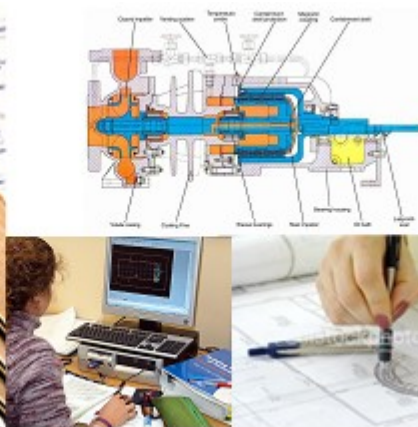


Chapter 3

Orthographic Projection



Contents

- Projection theory
- Multiview drawing
- Line convention



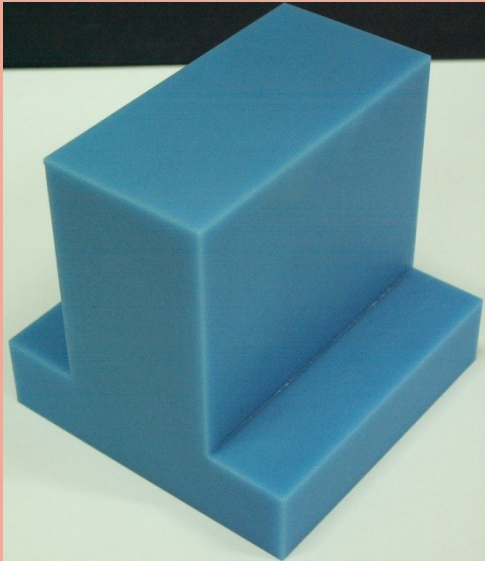
Projection Thoery

Contents

Purpose

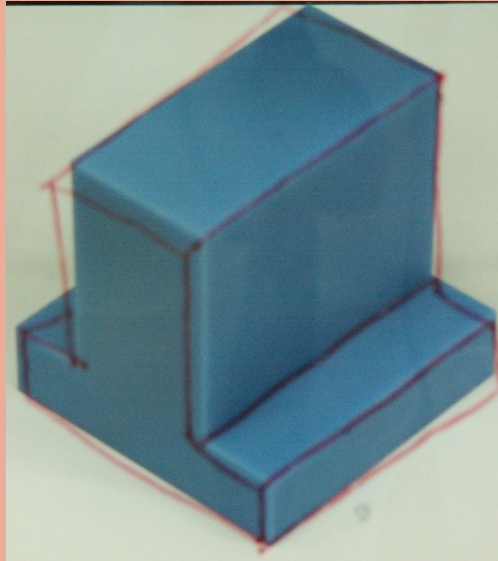
■ to graphically represent a 3-D object on 2-D media (paper, screen etc.).

Object (3D) placing on the paper (2D)



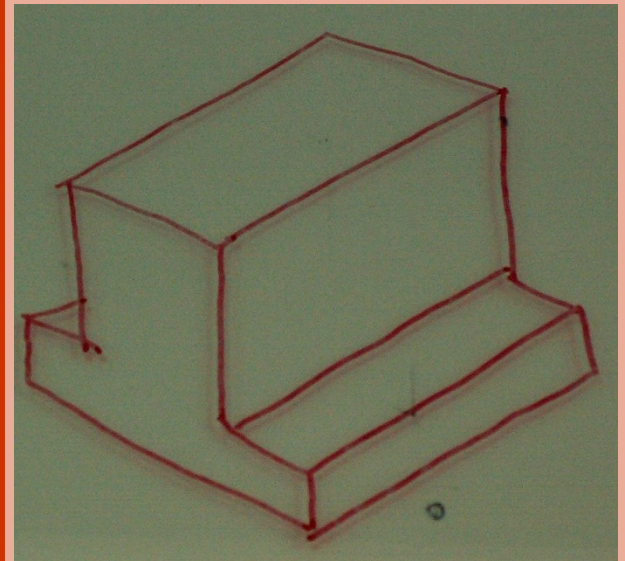
Inconvenient to communicate

Transparent plate is placed between object and observer's eyes.



Object's features are transferred through projection.

A view of an object on 2D media



Convenient to communicate

Concept

■ A projection theory is based on 2 variables:

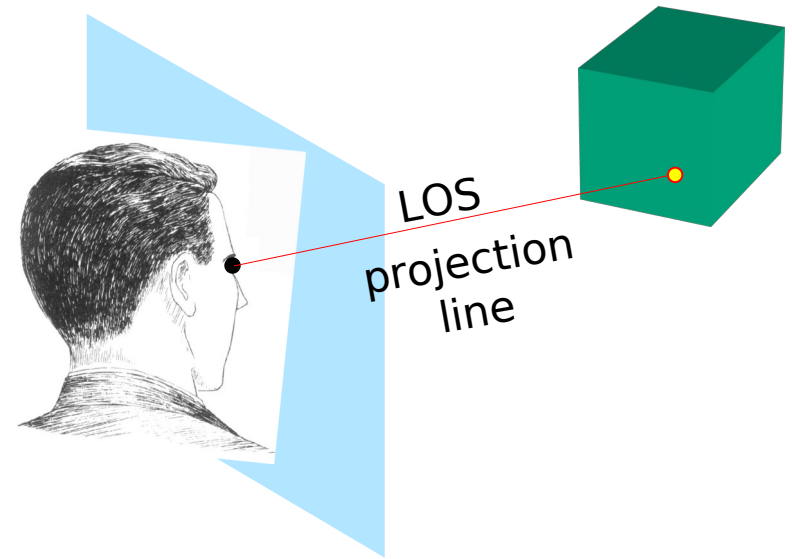
- 1) Line of sight
- 2) Plane of projection (image or picture plane)

■ Line of sight (LOS)

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

■ Plane of projection

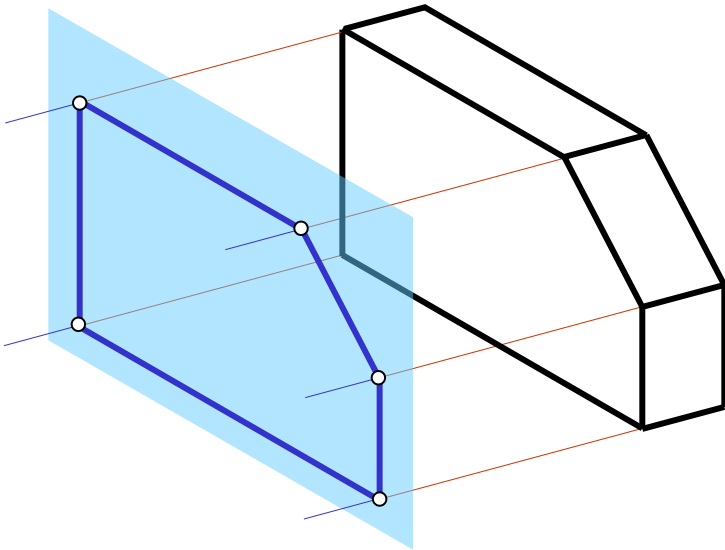
is an imaginary flat plane upon which the image created by the LOS is projected.



Line of sight

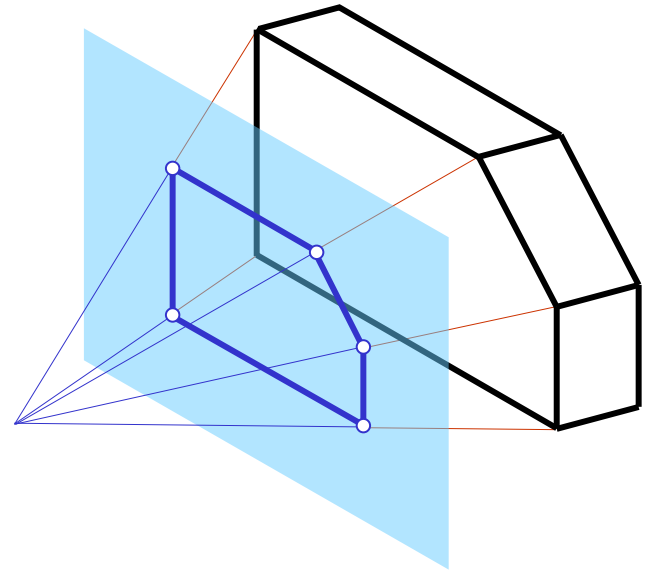
Lines of sight can be **parallel** or **converge**.

Parallel projection



Play

Converge projection



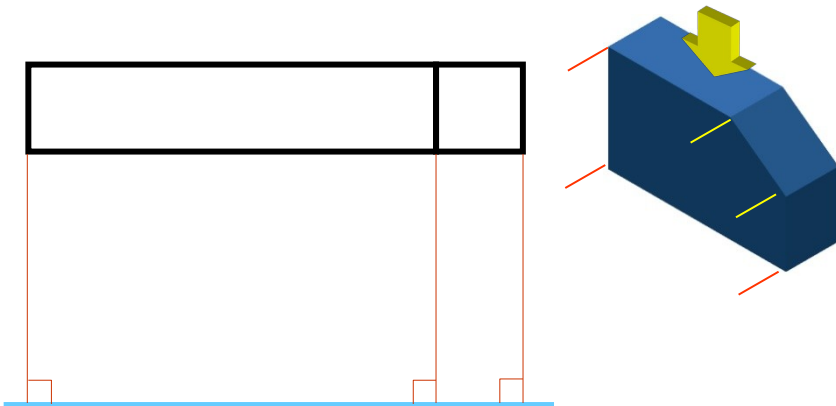
Play

Line of sight

The parallel projection lines can be **normal** (orthogonal) or **oblique** to the plane of projection.

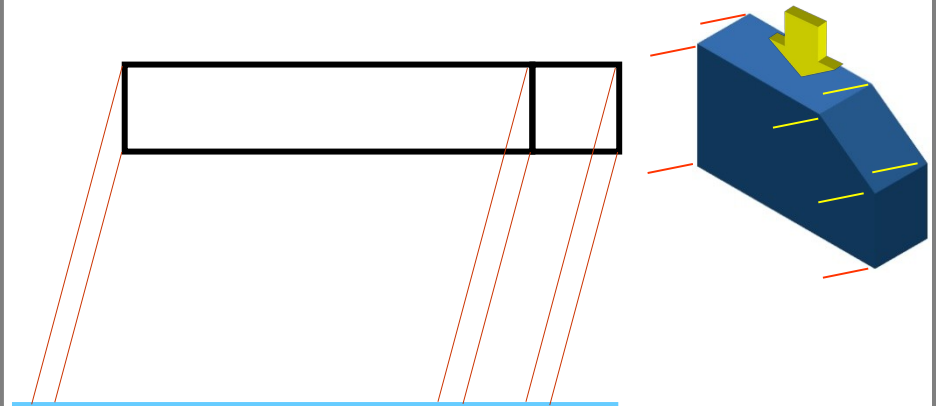
In this course, we consider only a parallel and orthogonal projection, i.e. **orthographic projection**.

Orthogonal



Play

Oblique



Play

View

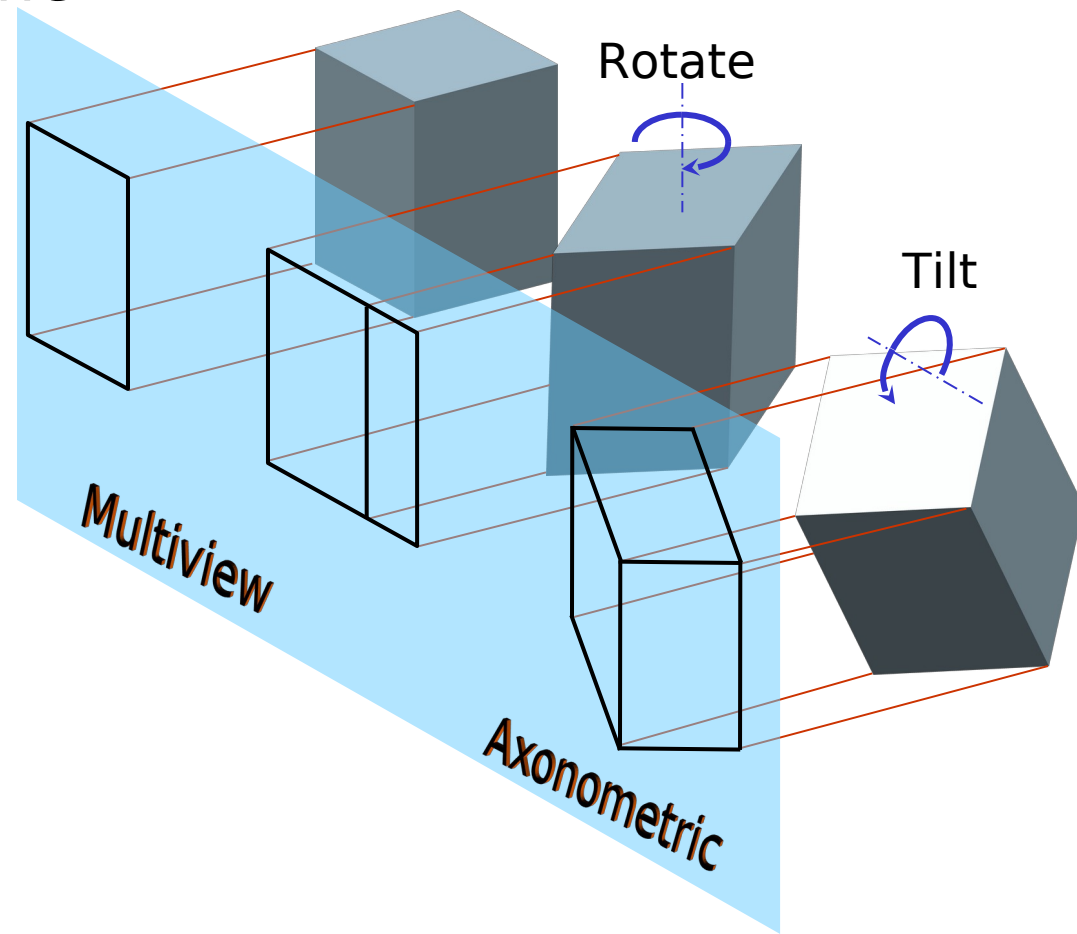
- Image on a projection plane.
- View depends on a **relative orientation** between an object and a plane.

- **Multiview drawing**

shows a 2D view of an object.

- **Axonometric drawing**

shows a virtual 3D view of an object.



Summary : Types of views

Projections

Parallel

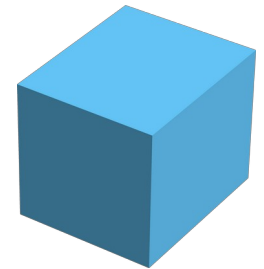
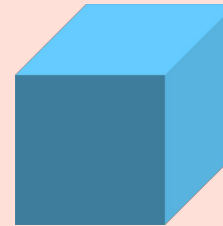
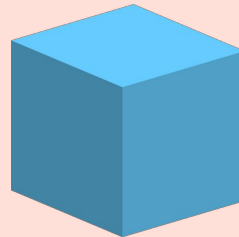
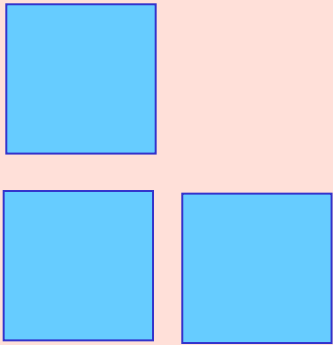
Converge

Orthogonal

Oblique

Multiview

Axonometric

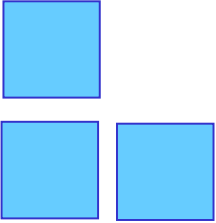
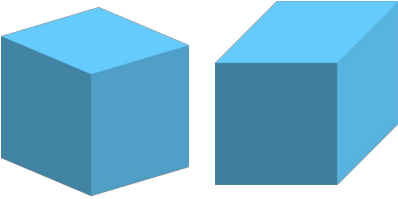
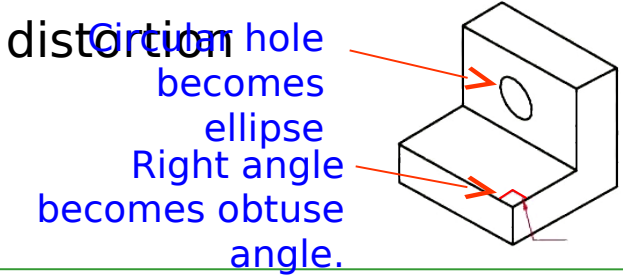
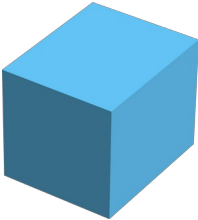
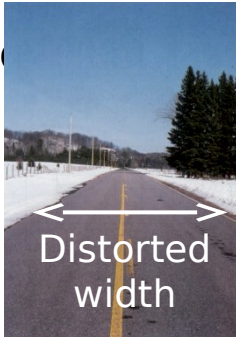


Multiview drawing
(This chapter)

Pictorial drawing
(Later chapter)

Perspective drawing

View comparison

Type	Advantage	Disadvantage
Multiview drawing 	Accurately presents object's details, i.e. size and shape.	Require training to visualization.
Pictorial drawing 	Easy to visualize.	- Shape and angle distortion - Circular hole becomes ellipse - Right angle becomes obtuse angle. 
Perspective drawing 	Object looks more like what our eyes perceive.	- Difficult to create - Size and shape distortion 

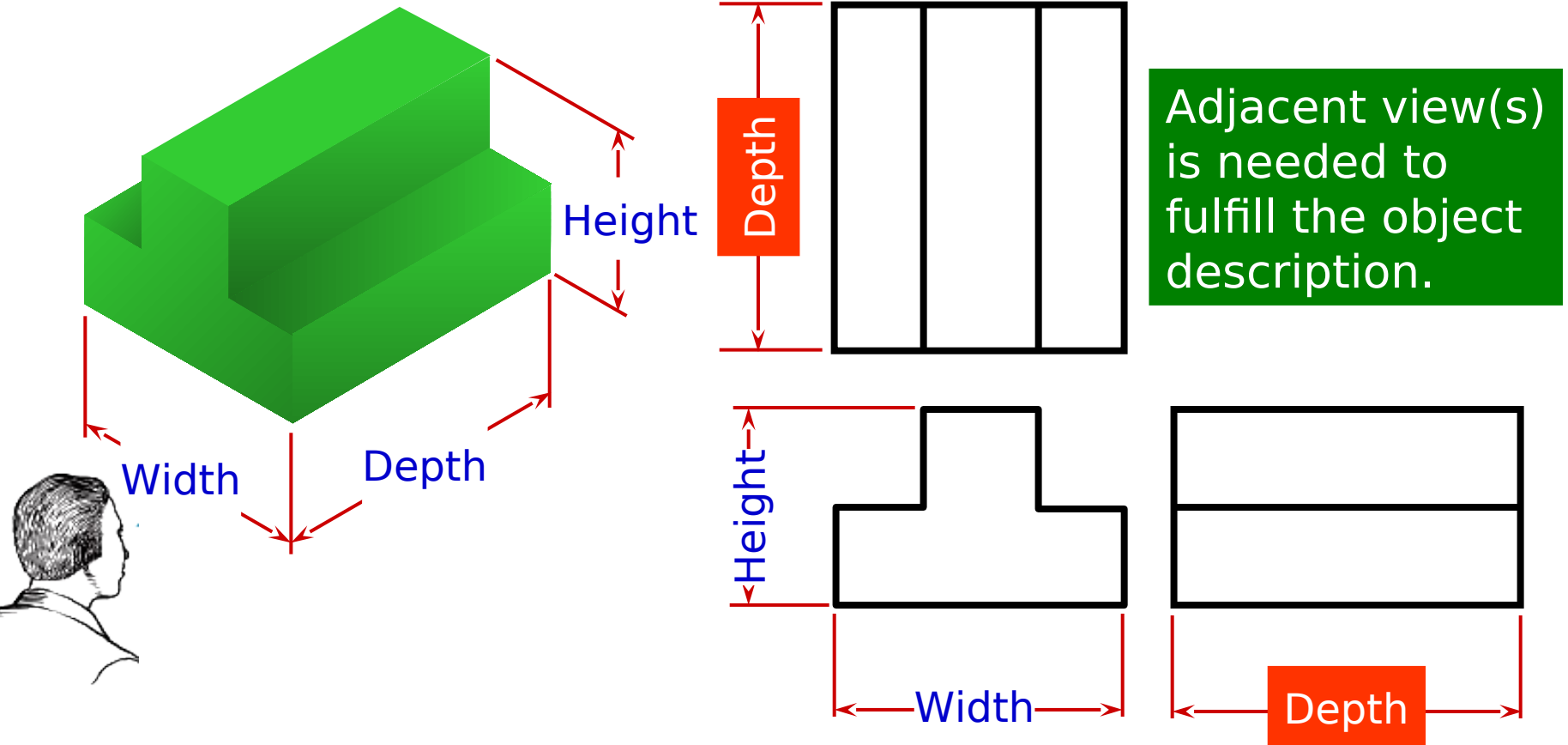


Multiview drawing

Contents

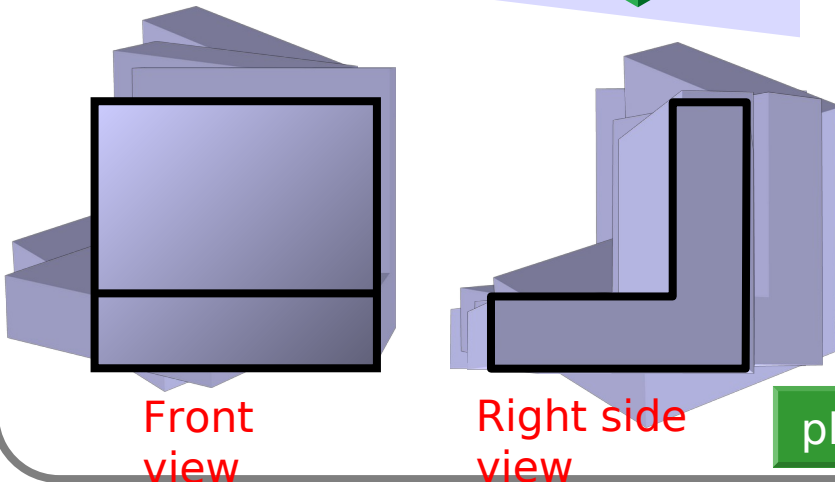
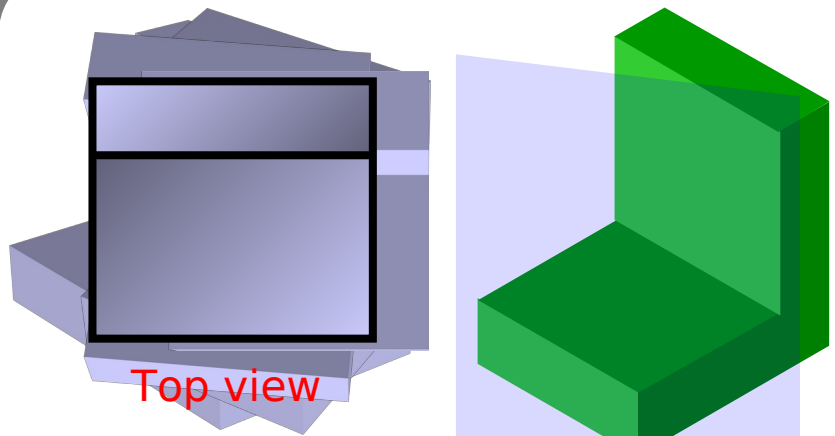
Definition

- Multi-view drawing is a **set of related images** that are created by viewing the object from a different direction.

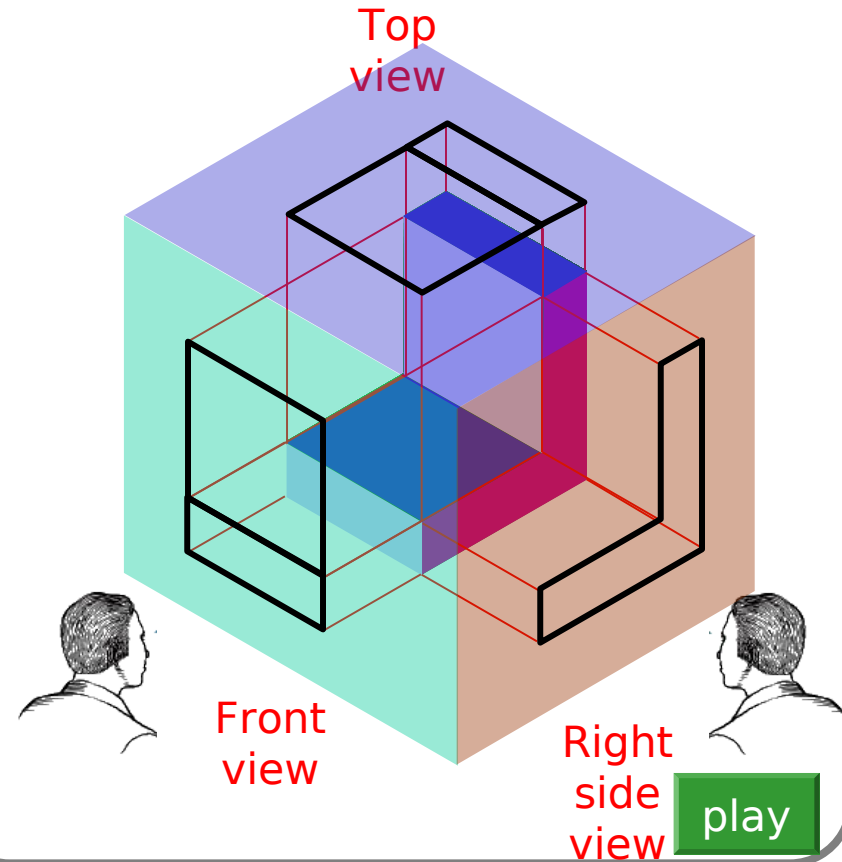


Methods

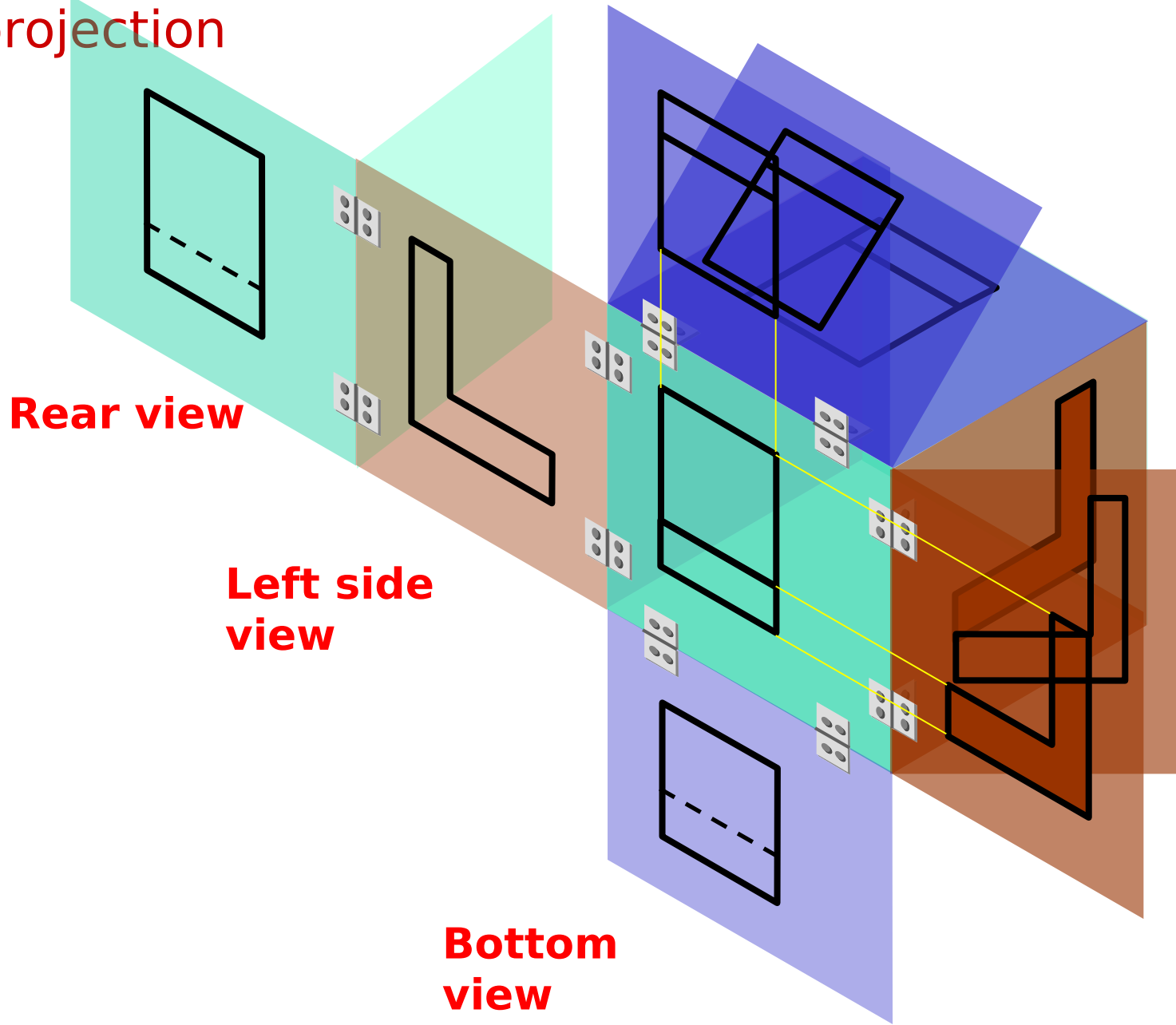
1. Revolve the **object** with respect to **observer**
2. The **observer** moves around the **object**.



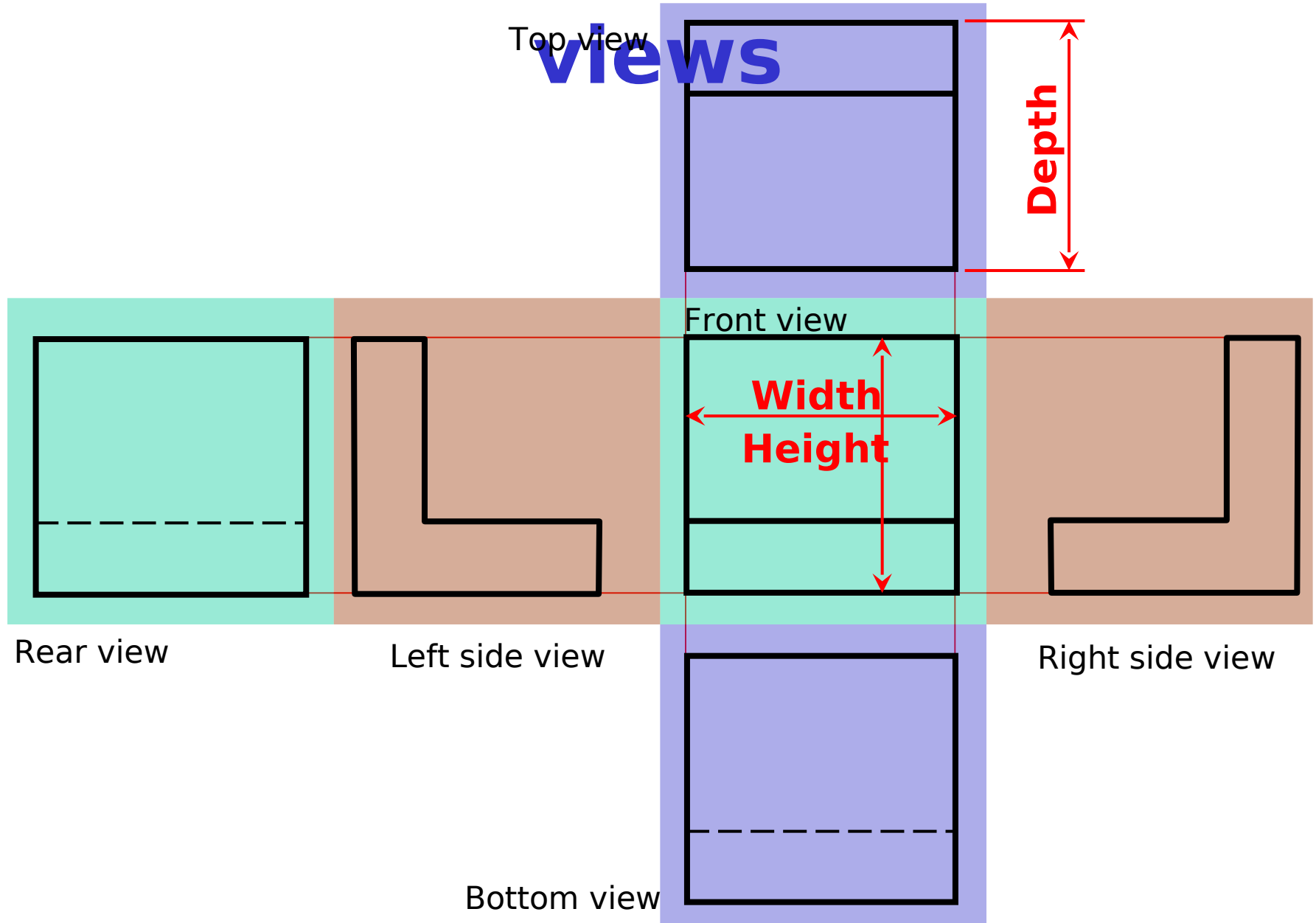
Glass box concept



Glass box : Revolution of the planes of projection

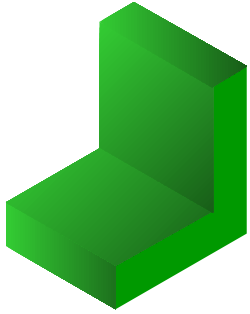


Relative orientation of views

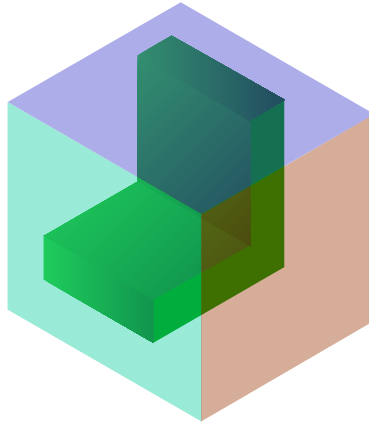


Summary : Problem solving steps

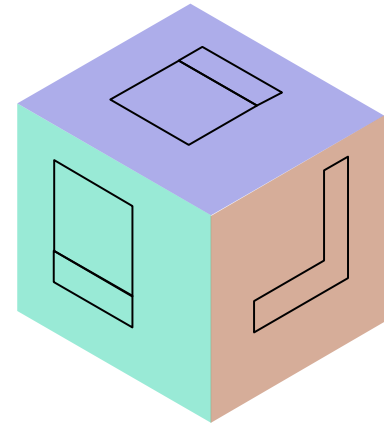
Given



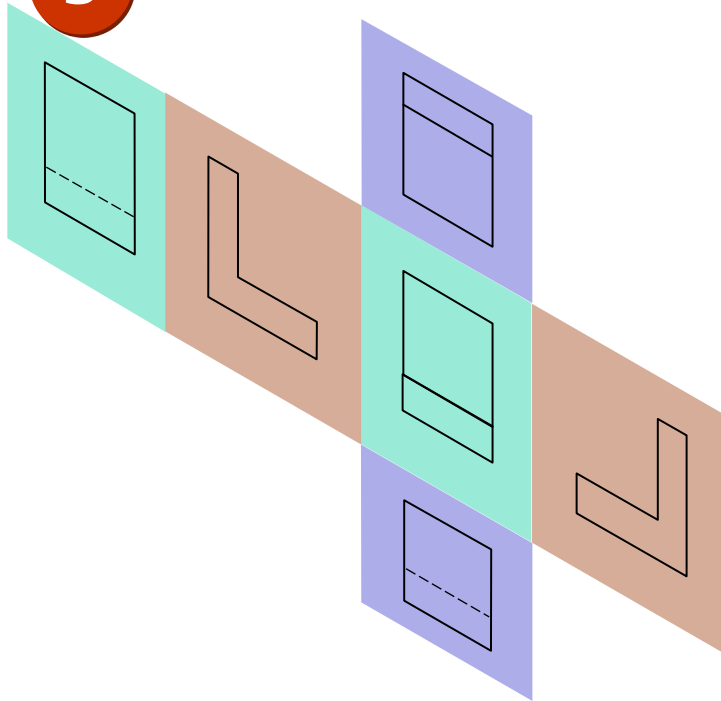
1



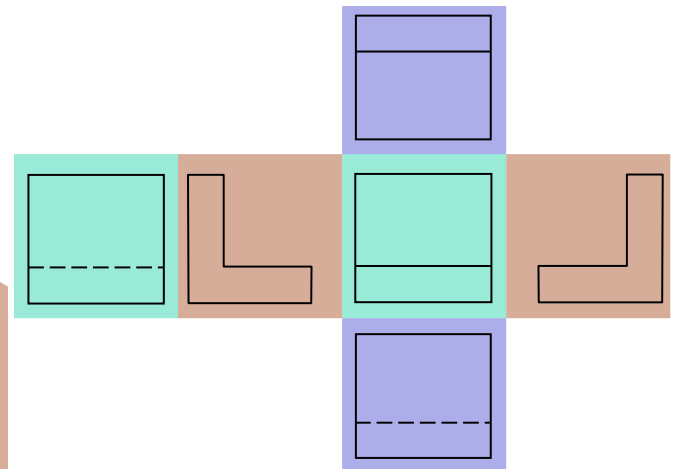
2



3

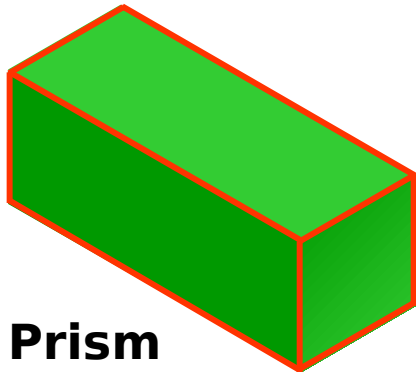


4

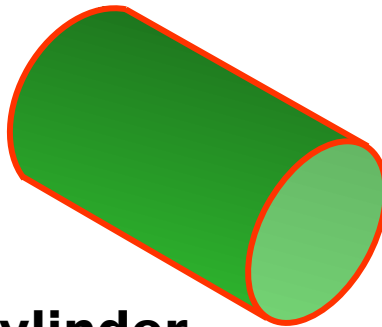


Object features

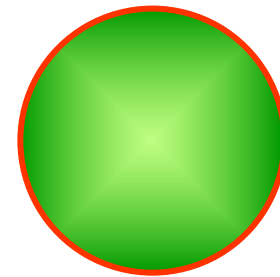
- **Edge** is a line that represent the **boundary between two faces** of an object.
- **Surface limit** is a line that represents the **last visible part of the curve surface**.
- **Surface** is an area that are bounded by edges or surface limit. Surface can be *plane* or *curve*.



Prism



Cylinder

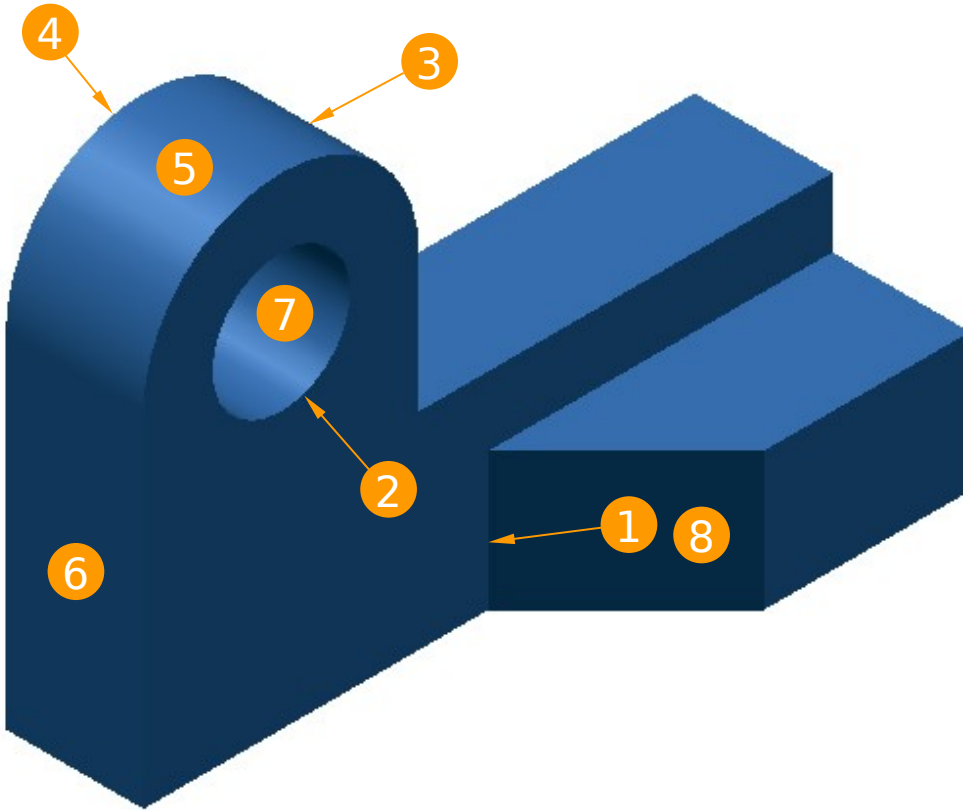


Sphere

No edges!

Note These features will appear as **lines** in a multiview drawing.

Class activity : Object's features



Identify name of the features denoted by a NO. 1 to 9?

	Edge	Surface	Surface		
	limit				
1	☐	☐	☐	✓	✗
2	☐	☐	☐	✓	✗
3	☐	☐	☐	✓	✗
4	☐	☐	☐	✓	✗
5	☐	☐	☐	✓	✗
6	☐	☐	☐	✓	✗
7	☐	☐	☐	✓	✗
8	☐	☐	☐	✓	✗

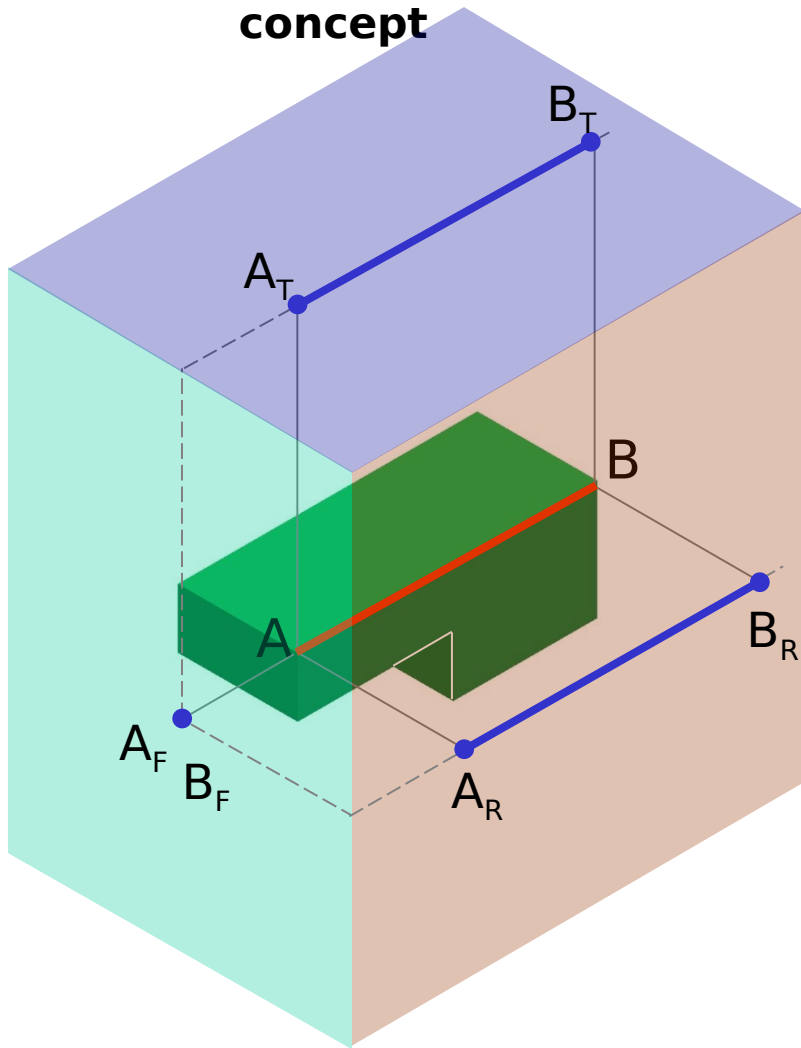
Reset all

Skip test

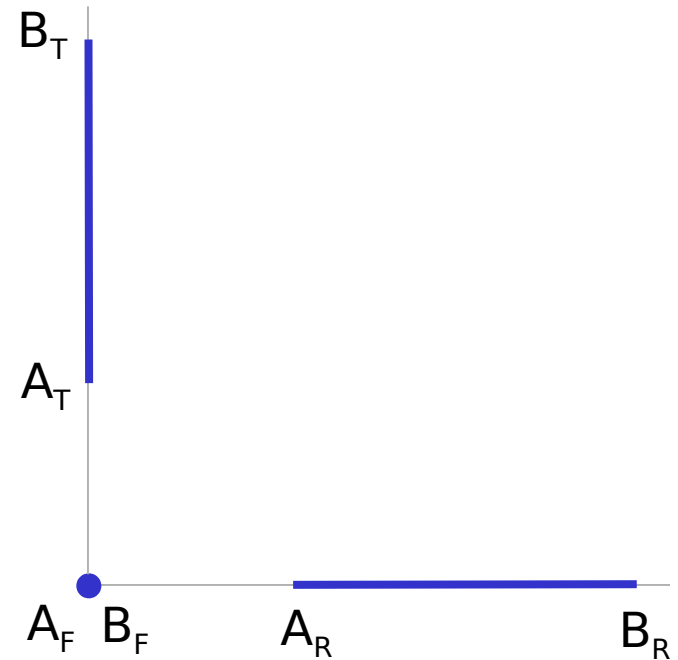
Next slide

Projection of a normal line

Glass box concept



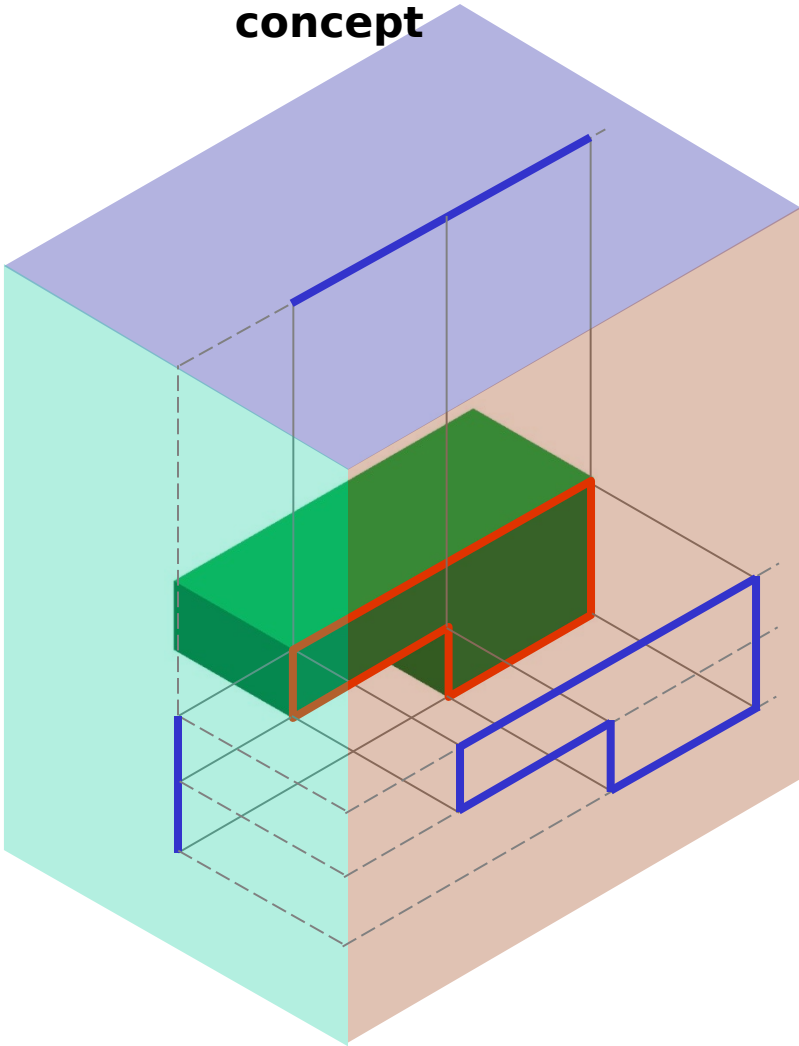
Multiview drawing



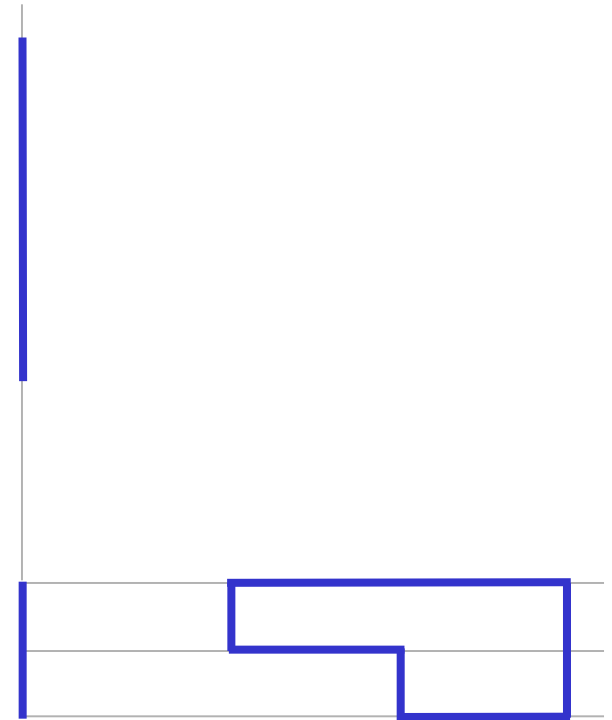
Play

Projection of a normal plane

Glass box concept



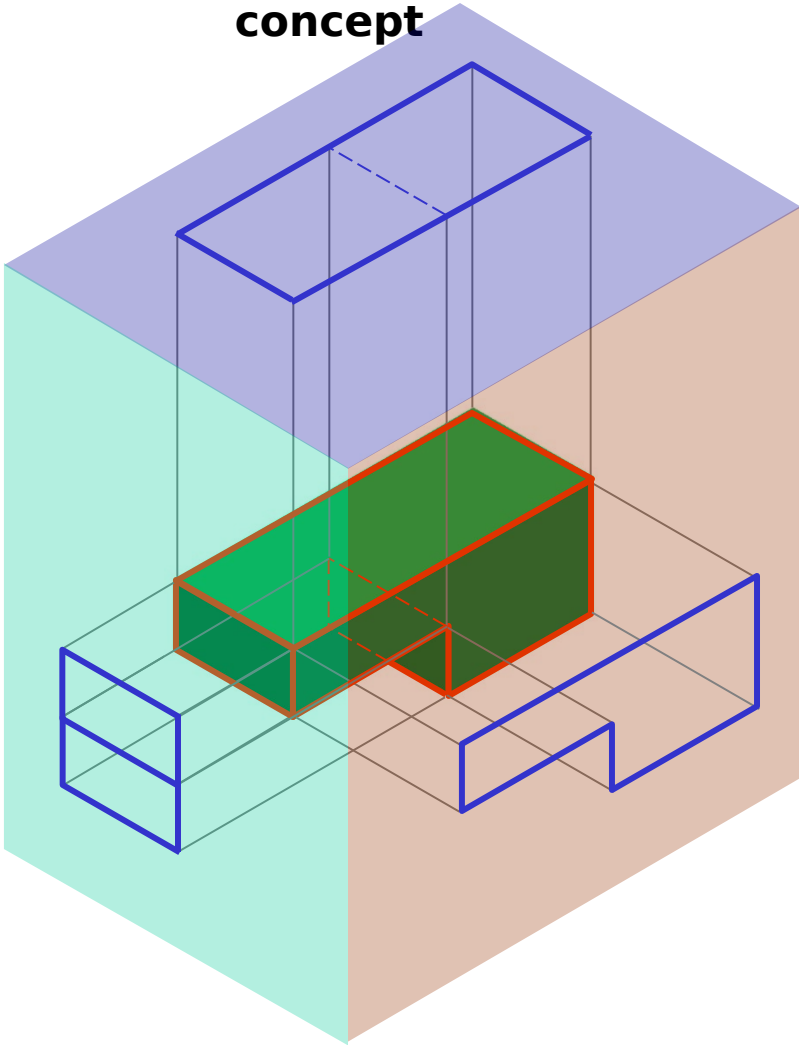
Multiview drawing



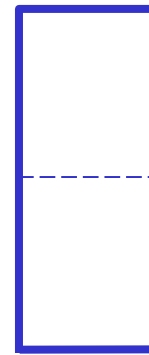
Play

Projection of an **object**

Glass box concept



Multiview drawing



Hidden line is used to show existence of a hidden edge.

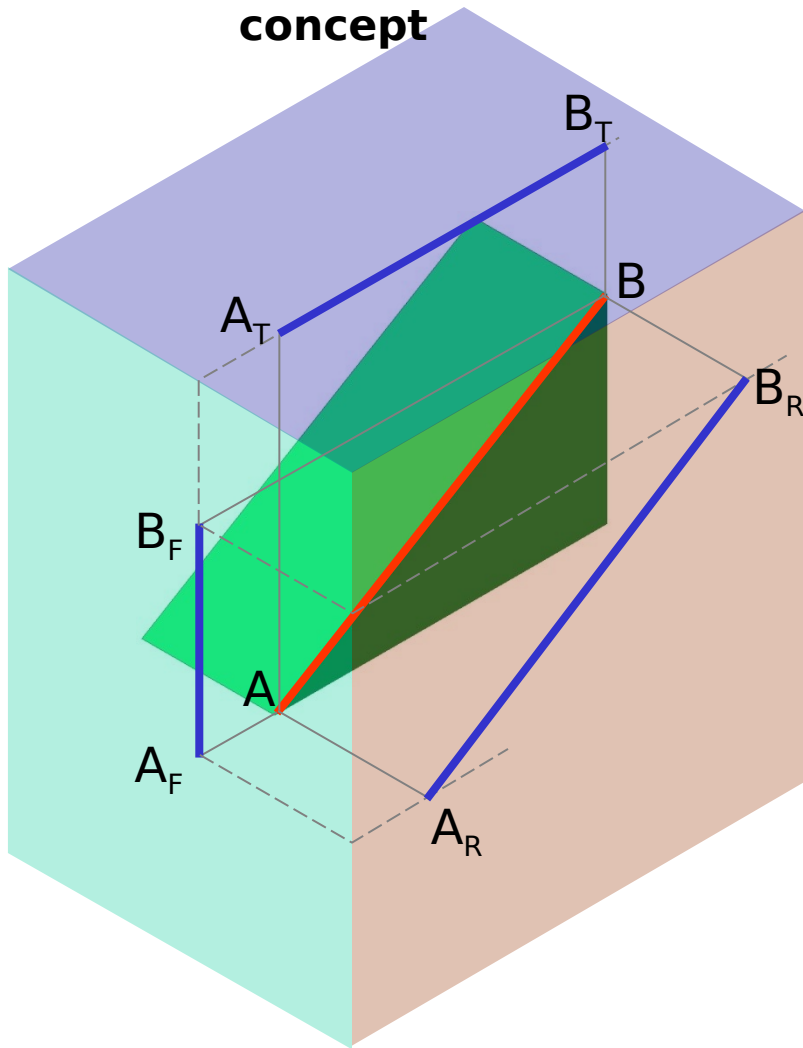


Do the same procedures for all remaining edges (or planes)

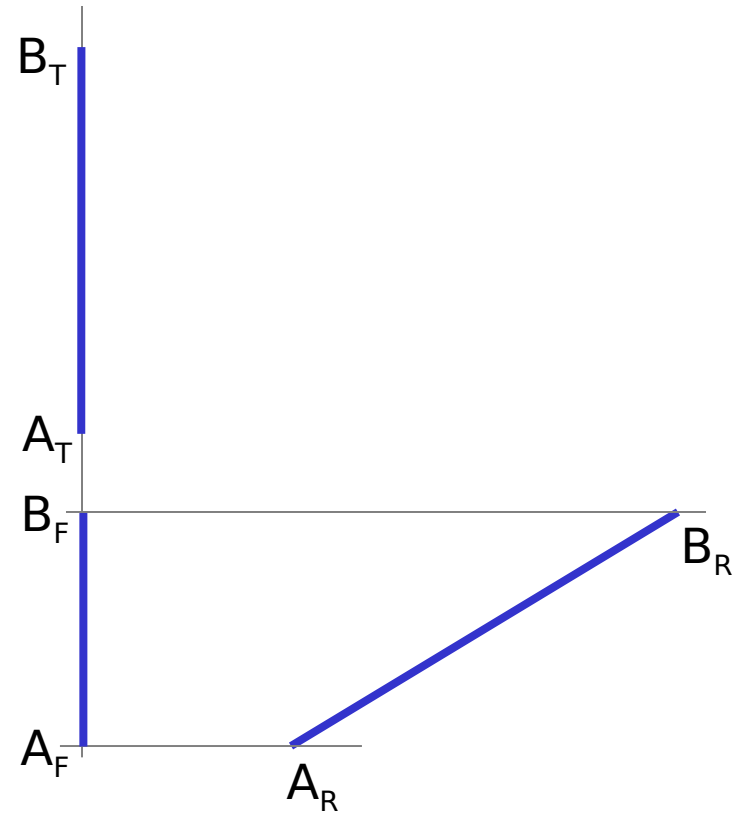
Play

Projection of an inclined line

Glass box concept



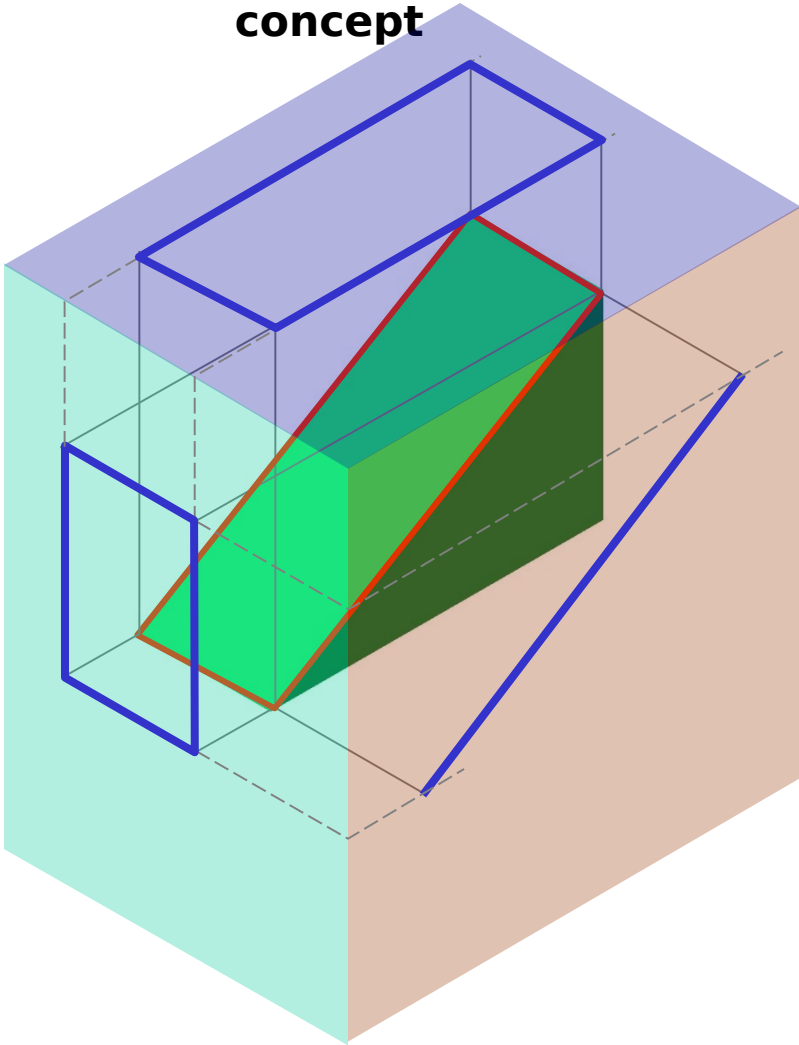
Multiview drawing



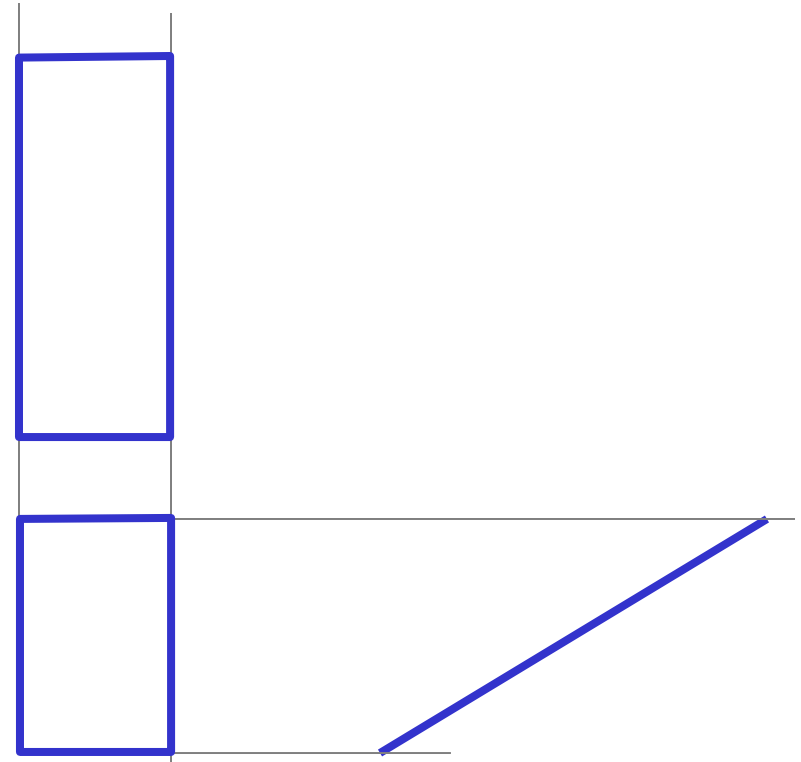
Play

Projection of an **inclined plane**

**Glass box
concept**



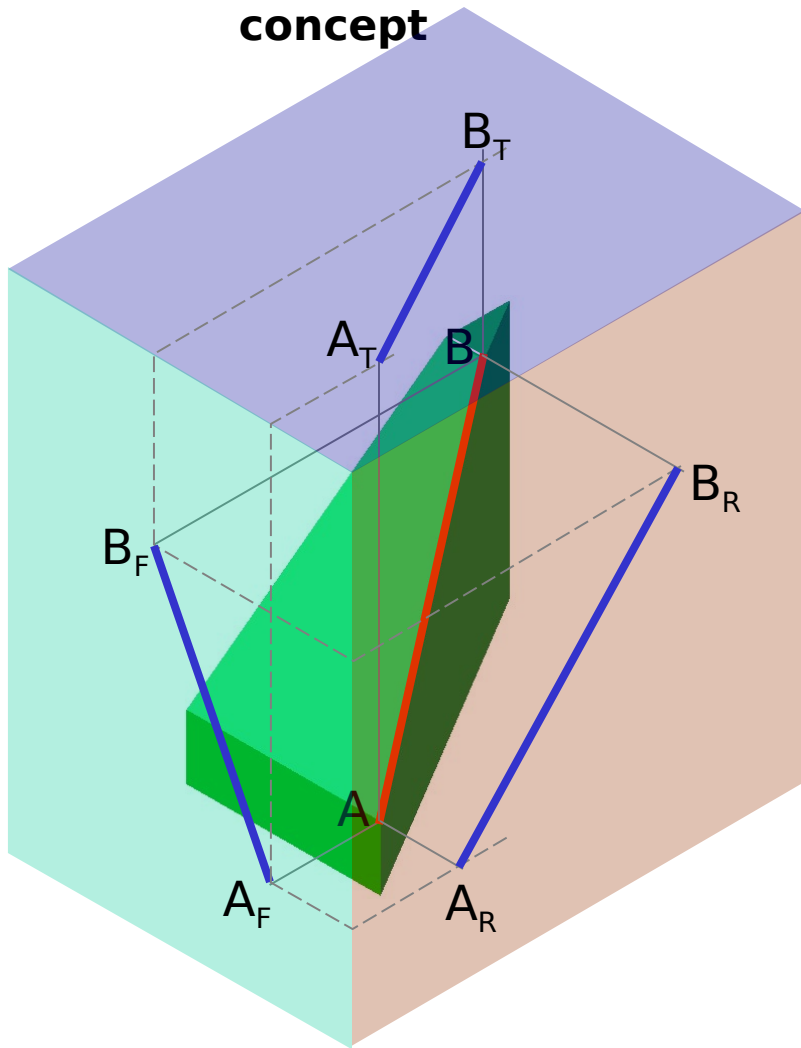
Multiview drawing



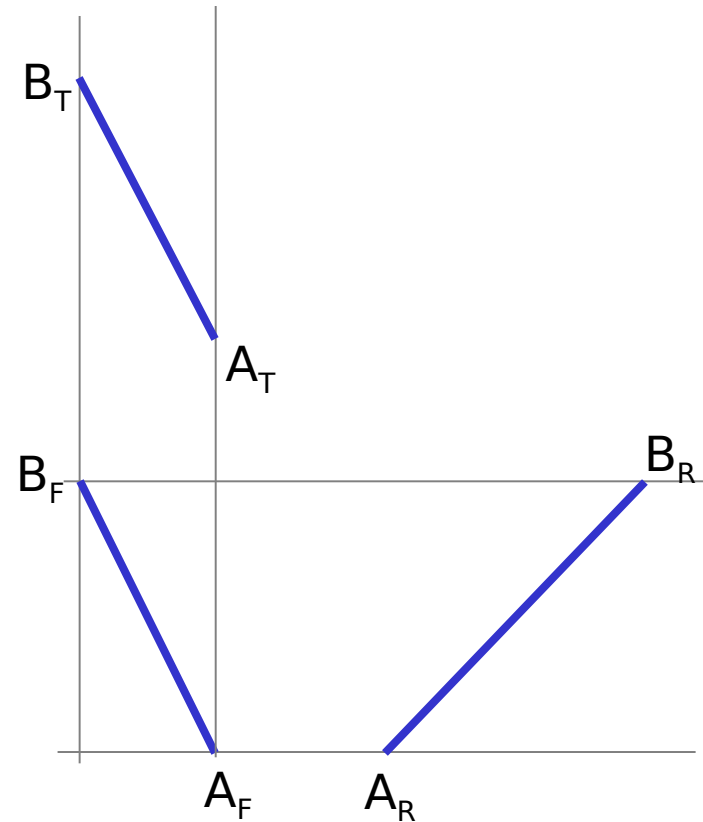
Play

Projection of an obliqued line

Glass box concept



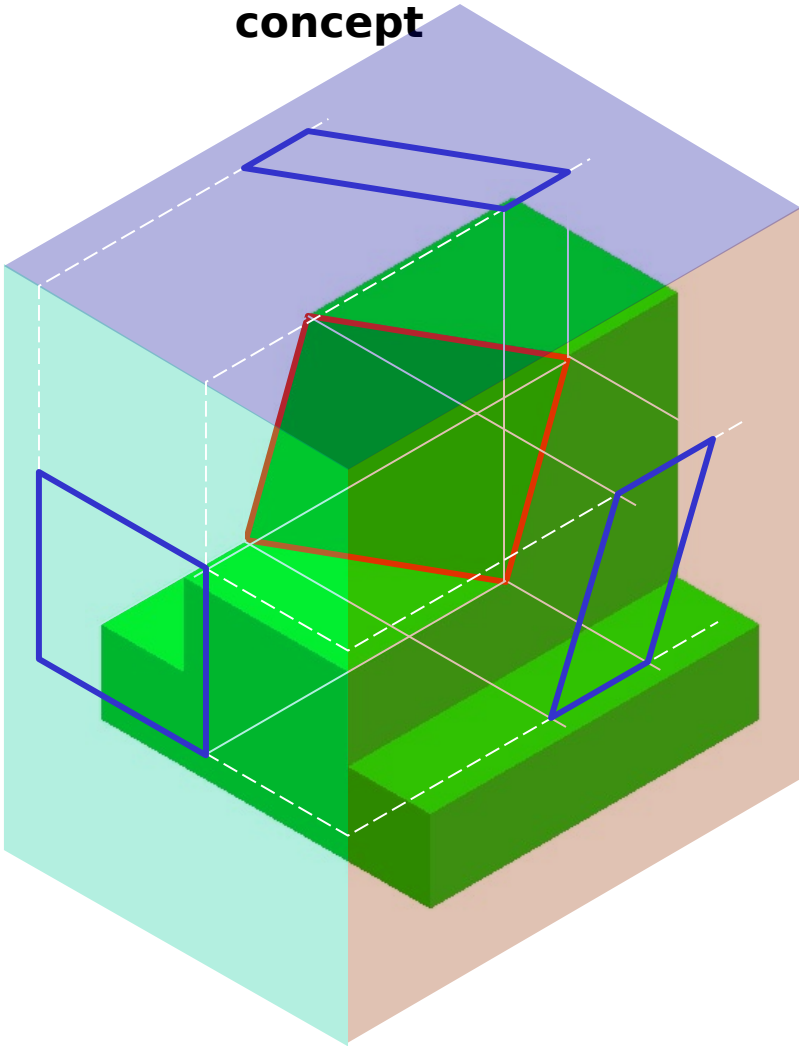
Multiview drawing



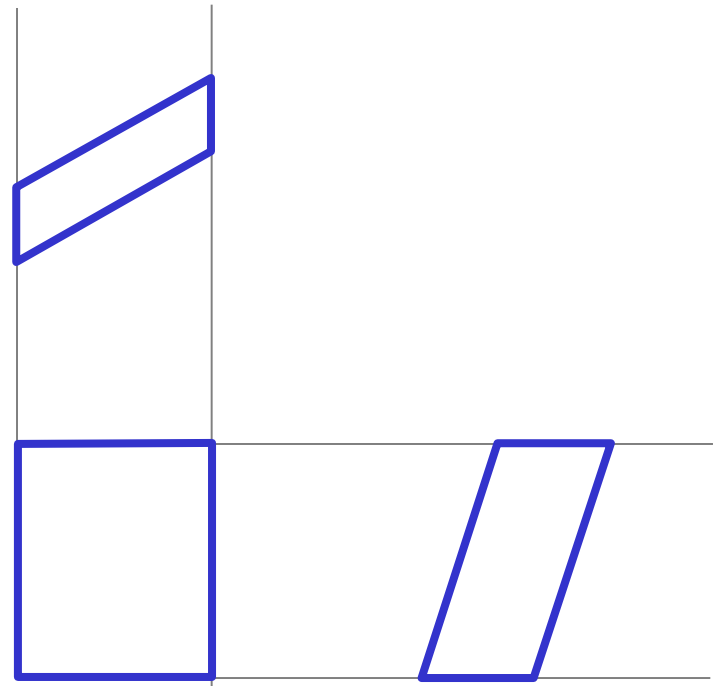
Play

Projection of an **obliqued plane**

Glass box concept



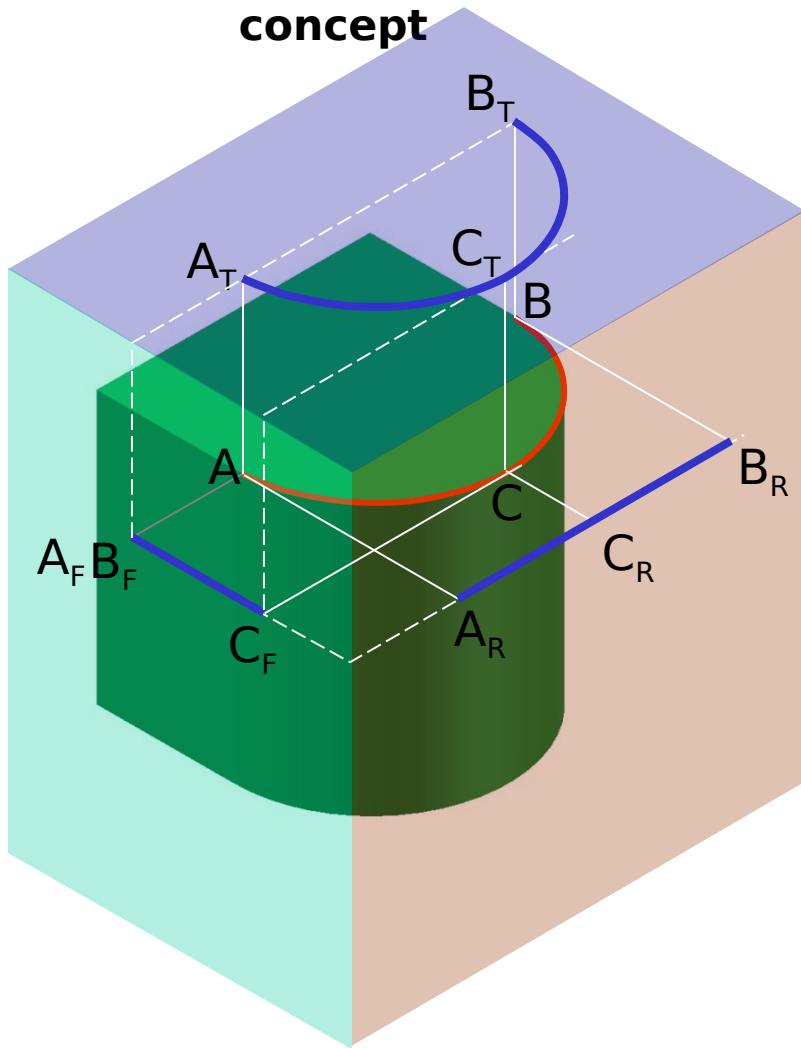
Multiview drawing



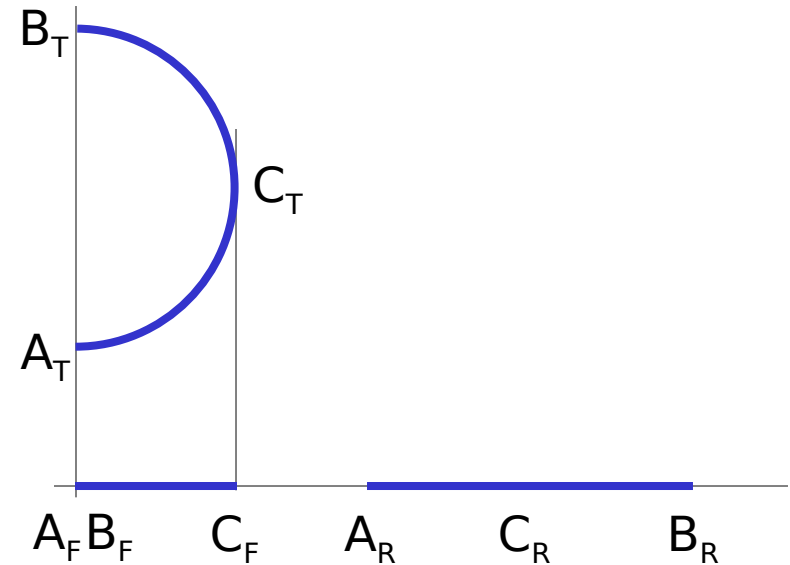
Play

Projection of a curve line

Glass box concept



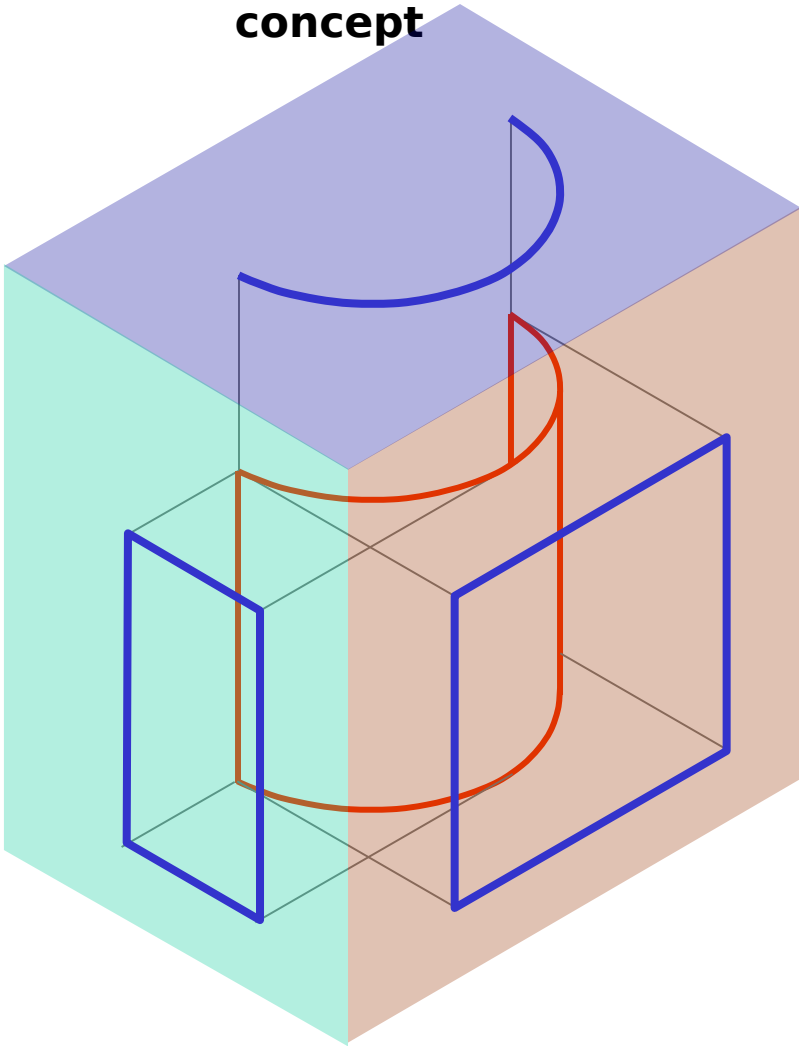
Multiview drawing



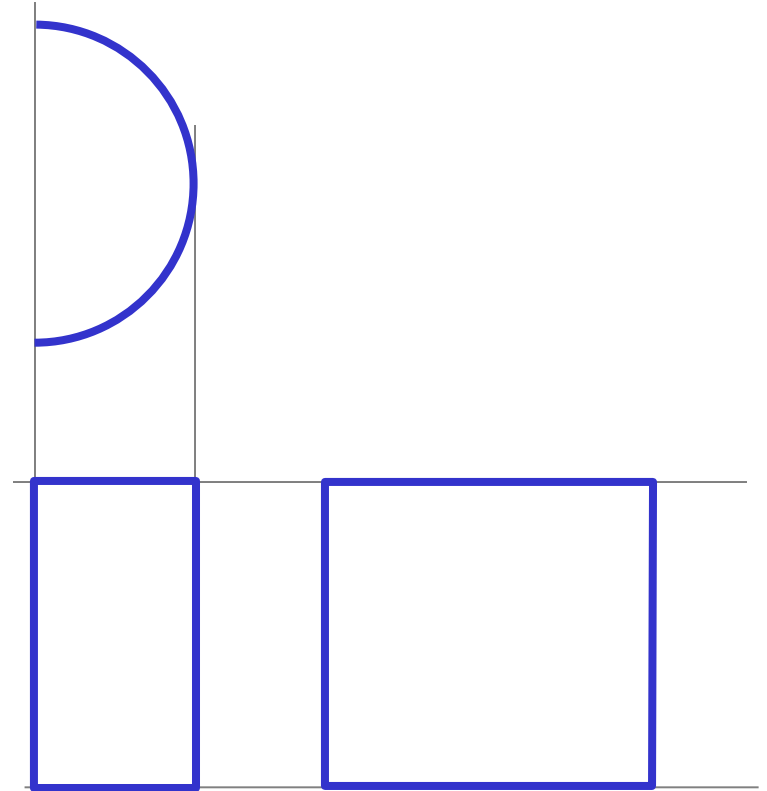
Play

Projection of a **curve surface**

Glass box
concept

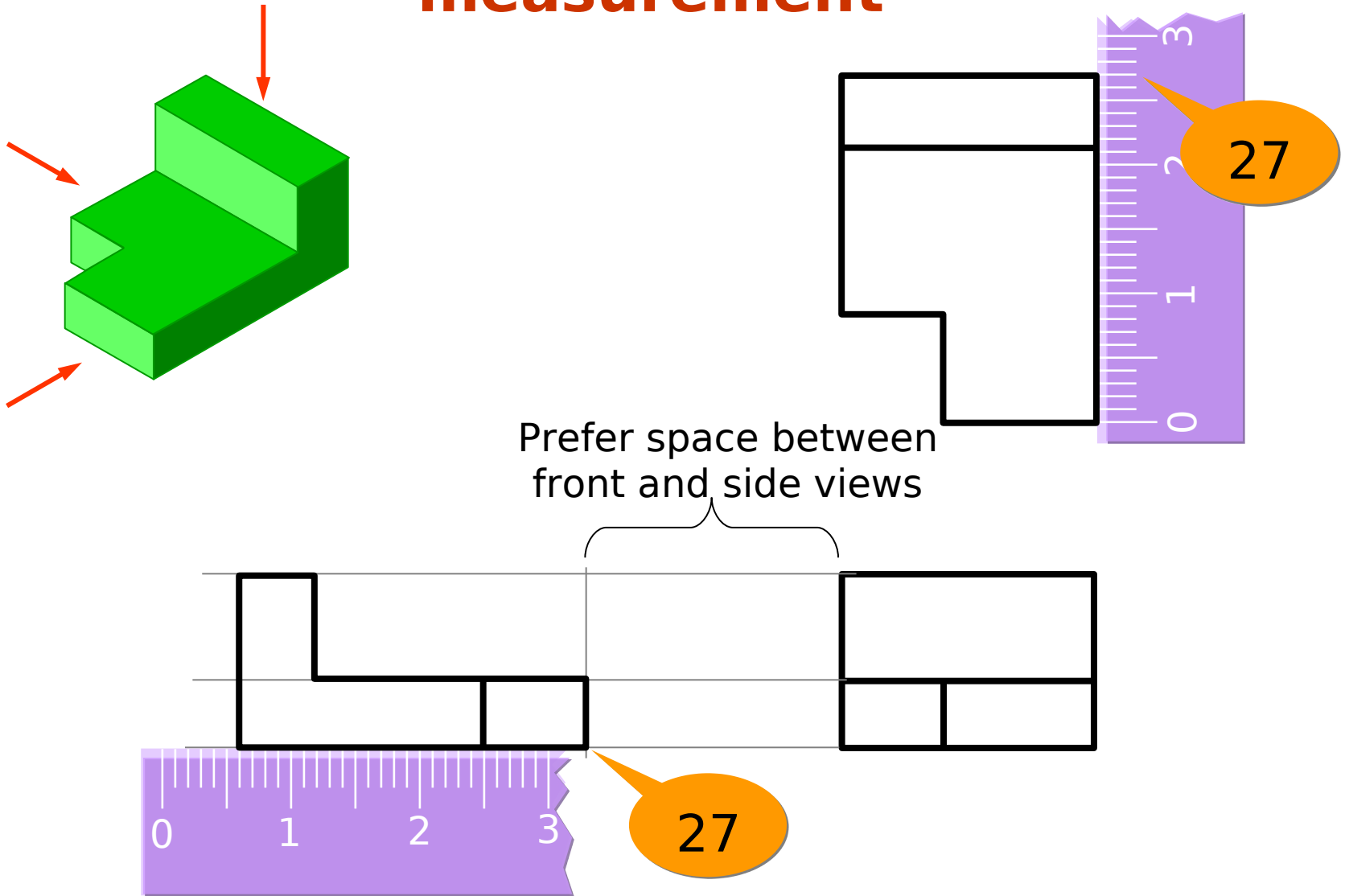


Multiview drawing

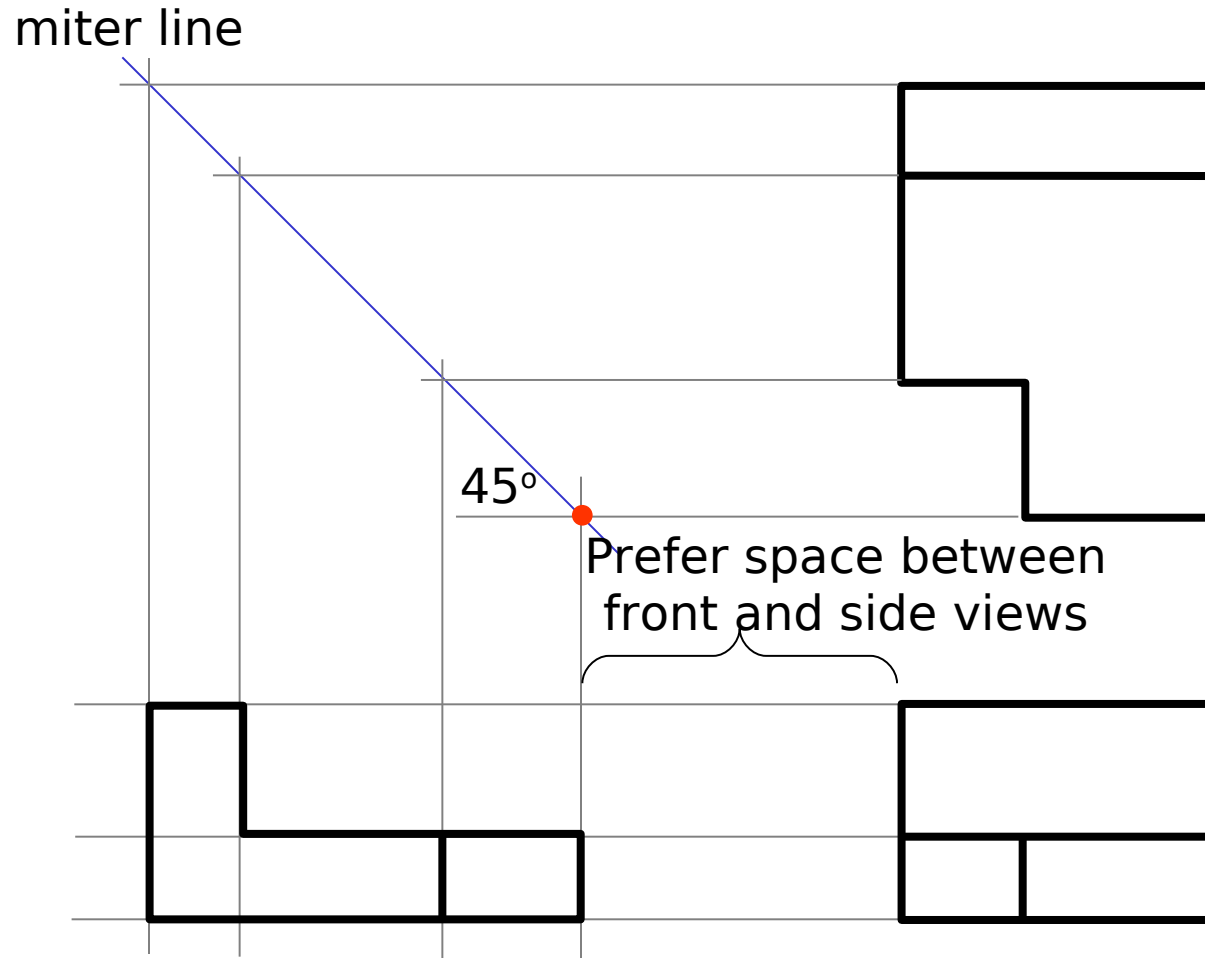


Play

Transferring a depth : **Direct measurement**

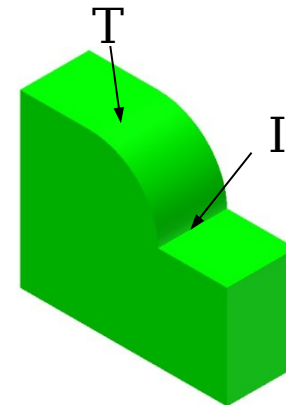
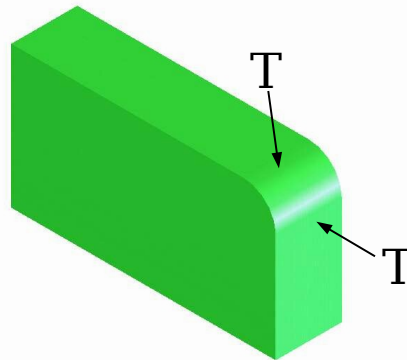
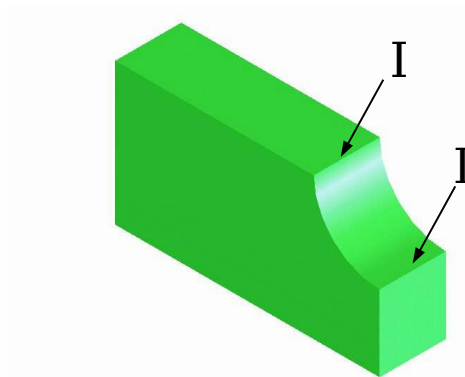


Transferring a depth : miter line



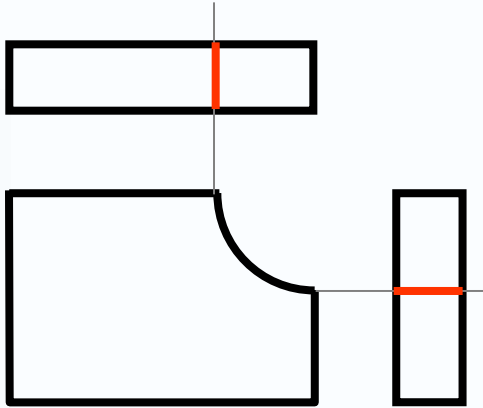
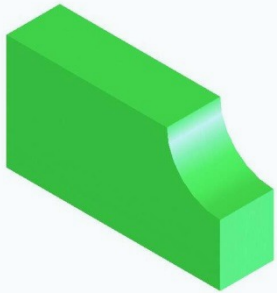
Projection of an **object** having curved surface and plane

- Curved surface can either **tangent** or **intersect** with an adjacent plane or curve surface.
- In the case of **intersection**, an **edge** exists and becomes a line in a multiview drawing
- In the case of **tangential**, there is **no edge** and **line** in a multiview drawing



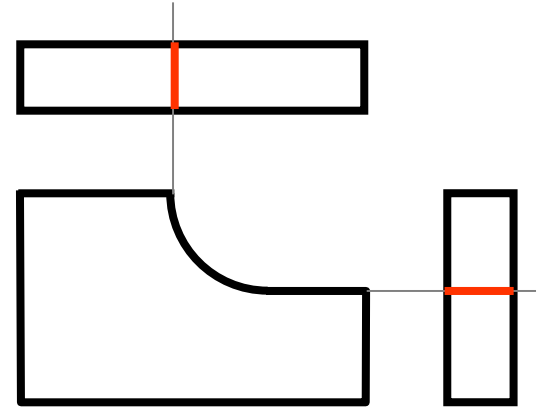
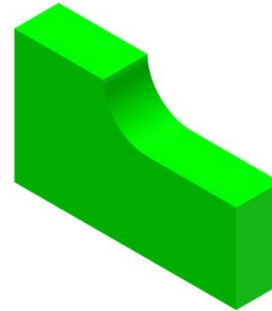
Examples

1



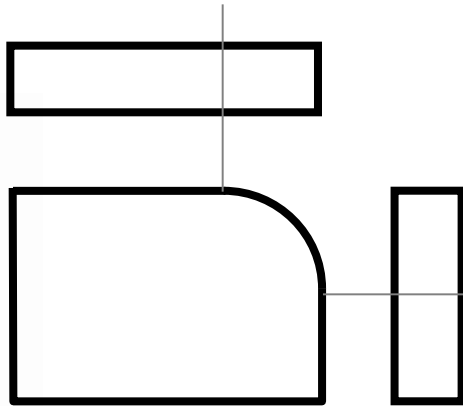
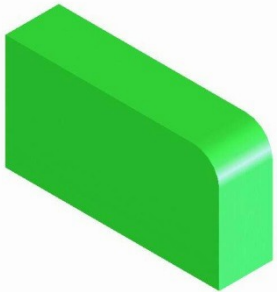
Play

2



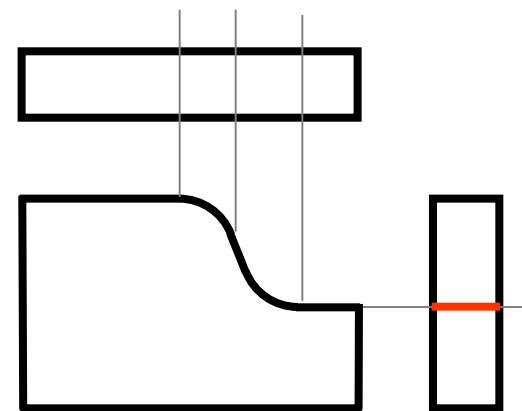
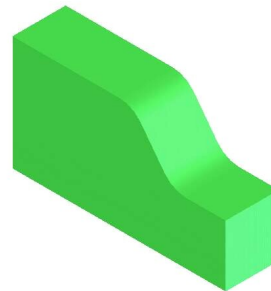
Play

3



Play

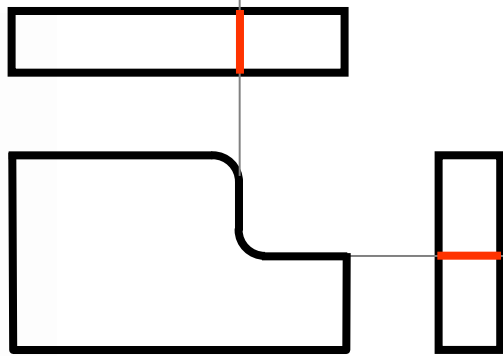
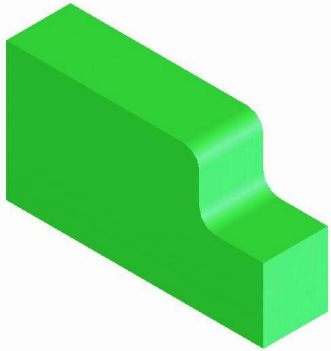
4



Play

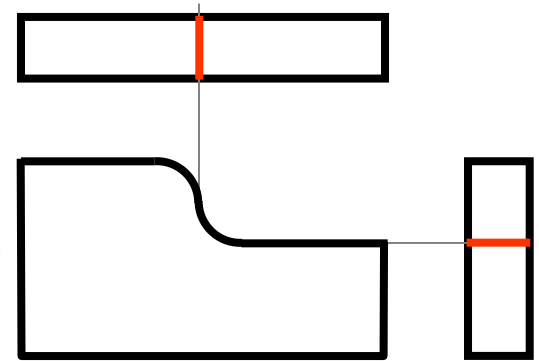
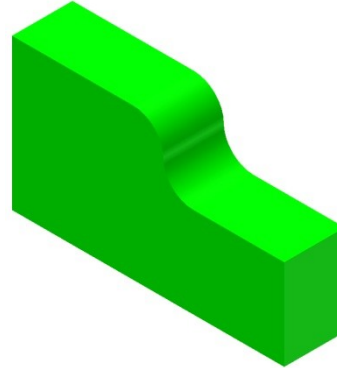
Examples

5



Play

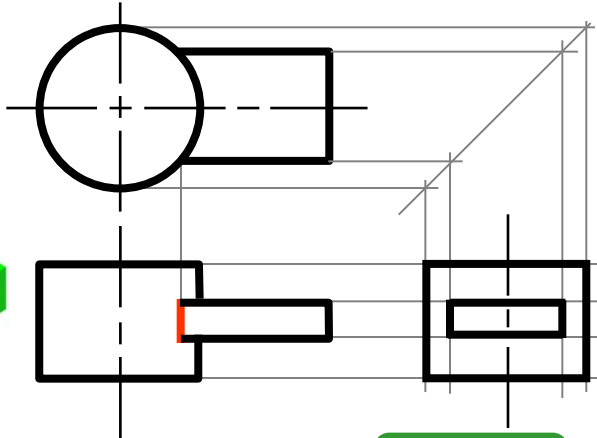
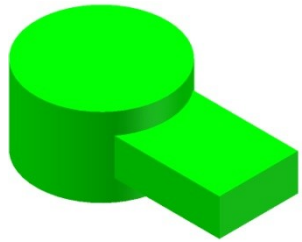
6



Play

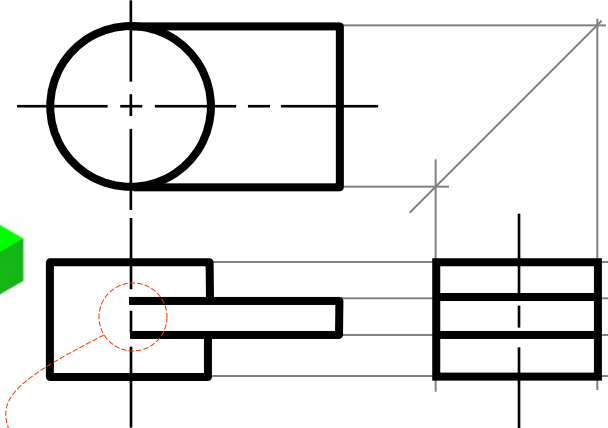
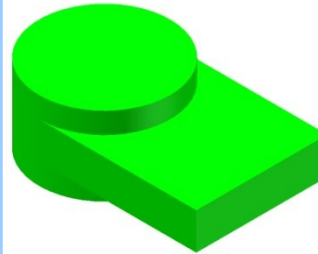
Examples

7



Play

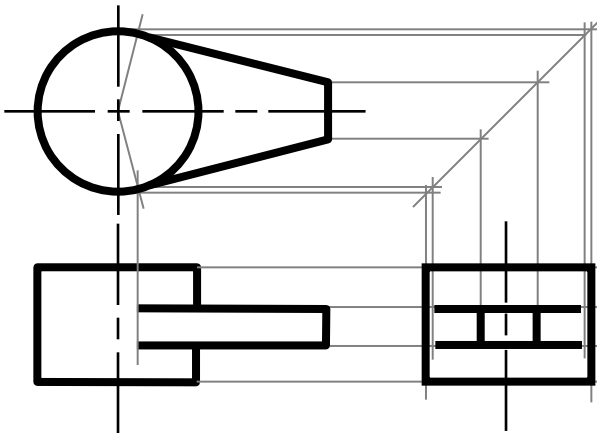
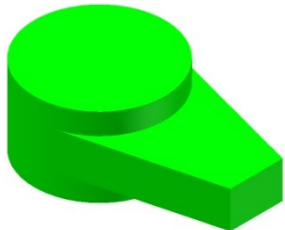
8



No line exists

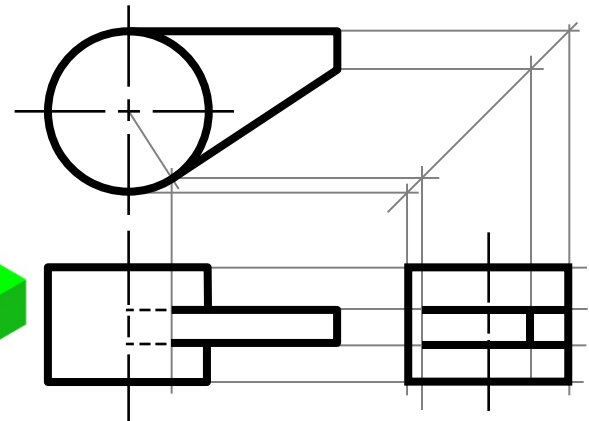
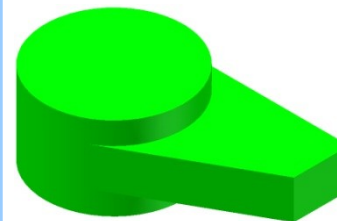
Play

9



Play

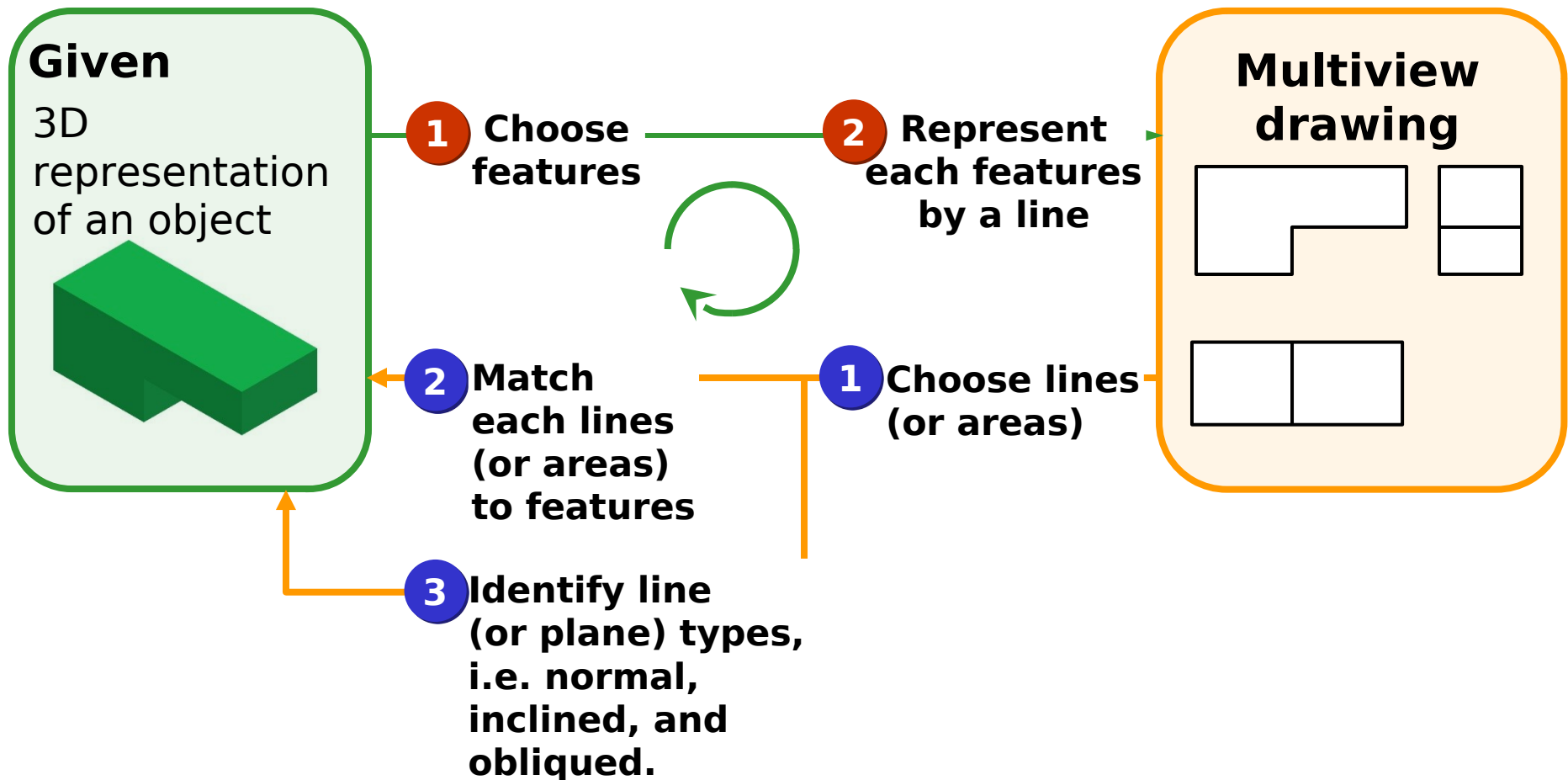
10



Play

Suggestion for practicing 1

Try to relate the object's features to the lines in a multiview drawing, i.e. interpret the meaning of lines.

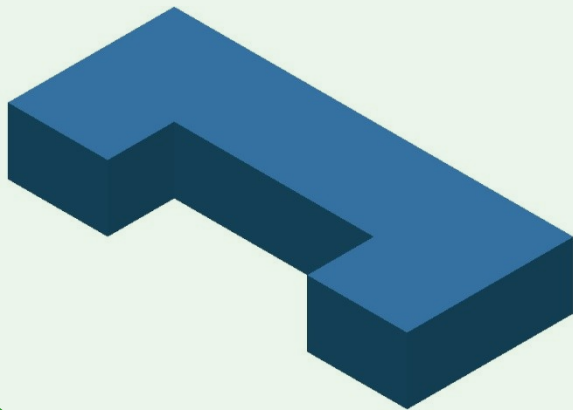


Suggestion for practicing 2

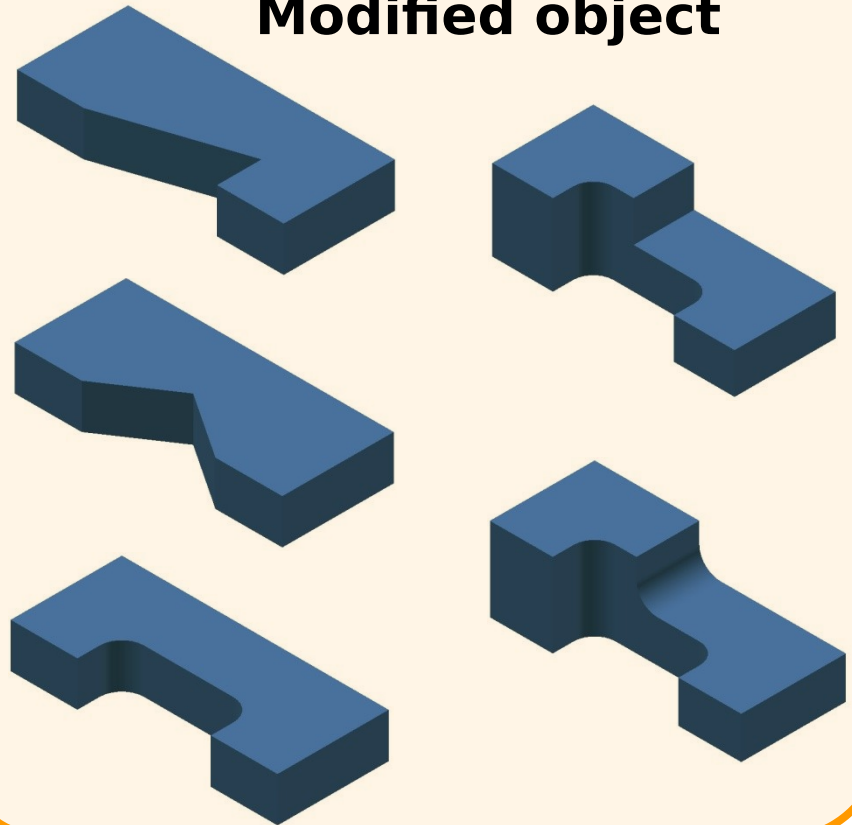
Modify the object's features of a given object, then observe what's changed on a multiview drawing.

Given

3D representation of a simple object



Modified object



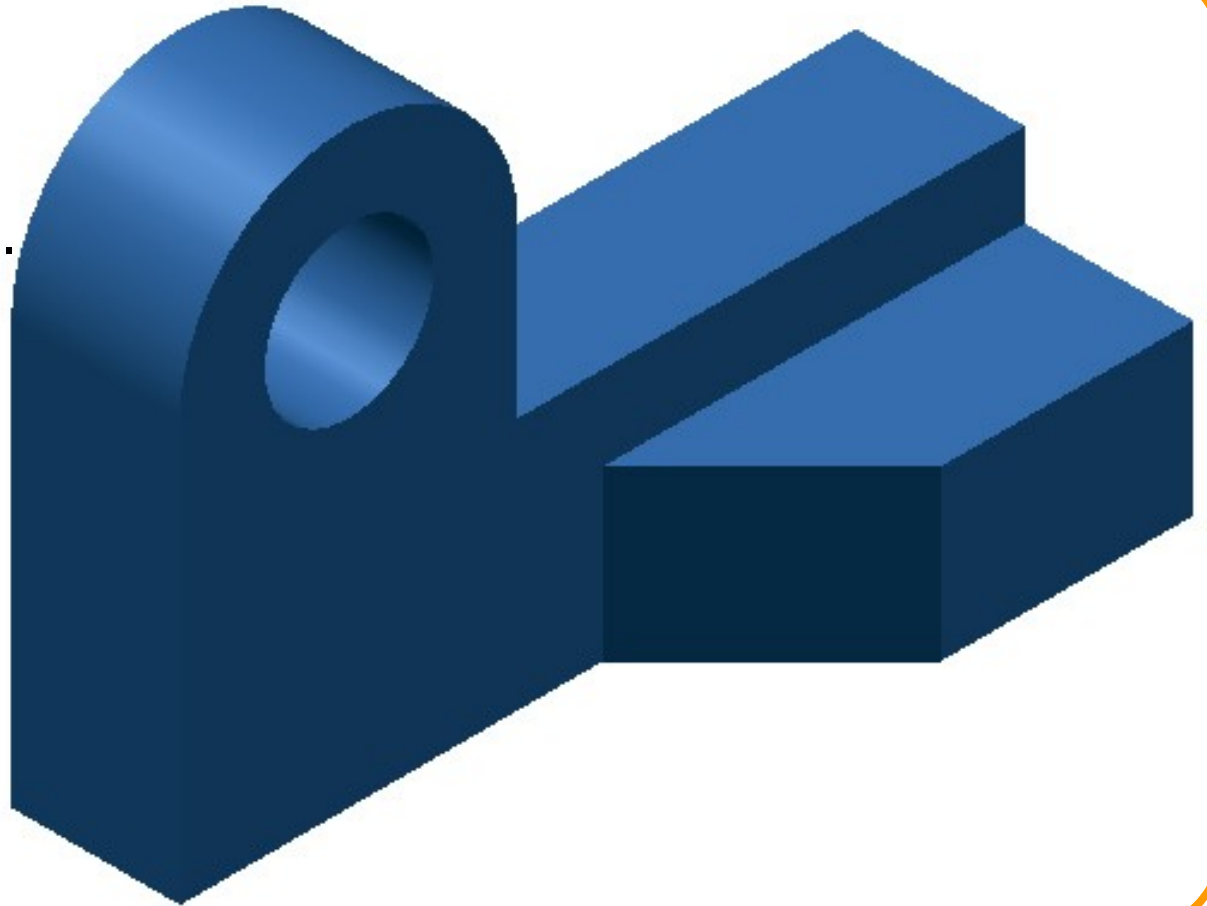
Self study : Type of planes

Click on any
area
of a given object.
You will get the
type of plane.

Normal plane

Inclined plane

Curve surface



Skip



Line convention

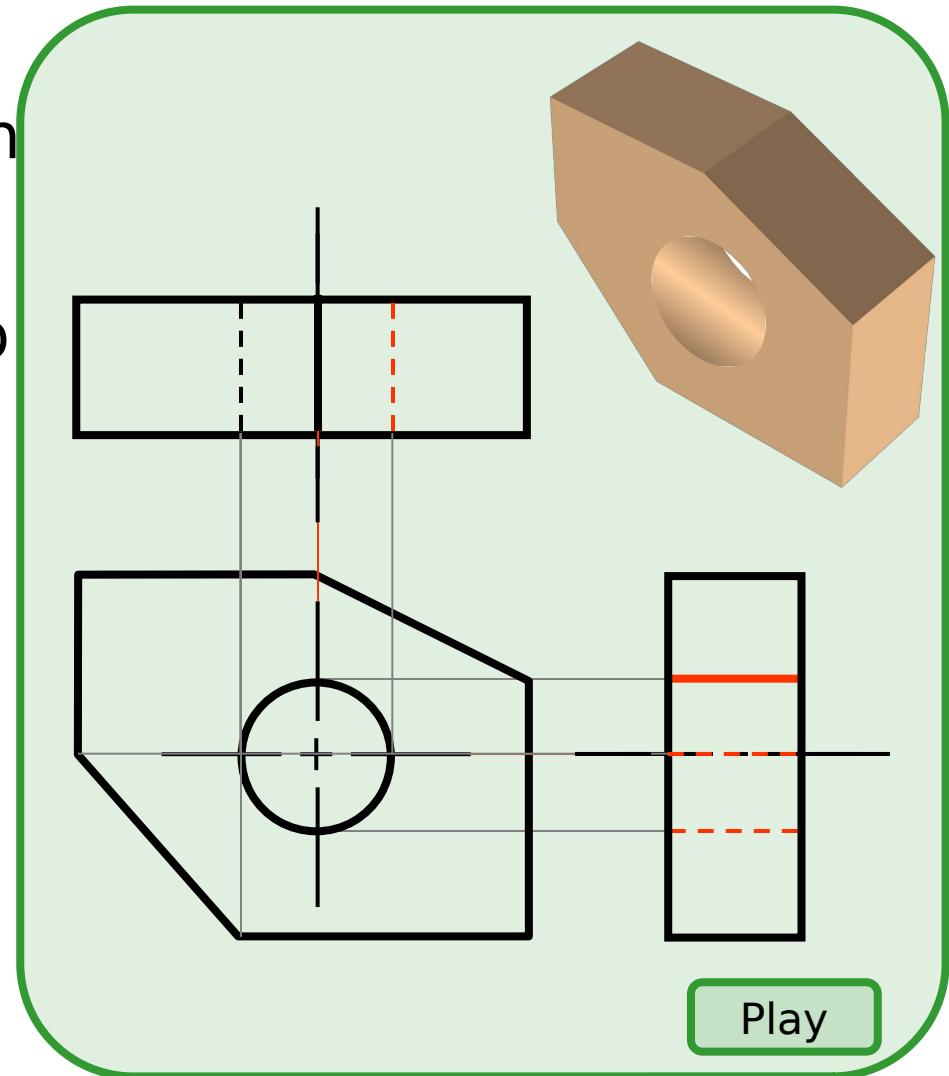
[Contents](#)

Line convention

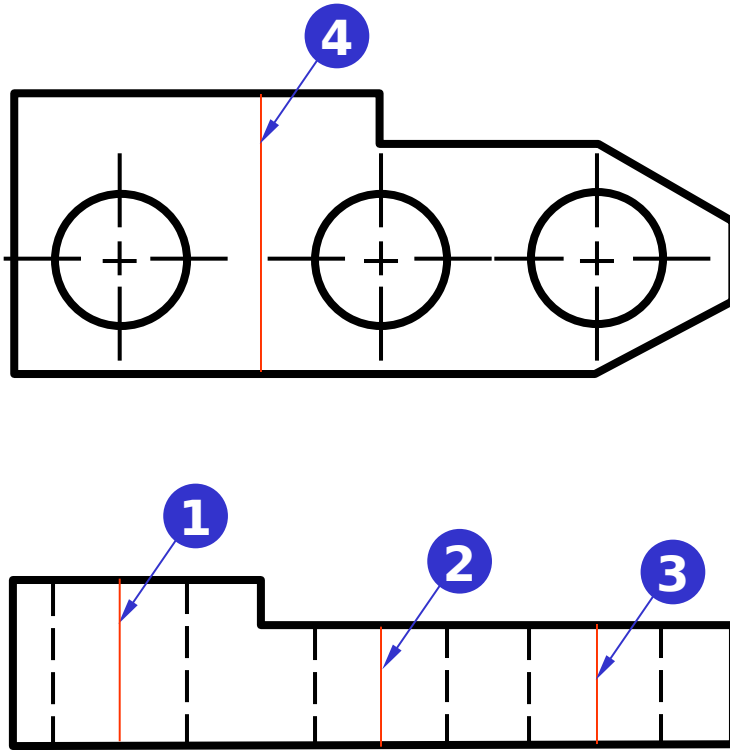
- Precedence of coincide lines
- Hidden line drawing
- Center line drawing

Precedence of line

- When lines coincide with each other, the more important lines cover up the other lines.
- Order of importance (highest to lowest)
 - visible line
 - hidden line
 - center line
 - construction line.



Class activity : Precedence of lines



What is an appropriate line type to replace the lines NO. 1-4?

	V	H	C		
1	☐	☐	☐	✓	✗
2	☐	☐	☐	✓	✗
3	☐	☐	☐	✓	✗
4	☐	☐	☐	✓	✗

“V” denotes visible line

“H” denotes hidden line

“C” denotes center line

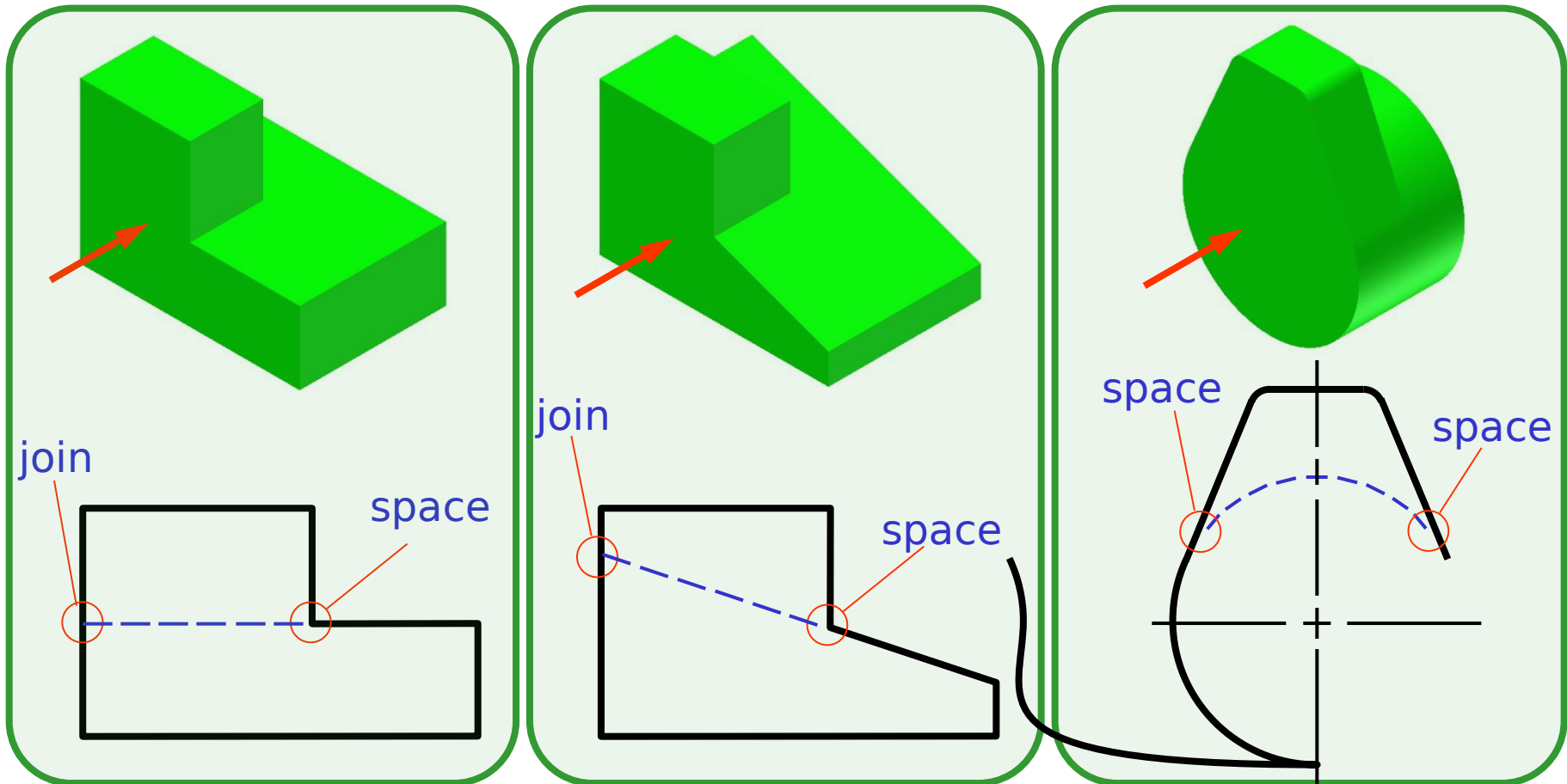
Reset all

Skip test

Next slide

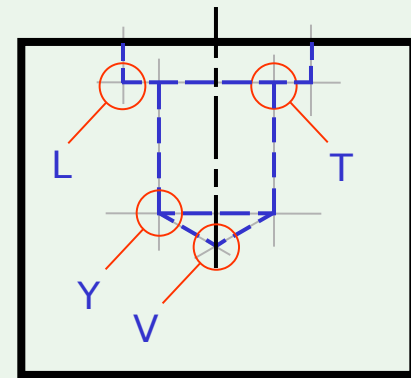
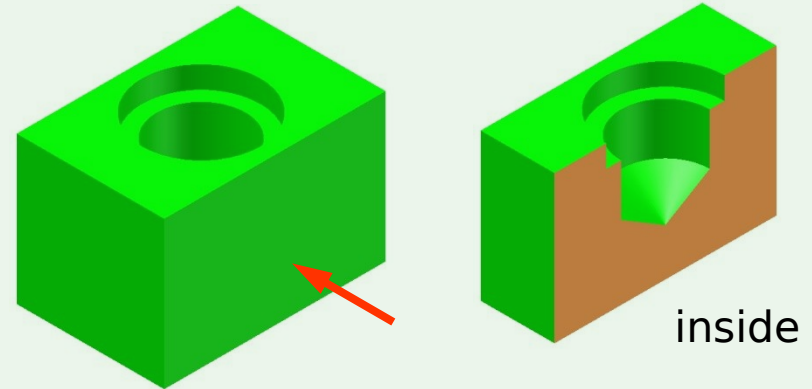
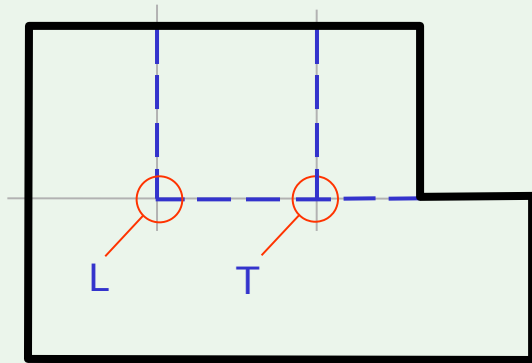
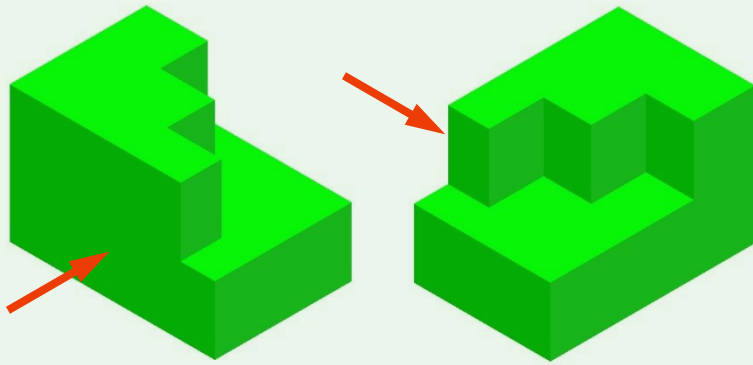
Hidden line drawing

- Hidden line should **join a visible line**, **except** it extends from a visible line.



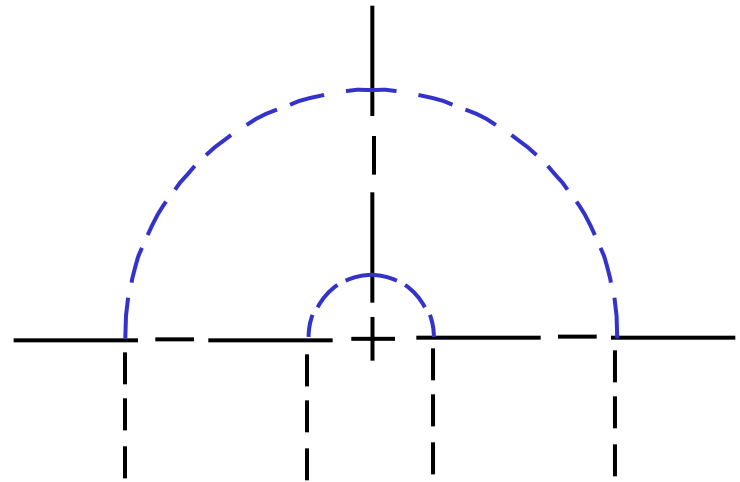
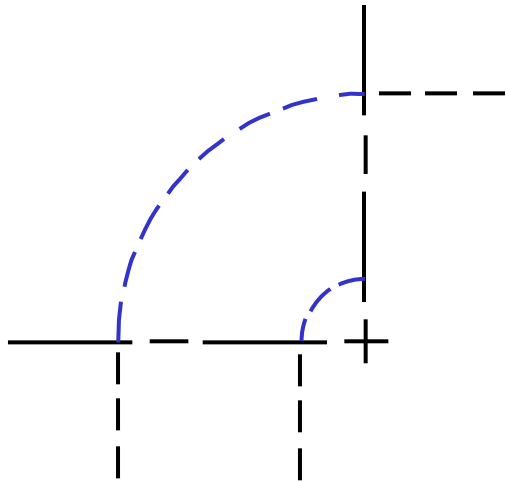
Hidden line drawing

- Intersection between hidden lines should form L, T, V or Y corner.



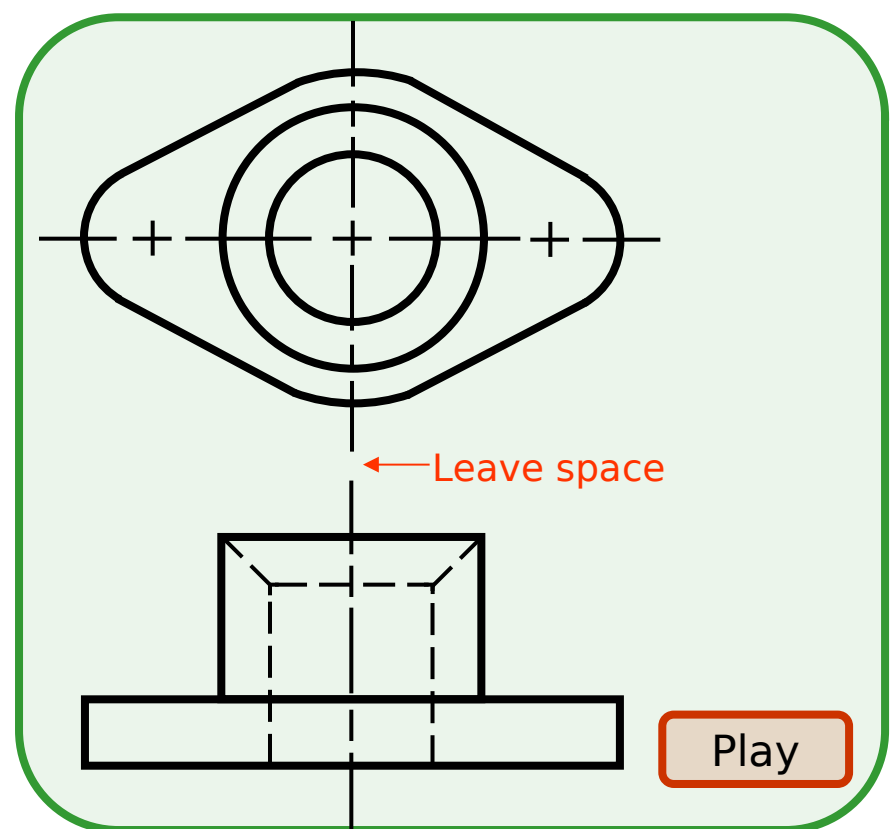
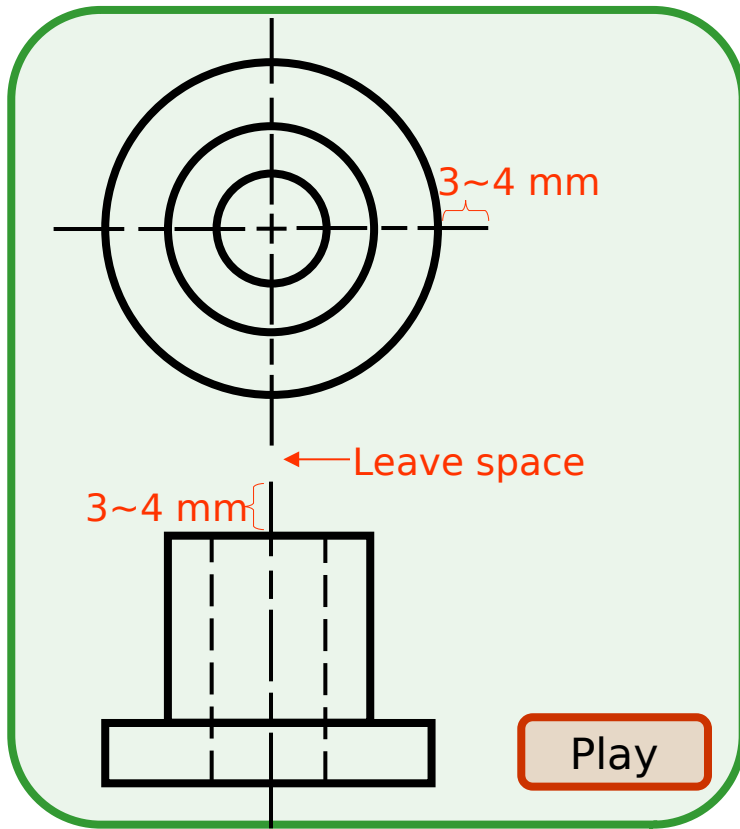
Hidden line drawing

■ A curve hidden line should start on a center line.



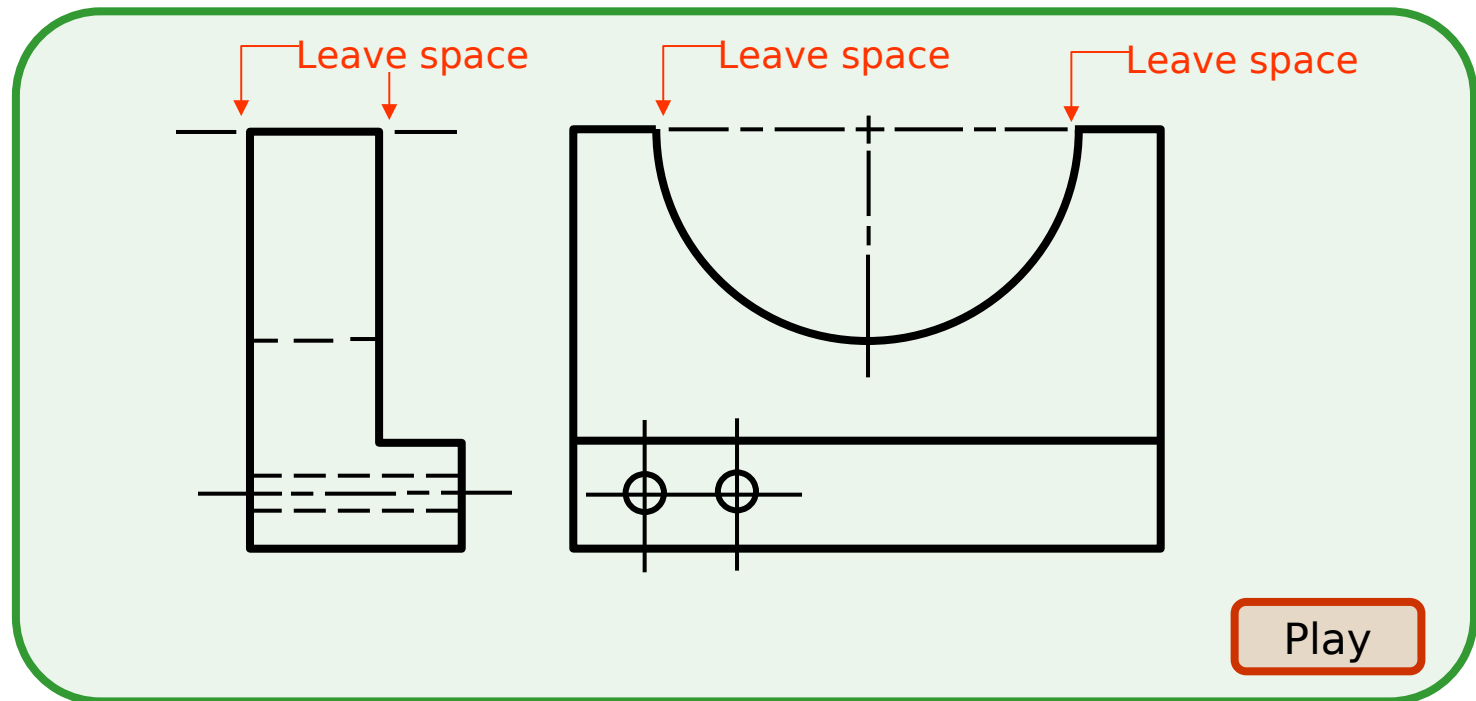
Center line drawing

- Center line should always **start** and **end** with **long dash**
- In a circular view, **short dash** of a center line should cross at the center of the circle or arc.
- Center line should **not** extend between views.

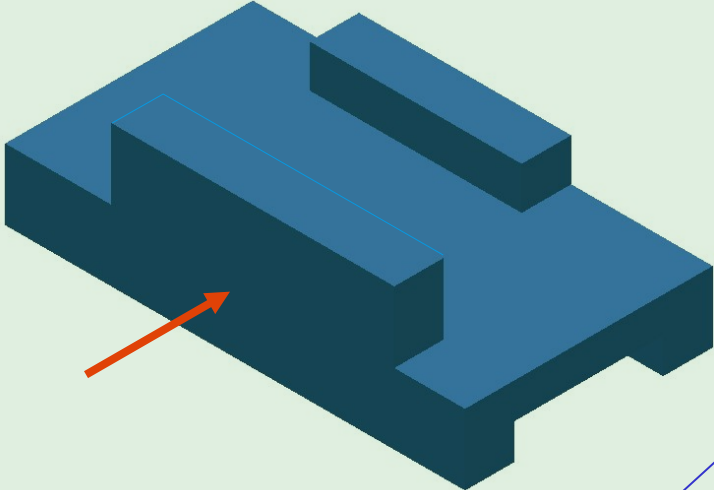


Center line drawing

- For a small hole, a center line is presented as a thin continuous line.
- Leave a gap when centerline forms a continuation with a visible or a hidden line.

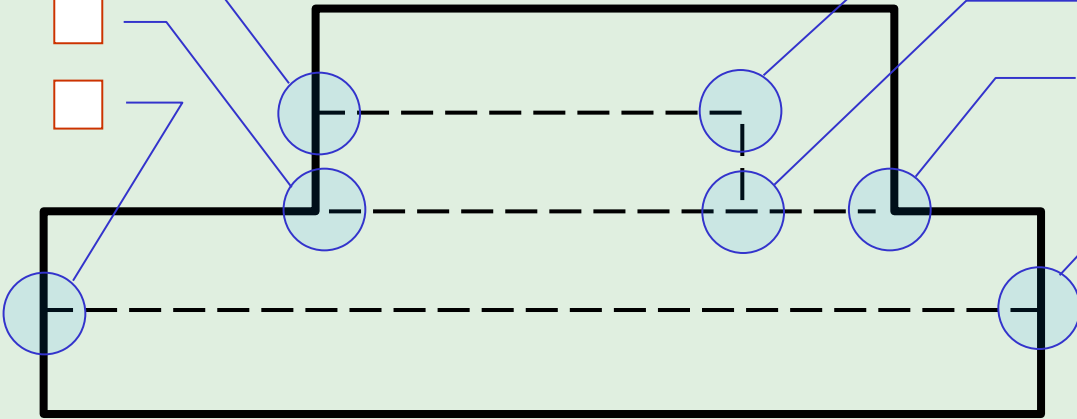


Class activity : Hidden line drawing



correctwrong

✓	✗	☐	☐
✓	✗	☐	☐
✓	✗	☐	☐



correctwrong

☐	☐	✓	✗
☐	☐	✓	✗
☐	☐	✓	✗
☐	☐	✓	✗

Reset all

Skip test

Next slide