Orthographic Projection

Week-05

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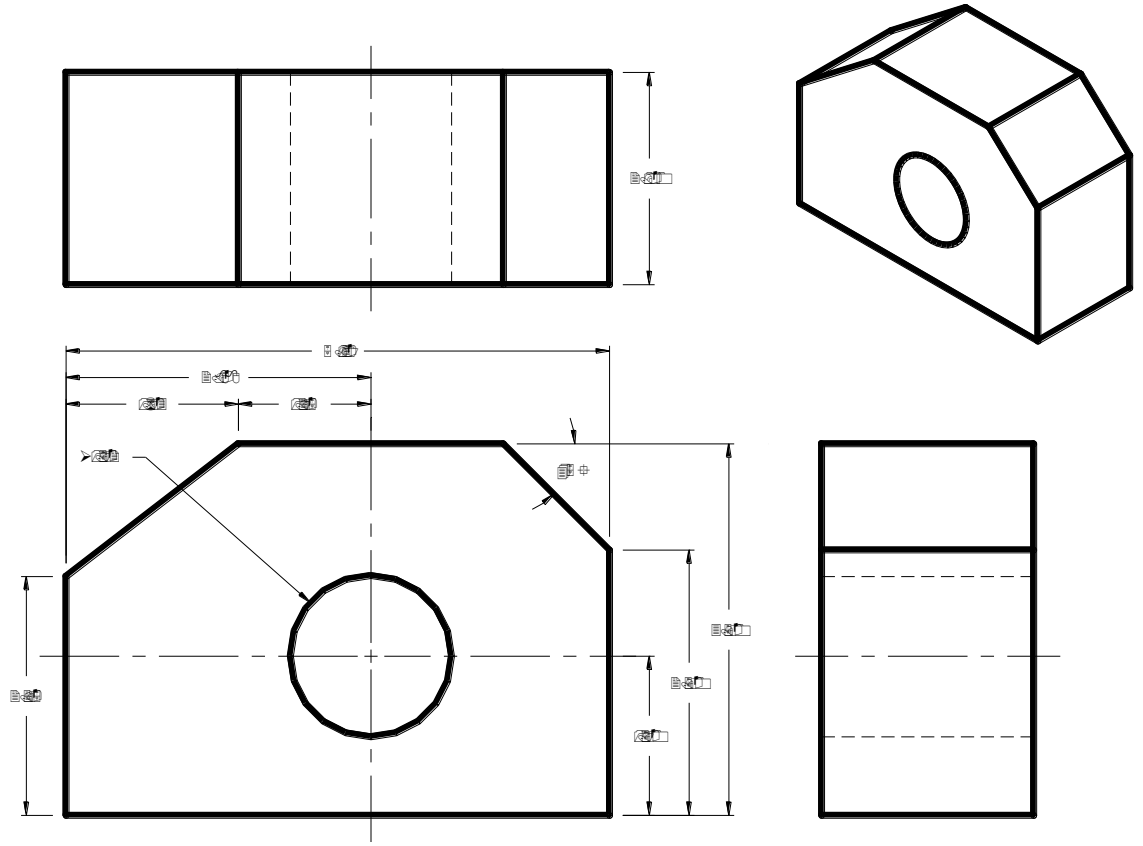
Multiview Drawing

- Another name for *orthographic projection* is *multiview drawing*

- Involves visualization and implementation
  - Ability to see clearly in the mind's eye an object
  - Process of drawing the object

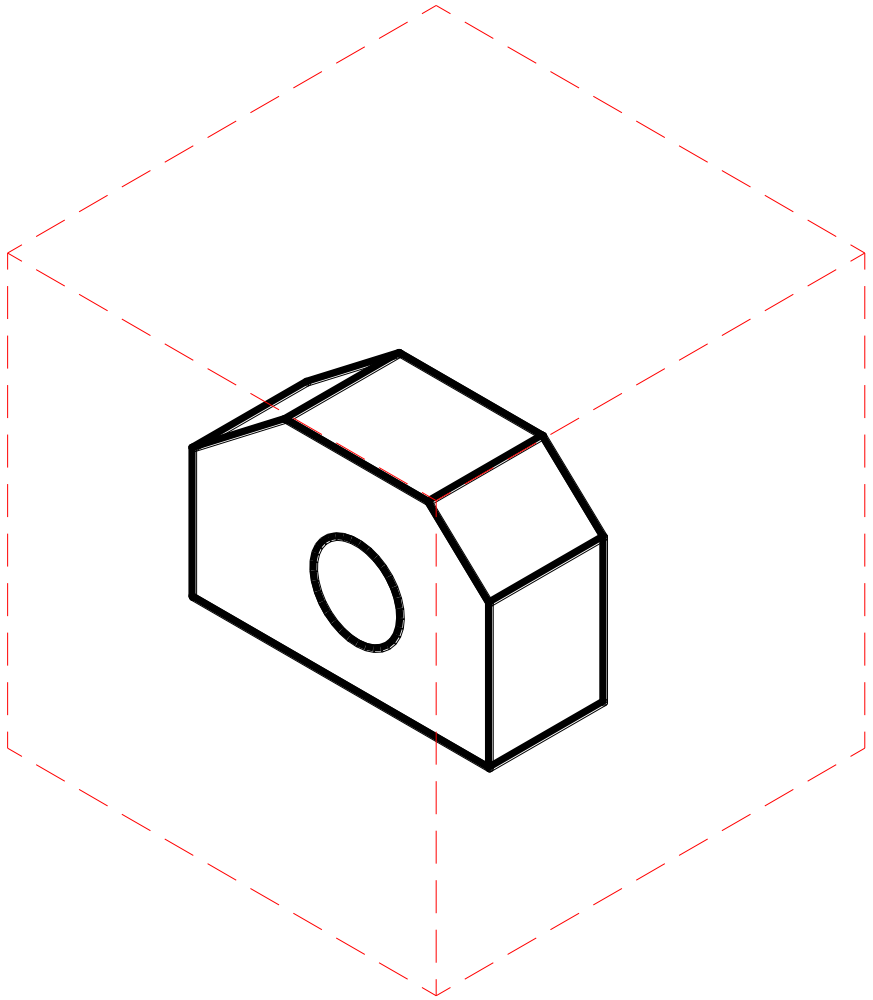
Multiview Drawing

- A system that allows you to make a two-dimensional drawing of a three-dimensional object



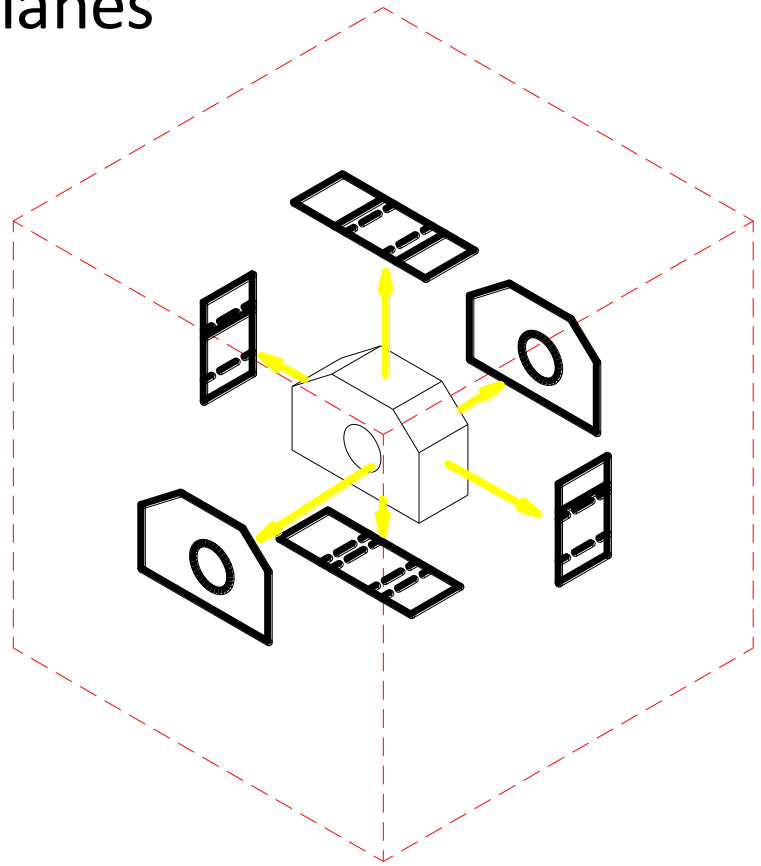
Viewing Objects

- A box is formed by six mutually perpendicular planes of projection that are located around the object



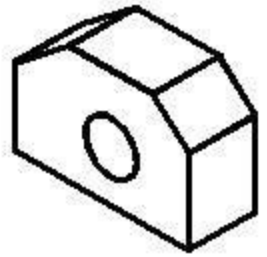
Viewing Objects

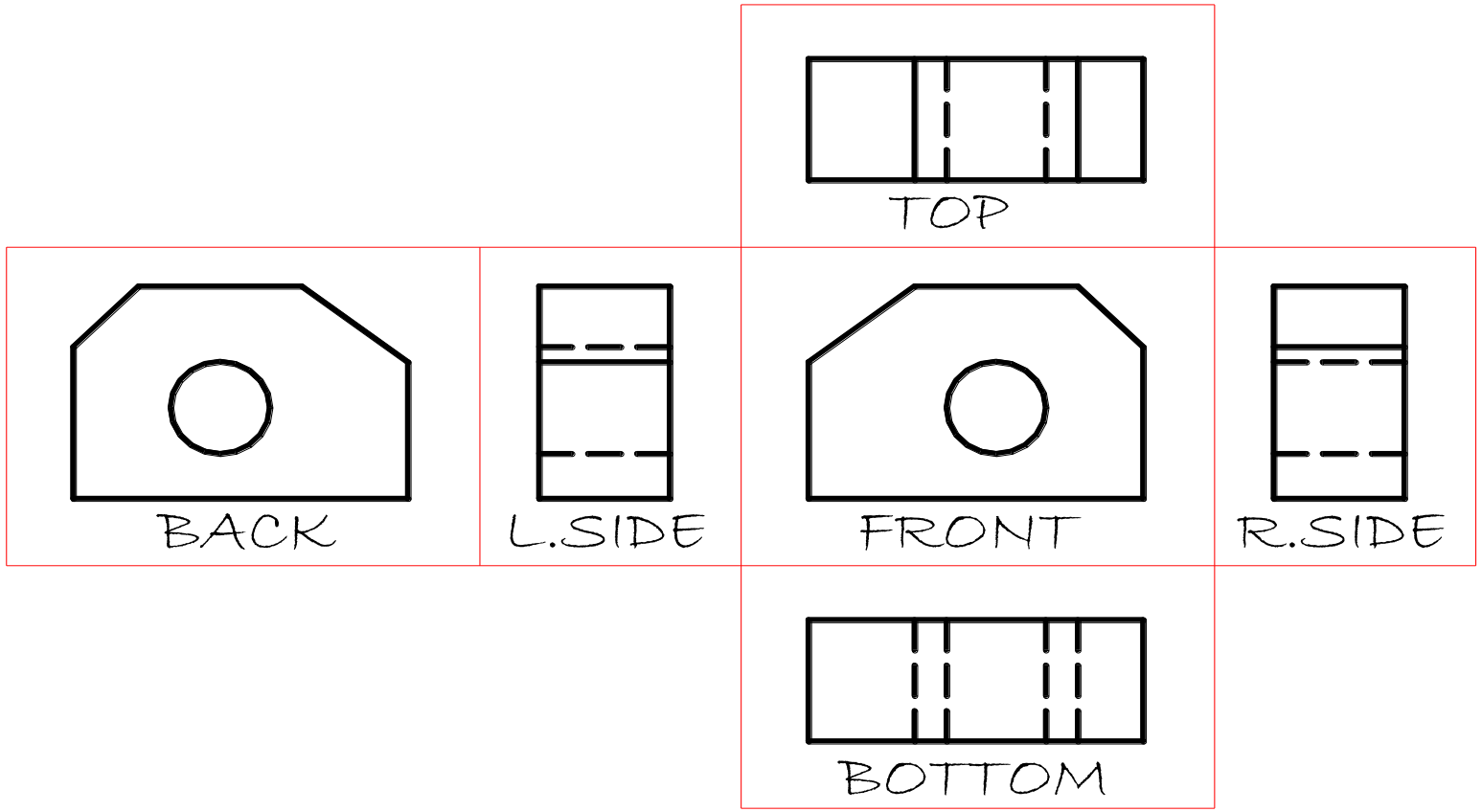
- Lines are formed on the planes by projecting the edges of the object onto the planes
  - These images are called “views”
  - There are six views formed by the planes of a box



Viewing Objects

- Unfolding the box produces an arrangement of the six views



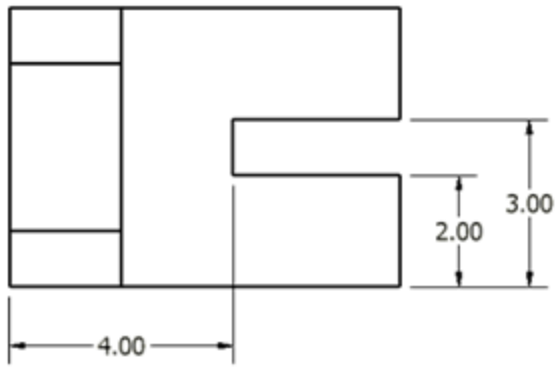


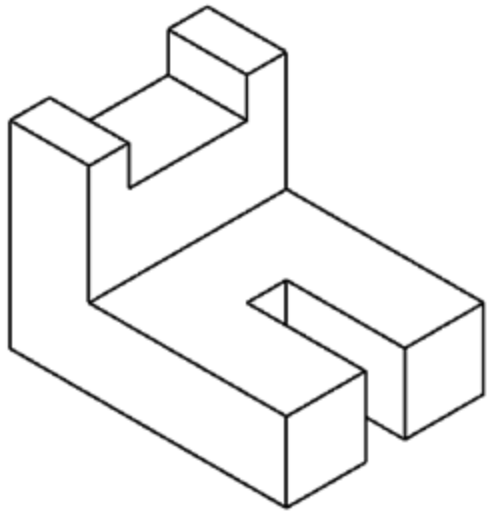
Multiview Drawing

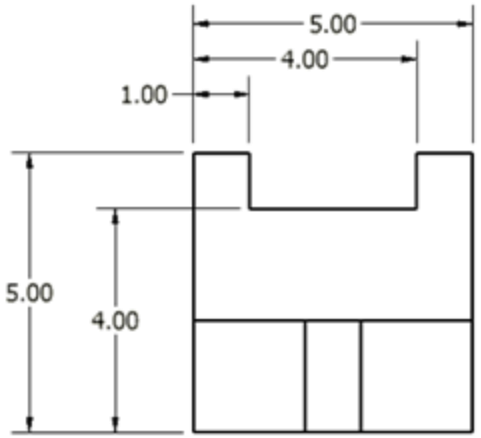
A ***multiview drawing*** is one that shows two or more two-dimensional views of a three-dimensional object.

Multiview drawings provide the shape description of an object. When combined with dimensions, multiview drawings serve as the main form of communication between designers and manufacturers.

Multiview Drawing







Width, Depth, and Height

All three-dimensional objects have ***width***, ***height***, and ***depth***.

Width is associated with an object's ***side-to-side*** dimension.

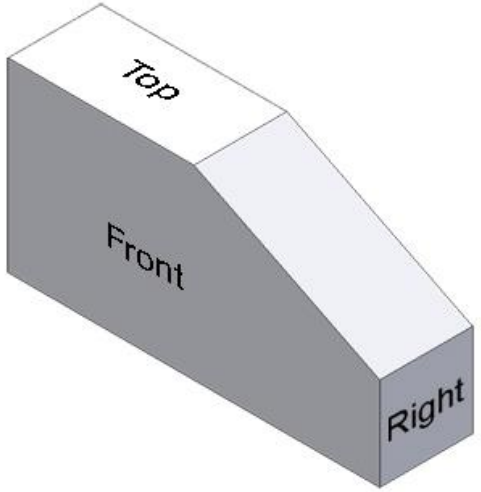
Height is the measure of an object from ***top-to-bottom***.

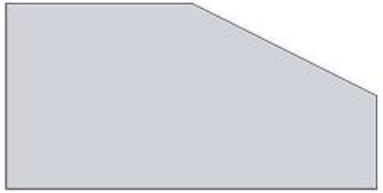
Depth is associated with ***front-to-back*** distance.

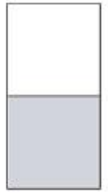
Dimensions of an Object

- Height is how tall the object is, as measured on the front view
- Width is how wide the object is, as measured on the front view
- Depth is how deep the object is from front to back
- Each dimension appears twice in the three regular views
- “Length” and “breadth” are terms not used

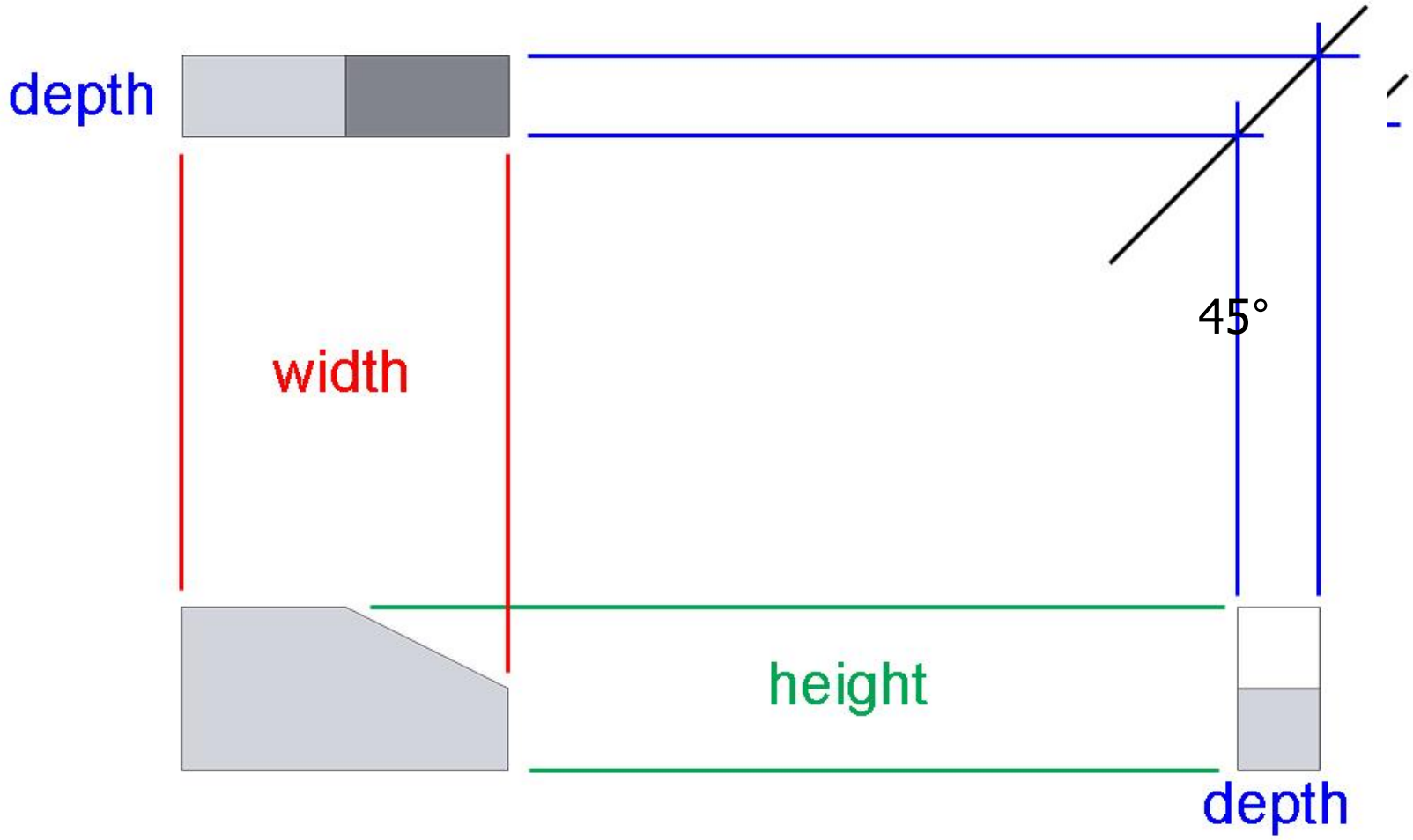
Width, Depth, and Height







Width, Depth, and Height



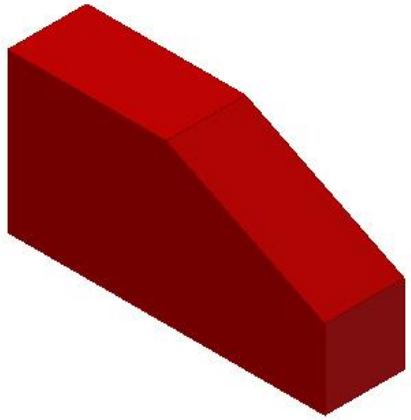
Orthographic Projection

Orthographic projection is a technique that is used to create multiview drawings.

Orthographic projection is any projection of the features of an object onto an imaginary plane of projection. The projection of the features of the object is made by lines of sight that are perpendicular to the plane of projection.

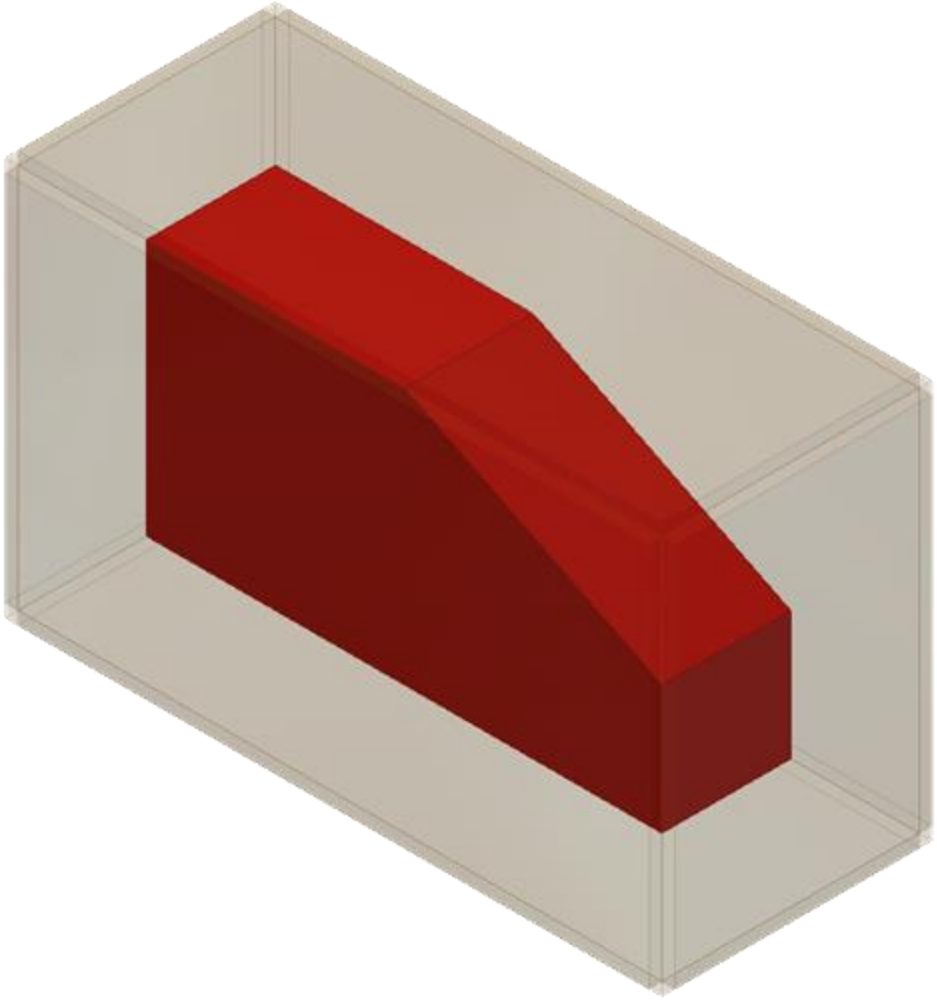
Orthographic Projection

The best way to understand ***orthographic projection*** is to imagine an object contained inside a glass box.



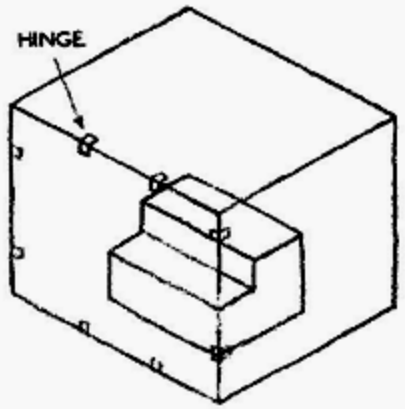
Orthographic Projection

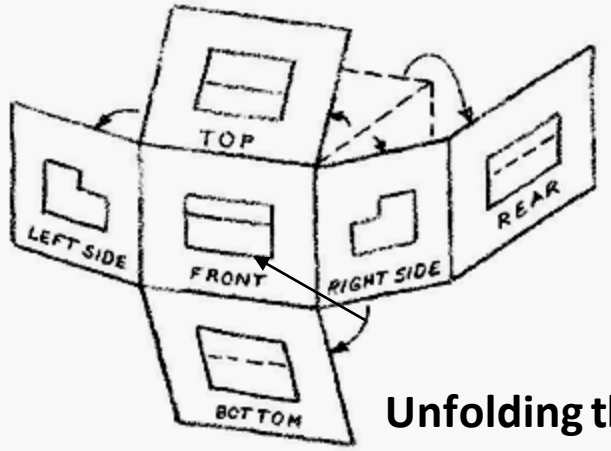
There is a total of six glass walls surrounding the object. Each wall represents a ***projection plane*** onto which a two- dimensional object view will be created.



Glass Box – 6 views of an object

Glass Box

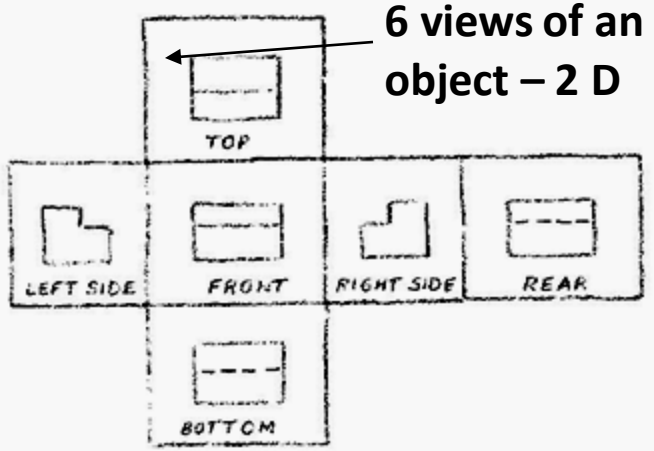




Unfolding the Glass Box

All the views unfold as shown around the stationary front view.

6 views of an object – 2 D



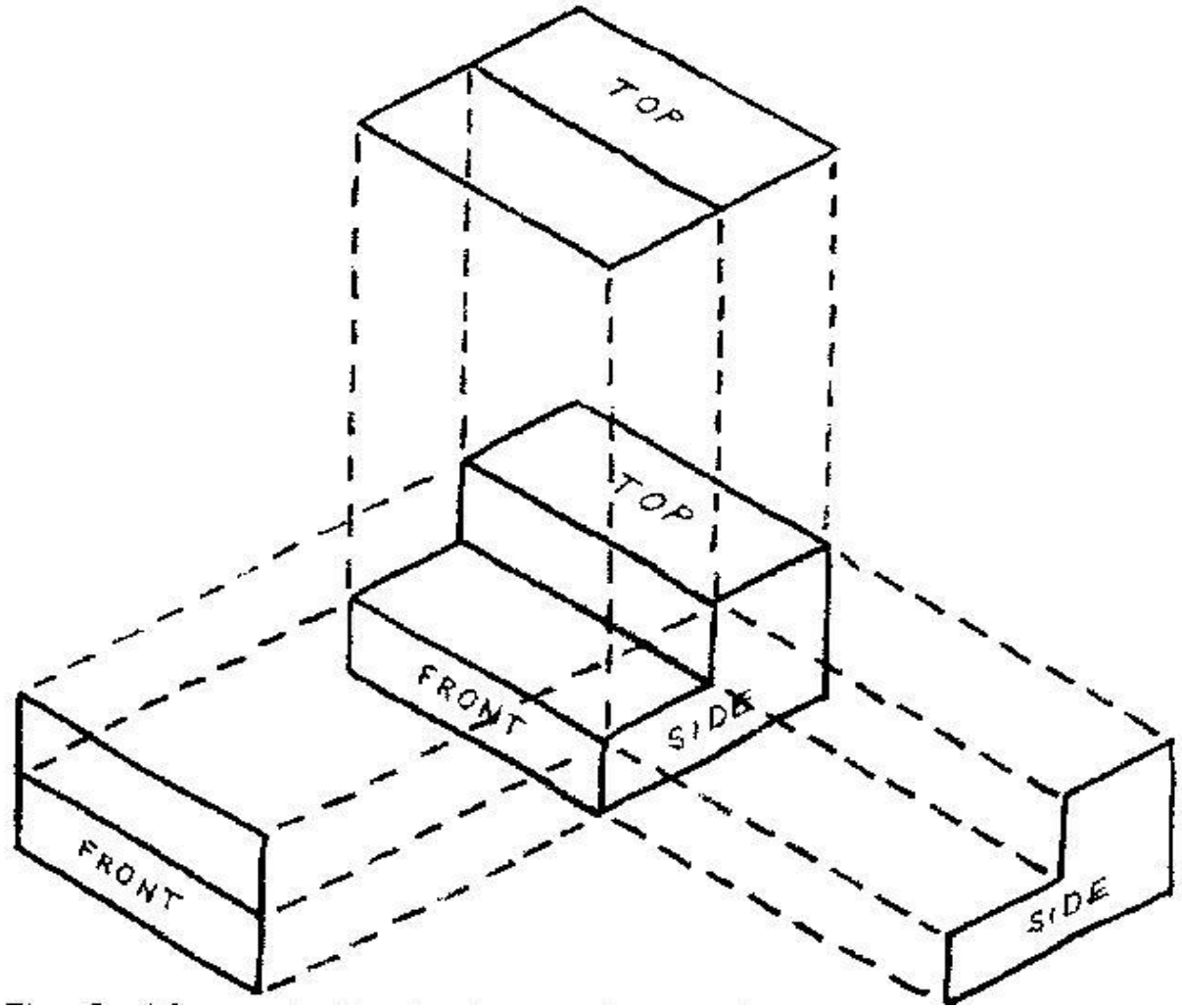
3 View Drawing
Most Commonly Used Views

Front View

Top View

Side View

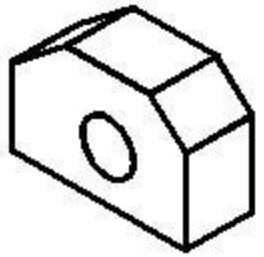
Color code can help to visualize



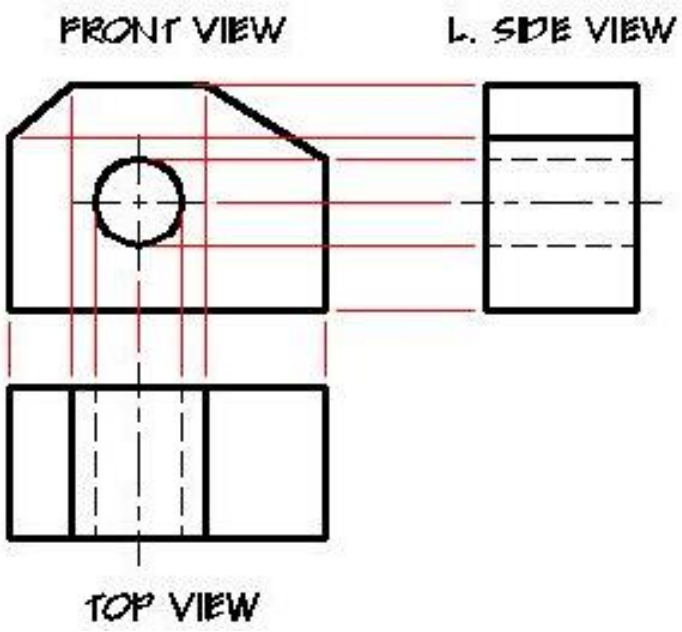
First- and Third-Angle Projection

- There are two main systems used for projecting and unfolding the views:
  - Third-angle projection which is used in the United States, Canada and some other countries
  - First-angle projection which is primarily used in Europe and Asia
- You should understand both methods

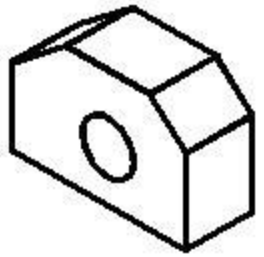
Angles of Projection



- First-angle projection
  - Used by many European countries
  - Object is projected onto planes from the first angle or quadrant
    - Front view projected to vertical plane
    - Top view projected to horizontal plane
    - Left-side view projected to profile plane



Angles of Projection



- Third-angle projection
  - Standard for the United States
  - Third quadrant is used for projection
    - Front view projected to vertical plane
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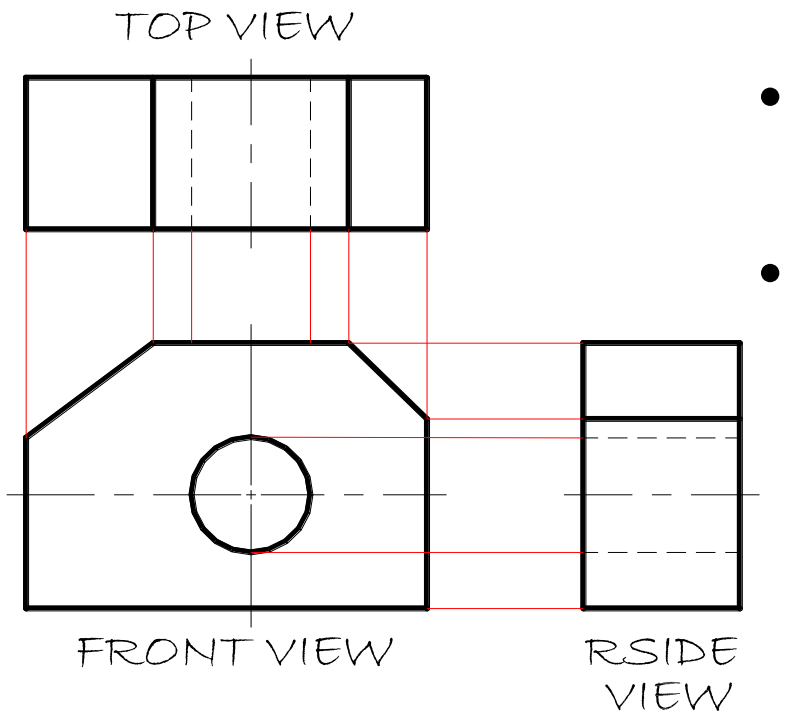
    - Right-side view projected to profile plane



Multiview Projection System

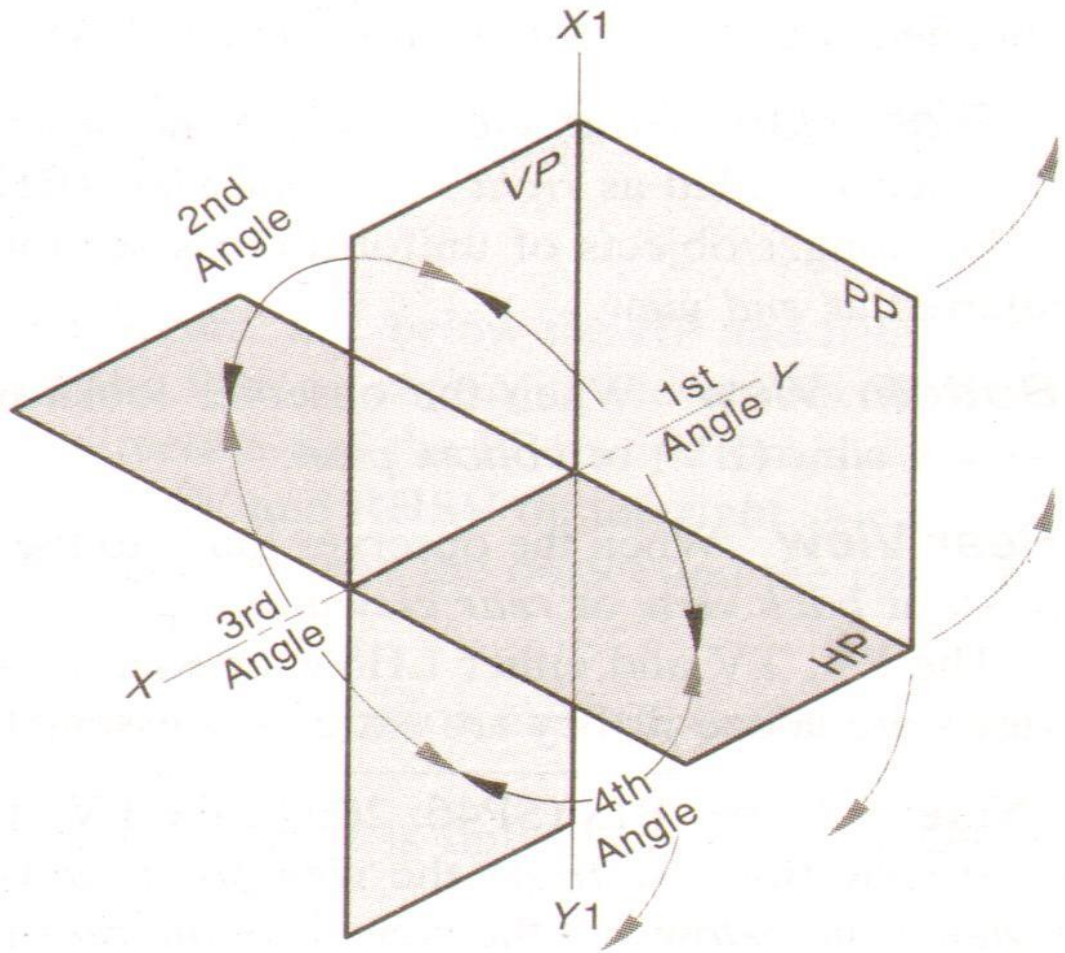


Fig. 9.1 Three principal planes

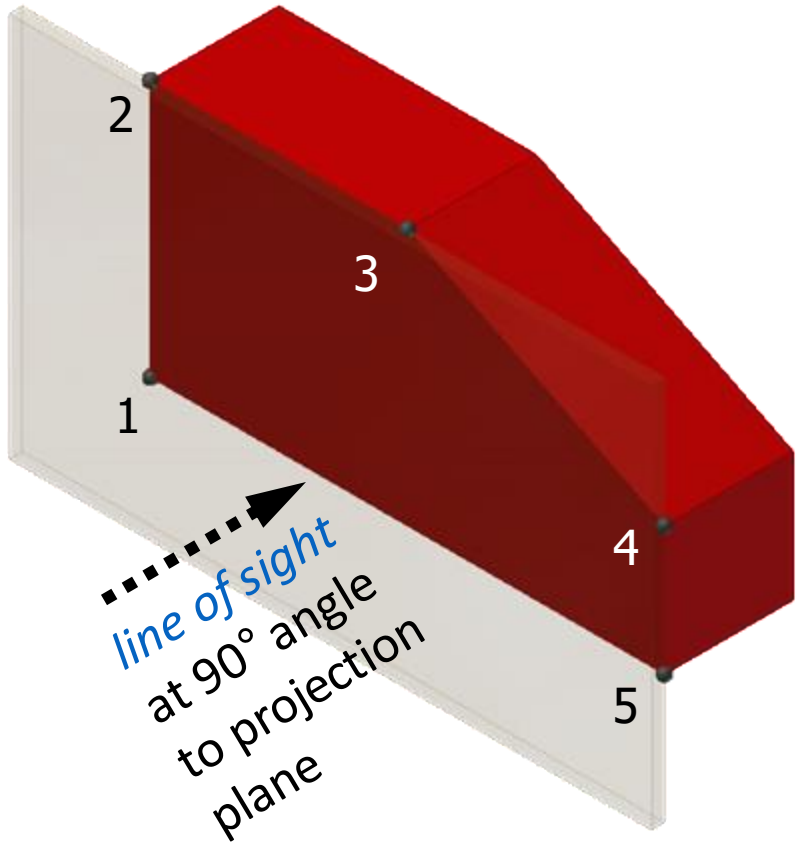
Projection Plane

The ***projection plane*** is the surface onto which a two-dimensional view of a three-dimensional object is projected and created.

Orthographic Projection

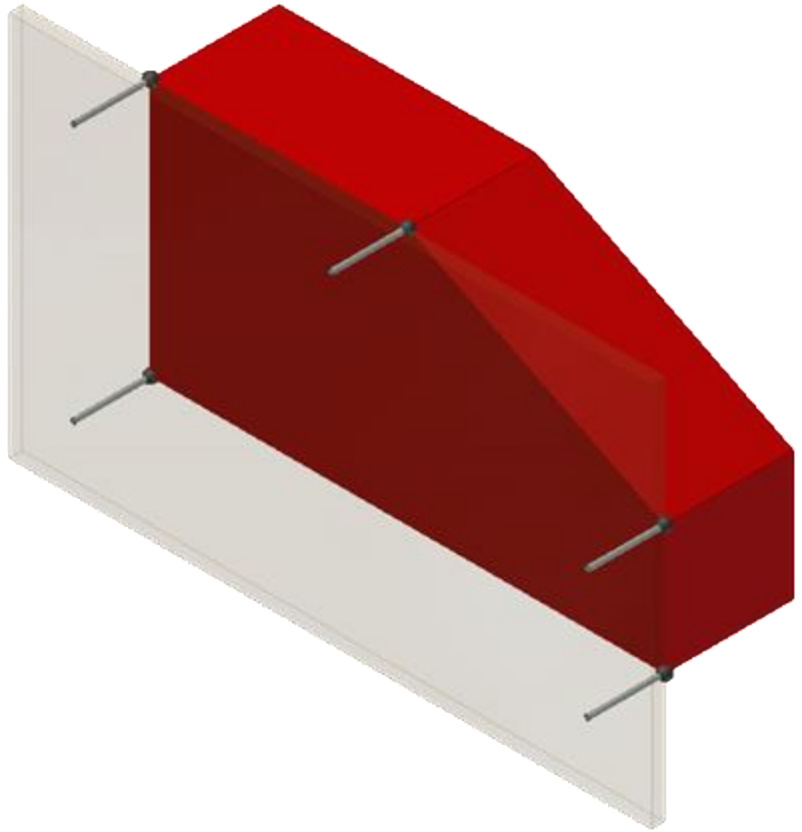
Start by focusing only on the front ***projection plane***.

A person standing in front of the object would see only the five corners identified in black.



Orthographic Projection

Projection lines are used to project each corner outward until they reach the ***projection plane***.

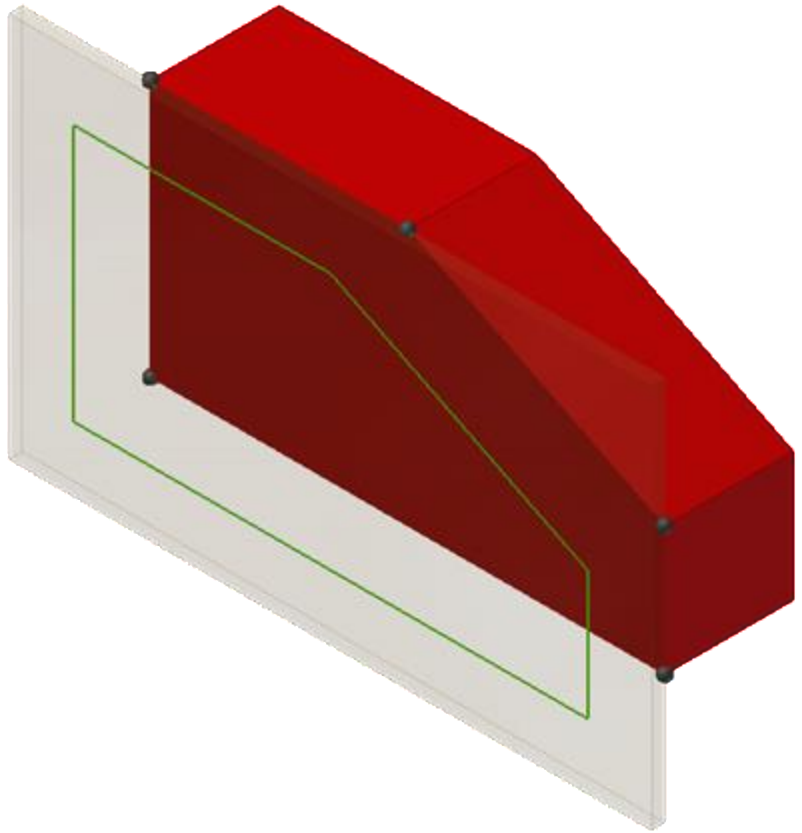


Projection Lines

A ***projection line*** is an imaginary line that is used to locate or project the corners, edges, and features of a three-dimensional object onto an imaginary two-dimensional surface.

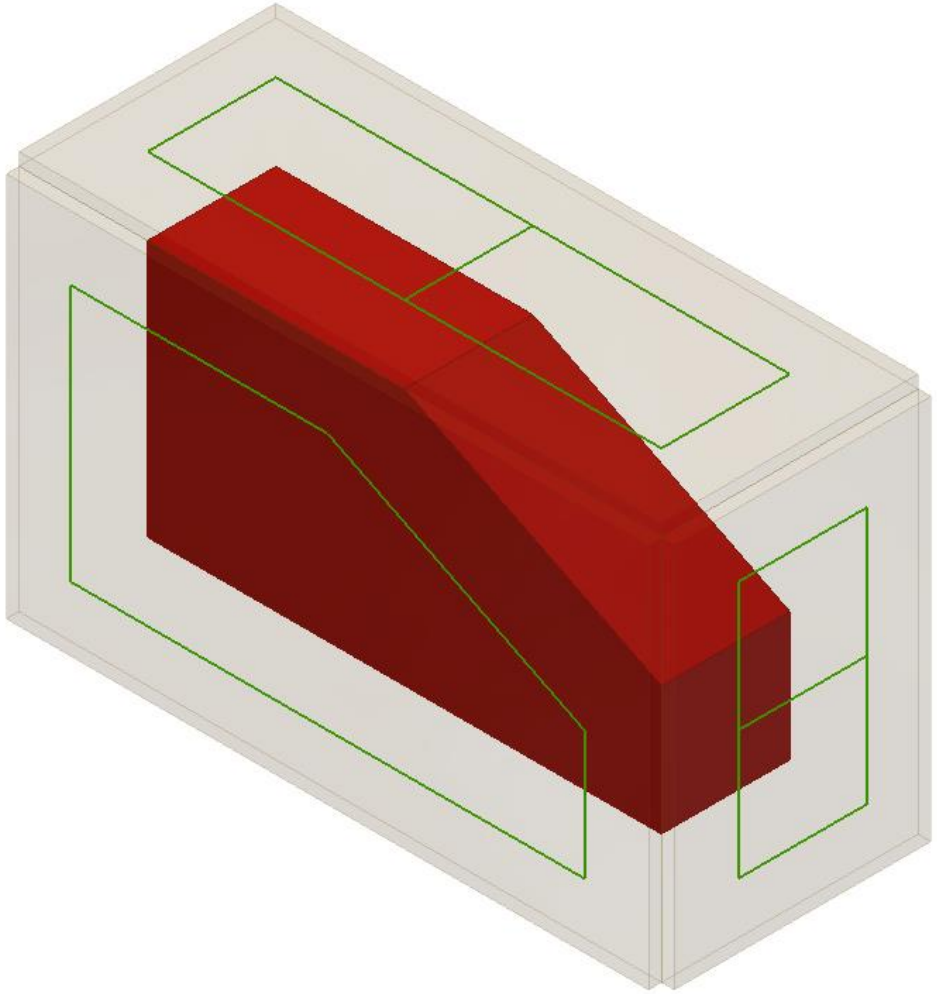
Orthographic Projection

The *visible edges* of the object are then identified on the ***projection plane*** by connecting the projected corners with ***object lines***.



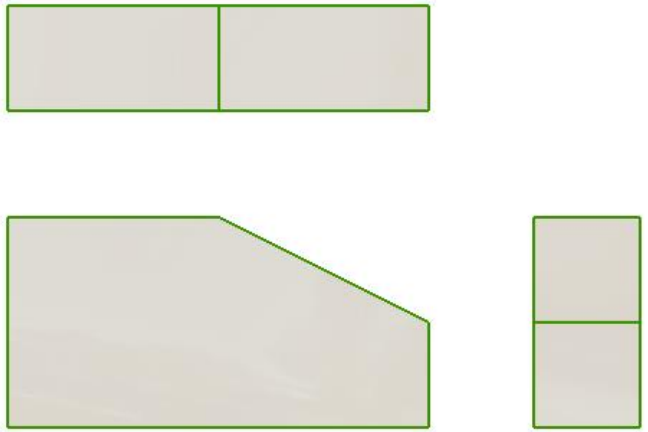
Orthographic Projection

The ***orthographic projection*** process is then repeated on the other ***projection planes***.



Sketching a Multiview Drawing

Given the overall dimensions of the object, a pencil, and a sheet of graph paper, a sketching multiview drawing can be easily done using points, construction lines, and object lines.



Sketching a Multiview Drawing

Step #1: Calculate the amount of space that the views will take up.

Sketching a Multiview Drawing

Step #1: Calculate the amount of space that the views will take up.

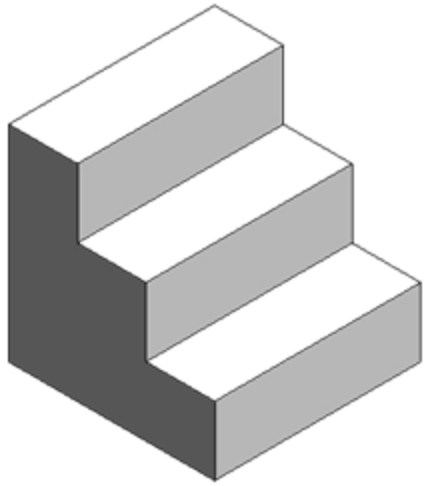
Step #2: Layout the boxes within which the individual views will occur using points and construction lines.

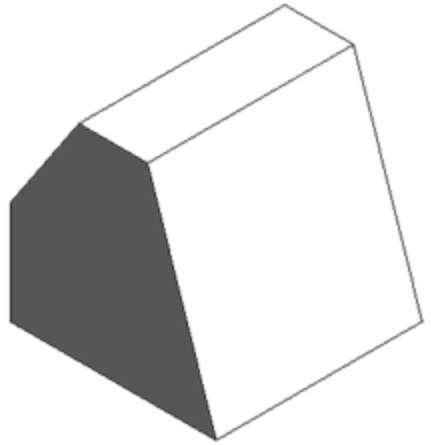
Step #3: Identify the visible edges by drawing object lines on top of the construction lines.

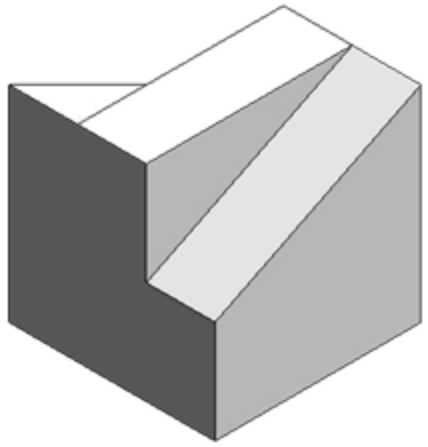
A Question…

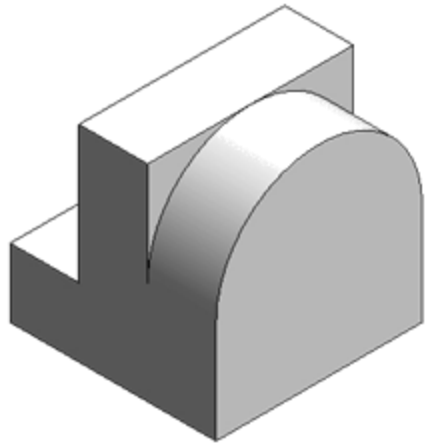
Each of the blocks at right has the same overall dimensions and color.

Draw the top view of all.

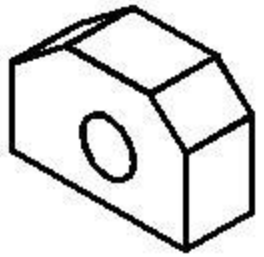








Angles of Projection



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  - Used by many European countries
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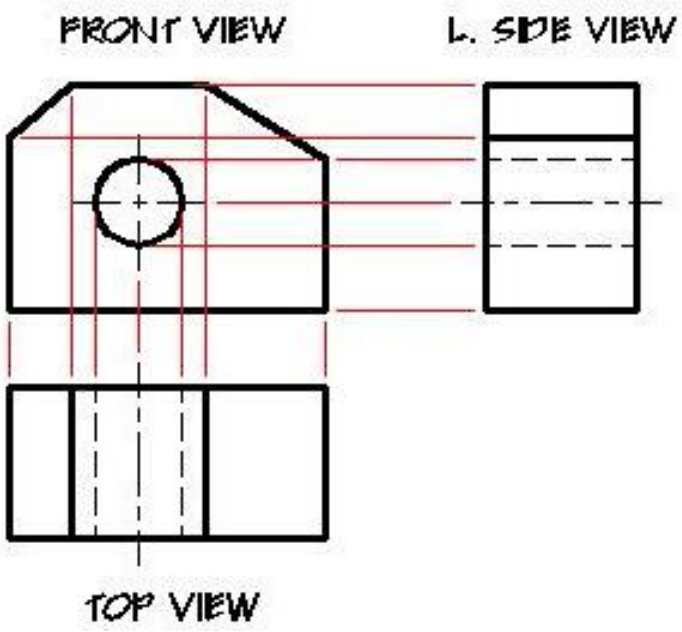
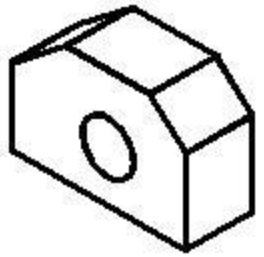
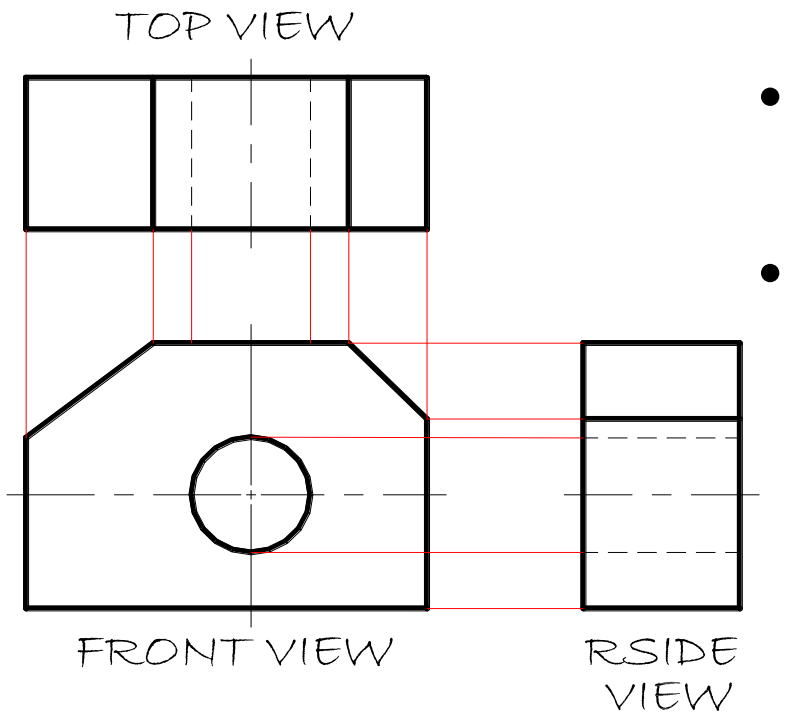


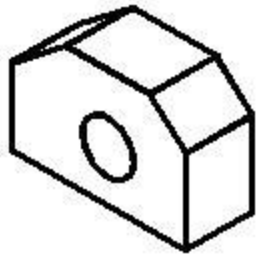
Angles of Projection



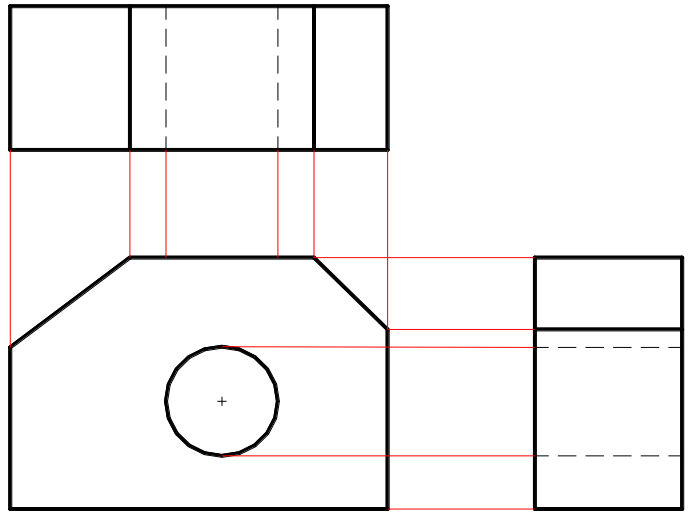
- Third-angle projection
  - Standard for the United States
  - Third quadrant is used for projection
    - Front view projected to vertical plane
    - Top view projected to horizontal plane
    - Right-side view projected to profile plane



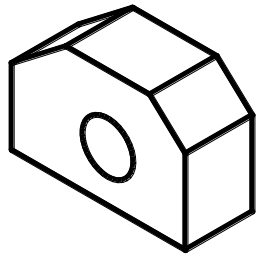
Viewing Objects



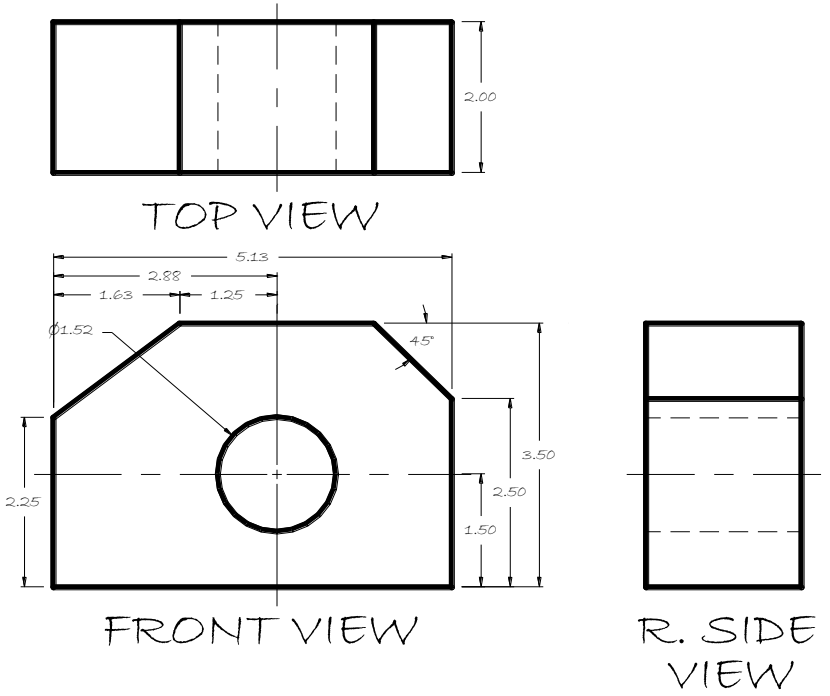
- Each view is placed in a constant location relative to the other views
- Each view must be placed in its correct position
- Views and features must be aligned



Choosing Views

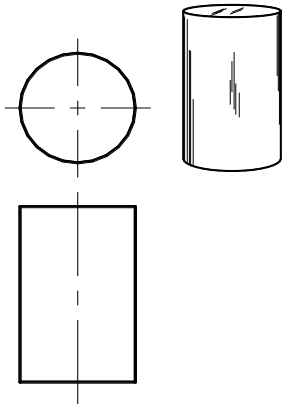


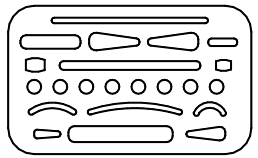
- Most commonly used views
  - Front View
  - Top View
  - Right Side View
- Most descriptive view is typically designated as the Front View



Choosing Views

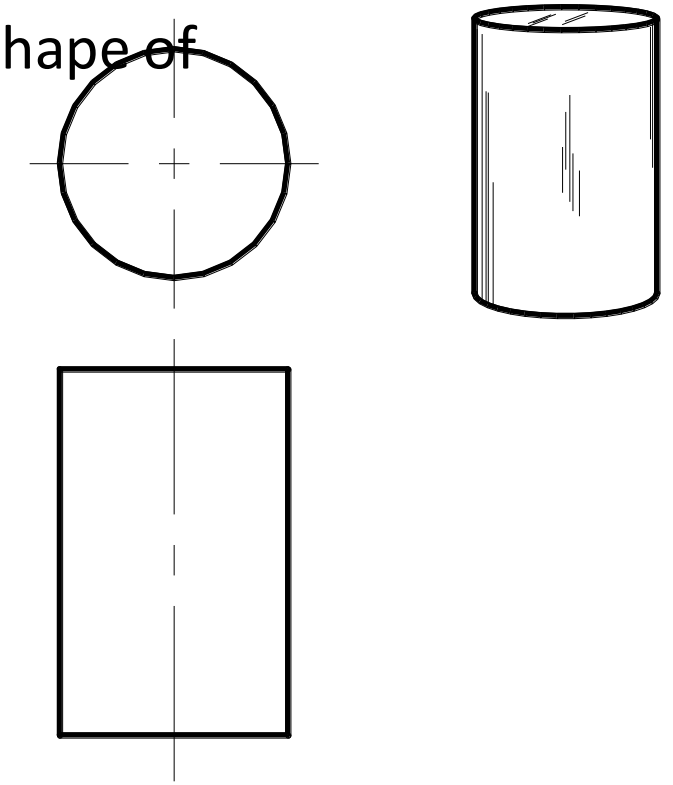
- Complex objects require three views to describe its shape
- Simple objects can be described with two views
  - Ex: Soda Can
- Thin objects can be described with only one view
  - Depth is given in a note
  - Ex: Erasing Shield





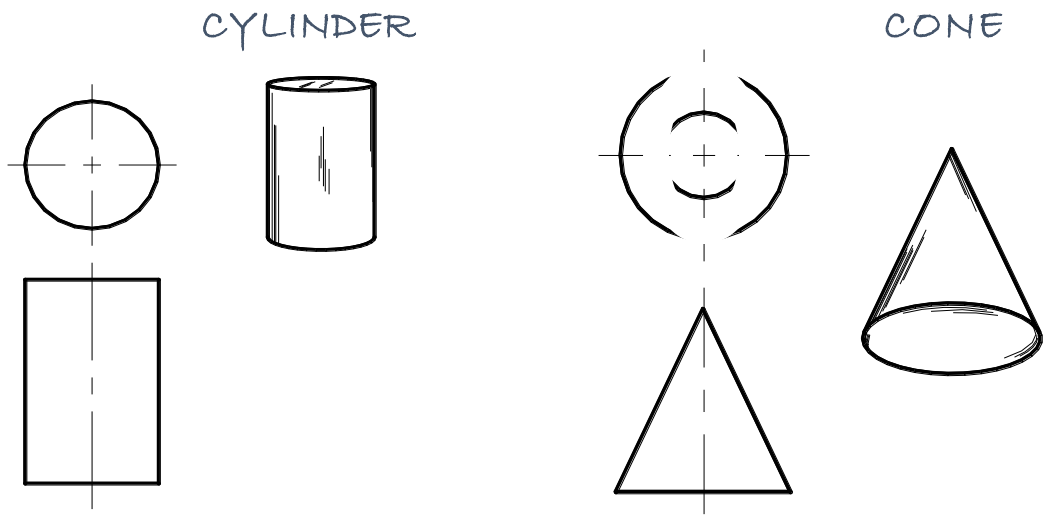
Choosing the Views

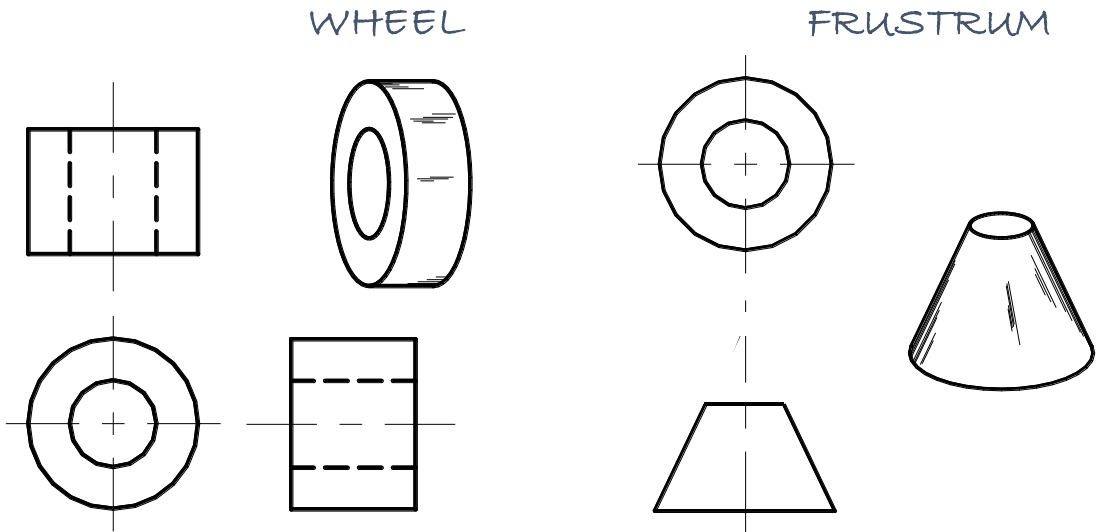
- Objects described in two views
  - Third view would add nothing to the description of the object
  - Carefully select views to describe shape of objects *accurately*



Curved Surfaces

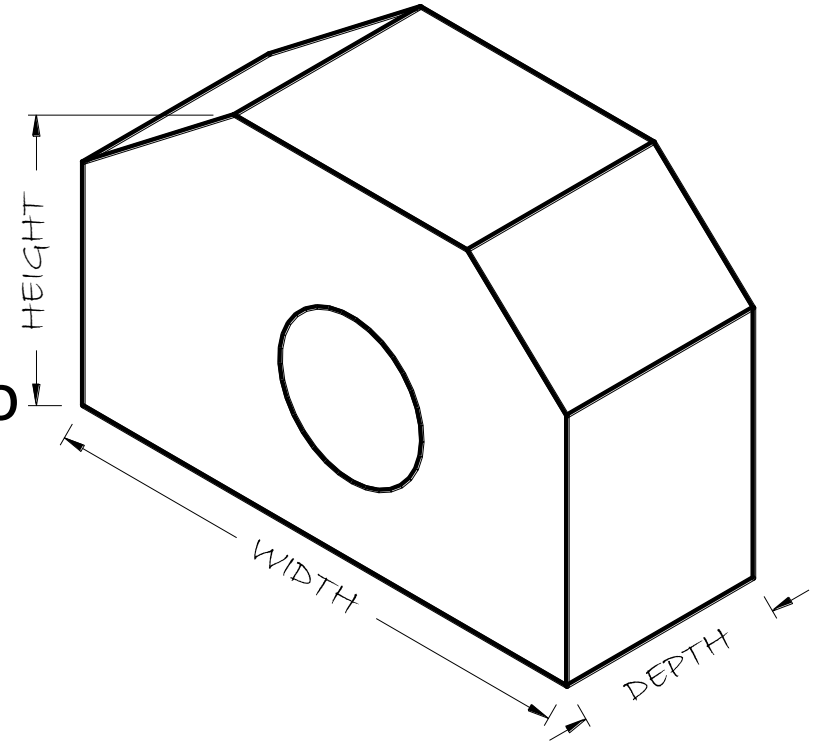
- Some curved surfaces do not show as curves in all views



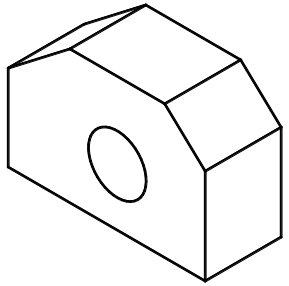


Object Dimensions

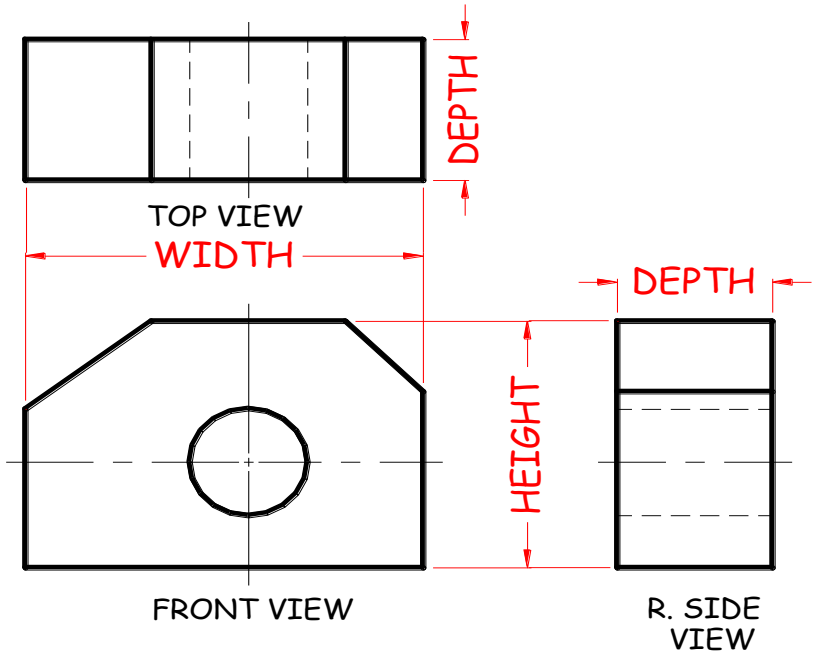
- All objects have 3 dimensions
  - ***Height***
    - Distance from top to bottom
  - ***Width***
    - Distance from side to side
  - ***Depth***
    - Distance from the front to back



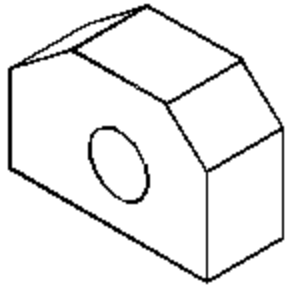
Object Dimensions



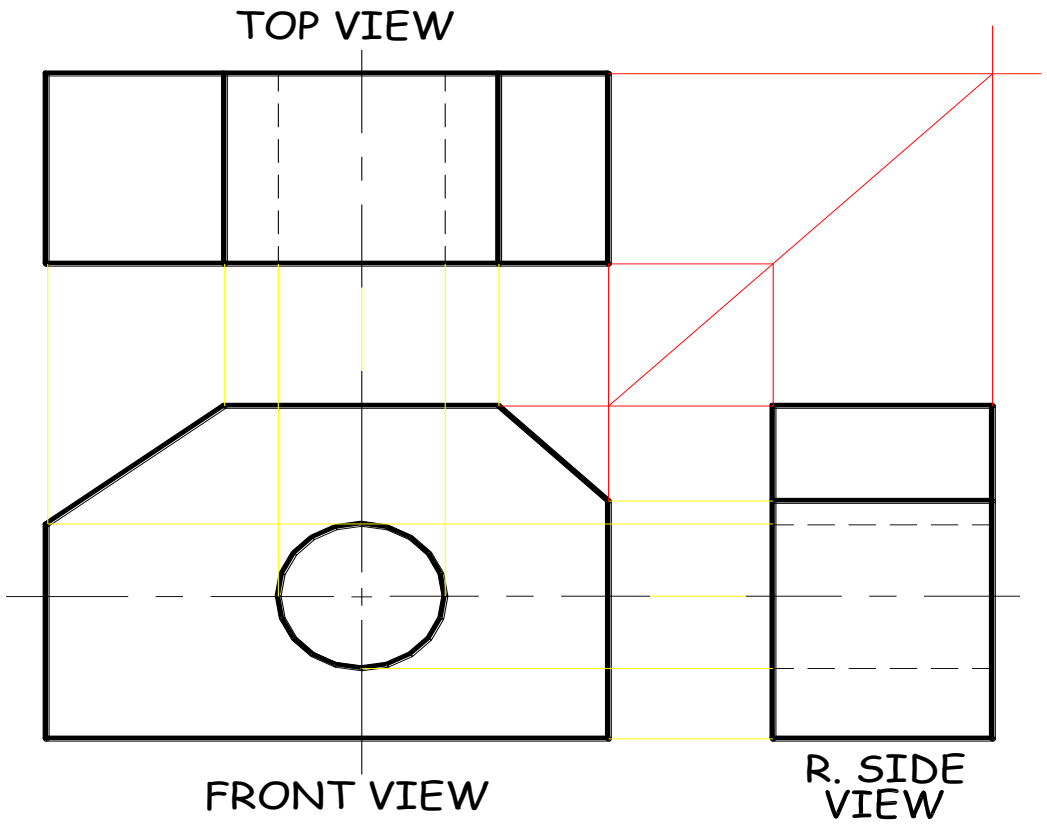
- Front View
  - Shows width & height
- Top View
  - Shows width & depth
- Side View
  - Shows height & depth



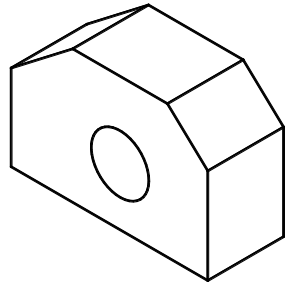
Drawing Views of Objects



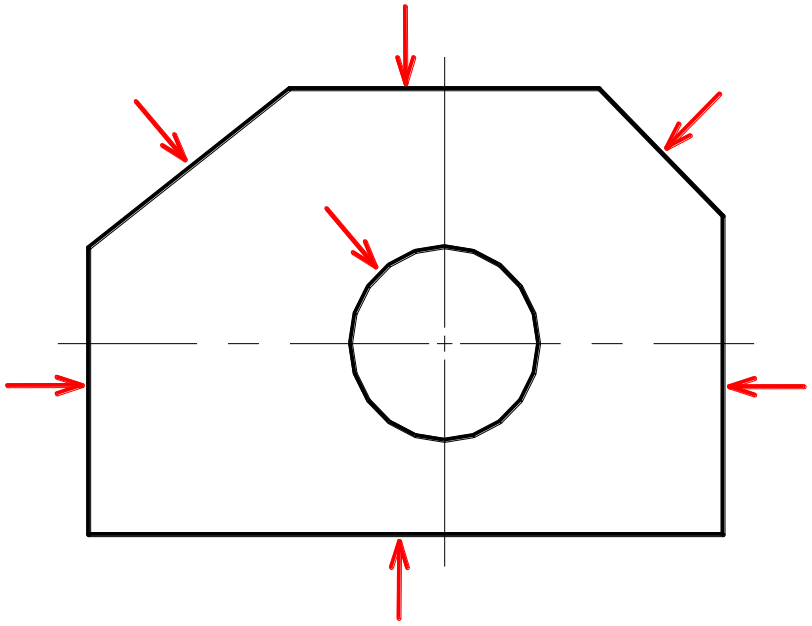
- Depth can be projected between views by using a 45° miter line



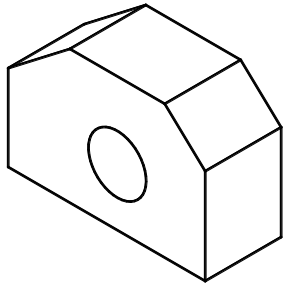
Line Types - Visible



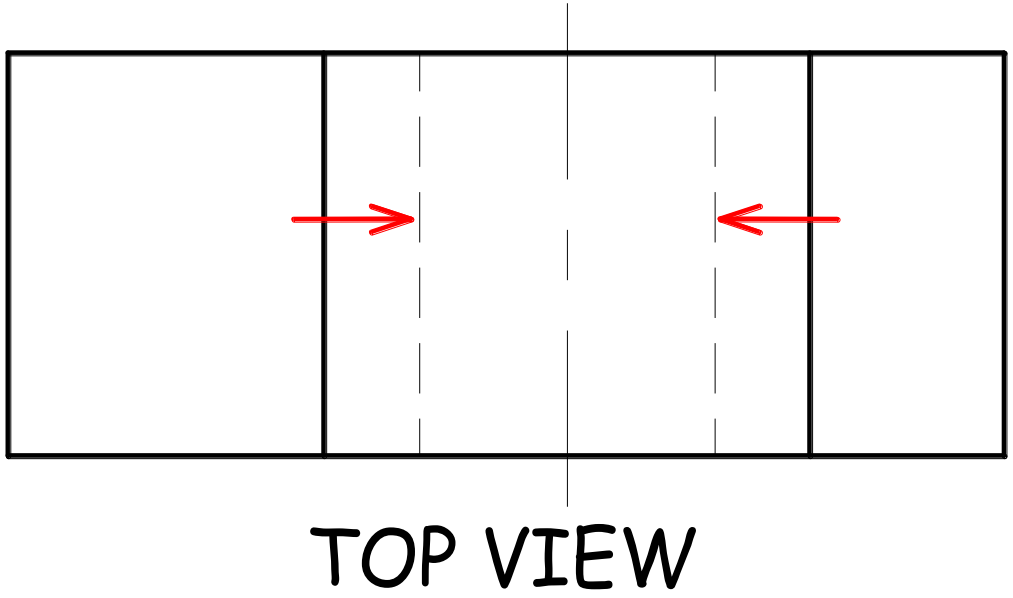
- Edges that can be seen in a given view are *Visible* or *Object* lines
- Visible lines are thick and dark
  - .028” or .7mm
  - F or HB lead



Line Types - Hidden

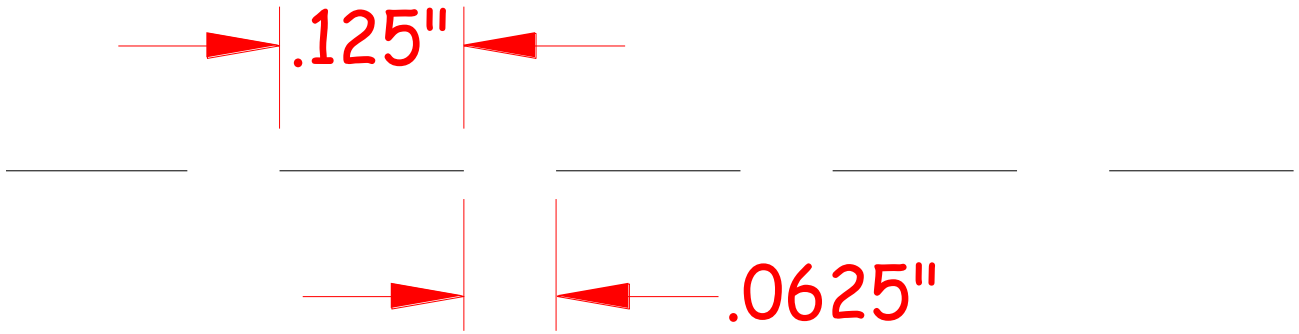


- Edges that cannot be seen from a given view are indicated by *Hidden* lines



Line Types - Hidden

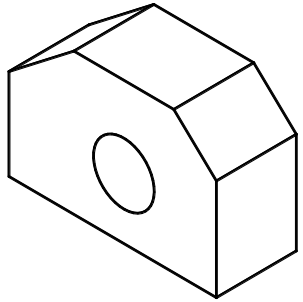
- Drawing hidden lines
  - .125” (3mm) dashes
  - .0625” (1mm) spaces between dashes
  - Thin: .020” (.5mm)
  - Dark: F or HB lead



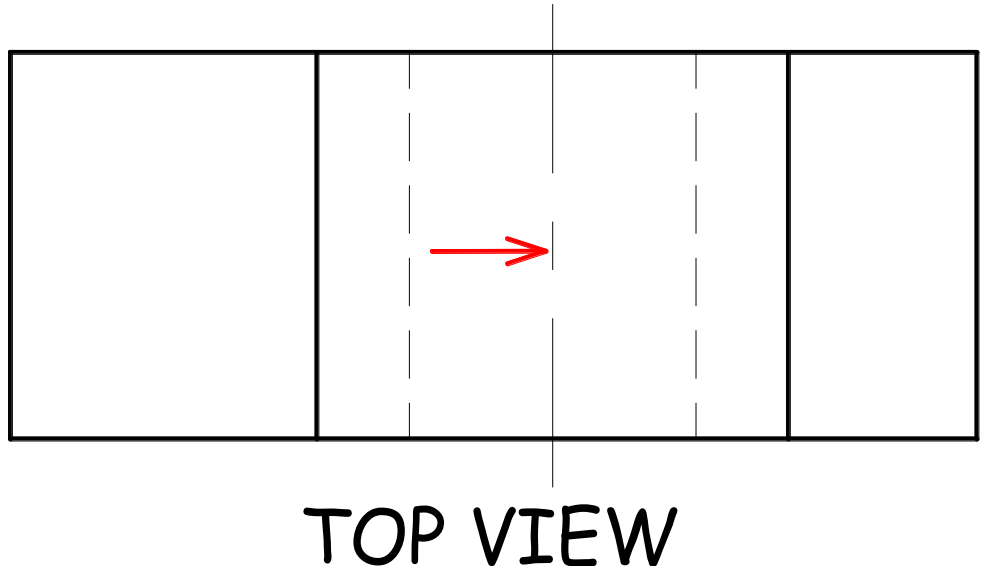
Line Types - Hidden

- Follow rules for hidden line placement
  - Alphabet of Lines
- Drawings produced with CAD may violate hidden line rules

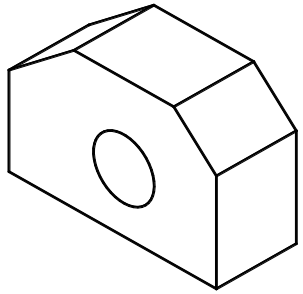
Line Types – Center



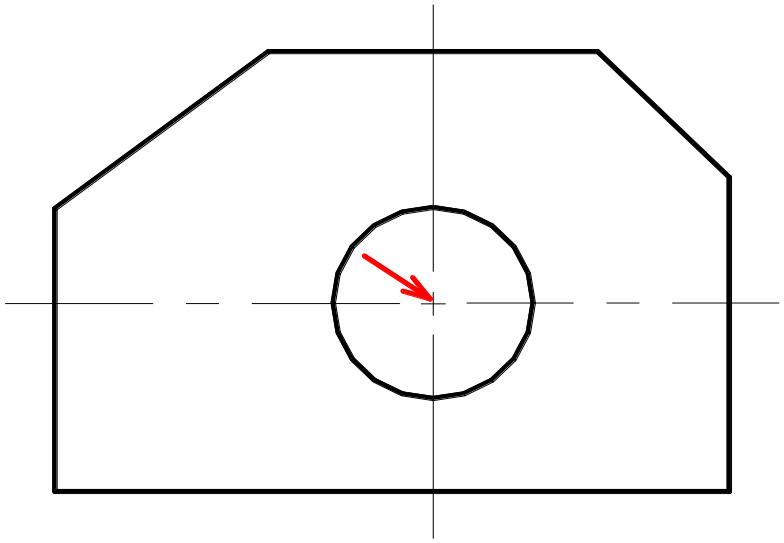
- *Center lines* indicate axes of symmetry

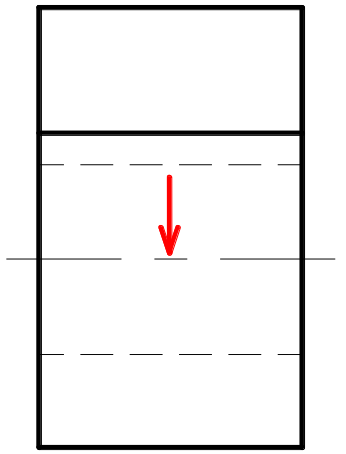


Line Types – Center



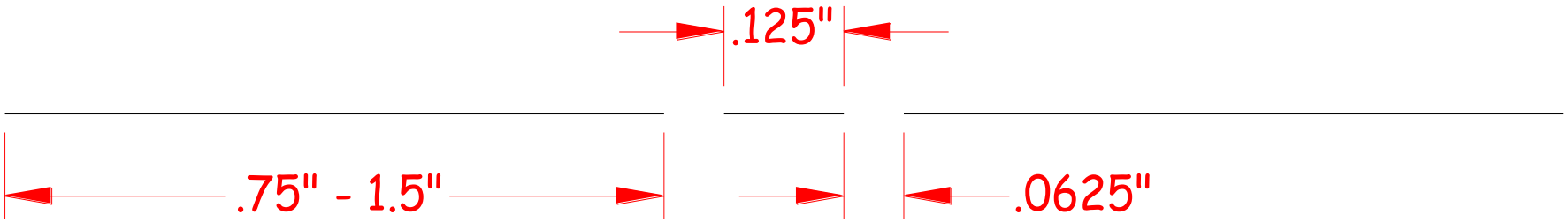
- Perpendicular lines for circular objects
  - Small dashes cross at the center point of feature
  - One center line drawn to indicate longitudinal axis of cylinder or hole





Line Types - Center

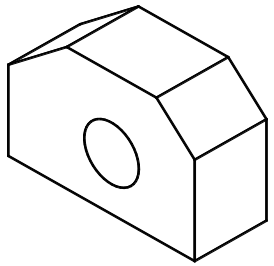
- Draw center lines using a series of long and short dashes
  - .125” (3mm) short dash @ the center
  - .75”- 1.5” (20mm-40mm) long dash
  - .0625” (1mm) spaces between dashes
  - Thin: .02” (5mm)
- Long dash extends .125” to .25” beyond feature



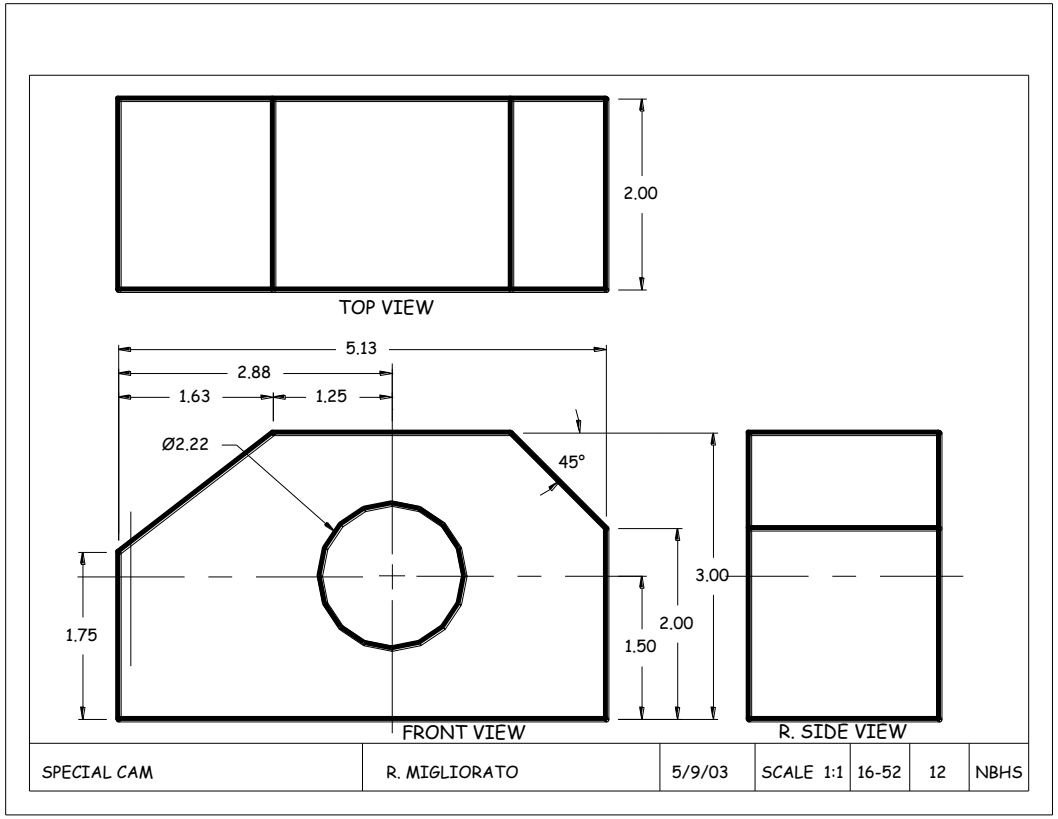
Precedence of Lines

- Which line should be drawn when two lines coincide?
  - Visible line coincides with hidden or center line
    - Visible line is shown
  - Hidden line coincides with center line
    - Hidden line is shown

Placement of Views



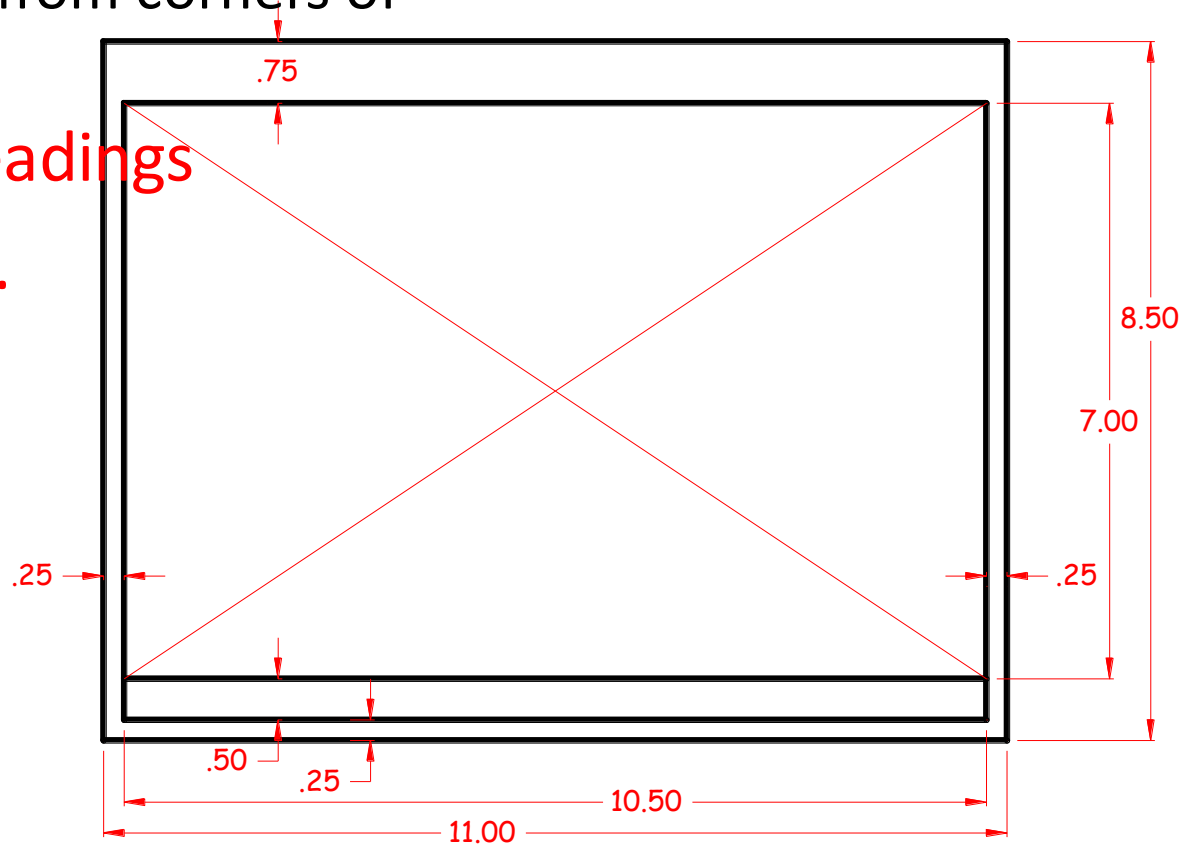
- Views should be visually balanced within the working space



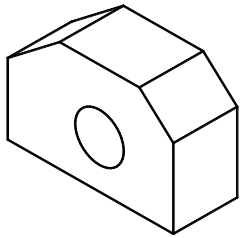
Steps for Centering a Drawing

- Draw border and title block using light construction lines
- Draw diagonal lines from corners of border
- Use dimension readings

Mentioned in class.

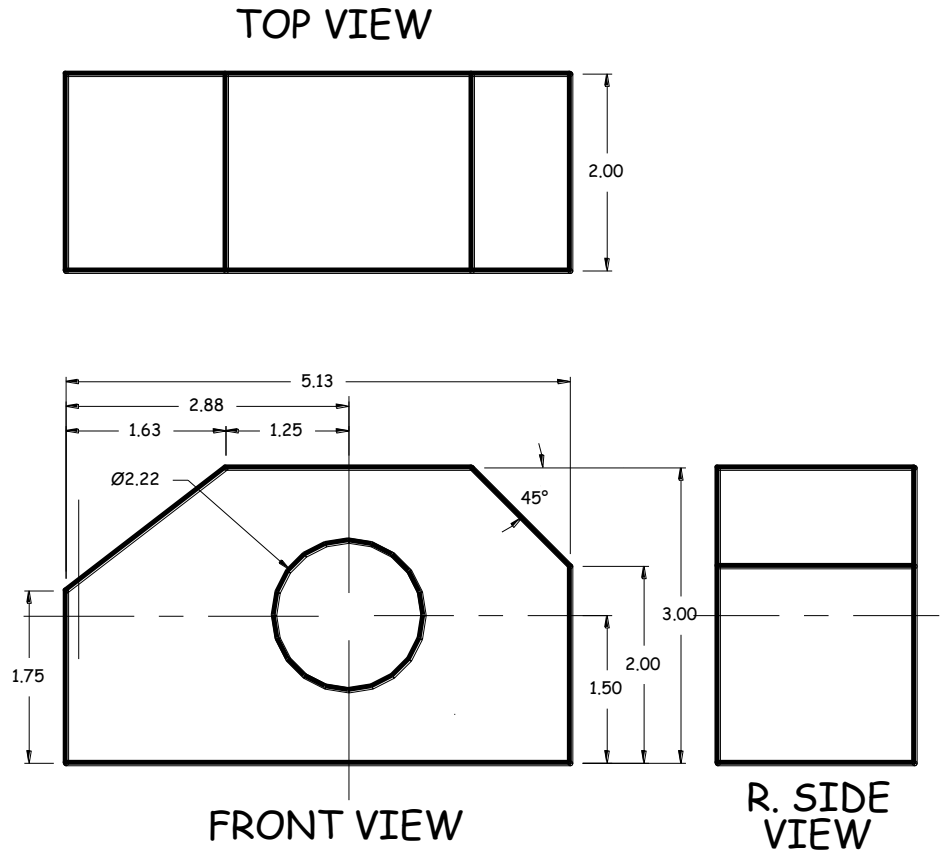


Steps for Centering a Drawing

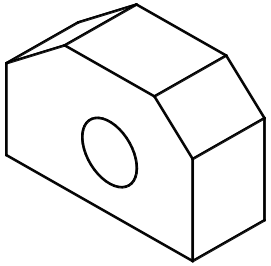


- Add:
  - Width 5.13
  - Space 1.50
  - Depth 2.00
  - ***Horizontal 8.63***

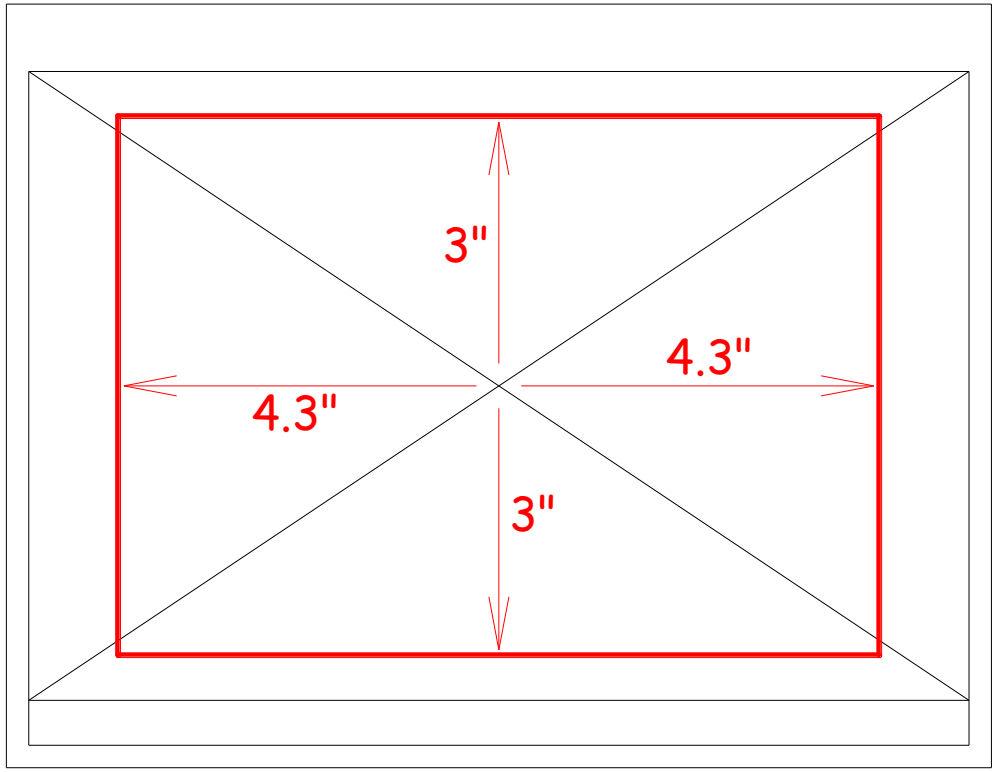
  - Height 3.00
  - Space 1.50
  - Depth 2.00
  - ***Vertical 6.50***



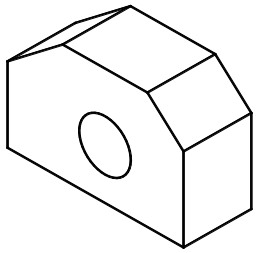
Steps for Centering a Drawing



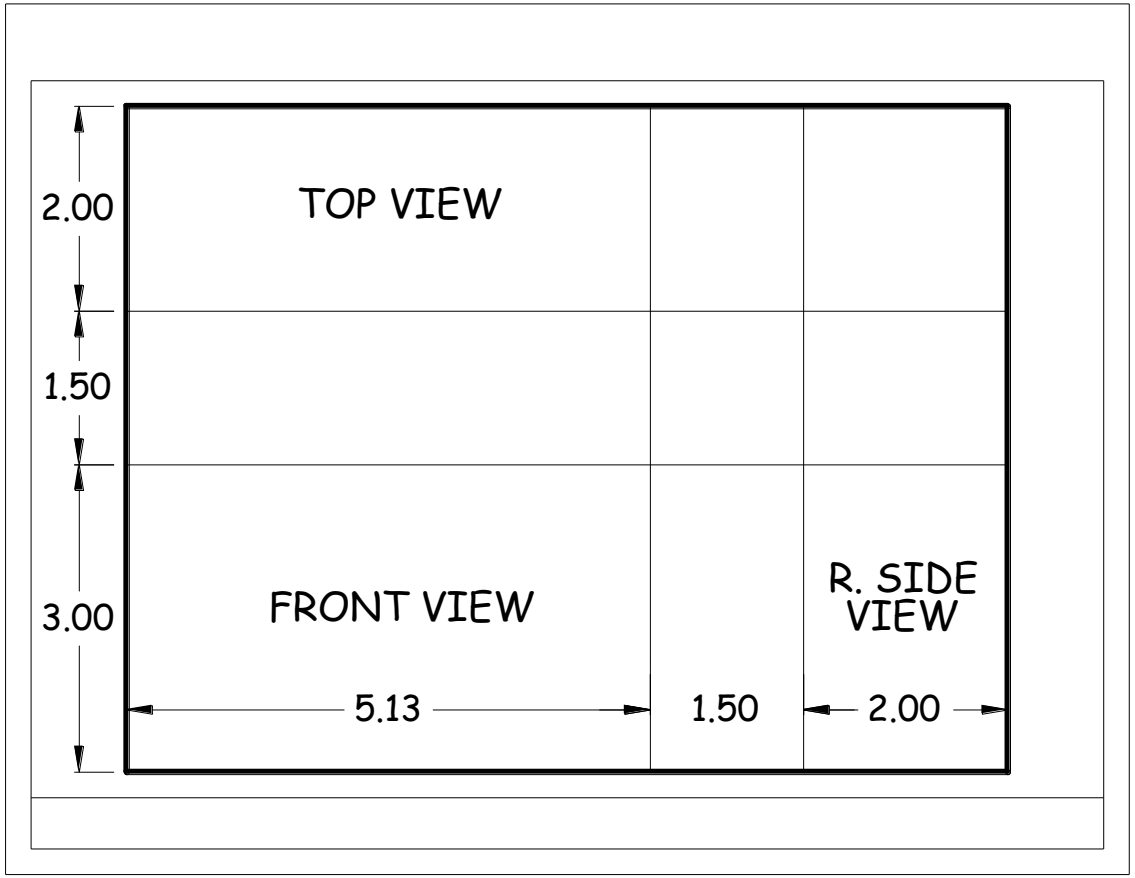
- Draw a box the size of all views
- Measure from the center:
  - Half the width
  - Half the height



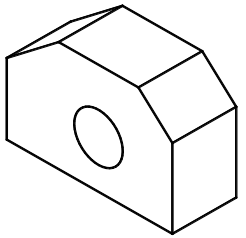
Steps for Centering a Drawing



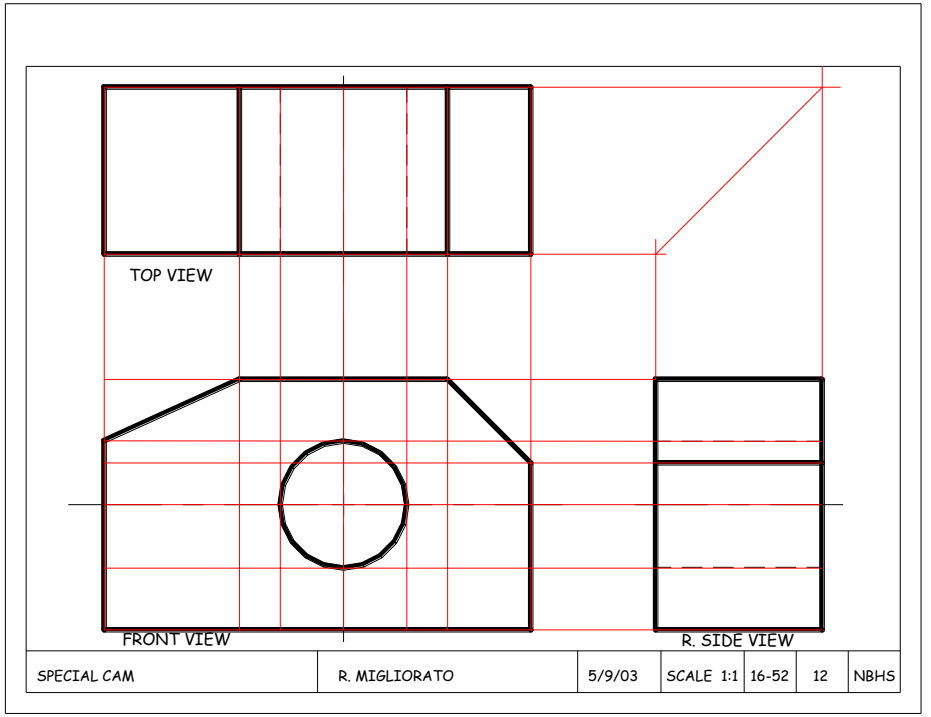
- Draw in views using light construction lines



Adding Details



- Add holes and features
- Transfer horizontal and vertical features
- Use miter line to transfer depth

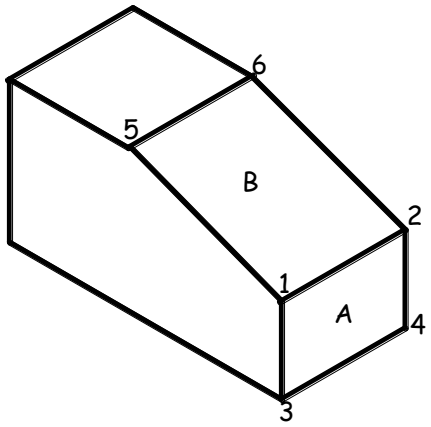


Multiview Drawing

5.02

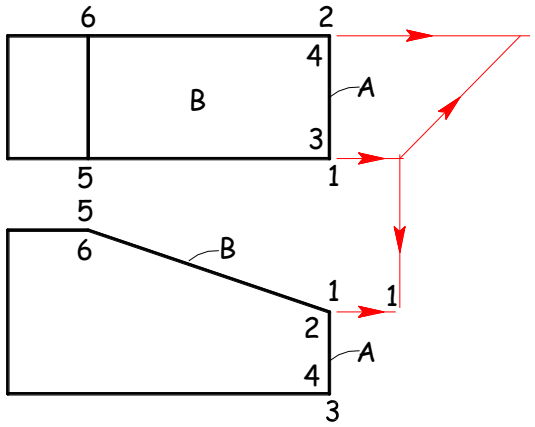
Visualize objects and views

Straight Edges

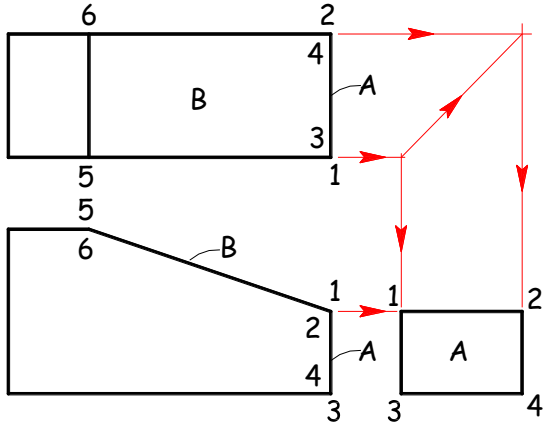


- Edges that are perpendicular to a plane of projection appear as a point

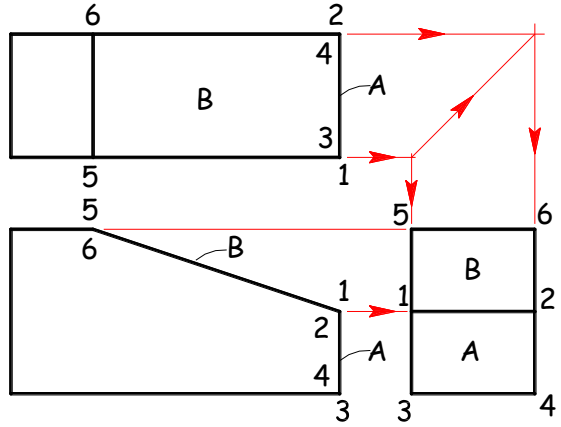
1



2

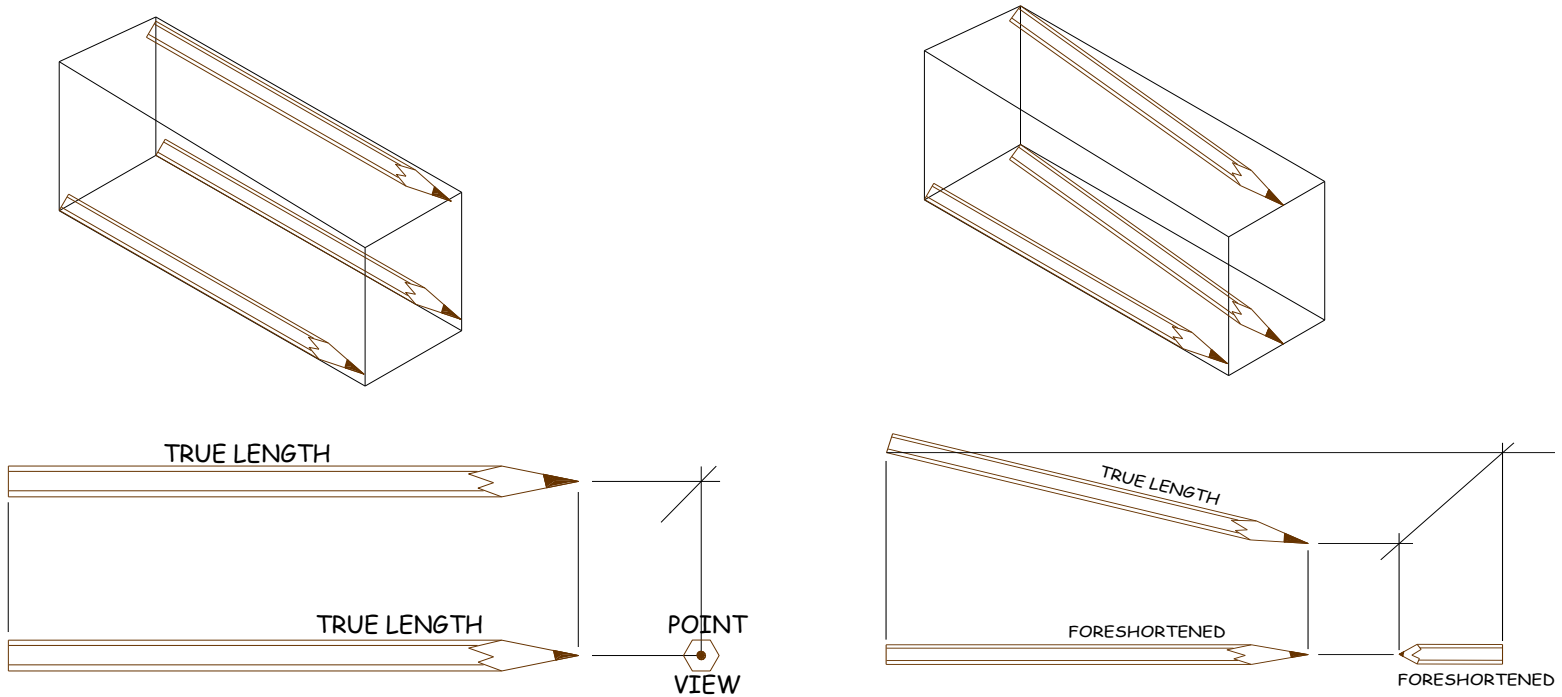


3



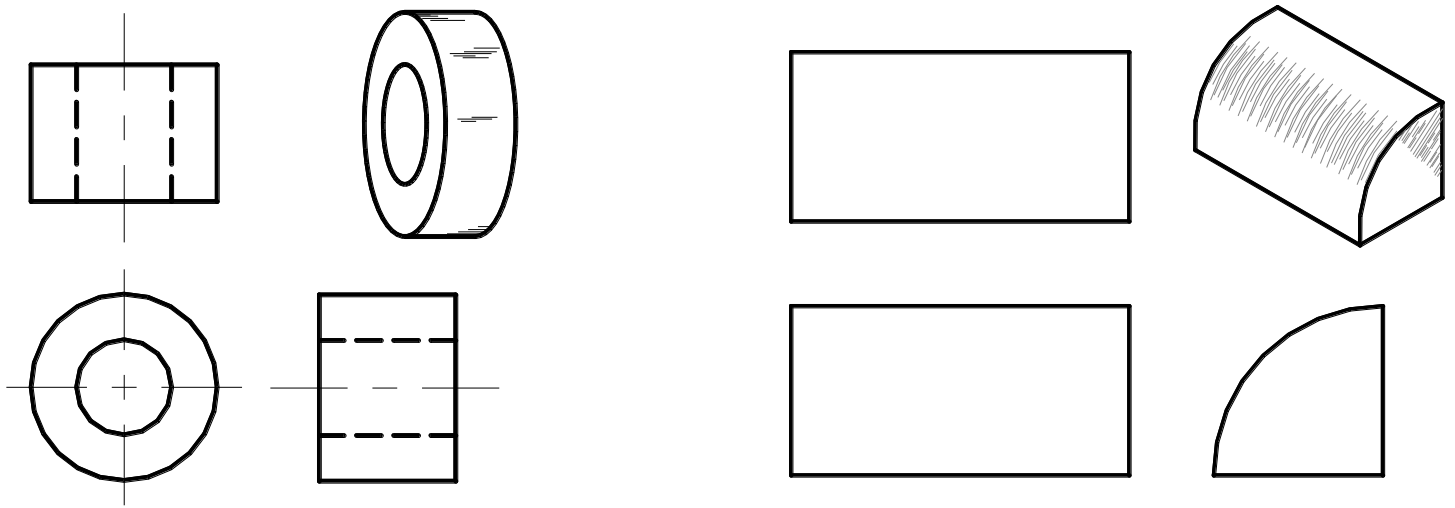
Straight Edges

- Edges that are parallel to a plane of projection appear as lines
- Edges that are inclined to a plane of projection appear as foreshortened lines



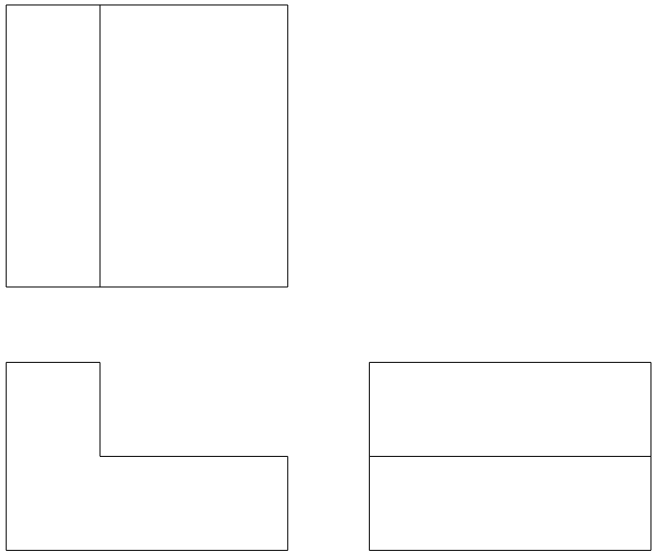
Curved Edges

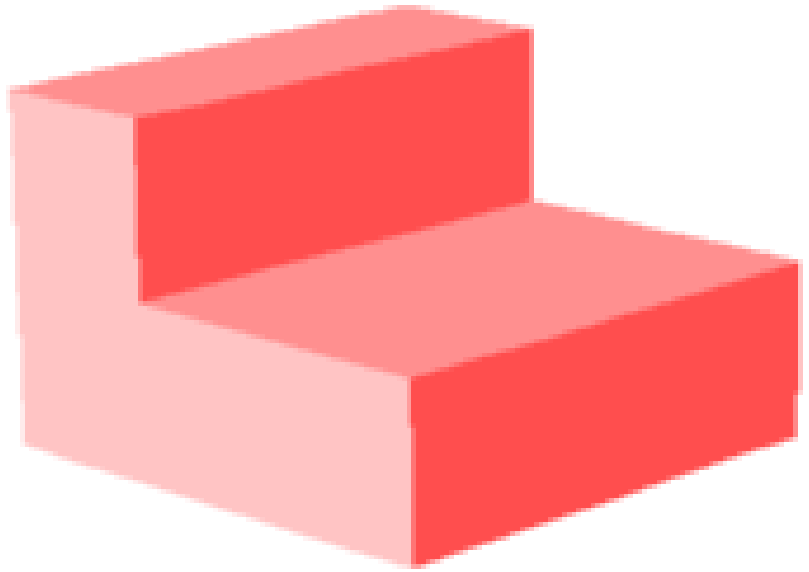
- Curved edges project as straight lines on the plane to which they are perpendicular
- Curved edges project as curved lines on the planes to which they are parallel or inclined



Normal Surfaces

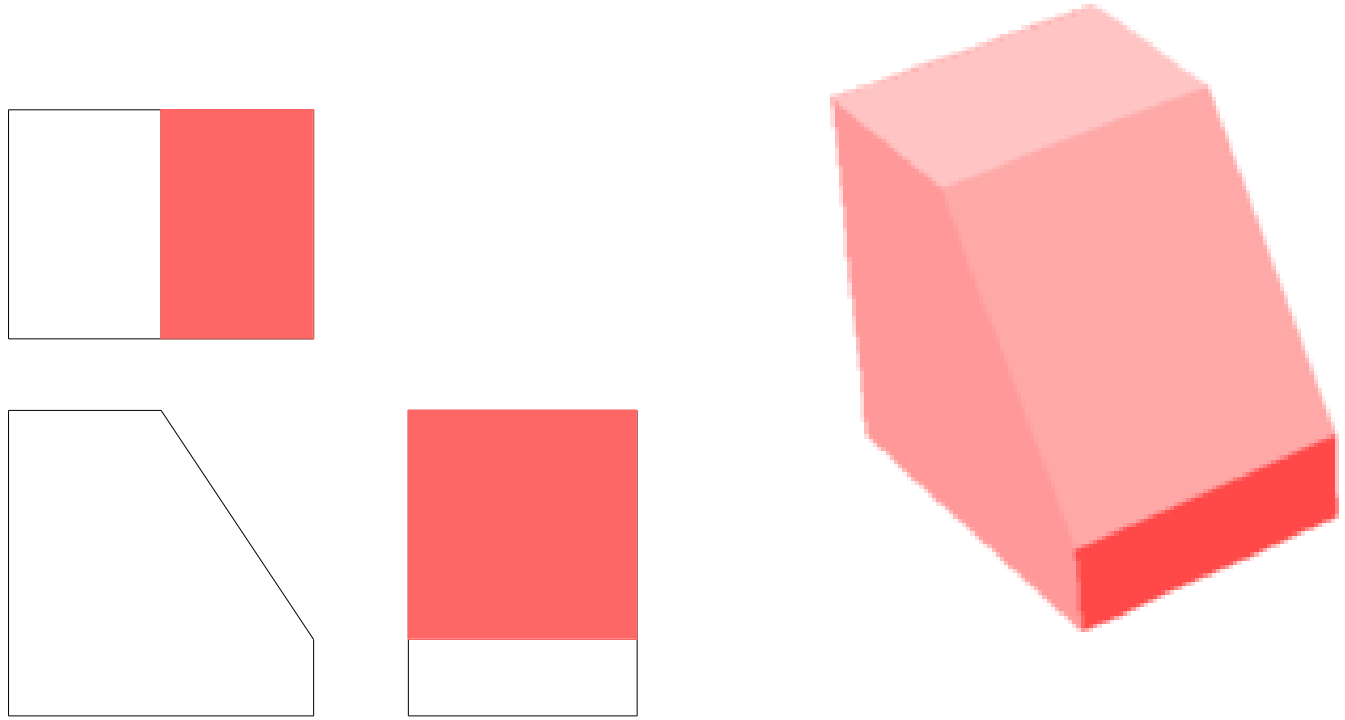
- Normal surfaces appear as an edge in two opposite principal views, and appear a surface in all other principal views.





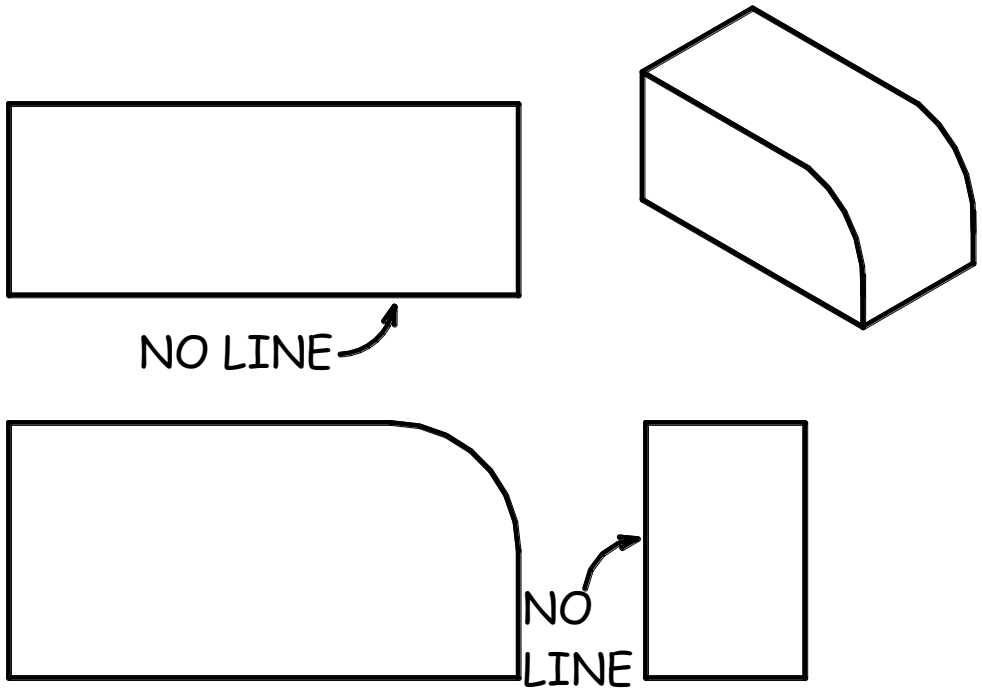
Inclined Surfaces

- Inclined surfaces appear as an edge in two opposite principal views, and appear foreshortened (not true size) in all other principal views.



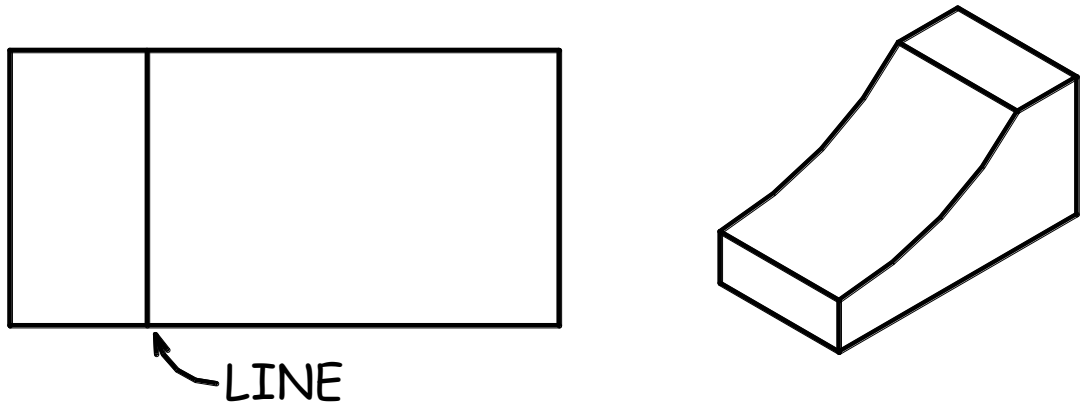
Intersections & Tangencies

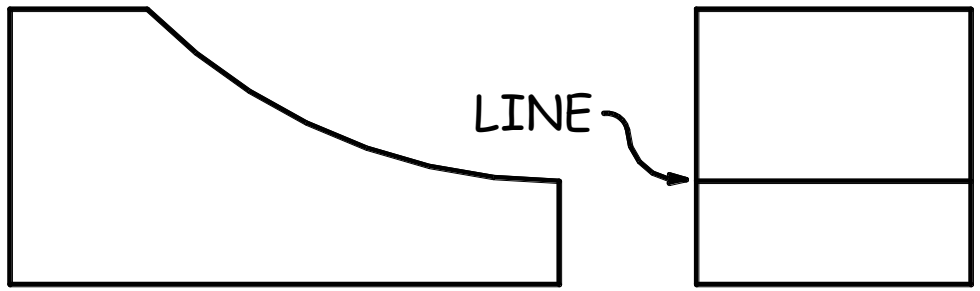
- Where a curved surface is *tangent* to a plane surface, no line should be shown where they join



Intersections & Tangencies

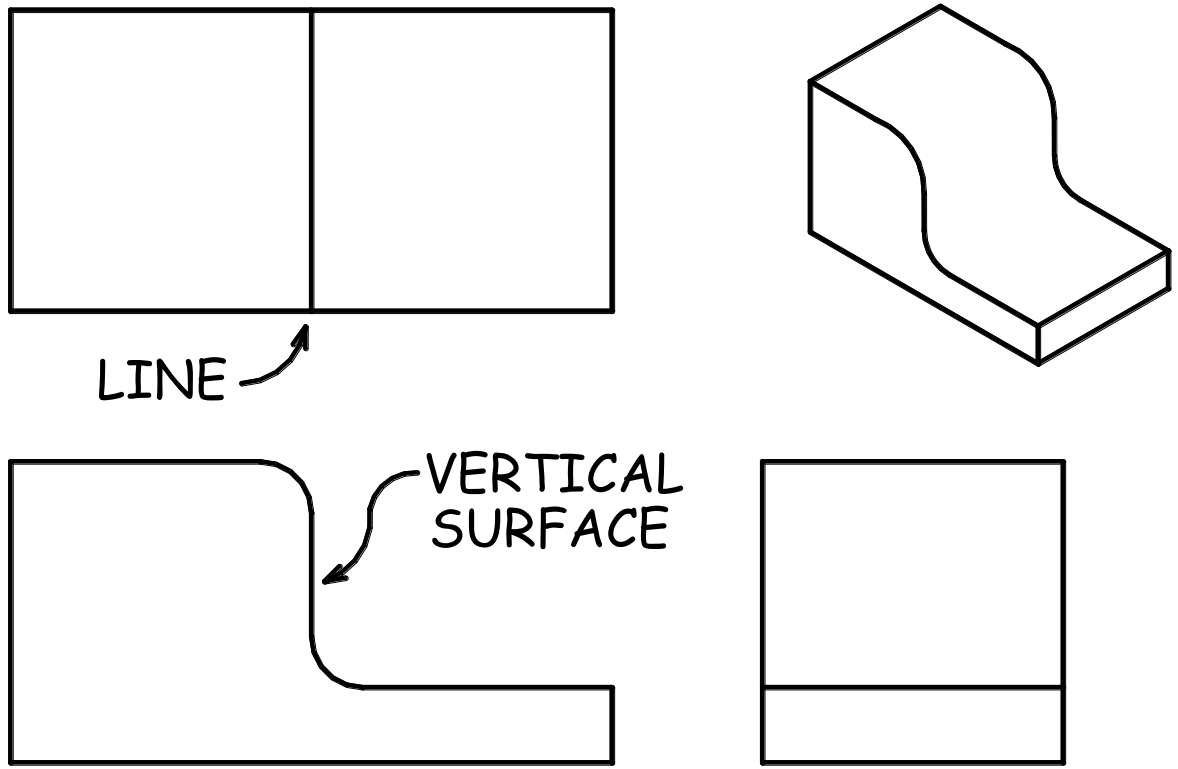
- Where a plane surface intersects a curved surface, an edge is formed





Intersections & Tangencies

- Where the plane surface is horizontal or vertical, exceptions to these rules may occur



References

1) UMAMS Design and Engineering,B-211 – Tech Lab, Cullen.
2) Project Lead The Way
3) Mechanical Drawing, Multi-view drawings, Chapter 5
4) ORTHOGRAPHIC PROJECTION Exercises mod