MECH 220
Engineering Graphics

Orthographic Drawings

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MECH 220: 2nd LECTURE

Topics

- Overview
- Available Convention
- Orthographic Projection
- Transferring Dimensions
- Drawing Curved Shapes
- Selecting Views
- Geometric Entities Representation
- Sketching Exercise

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History

- Orthographic Projection was formalized by Gaspard Mongne (b. 1746).
- Mongne worked as a drafter in the fortification design office of the school at Mezier for French army officers
- His work was kept a military secret for a number of years until he was allowed to publish in 1795.
- Stone cutters were the first to adopt his methods. Later carpenters and other trades abandoned their old methods for orthographic projection.

Elements of Engineering Drawing

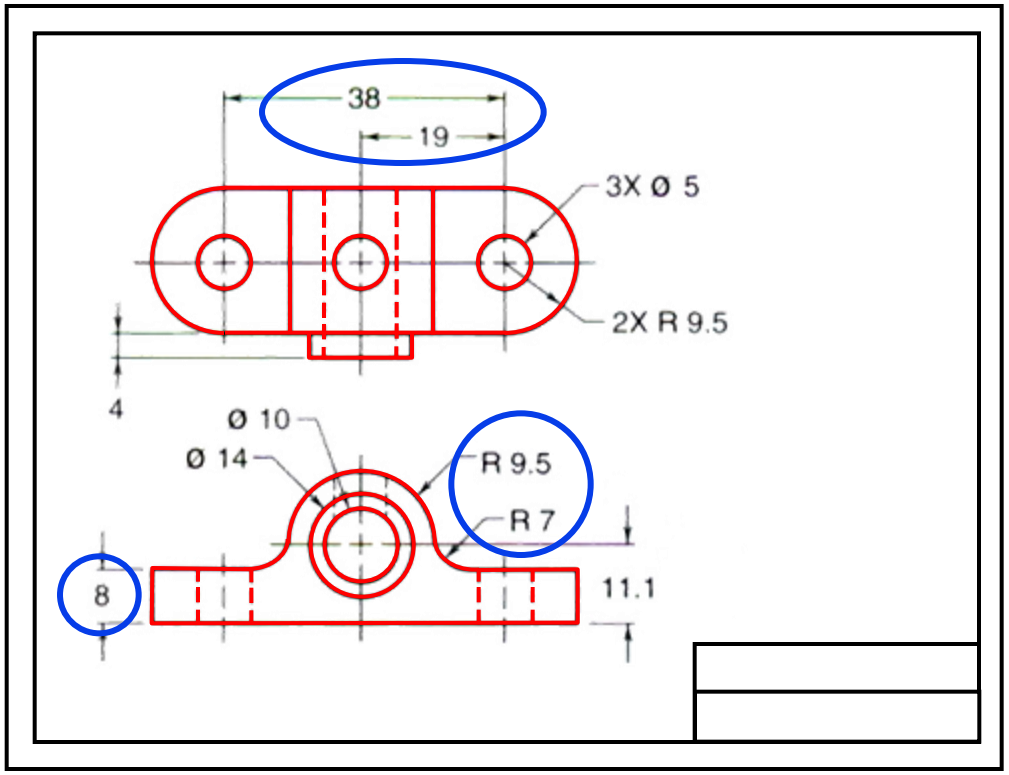
Engineering drawing are made up of ***graphics language*** and ***word language***.

Graphics language

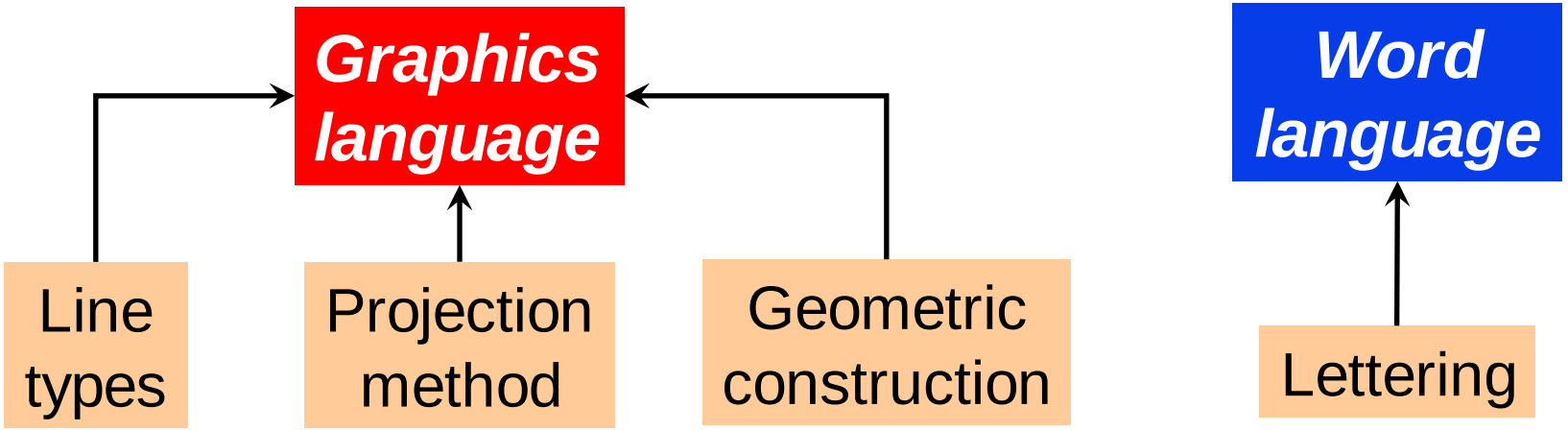
Describe a shape (mainly).

Word language

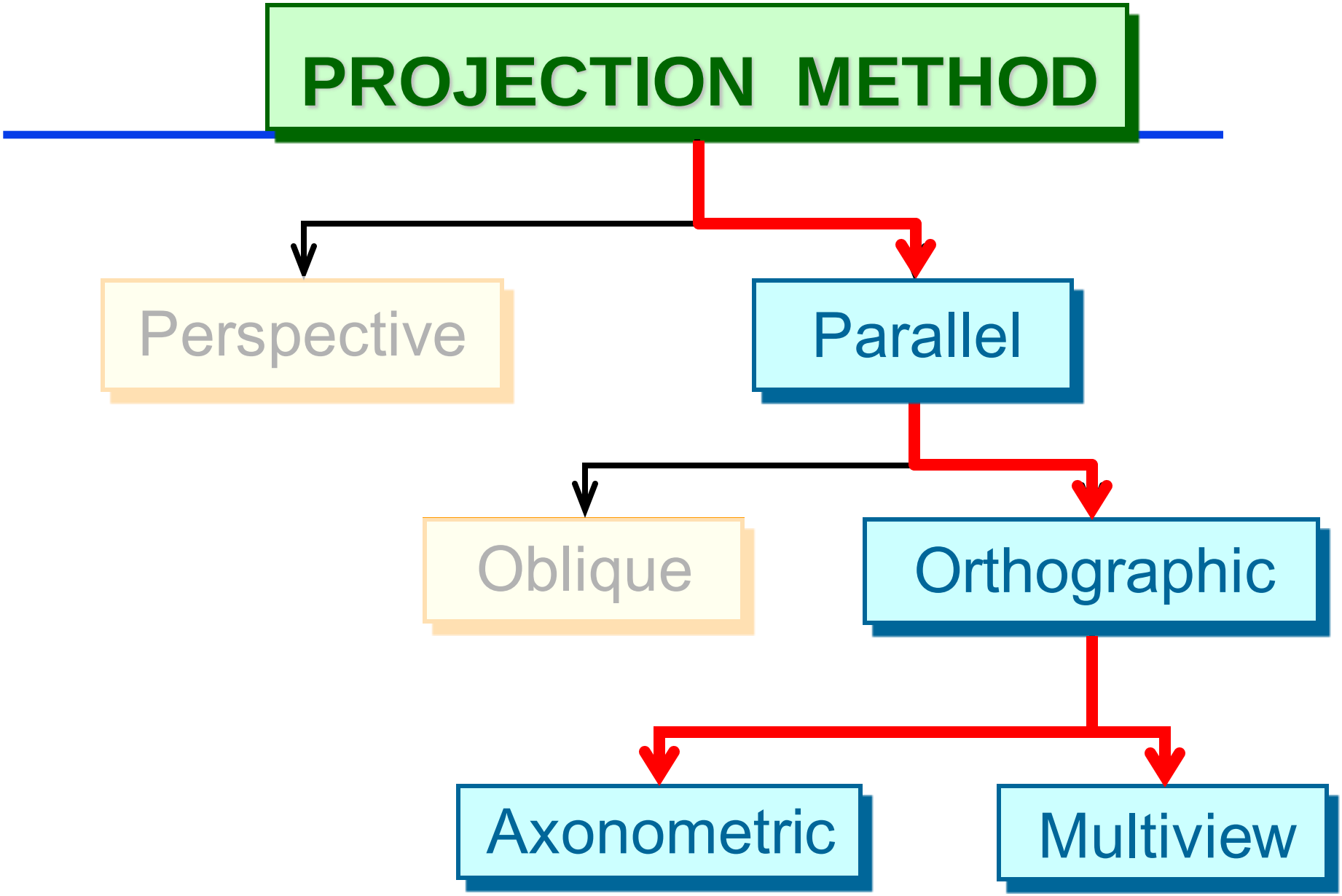
Describe size, location and specification of the object.



Basic Knowledge for Drafting



PROJECTION METHOD


PROJECTION METHOD
Perspective
Parallel
Oblique
Orthographic
Axonometric
Multiview

PROJECTION THEORY

- The projection theory is used to graphically represent 3-D objects on 2-D media (paper, computer screen).

- The projection theory is based on two variables:

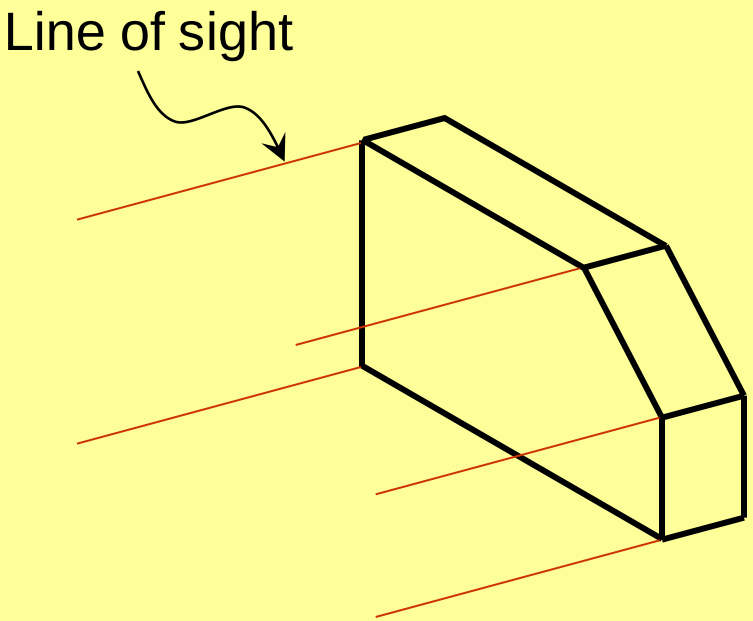
  1) Line of sight

  2) Plane of projection (image plane or picture plane)

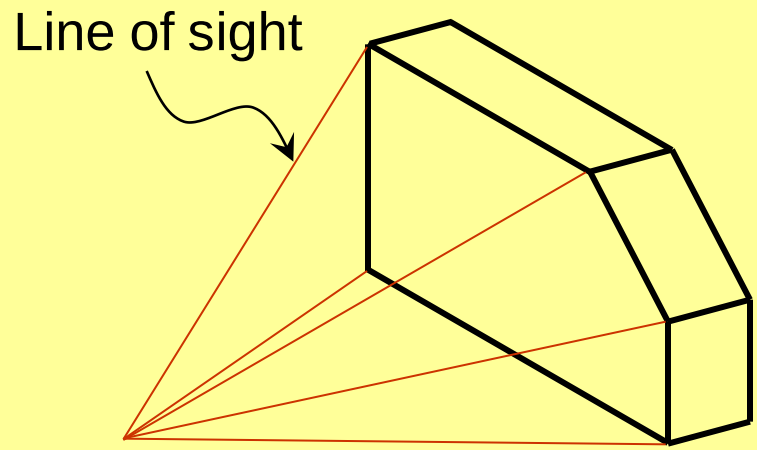
Line of sight is an imaginary ray of light between an observer's eye and an object.

- There are 2 types of LOS : parallel and converge

Parallel projection



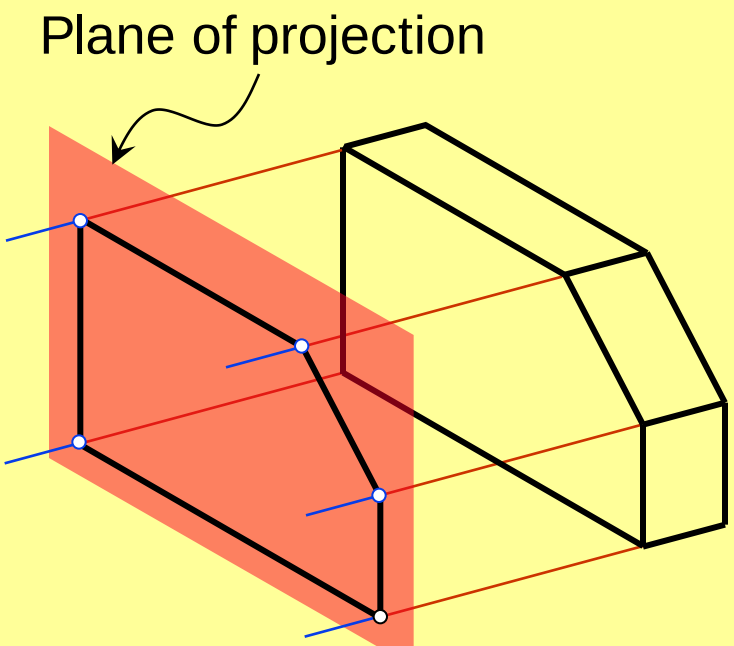
Perspective projection



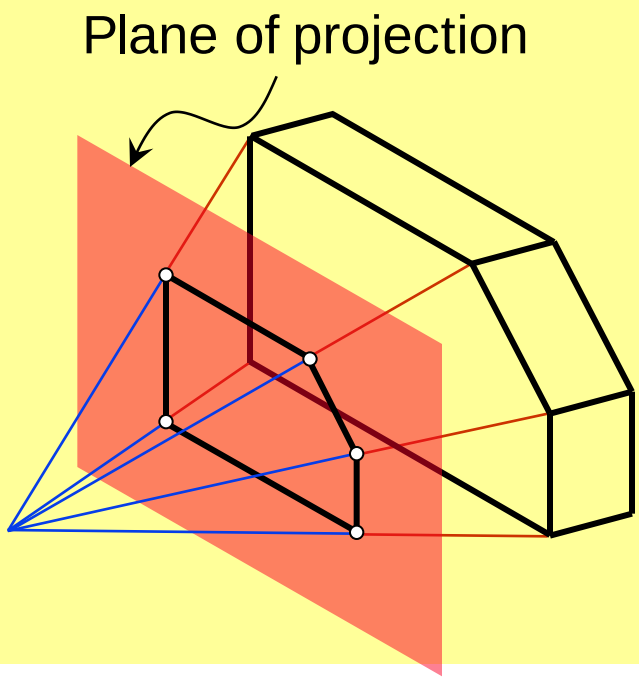
Plane of projection is an imaginary flat plane which the image is created.

- The image is produced by connecting the points where the LOS pierce the projection plane.

Parallel projection



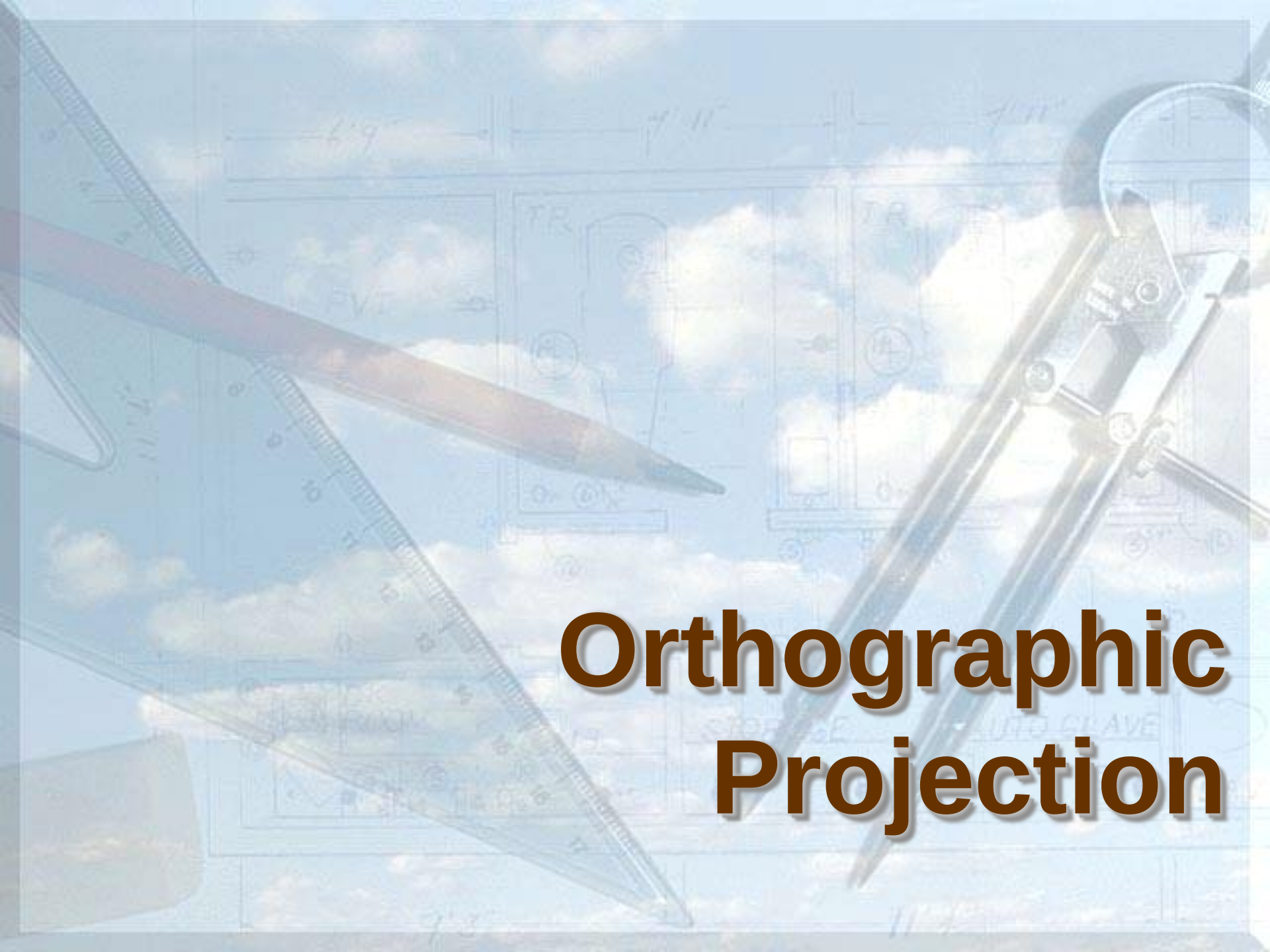
Perspective projection



Disadvantage of Perspective Projection

- Perspective projection is ***not*** used by engineer for manu-facturing of parts, because

  1) It is difficult to create.
  2) It does not reveal exact shape and size.


Orthographic
Projection

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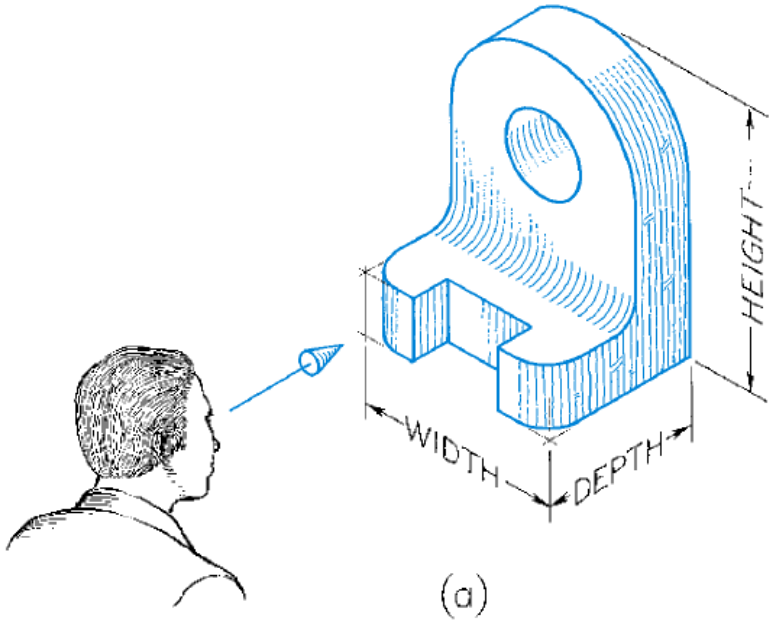
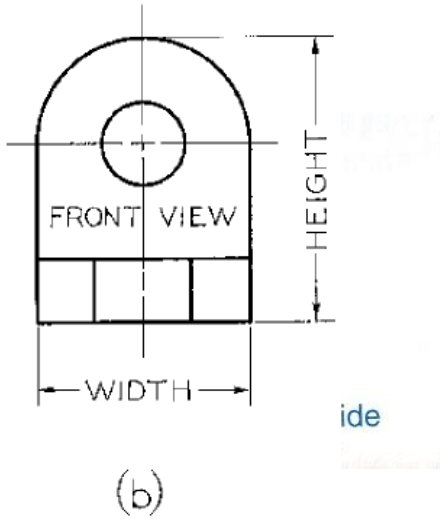
Orthographic Projection

- Is the backbone of technical drafting
- A system of drawings viewed using perpendicular projectors from the object to a plane of projection
- Views are generated using the flat planes





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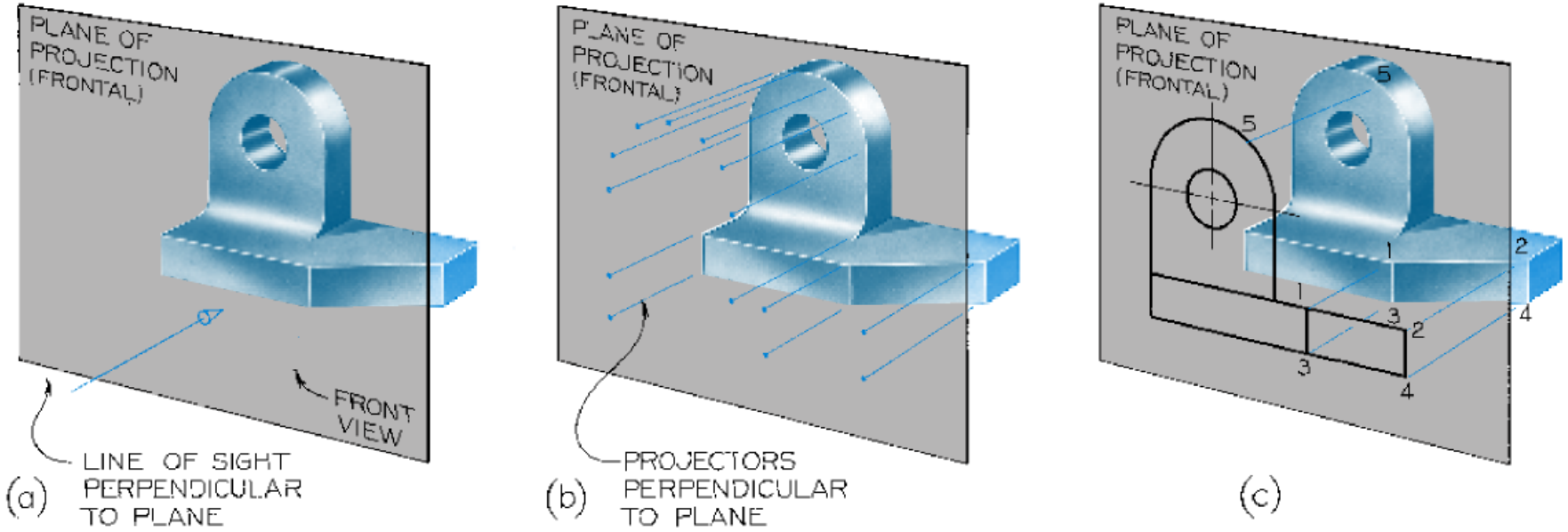
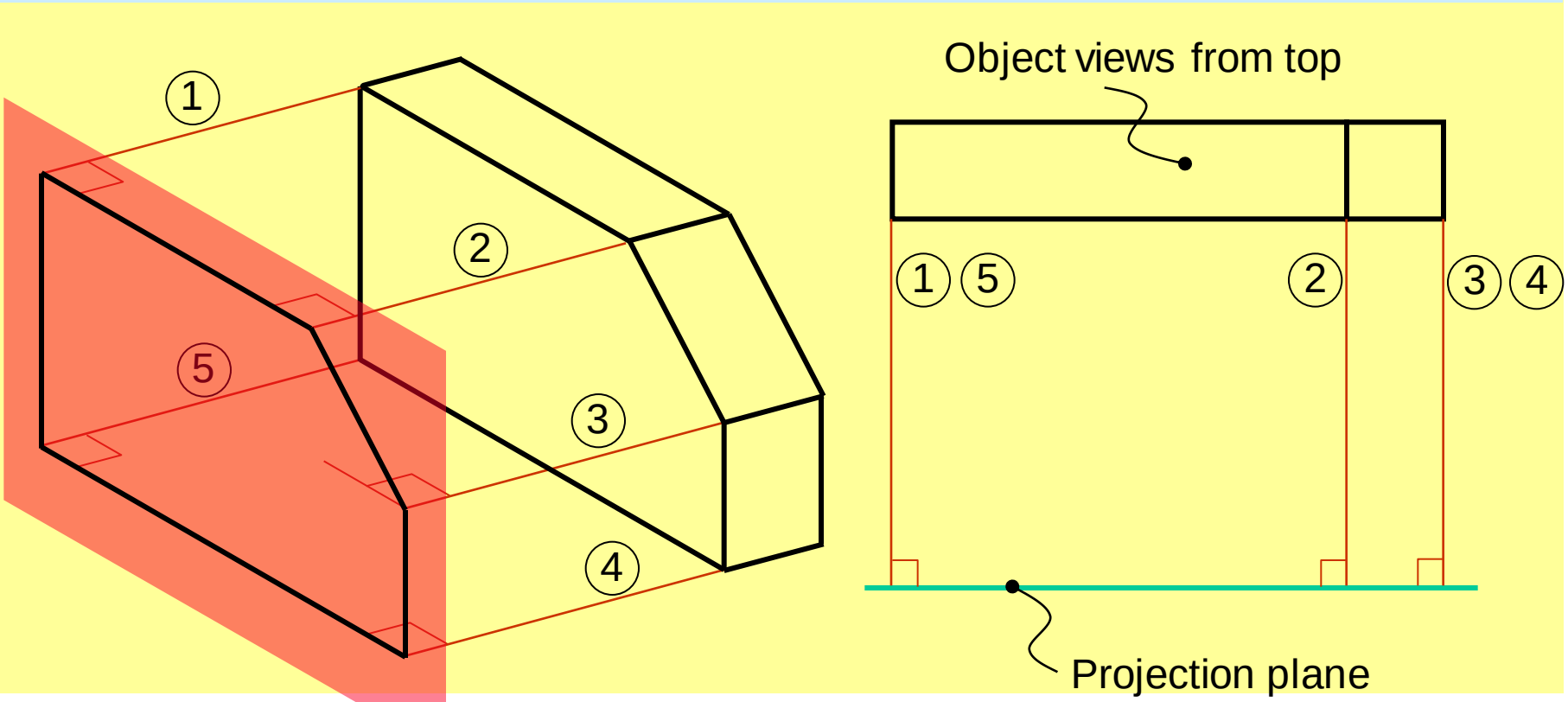
Projection of an Object



a. **Identifying the projection plane**
b. **Rays extending form every point of the object and perpendicular to the projection plane are generated**
c. **Intersection of the rays with the projection plan generates the required view**

MEANING

Orthographic projection is a parallel projection technique in which the parallel lines of sight are ***perpendicular*** to the projection plane



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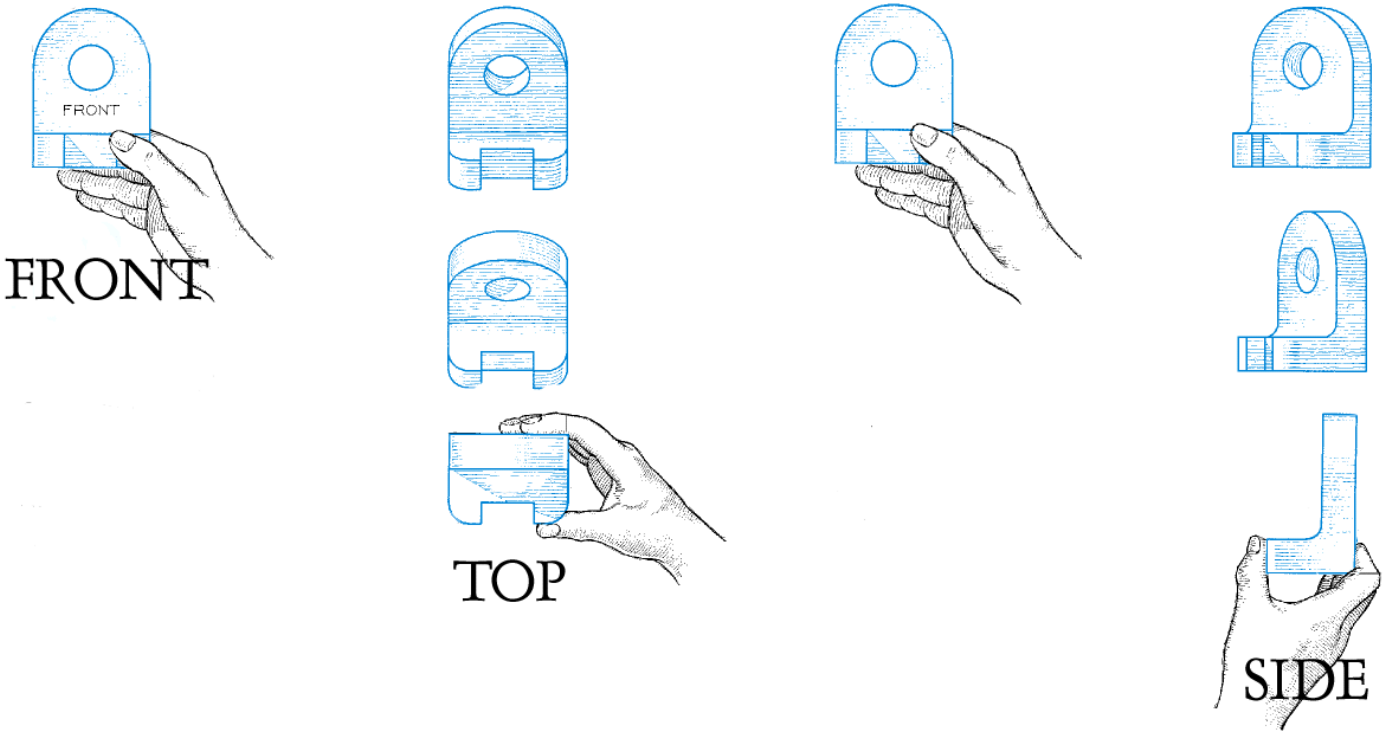
Revolving an Object to Produce the Six Basic Views



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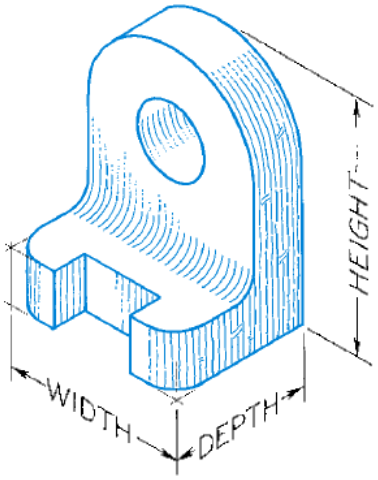
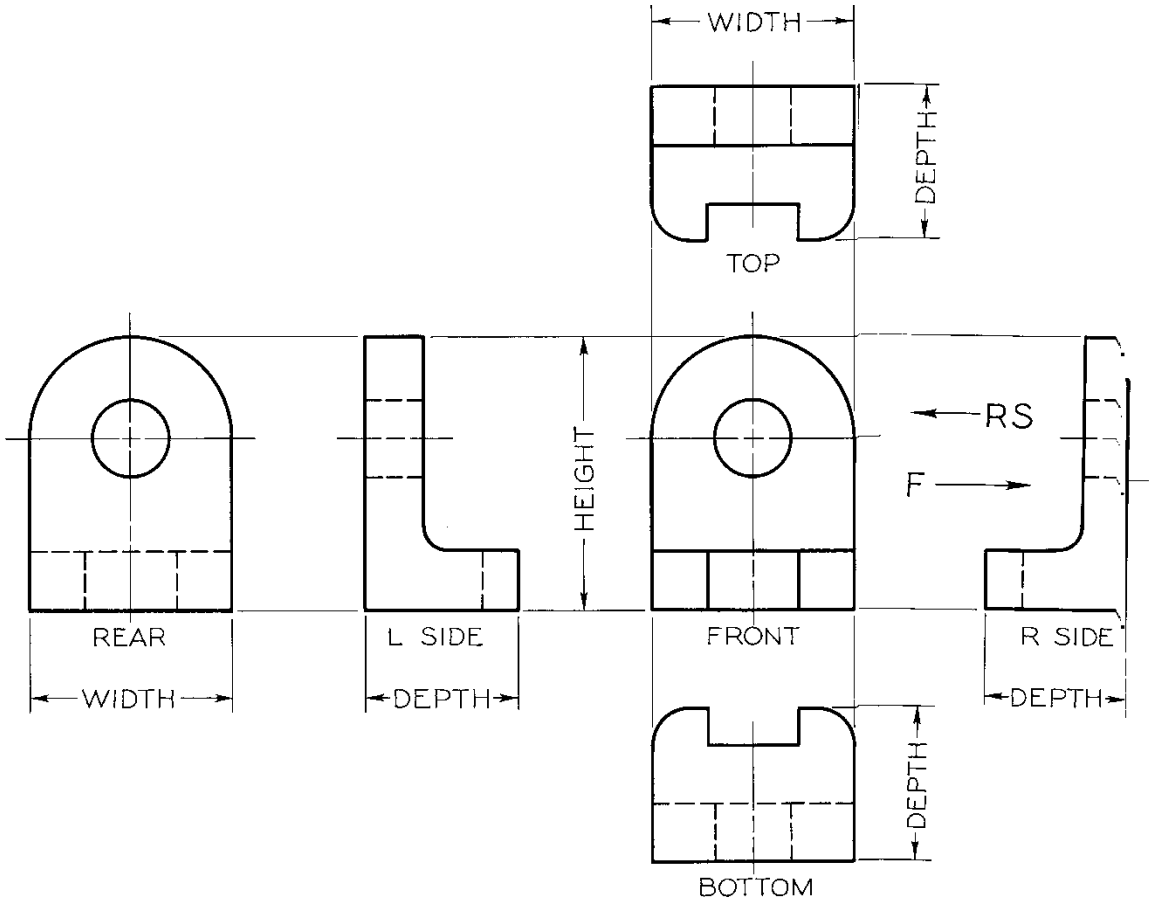
Revolving an Object to Produce the Six Basic Views



(a)



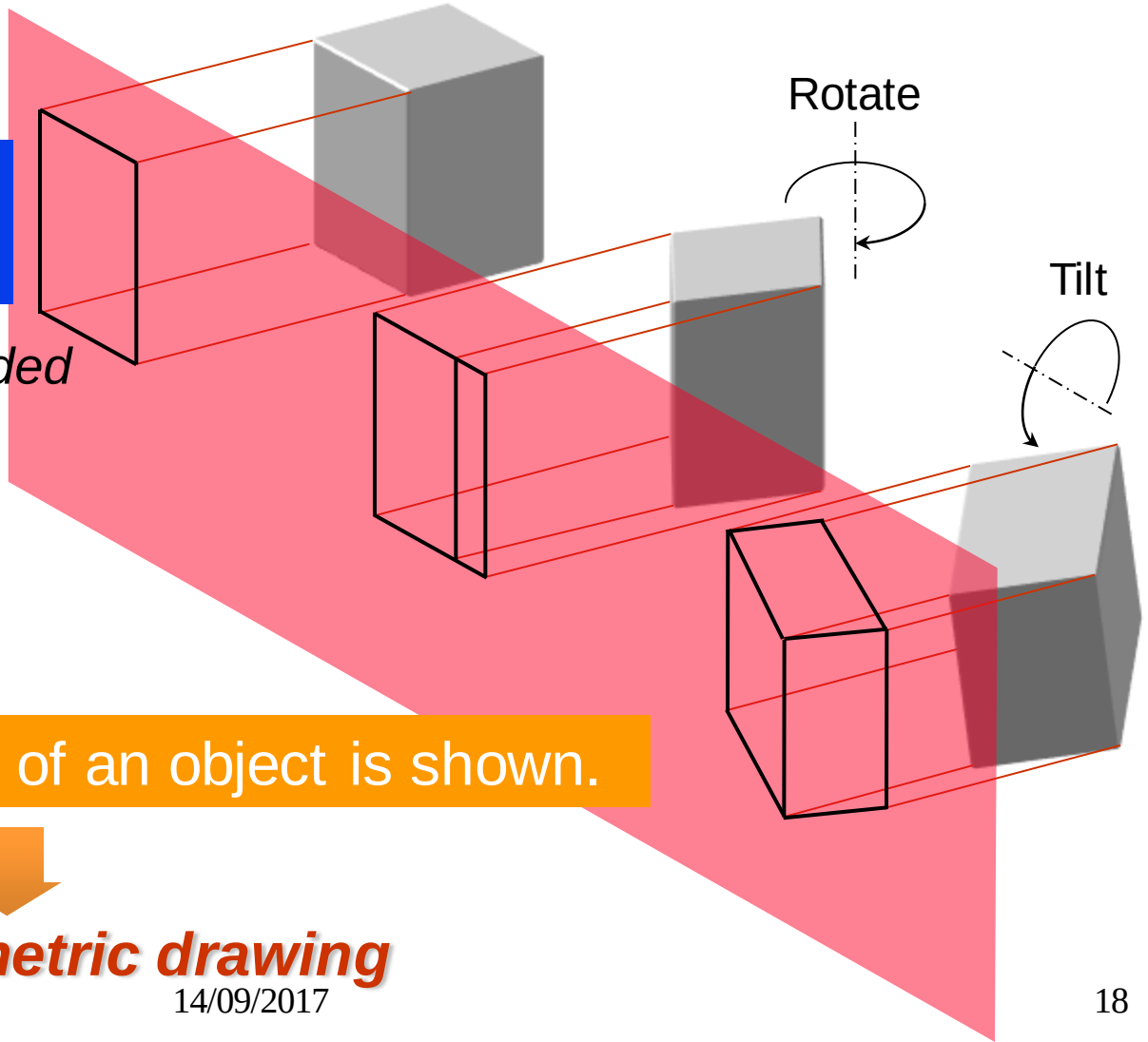
ORTHOGRAPHIC VIEW

Orthographic view depends on relative position of the object to the line of sight.

Two dimensions of an object is shown.

More than one view is needed to represent the object.

Multiview drawing



Three dimensions of an object is shown.

Axonometric drawing

ORTHOGRAPHIC VIEW

NOTES

- Orthographic projection technique can produce either

  1. ***Multiview drawing***
     that each view show an object in two dimensions.

  2. ***Axonometric drawing***
     that show all three dimensions of an object in one view.

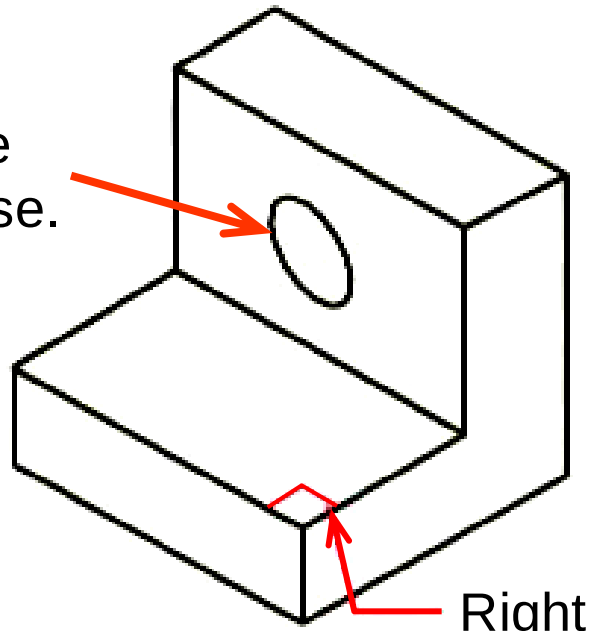
- Both drawing types are used in technical drawing for communication.

Axonometric (Isometric) Drawing

Advantage Easy to understand

Disadvantage Shape and angle distortion

Example Distortions of shape and size in isometric drawing

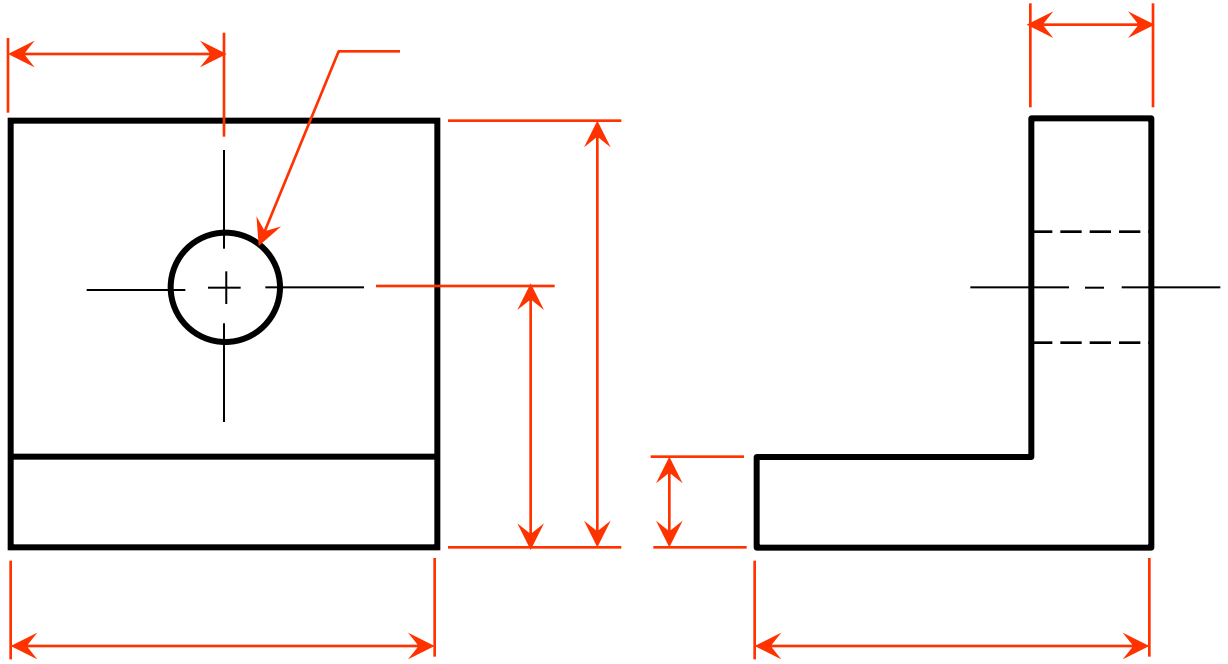


Multiview Drawing

Advantage It represents accurate **shape and size.**

Disadvantage Require practice in writing and reading.

Example Multiviews drawing (2-view drawing)



ORTHO VIEWS

Available Convention

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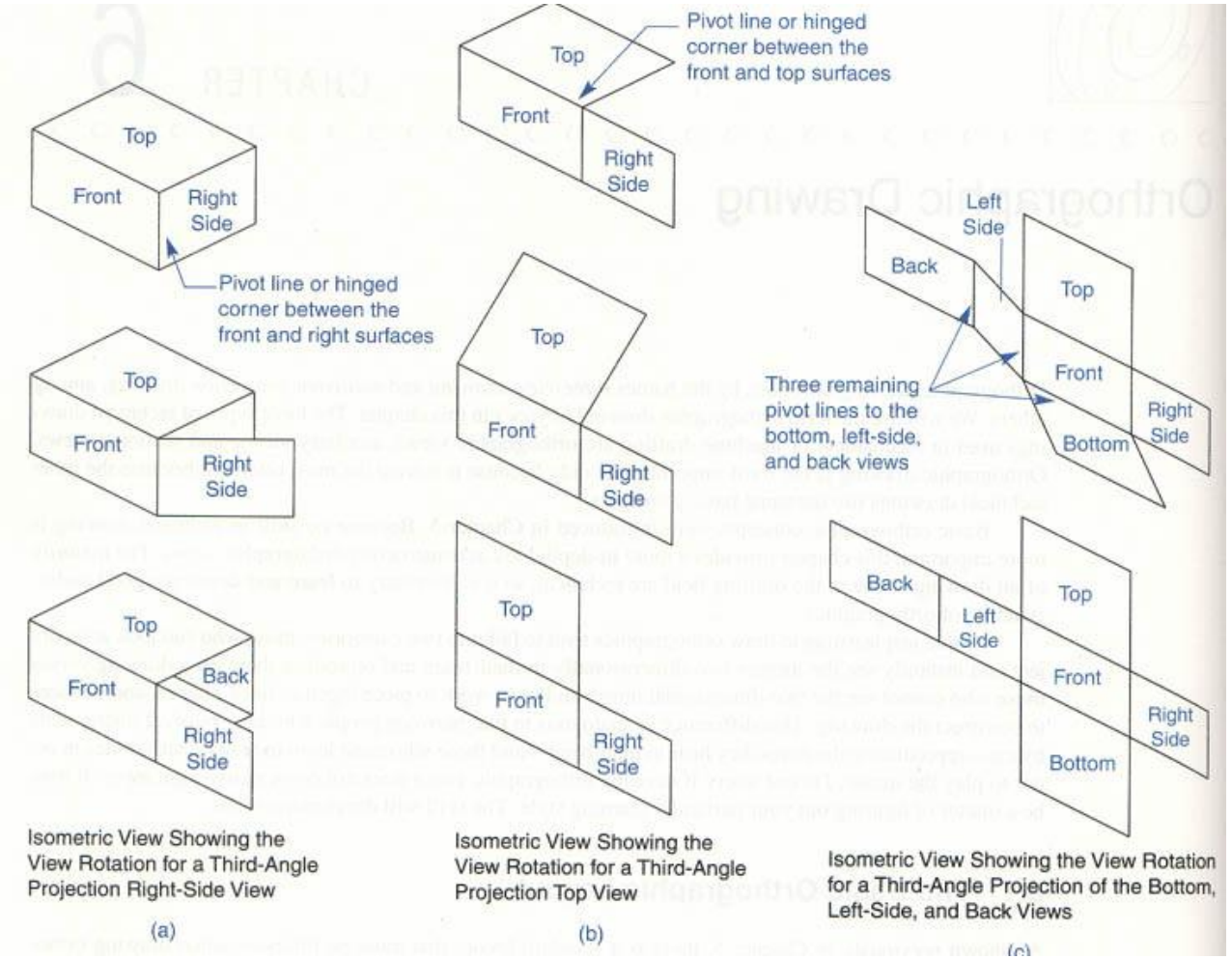
ORTHO VIEWS

Third Angle Convention

- Third angle convention is used mainly in Canada and US for views alignment.
- The object is rotated by using the corner where the view is located as a hinge corner



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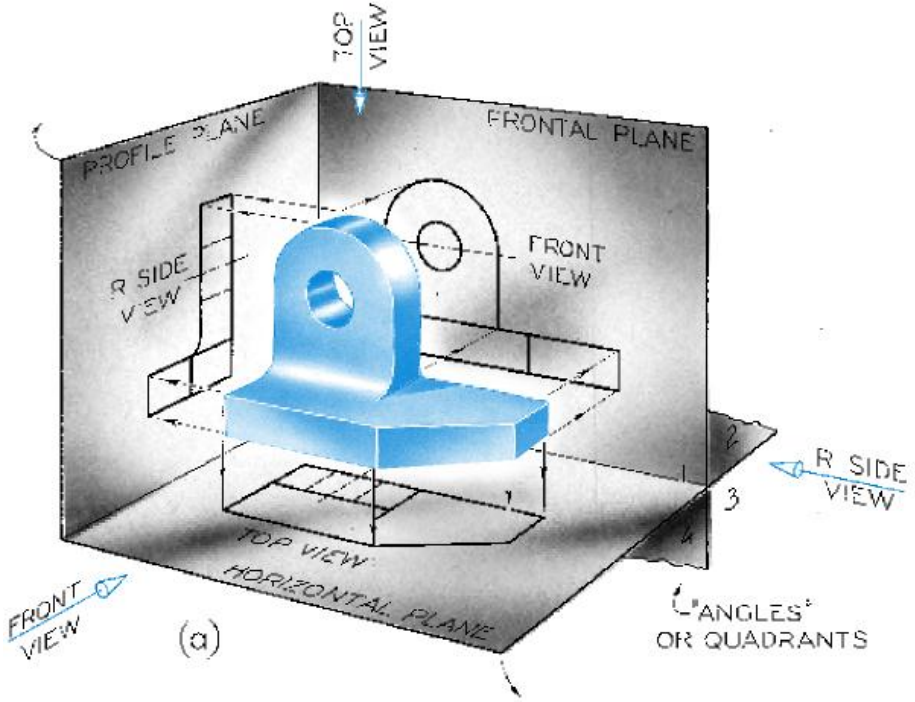
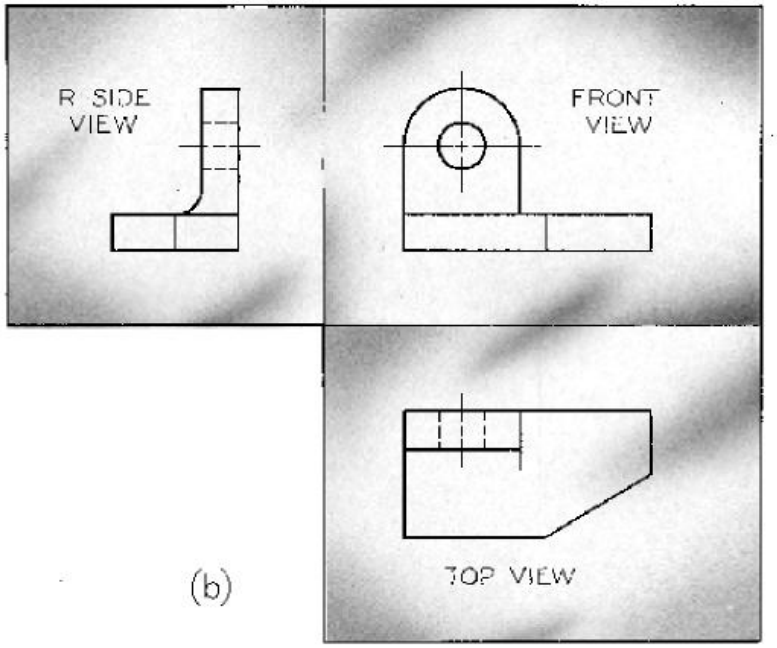
ORTHO VIEWS

First Angle Convention





- **The object is rotated by using the corner opposite where the view is located as a hinge corner**

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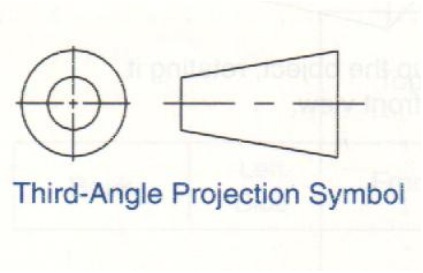
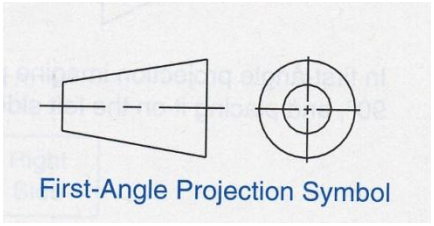
ORTHO VIEWS:

Third Angle Convention Versus First Angle Convention

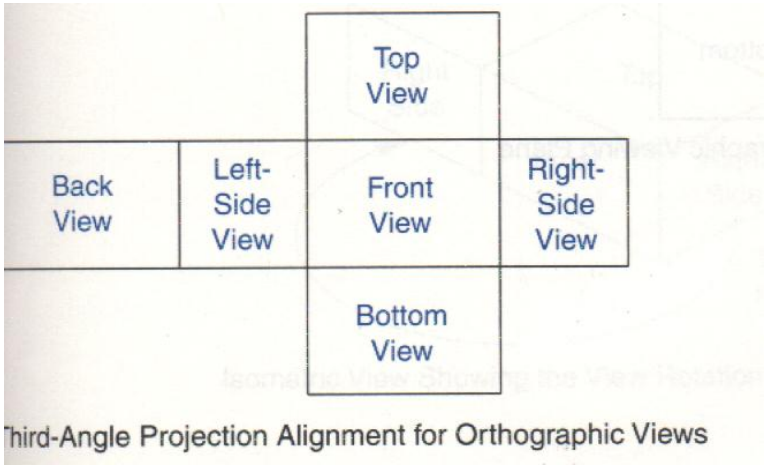
- Universal symbols are used to identify which format being used
- Combining the two systems in the same drawing is a major mistake



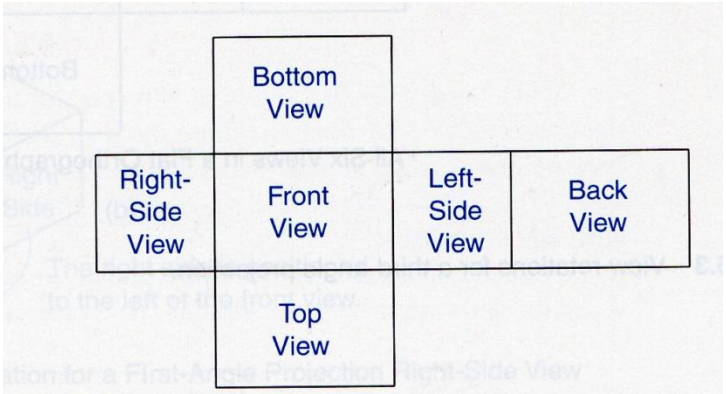
Third-Angle Projection Symbol



First-Angle Projection Symbol



Third-Angle Projection Alignment for Orthographic Views



First-Angle Projection for Orthographic Drawing

FIGURE 6.2 First-angle projection symbol and layout.

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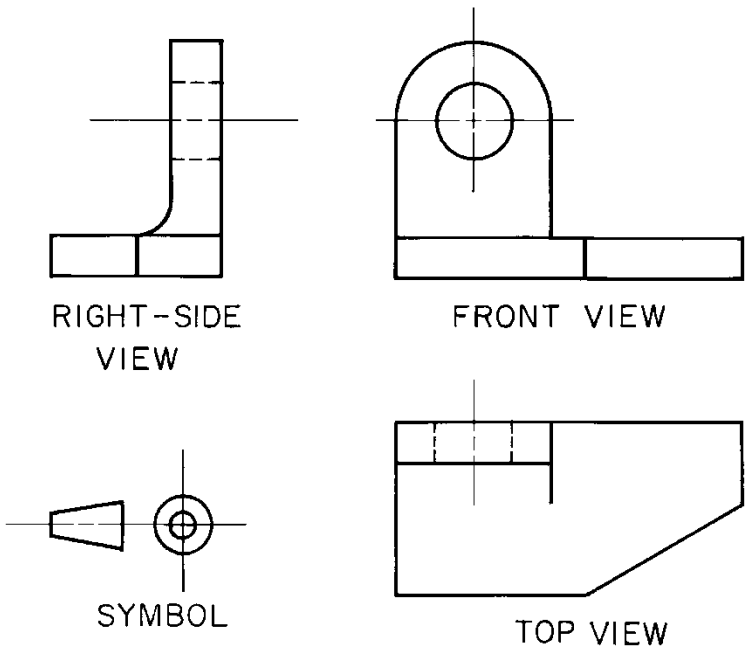
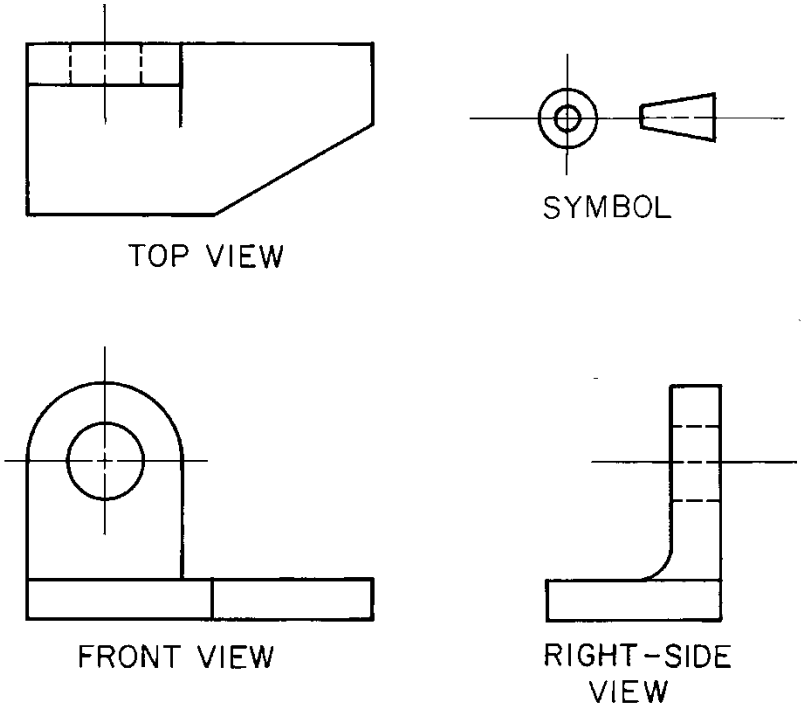
Sample for 1st & 3rd Angle Projection Drawing

- **The only difference between the two systems is the views location**



(a) FIRST-ANGLE PROJECTION

First angle projection



(b) THIRD-ANGLE PROJECTION

Third angle projection is used in the U.S., and Canada

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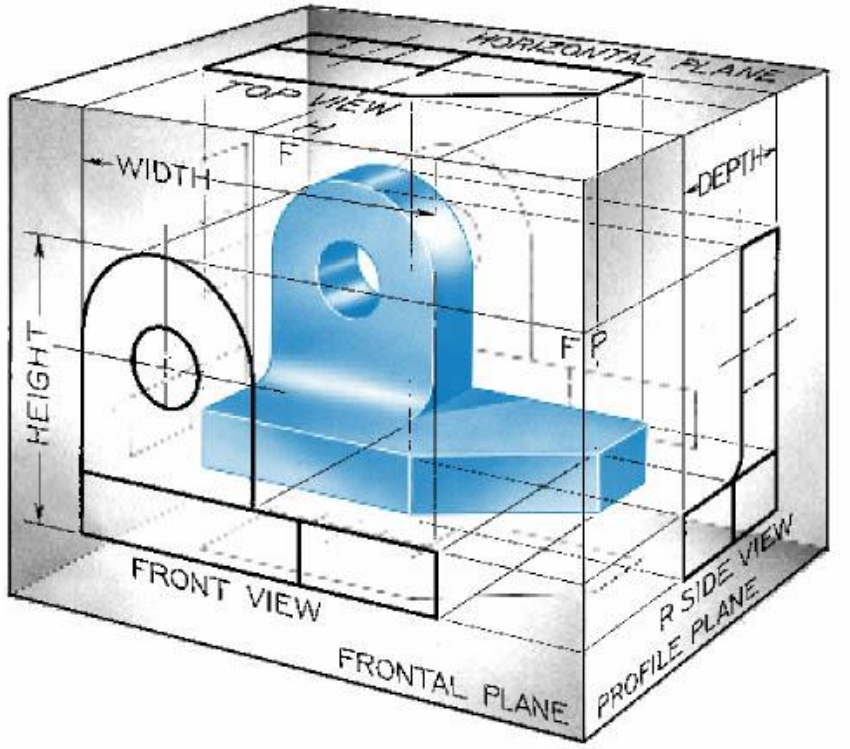
The Glass Box

- More than one view is required to describe an object
- Imagine that the object you are going to draw is positioned inside a glass box, so that the large flat surfaces of the object are parallel to the walls of the box.
- From each point on the object, imagine a ray, or *projector* perpendicular to the wall of the box forming the view of the object on that wall or projection plane.



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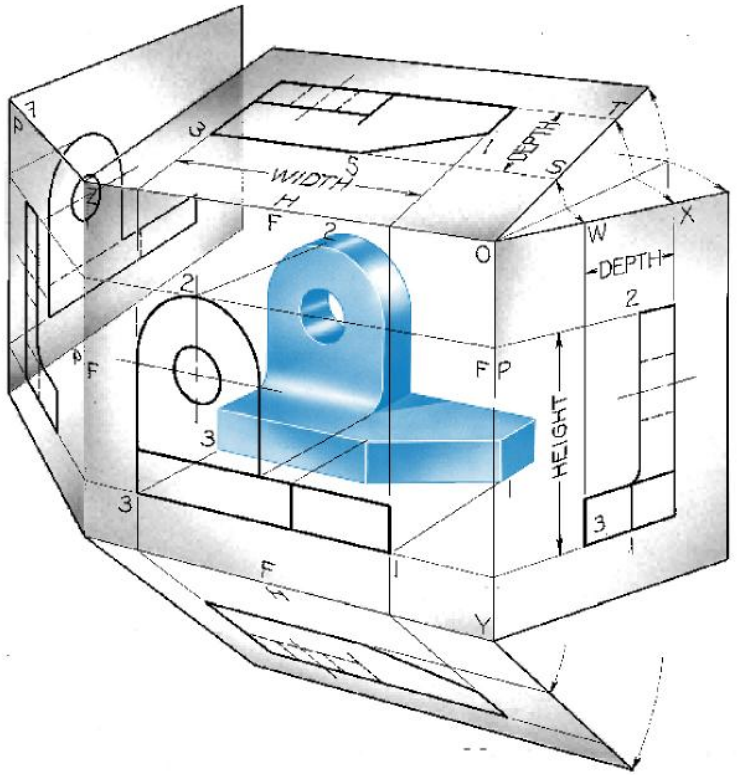
Unfolding the Glass box

- For Third Angle Projection (the method in the U.S.)
- Imagine that the walls of the box are hinged and unfold the views outward around the front view.
- This will give you the standard arrangement of views for 3rd Angle Projection which is used in the US, Canada, and some other countries.



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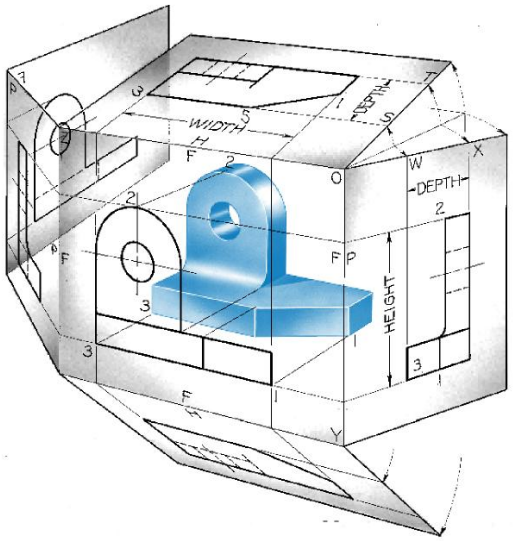
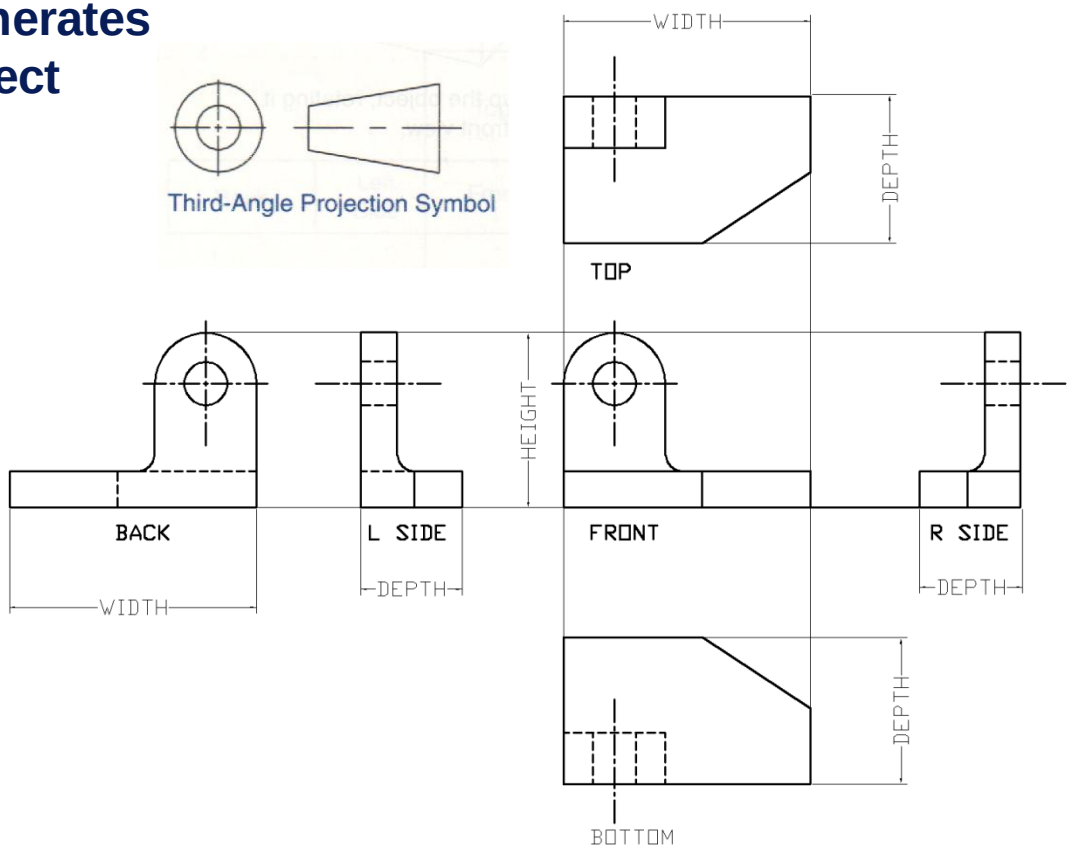
The Six Basic Views

- **Unfolding the glass box generates the 6 basic views of the object**





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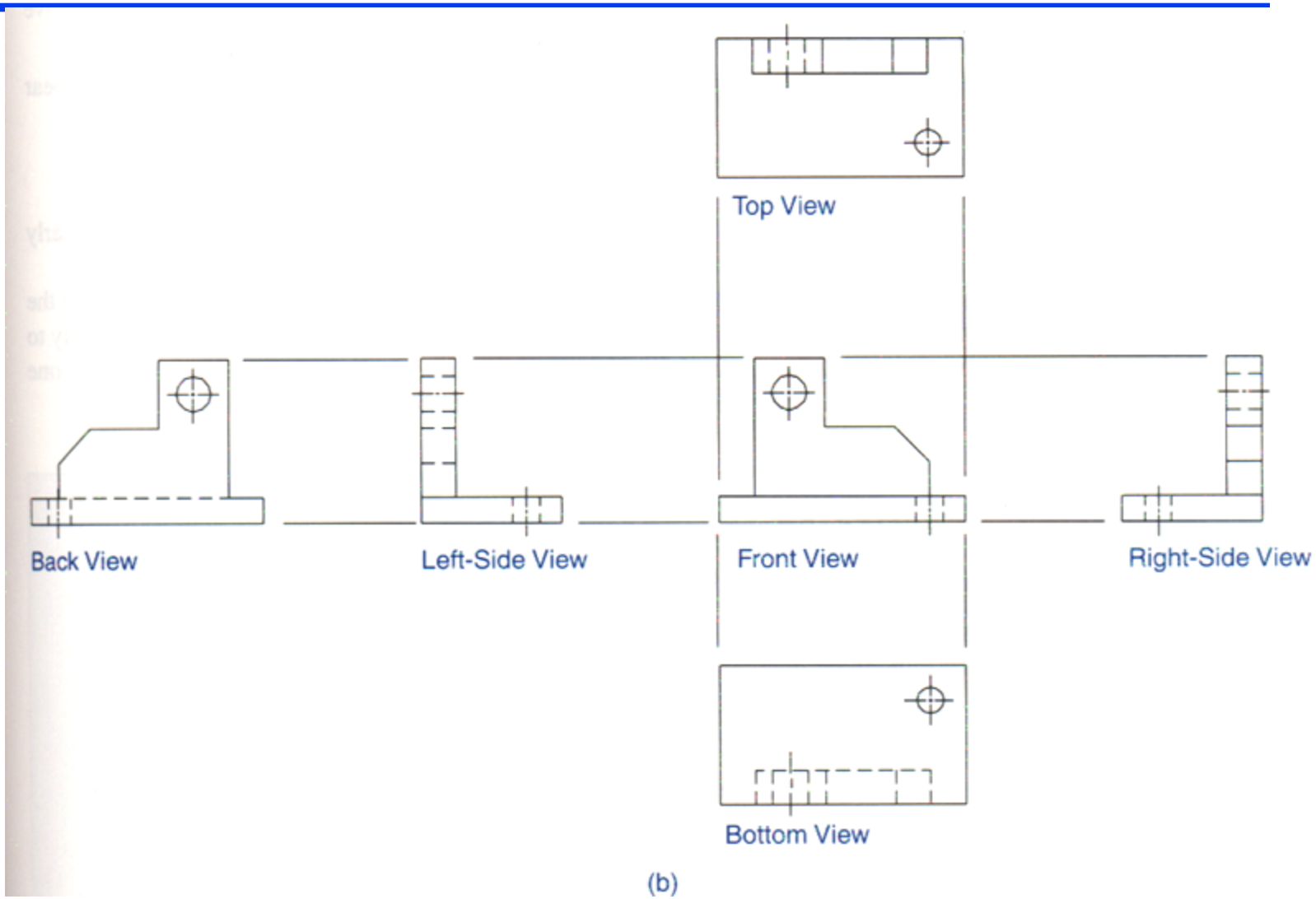
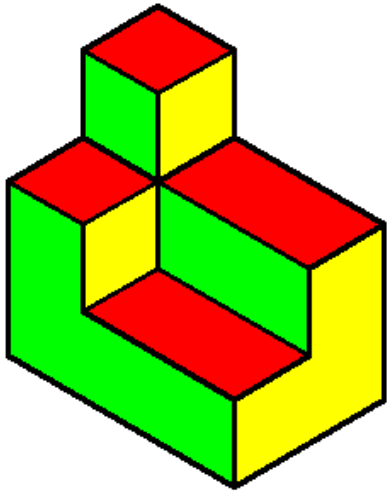
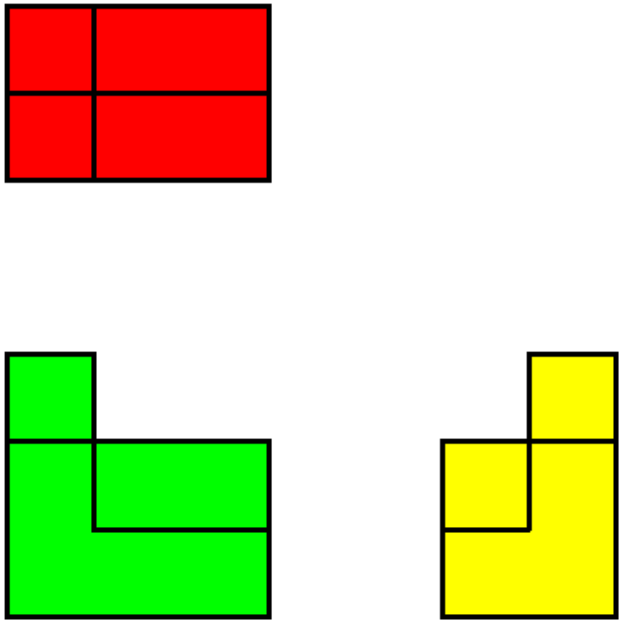
ORTHO VIEWS: Third Angle Convention



ORTHOGRAPHIC vs. ISOMETRIC



ISOMETRIC
DRAWING



ORTHOGRAPHIC
DRAWING

ORTHO VIEWS

Transferring Dimensions

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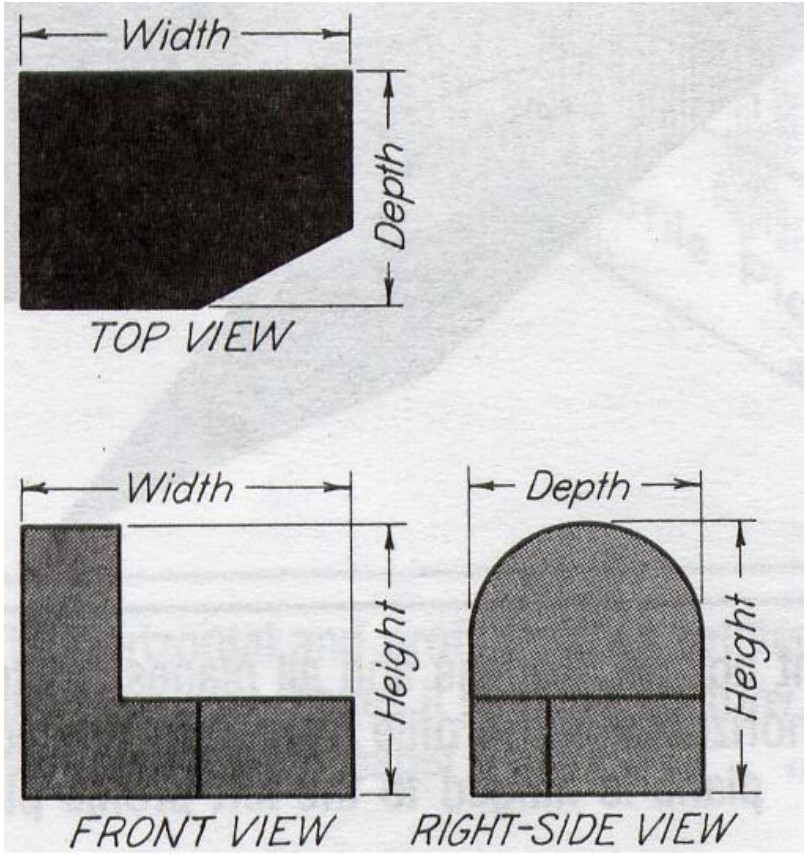
ORTHO VIEWS:

projections & relevant dimensions

- **The six orthographic views uses repeatedly the same the dimensions of the part**
  - **a.** Width
  - **b.** Depth
  - **c.** Height
- **Transferring dimension form one view to another reduces drafting time**
- **Mesurment transfer are:**
  a. Scale technique
  b. Divider technique
  c. The 45 angle line technique



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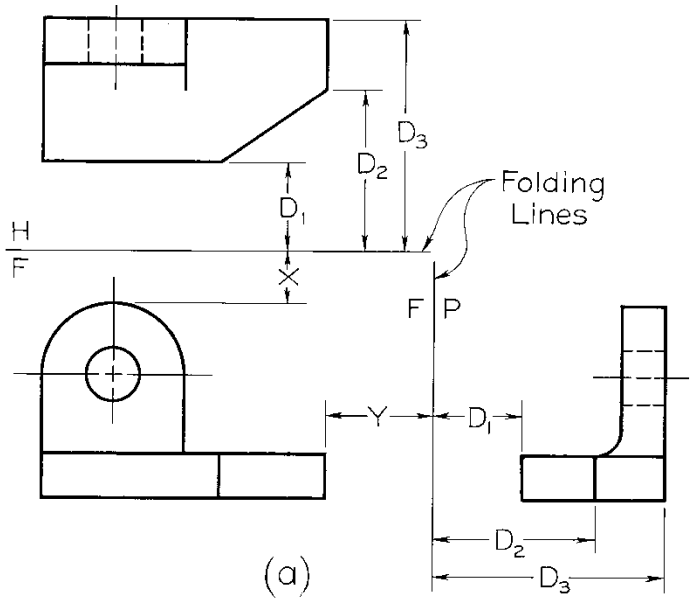
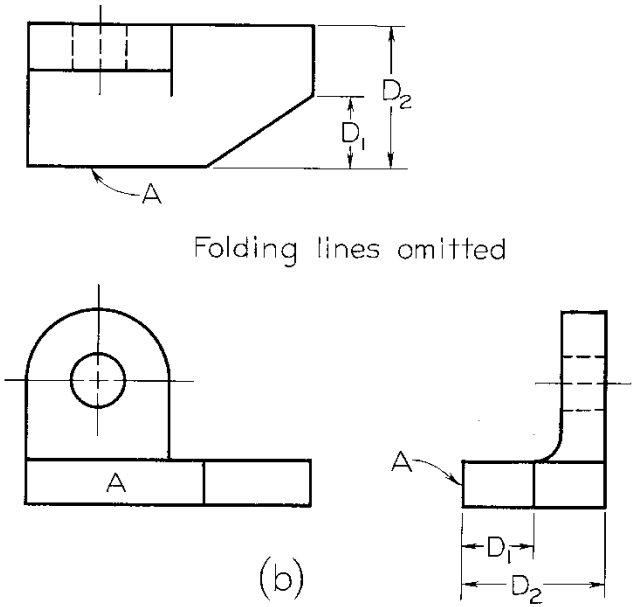
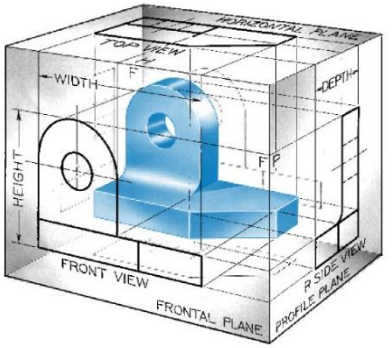
Transferring Dimensions





- **Scale technique use a scale or a ruler each time to transfer dimensions.**
- **Divider technique use a divider or a compass to transfer dimensions**



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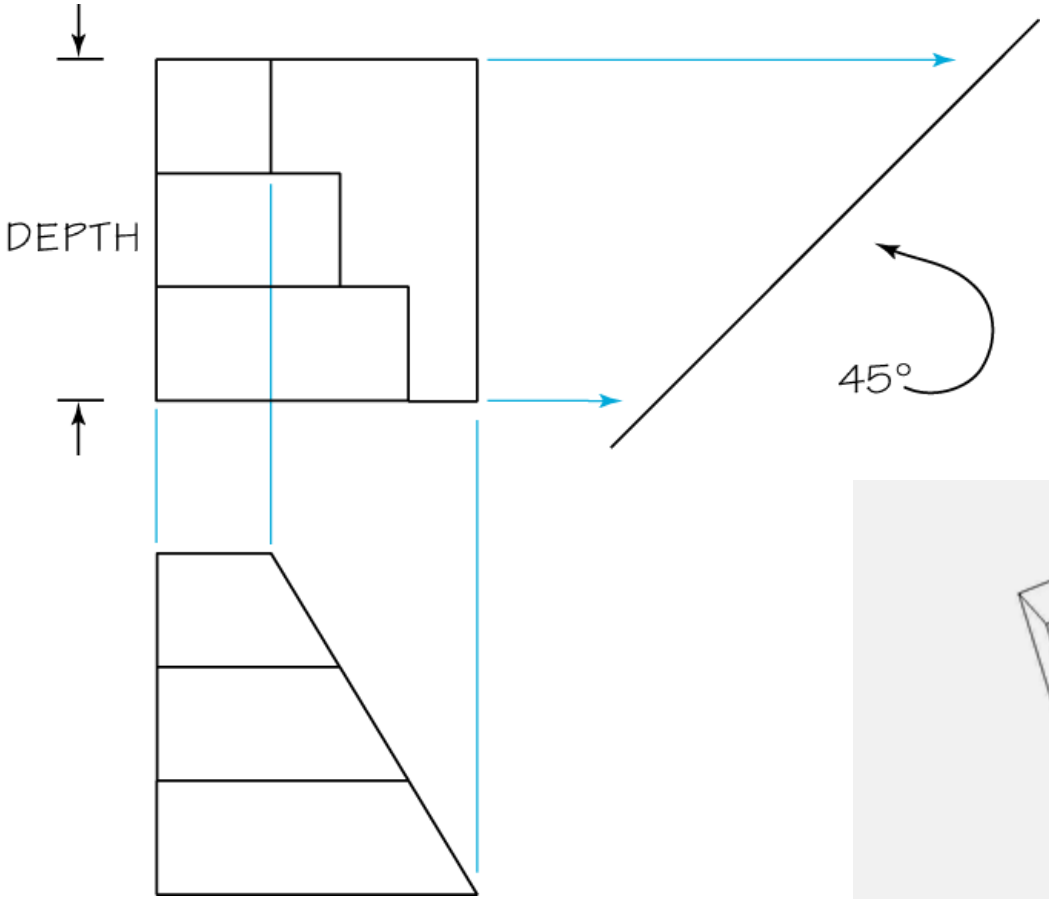
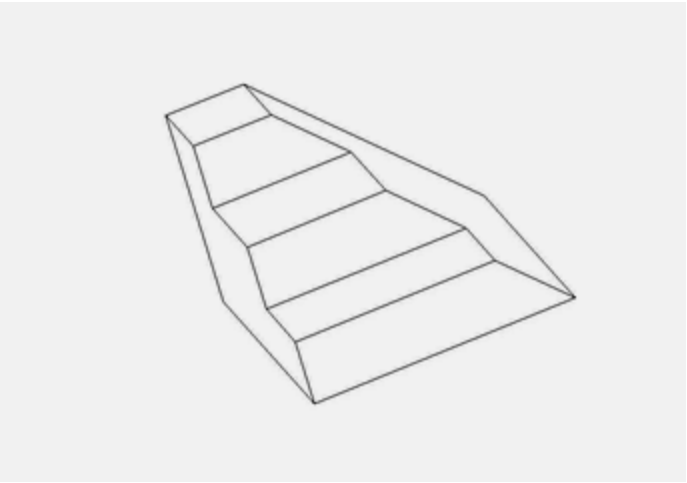
Using a Miter Line to Transfer Depth

1.



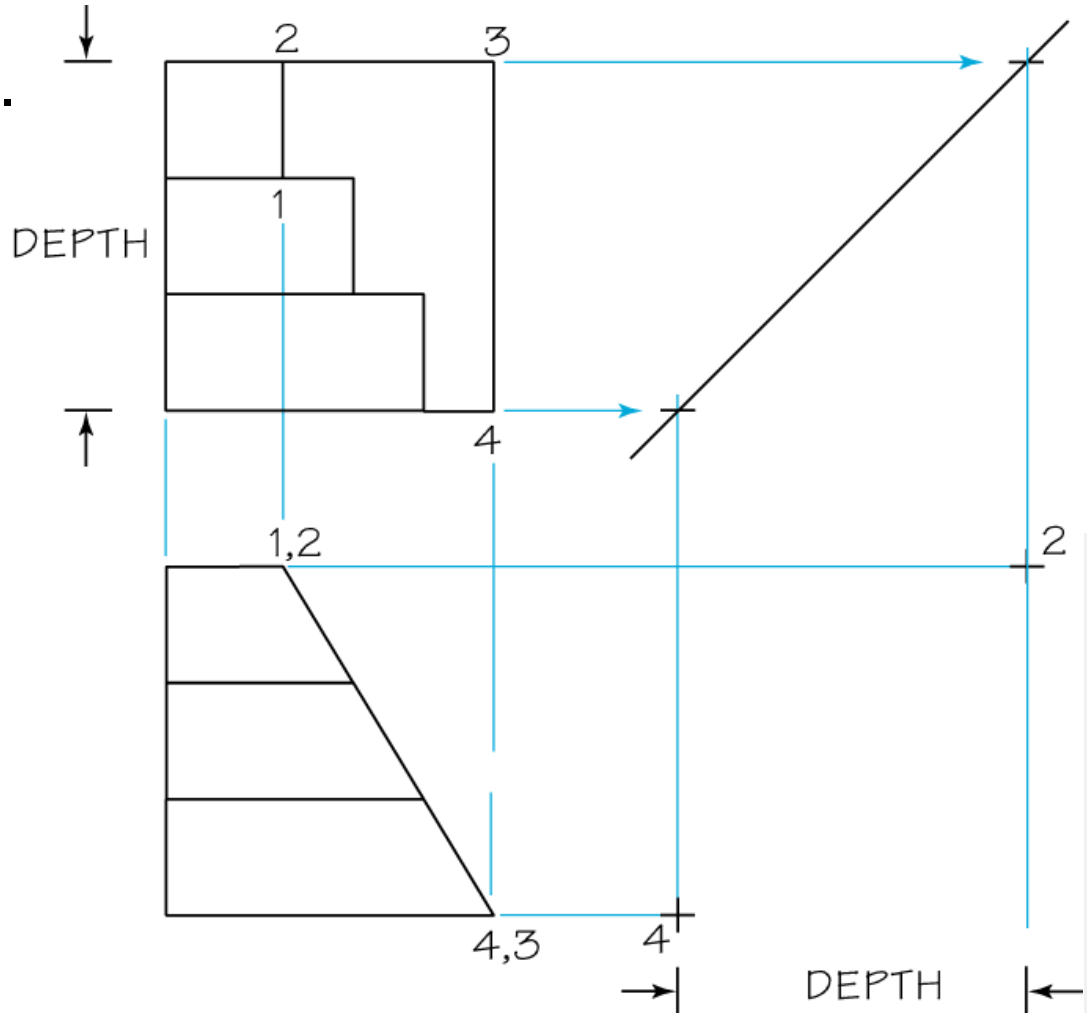
Draw miter line at 45 degrees at a convenient distance to produce the desired view.



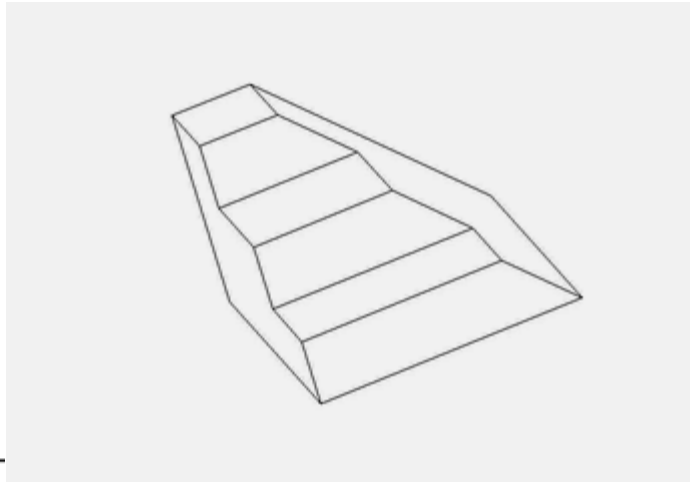
MECH 220: 2nd LECTURE

Using a Miter Line to Transfer Depth

2.



- Identify critical points delimiting the required view
- Sketch light lines projecting depth locations for points to miter line and then down into side view as shown.



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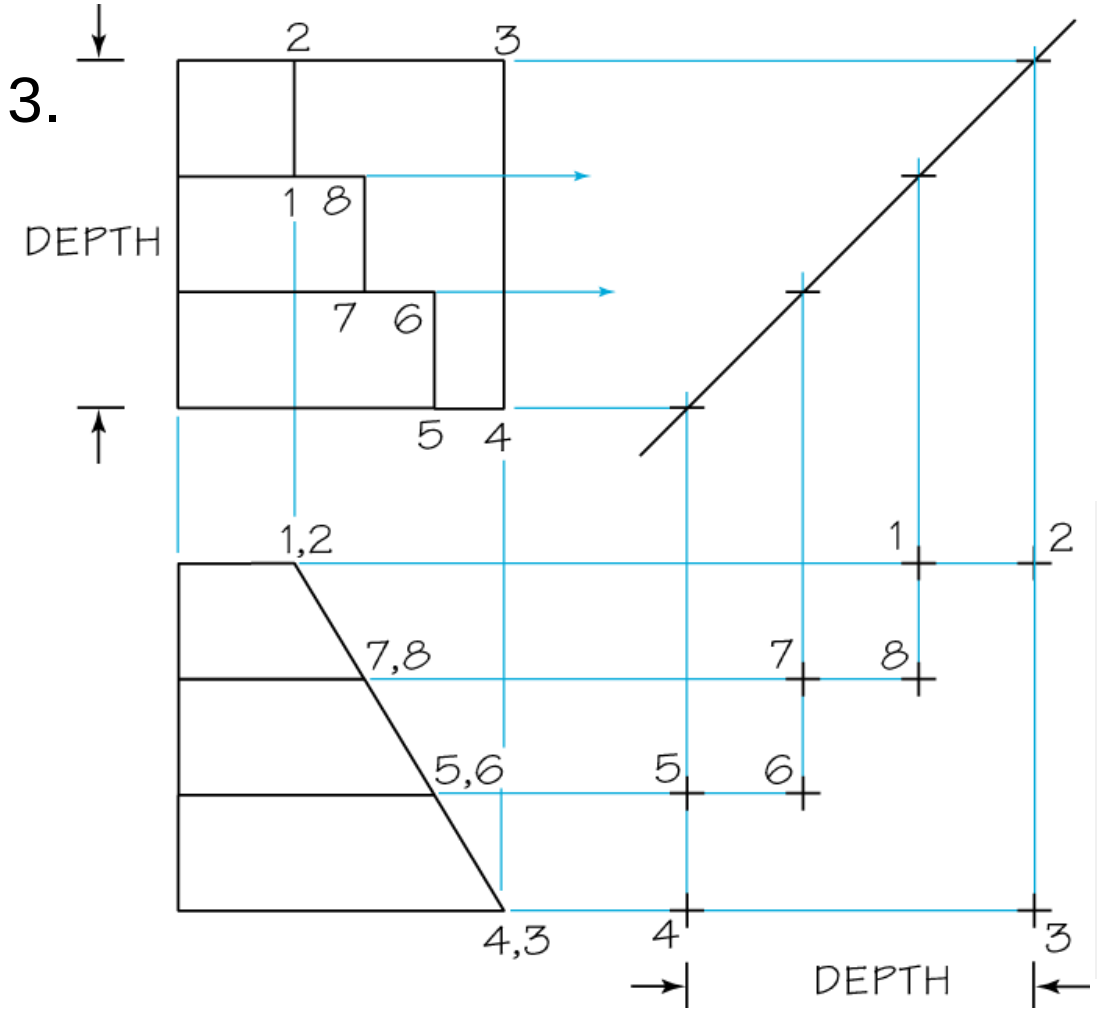
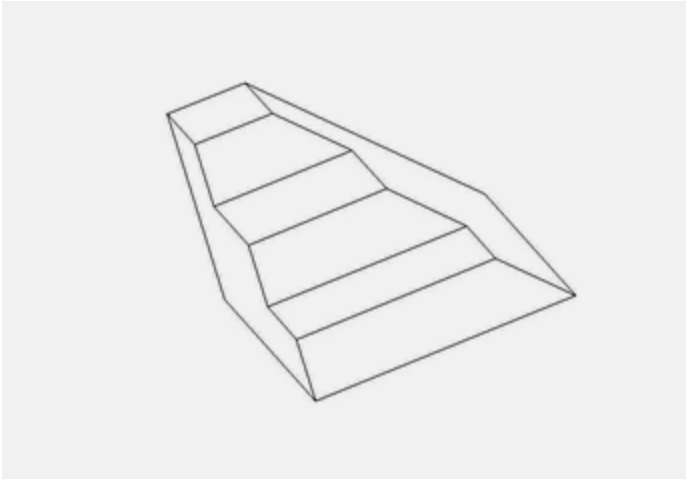
Using a Miter Line to Transfer Depth

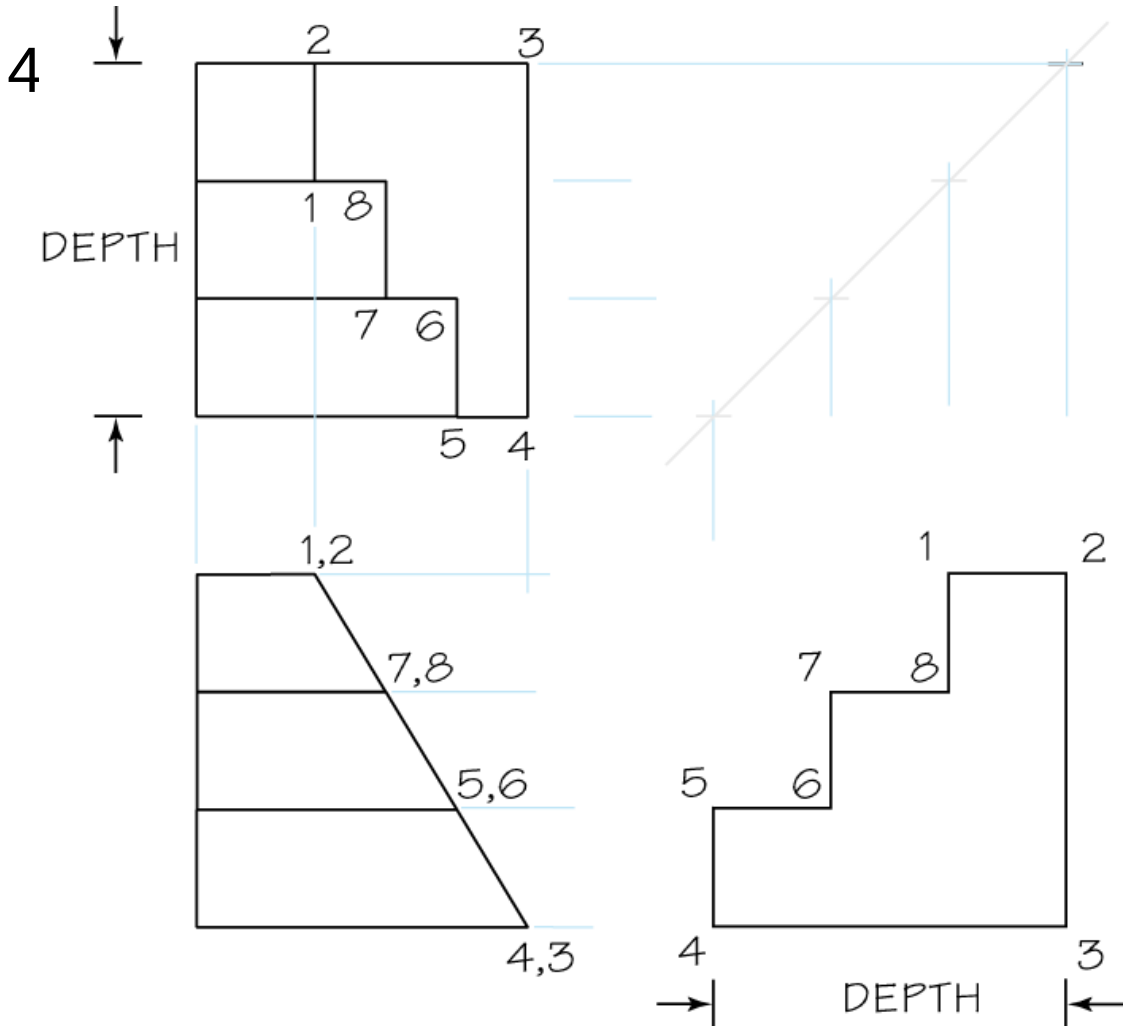


Project additional points, surface by surface.

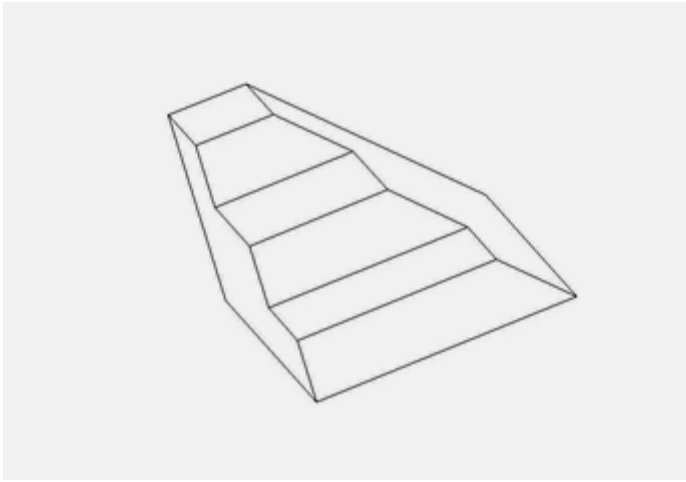


MECH 220: 2nd LECTURE

Using a Miter Line to Transfer Depth



Draw the view locating each vertex of the surface on the projection and miter line.



ORTHO VIEWS

Drawing Curved Shapes

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Plotting Curved Shapes using mitered lines

- Using the View showing the curve as a true circle
- Identify point on the circle dividing it into arcs of 30 degrees increment
- Transfer the identified points to the front view

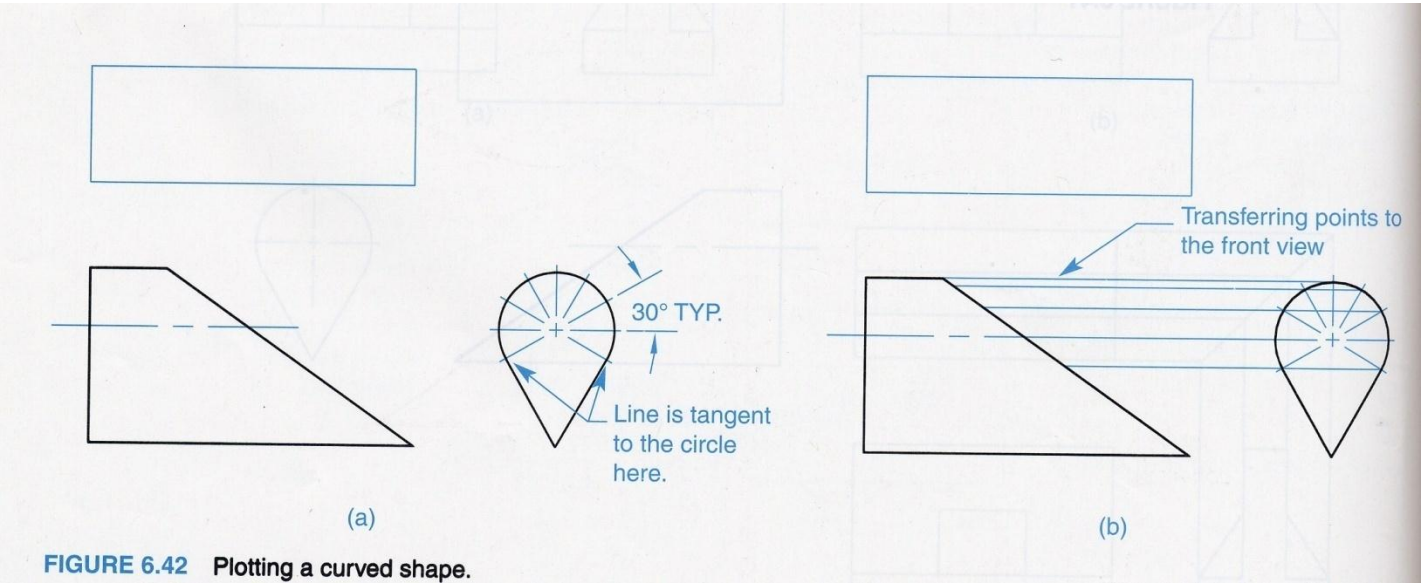
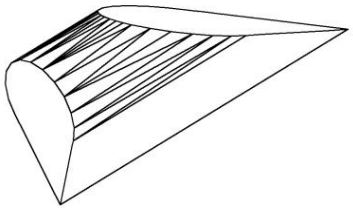


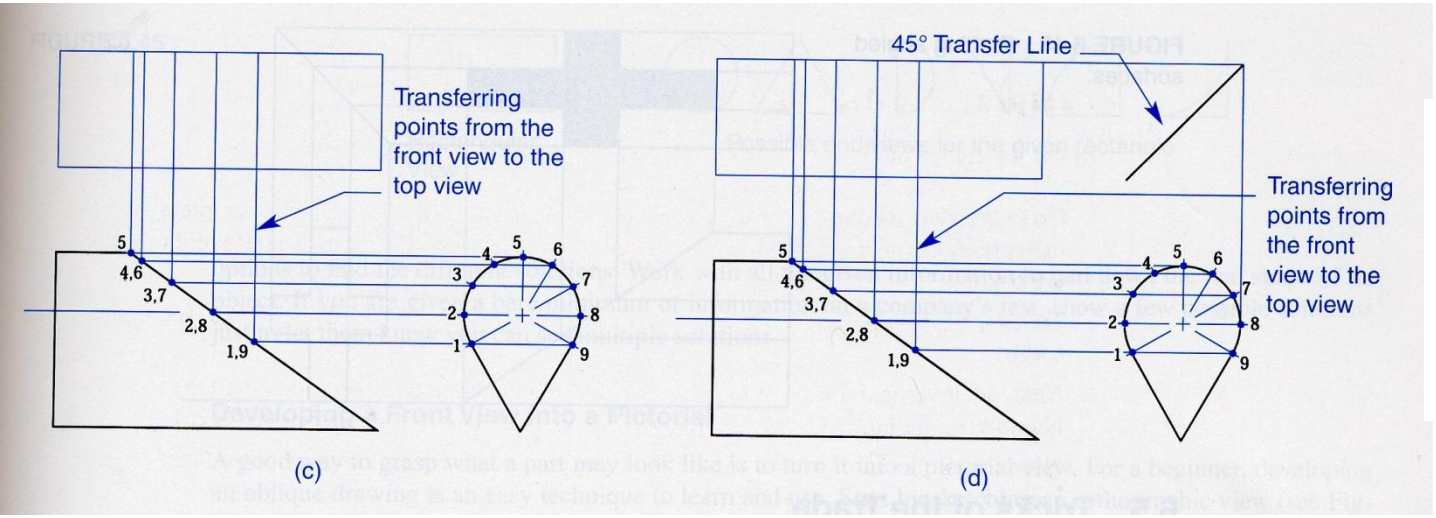
FIGURE 6.42 Plotting a curved shape.

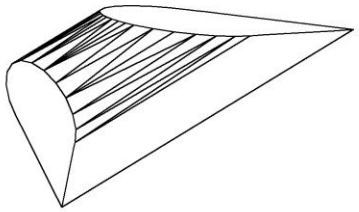


MECH 220: 2nd LECTURE

Plotting Curved Shapes using mitered lines

- Numbering the point helps you keep track of your lines
- Draw vertical lines projecting the identified point from the front view to the top view
- Identify your 45 degree transfer line

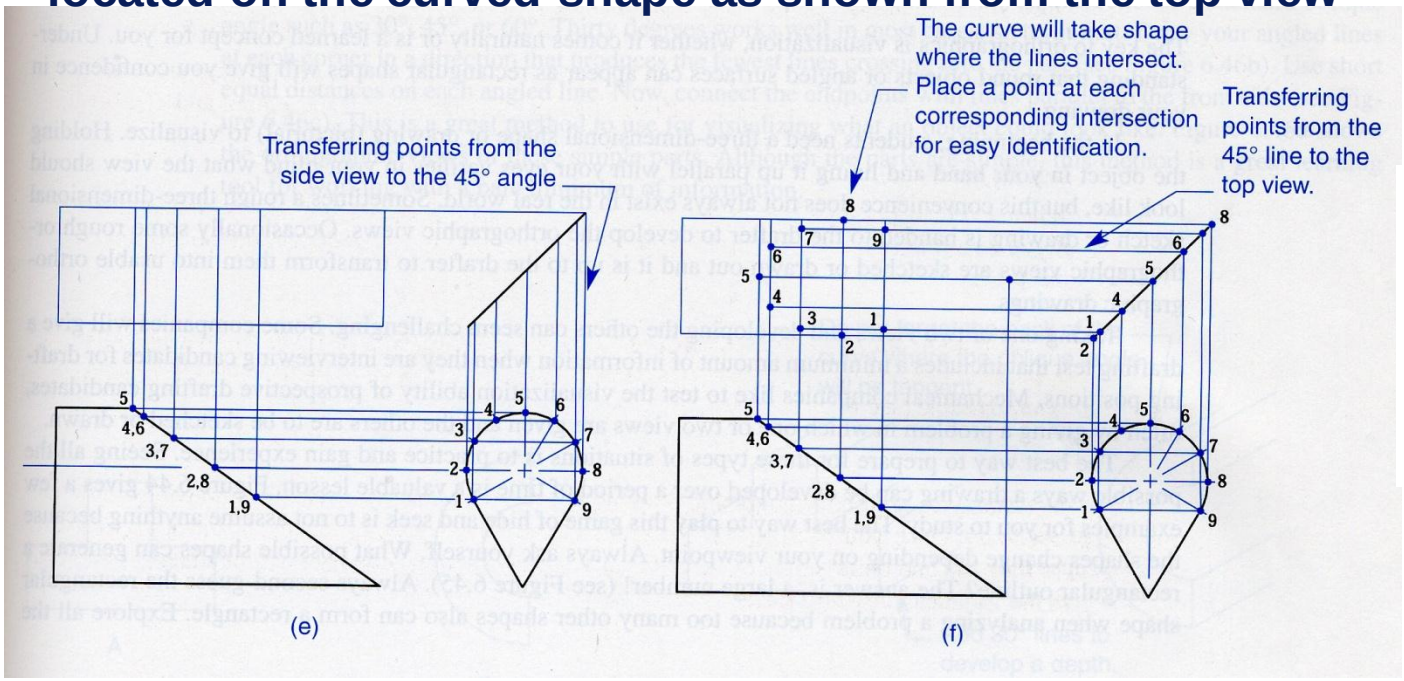


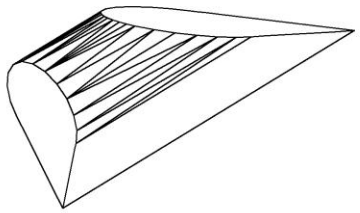


MECH 220: 2nd LECTURE

Plotting Curved Shapes using mitered lines

- Project the identified points from your right view vertically to the 45 degree transfer line
- Draw horizontal line form the projected points to you top view
- Intersection of the corresponding Vertical line initiated form the front view and the horizontal lines initiated from the right view identifies the points located on the curved shape as shown from the top view

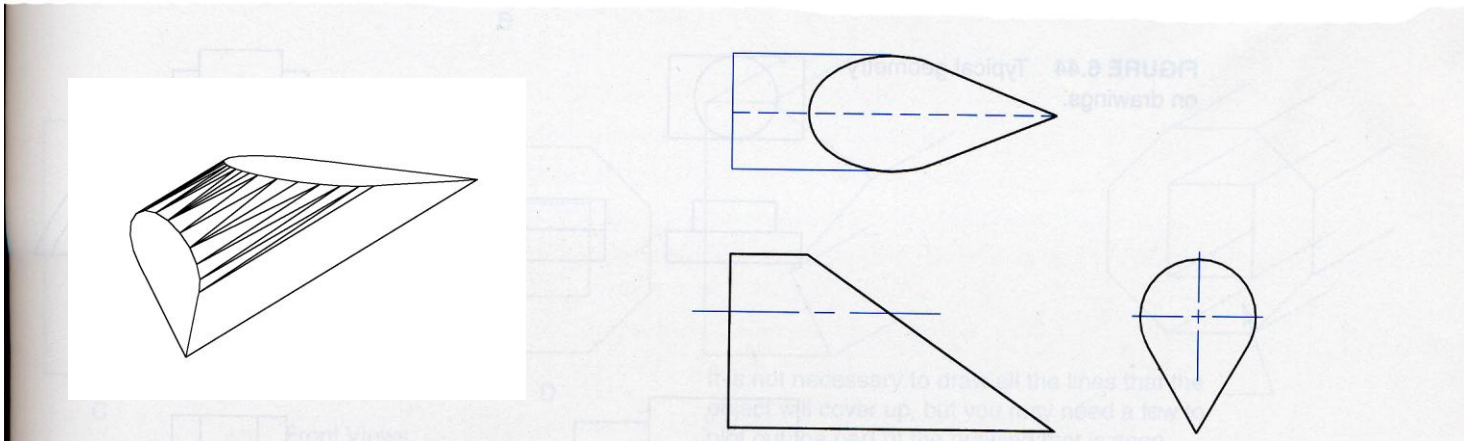




MECH 220: 2nd LECTURE

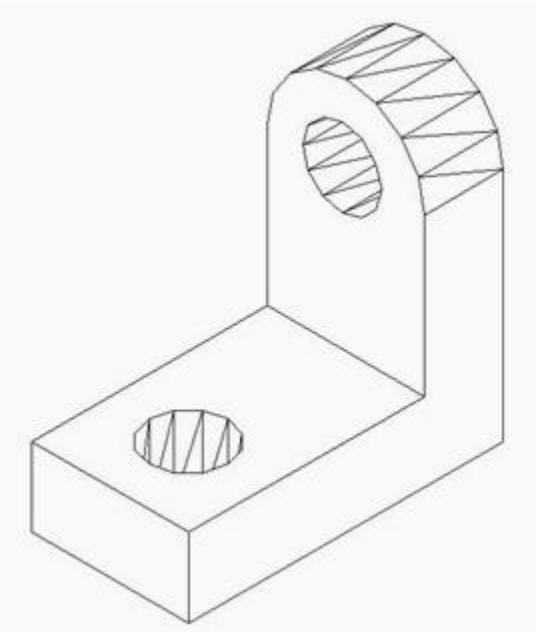
Plotting Curved Shapes using mitered lines

- The result of the connected point is show in figure below

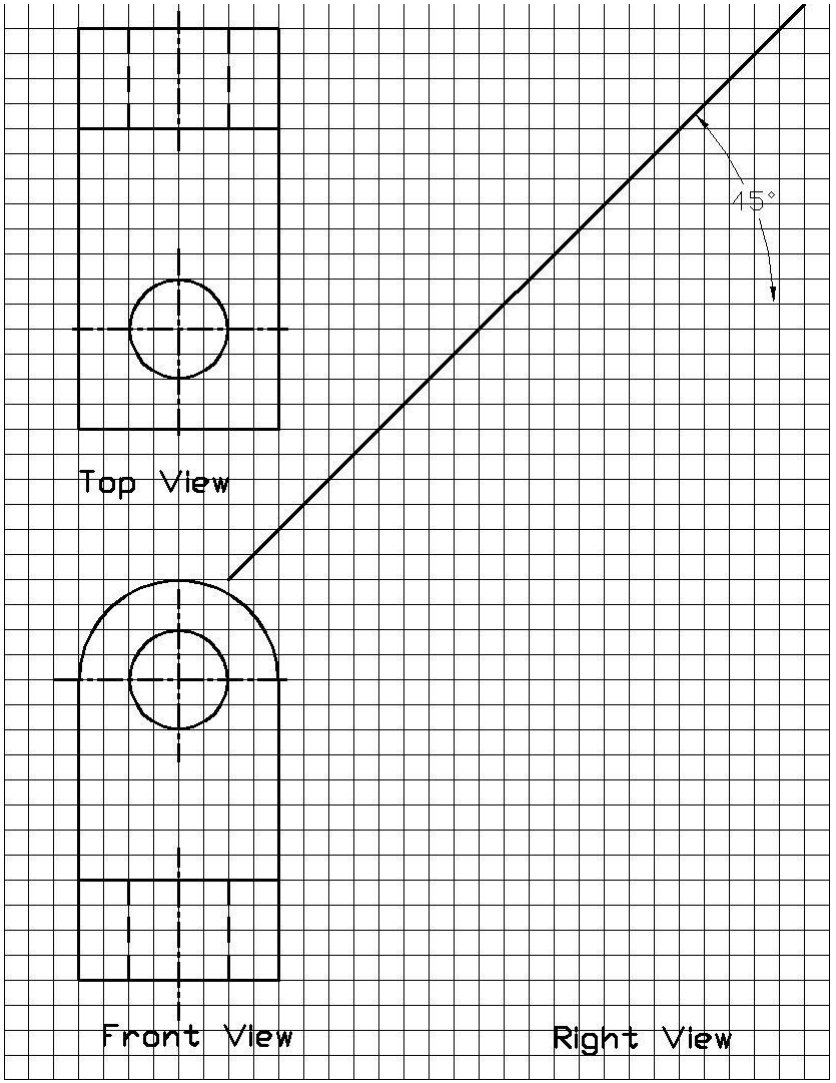


MECH 220: 2nd LECTURE

Freehand sketching exercise



Generate the Right View of above model based on the provided front and top views



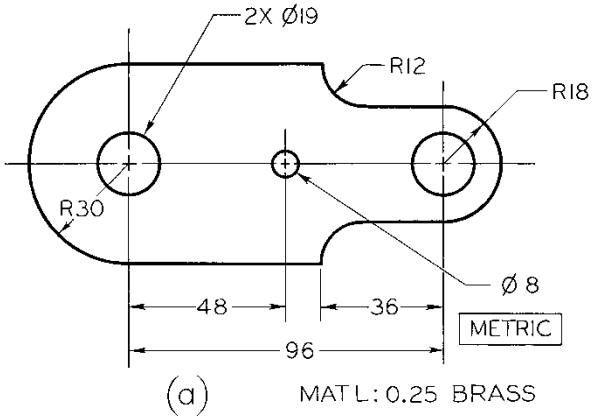
ORTHO VIEWS

Selecting Views

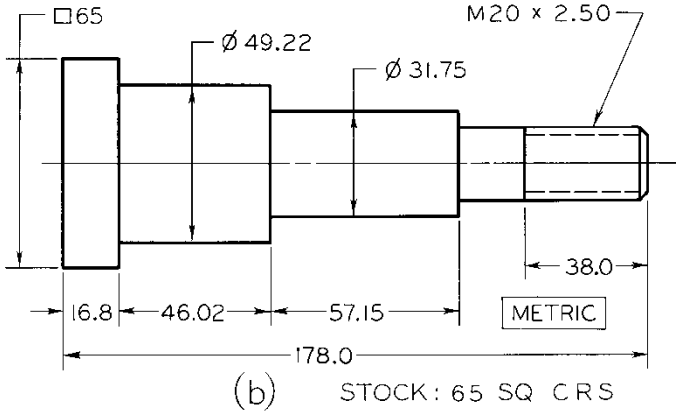
MECH 220: 2nd LECTURE

Necessary Views

A sketch or drawing should only contain the views needed to clearly and completely describe the object. Choose the views that show the shape most clearly, have the fewest hidden lines, and show the object in a usual, stable, or operating position.



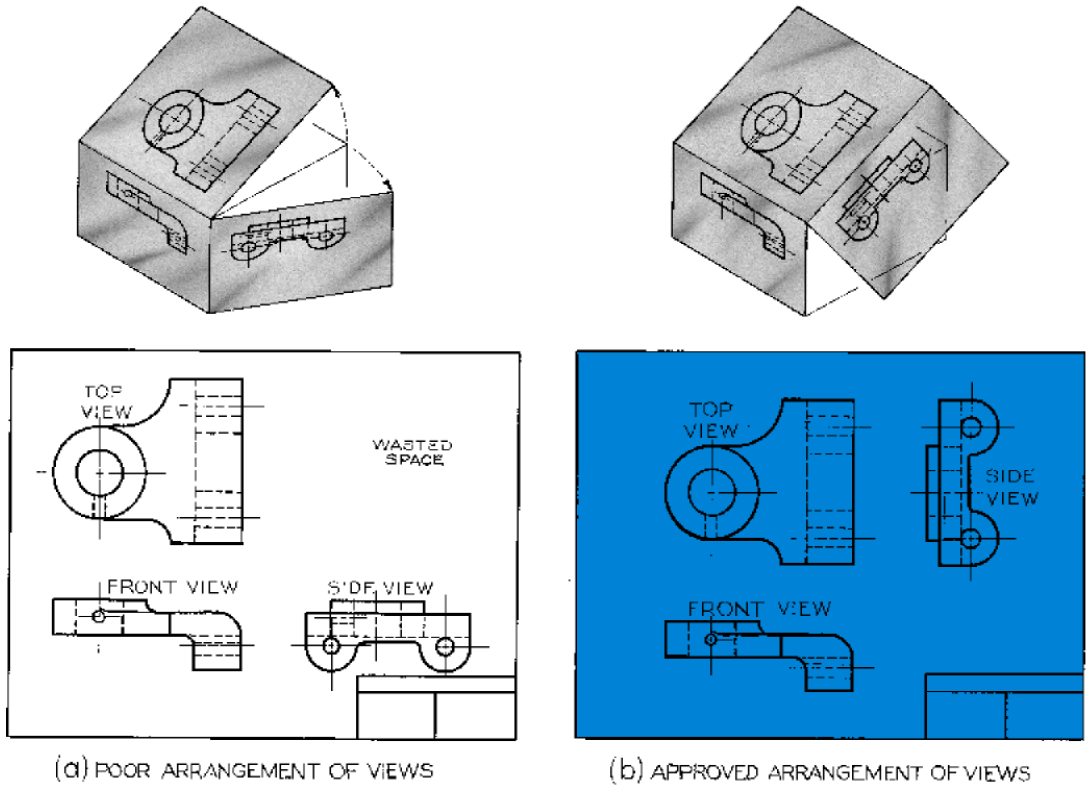
One view drawing of a shim



One view drawing of a connecting rod

MECH 220: 2nd LECTURE

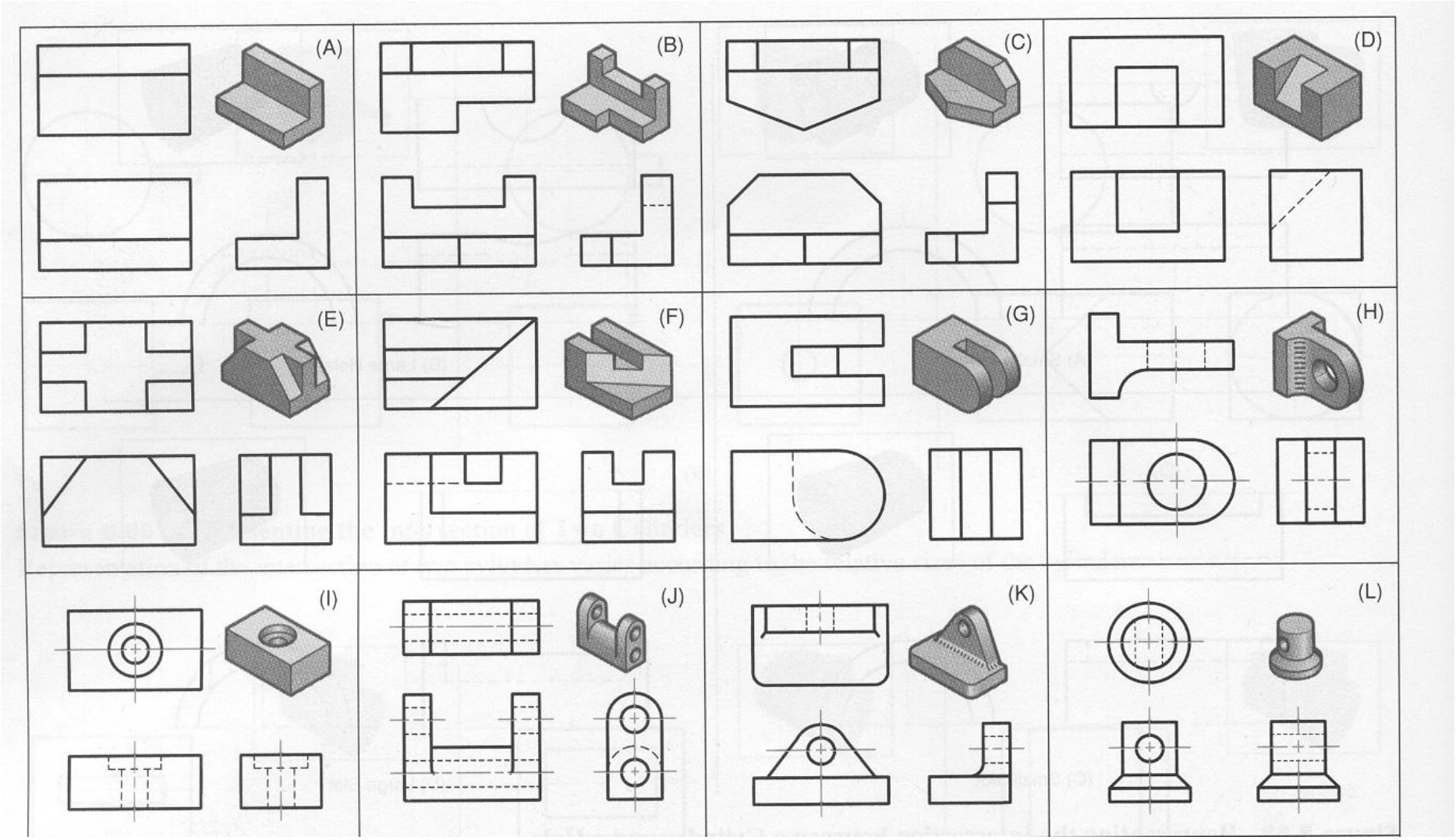
Position of Side Views



An alternative position for the side view is rotated and aligned with the top view.

MECH 220: 2nd LECTURE

ORTHO VIEWS: Examples



ORTHO VIEWS

Geometric Entities Representation

MECH 220: 2nd LECTURE

ORTHO VIEWS

Conventions: Representing Hidden Entities

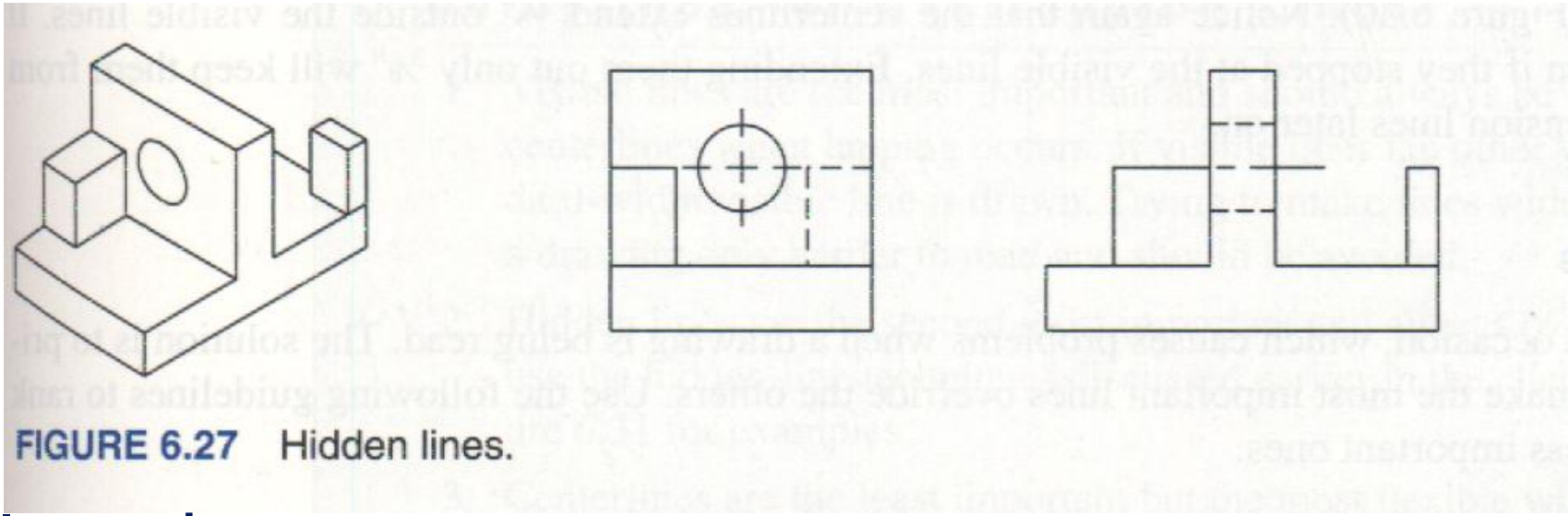


FIGURE 6.27 Hidden lines.

In any view:

if geometric entities (edge, surface, etc..) are blocked from view, hidden lines (instead of solid edges) are used to identify those entities.

Proper Drafting:

use broken line with 1/8" length & 1/16" gap)

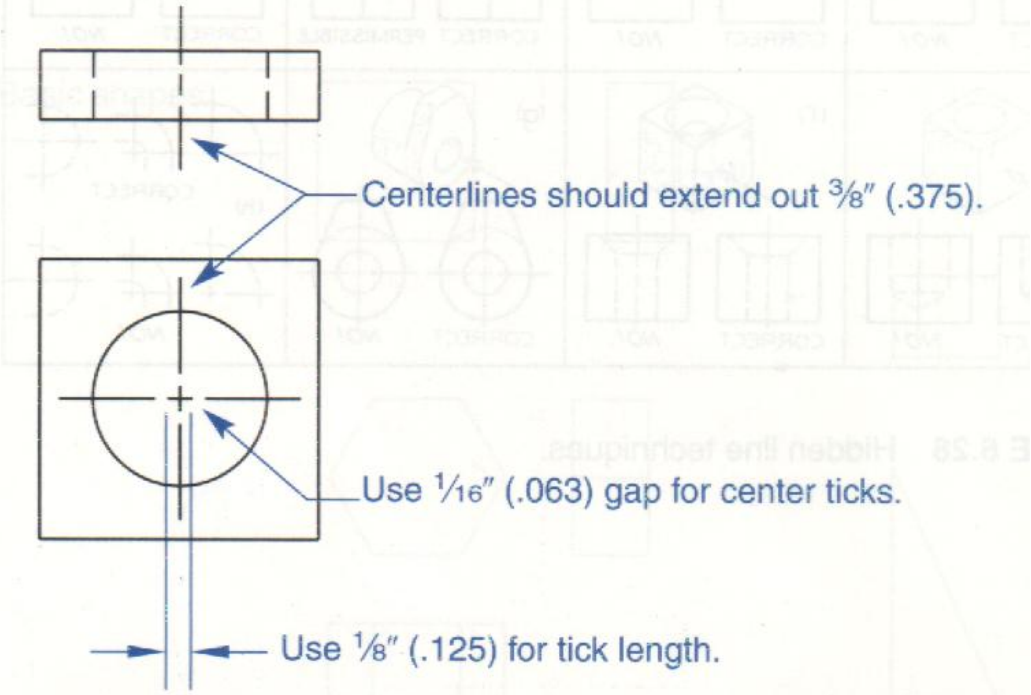
MECH 220: 2nd LECTURE

ORTHO VIEWS

Conventions: Representing Cylindrical Entities

In any view:

it is desirable to use center lines and center tick marks to represent cylindrical geometric entities (shaft, hole, etc..).



Proper Drafting:

* use 1/8"-long ticks & 1/16" gap to represent the center mark (cross-hair)

* extend centerlines out 3/8" beyond the edge describing the round entity.

MECH 220: 2nd LECTURE

ORTHO VIEWS

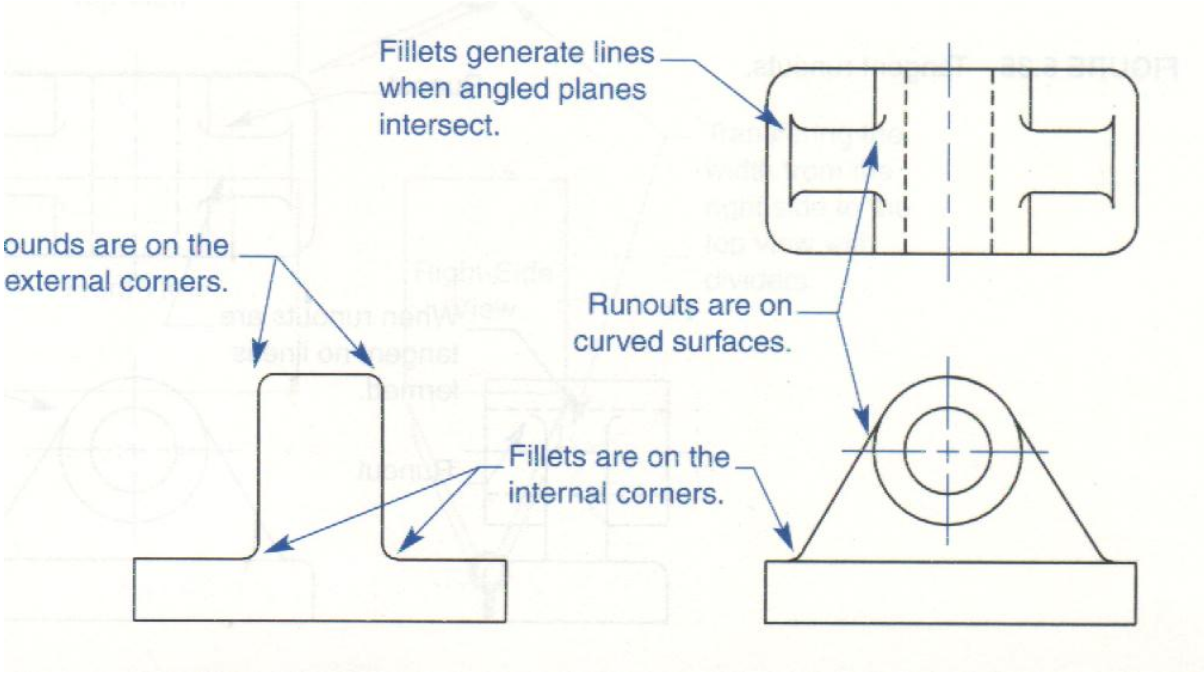
Conventions: Representing fillets & rounds

In any view:

In M.E. designs, it is common practice to round sharp corners.

* Rounded internal corners are called fillets

* Rounded external corners are called rounds



Proper Drafting:

when projecting views, generate lines to show only those curves (rounds & fillets) that are < 1/4" in diameter.

MECH 220: 2nd LECTURE

Assignment Due Next week

- Exercises posted on moodle
- A girded paper is available on MOODLE

MECH 220: 2nd LECTURE

Summary

- The six standard views are often thought of as produced from an unfolded glass box.
- Distances can be transferred or projected from one view to another.
- Only the views necessary to fully describe the object should be drawn.