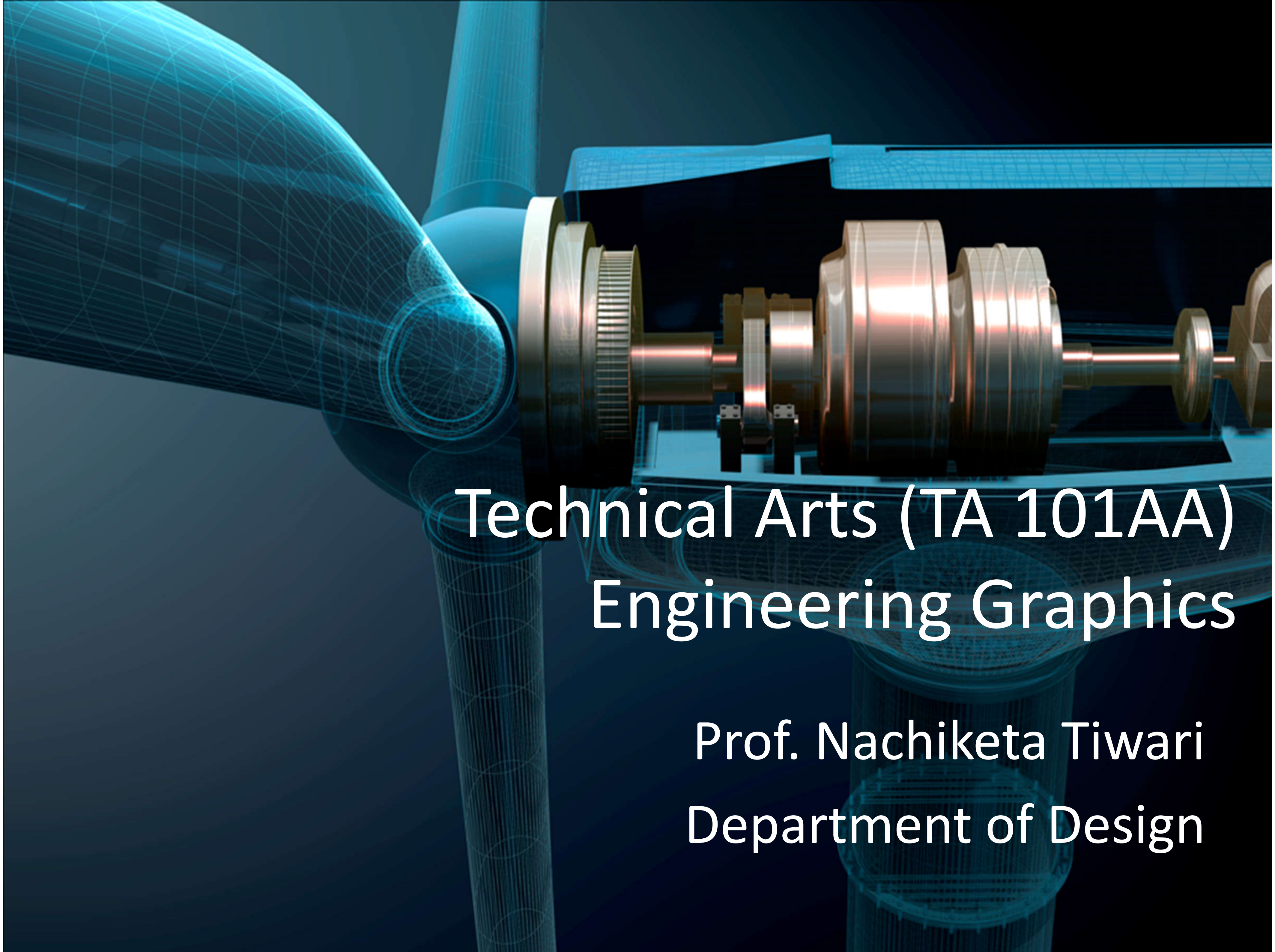


Technical Arts (TA 101AA)
Engineering Graphics

Prof. Nachiketa Tiwari
Department of Design

Isometric Projections

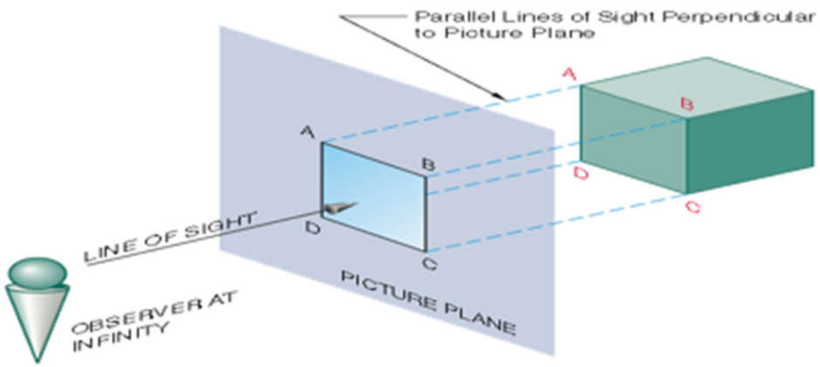
Pictorial Representations

- Easier to visualize.
    - Provide a better grasp of form in 3D.

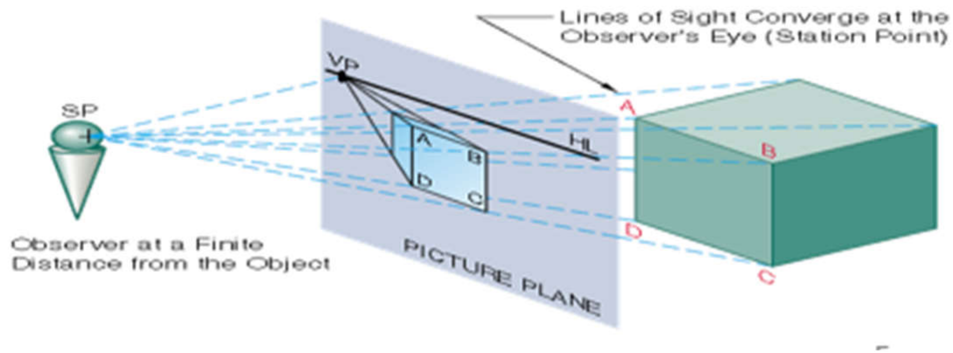
- Difficult to draw.

- Ads, brochures, catalogs, etc.

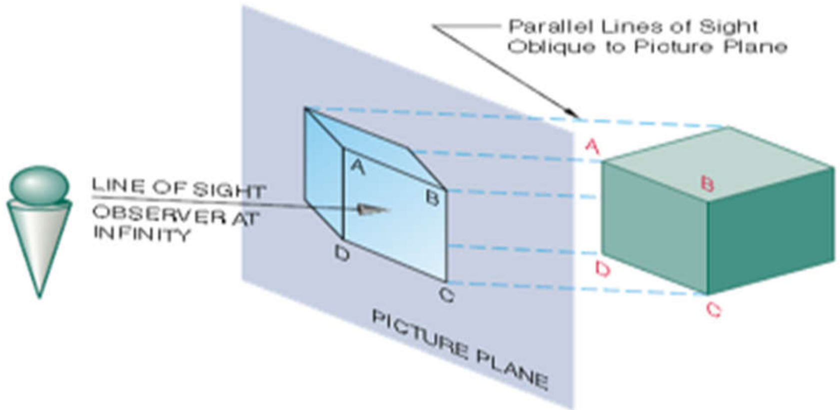
Four Projection Methods



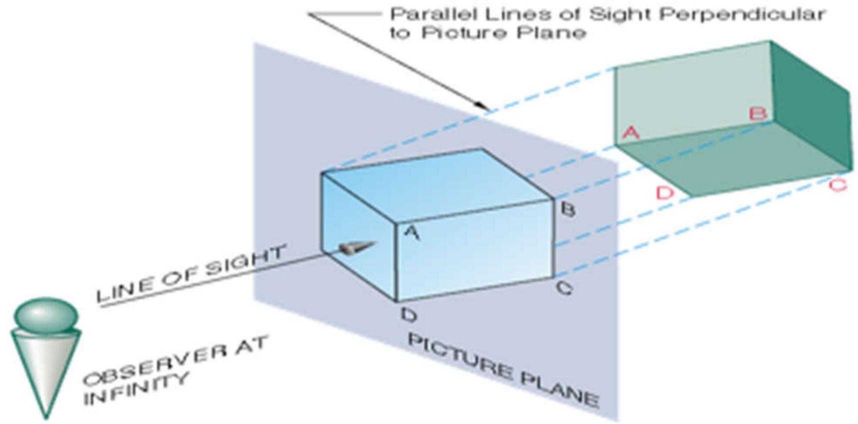
Multiview/Orthographic



Perspective



Oblique

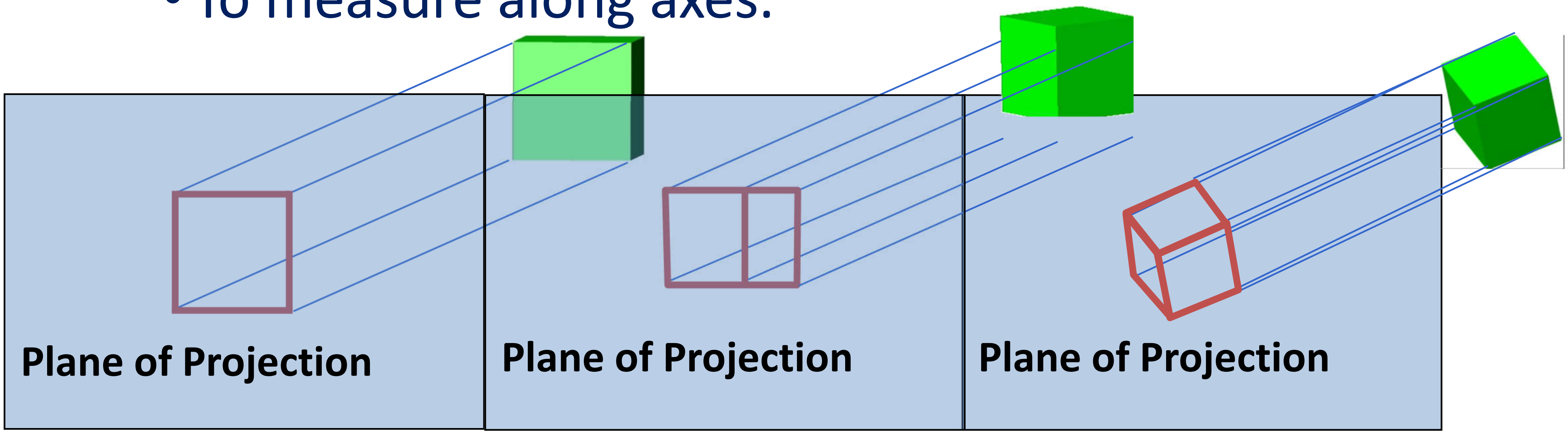


Axonometric

Axonometric Projection

- Axonometric projection is a special type of orthographic projection where:
  - Only one plane is used for projection.
  - Object being turned so that its three faces are visible.

- Axonometric: *axon* (axis), *metric* (measure)
  - To measure along axes.

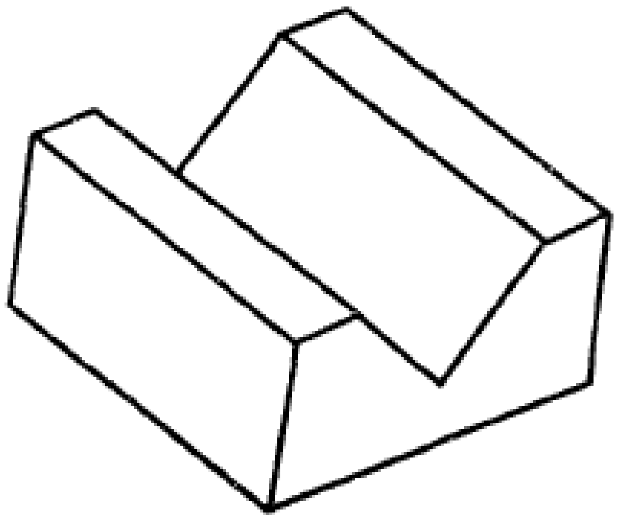


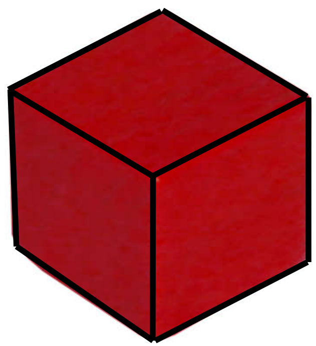
Orthographic Projection **Axonometric Projection**

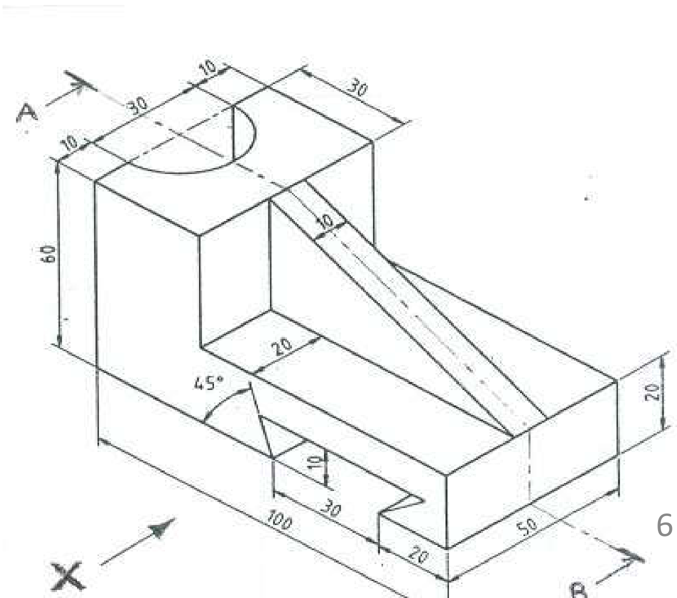
Axonometric Projection

- **Orthographic projection**: Projections are taken on two or more mutually perpendicular planes. *Only two dimensions are visible in a specific view*.

- **Axonometric projection**: Object is oriented such that *most* of its 3D features are *clearly visible* on the vertical plane of projection. *All three dimensions are visible in the same view*.





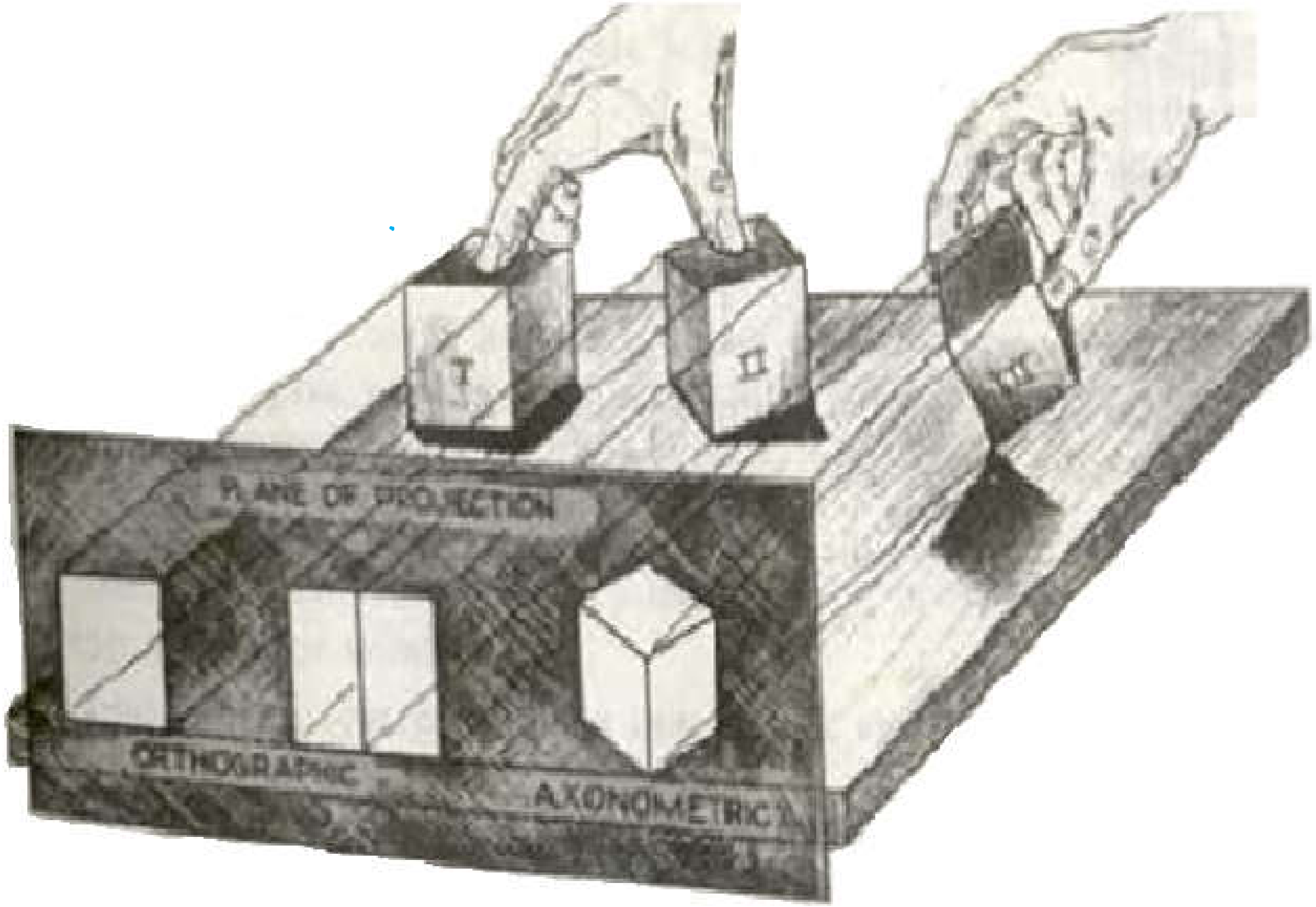


Axonometric Projection

- Advantage
  - Easier to visualize the design
  - Useful for marketing, conceptualization, discussions, brochures, catalogs, etc.

- Limitations
  - Does not show true shapes (shapes distorted)
  - Does not provide all the details
  - Inappropriate for dimensioning/manufacturing

Two Rotations For Axonometric Projection



- One may get several views depending on the angle of each rotation.
- Some sort of uniformity and standardization is required.

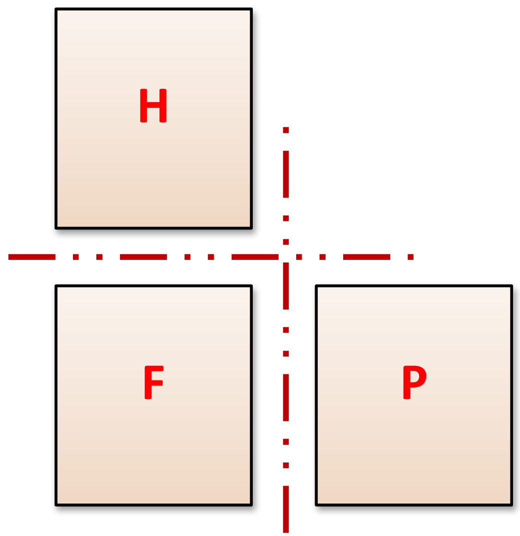
Foreshortening

The height of the man appears lesser in proportional terms than what it actually is.

Axonometric & Equal Foreshortening –> Isometric Projection

Foreshortening Due to Rotation
Context: Cube

Case 1
No rotation of the object.

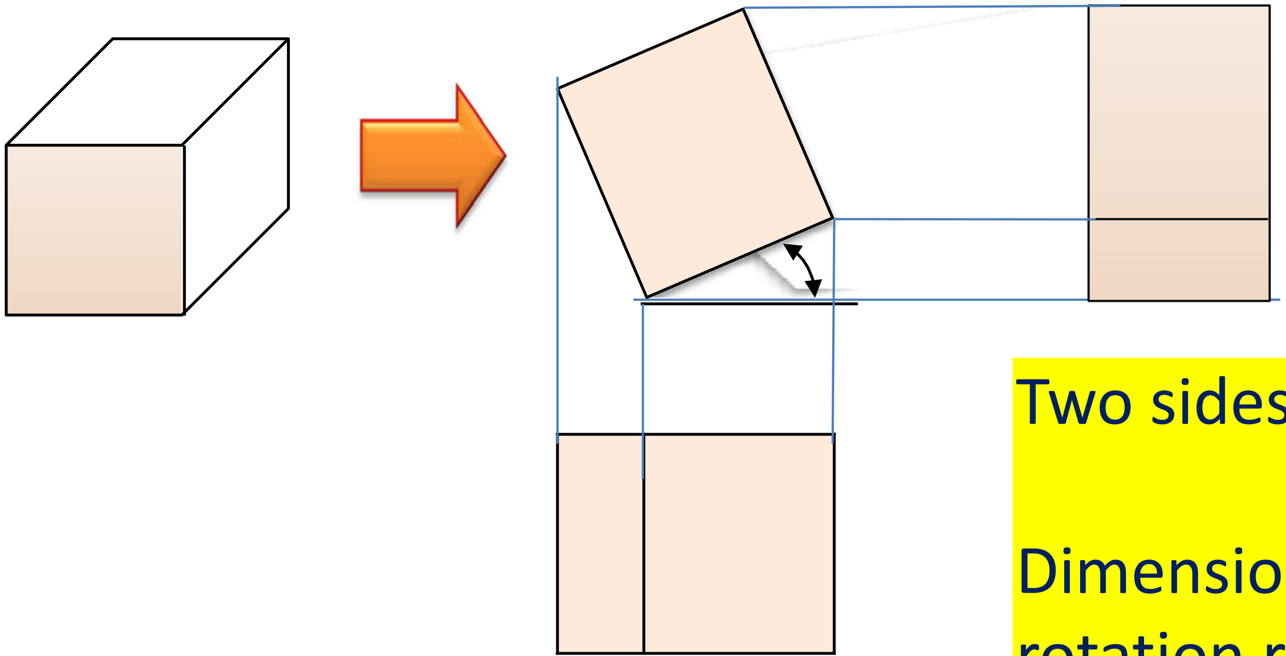


Regular Orthographic Views
(Front-Top-Right)
(No Foreshortening)

F: Frontal plane
H: Horizontal plane
P: Profile plane

Foreshortening Due to Rotation
Context: Cube

Case 2
Rotation About One Axis
(i.e. in the direction of depth)

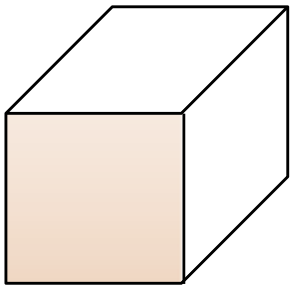


Two sides get foreshortened.

Dimension parallel to axis of rotation remains unaltered.

Foreshortening Due to Rotation
Context: Cube

Case 3
Rotation About Two Axes



Example
Rotation 1: About vertical axis.
Rotation 2: About profile axis.

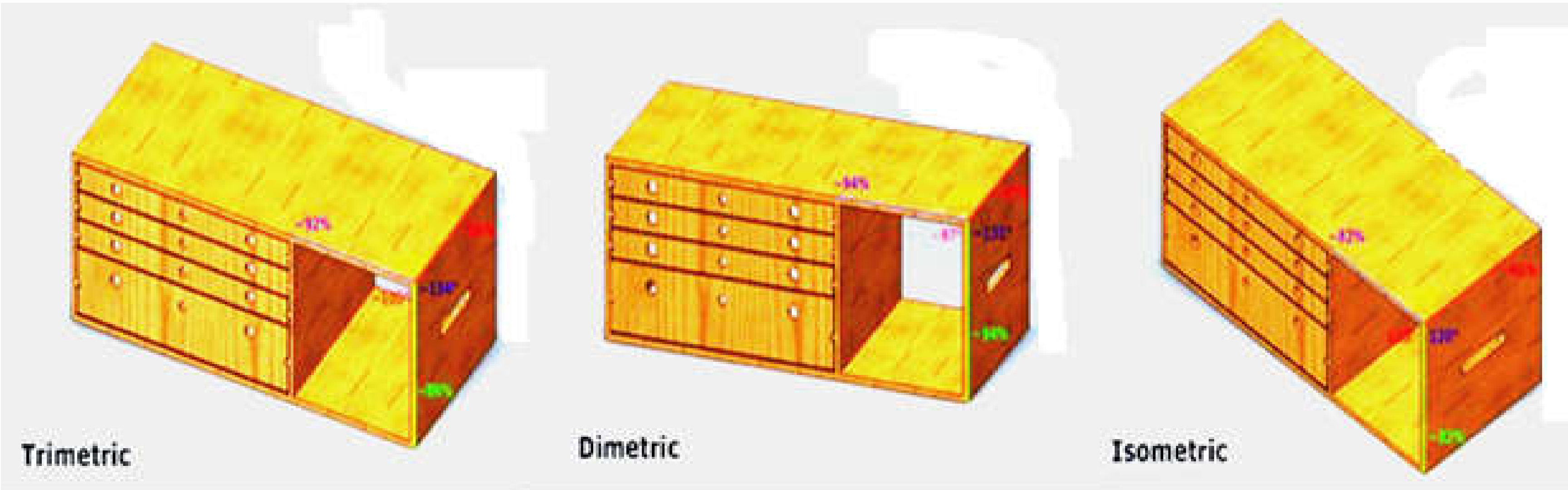
Result
All the three sides get foreshortened.

Types of Axonometric Projections

- *Trimetric:* All three axes foreshortened in different proportions.
  - Supposedly most pleasing to the eye.

- *Dimetric:* Two sides equally foreshortened.
  - Supposedly less pleasing to the eye.

- *Isometric:* All three sides are equally foreshortened.
  - Supposedly least pleasing to the eye.

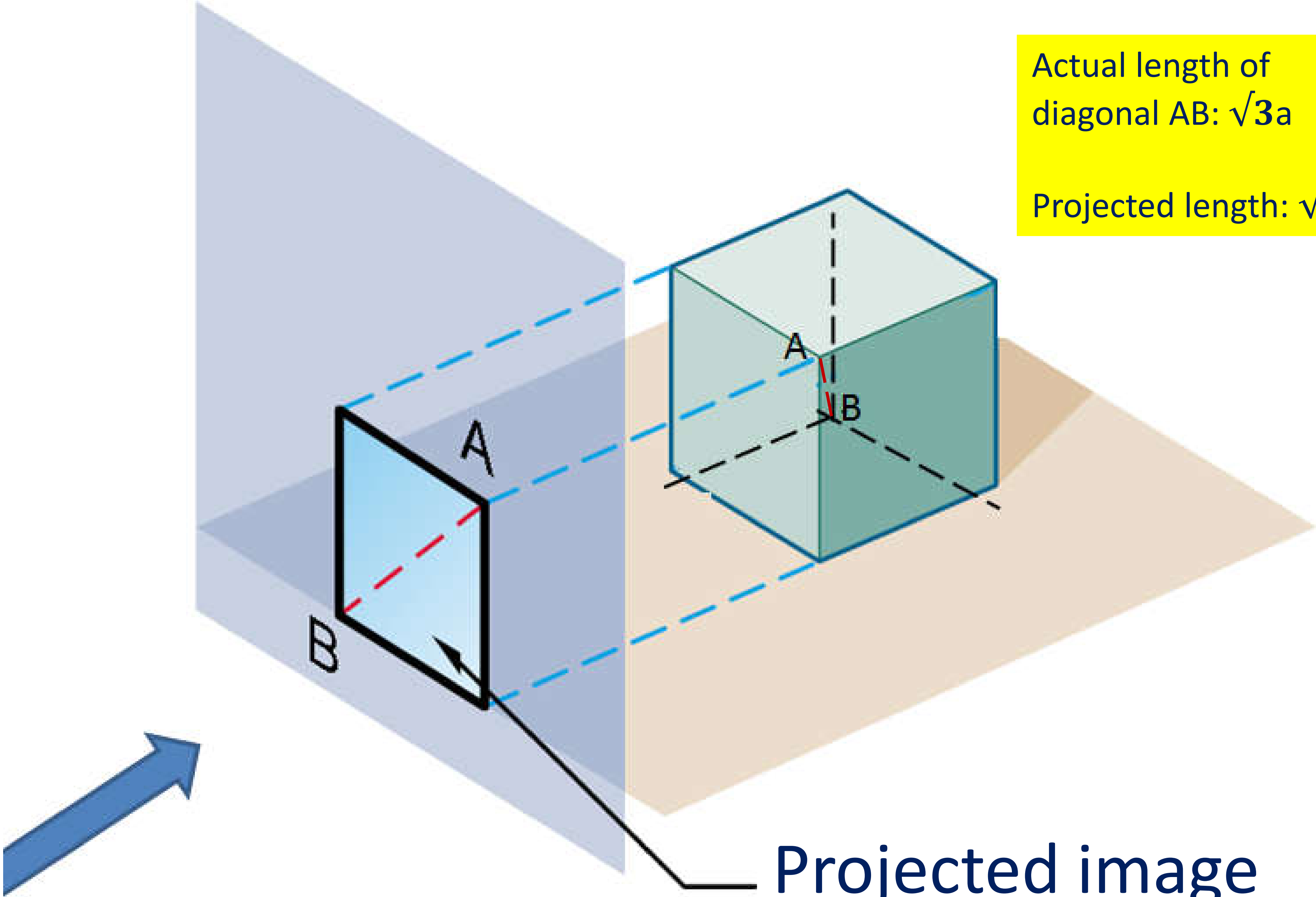


Developing Isometric Projection

- To get an isometric view, the object is:
  - Rotated first by 45^0 about the vertical axis.
  - And then by 35^0 15’ 52’’ about the profile axis.

- These operations eventually results in equal amount of ‘foreshortening’ of the object along the isometric axes.

Developing Isometric Projection



Actual length of diagonal AB: $\sqrt{3}$a

Projected length: $\sqrt{2}a$

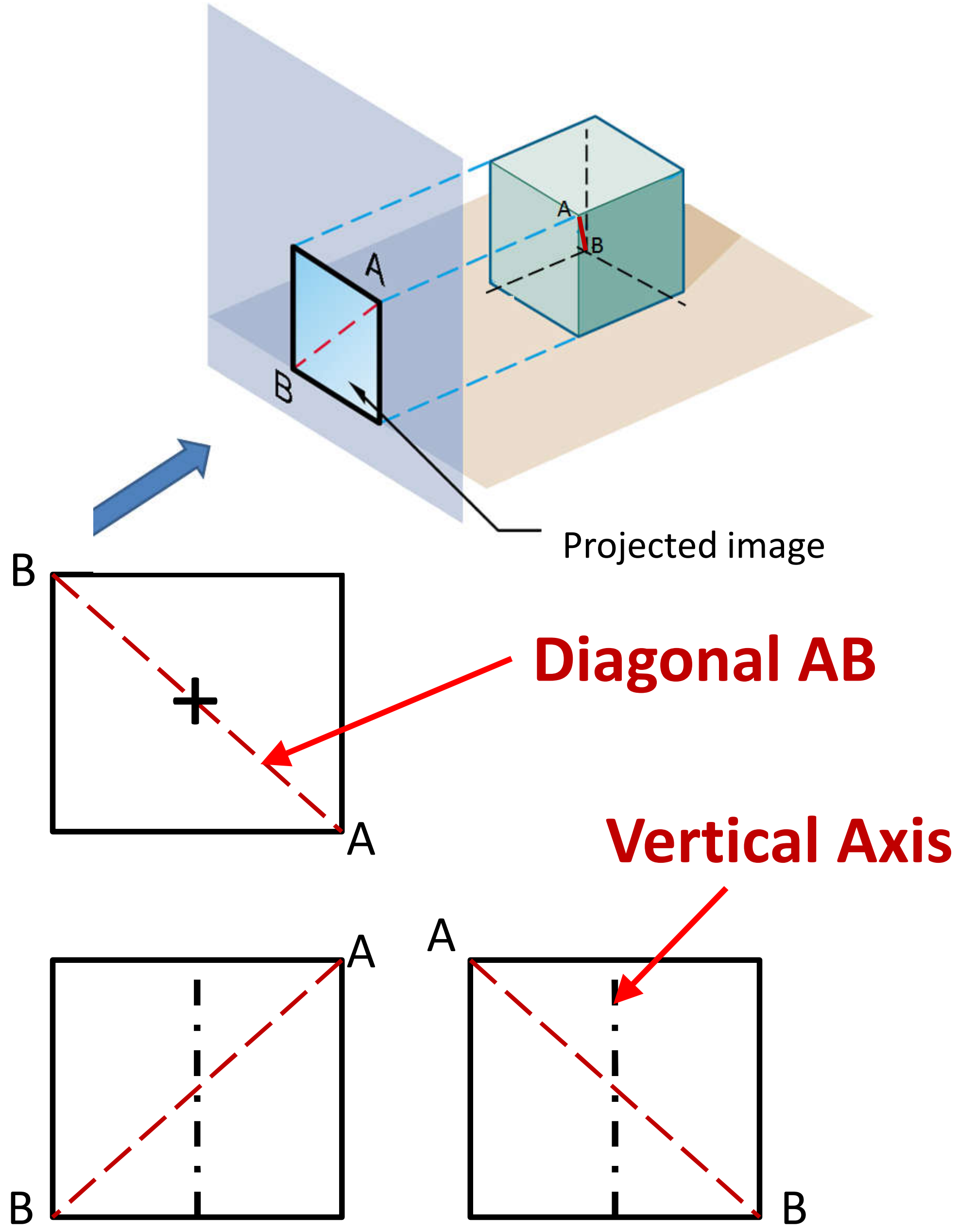
Projected image

Developing Isometric Projection

STEP 1

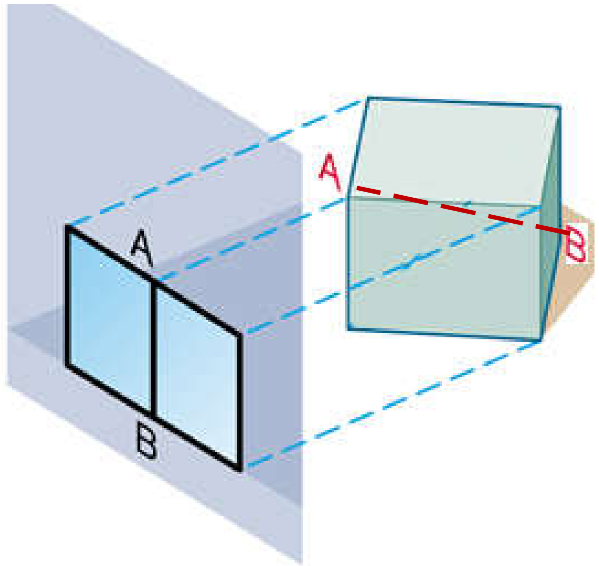
Using the front (principal) face of the object (cube) which is parallel to the projection plane, generated all the three orthographic views. Here 3rd angle convention is used.

Also, mark the axis along which 1st rotation will be executed.



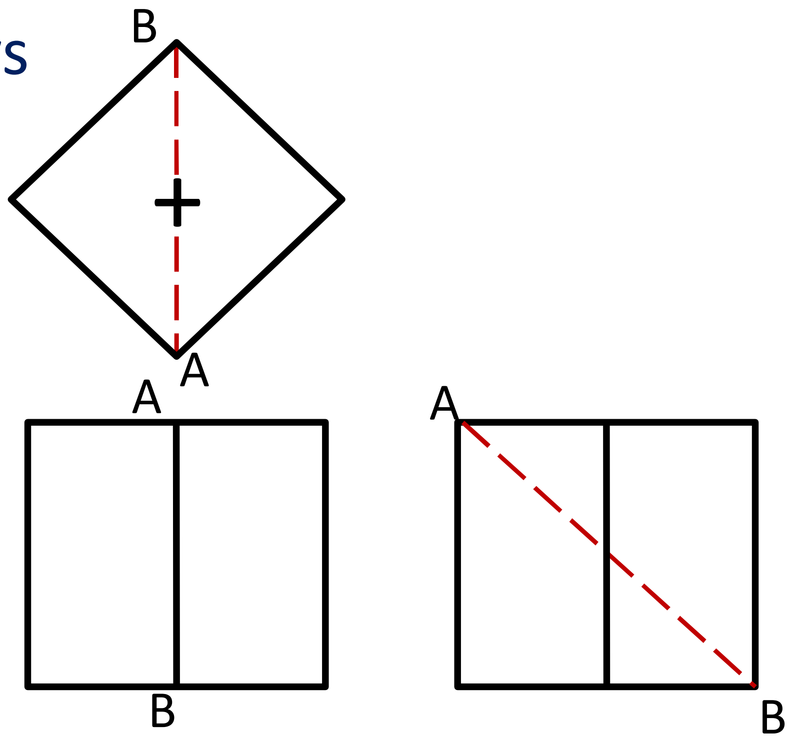
Developing Isometric Projection

STEP 2



Rotate the object by 45° about its vertical axis as defined earlier.

Modify all the three views accordingly.

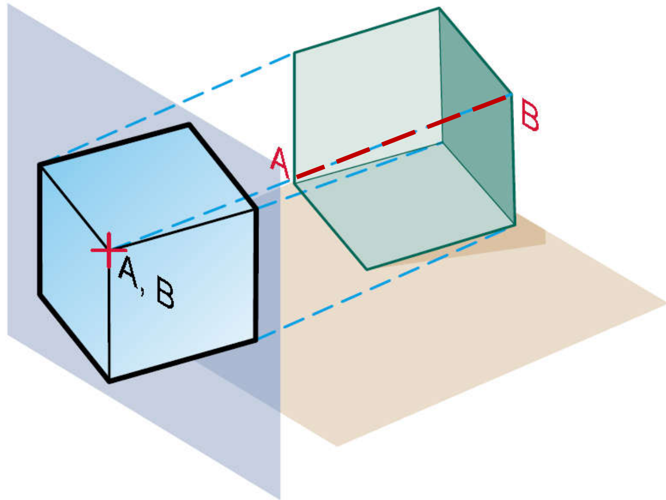


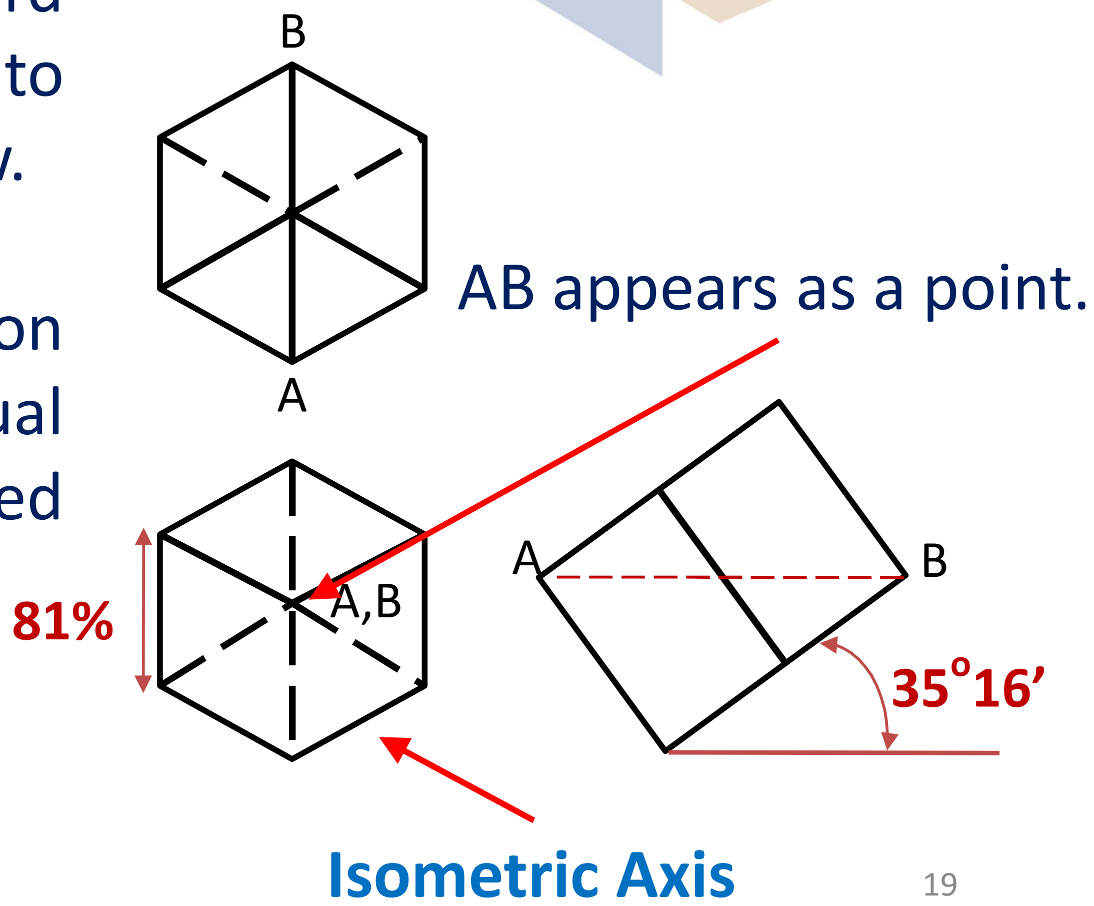
Developing Isometric Projection

STEP 3

Next, tilt the object forward by 35°16’. For a cube, such a forward tilt causes body diagonal *AB* to appear as a point in the front view.

The three axes that meet at *A* on the projection plane form equal angles of 120°. They are termed **isometric axes**.



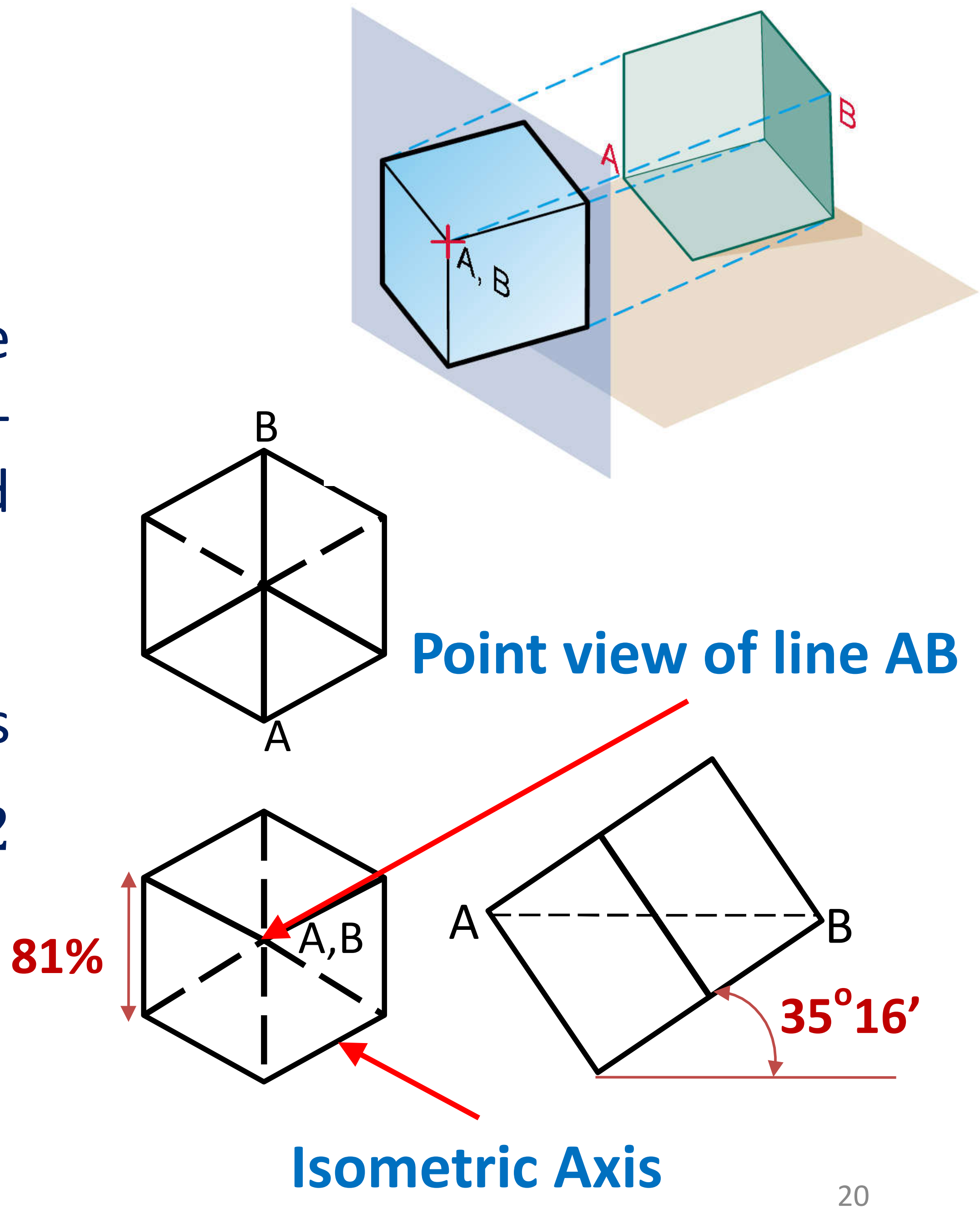


Developing Isometric Projection

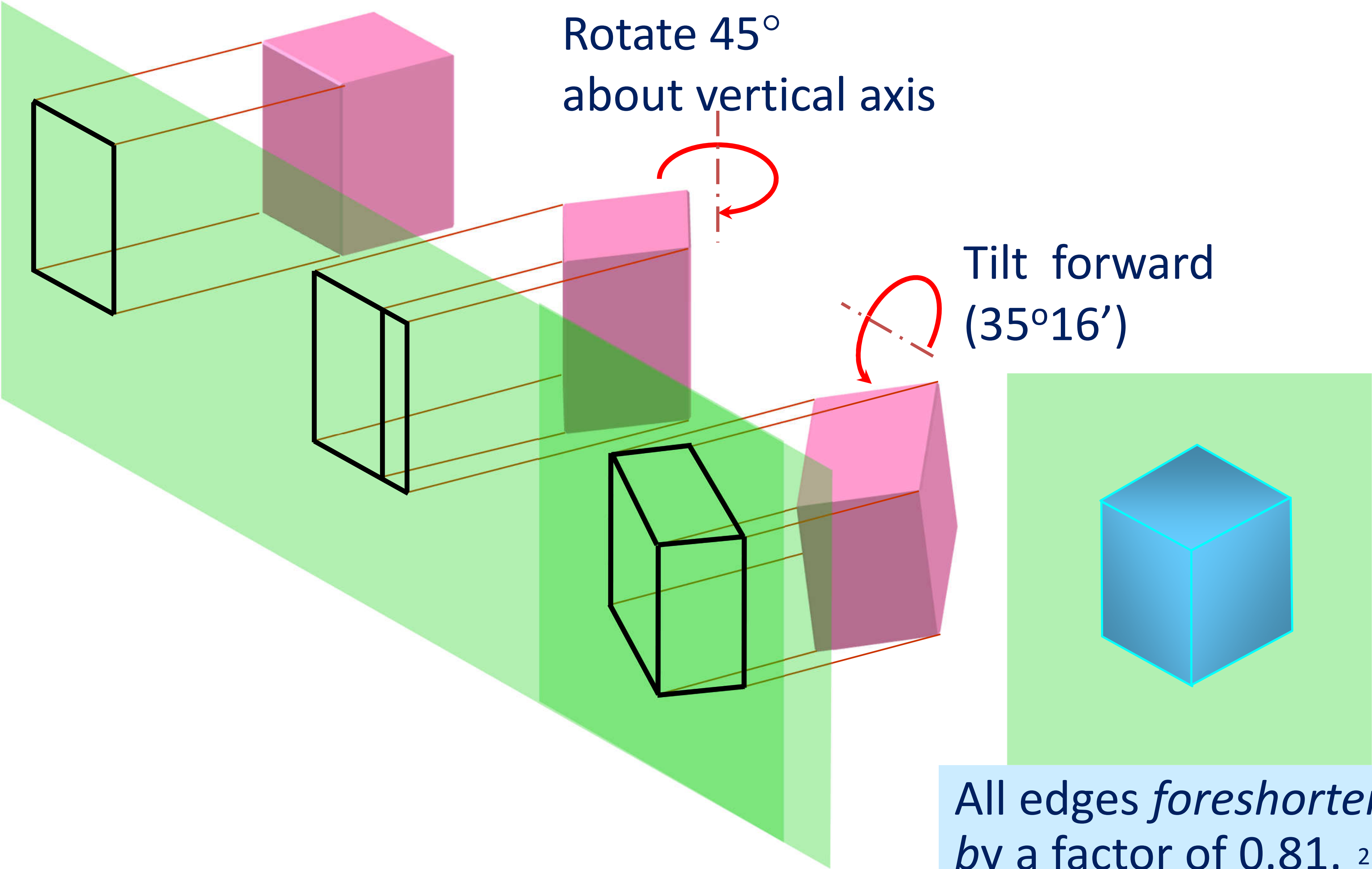
STEP 3 (contd.)

Such forward tilt causes the edges & planes to become fore-shortened as they are projected on the projection plane.

The length of the projected lines equal Cos (35°16') = $\frac{\sqrt{2}}{\sqrt{3}} \approx 0.82$ times true lengths.



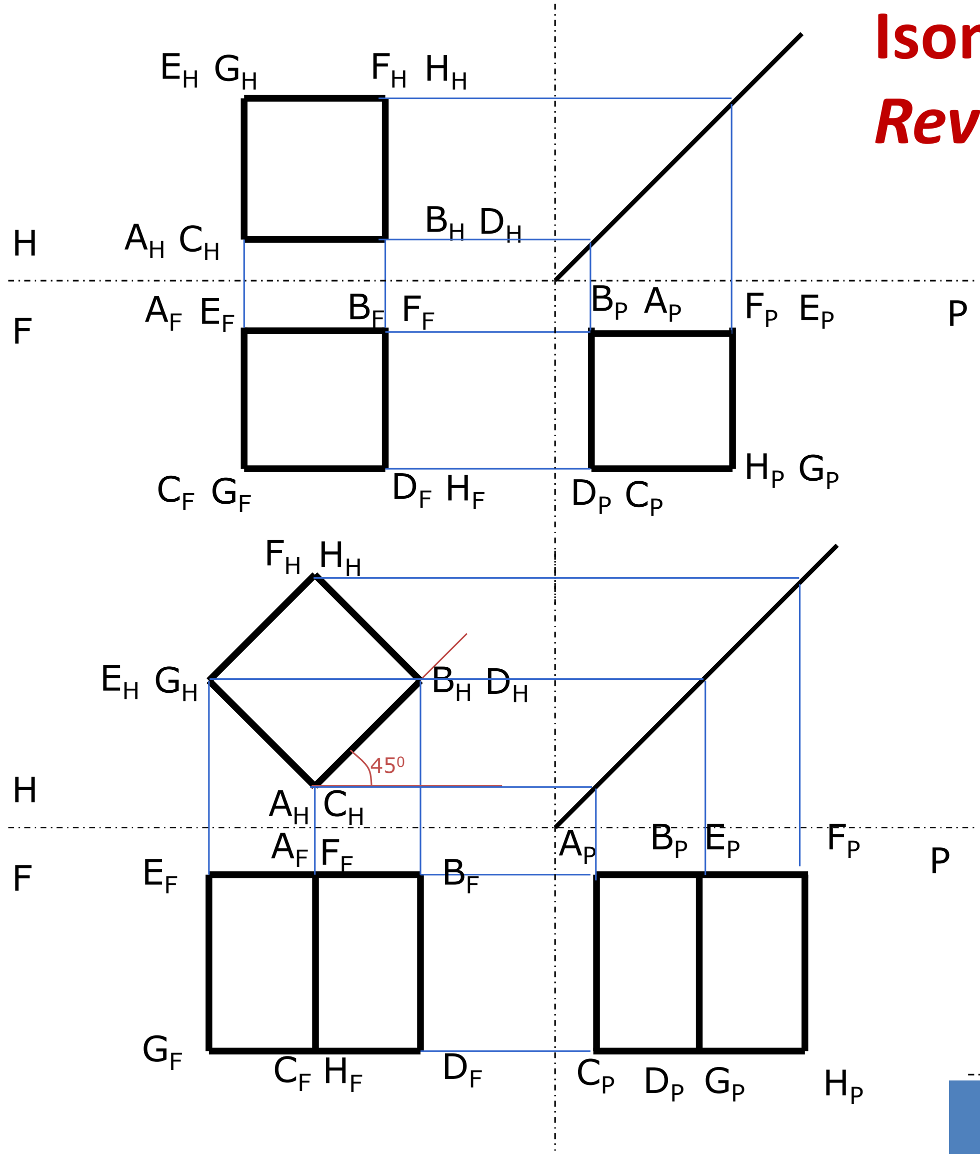
Summary

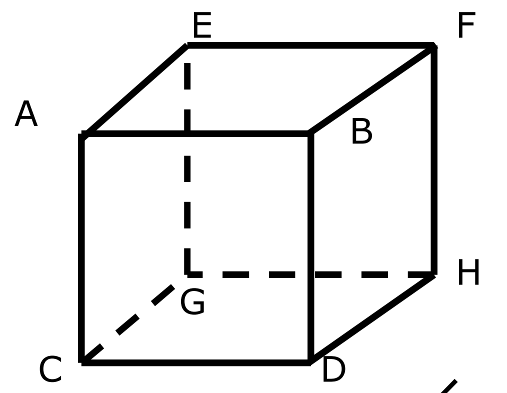


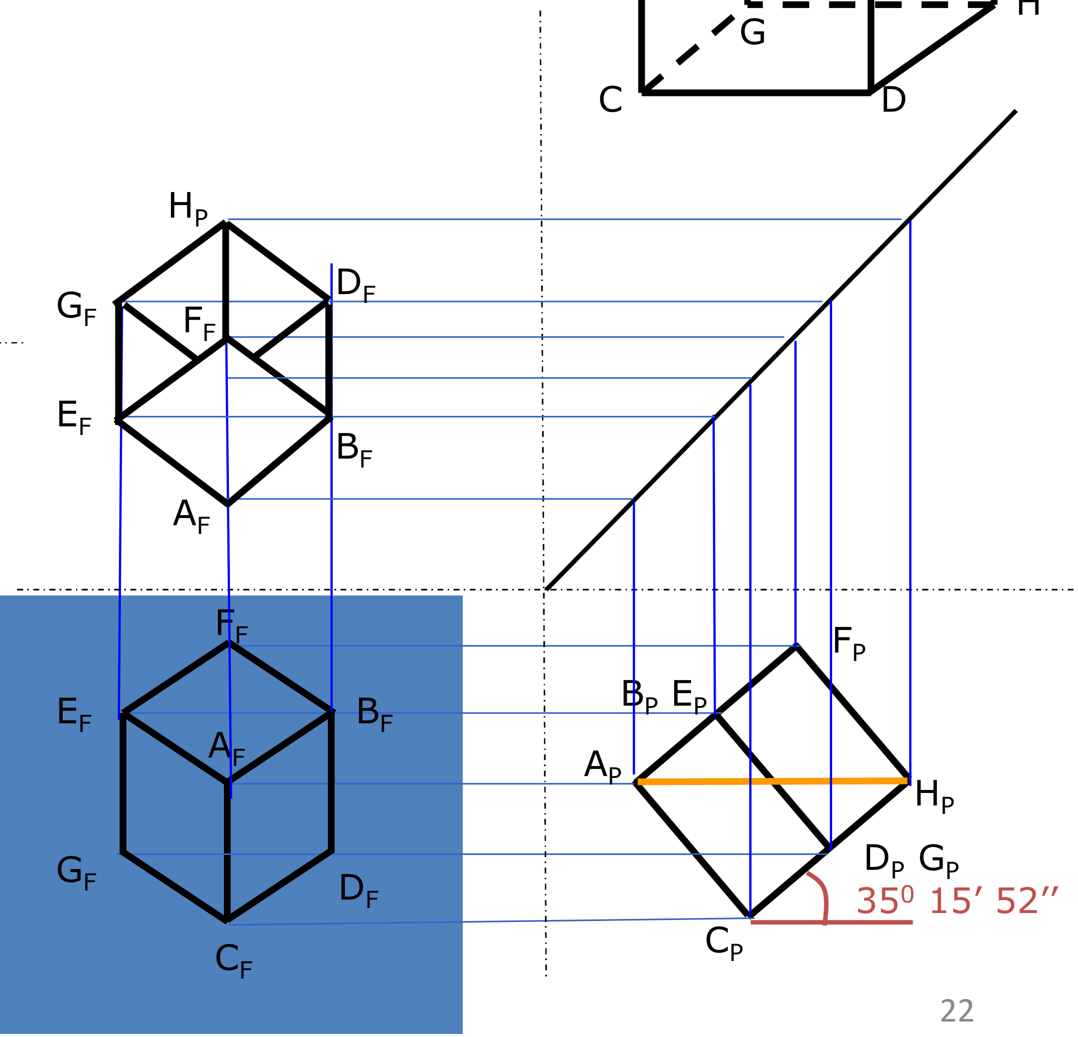
All edges *foreshorten by* a factor of 0.81.

Isometric Projection:

Reviewing The Process Again







Isometric Projection as Seen in the Frontal Plane

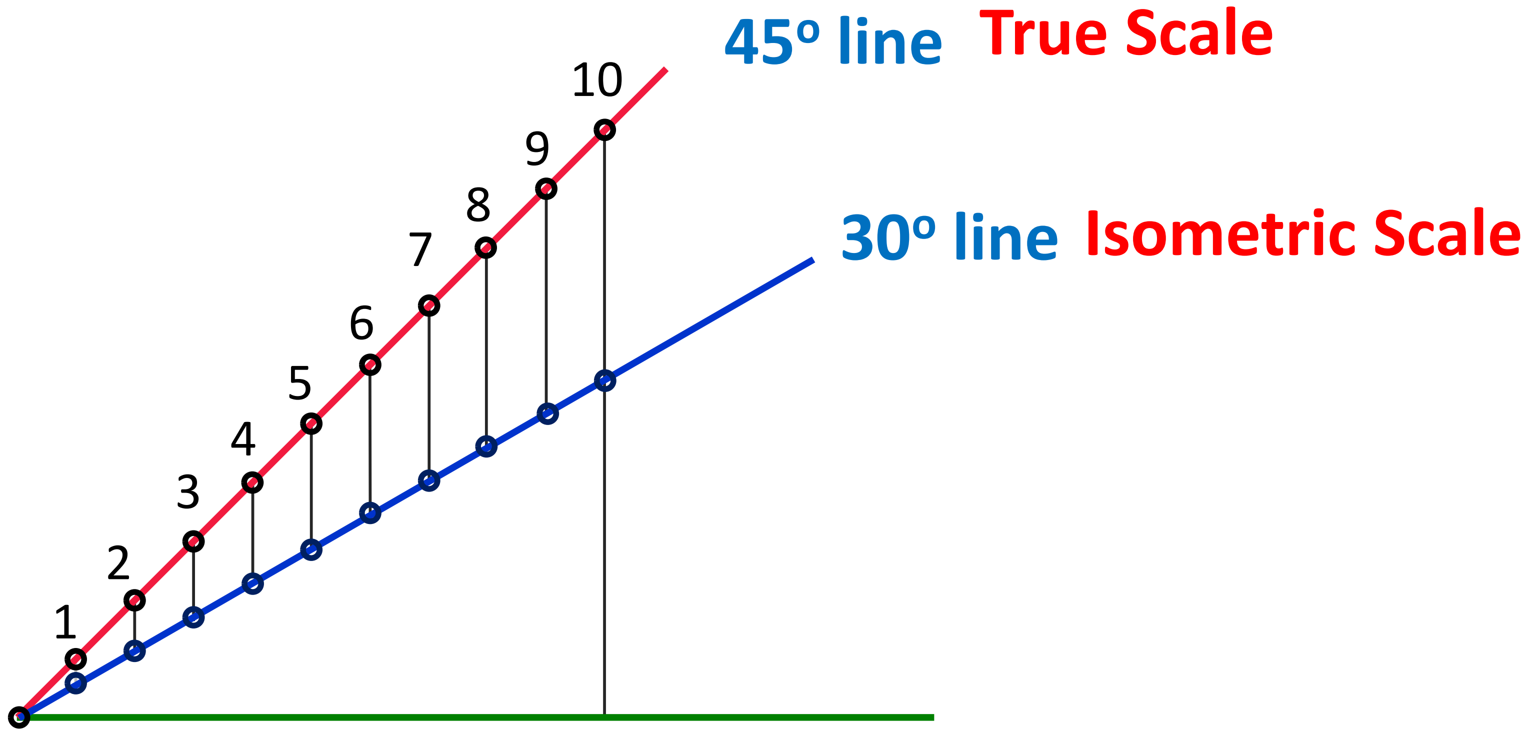
Isometric Projections
and
Isometric Drawings/Views

Isometric Views/Drawings

- Isometric Projection: Described earlier
  - A line which is parallel to isometric axes, and is actually 100 mm long, will be only 81.6 mm long in such projection. Scale: 1:1.225
  - Foreshortening by a factor of 0.81.

- Isometric View/Drawing: Same as isometric projection, BUT
  - No foreshortening.
  - Thus, a line which is parallel to isometric axes, and is actually 100 mm long, will be 100 mm long in such projection. Scale: 1:1
  - Same proportions but larger by a factor of 1.225 in each direction.

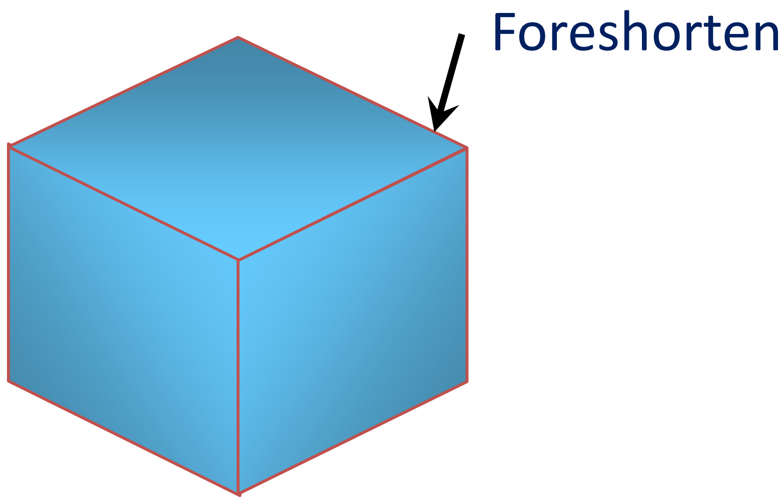
Construction of an Isometric Scale



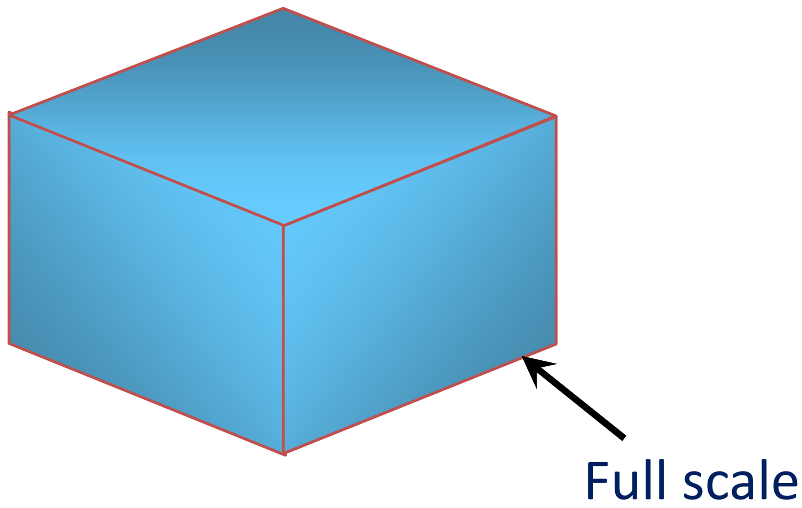
- Isometric Projections: Use Isometric Scale
- Isometric Drawing/View/Sketch: Use Regular/True Scale

Isometric Drawing/View

Isometric Projection



Isometric Drawing



- Isometric Projection: Foreshortened (81/100)
- Isometric Drawing: No foreshortening (100/100)
- No difference in shape

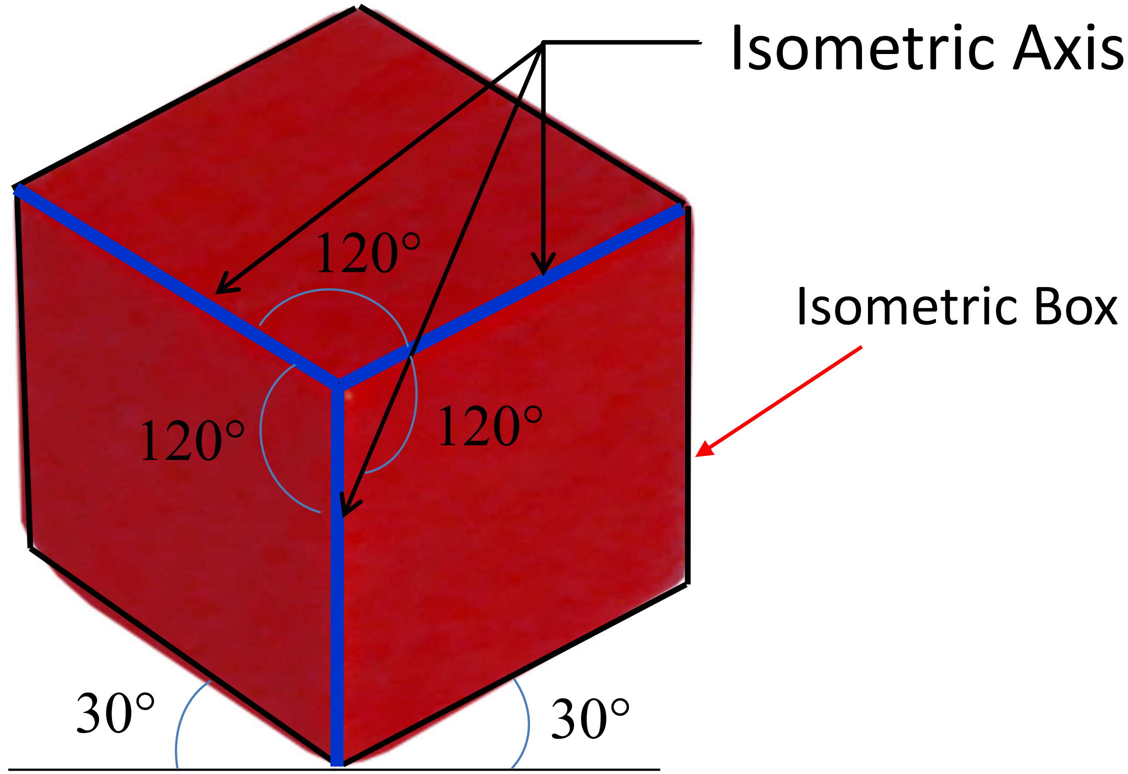
Isometric Axes

Isometric Lines

Isometric Faces

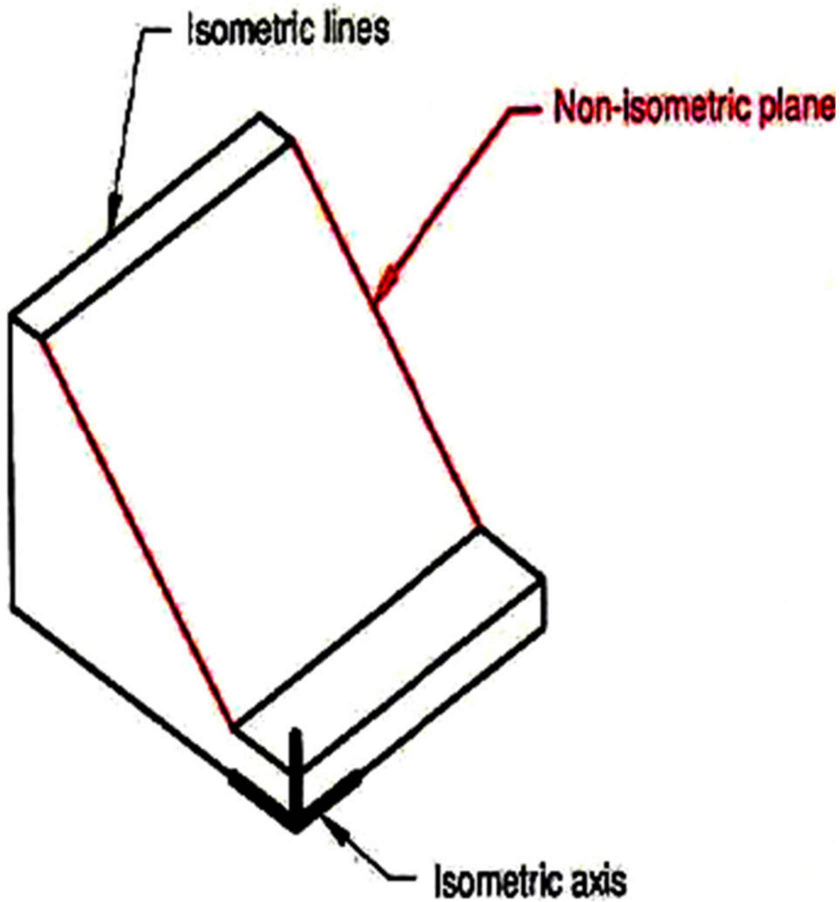
Axes-Lines-Faces

- Each edge of the cube is parallel to one of the **isometric axes**.
- Any line that is parallel to an isometric axis is called an **isometric line**.
- All faces of the cube, and all planes parallel to these are termed isometric planes.

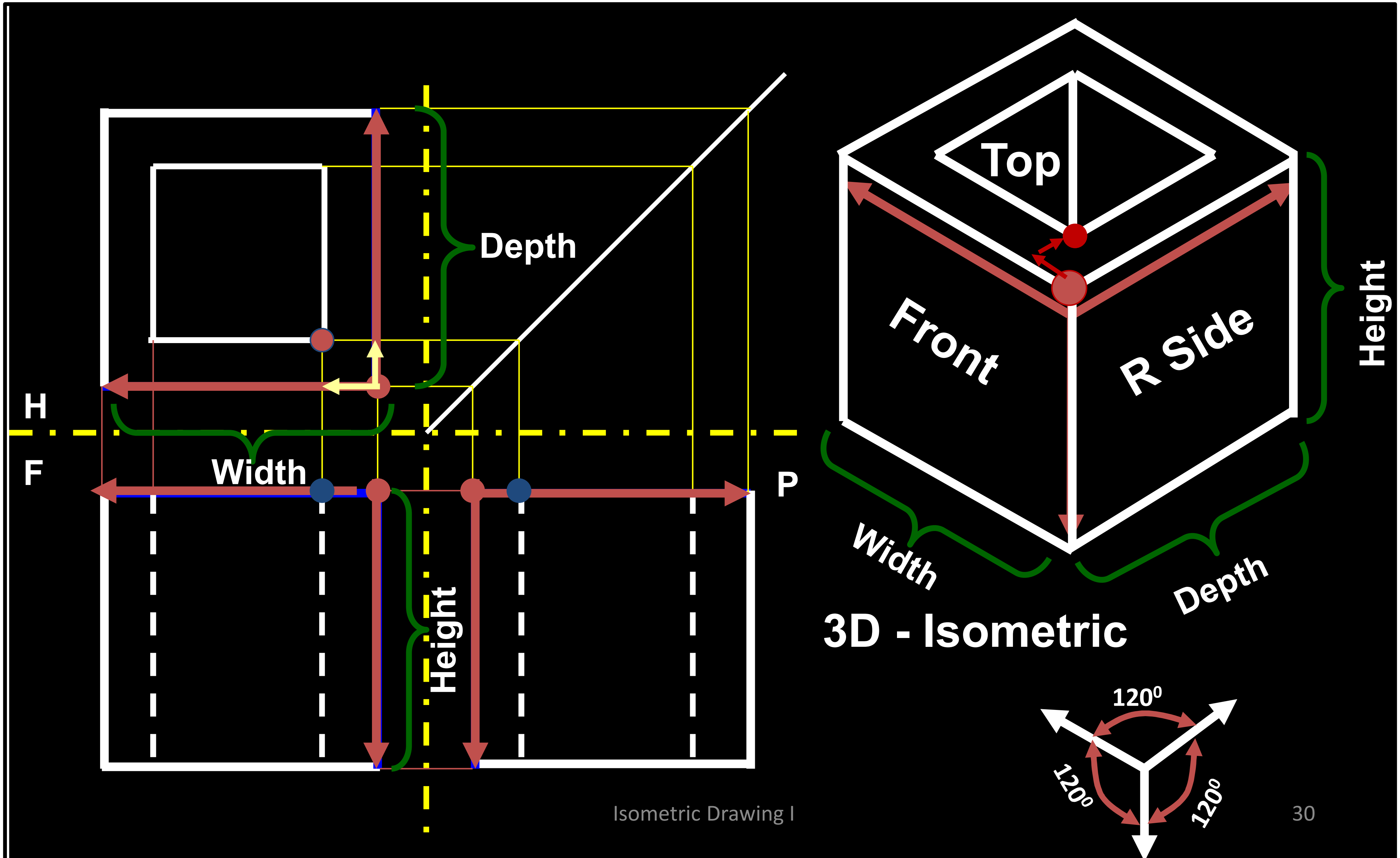


Be Careful

- In isometric projection or drawings, distances are to be measured only along isometric lines/axes.
- Any line that does not run parallel to an isometric axis is **non-isometric**.
- Length of such lines cannot be measured directly.
- The lengths are measured by using advanced techniques.

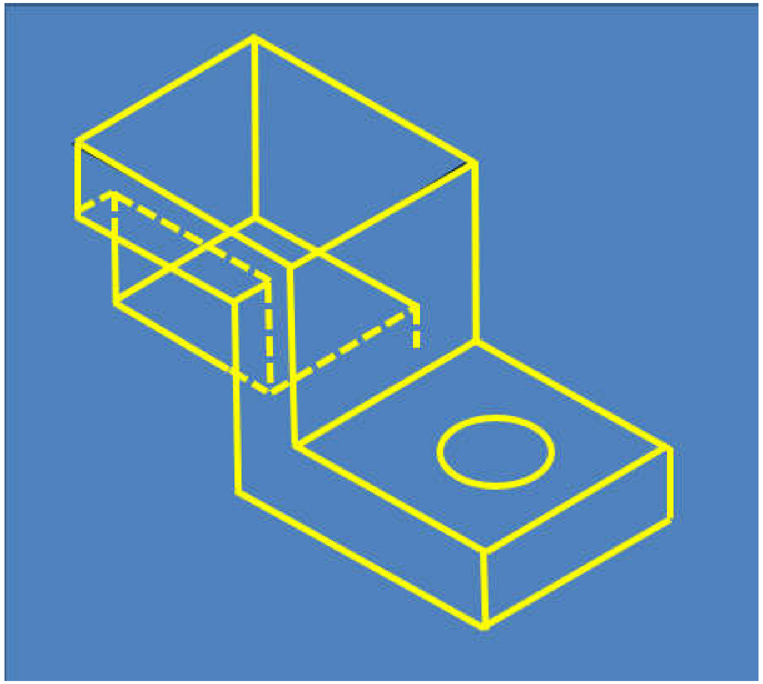


Making Isometric Drawing - Axis, Views & Dimensions



Representing Hidden Lines

- **Usually**, hidden lines are not shown in isometric sketches.
- Chose an appropriate orientation such that hidden line can be avoided.
- Holes are assumed to go completely through the body, unless their depth is indicated with a note.



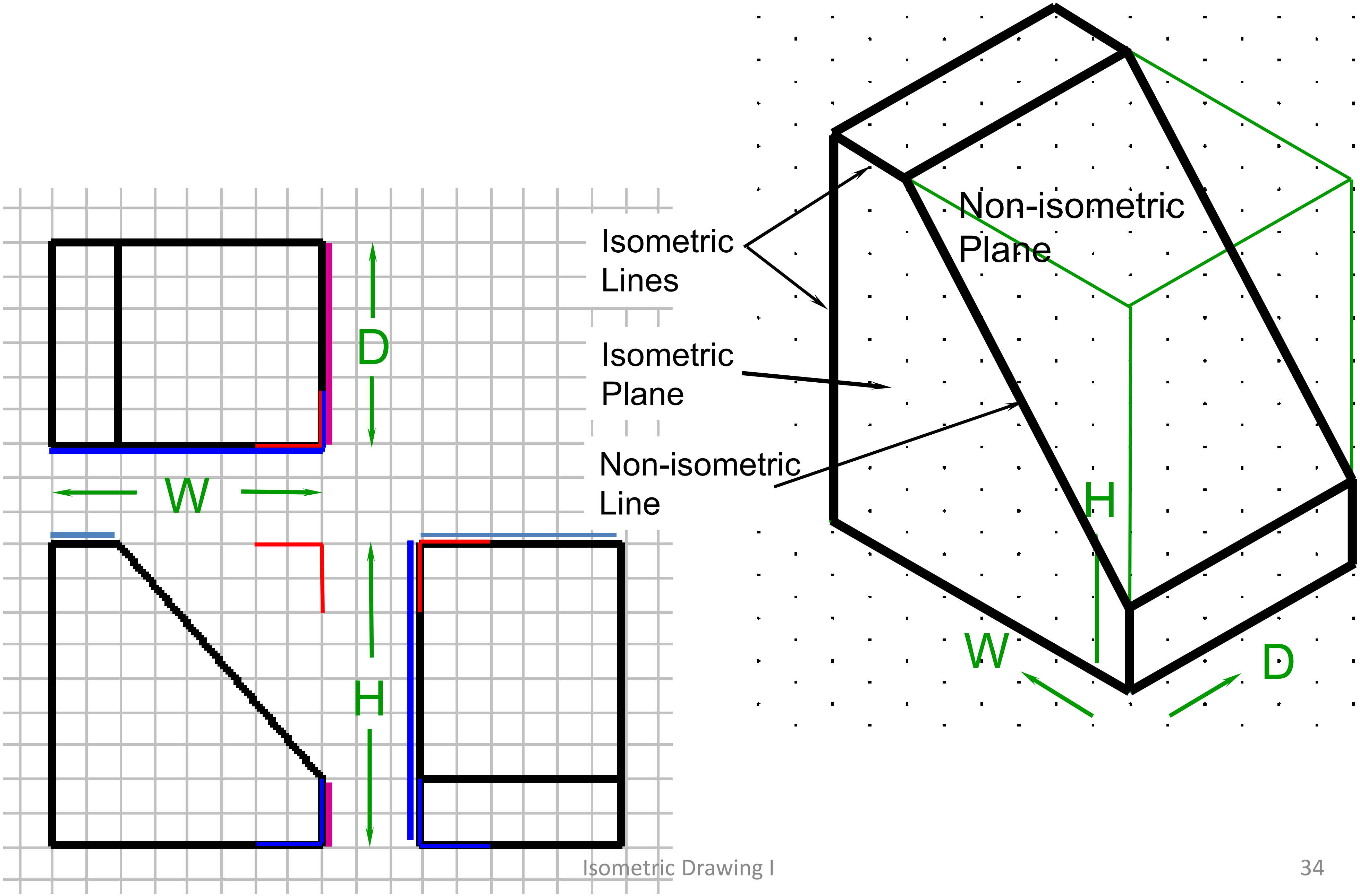
Creating Isometric Drawings

- Boxing Method
  - Orthographic projections of the object are drawn.
  - Now, size of a rectangular box in which the object will fit is determined.
  - Such a box is then drawn in isometric format.
  - Finally, the actual object is depicted in the box by locating its key points in such a box.

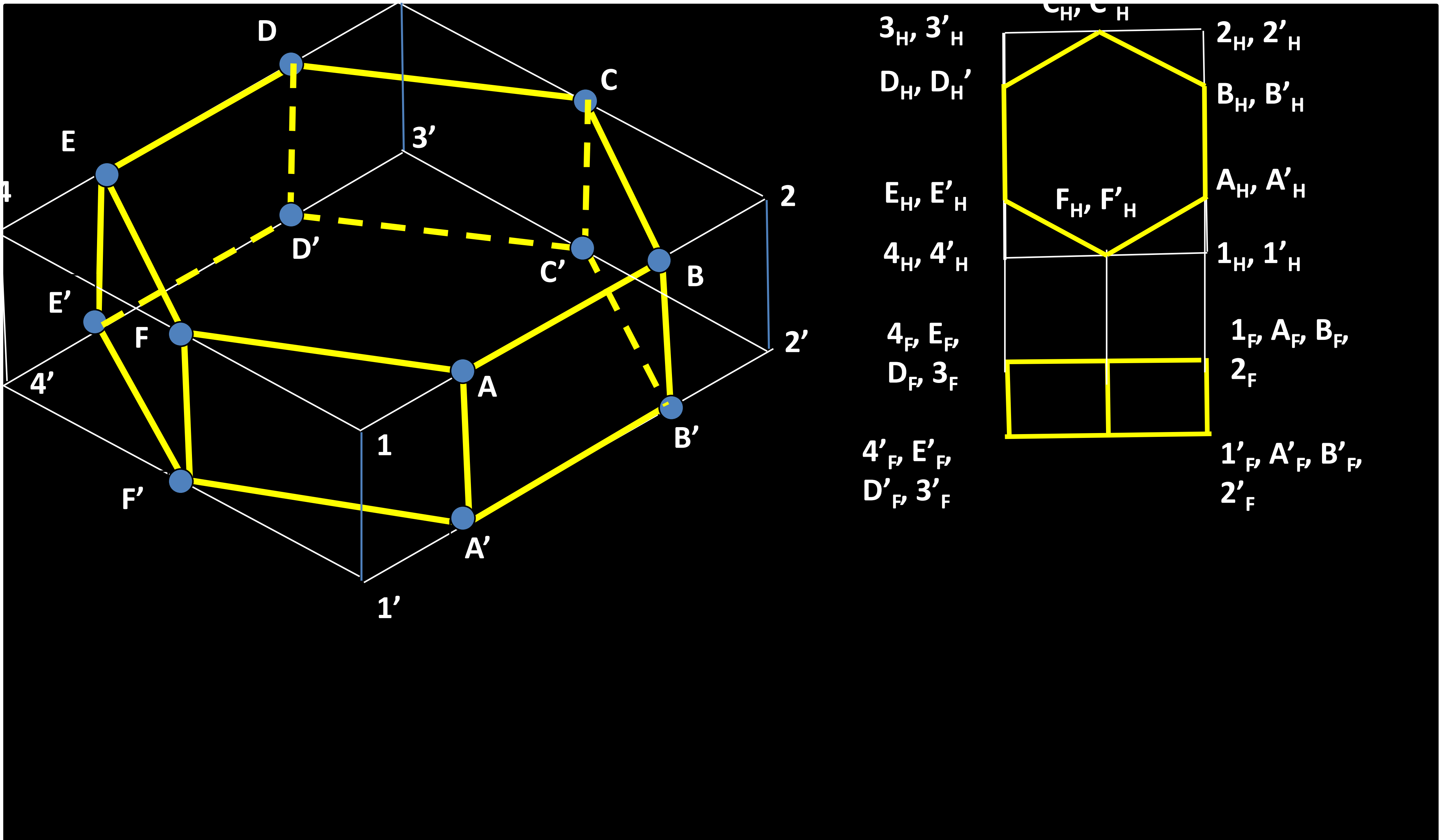
Creating Isometric Drawings

- Offset Method: Useful when the object has several features which cannot be directly related to non-isometric planes.
  - First, locate the points on the base plane (isometric plane)
  - Next, perpendicular (isometric lines) are drawn from these points for a given height dimension.

The Boxing Method

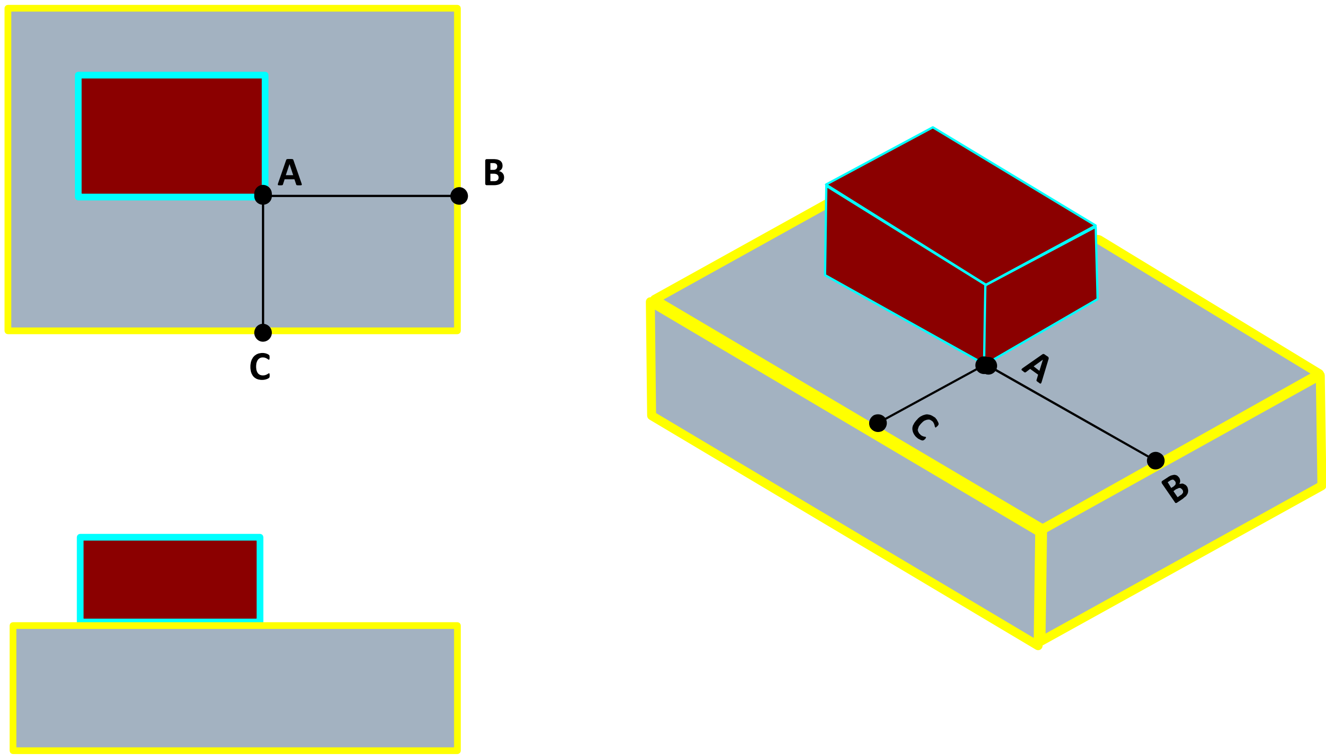


Another example



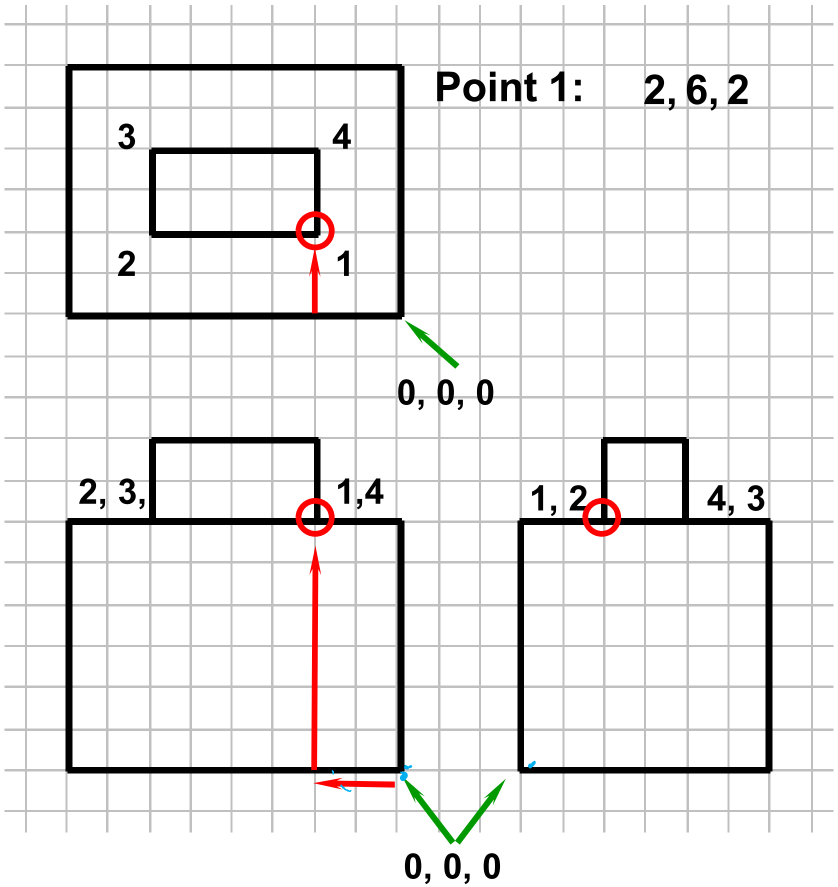
Locating Features

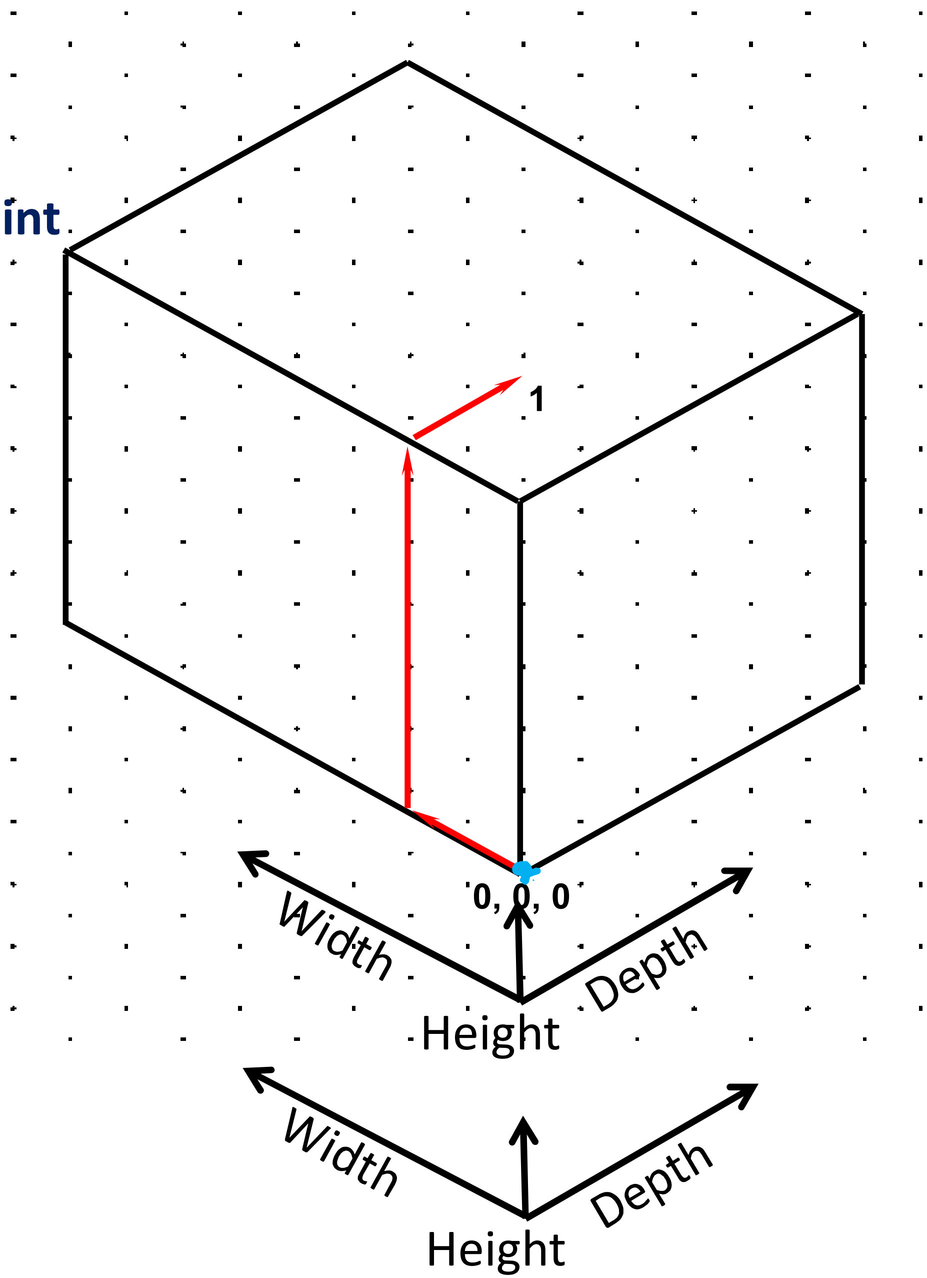
- To locate a feature such as the upper block, make measurements from an existing corner as shown below.



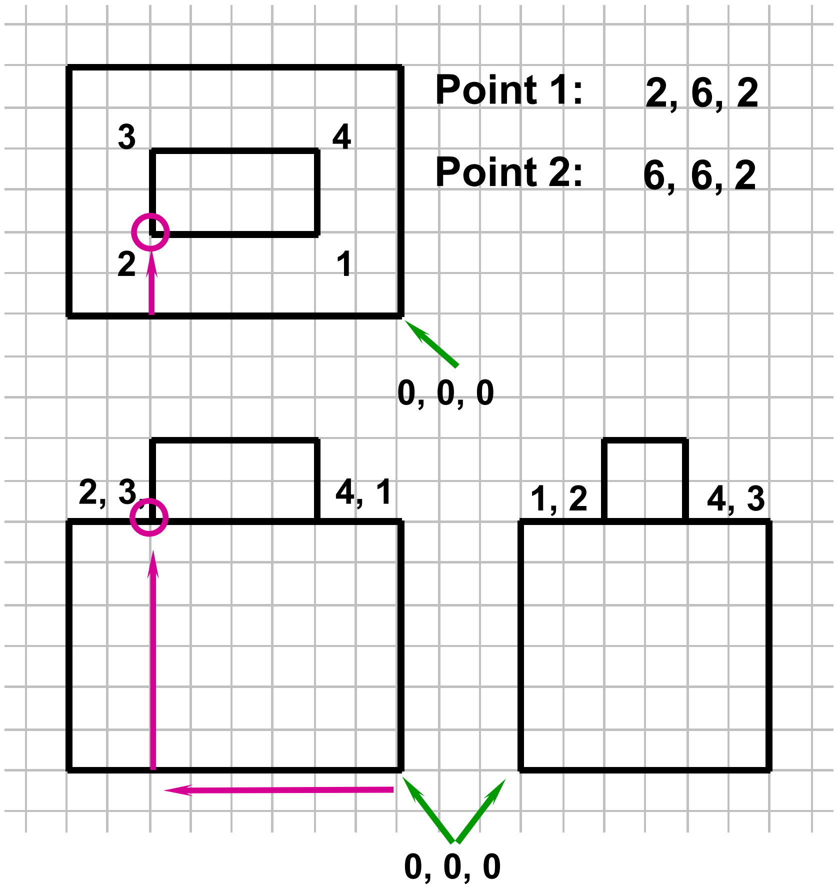
Plotting Points

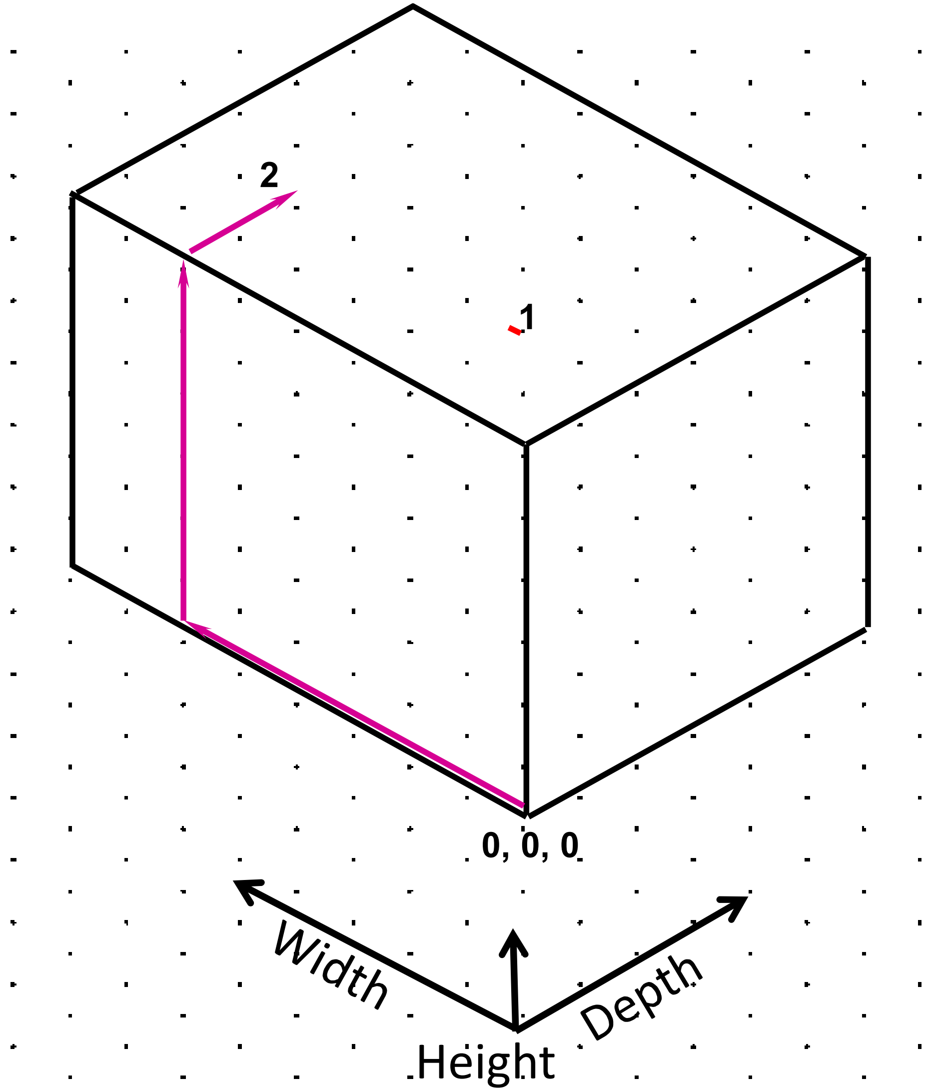
1. Number the plane you want to locate.
2. Number the plane in the other views.
3. Locate the plane in the isometric view point by point



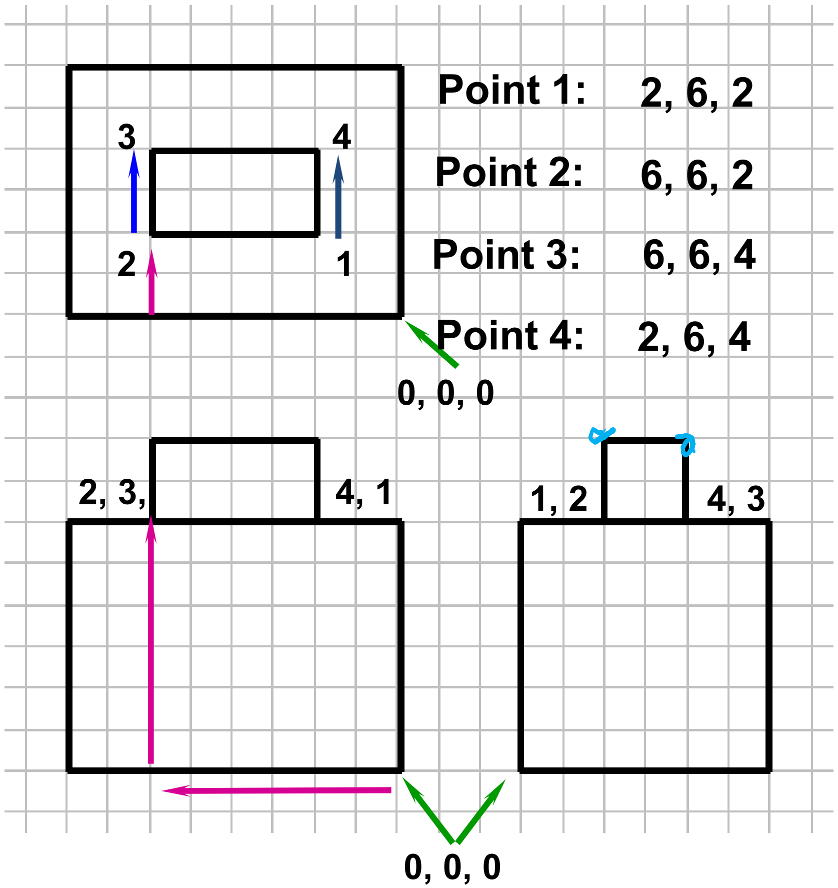


Plotting Points

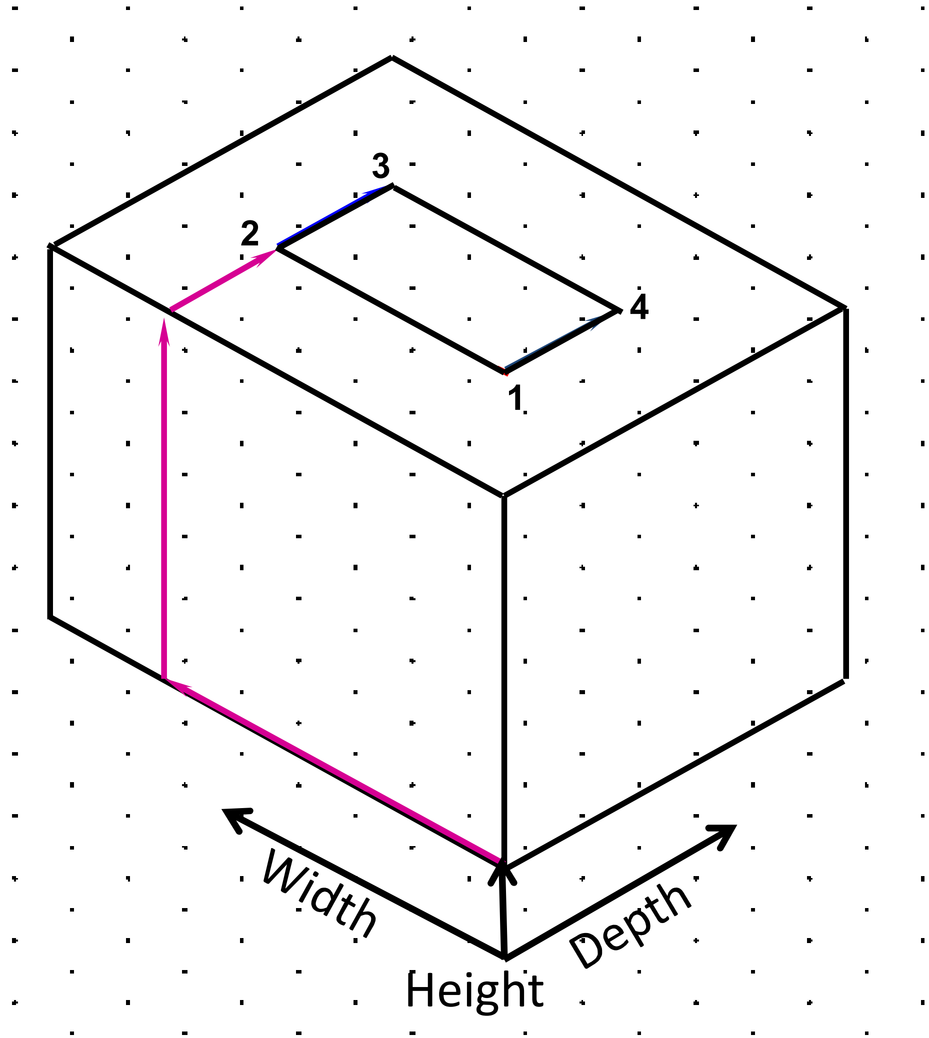




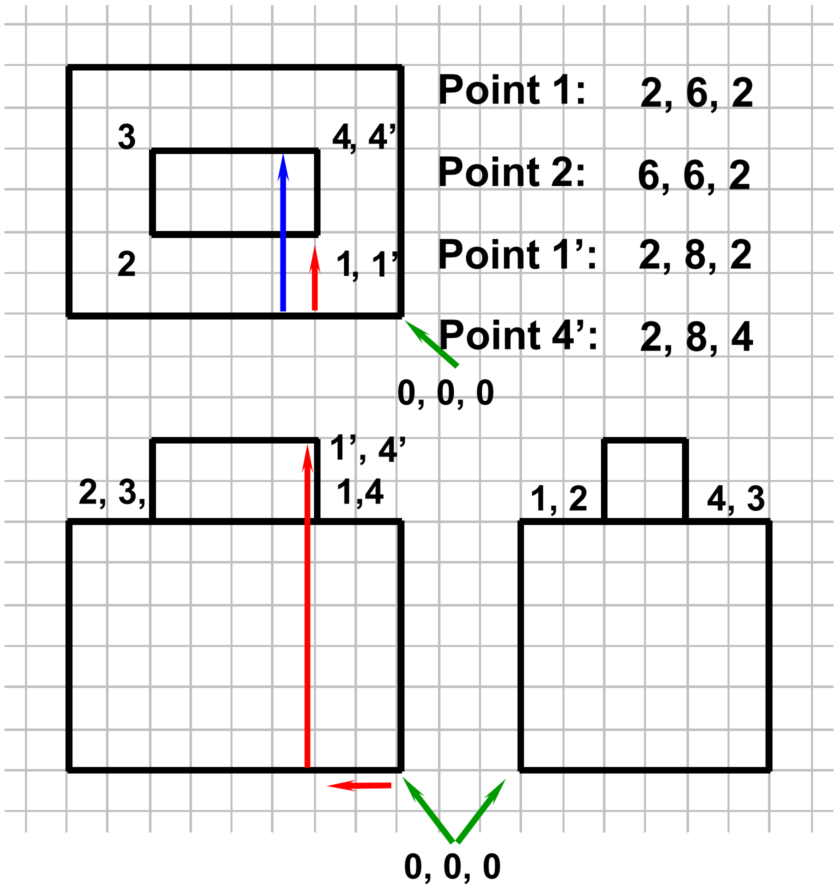
Plotting Points

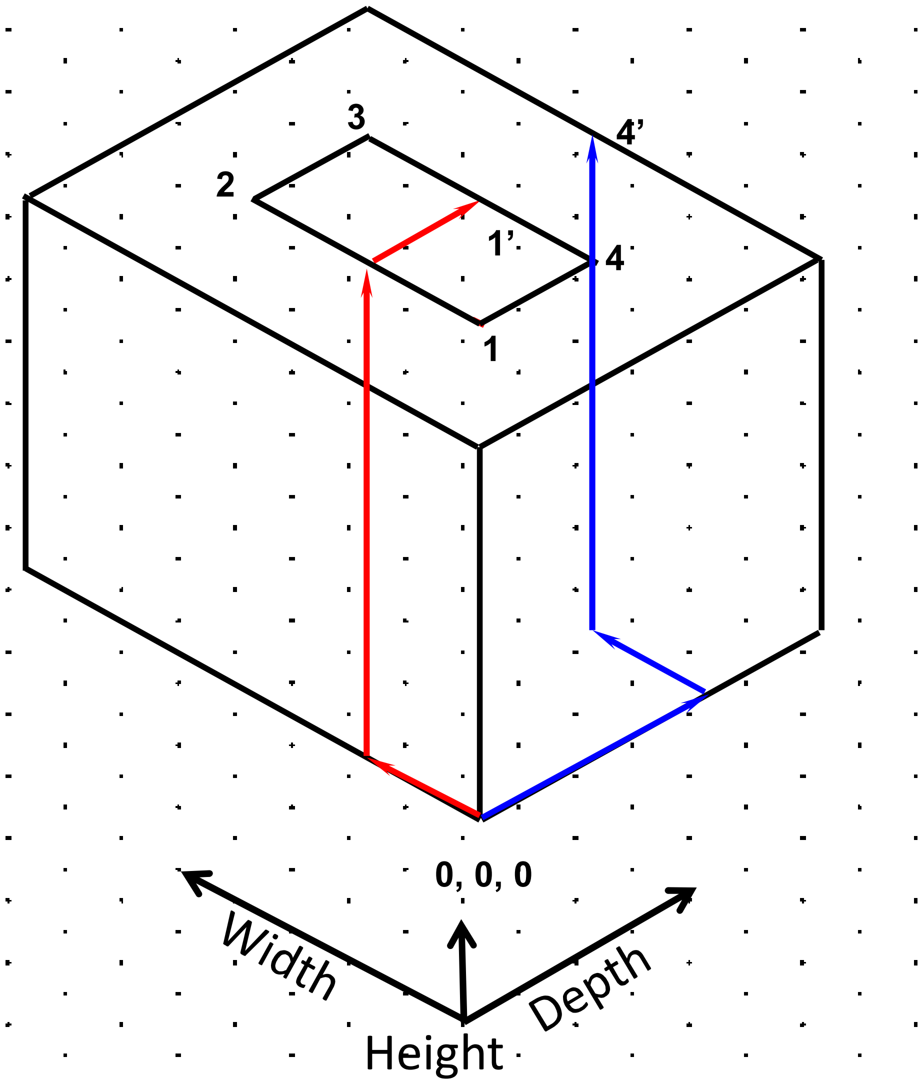


Point 1:	2, 6, 2
Point 2:	6, 6, 2
Point 3:	6, 6, 4
Point 4:	2, 6, 4

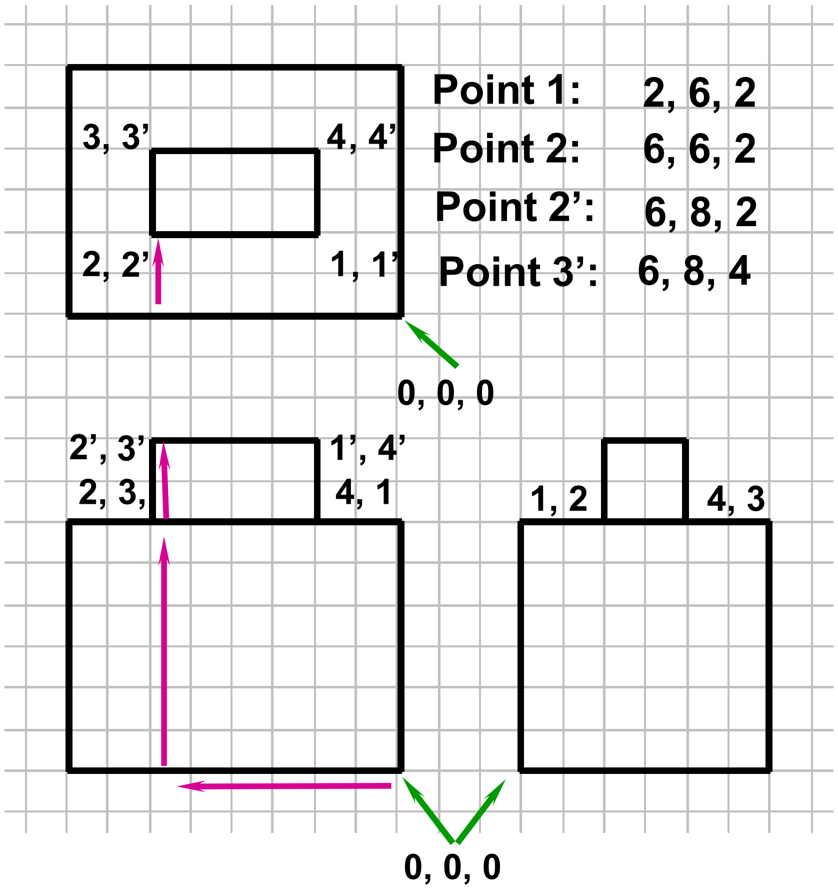


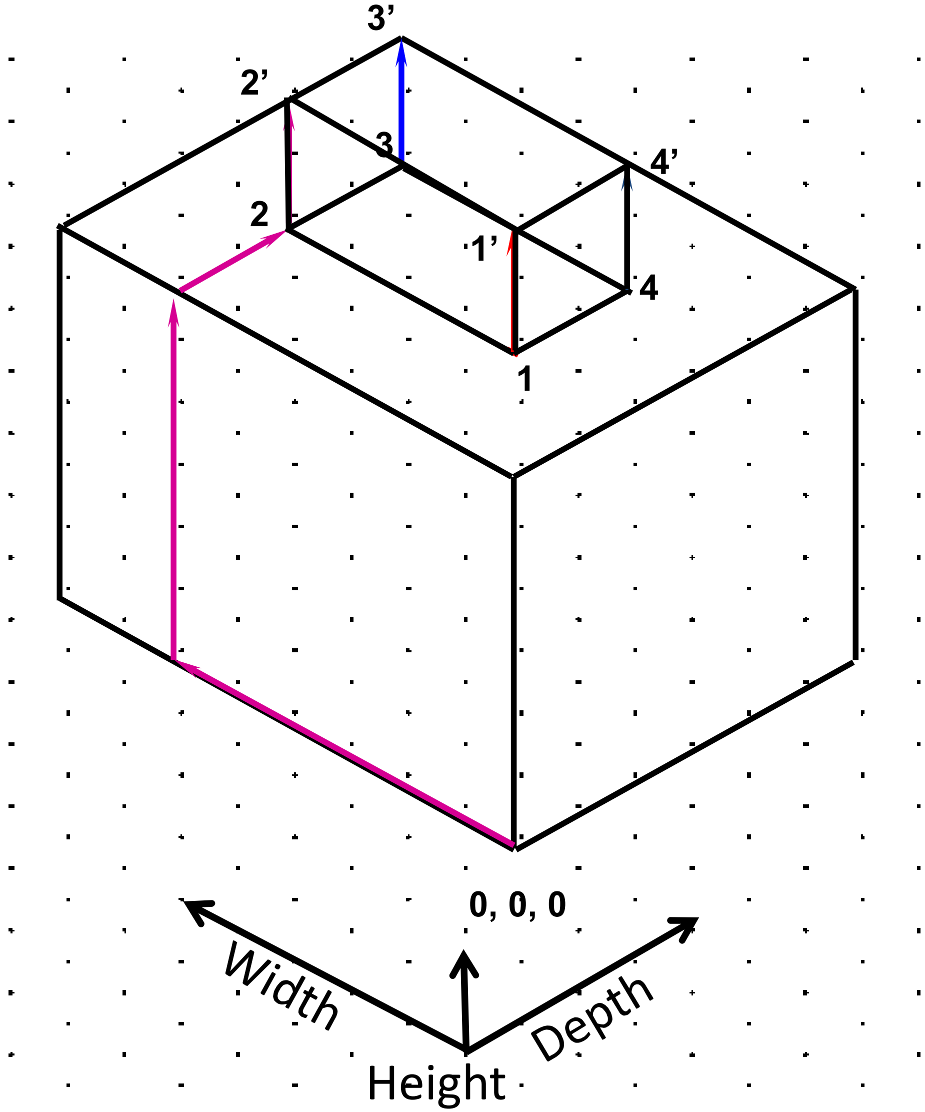
Plotting Points



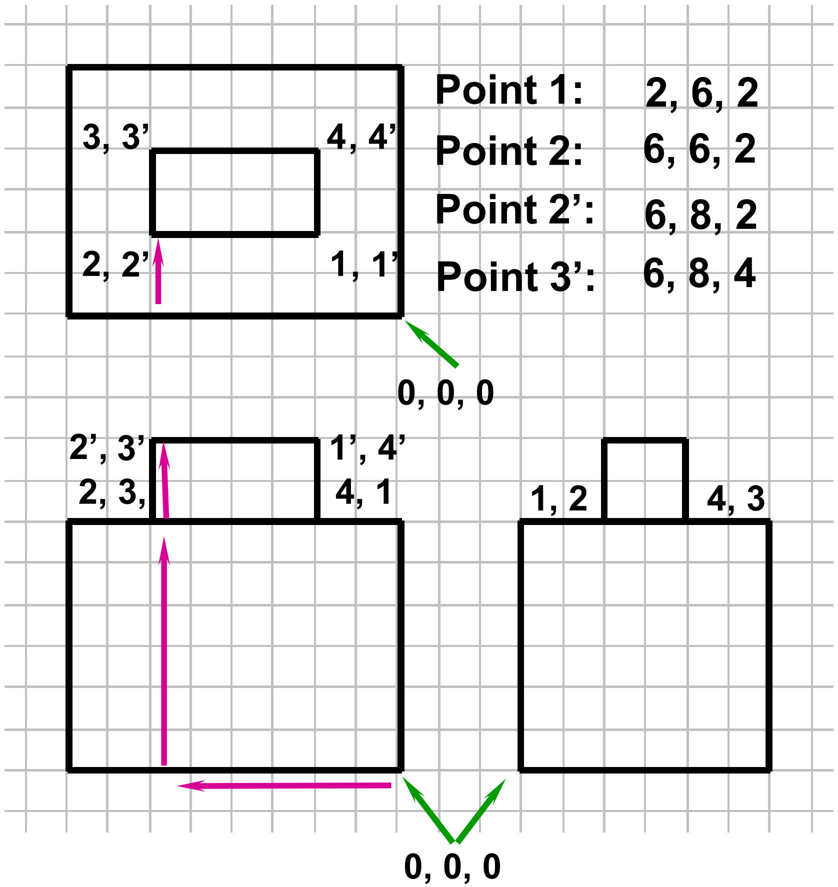


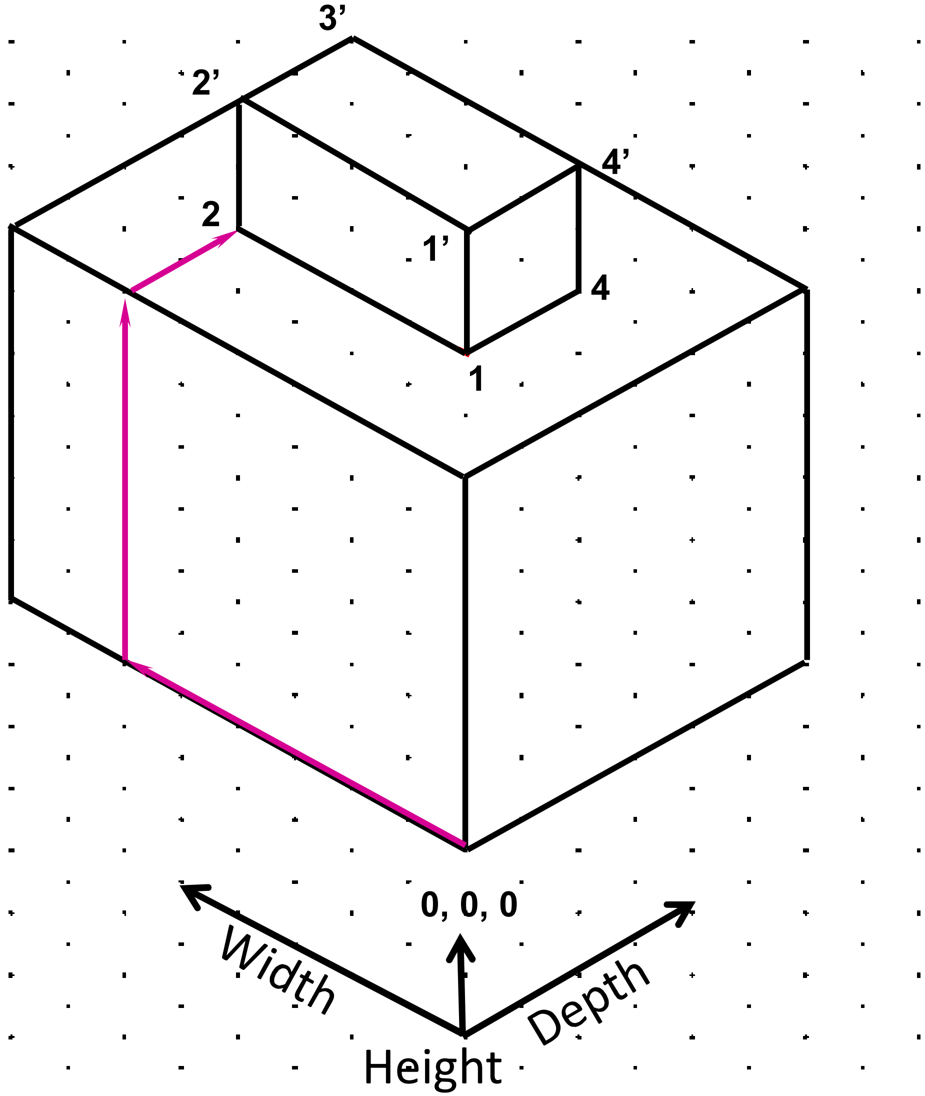
Plotting Points





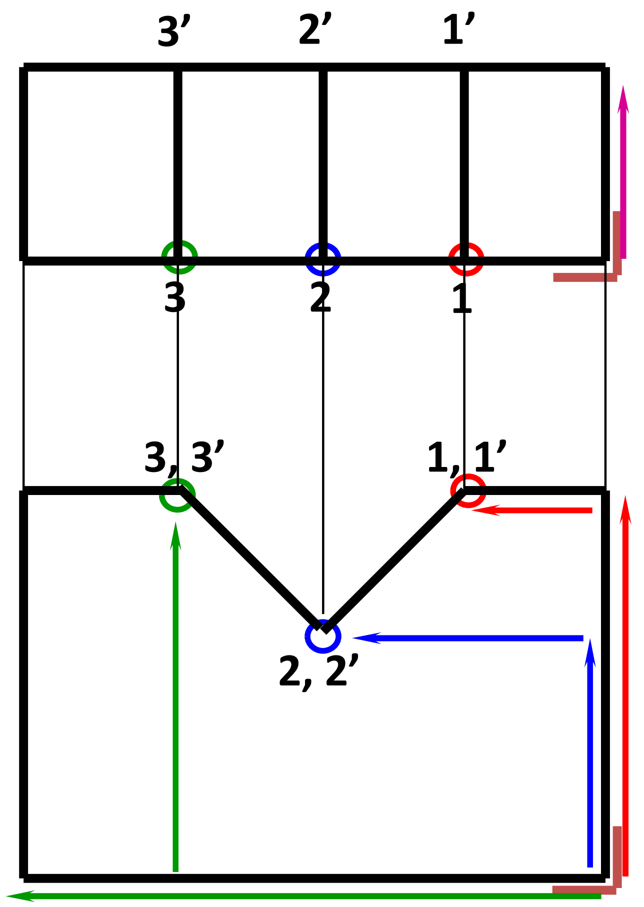
Plotting Points

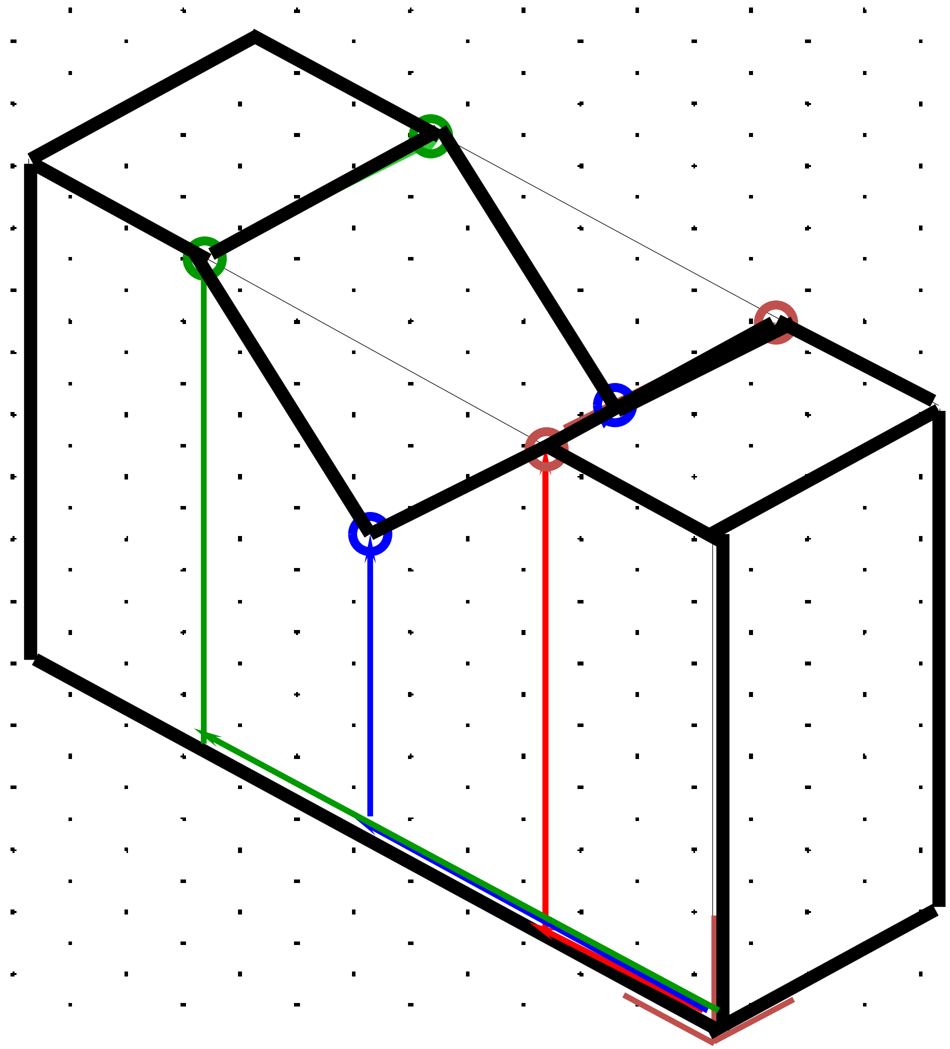




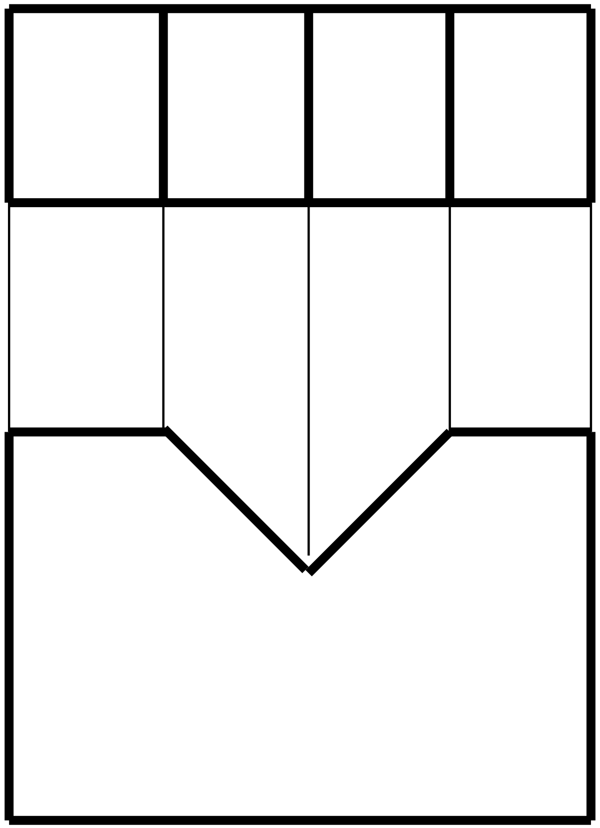
Making Isometric Drawing

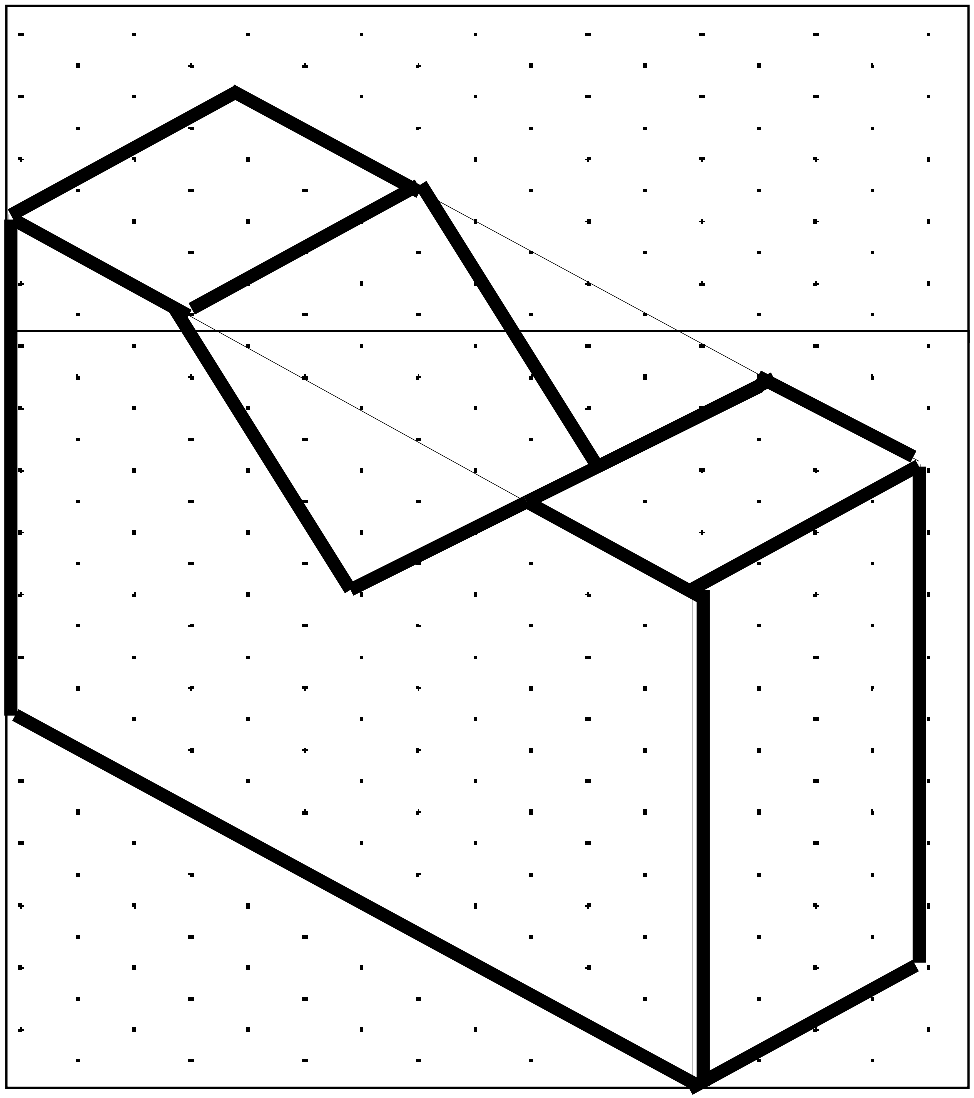
1. Number points.
2. Locate axis (0,0,0) (W,H,D)
3. Locate each point.
4. Connect points
5. Darken appropriate lines.





Making Isometric Drawing

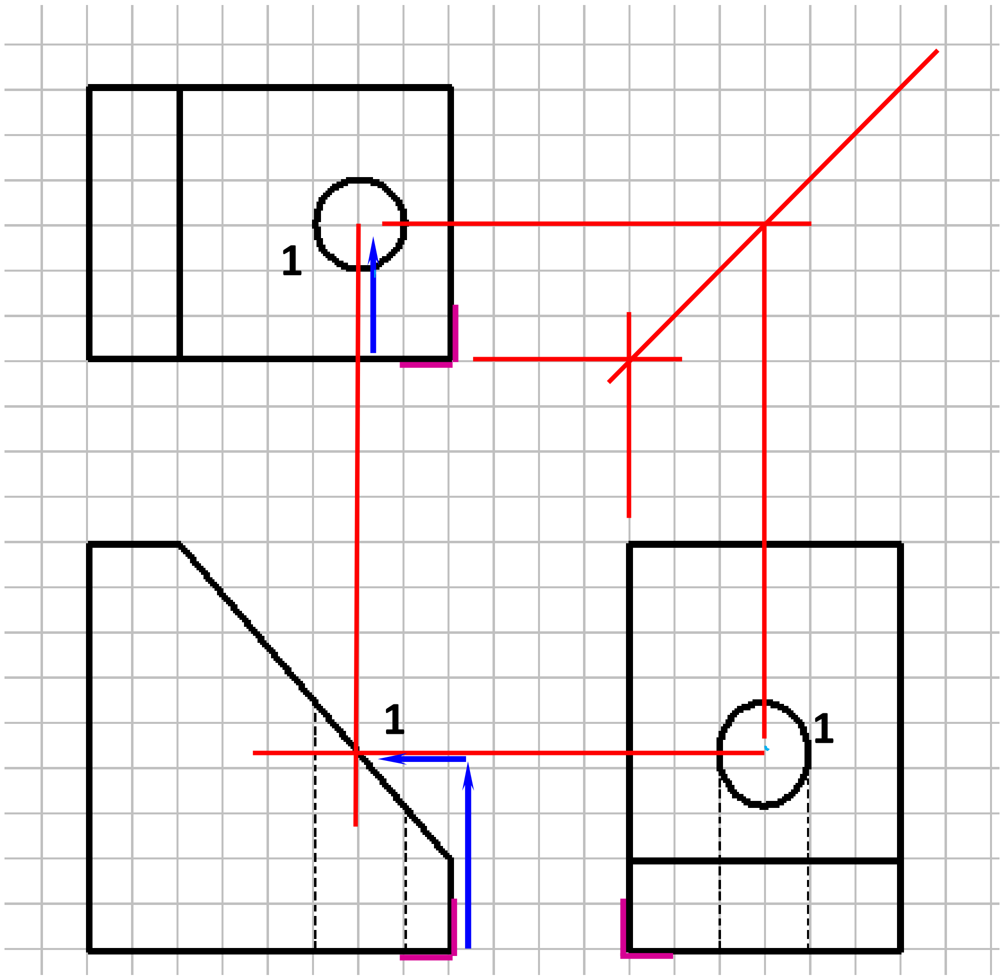


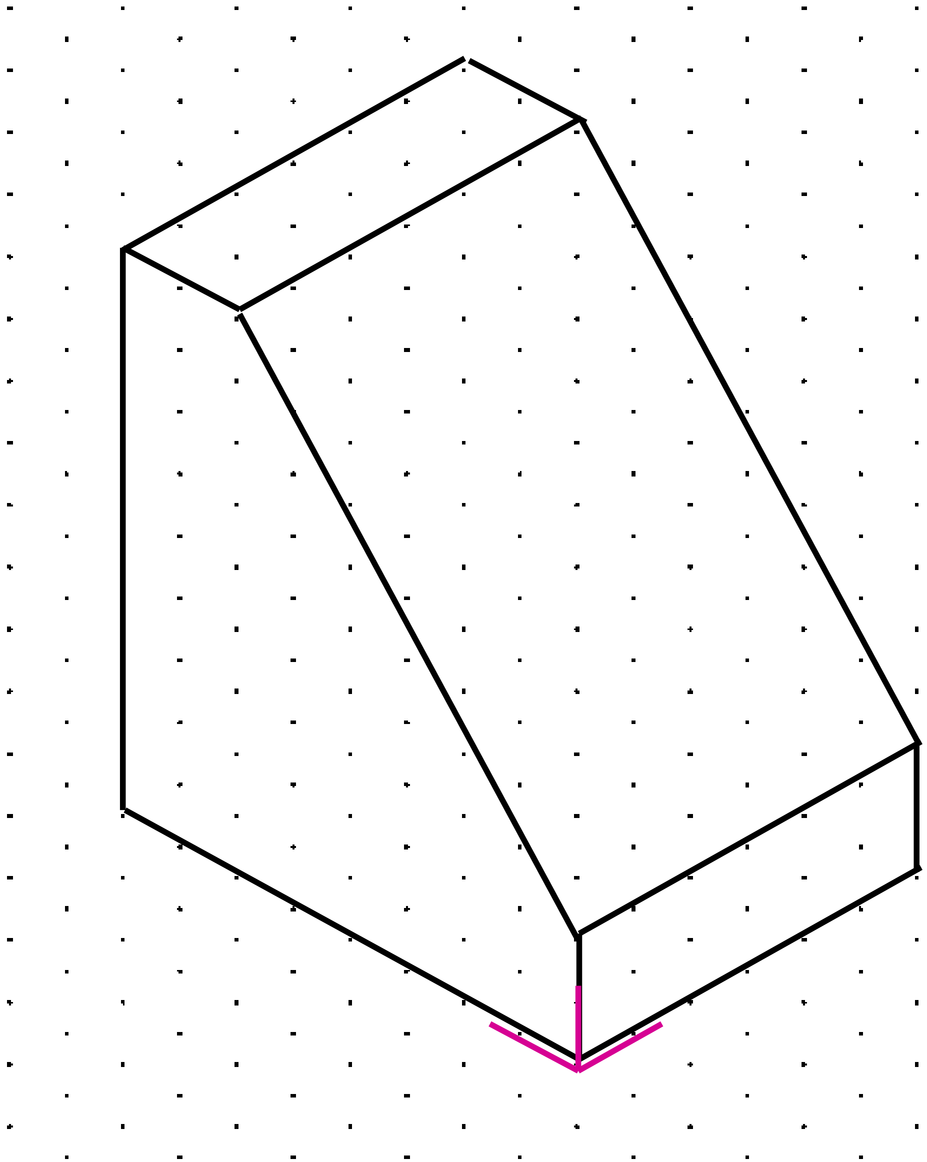


Locating on a Non-isometric Plane

Locate the center of the circle.

Point 1 coordinates? 2, 4, 3





Locating on a Non-isometric Plane

Locate the center of the circle.

Point 1 coordinates? 2, 4, 3