



**Addis Ababa University
Addis Ababa Institute of Technology
School of Mechanical & Industrial Engineering**

Engineering Drawing (MEng 2061)

Chapter Two

Theory of Projection

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April, 2021**

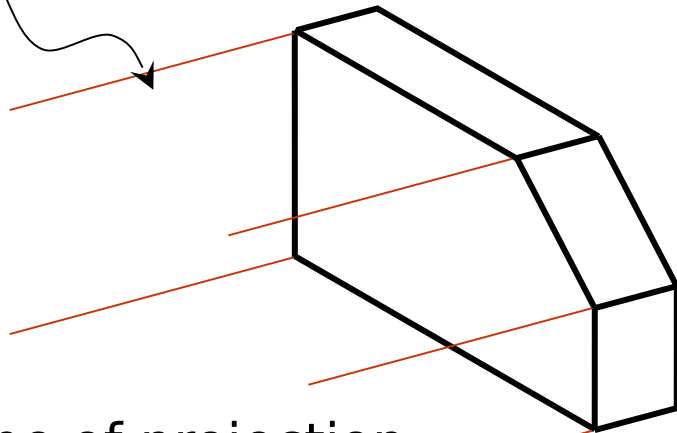
Projection Theory

- The projection theory is used to graphically represent 3D objects on 2D media (paper, computer screen).
- **Projection** is the image of an object drawn on a **plane of projection** as it would appear to the **observer** stationed at a **point** and viewing along the direction of **line of projection**.
- **lines of projection** are an **imaginary lines** that emerges from observer's eyes and moves to contour of an object.

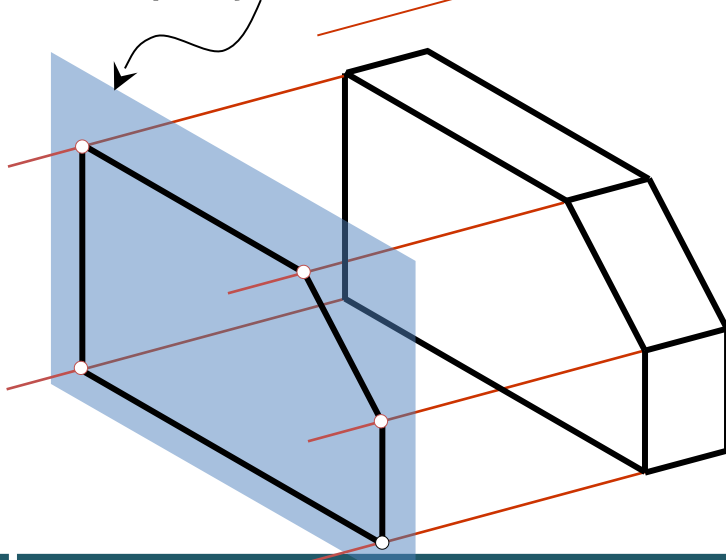
Projection Theory

Parallel projection

lines of projection

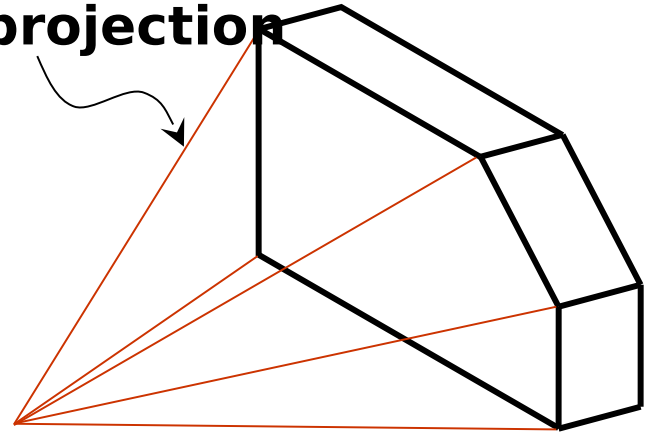


Plane of projection

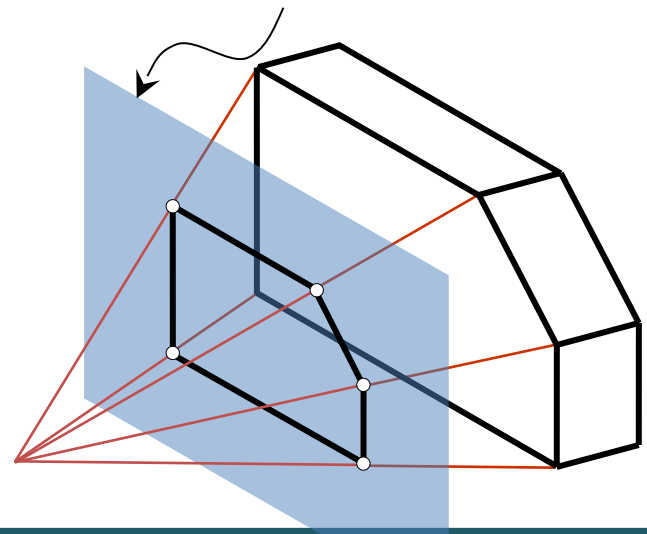


Perspective projection

lines of projection



Plane of projection



Projection Theory

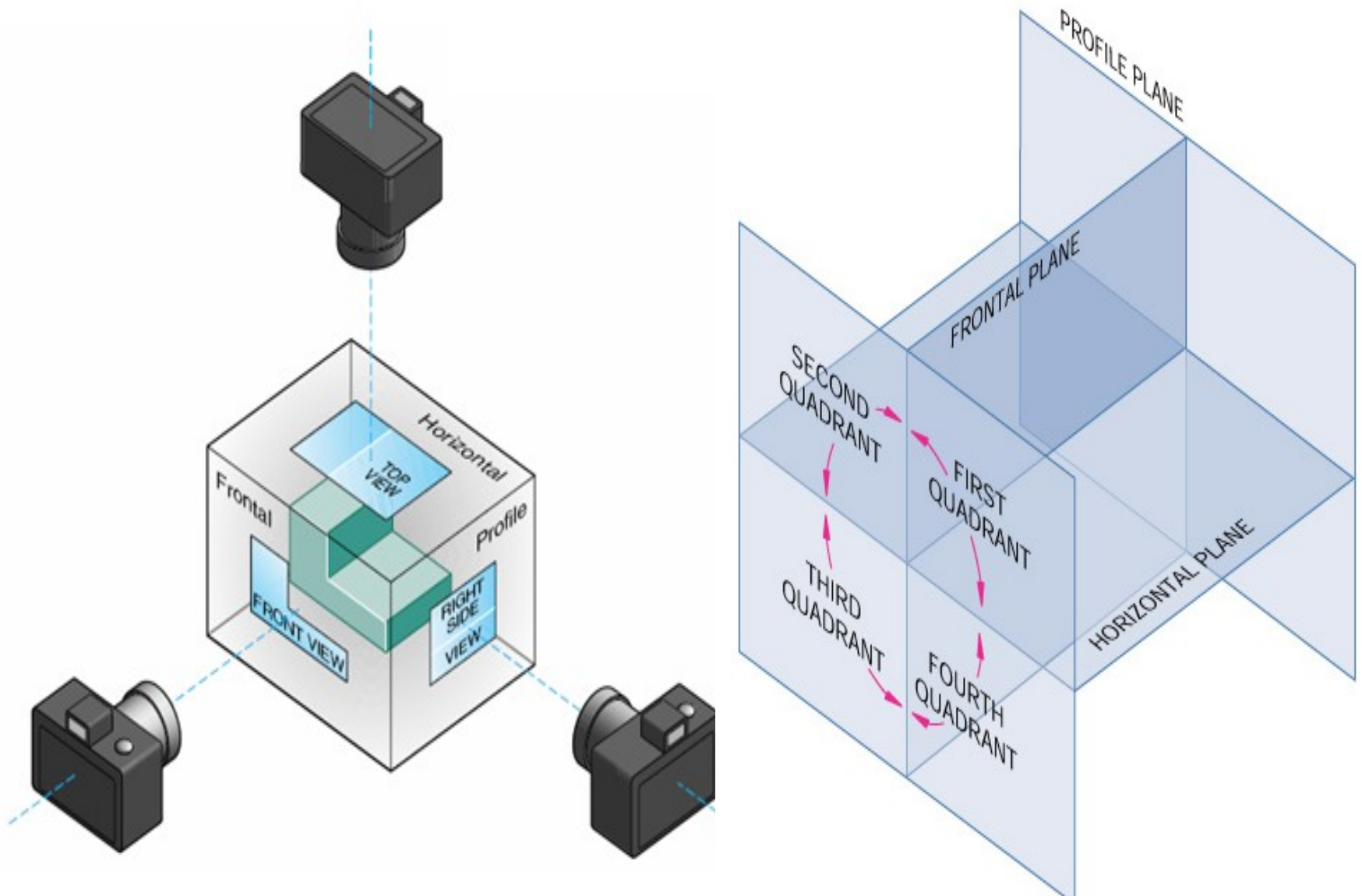
Station point is the location of an observer.

Plane of projection / picture plane are an **imaginary plane** on which the image of an object is represented / drawn.

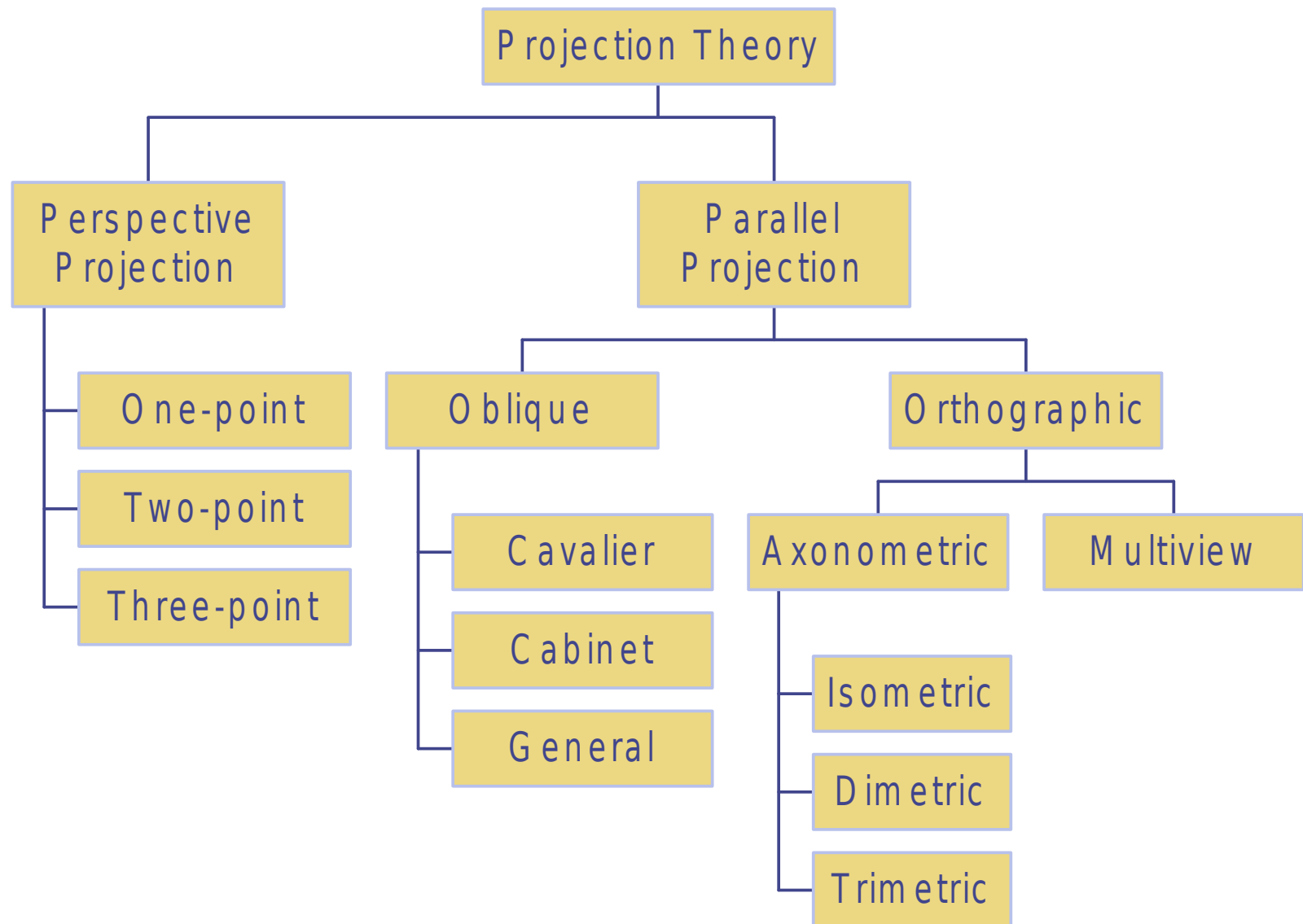
The plane on which principal view of an object is represented / drawn is called **principal plane**.

The three principal planes are **vertical plane** used to represent **front / rear** view; **horizontal plane** used to represent **top / bottom** view; and **profile plane** used to represent **right / left side** view of an object.

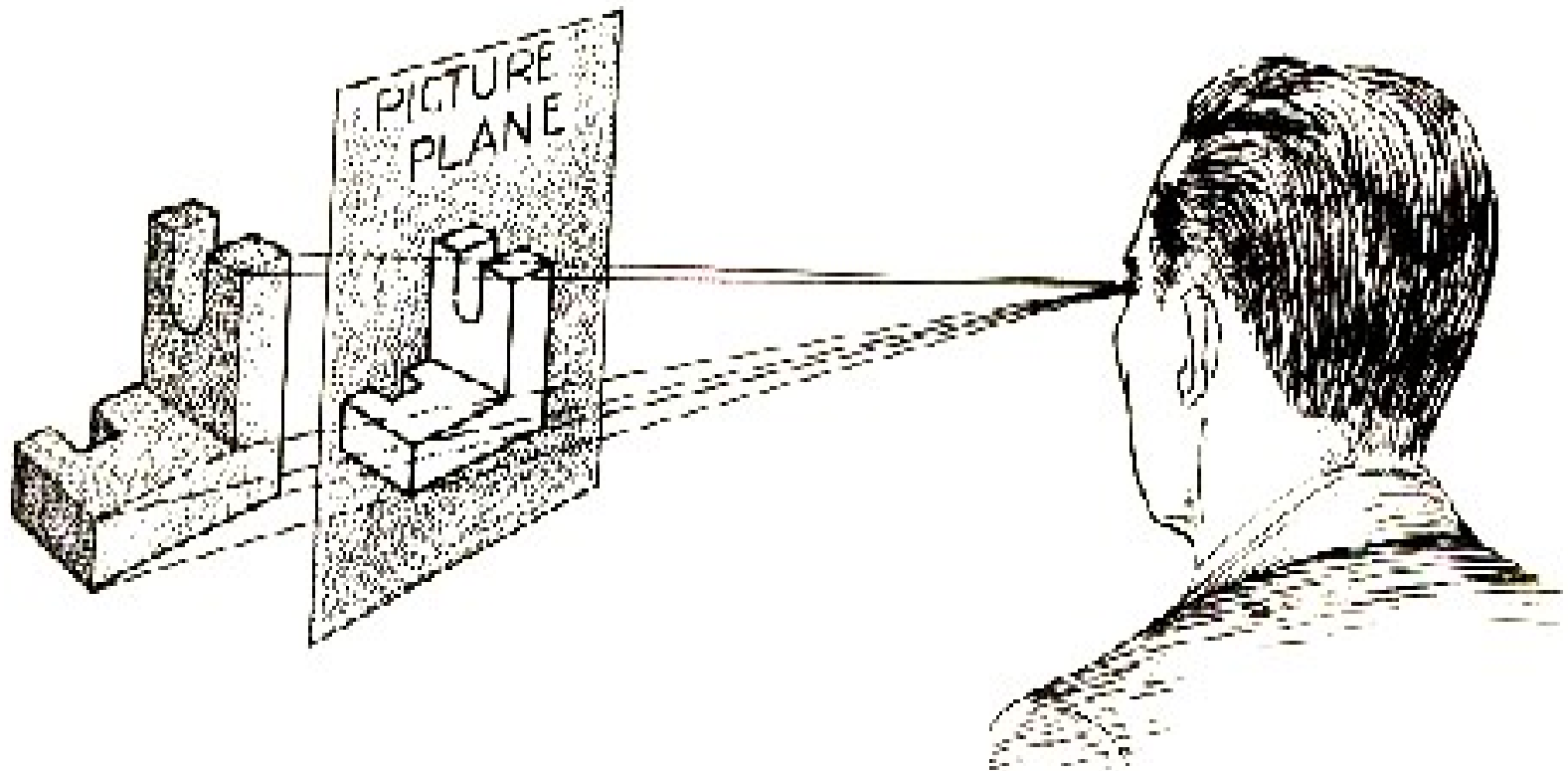
Projection Theory



Classification of Projections



Perspective Projection



Perspective Projection

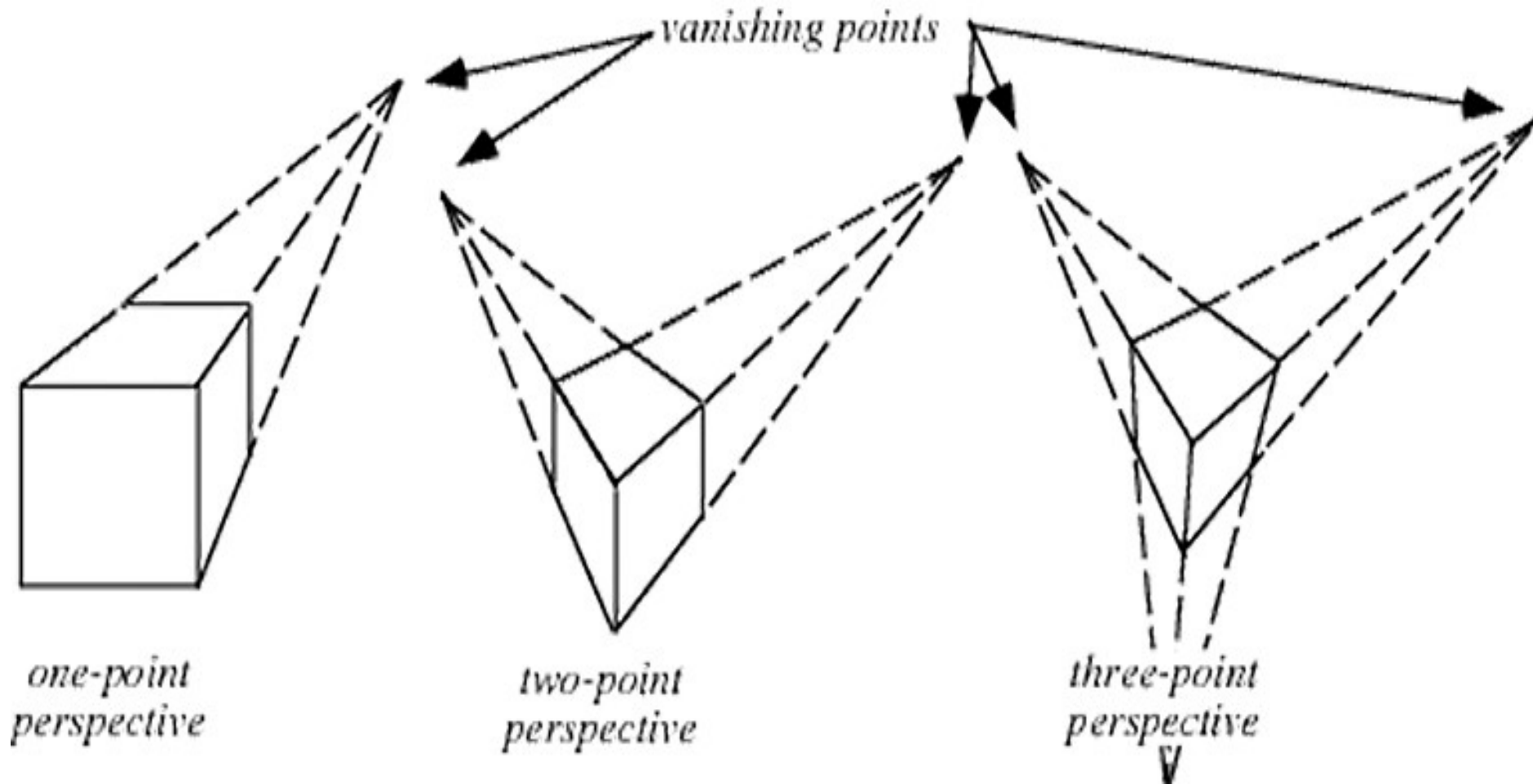
- A perspective drawing offers the most **realistic** three-dimensional view of all the pictorial methods, because it portrays the object in a manner that is most similar to how the human eye perceives the visual world.



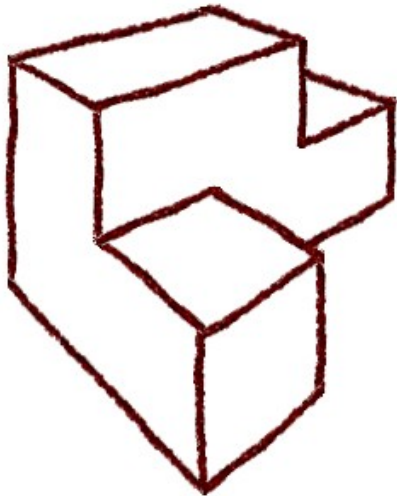
Perspective Projection

- The observer is placed at a **fixed** distance.
- The projectors would converge and meet at what is referred to as the **vanishing point (VP)**. It can have one, two or three vanishing points.
- The resulting view formed on the picture plane is of **different size** and **shape** as compared to the actual size of the actual object.
- **Not suitable** for working drawings.

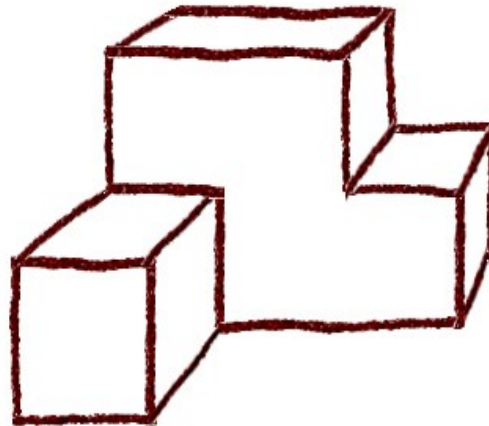
Types of Perspective Projection



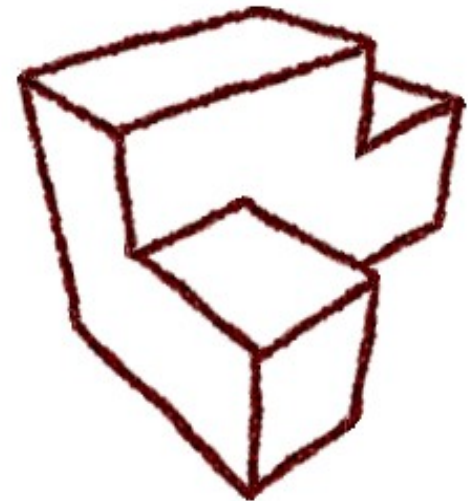
Perspective Drawing



**1-
Point**

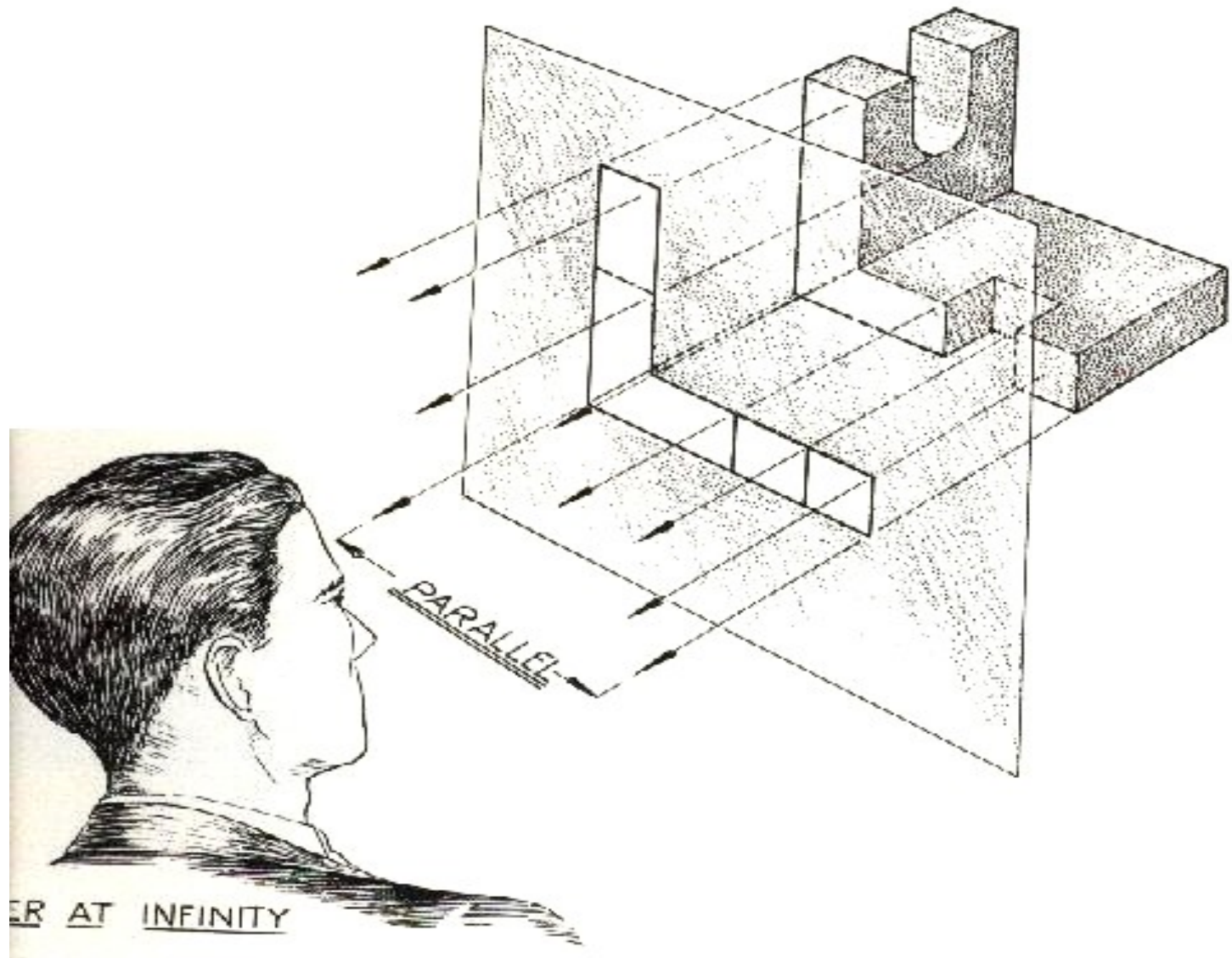


**2-
Point**



**3-
Point**

Parallel Projection



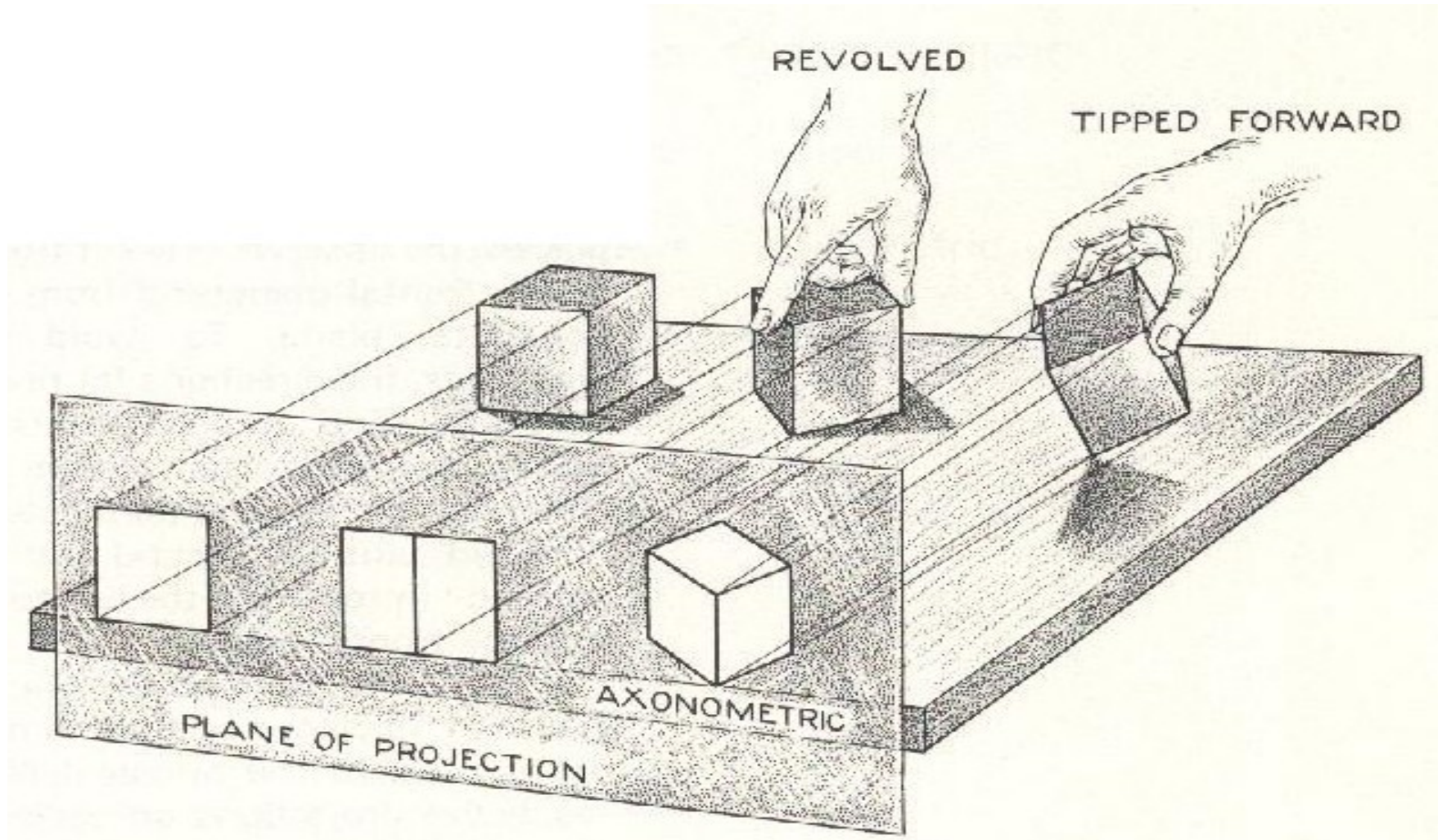
Parallel Projection

- The projectors are parallel and do not meet.
- The observer is placed at an **infinite distance** from the object.
- The view formed on the picture plane is of the **same size** and **shape** as that of the object.

Axonometric Projection

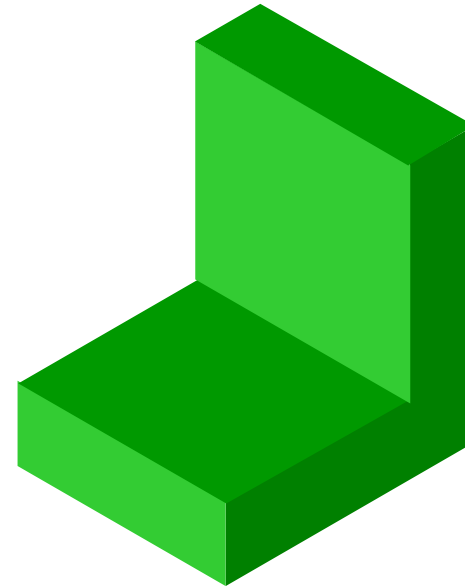
- If the object is **turned** and **tilted** so that the three faces are inclined to the plane of projection is a special type of orthographic projection known as **Axonometric** projection.
- Note that, the projectors from the object to the plane are perpendicular to the plane.

Axonometric Projection

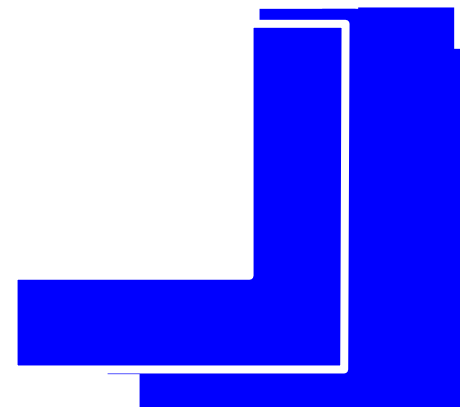




**Top
view**



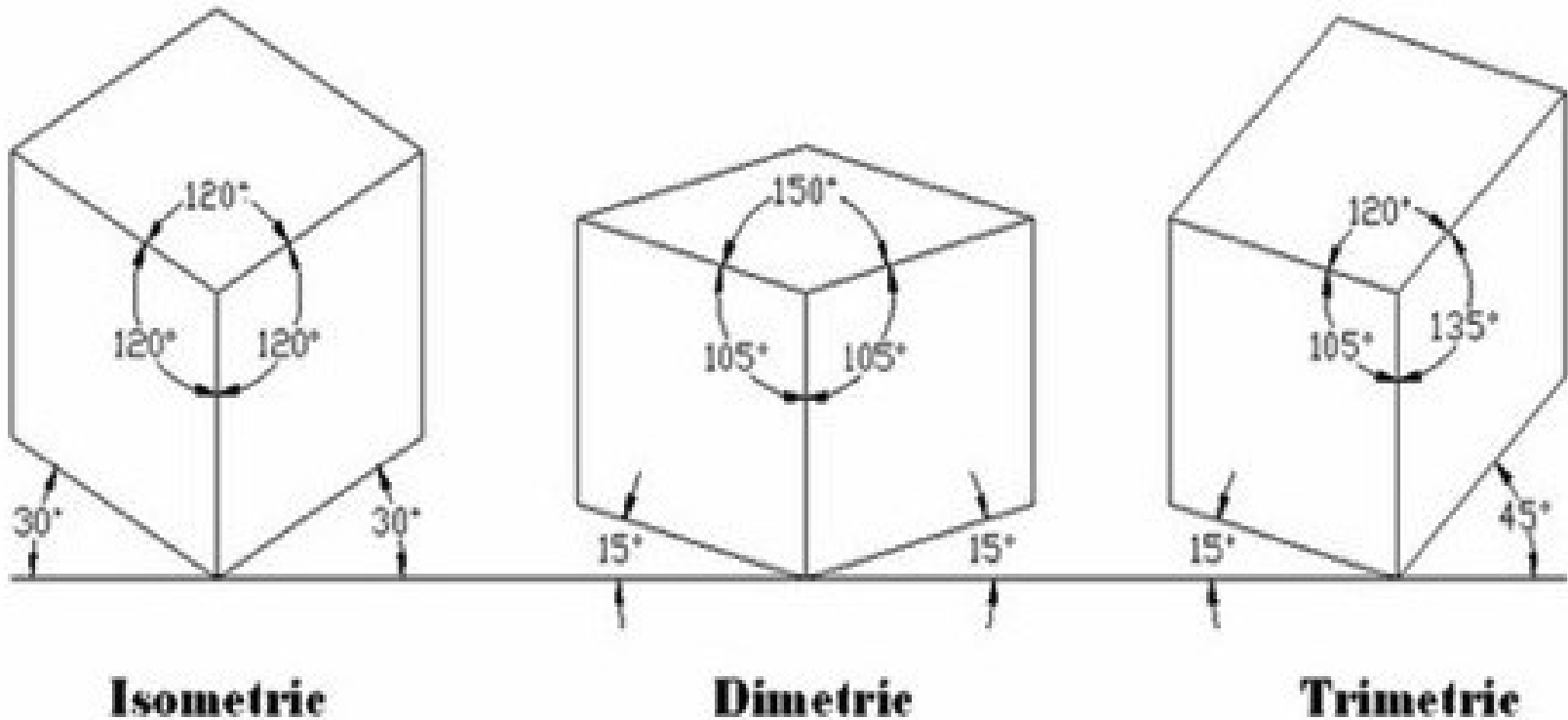
Front



Right side

Types of Axonometric Projection

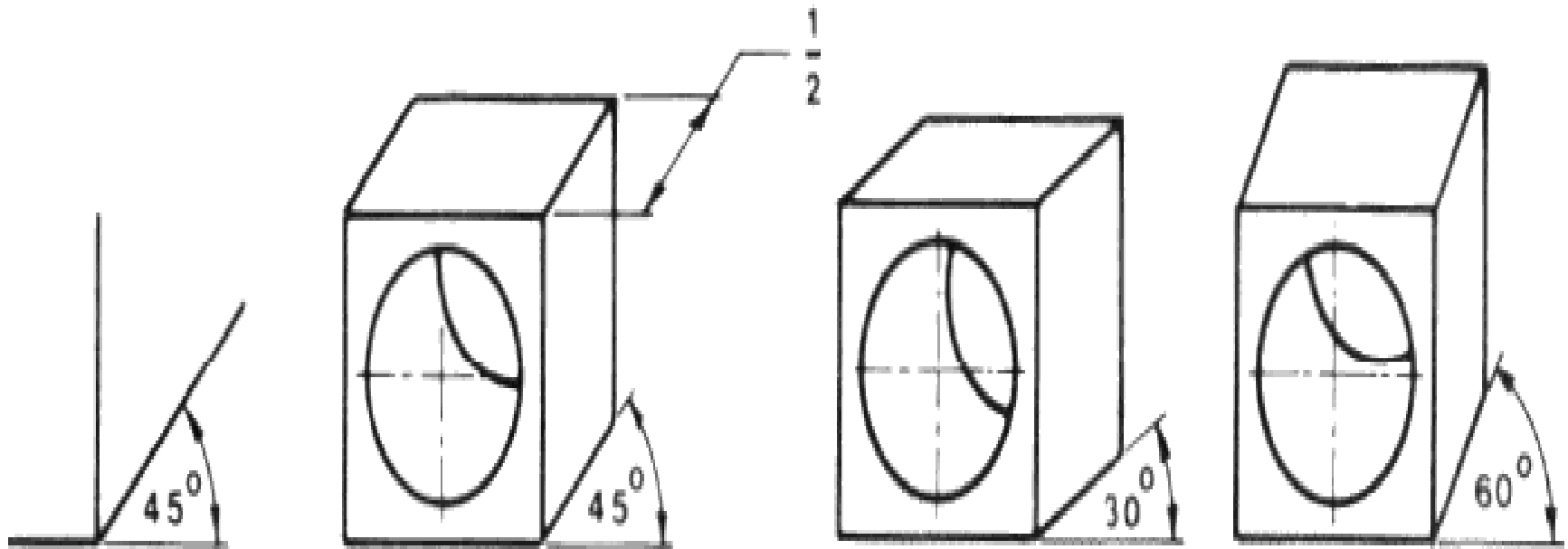
Axonometric Projections



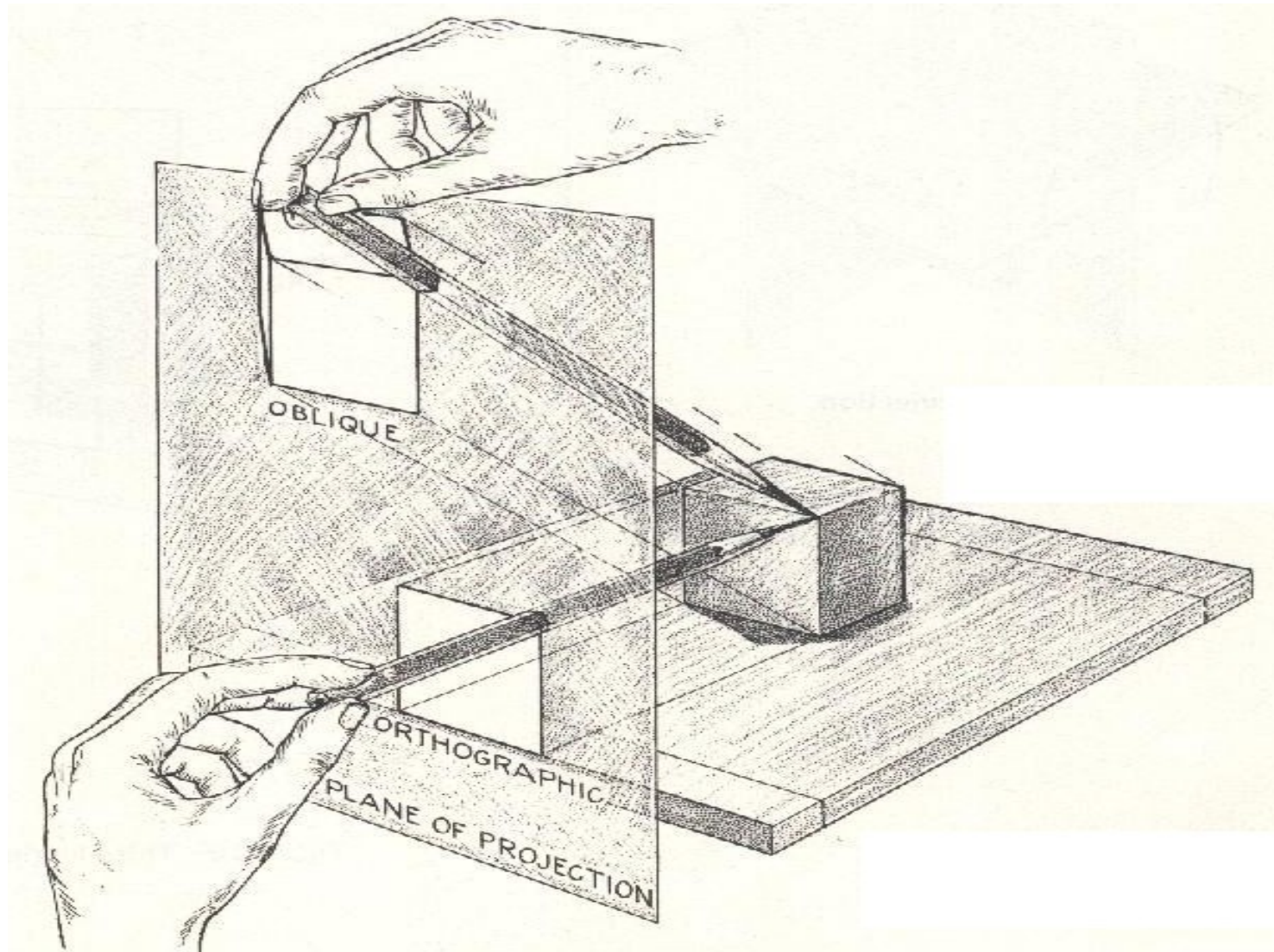
Oblique Projection

- This form differs from orthographic projection in that, although one face (front) is imagined parallel to the plane of projection, the projectors make an angle other than 90° .
- Front face sketched as a true shape. Starts with two axes, one horizontal, one vertical. The third axis is usually drawn at 45° , 30° and 60° .

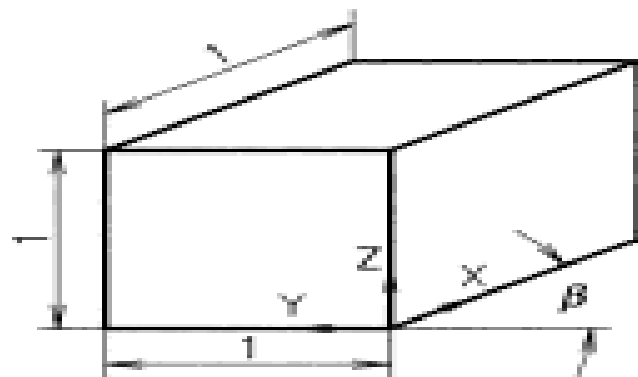
Oblique Projection



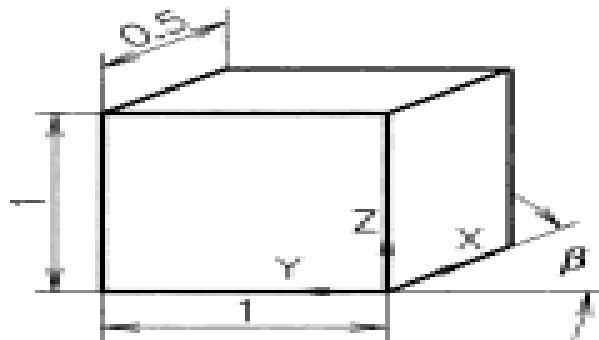
Oblique Projection



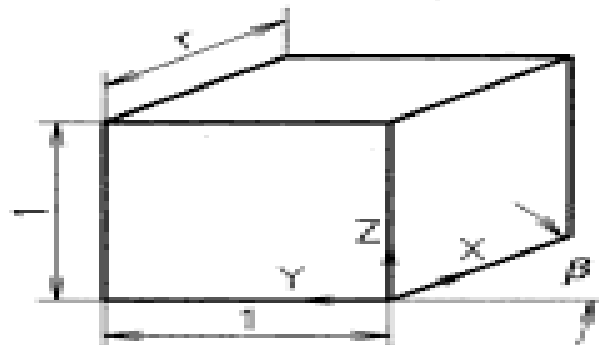
Types of Oblique Projection



(a) Cavalier, 1:1:1



(b) Cabinet, 1:1:0.5

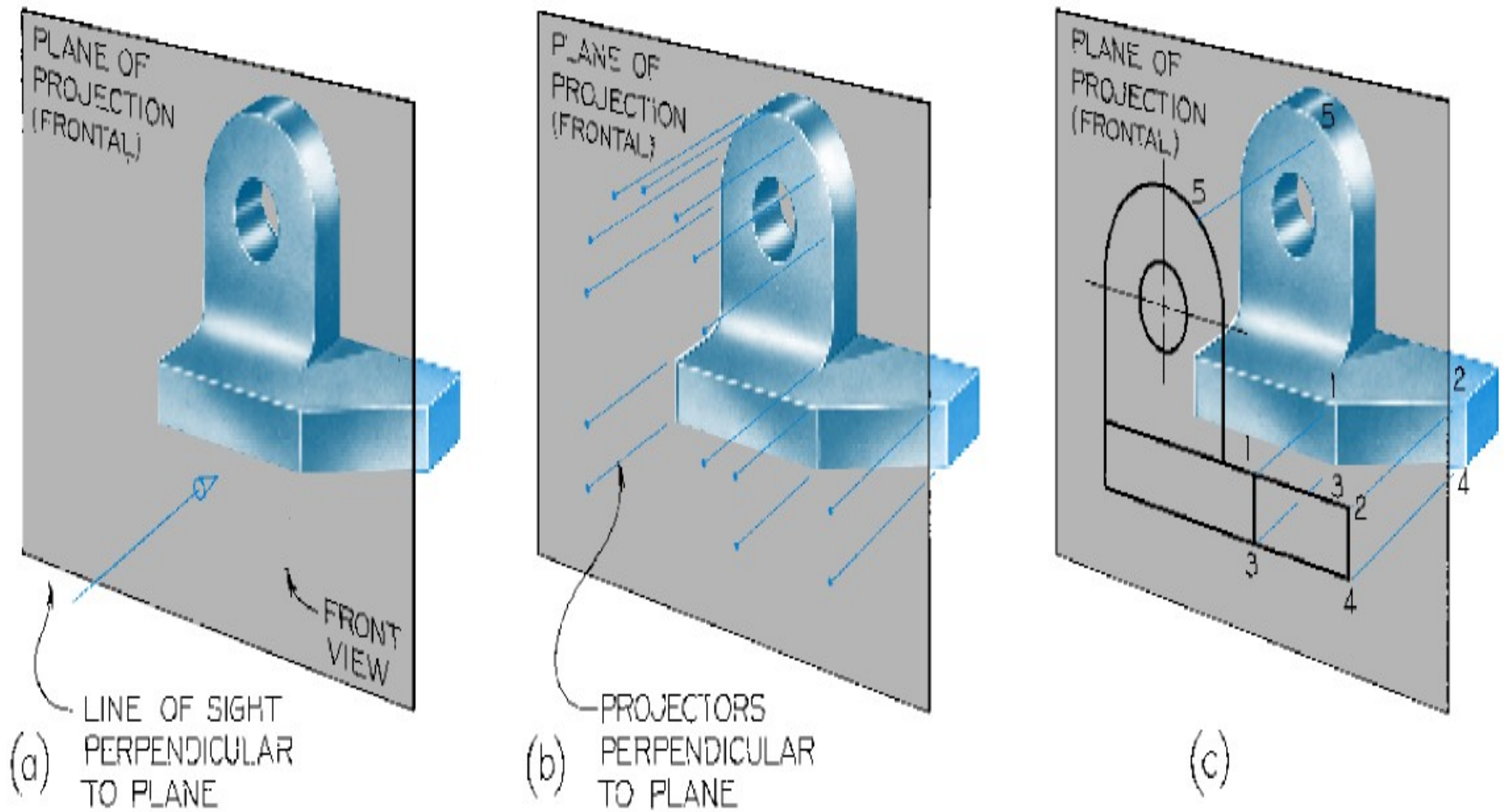


(c) General, 1:1:r ($r \neq 1$ or 0.5)

Orthographic Projection

- The word orthographic means to draw at right angles and is derived from the Greek words: **ORTHOS** - straight, rectangular, upright and **GRAPHOS** - written, drawn.
- Orthographic projection is a **parallel projection**. It is used as an unambiguous and accurate way of providing information, primarily for **manufacturing** and **detail design**.

Orthographic Projection

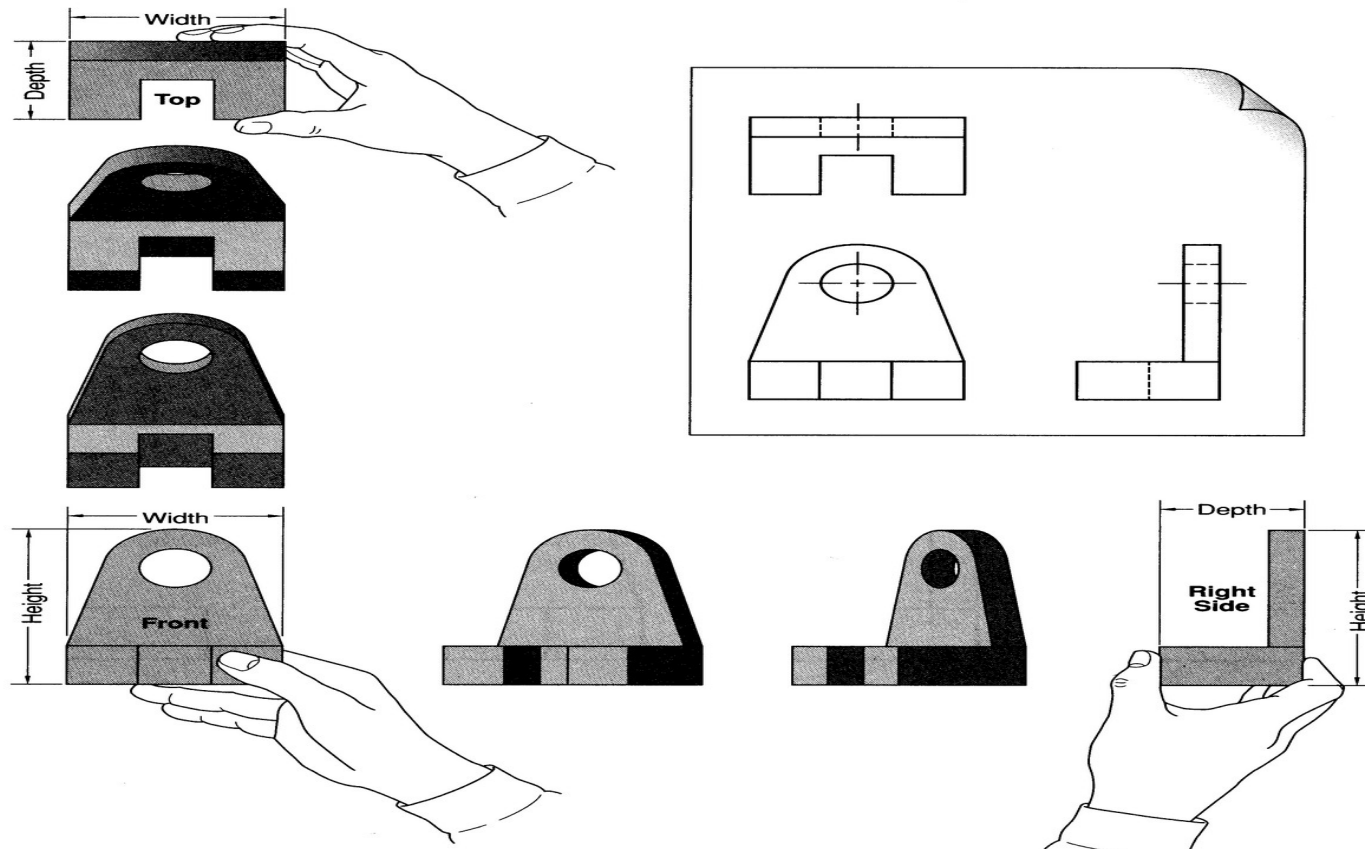


Orthographic Projection

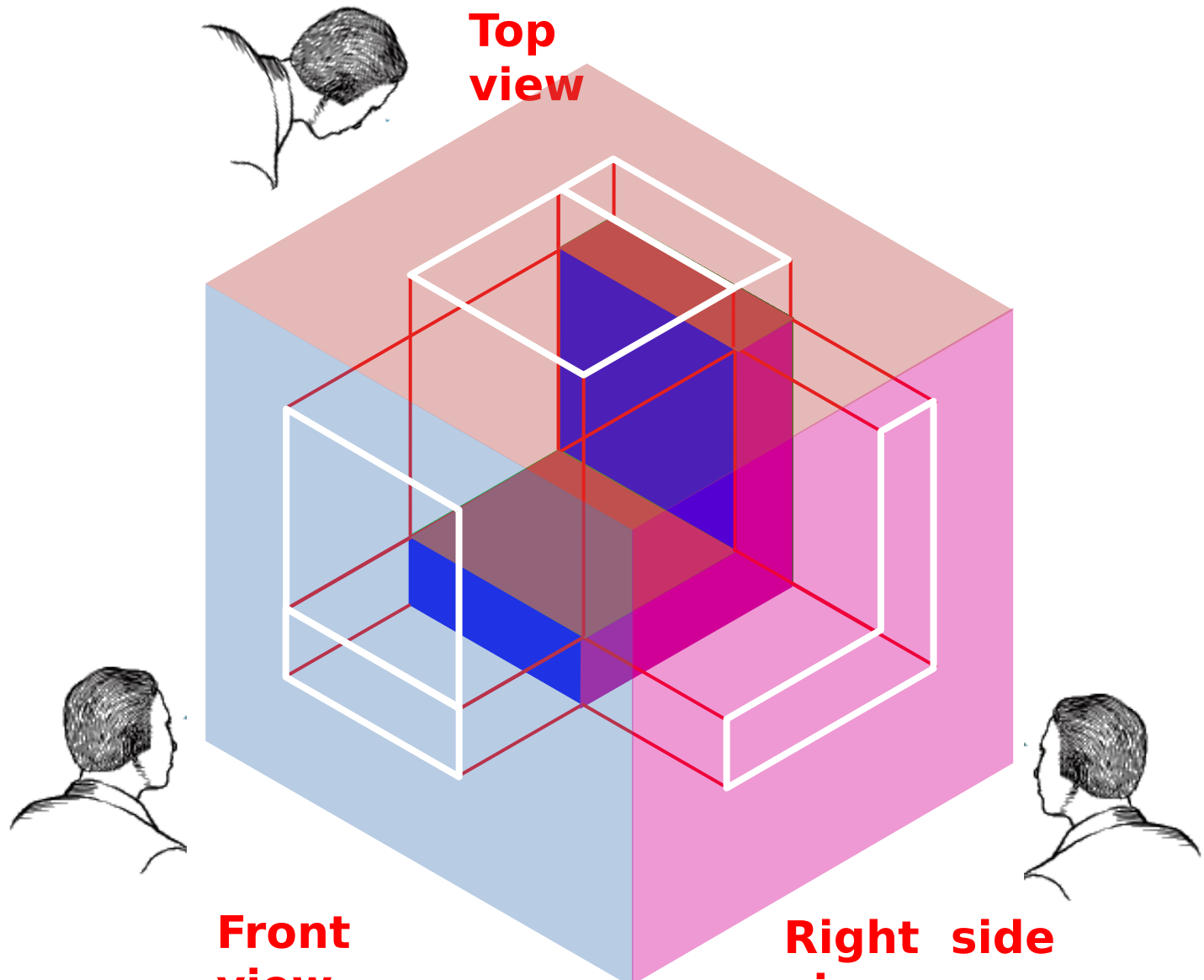
- To defining the six principal views or orthographic views there are two methods:
 - 1- **Natural method** and
 - 2- **Glass box method**

Orthographic Projection

1-Natural method: Each of the necessary view is obtained by **looking directly** at the particular side of the object the view is to represent.



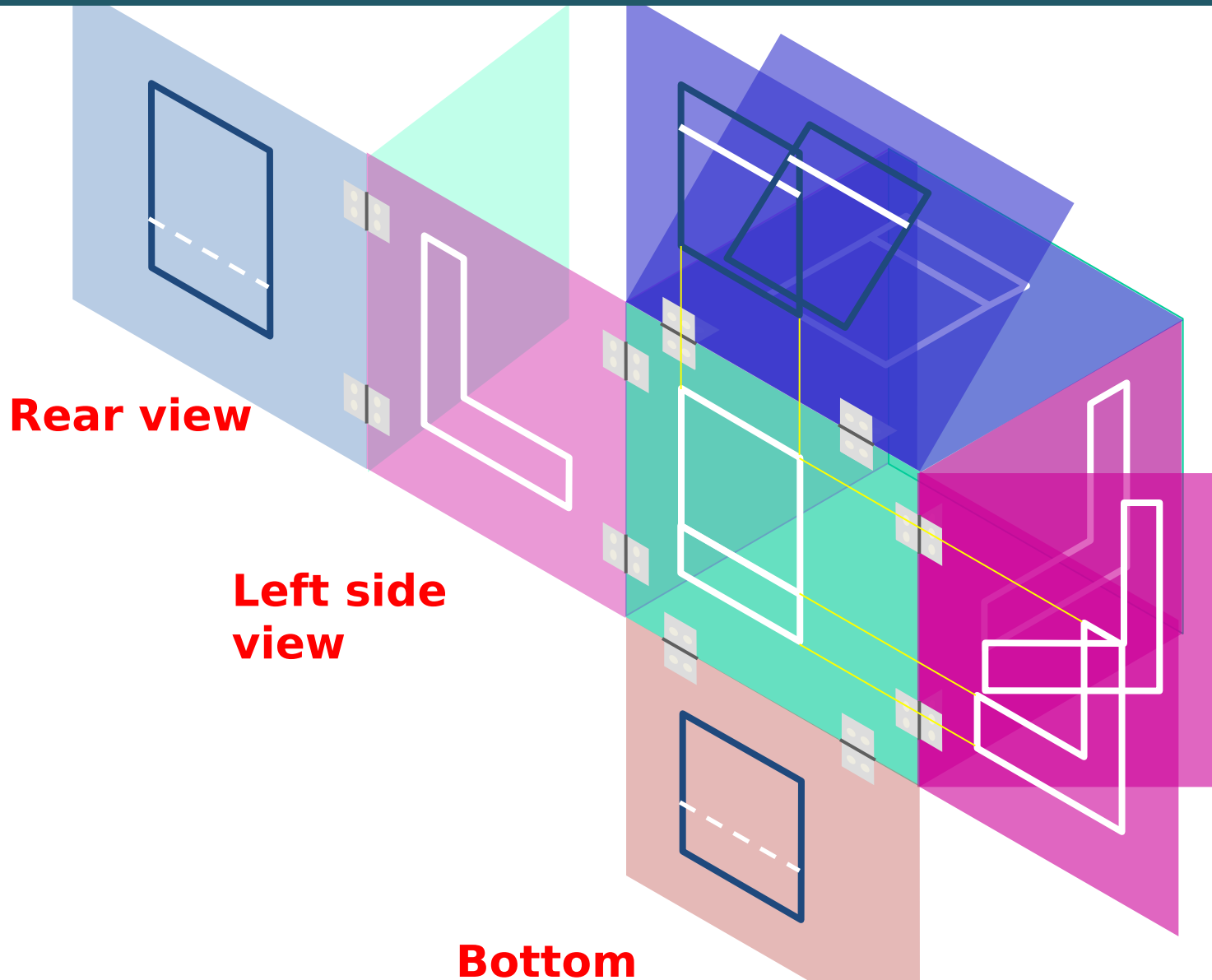
Natural Method



2-Glass box method:

- Most powerful technique to understand orthographic projections.
- Suspend the object with transparent strings inside a glass box.
- Fix the view from each direction (each of the six sides of the box) and unfold the box.

The Glass Box Concept



Orthographic Projection

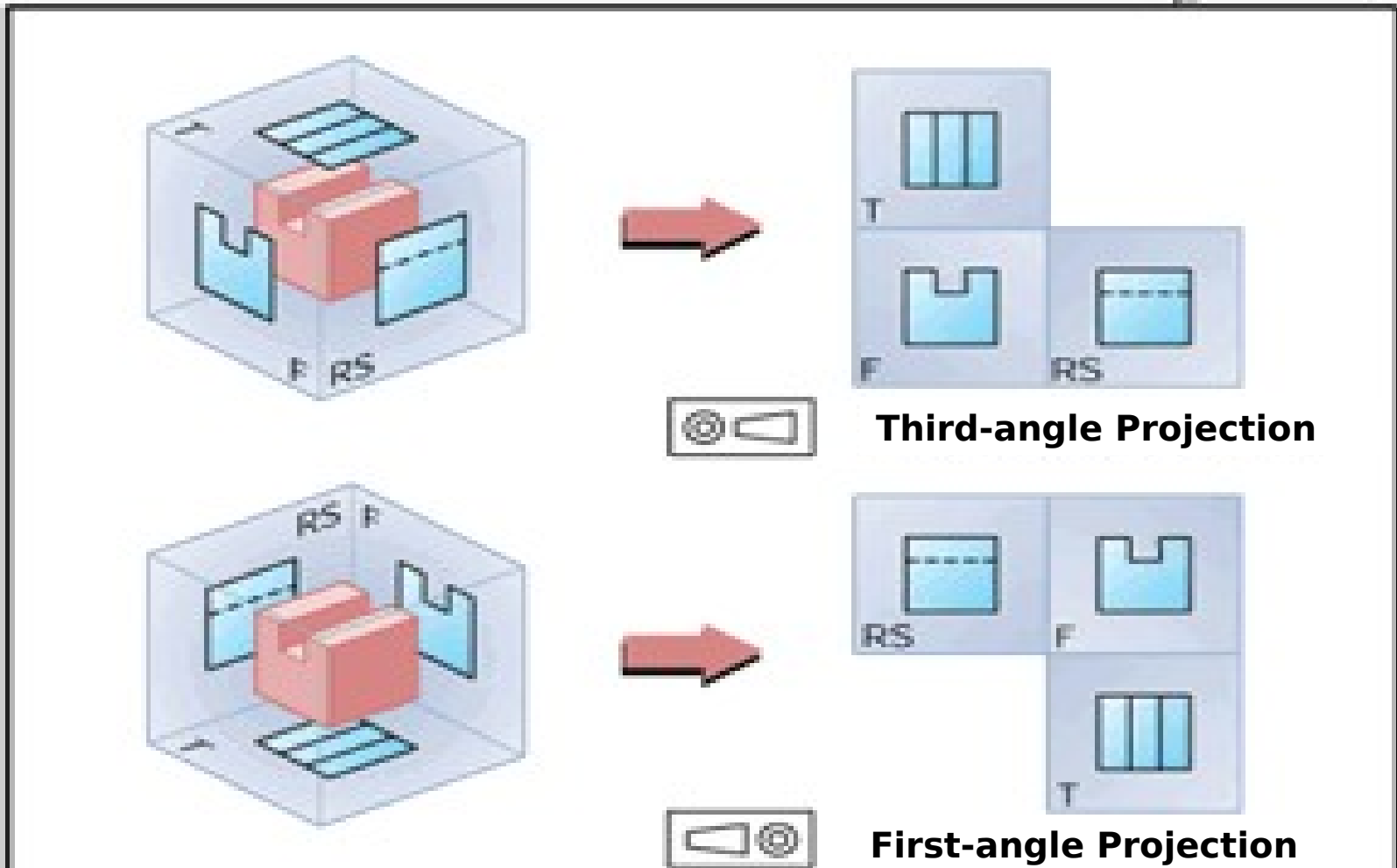
- **First angle projection:** The **object** is between observer and plane of projection. It is ISO standard and popular in European country.
- **Third angle projection:** The **plane** is between observer and object of projection. It is popular in USA, Japan and Thailand.

First angle and third angle projection

First angle projection	Third-angle projection
Object is kept in the first quadrant.	Object is assumed to be kept in the third quadrant.
Object lies between observer and the plane of projection.	Plane of projection lies between the observer and the object.
The plane of projection is assumed to be non-transparent.	The plane of projection is assumed to be transparent.
Front (elevation) view is drawn above the XY line	Front (elevation) view is drawn below the XY line
Top (plan) view is drawn below the XY line	Top (plan) view is drawn above the XY line
Left view is projected on the right plane and vice versa	Left view is projected on the left plane itself.
Followed in India, European countries	Followed in USA

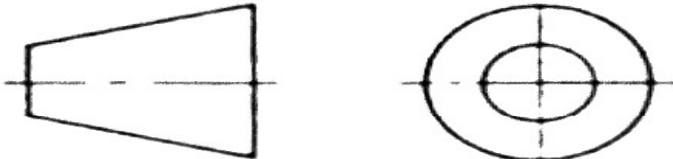
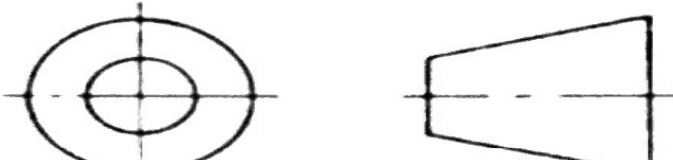
Orthographic Projection

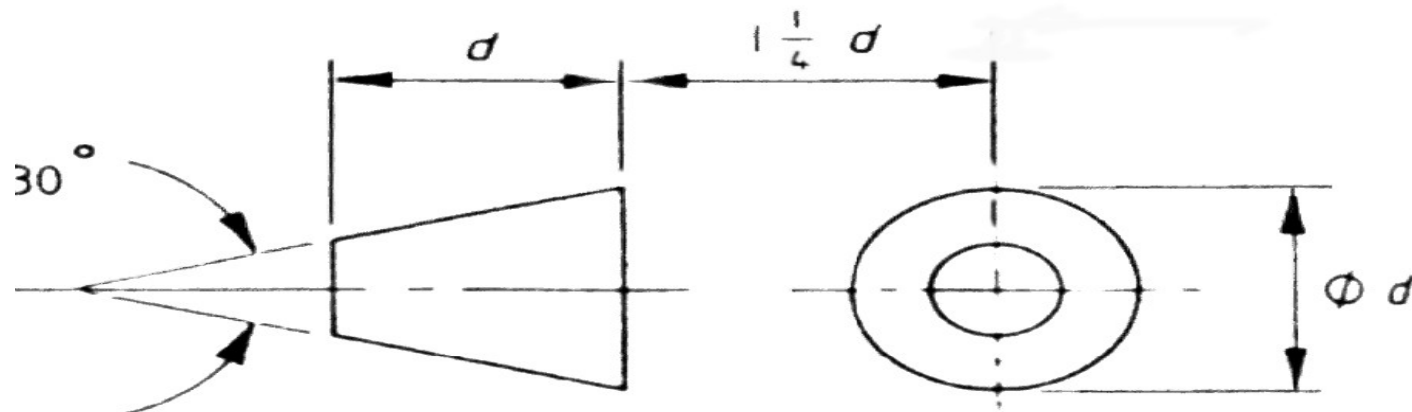
- First and third angle projections



Orthographic Projection

- First and third angle projections

Projection	Symbol
First angle	
Third angle	

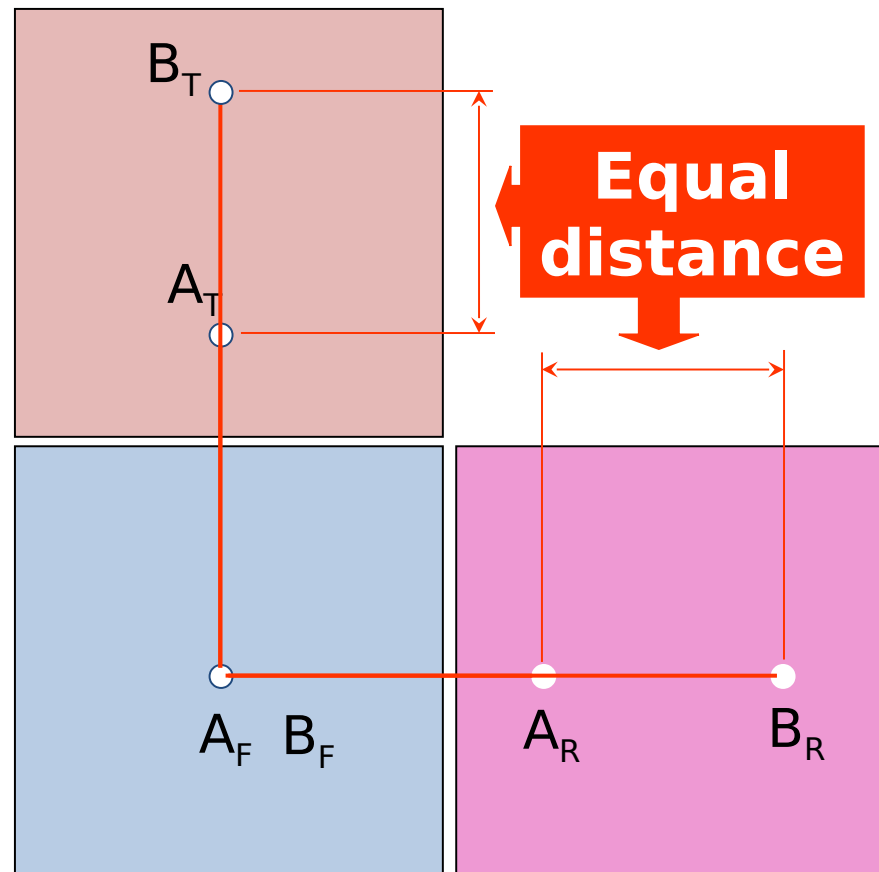
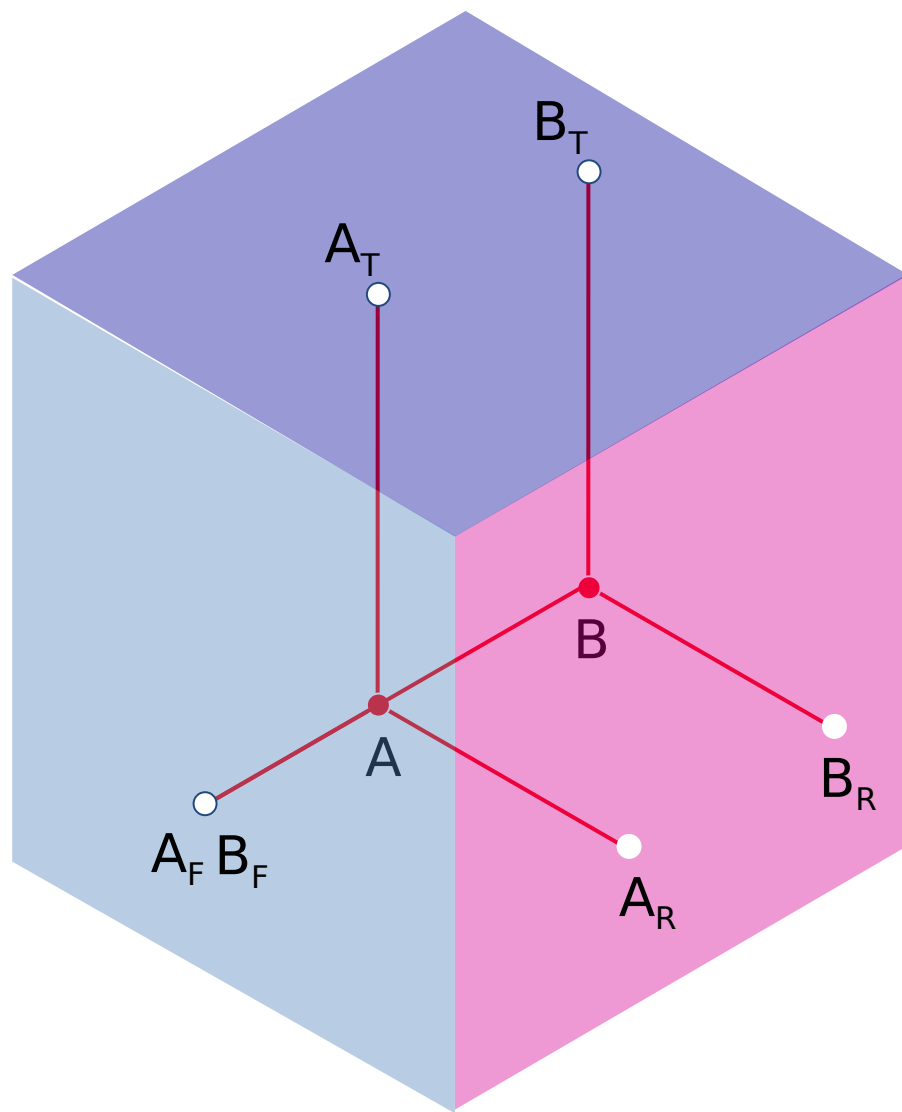


Projections of points, lines and planes

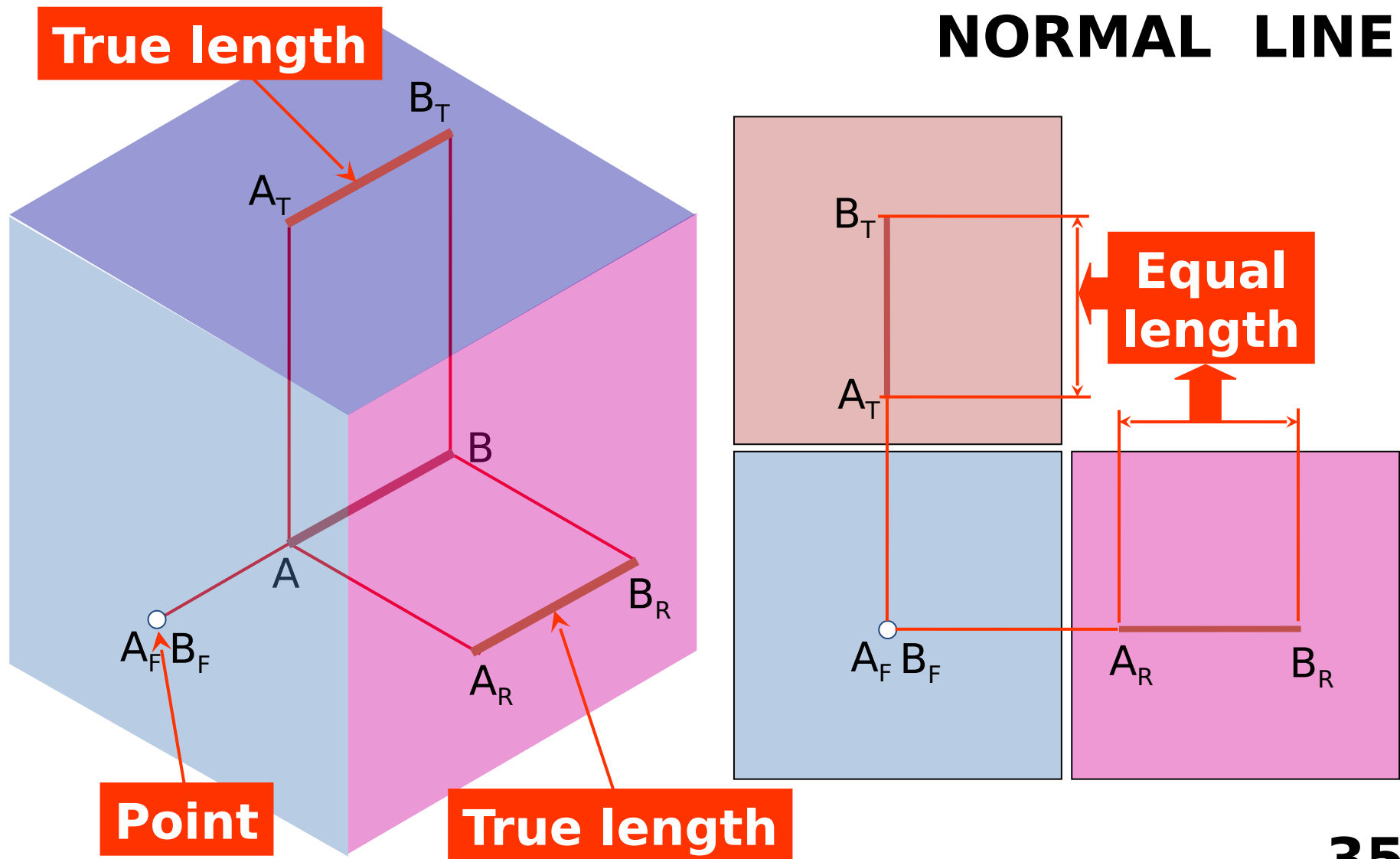
Naming of Views

Object	Point A	Line AB	Plane ABC
It's Front View	A_F	A_FB_F	$A_FB_FC_F$
It's Top View	A_T	A_TB_T	$A_TB_TC_T$
It's R. Side View	A_R	A_RB_R	$A_RB_RC_R$
It's L. Side View	A_S	A_SB_S	$A_SB_SC_S$

Projection of points

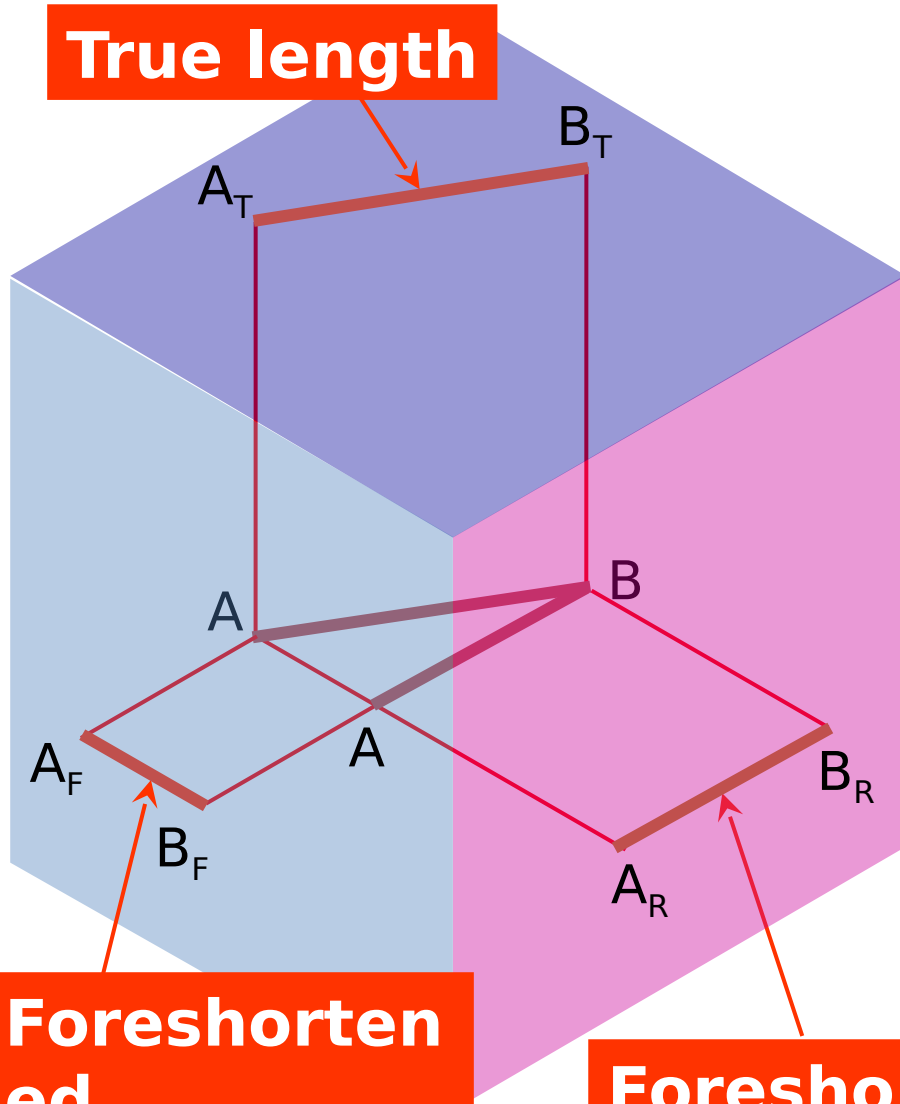


Projection of lines



Projection of a line

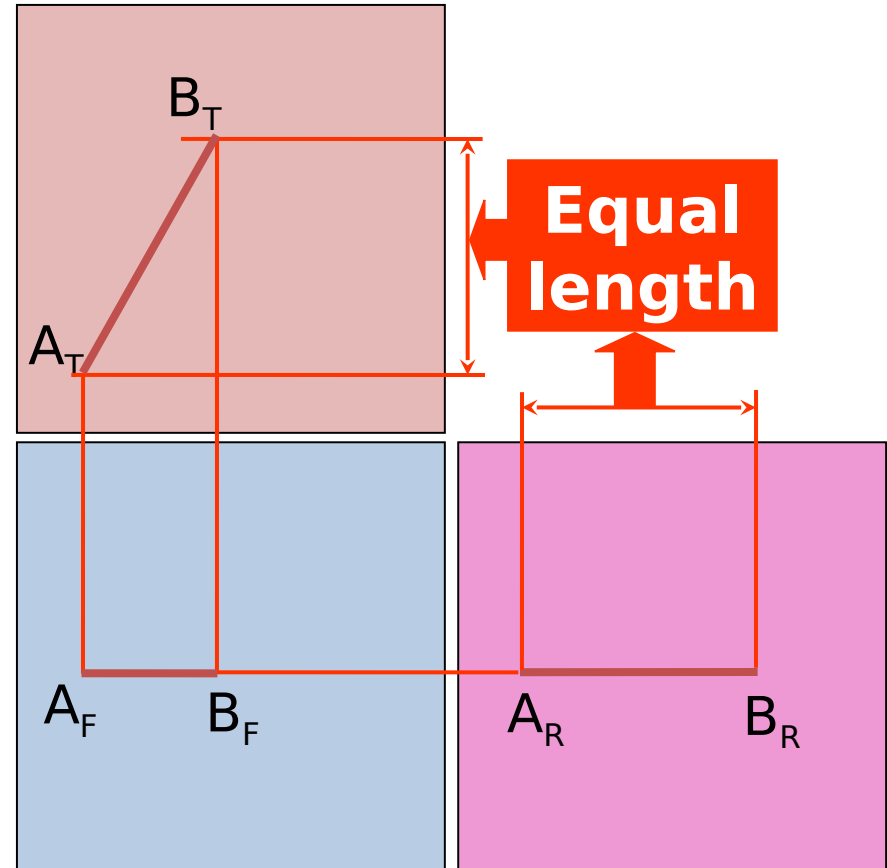
True length



**Foreshorten
ed**

Foreshorten

INCLINED LINE

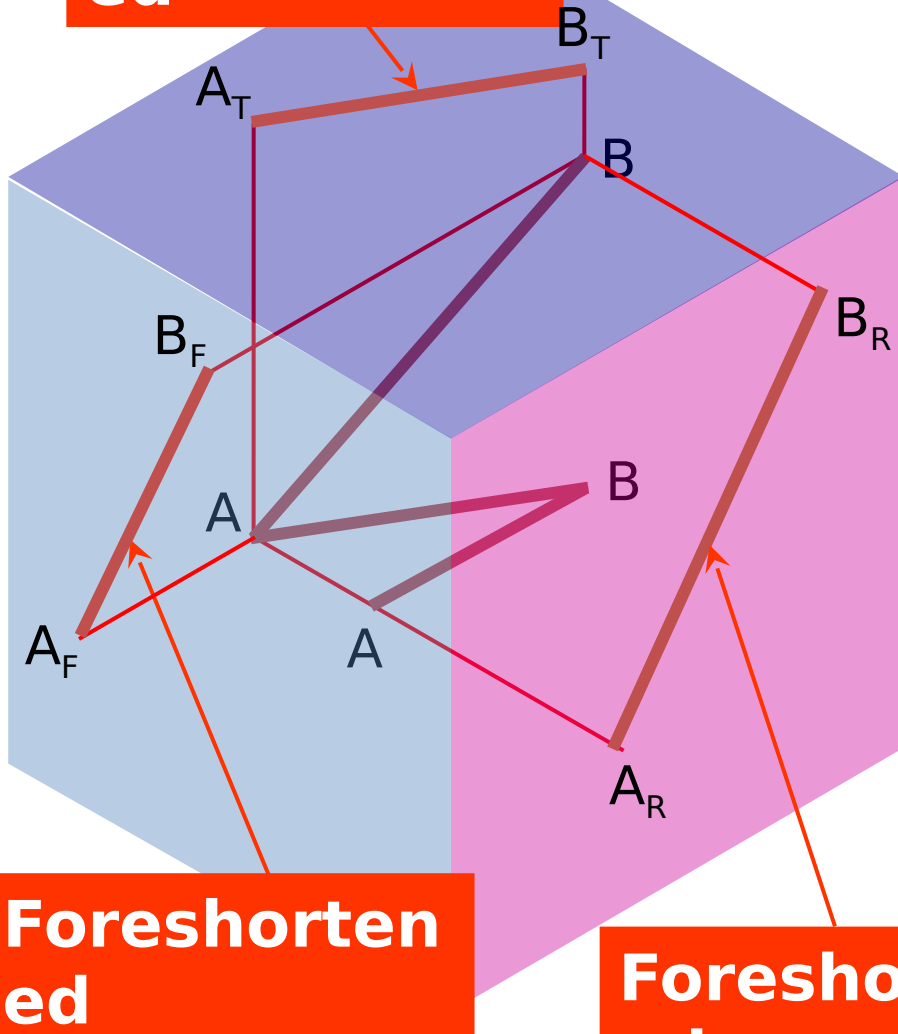


**Equal
length**

Projection of a line

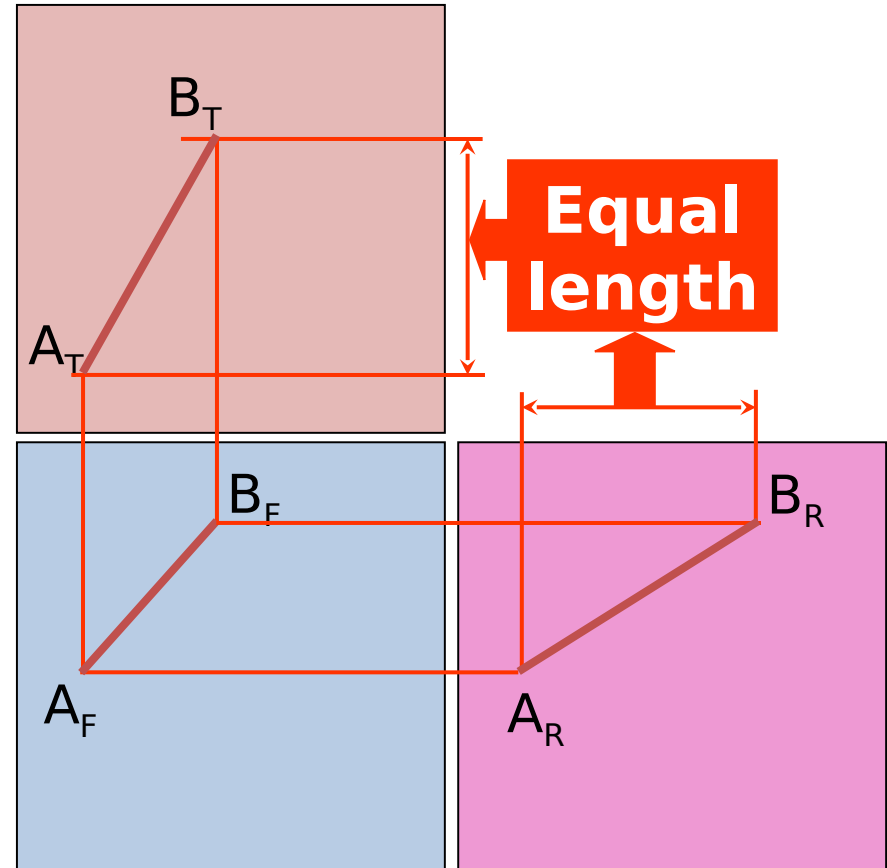
OBLIQUE LINE

**Foreshorten
ed**



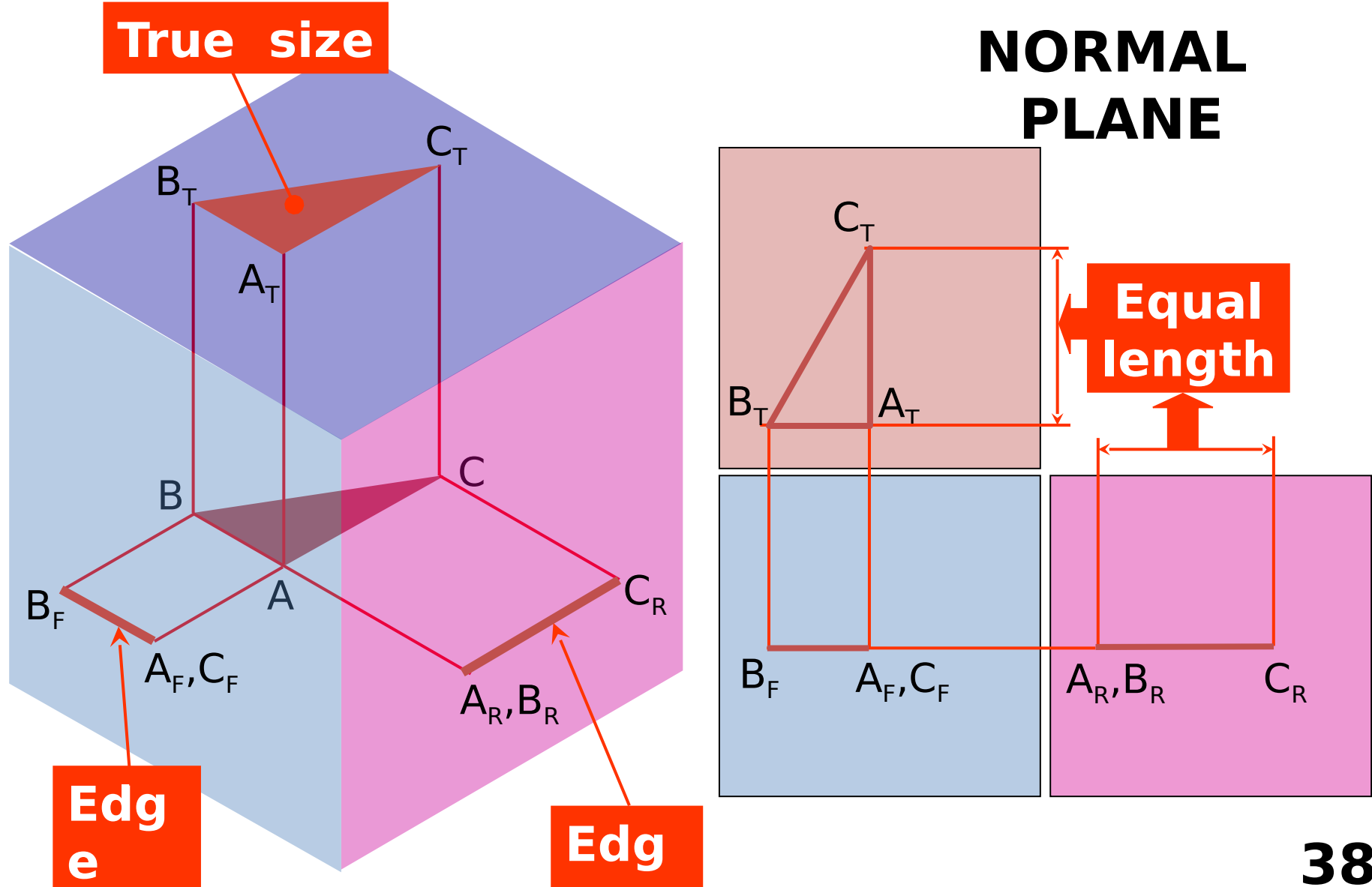
**Foreshorten
ed**

Foreshorten



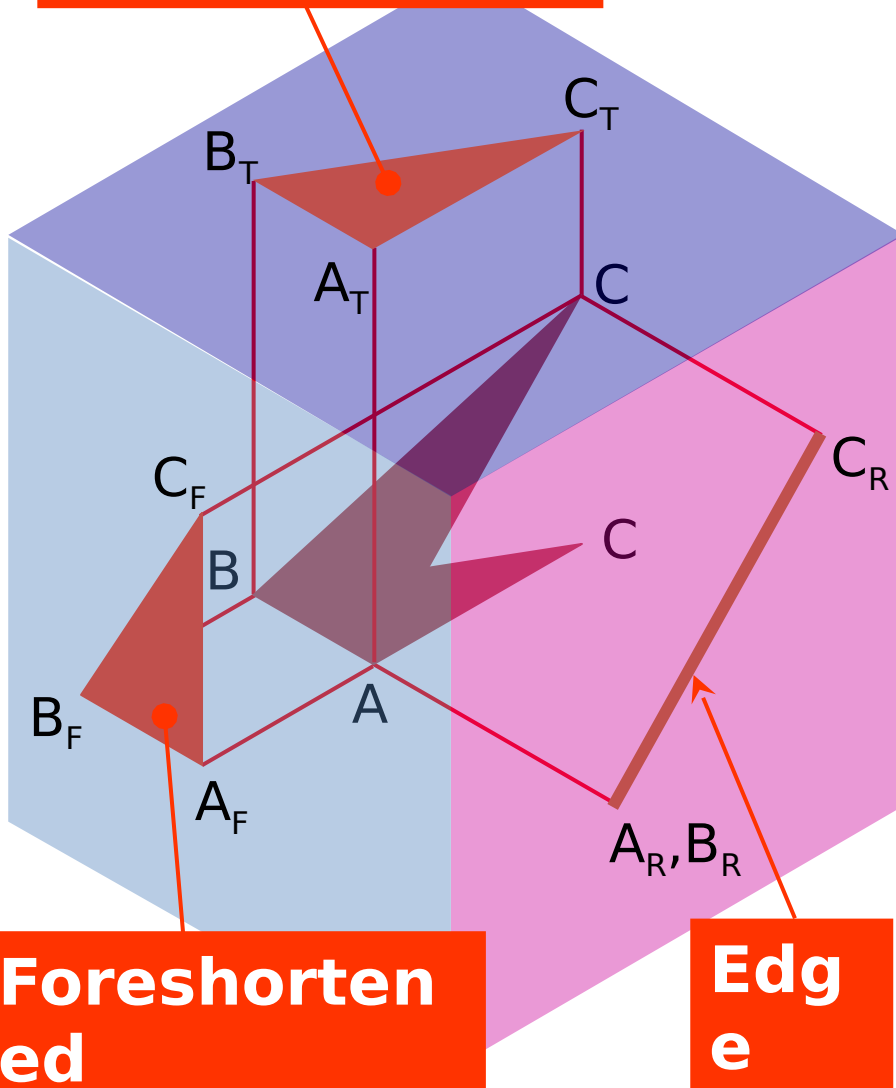
**Equal
length**

Projection of a plane

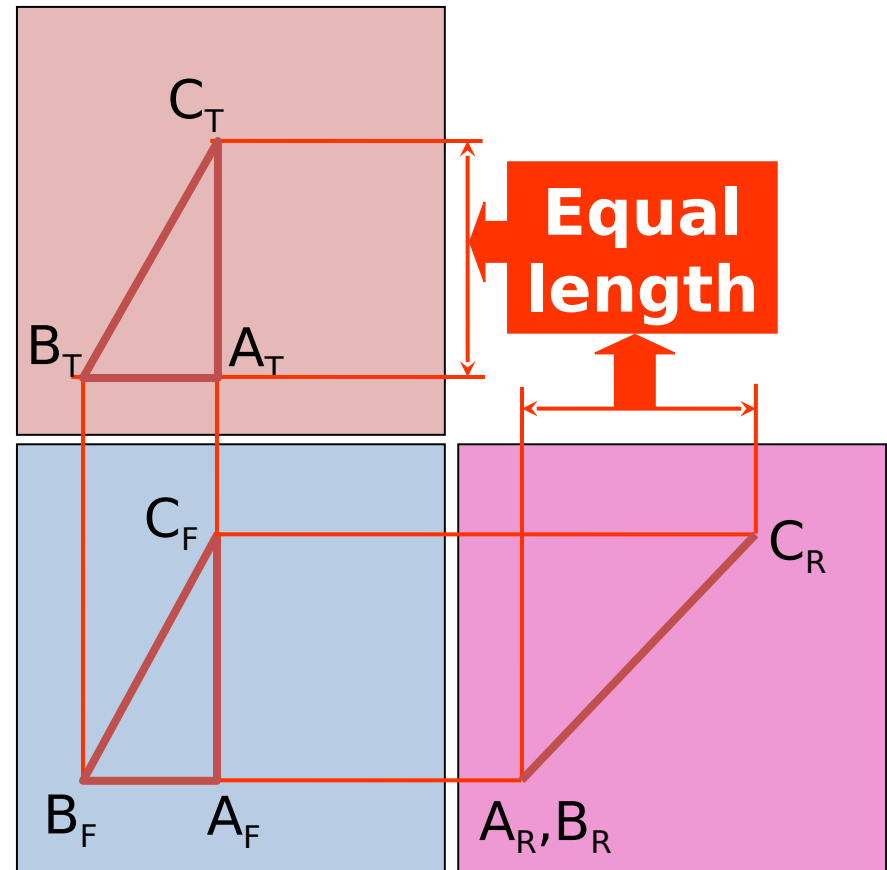


Projection of a plane

Foreshortened

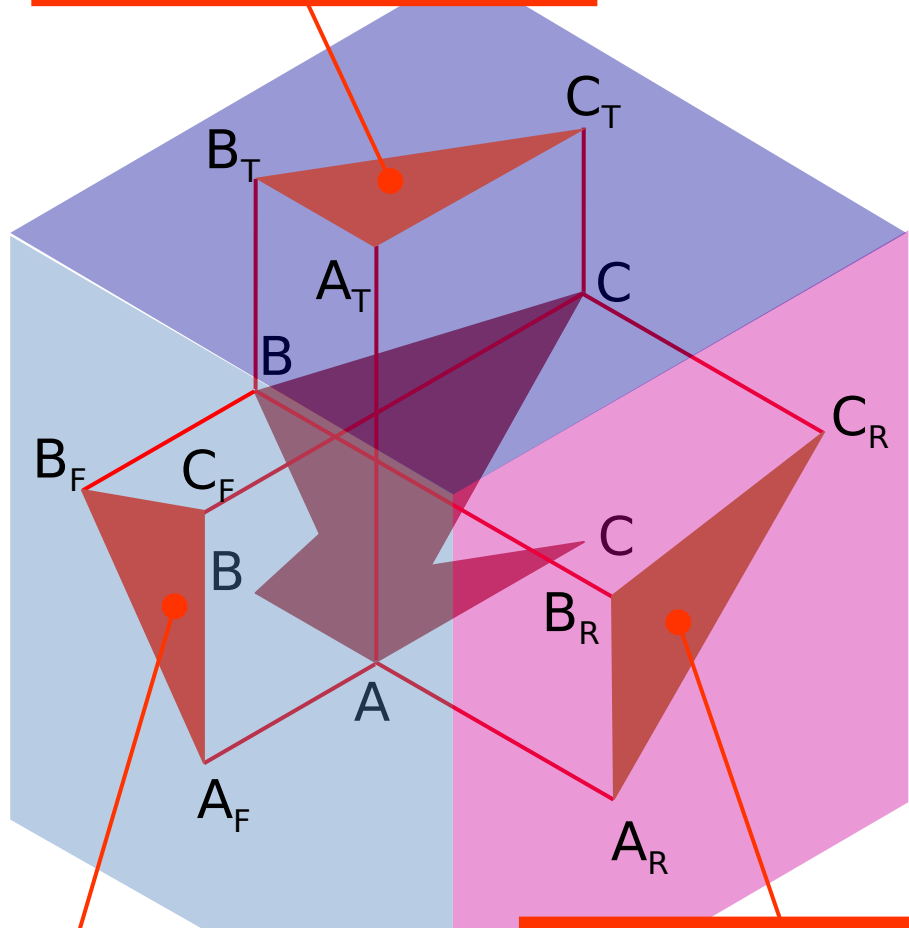


INCLINED PLANE



Projection of a plane

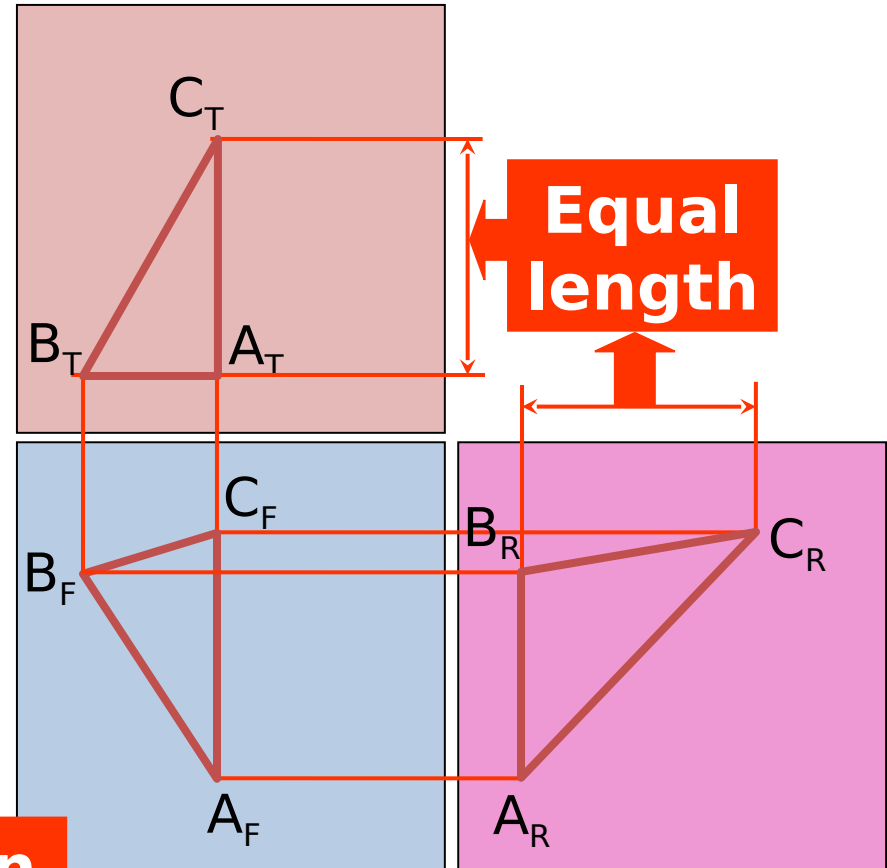
Foreshortened



**Foreshorten
ed**

**Foreshorten
ed**

**OBLIQUED
PLANE**



Thank You
Any Question?