

## Fundamentals of Drafting - First Angle Orthographic Projection

### Objectives:



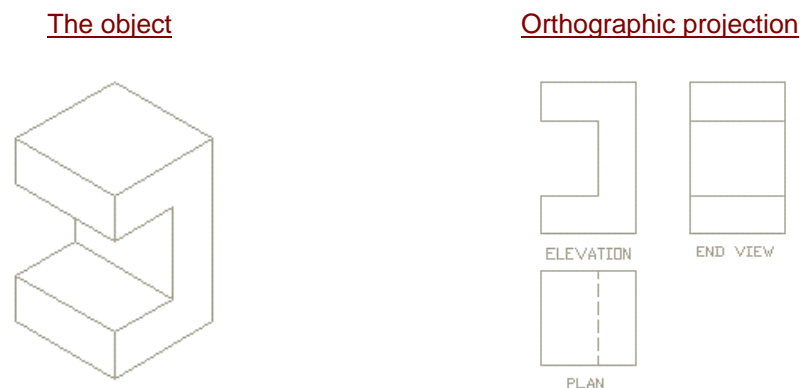
1. To define orthographic projection.
2. To explain with the aid of drawings the meaning of orthographic projection in terms of:
  - (a) principal planes of projection
  - (b) auxiliary vertical plane
3. To identify and draw the views of an object projected on to the principal planes and the auxiliary vertical plane in First Angle Orthographic Projection.
4. To recognise the symbol for First Angle Orthographic Projection.
5. To apply the principle of First Angle Orthographic Projection to engineering drawing problems.

### The definition

Orthographic projection is a method of producing a number of separate two-dimensional inter-related views. These views are drawn mutually at right angle to each other.

In engineering practice, orthographic projection is universally used to represent solid objects by two dimensional views, as many as are necessary to give all the information needed, clearly and accurately.

Example:



Depending on the positioning of the object, there are two forms of orthographic projection:

- (i) First angle orthographic projection
- (ii) Third angle orthographic projection

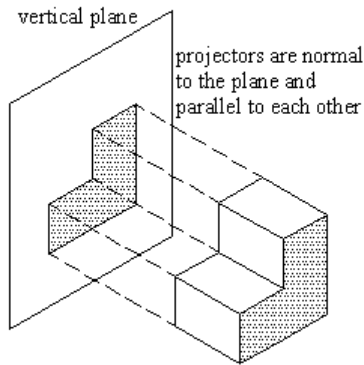
### The principle

A point or line is said to be projected orthographically if the projector is normal to the plane. Therefore the word **orthographic** stands for **drawing at right angle**.

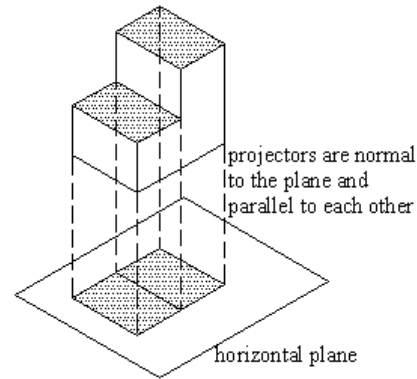
Solids consist of points linked by lines. Using a system of parallel projectors from their boundaries, the lines (or points) may be projected orthographically on to any planes.

The figures below illustrate how a solid object is projected on to a vertical plane and a horizontal plane, the projectors are being normal to the planes and parallel to each other

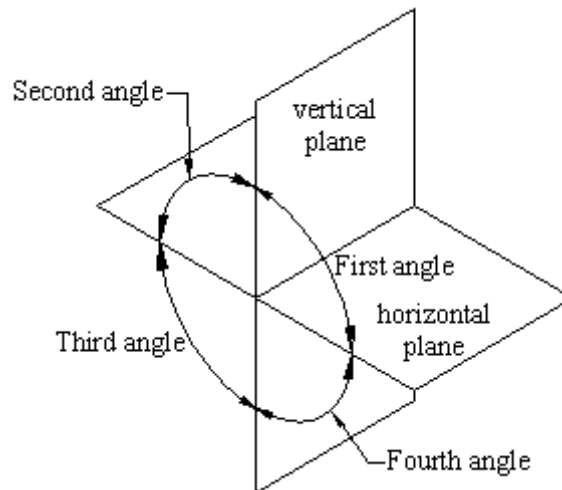
Orthographic projection of a solid on to a vertical plane



Orthographic projection of a solid on to a horizontal plane

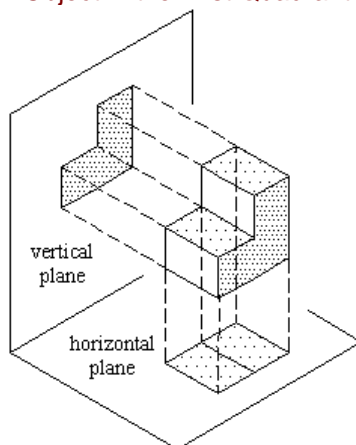


In practice, orthographic projection uses two principal planes: a vertical plane and a horizontal plane. These two planes intersect each other and produce four quadrants or angles.

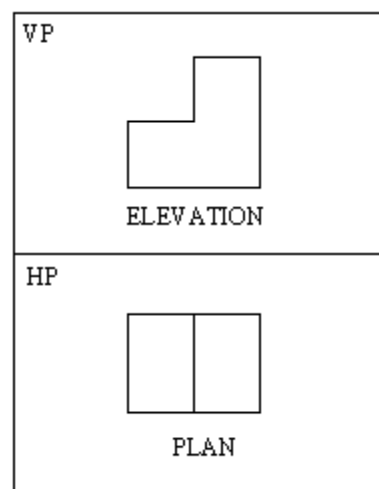


When an object is positioned in space in the first quadrant (first angle), views of the object are projected by drawing parallel projectors (lines) from the object to the principal planes. This is known as the **First Angle Orthographic Projection**.

Object in the First Quadrant



Opening out the horizontal plane



The name of the view projected on to the principal planes are:

- (i) on the vertical plane: **ELEVATION**  
 (also known as **FRONT VIEW, FRONT ELEVATION**)
- (ii) on the horizontal plane: **PLAN**  
 (also known as **PLAN VIEW**)

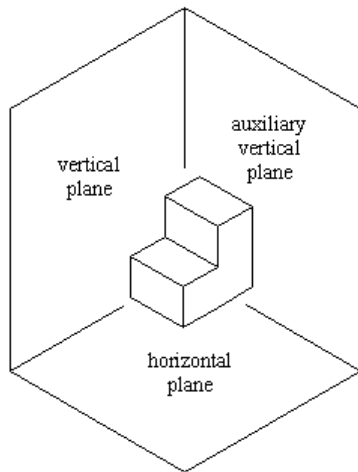
**Auxiliary vertical plane**

The views projected on to the principal planes (VP and HP) in First Angle Orthographic Projection are not always sufficient to describe an object clearly and completely. Therefore a third view projected on to an auxiliary vertical plane (AVP) is drawn.

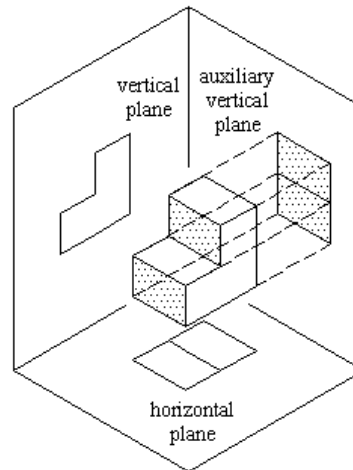
This plane is at right angle to both the vertical and horizontal planes. It may be placed in either side of the vertical plane. The choice of the AVP depends on which face of the object is the more important.

Similar to the principal planes, a view of the object is projected by drawing parallel lines from the object to the AVP.

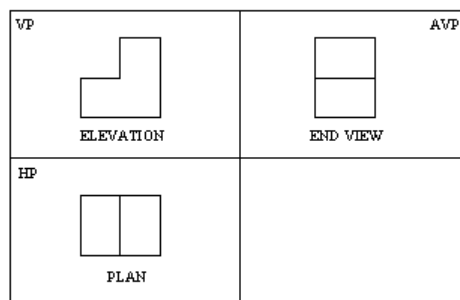
**Orthographic projection of a solid with principal planes and AVP**



**Orthographic projection of a solid on to the AVP**



When opening out the horizontal plane and the auxiliary vertical plane, the three views appear in the positions as shown below.



The names of the views projected on to the three planes are:

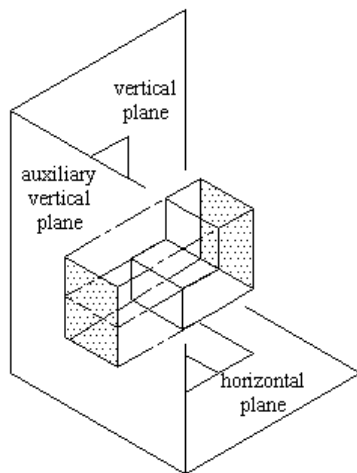
- (i) on the vertical plane: **ELEVATION**  
 (also known as **FRONT VIEW, FRONT ELEVATION**)
- (ii) on the horizontal plane: **PLAN**  
 (also known as **PLAN VIEW**)

- (iii) on the auxiliary vertical plane: **END VIEW**  
 (also known as **END ELEVATION, SIDE VIEW, SIDE ELEVATION**)

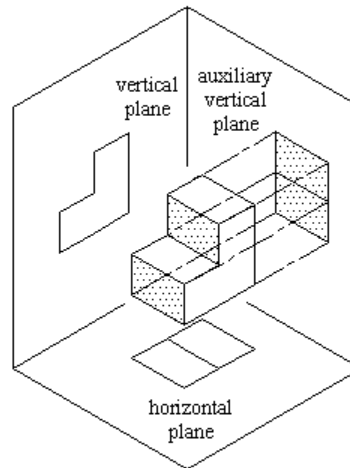
### Principal views

Orthographic projection can be used to describe even complex objects fully and clearly. A number of views are projected on to the principal planes and an auxiliary vertical plane. In some cases, it may be necessary to draw views on both the AVPs.

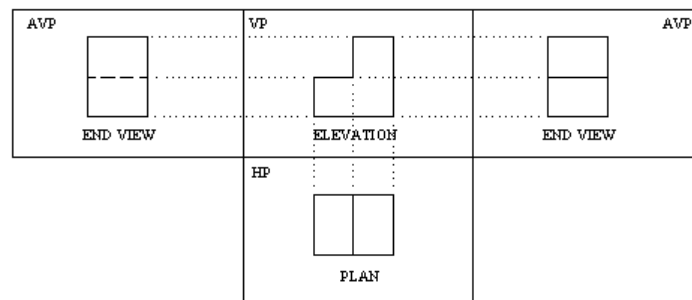
Orthographic projection of a solid on to the left AVP



Orthographic projection of a solid on to the right AVP



When the two AVPs are opened out with the horizontal plane, the four views appear in the positions as shown below.



When drawing these views, it should be noted that:

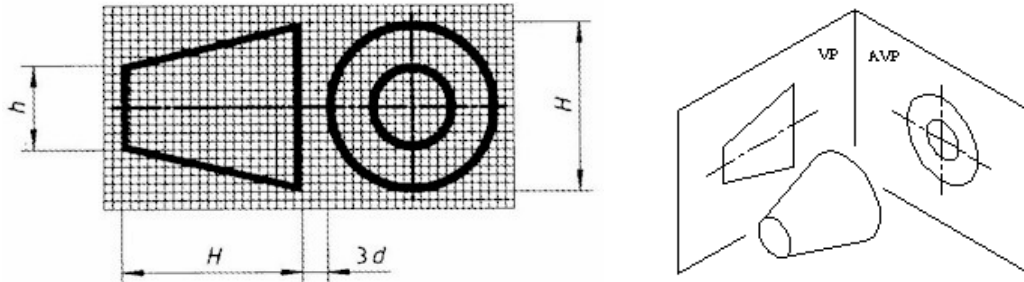
- (i) Allow enough space for the required views before beginning.
- (ii) Use a minimum number of views to describe the object completely.
- (iii) Heights in the elevation and end views are equal and drawn at the same level.
- (iv) Plan view is obtained by viewing the elevation from the top and projecting downward, keeping the corresponding points on the same vertical line.
- (v) Depth in the plan is equal to the width in end views.
- (vi) Each view shows what would be seen by looking on the **far side** of an adjacent view (i.e. further away from the viewing direction),  
 e.g. When viewing the elevation from the left hand side, then the end view is drawn on the right hand side of the elevation
- (vii) It is the principle of first angle orthographic projection to position the views in a fixed pattern. Do not draw the views in other ways.
- (viii) Draw in short dashed lines to represent those hidden outlines and edges.

- (ix) Build up all the views together to avoid making measurement on two or more views separately.

### First angle projection symbol

The system of projection used on a drawing should be indicated by an appropriate symbol.

First angle projection symbol (BS EN ISO 5456-2)

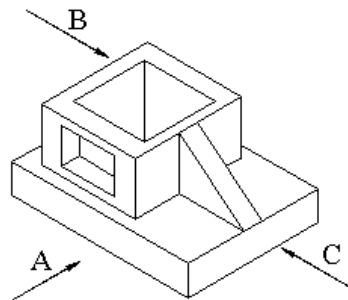


The symbol is derived from projecting a circular taper on to the VP and AVP, so that it shows a front view and a left end view of the circular taper.

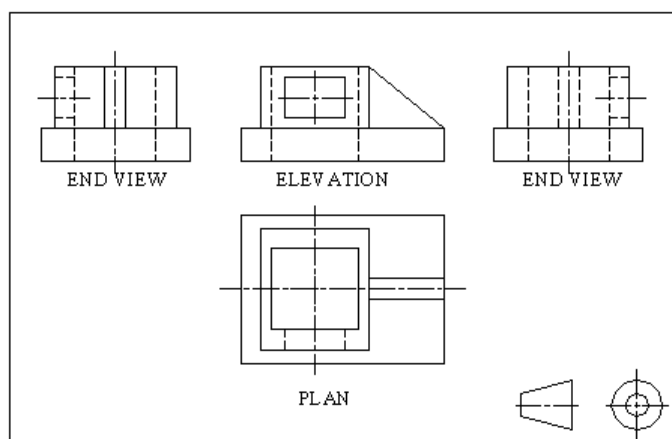
### Worked example

Draw in First Angle Orthographic Projection the following views of the detail shown below.

- (a) Elevation in the direction of arrow A
- (b) Plan view projected from view (a)
- (c) End view in the direction of arrow B
- (d) End view in the direction of arrow C



All Views



### Drawing practice

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#### Question No. 1 (Referring to Figure 5.7)

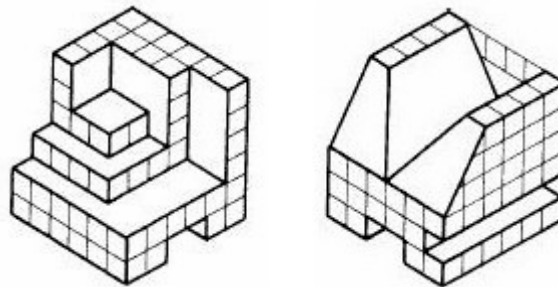
Figure 5.7 shows the components A, B, C, D, E, and F in pictorial projection. The direction of viewing indicated by the arrow corresponds to the front view.

Select from the given orthographic views 1 to 18 the relevant front views, end views and plan views, and insert your answers in a table like the one provided.

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#### Question No. 2 (Referring to Figure 5.8)

Draw full size in First Angle Projection the components shown below. Each construction square represents a 10 mm measurement.



Follow your tutor's instruction to draw the three views (elevation, plan and end views) as required.

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#### Question No. 3 (Referring to Figure 5.9)

Complete the third missing view for each object shown in first angle projection in Figure 5.9. Squared or tracing paper may be used.