Acknowledgement

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  - Prof. S.C. Mishra, IIT Guwahati
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ME 111: Engineering Drawing

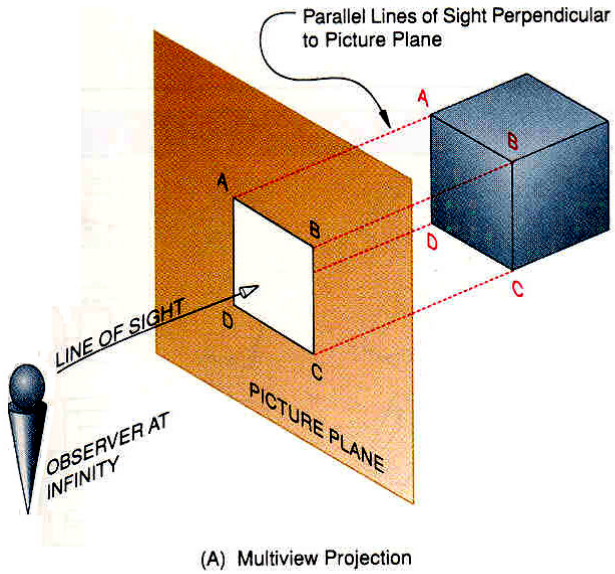
Date: 17/10/2011
Lecture 15
Isometric Projections

Indian Institute of Technology Guwahati
Guwahati – 781039

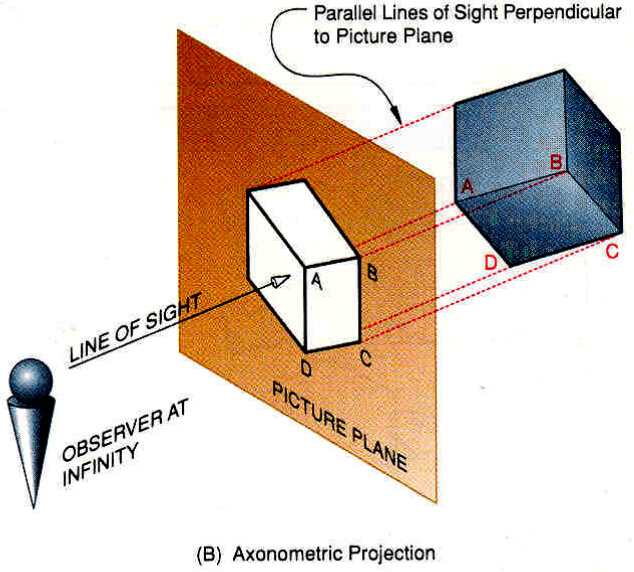
Announcement

- Makeup lab class (Lab 12):
  - Inform the respective Tutor one week before lab 12 or during lab 11, about the lab (only one) you want to perform as makeup class.
  - Give Your Name, Roll No., Group No. and Lab details

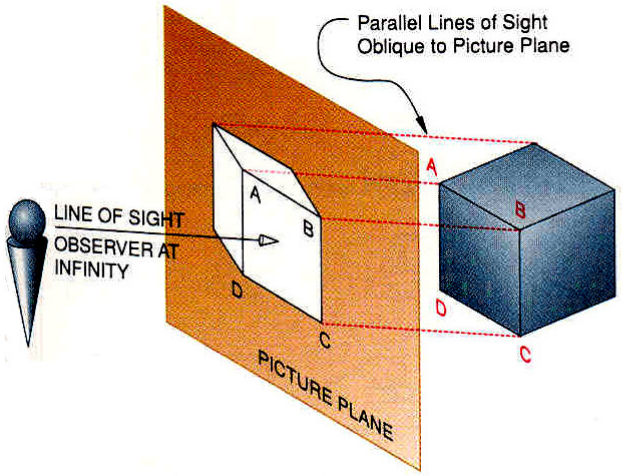
- End semester examination:
  - 19th Nov. 2011 (Saturday), and
  - 20th Nov. 2011 (Sunday)



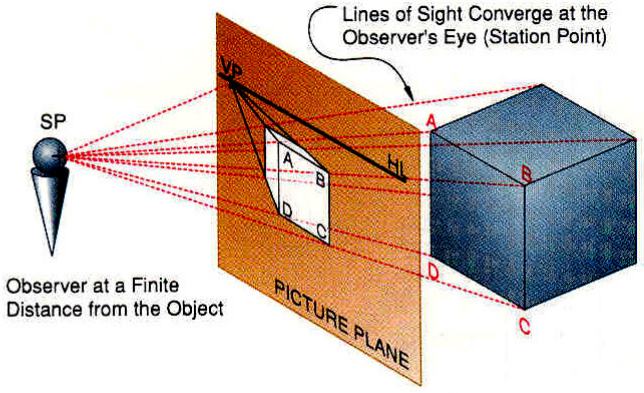
(A) Multiview Projection



(B) Axonometric Projection



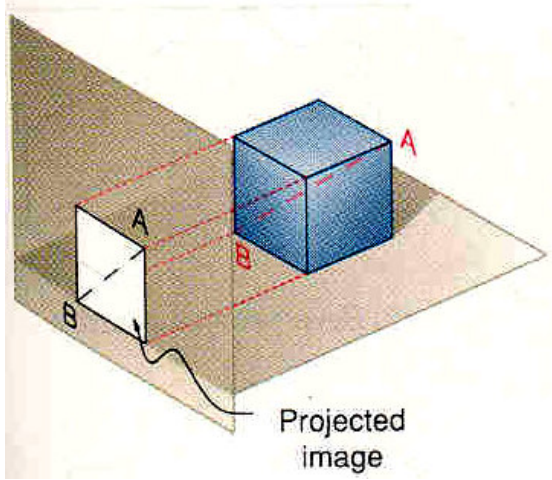
(C) Oblique Projection

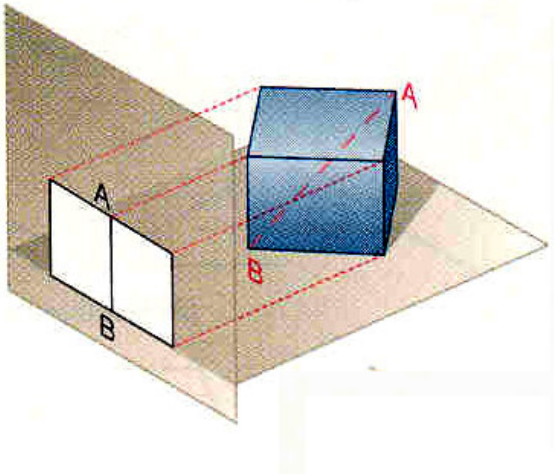


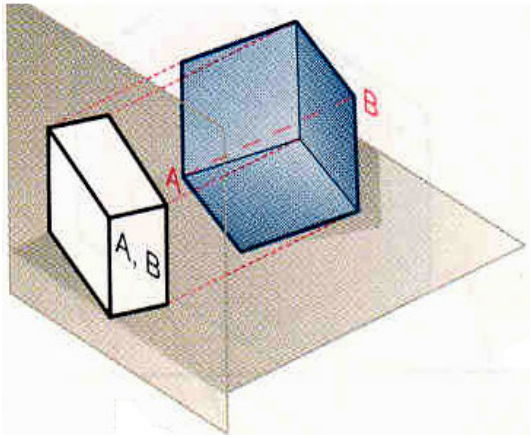
(D) Perspective Projection

The axonometric projection is produced by multiple parallel lines of sight perpendicular to the plane of projection, with the observer at infinity and the object rotated about an axis to produce a pictorial view

Axonometric projection - is a parallel projection technique used to create a pictorial drawing of an object by rotating the object on an axis relative to a *projection* or *picture plane.*



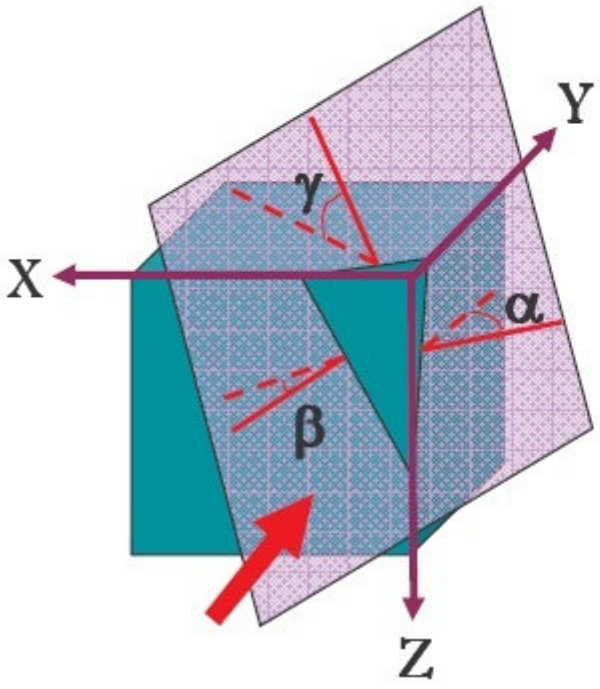




The differences between a multiview drawing and an axonometric drawing are that, in a multiview, only two dimensions of an object are visible in each view and more than one view is required to define the object; whereas, in an axonometric drawing, the object is rotated about an axis to display all three dimensions, and only one view is required.

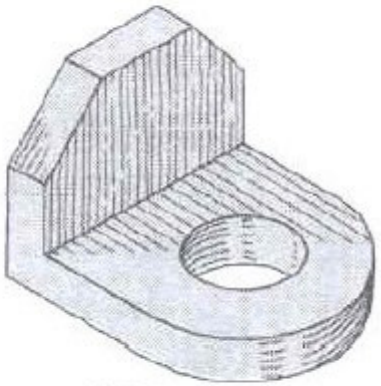
Viewing Planes

- Axonometric Projections
  - Viewing plane NORMAL to viewing/projection lines



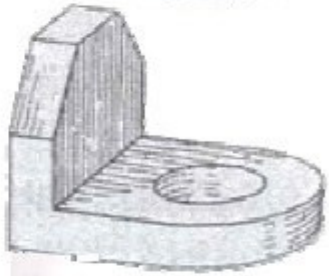
Isometric

$\alpha = \beta = \gamma$



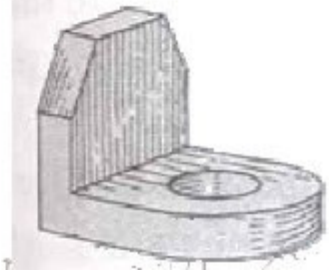
Dimetric

$\alpha = \beta \neq \gamma$



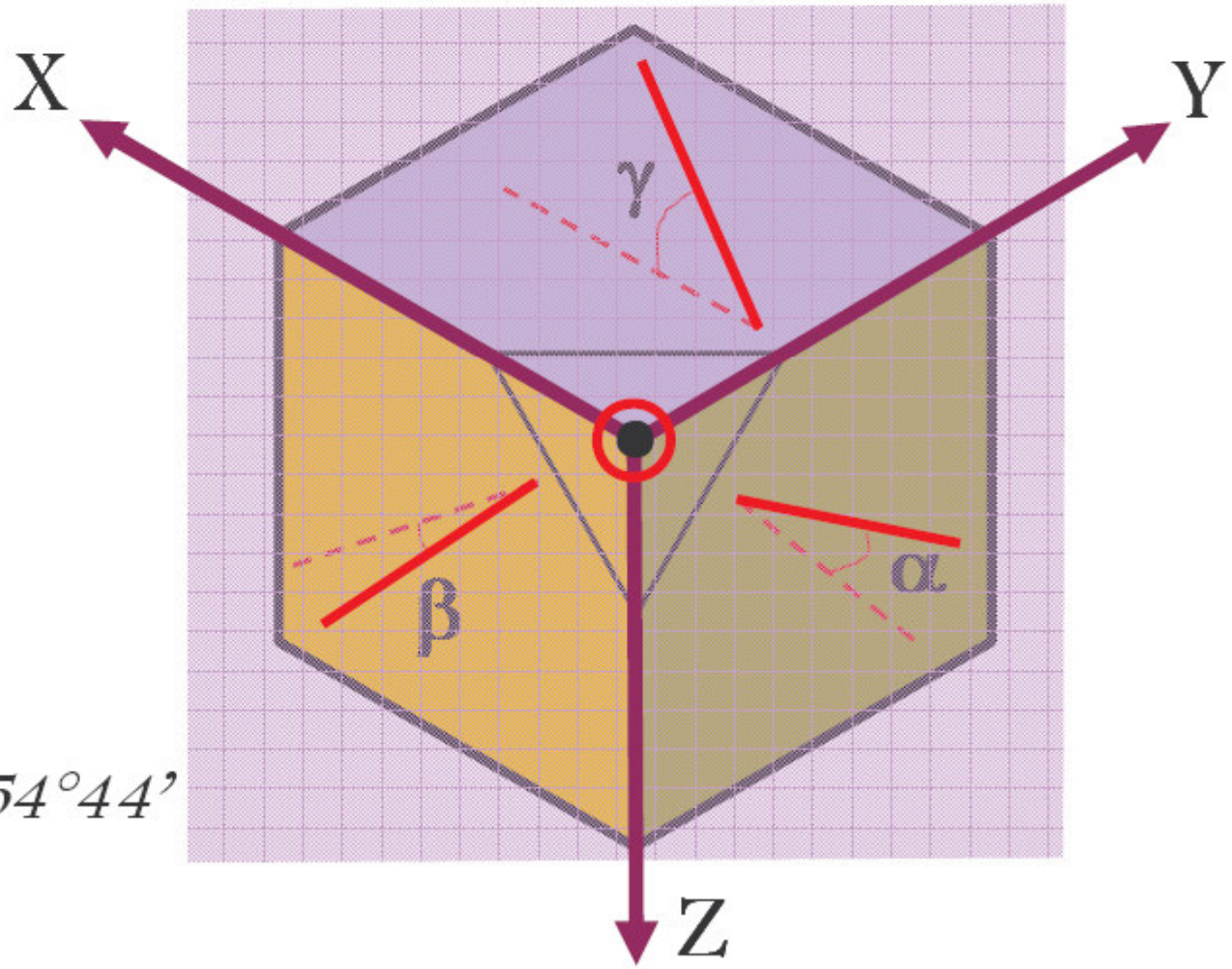
Trimetric

$\alpha \neq \beta \neq \gamma$



Isometric View

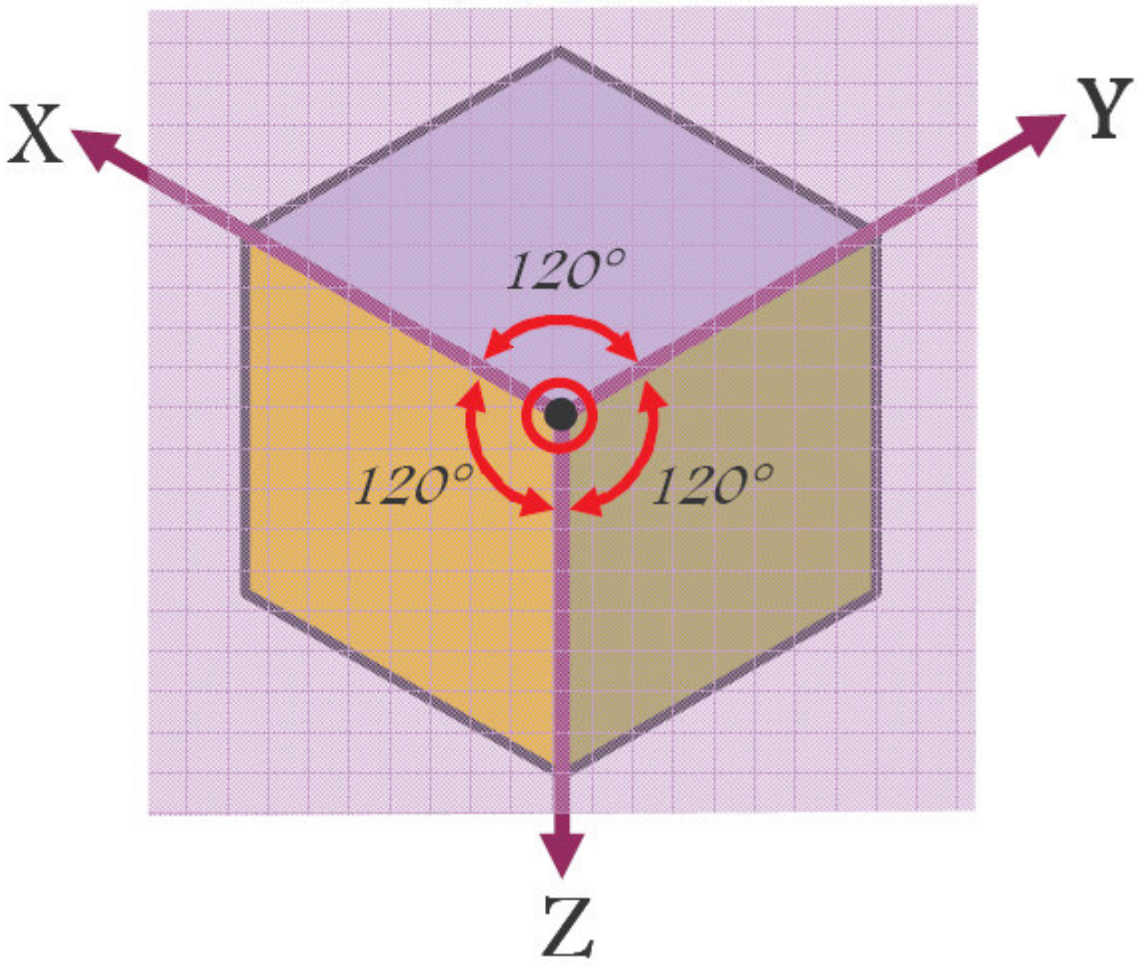
- Cube in Isometric View



$\alpha = \beta = \gamma = 54°44'$

Isometric View

- Cube in Isometric View



Isometric axes can be positioned in a number of ways to create different views of the same object.

Figure *A* is a regular isometric, in which the viewpoint is looking down on the top of the object.

In a regular isometric, the axes at 30° to the horizontal are drawn upward from the horizontal.

For the reversed axis isometric, the viewpoint is looking up on the bottom of the object, and the 30° axes are drawn downward from the horizontal.

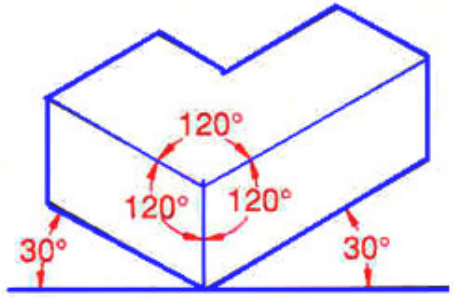


Figure A Regular Isometric

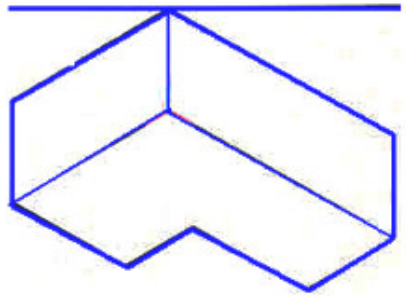


Figure B Reversed Axis isometric

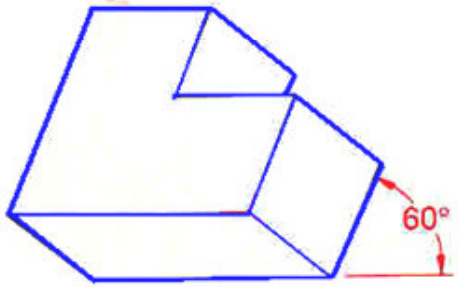


Figure C Long axis isometric

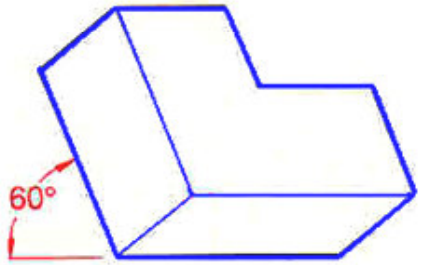
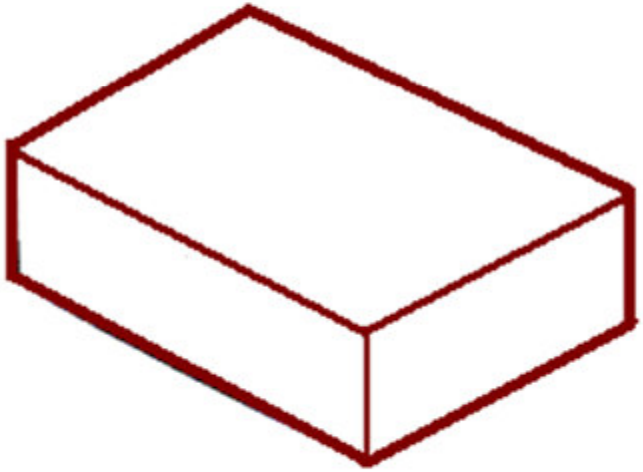


Figure D Long axis isometric

For the long axis isometric, the viewpoint is looking from the right or from the left of the object, and one axis is drawn at 60 ° to the horizontal.

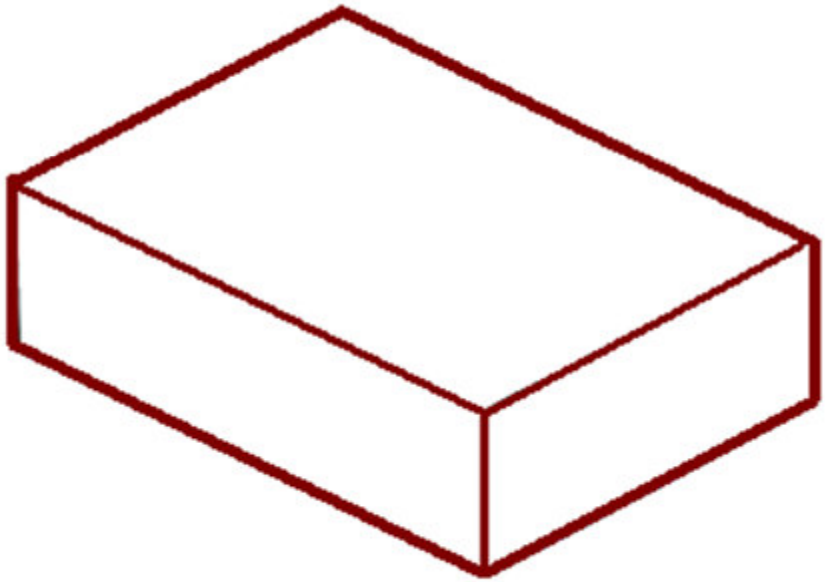
ISOMETRIC PROJECTION and ISOMETRIC DRAWING

Isometric drawings are almost always preferred over isometric projection for engineering drawings, because they are easier to produce.



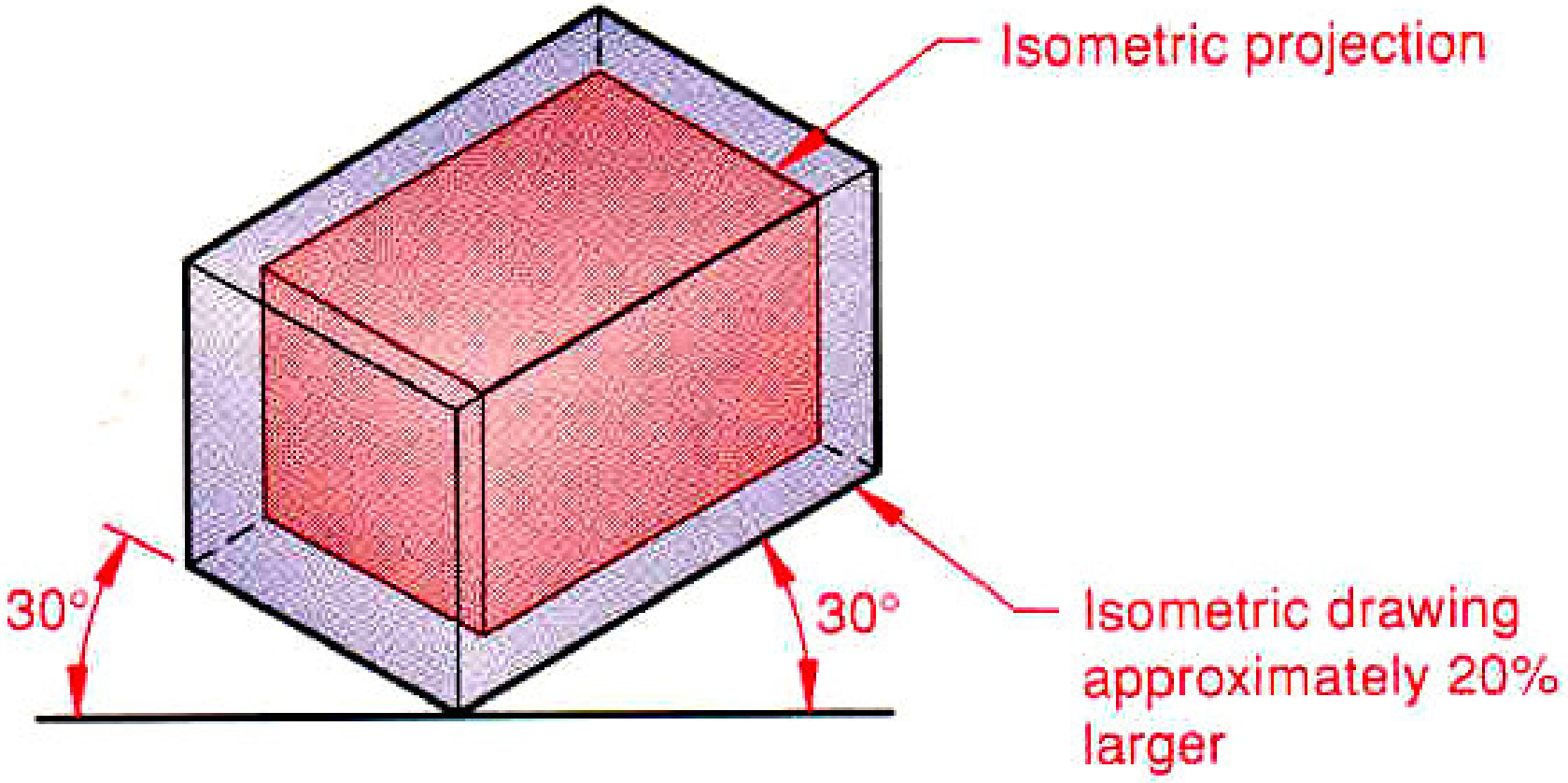
isometric projection

82% of ful scale



Full scale Isometric drawing

An *isometric drawing* is an axonometric pictorial drawing for which the angle between each axis equals 120° and the scale used is full scale.

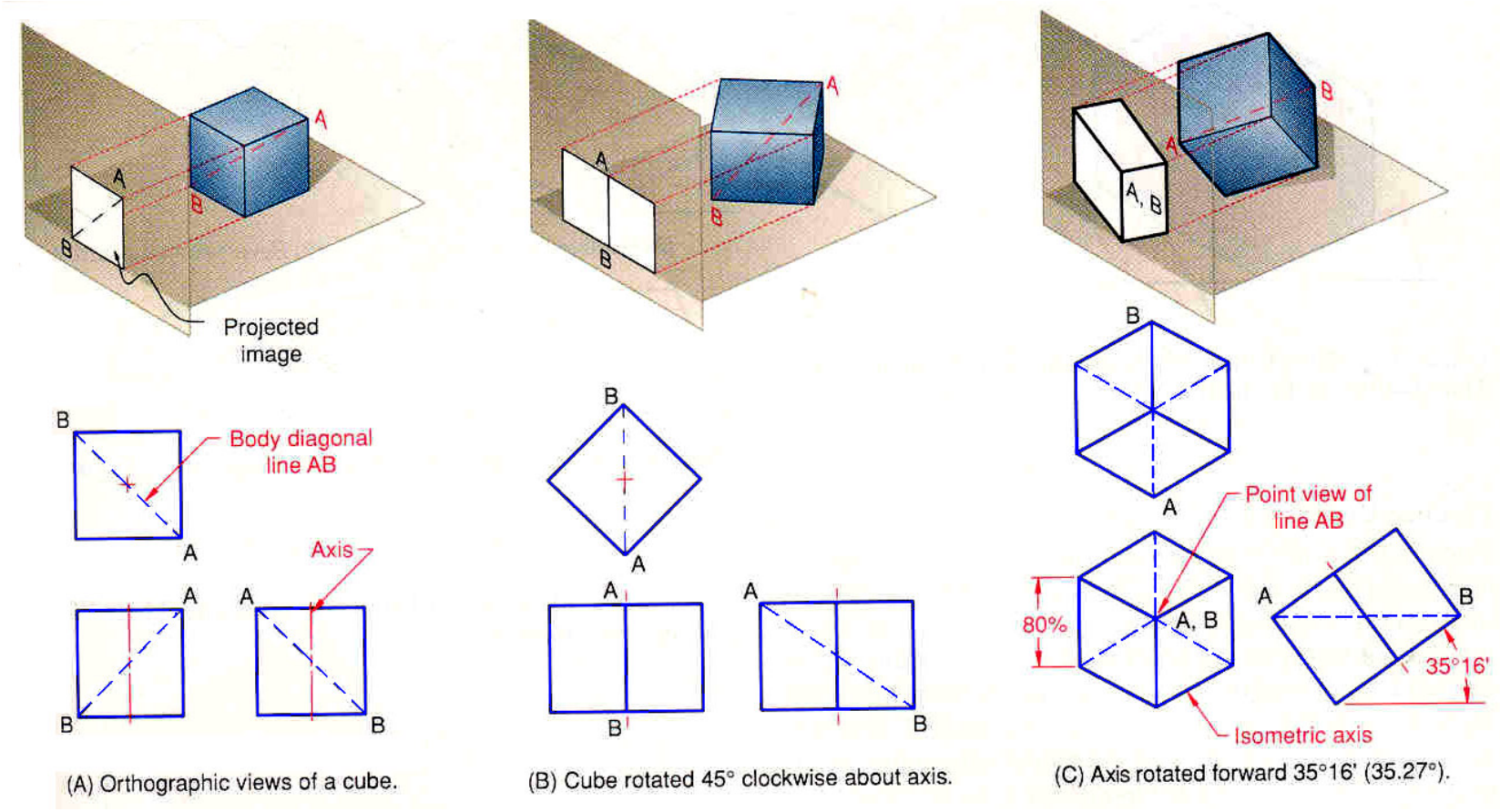


Size comparison of Isometric Drawing and True Isometric Projection

Isometric Axonometric Projections

An isometric projection is a true representation of the isometric view of an object.

An isometric view of an object is created by rotating the object 45° about a vertical axis, then tilting the object (see figure - in this case, a cube) forward until the body diagonal (AB) appears as a point in the front view

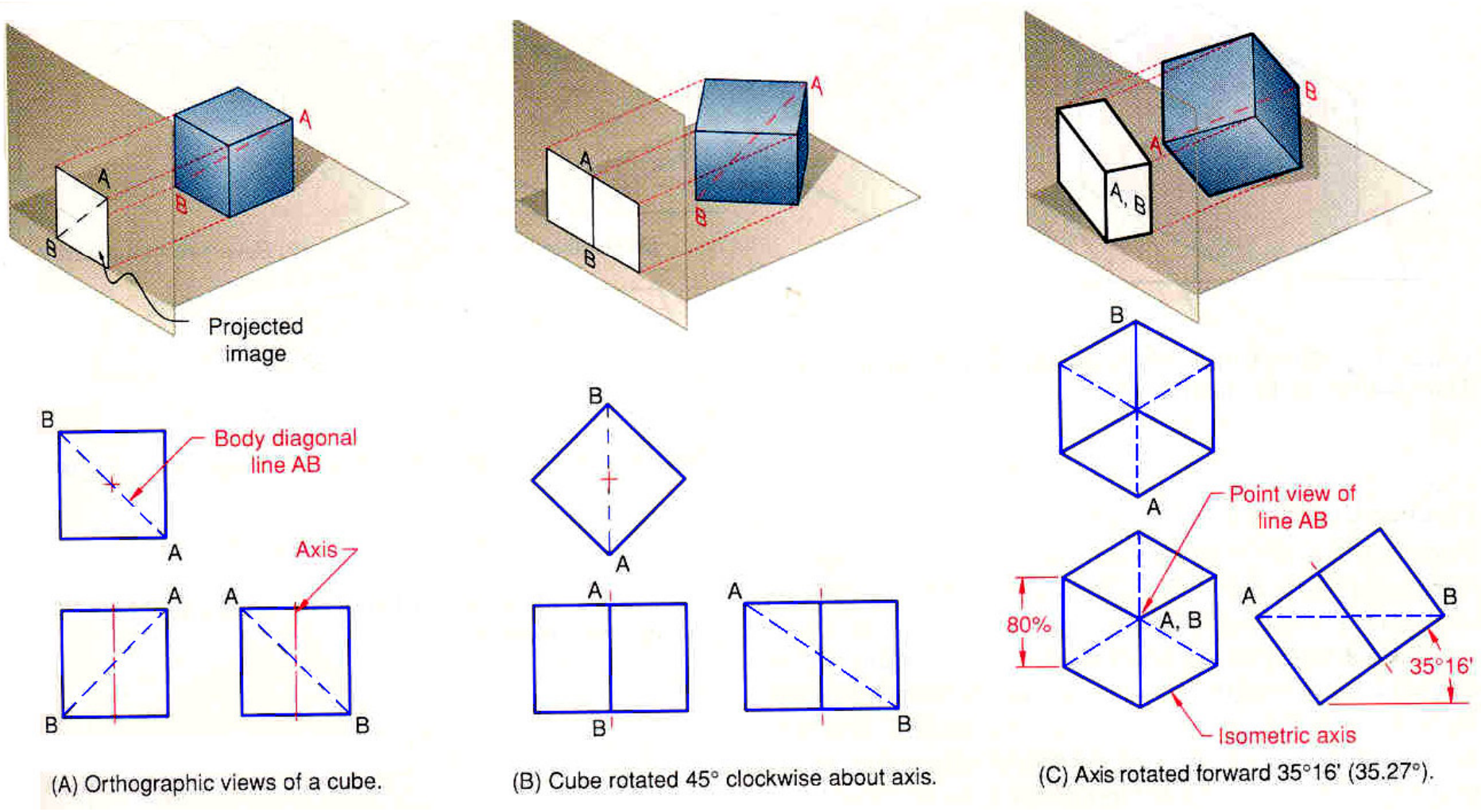


The angle the cube is tilted forward is 35° 16'. The 3 axes that meet at A, B form equal angles of 120° and are called the isometric axes.

Each edge of the cube is parallel to one of the isometric axes.

Line parallel to one of the legs of the isometric axis is an isometric line.

Planes of the cube faces & all planes parallel to them are isometric planes



(A) Orthographic views of a cube.

(B) Cube rotated 45° clockwise about axis.

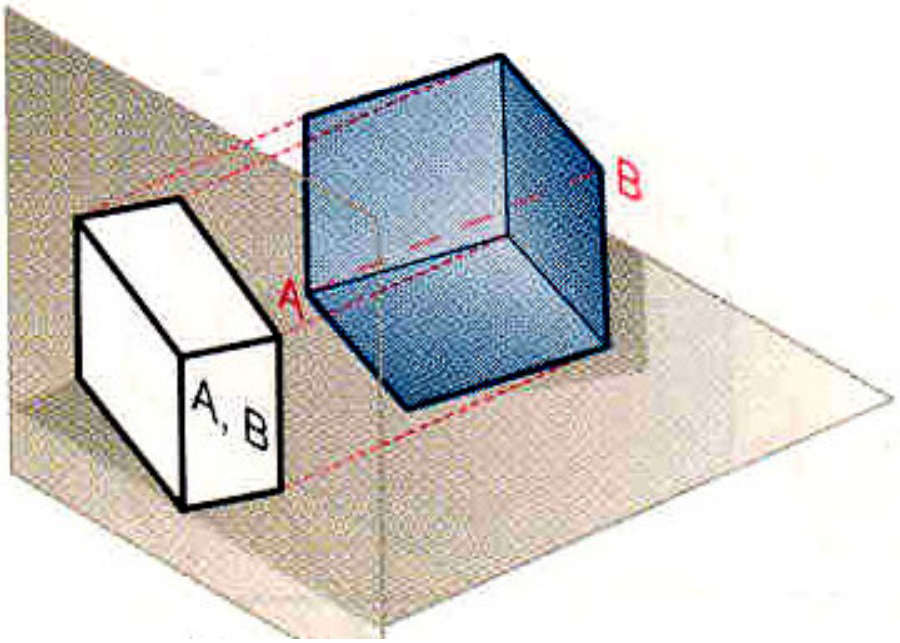
(C) Axis rotated forward 35°16' (35.27°).

The forward tilt of the cube causes the edges and planes of the cube to become shortened as it is projected onto the picture plane.

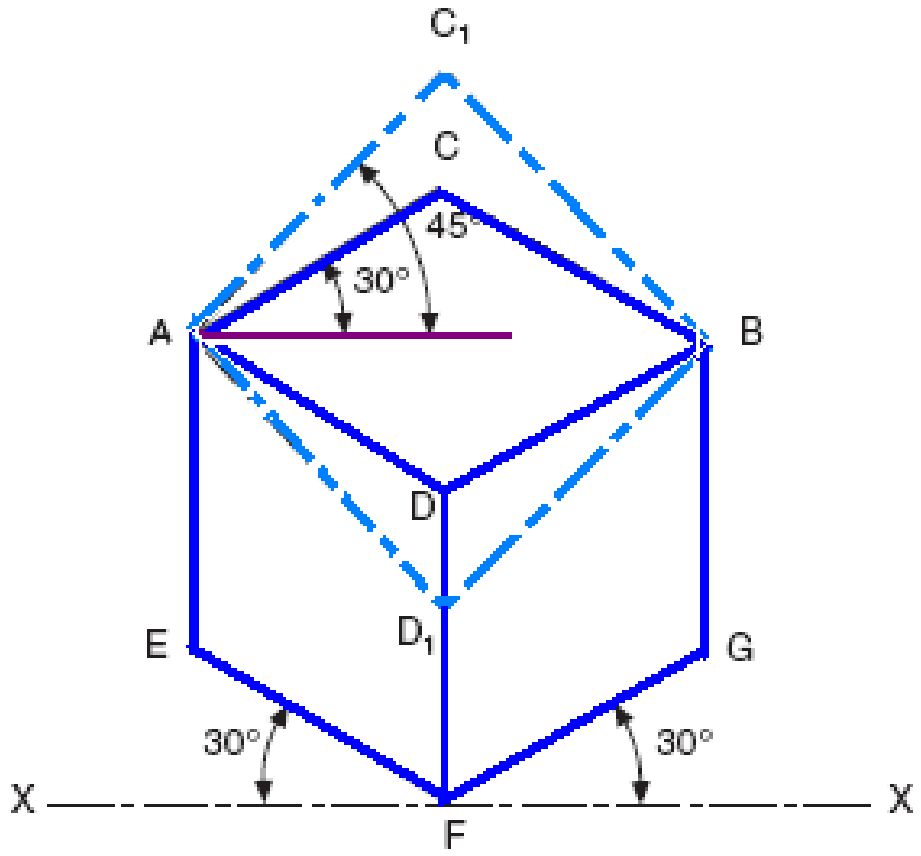
The lengths of the projected lines are equal to the cosine of 35° 16', or 0.81647 times the true length. In other words, the projected lengths are approximately 82% of the true lengths.

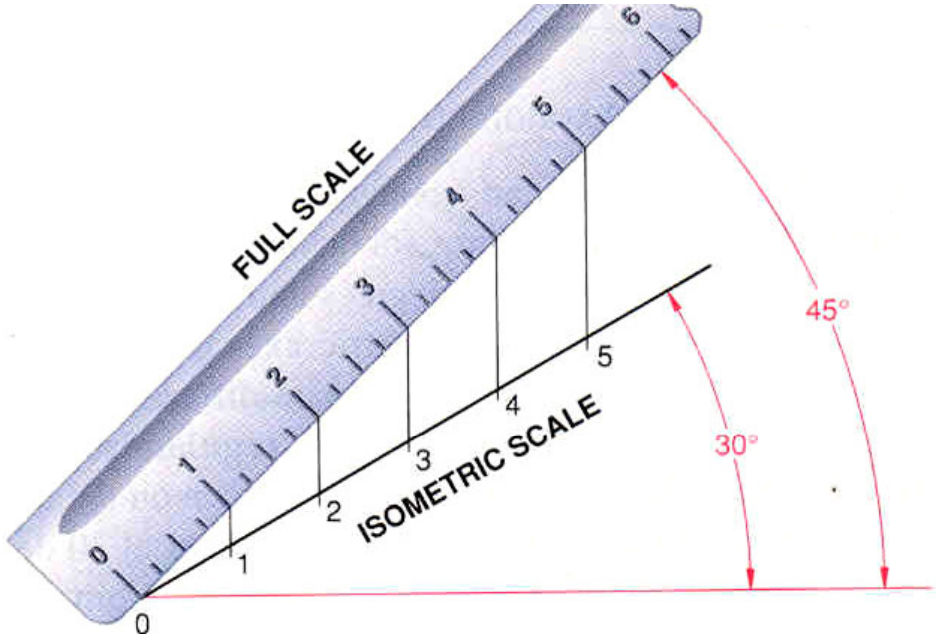
A drawing produced using a scale of 0.816 is called an *isometric projection* and is a true representation of the object.

However, if the drawing is produced using full scale, it is called an *isometric drawing*, which is the same proportion as an isometric projection, but is larger by a factor of 1.23 to 1.



Isometric scale is produced by positioning a regular scale at 45 ° to the horizontal and projecting lines vertically to a 30° line.





$$\text{Isometric scale} = (\text{Isometric length/True length}) = \frac{\cos 45^\circ}{\cos 30^\circ} = \frac{1}{\sqrt{2}} \div \frac{\sqrt{3}}{2} = \frac{\sqrt{2}}{\sqrt{3}} = 0.8165$$

$$= 82\% \text{ (approximately)}$$

Isometric length = 0.82* True length

In an isometric drawing, true length distances can only be measured along isometric lines, that is, lines that run parallel to any of the isometric axes. Any line that does not run parallel to an isometric axis is called a non-isometric line.

Non-isometric lines include inclined and oblique lines and can not be measured directly. Instead they must be created by locating two end points.

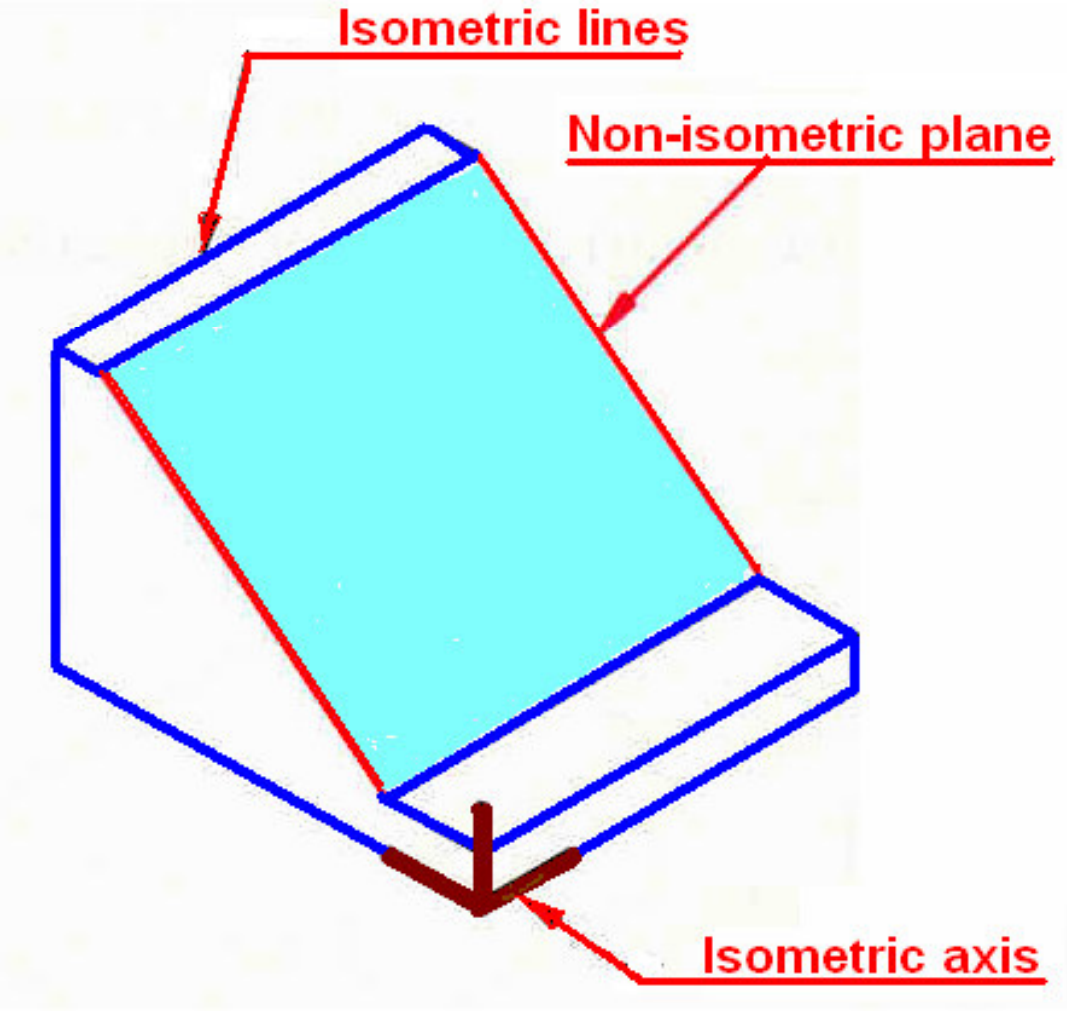


Figure A is an isometric drawing of a cube. The three faces of the isometric cube are isometric planes, because they are parallel to the isometric surfaces formed by any two adjacent isometric axes.

Planes that are not parallel to any isometric plane are called non-isometric planes (Figure B)

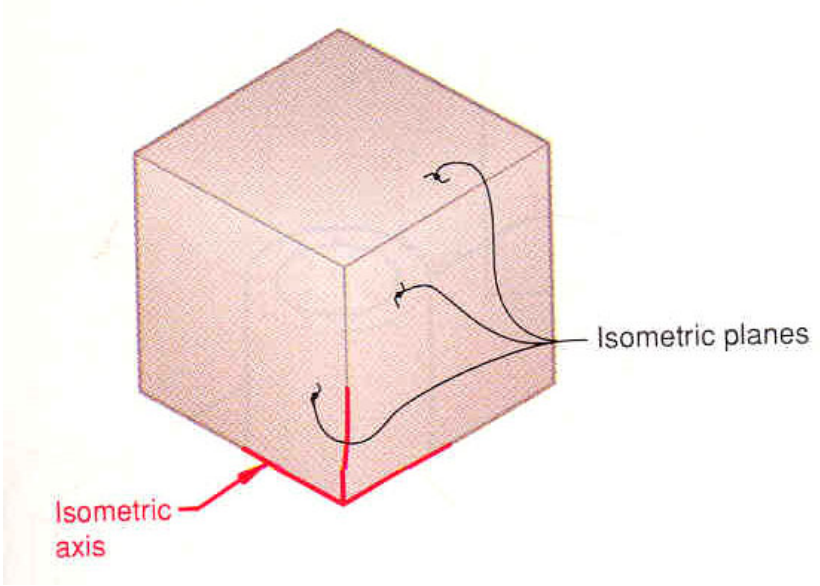


Figure A: Isometric planes relative to isometric axes

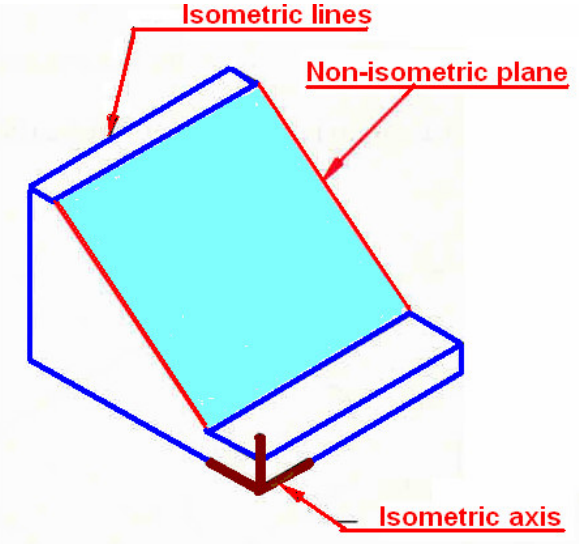


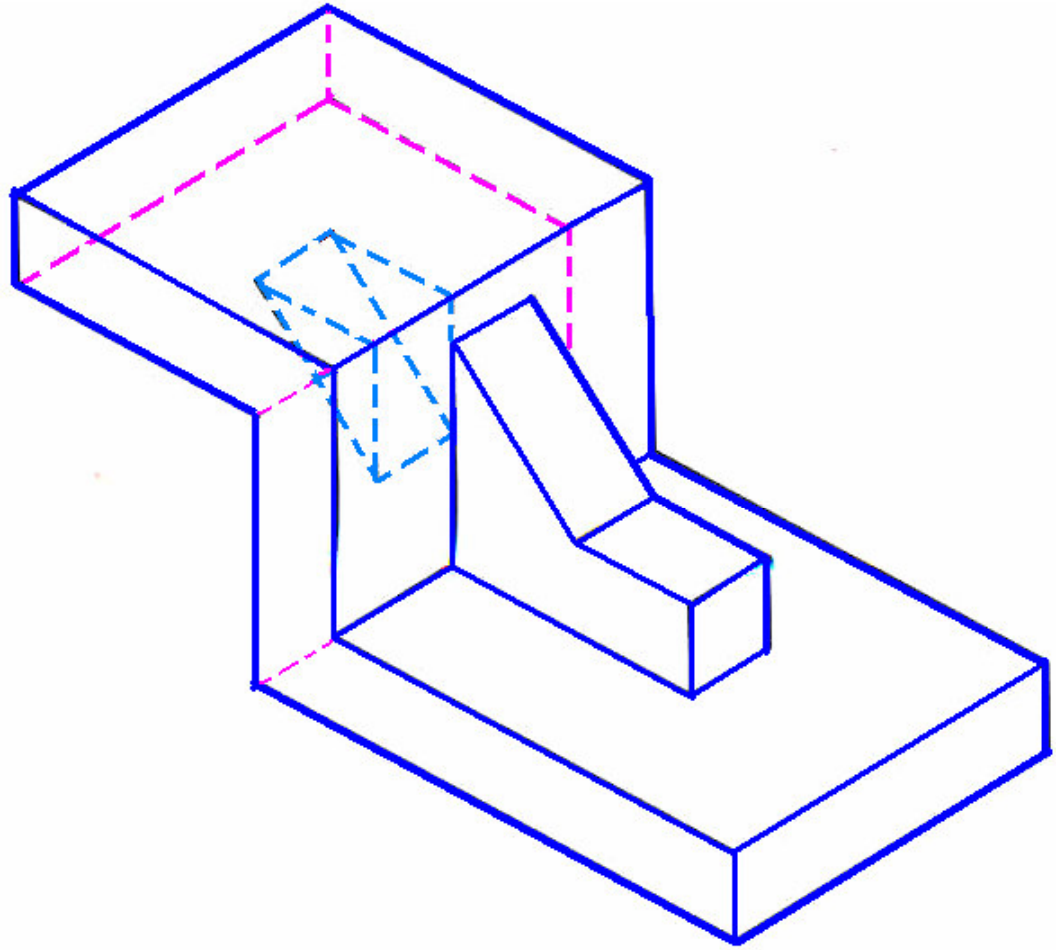
Figure B: Non-isometric plane

Standards for Hidden Lines, Center Lines and Dimensions

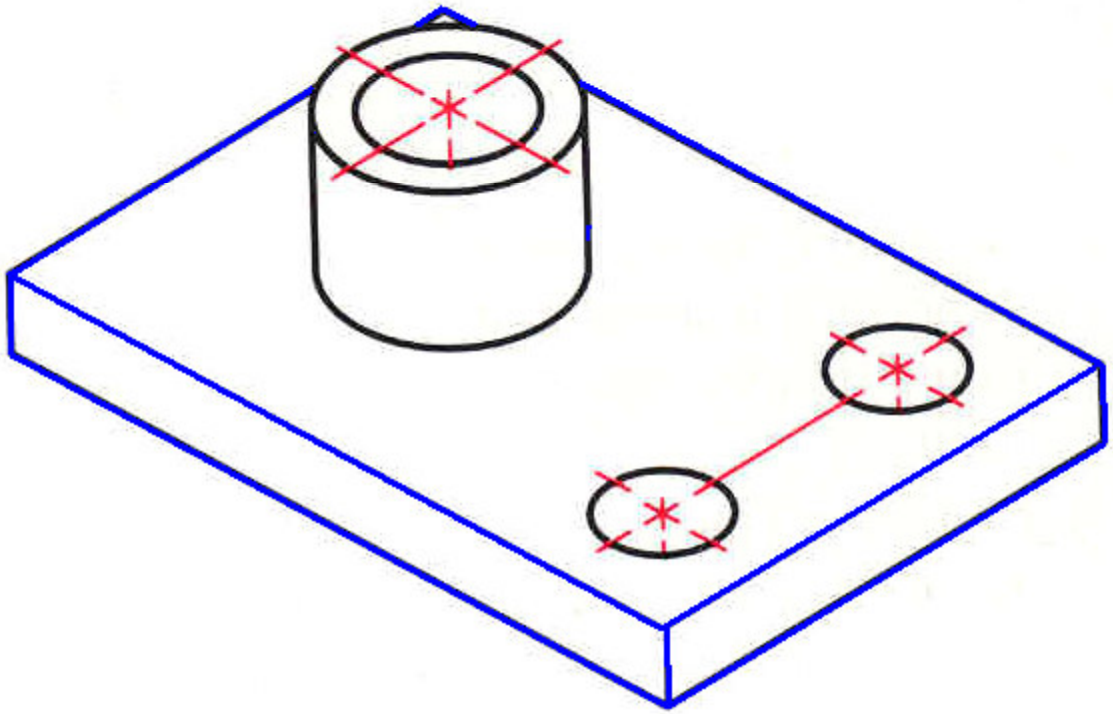
In isometric drawings, hidden lines are omitted unless they are absolutely necessary to completely describe the object. Most isometric drawings will not have hidden lines.

To avoid using hidden lines, choose the most descriptive viewpoint.

However, if an isometric viewpoint cannot be found that clearly depicts all the major features, hidden lines may be used.



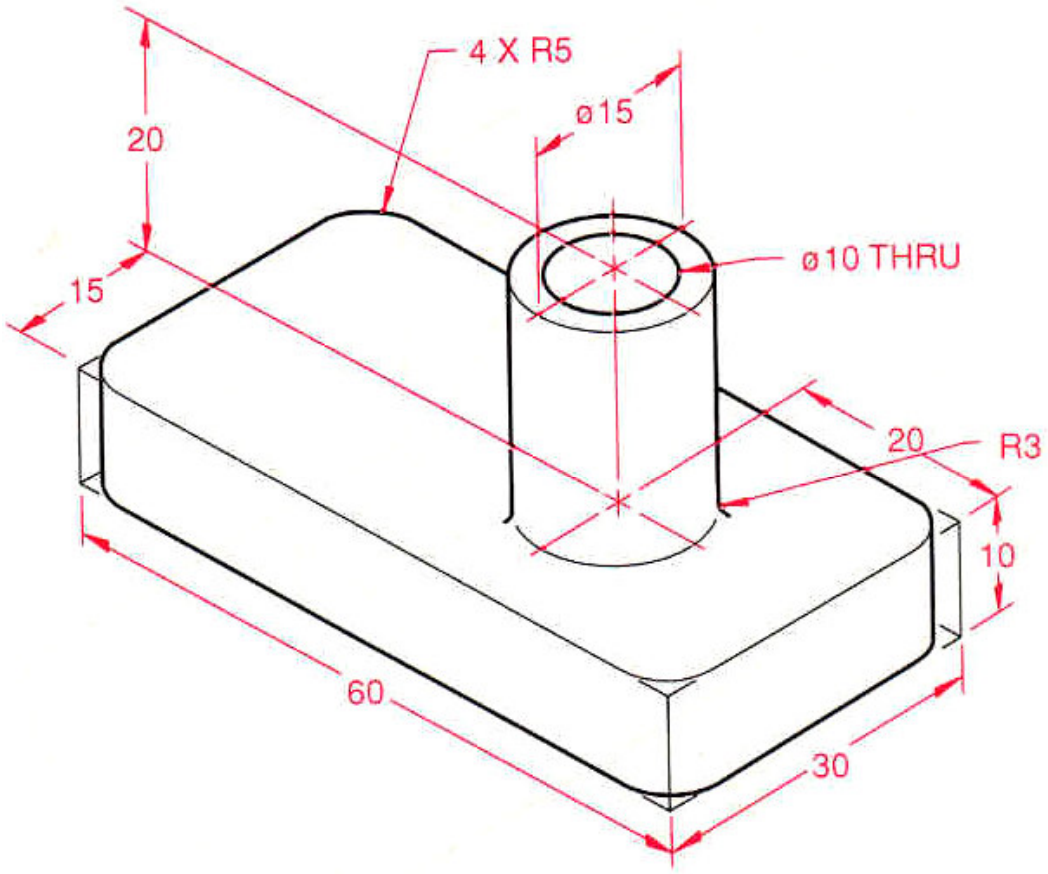
Centerlines are drawn only for showing symmetry or for dimensioning. Normally, centerlines are not shown, because many isometric drawings are used to communicate to non-technical people and not for engineering purposes.



As per the Standards:

Dimension lines, extension lines, and lines being dimensioned shall lie in the same plane.

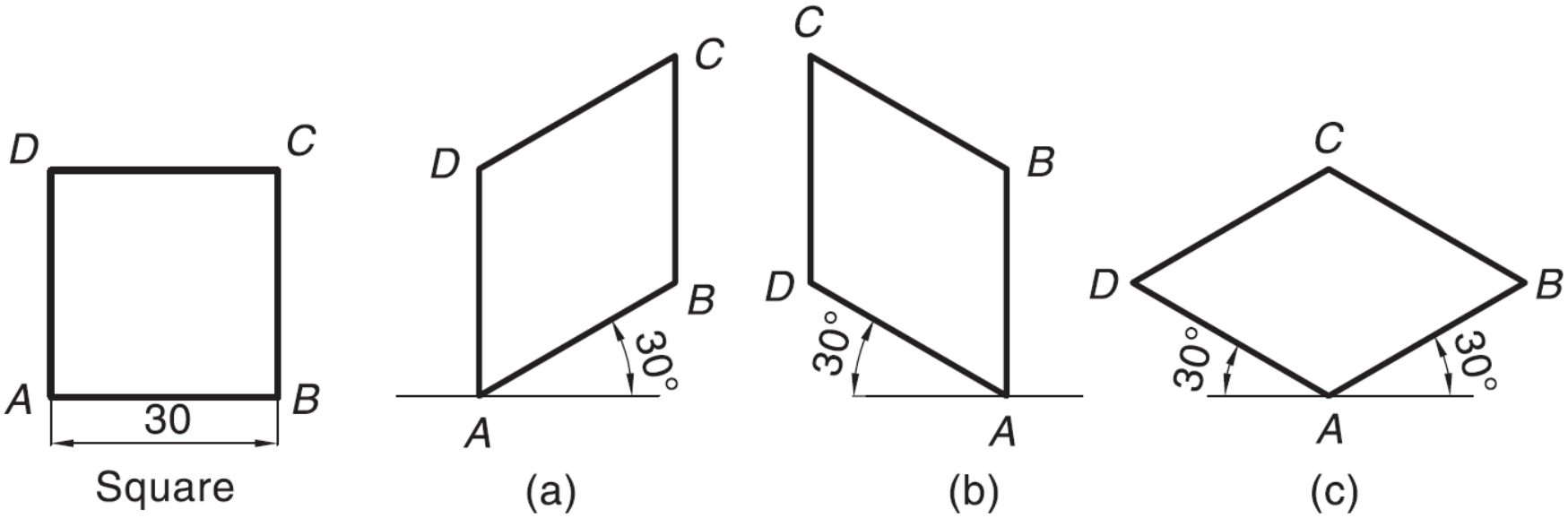
All dimensions and notes should be unidirectional, reading from the bottom of the drawing upward and should be located outside the view whenever possible. The texts is read from the bottom, using horizontal guidelines.



ISOMETRIC VIEWS OF STANDARD SHAPES

Square

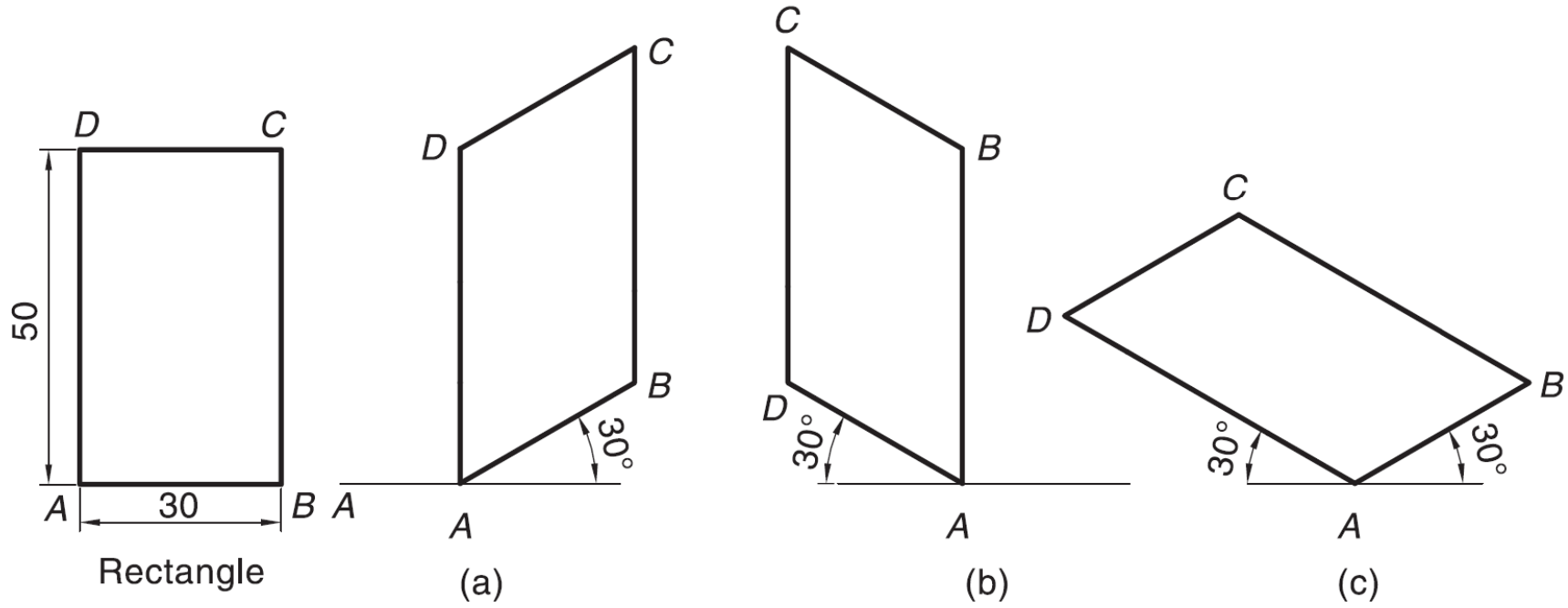
Consider a square *ABCD* with a 30 mm side shown in Fig. If the square lies in the vertical plane, it will appear as a rhombus with a 30 mm side in isometric view as shown in Fig. (a) or (b), depending on its orientation, i.e., right-hand vertical face or left-hand vertical face. If the square lies in the horizontal plane (like the top face of a cube), it will appear as in Fig.(c). The sides *AB* and *AD*, both, are inclined to the horizontal reference line at 30°.



Taken from Dhananjay A Jolhe, Engg. Drawing, MGH

Rectangle

A rectangle appears as a parallelogram in isometric view. Three versions are possible depending on the orientation of the rectangle, i.e., right-hand vertical face, left-hand vertical face or horizontal face.



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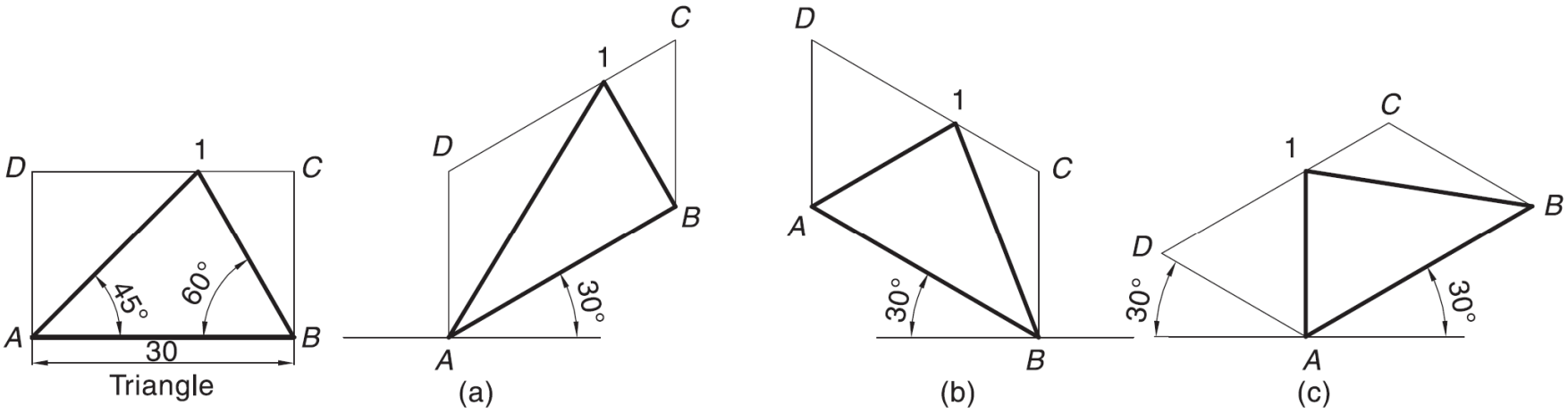
Triangle

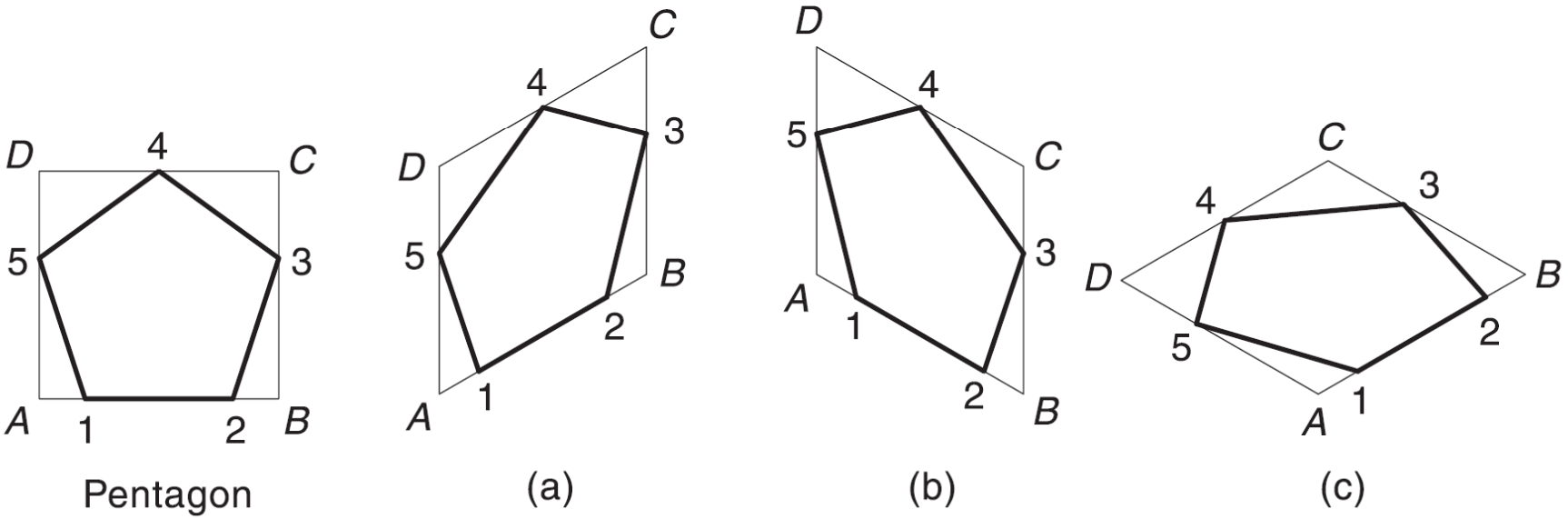
A triangle of any type can be easily obtained in isometric view as explained below. First enclose the triangle in rectangle *ABCD*. Obtain parallelogram *ABCD* for the rectangle as shown in Fig. (a) or (b) or (c). Then locate point 1 in the parallelogram such that *C*–1 in the parallelogram is equal to *C*–1 in the rectangle. *A*–*B*–1 represents the isometric view of the triangle.



Taken from Dhananjay A Jolhe, Engg. Drawing, MGH

Pentagon

Enclose the given pentagon in a rectangle and obtain the parallelogram as in Fig. 18.9(a) or (b) or (c). Locate points 1, 2, 3, 4 and 5 on the rectangle and mark them on the parallelogram. The distances *A*–1, *B*–2, *C*–3, *C*–4 and *D*–5 in isometric drawing are same as the corresponding distances on the pentagon enclosed in the rectangle.



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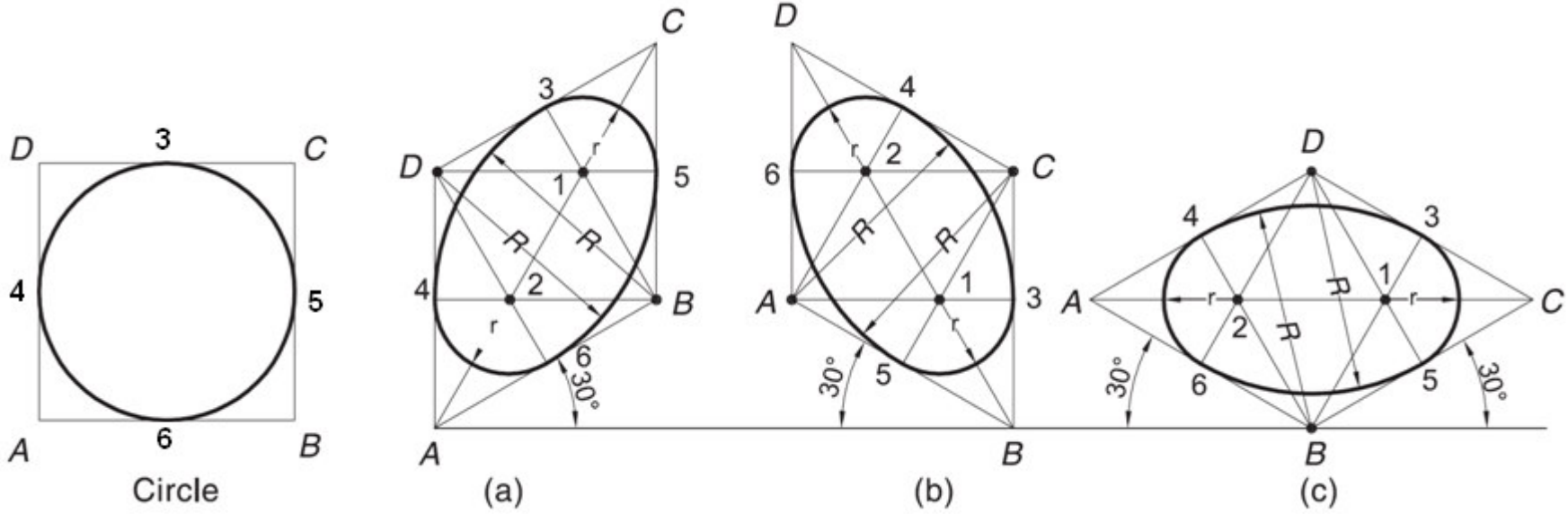
Circle

The isometric view or isometric projection of a circle is an ellipse. It is obtained by using four-centre method explained below.

Four-Centre Method **: First, enclose the given circle into a square *ABCD*. Draw rhombus *ABCD* as an isometric view of the square. Join the farthest corners of the rhombus, i.e., *A* and *C*. Obtain midpoints 3 and 4 of sides *CD* and *AD* respectively. Locate points 1 and 2 at the intersection of *AC* with *B*–3 and *B*–4 respectively. Now with 1 as a centre and radius 1–3, draw a small arc 3–5. Draw another arc 4–6 with same radius but 2 as a centre. With *B* as a centre and radius *B*–3, draw an arc 3–4. Draw another arc 5–6 with same radius but with *D* as a centre.**



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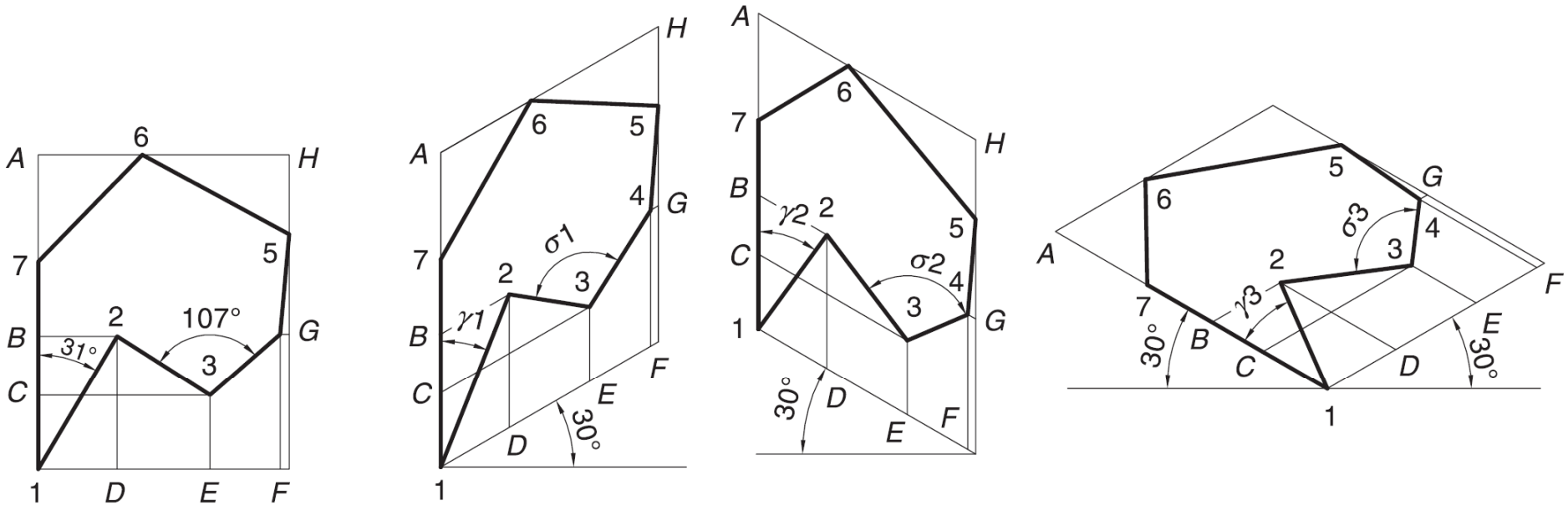
Any irregular Shape

Any irregular shape 1–2–3–4–5–6–7 can be drawn in isometric view as follows: The figure is enclosed in a rectangle first. The parallelogram is obtained in isometric for the rectangle as shown. The isolines *B*–2, *D*–2, *C*–3, *E*–3, *G*–4, *F*–4, *H*–5, *H*–6 and *A*–7 has the same length as in original shape, e.g., *B*–2 in isometric = *B*–2 in irregular shape.



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Isometric views for solids

The Boxing-in Method

The four basic steps for creating an isometric drawing are:

Determine the isometric viewpoint that clearly depicts the features of the object, then draw the isometric axes which will produce that view-point.

Construct isometric planes, using the overall width (W), height (H), and depth (D) of the object, such that the object will be totally enclosed in a box.

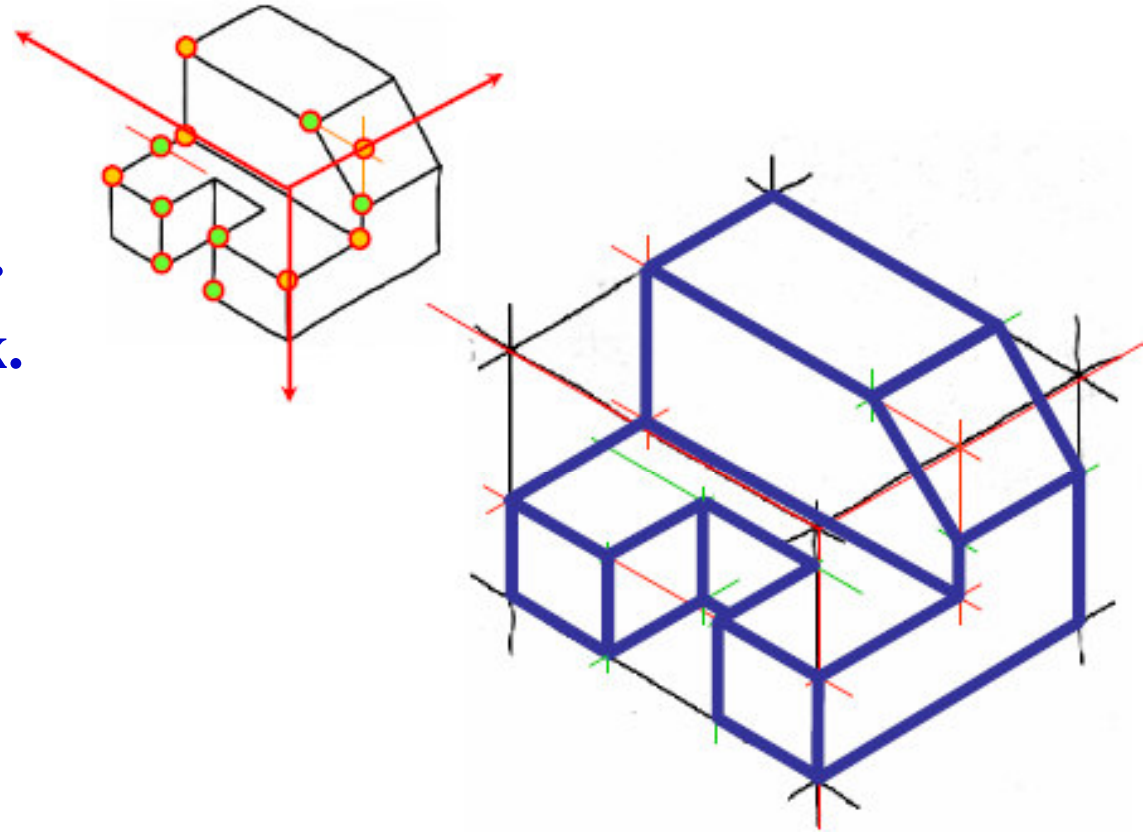
Locate details on the isometric planes.

Darken all visible lines, and eliminate hidden lines unless absolutely necessary to describe the object.

Sketch from an actual object

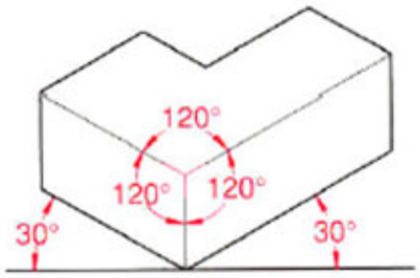
STEPS

1. **Positioning object.**
2. **Select isometric axis.**
3. **Sketch enclosing box.**
4. **Add details.**
5. **Darken visible lines.**

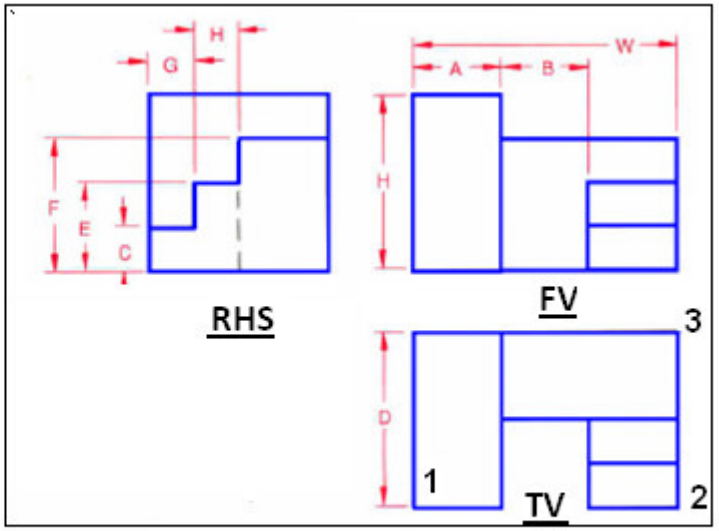


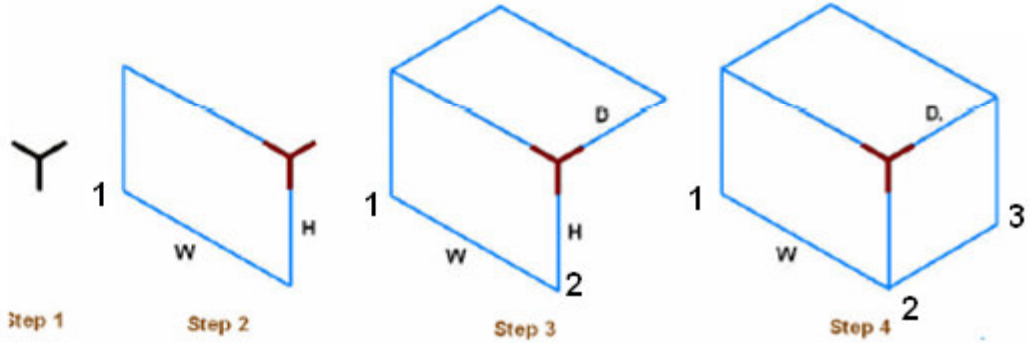
Note In isometric sketch/drawing), hidden lines are *omitted* unless they are absolutely necessary to completely describe the object.**Sketch from an actual object**

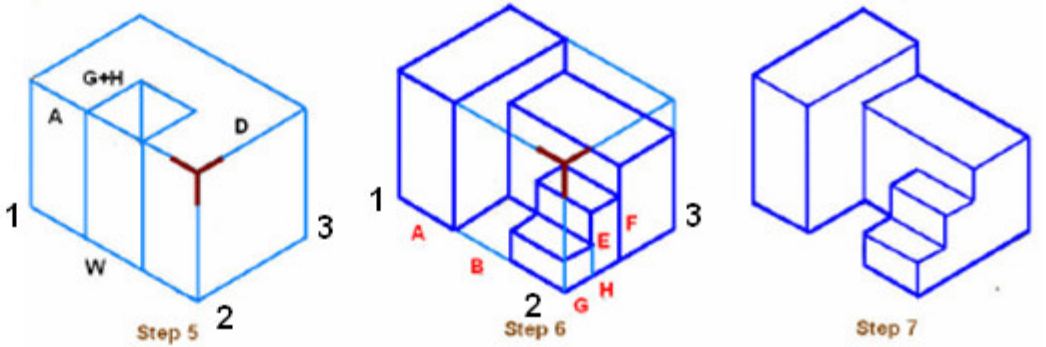
Step 1. **Determine the desired view of the object, then draw the isometric axis. For this example, it is determined that the object will be viewed from above (regular isometric) and axis shown in Fig A is used.**



(A) Regular Isometric

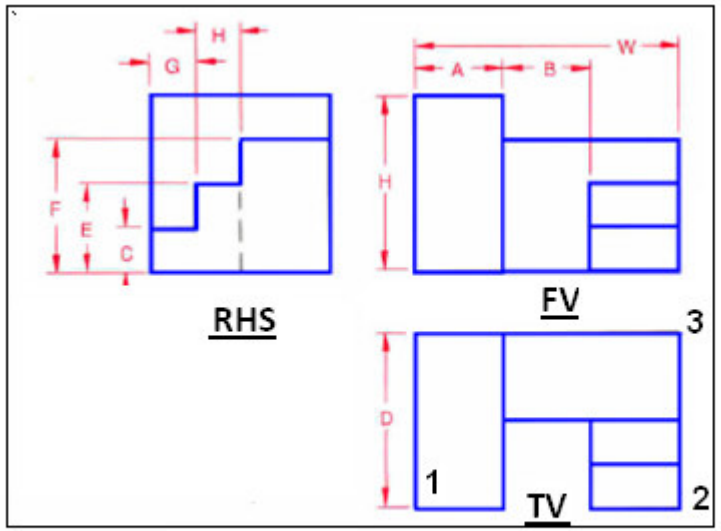


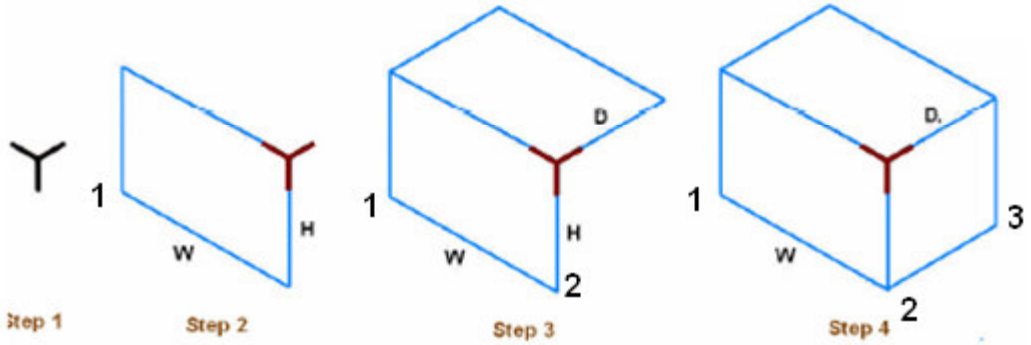


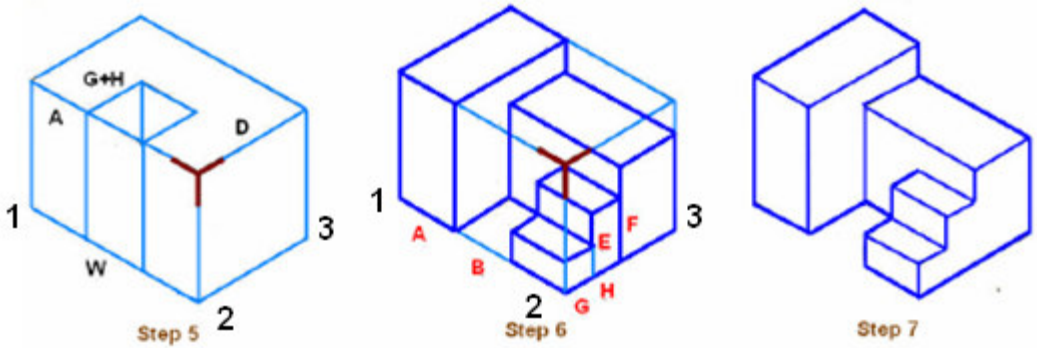


***Step* 2.** Construct the front isometric plane using **W** and **H** dimensions. **Width** dimensions are drawn along 30-degree lines from the horizontal. **Height** dimensions are drawn as vertical lines.

***Step* 3.** Construct the top isometric plane using the **W** and **D** dimensions. Both **W** and **D** dimensions are drawn along 3o-degree lines from the horizontal.

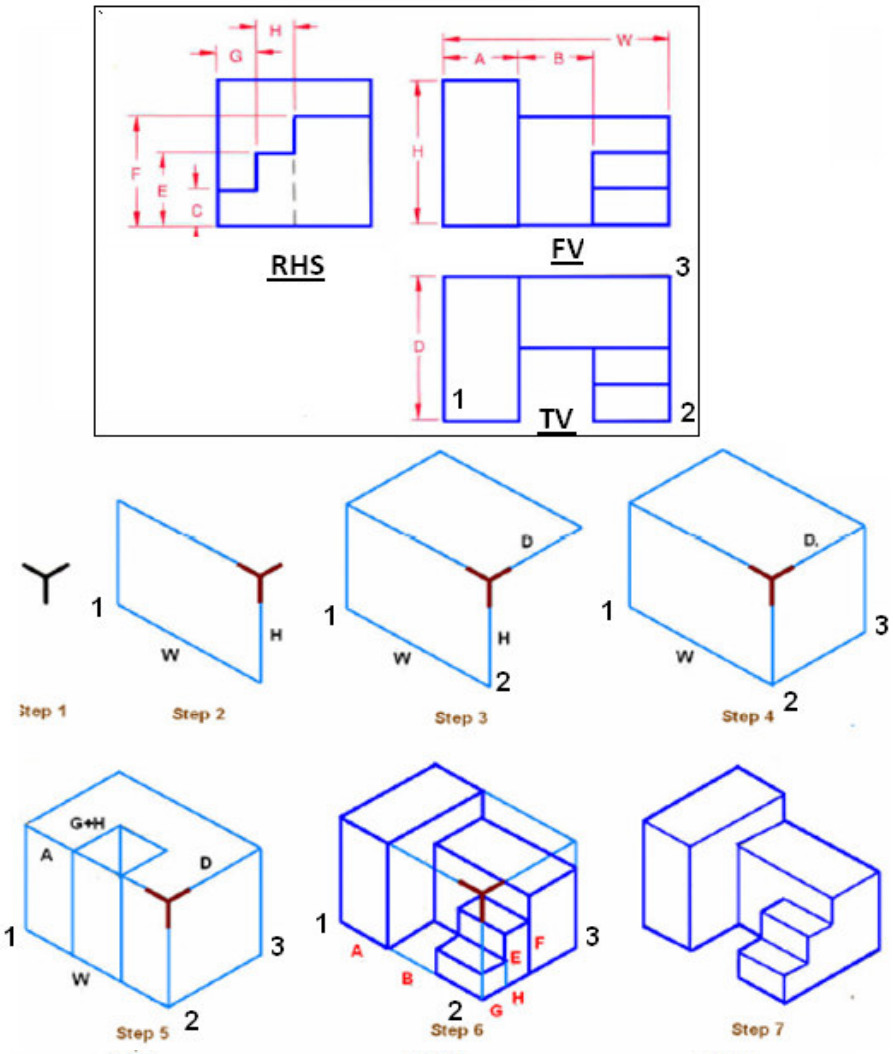






***Step* 4.** Construct the right side isometric plane using **D** and **H** dimensions. Depth dimensions are drawn along 30-degree lines and height dimensions are drawn as vertical lines.

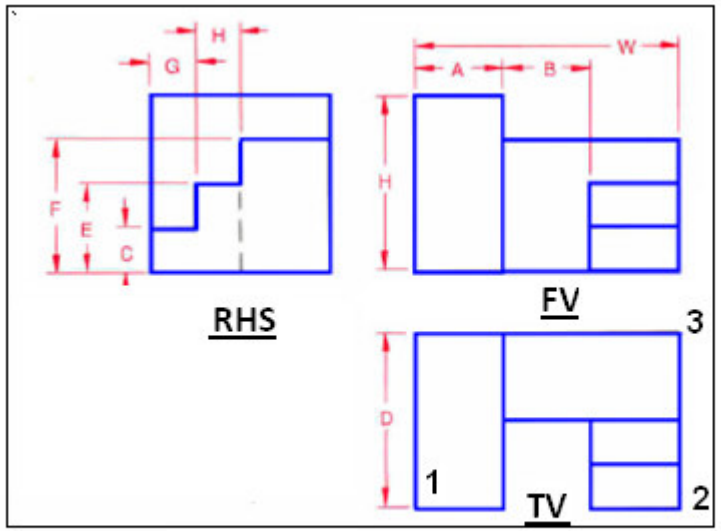
***Step* 5.** Transfer some distances for the various features from the multiview drawing to the isometric lines that make up the isometric rectangle. on the front and top planes of the isometric box.

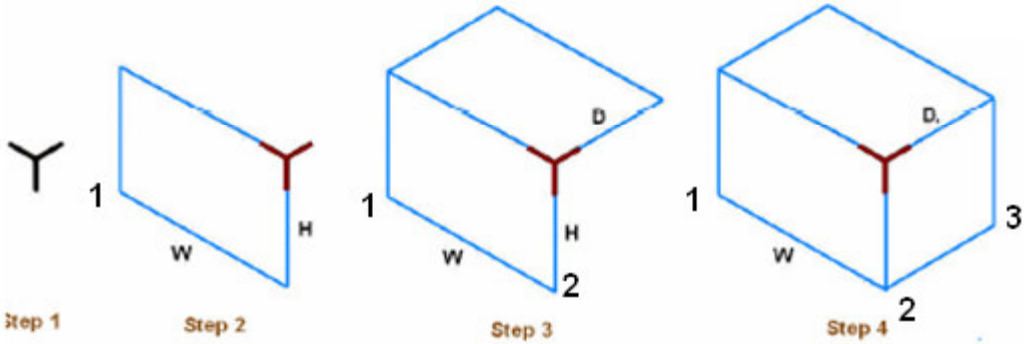


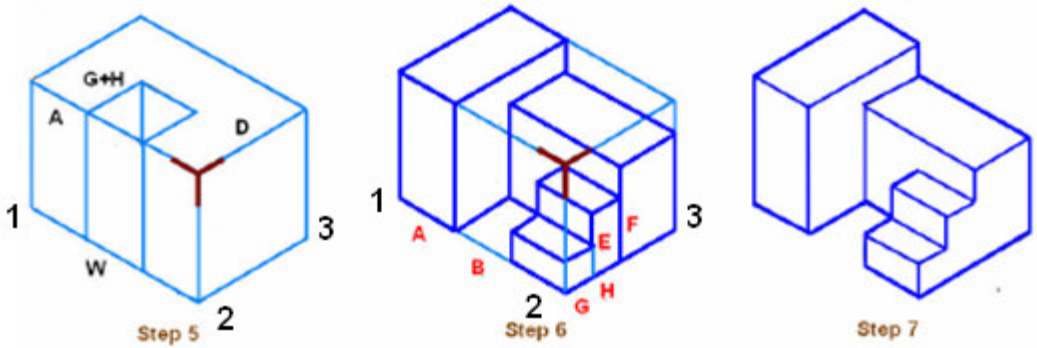
For example, distance **A** is measured in the multiview drawing, then transferred to a width line in the front plane of the isometric rectangle. Begin drawing details of the block by drawing isometric lines between the points transferred from the multiview drawing. For example, a notch is taken out of the block by locating its position on the front and the top planes of the isometric box.

Step 6. Transfer the remaining features from the multi-view drawing to the isometric drawing. Block in the details by connecting endpoints of the measurements taken from the multiview drawing.

Step 7. Darken all visible lines and erase or lighten the construction lines to complete the isometric drawing of the object







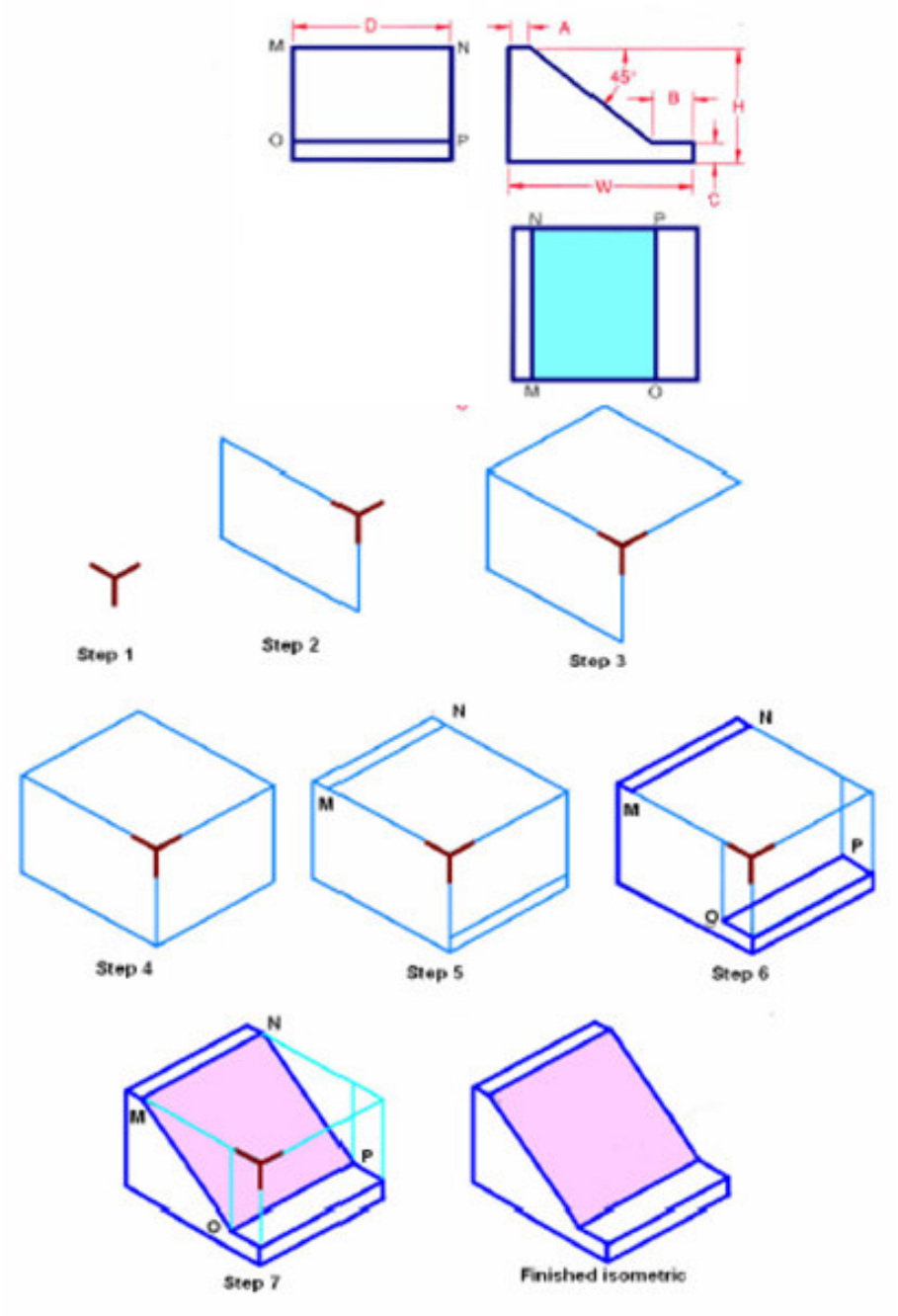
Non-Isometric Lines

Normally, non-isometric lines will be the edges of inclined or oblique planes of an object as represented in a multiview drawing.

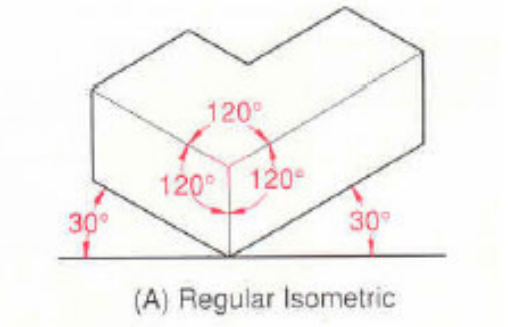
It is not possible to measure the length or angle of an inclined or oblique line in a multiview drawing and then use that measurement to draw the line in an isometric drawing.

Instead, non-isometric lines must be drawn by locating the two end points, then connecting the end points with a line.

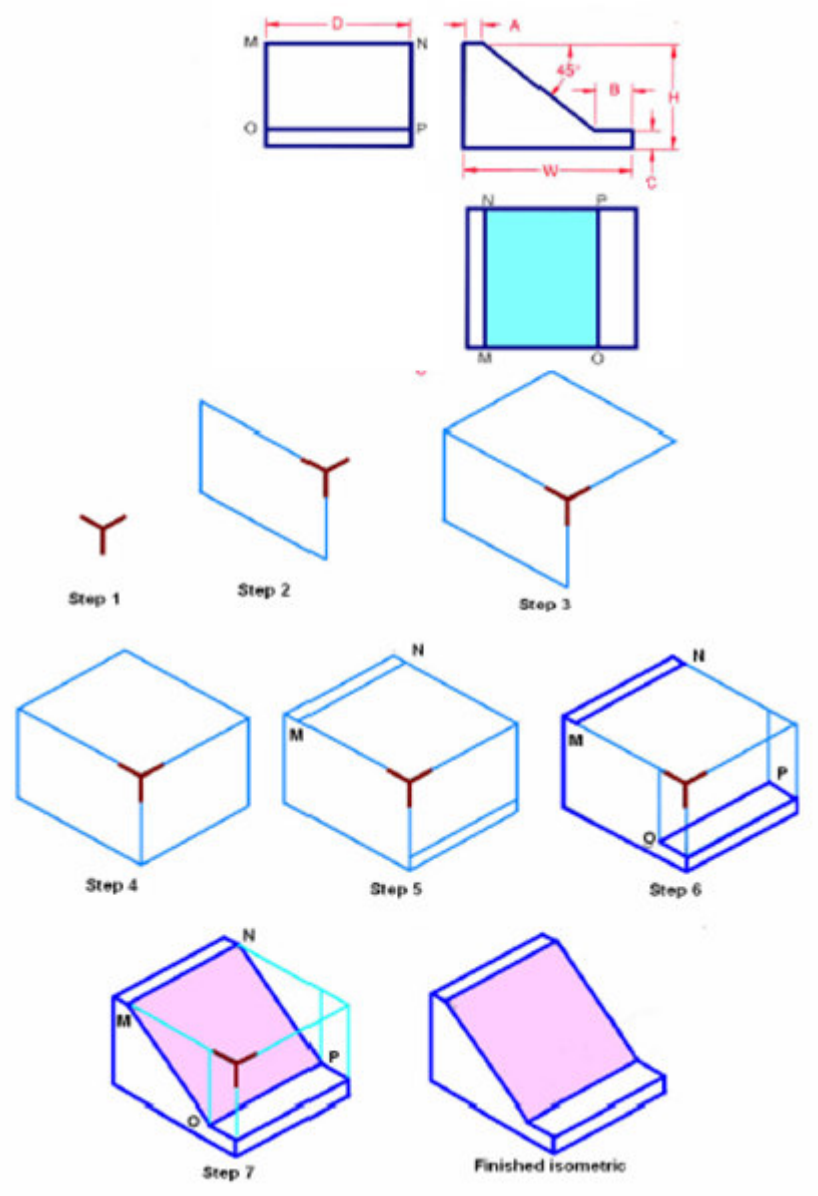
The process used is called offset measurement, which is a method of locating one point by projecting another point.



***Step* 1**. Determine the desired view of the object, then draw the isometric axes. For this example, it is determined that the object will be viewed from above, and the axis shown in Figure A is used.



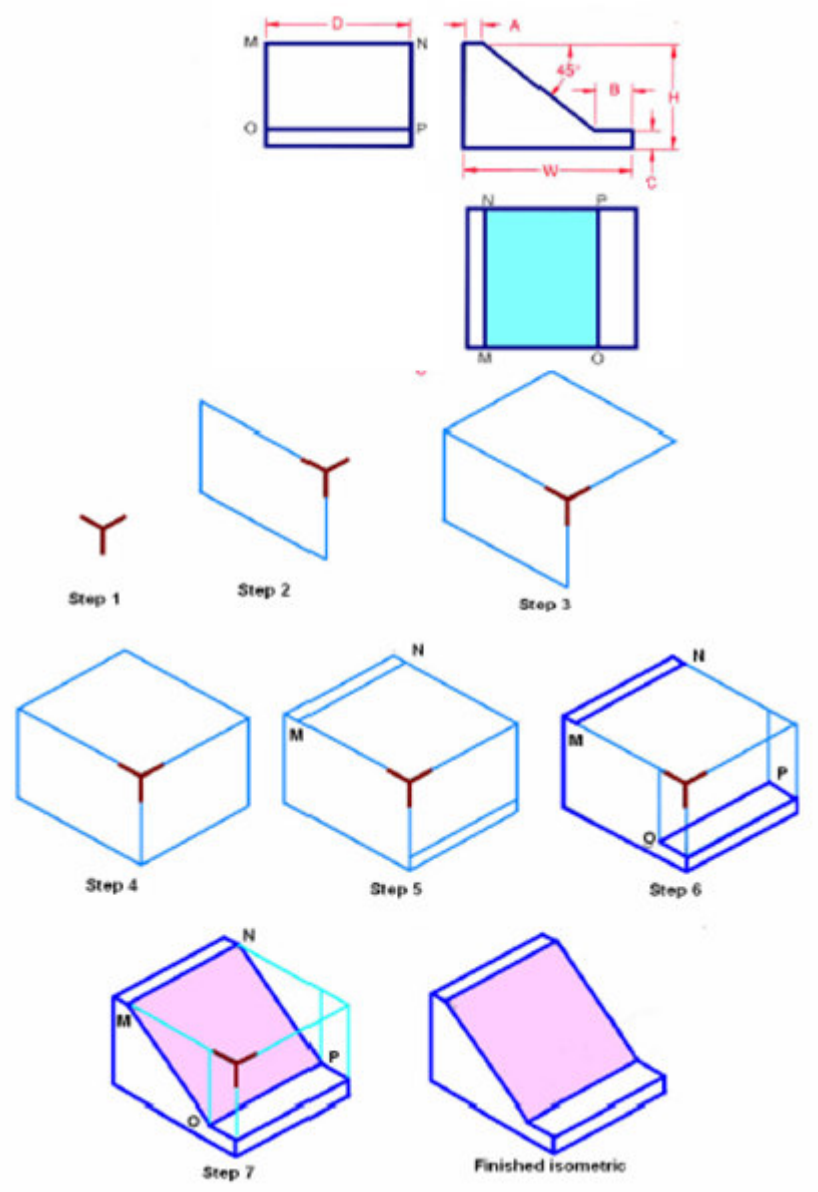
(A) Regular Isometric



***Step* 2**. Construct the front isometric plane using **W** and **H** dimensions.

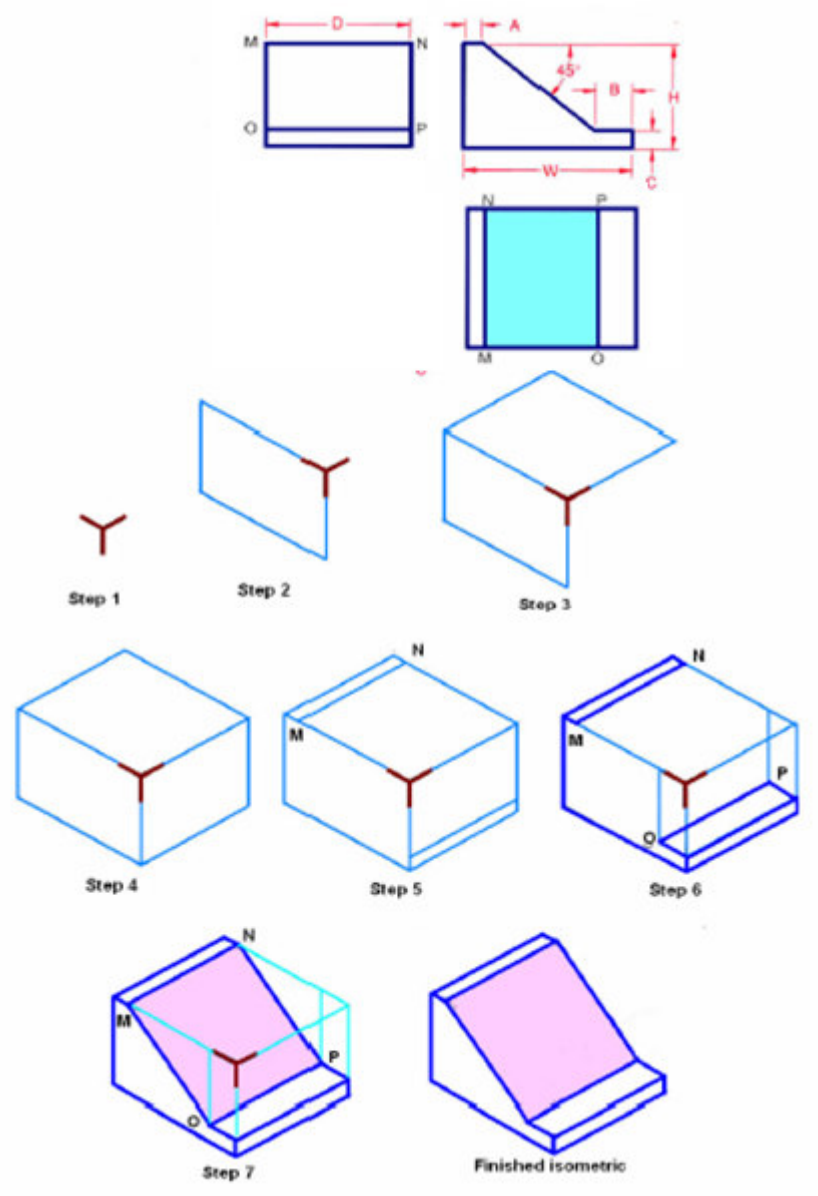
***Step* 3.** Construct the top isometric plane using the **W** and **D** dimensions.

***Step* 4.** Construct the right side isometric plane using **D** and **H** dimensions.



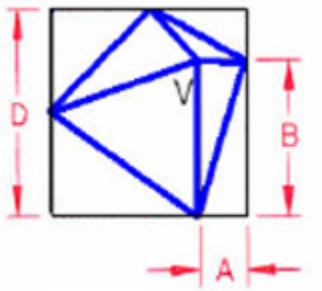
***Step* 5.** Transfer the distances for **C** and **A** from the multi-view drawing to the top and right side isometric rectangles.

Draw line **MN** across the top face of the isometric box. Draw an isometric construction line from the endpoint marked for distance **C**. This, in effect, projects distance **C** along the width of the box.

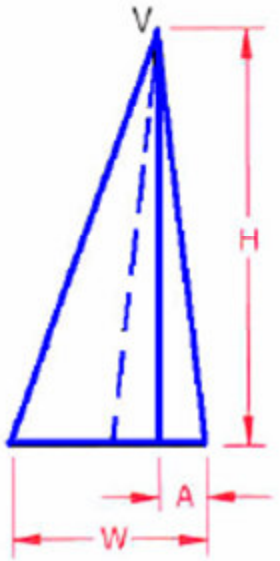


***Step* 6**. Along these isometric construction lines, mark off the distance **B**, thus locating points **0** and **P**. Connect points **OP**.

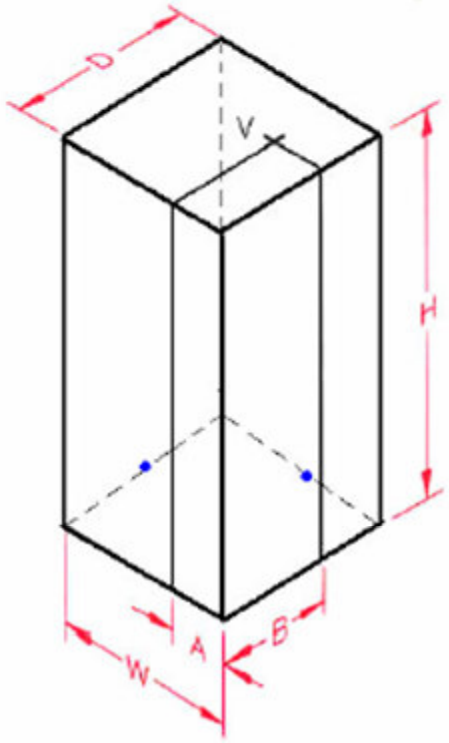
***Step* 7.** Connect points **MO** and **NP** to draw the non-isometric lines.



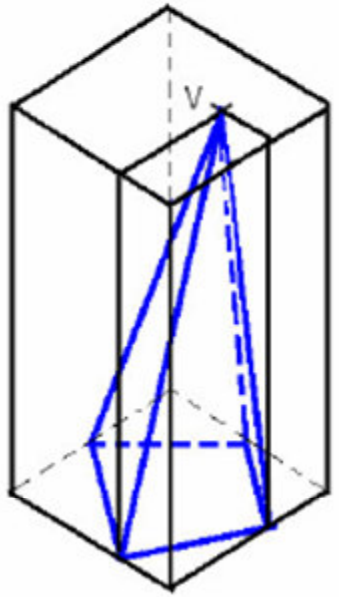
T.V.

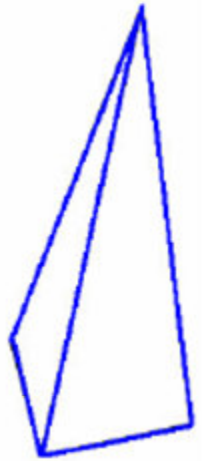


F.V.



Box



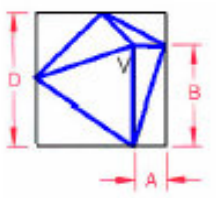


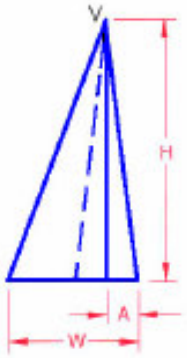
An example of how to locate points to make an isometric drawing of an irregular object

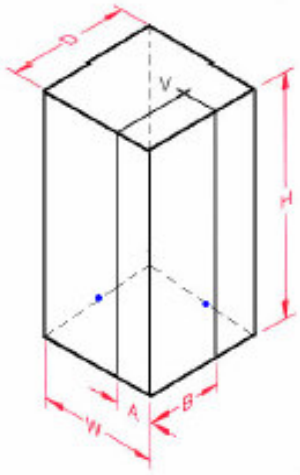
Determine dimensions A and B in the multi-view drawing. Construct an isometric box equal to the dimensions W, H and D as measured in the multi-view drawing. Locate dimensions A and B along the base of the isometric box, then project them along the faces to the edge of the top face, using vertical lines..

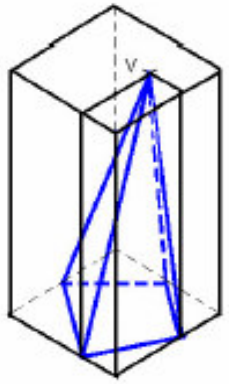
Project the points of intersection across the top face using isometric lines. Point V is located at the intersection of these last two projections.

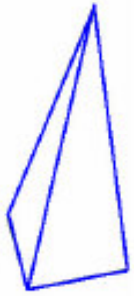
Locate the remaining points around the base and draw the figure.



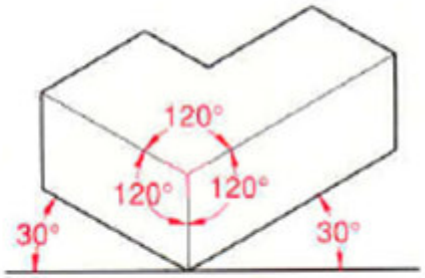




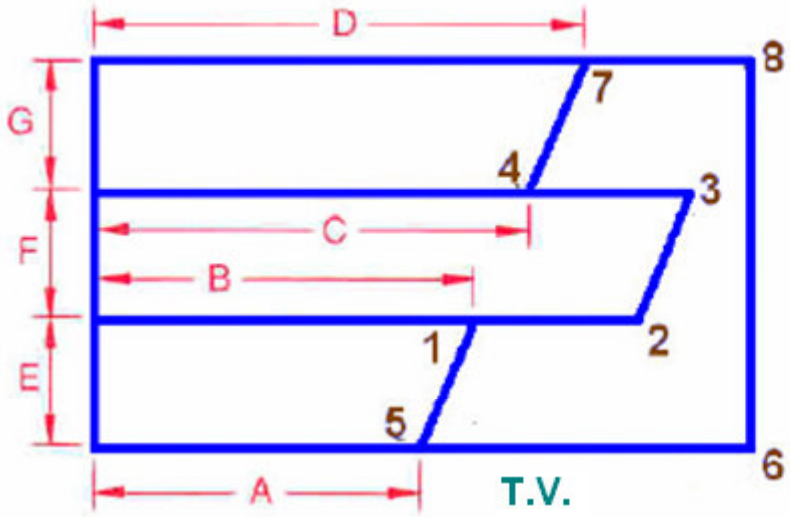




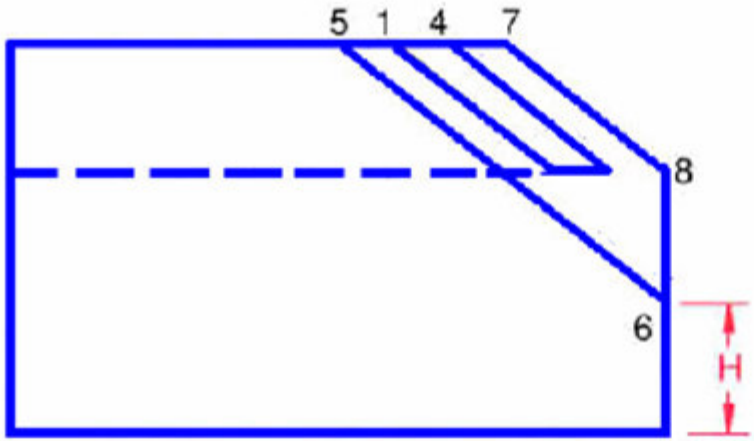
Step 1: Determine the desired view of the object, then draw the isometric axes. For this example it is determined that the object will be viewed from above and the axis will be as shown in Fig. A.



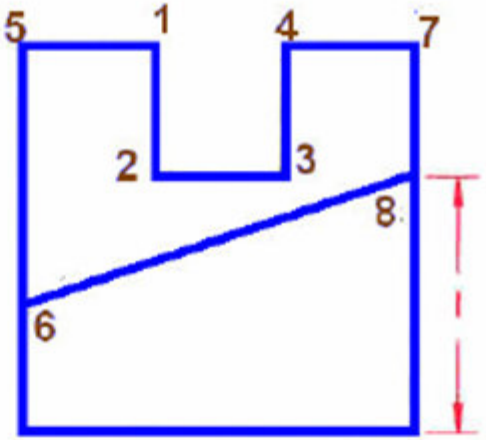
(A) Regular Isometric



T.V.



F.V.



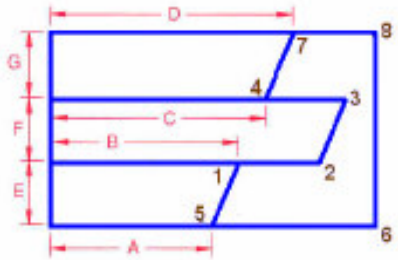
S.V.

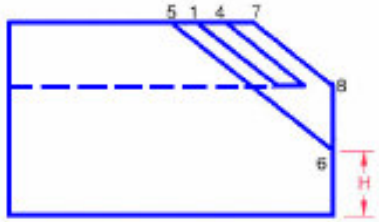
Step 2. Construct the front isometric plane using **W** and **H** dimensions.

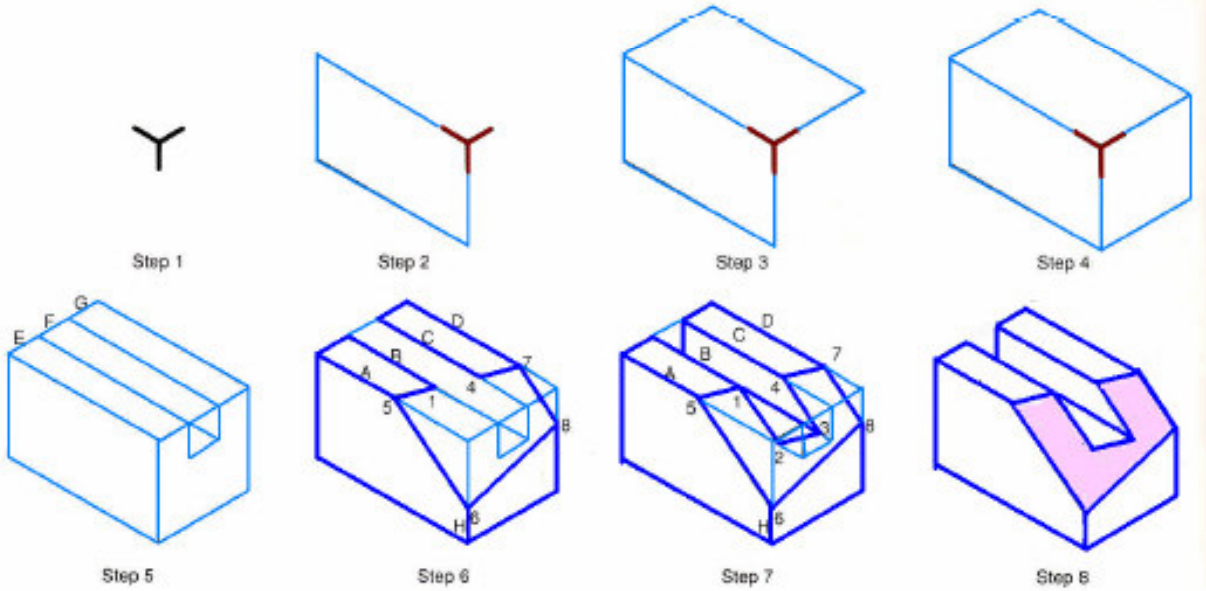
***Step* 3.** Construct the top isometric plane using the **W** and **D** dimensions.

***Step* 4.** Construct the right side isometric plane using **D** and **H** dimensions.

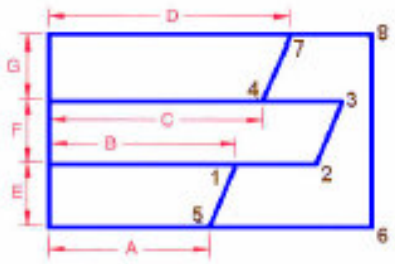
***Step* 5.** Locate the slot across the top plane by measuring distances **E, F**, and **G** along isometric lines.

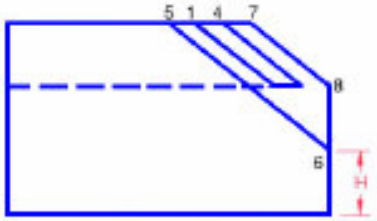


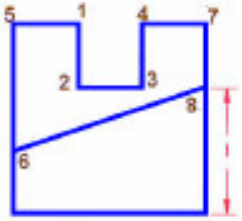




***Step* 6.** Locate the endpoints of the oblique plane in the top plane by locating distances **A, B, C**, and **D** along the lines created for the slot in Step **5.** Label the end-point of line **A** as **5**, line **B** as **1**, line **C** as **4**, and lire **D** as **7**.

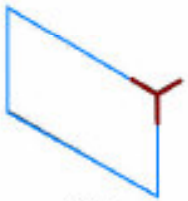




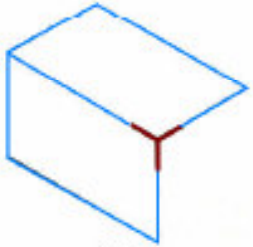


Locate distance **H** along the vertical isometric line in the front plane of the isometric box and label the end point **6**. Then locate distance **I** along the isometric line in the profile isometric plane and label the end point **8**. Connect endpoints **5-7** and endpoint **6-8**. Connect points **5-6** and **7-8**.

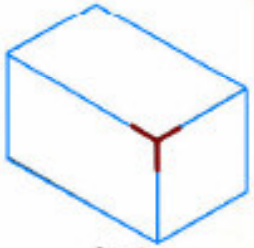
Step 1



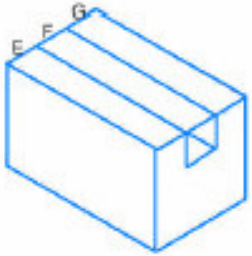
Step 2



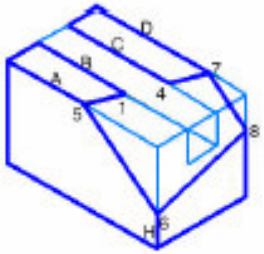
Step 3



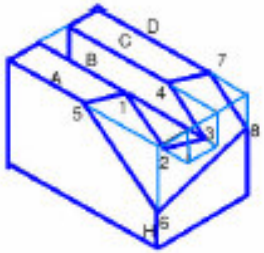
Step 4



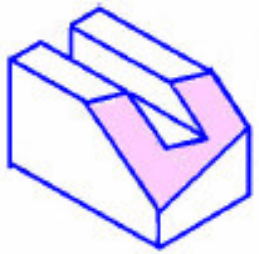
Step 5



Step 6



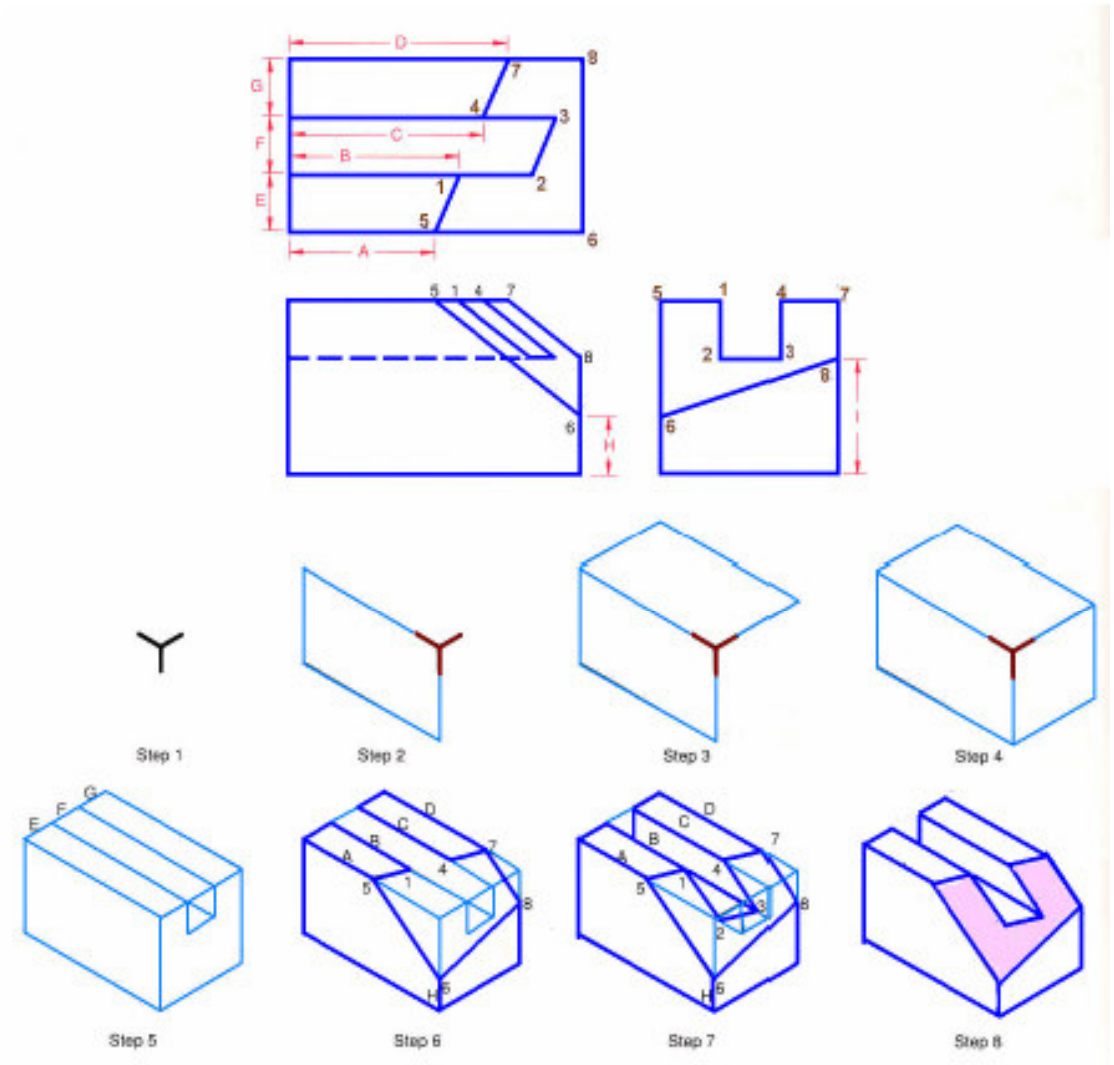
Step 7



Step 8

***Step* 7.** Draw a line from point **4** parallel to line **7**. This new line should intersect at point **3**. Locate point **2** by drawing a line from point **3** parallel to line **4** and equal in length to the distance between points **1** and **4**. Draw a line from point **1** parallel to line **5-6**. This new line should intersect point **2.**

***Step* 8.** Darken lines **4-3**, **3-2**, and **2-1** to complete the isometric view of the object.



Irregular Curves - Irregular curves are drawn in isometric by constructing points along the curve in the multi-view drawing, locating those points in the isometric view, and then connecting the points using a drawing instrument such as a French curve.

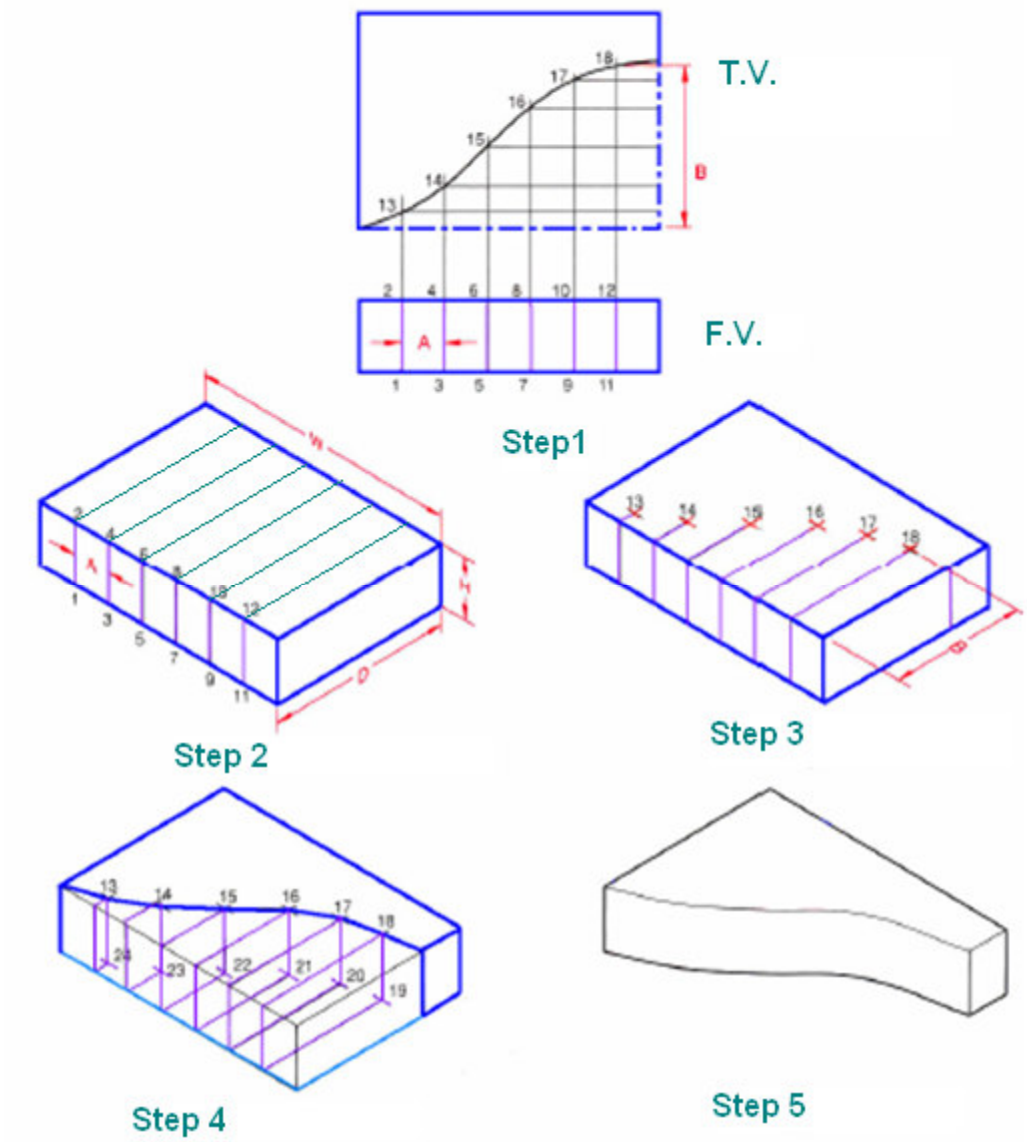
The multi-view drawing of the curve is divided into a number of segments by creating a grid of lines and reconstructing the grid in the isometric drawing.

The more segments chosen, the longer the curve takes to draw, but the curve will be more accurately represented in the isometric view.

***Step* 1**. On the front view of the multi-view drawing of the curve, construct parallel lines and label the points **1-12.**

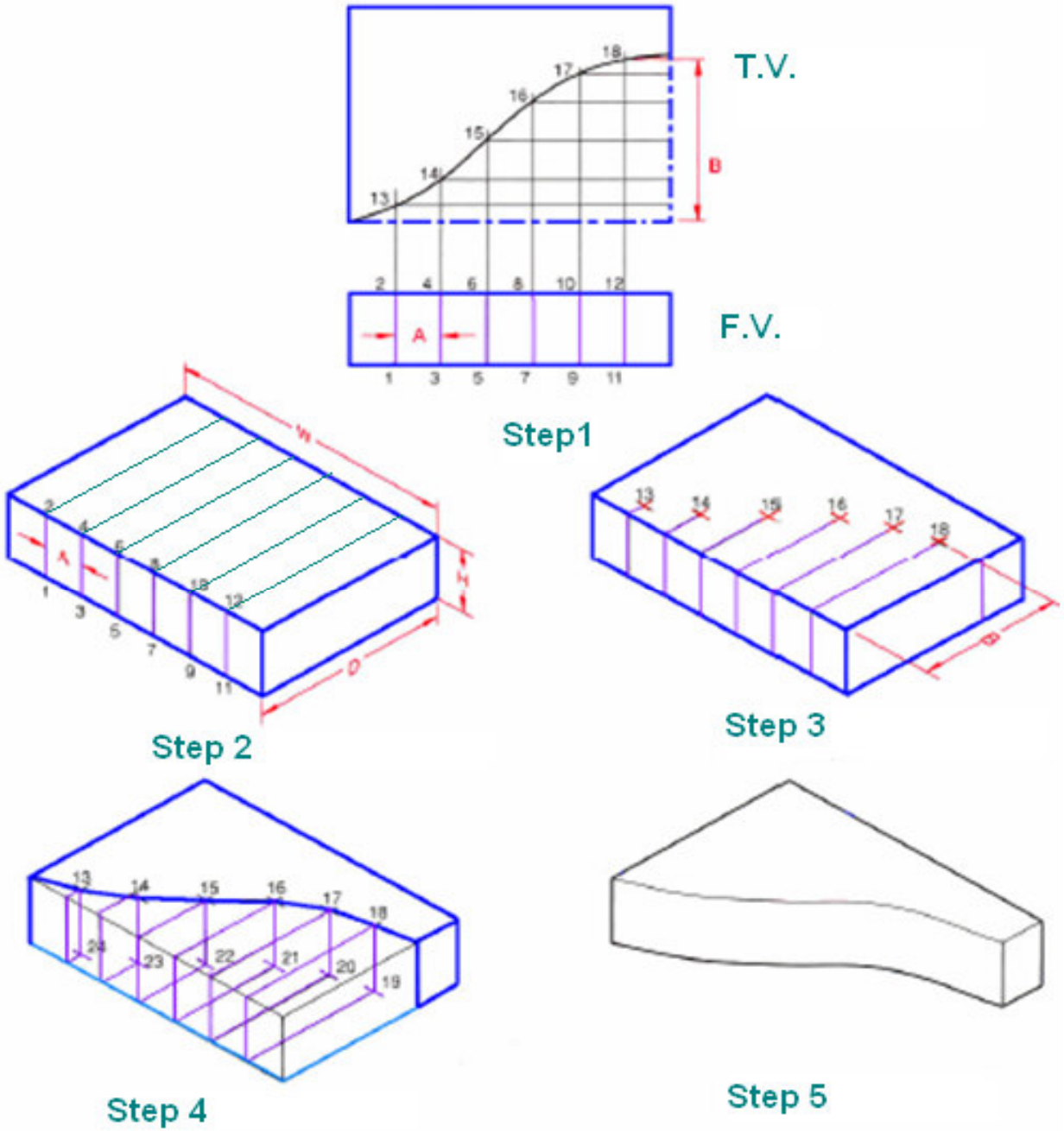
Project these lines into the top view until they intersect the curve.

Label these points of intersection **13-18**, as shown in the Figure. Draw horizontal lines through each point of intersection, to create a grid of lines.



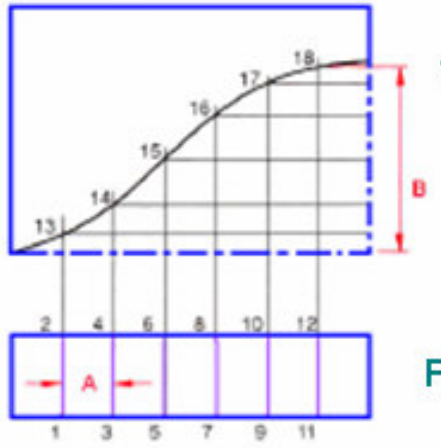
***Step* 2**. Use the **W**, **H**, and **D** dimensions from the multi-view drawing to create the isometric box for the curve.

Along the front face of the isometric box, transfer dimension **A** to locate and draw lines **1-2**, **3-4**, **5-6**, **7-8**, **9-10**, and **11-12**.

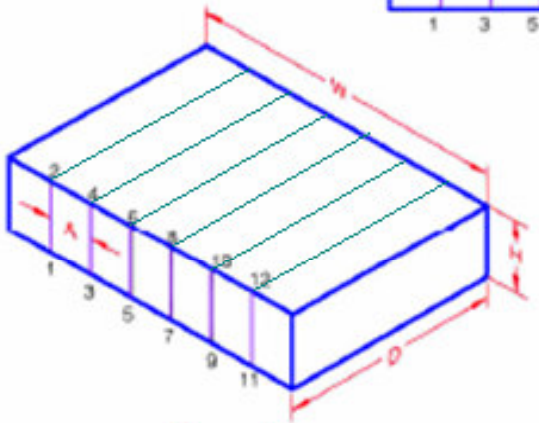


***Step* 3**. From points **2, 4, 6, 8, 10**, and **12**, draw isometric lines on the top face parallel to the **D** line.

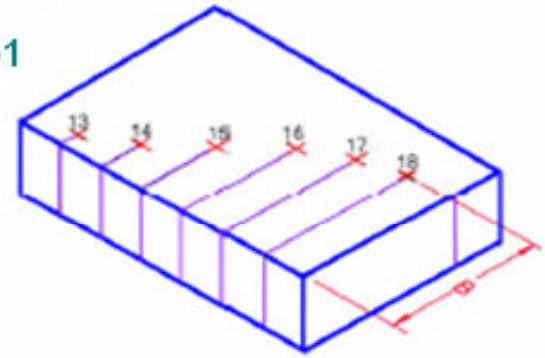
Then, measure the horizontal spacing between each of the grid lines in the top multi-view as shown for dimension **B**, and transfer those distances along isometric lines. parallel to the **W** line. The intersections of the lines will locate points **13-18**.



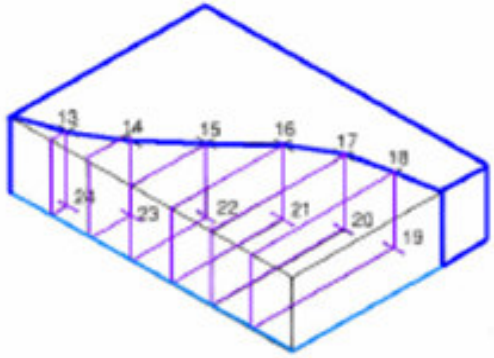
Step1



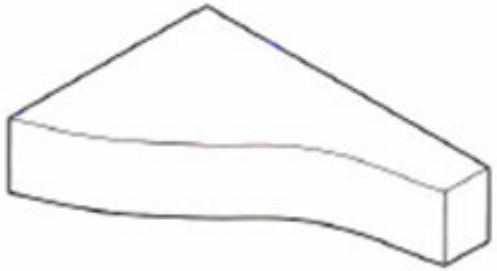
Step 2



Step 3



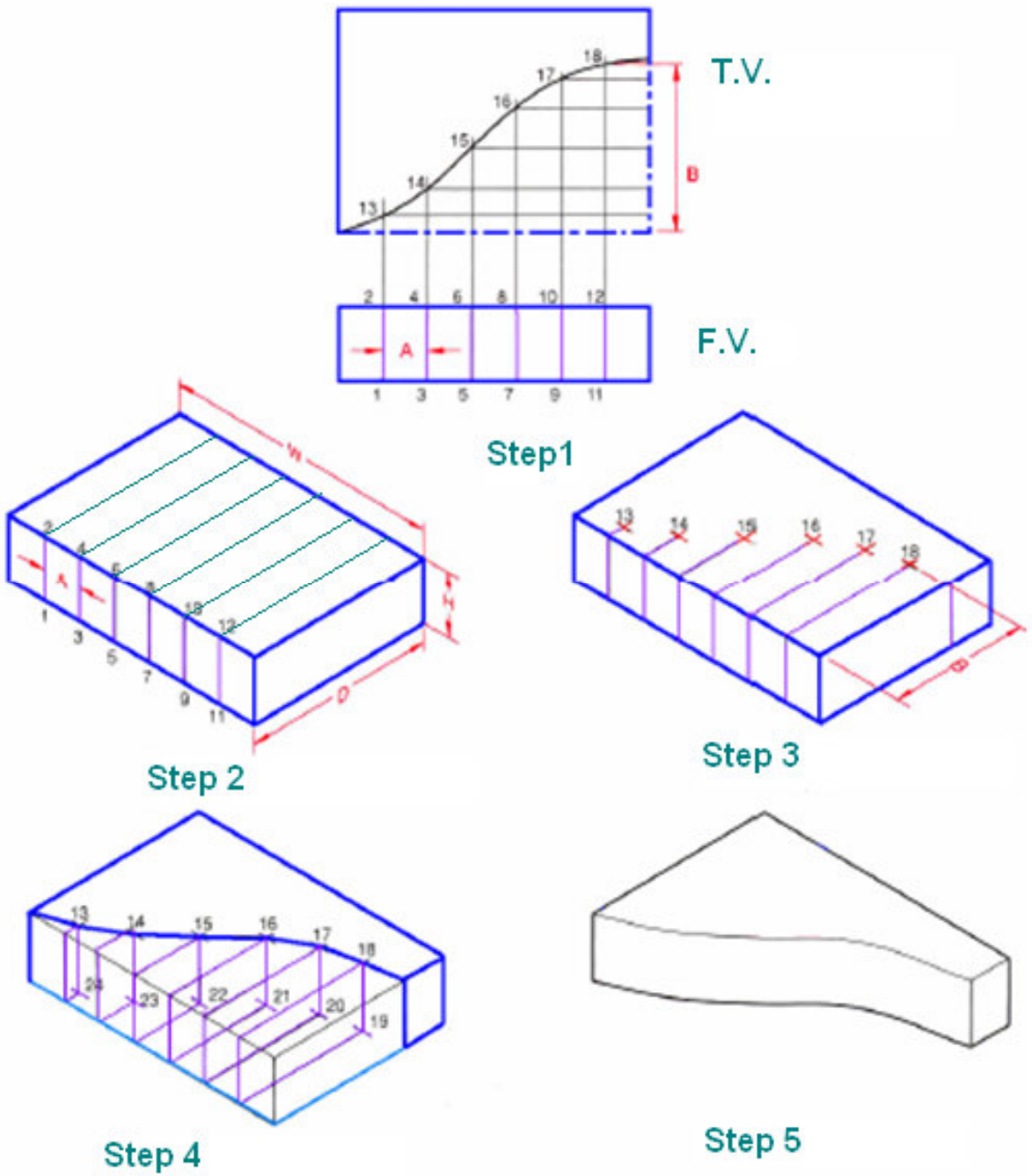
Step 4



Step 5

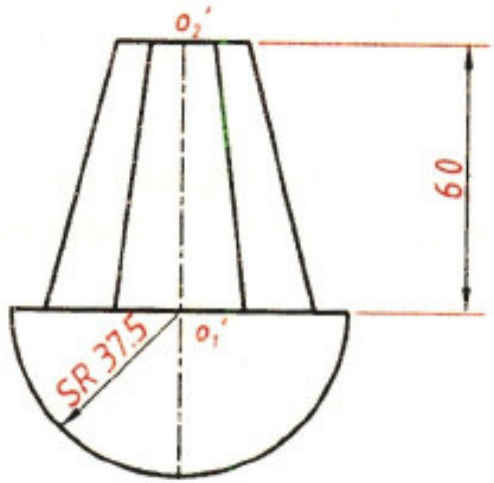
***Step* 4**. Draw the curve through points **13-18**, using an irregular curve. From points **13-18**, drop vertical isometric lines equal to dimension **H**. From points **1, 3, 5, 7, 9**, and **11**, construct isometric lines across the bottom face to intersect with the vertical lines dropped from the top face to locate points **19-24**. Connect points **19-24** with an irregular curve.

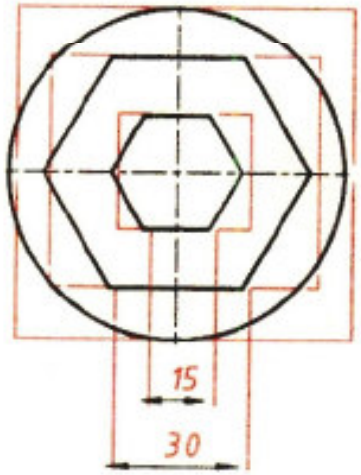
***Step* 5.** Erase or lighten all construction lines to complete the view



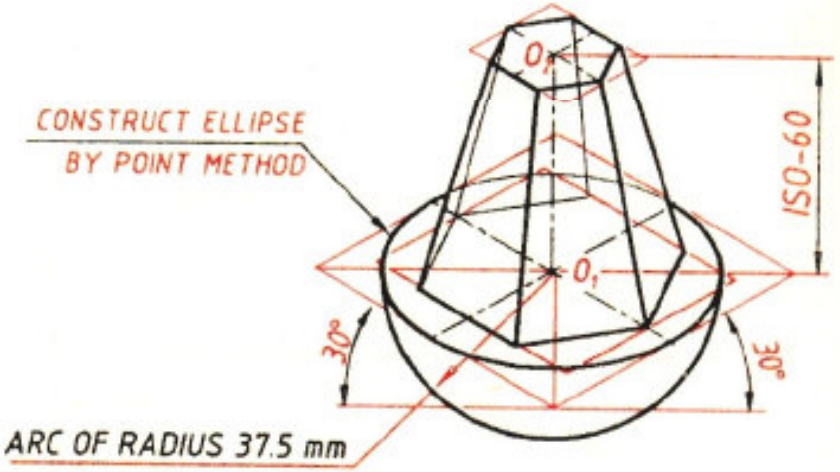
Combinations of solids

Isometric projection of sphere & hexagonal pyramid





A
Orthographic Views



B
Isometric Projection

Taken for K.R. Gopalakrishna, Engineering Graphics, Subash stores


THANK YOU