FIG. 8-10

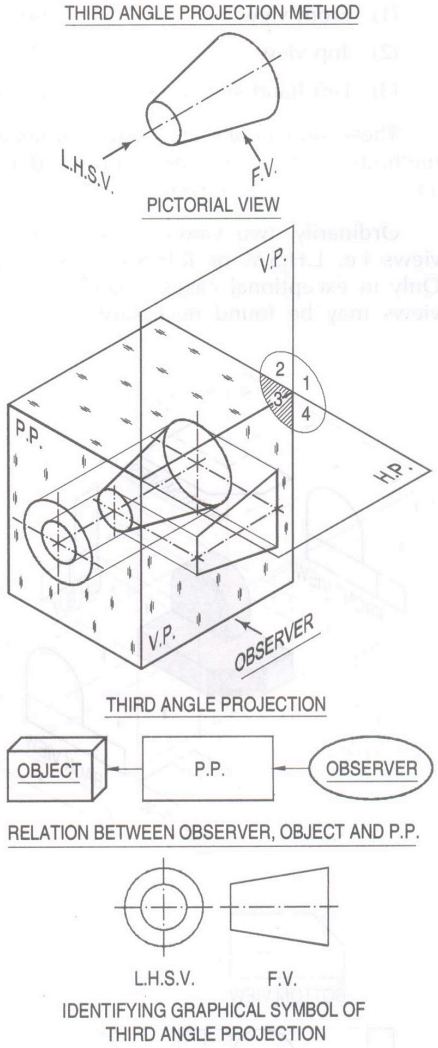
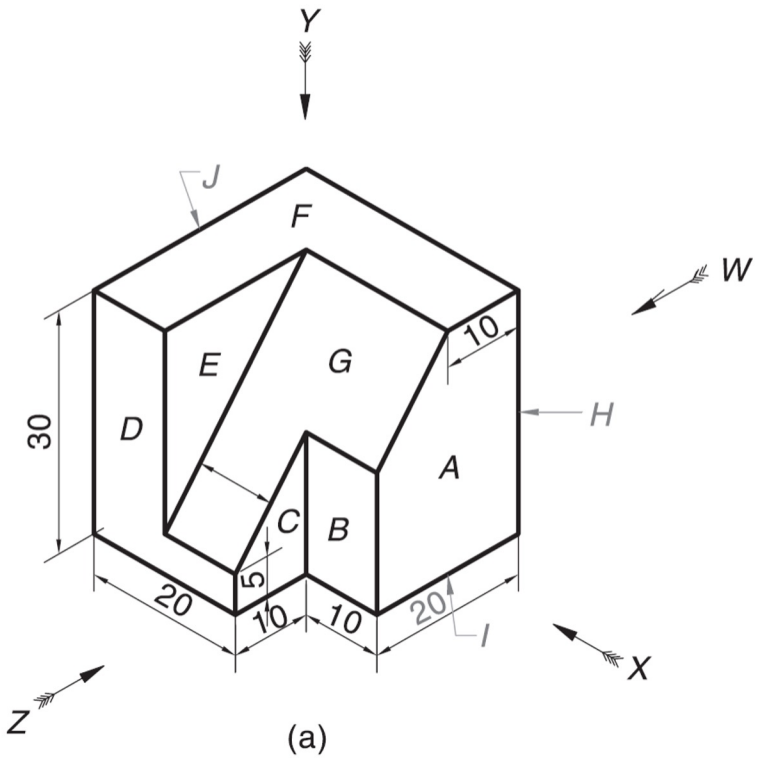


FIG. 8-11

Example


Y
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B
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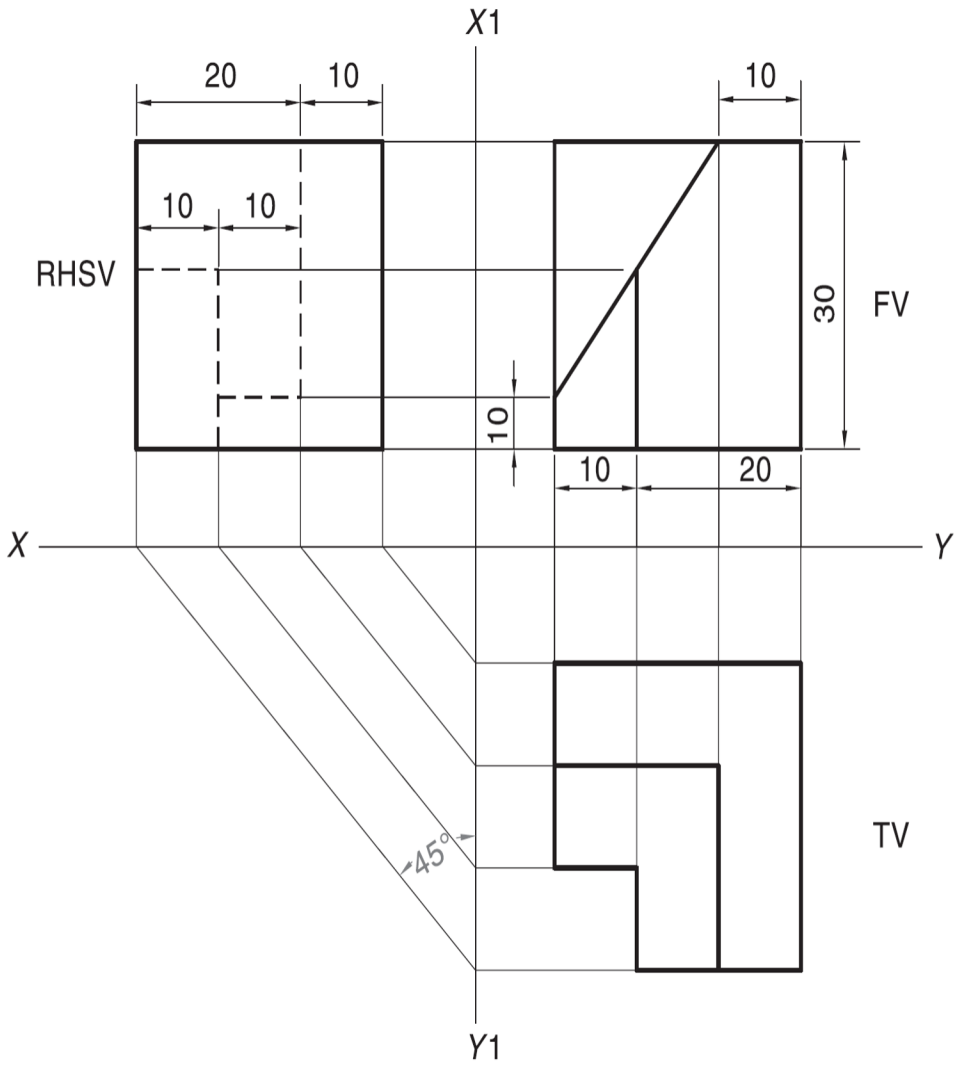
(a)


X1
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10
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FV
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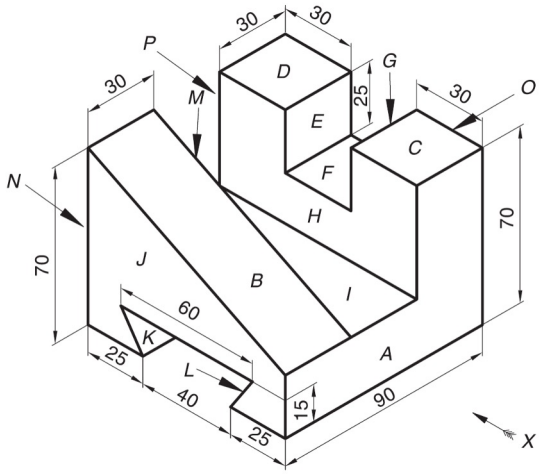
Example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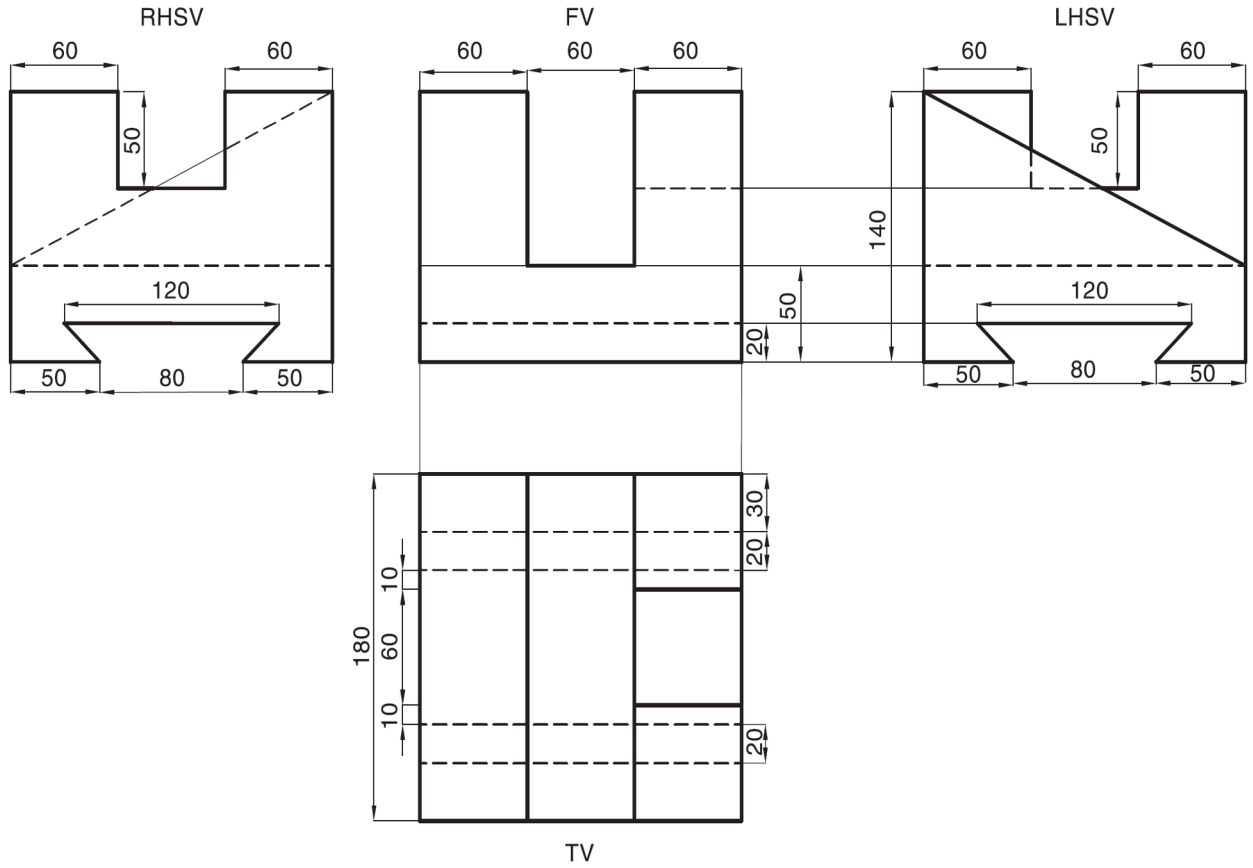
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180
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TV

Concluding Remarks

- Lab session 2 cycle: Thursday, Aug. 15* to Tuesday, Aug. 20.
- Drawing of
  - Multiview orthographic projections from the given iseometric (3-D) view of an object.
  - From the given multiview orthographic projections, draw the isometric (3-D) view of the object.
- Lab assignment questions **will not be posted beforehand on Moodle.**
- Before the lab session, refer to the book by Bhatt and Panchal for numerous examples/exercises (with solutions provided for many problems).
  - Chapter 8: Orthographic Projection (Basic)
  - Chapter 20: Orthographic Reading and Conversion of Views (Advanced)
- For lab 2, mobile phones/laptops/tablets/any other electronic devices are strictly prohibited.
  - If found on you, you will be asked to leave the lab with zero marks for this lab session, and no make-up permitted.