Chapter 18

Auxiliary Elevations and Plans

Auxiliary Elevations

The pictorial view of the thatched cottage shown below indicates how the front elevation is:

(i) Obtained from a viewing direction looking in the direction of arrow A.
(ii) Projected onto the vertical plane, which is positioned at right angles to the viewing direction.

Auxiliary elevations can be obtained by changing the viewing direction. Consider, for example, the new viewing direction also shown below:

(i) An auxiliary vertical plane (AVP) can be located in any convenient position at right angles to the viewing direction.
(ii) Points on the object are projected perpendicularly onto the AVP and joined in order.
(iii) The planes are rotated into one plane allowing the views to be transferred to a sheet of paper as shown below.

The line of intersection between the auxiliary vertical plane and the horizontal plane is called the \( X_1Y_1 \) line and is the new ground line.

Note that changing the viewing direction relative to the plan will not affect the heights of an object. Accordingly, heights can be transferred from the front elevation to an auxiliary elevation as indicated over.
Example
Represent the object shown over by drawing the following views:

(a) An **elevation** looking in the direction of arrow **A**.
(b) A **plan** looking in the direction of the arrow **B**, projected from the elevation.
(c) An **auxiliary elevation** with the viewing direction at 30° from the right-hand side.

Build the object from 25 mm cubes as shown above. View the model from the viewing direction to help you visualise the solution.

1. The elevation and plan are drawn as shown below.
2. Draw the new ground line $X_1Y_1$ in any convenient position at right angles to the viewing direction.
3. Project points on the object from the plan at right angles to the new ground line.
4. Transfer the heights from the front elevation to the auxiliary elevation.
5. Line in the auxiliary elevation as appropriate.
Exercises

1. Represent each of the objects shown below by drawing the following views:
   (a) An **elevation** looking in the direction of arrow A.
   (b) A **plan** looking in the direction of the arrow B, projected from the elevation.
   (c) An **auxiliary elevation** with the viewing direction at 30° from the right-hand side.

   Build each of the objects from 25 mm cubes and use the models to help you visualise the solutions.

2. Represent each of the objects shown below by drawing the following views:
   (a) An **elevation** looking in the direction of arrow A.
   (b) A **plan** looking in the direction of the arrow B, projected from the elevation.
   (c) An **auxiliary elevation** with the viewing direction at 45° (first object from the left-hand side and second object from the right-hand side).

   **Answer Worksheets 18A and 18B**
Determining True Shape using Auxiliary Elevations

A surface will appear in true shape in an auxiliary elevation in which the viewing direction is at right angles to that surface.

Example

Represent the object shown over by drawing the following views:

(a) An elevation looking in the direction of arrow A.
(b) A plan looking in the direction of the arrow B, projected from the elevation.
(c) An auxiliary elevation of the object, which will show the true shape of the surface S.

1. Consider the pictorial shown below. The true shape of surface S will appear in an auxiliary elevation in which the viewing direction is at right angles to the surface S, as indicated.
2. The elevation and plan are drawn as shown below.

3. The viewing direction will be $\perp$ to the plan of surface S. Draw the new ground line $X_1Y_1$ in any convenient position at right angles to the viewing direction (parallel to the plan of surface S).

4. Project points on the object from the plan at right angles to the new ground line.

5. Transfer the heights from the front elevation to the auxiliary elevation.

6. Line in the auxiliary elevation as shown below.
Exercises
The figure below shows pictorial views of some solids. In each case:
(a) Draw an **elevation** looking in the direction of arrow A.
(b) Draw a **plan** looking in the direction of arrow B, projected from the elevation.
(c) Draw an **auxiliary elevation** of the entire object, which will show the true shape of the surface S.
Circles appear elliptical in auxiliary elevations.

**Example**
The elevation and plan of an archway based on the *Arc de Triomphe* are shown over.
(a) Draw the given views.
(b) Draw an auxiliary elevation of the *entire archway* on the given ground line \(X_1Y_1\).

1. The elevation and plan are drawn as shown below.
2. Set up the auxiliary elevation of the archway in the normal manner, omitting the curved surface.
3. Locate points on the elevation of the semicircles (use 30° divisions for convenience) and project them to the plan.
4. The semicircles will appear as semi-ellipses in the auxiliary view. These curves can be drawn by first projecting the points on the plan of the semicircles to the auxiliary view as shown below.

5. Then transfer the heights of these points from the front elevation to the auxiliary elevation and join them in order. Some construction lines have been omitted below for clarity.

Exercises

1. The elevation and plan of an archway are shown across.
   (a) Draw the given elevation and plan.
   (b) Draw an auxiliary elevation of the entire archway on the given ground line $X_1 Y_1$. 
2. The elevation and plan of a **flight of steps** are shown below.
   (a) Draw the given views.
   (b) Draw an **auxiliary elevation** of the *entire structure* on the given ground line $X_1Y_1$.

3. The figure below shows the elevation and plan of a **solid**.
   (a) Draw the elevation and plan.
   (b) Draw an **auxiliary elevation** of the solid on the given ground line $X_1Y_1$. 
4. The elevation and plan of a component are shown across.
   (a) Draw the given views.
   (b) Draw an auxiliary elevation of the entire component which will show the true shape of the surface S.

5. The figure over shows a pictorial view of a trophy, which contains a regular hexagon.
   (a) Draw an elevation of the trophy looking in the direction of arrow A.
   (b) Draw a plan looking in the direction of arrow B, projected from the elevation.
   (c) Draw an auxiliary elevation of the trophy, which will show the true shape of the surface S.

Answer Worksheets 18C and 18D
**True Length using Auxiliary Elevations**

A line will appear in true length in an auxiliary elevation in which the viewing direction is at right angles to the plan of the line.

### Example

The elevation and plan of a solid are shown over. Draw an auxiliary elevation of the entire solid which will show the true length of the line AB.

1. The true length of the line AB will appear in an auxiliary elevation in which the viewing direction is at right angles to the plan of the line AB, as illustrated below, right. Accordingly, draw the X,Y₁ line parallel to the plan of the line AB and project the auxiliary elevation as shown below, left.

### Exercise

The elevation and plan of a birdhouse are shown over.

(a) Draw the given views.

(b) Draw an auxiliary elevation of the birdhouse which will show the true length of the line AB.

**Answer Worksheet 18E**
Auxiliary Plans

Auxiliary plans can be obtained by changing the viewing direction also. Take for example the pictorial view of the corner unit shown over. It shows:

(i) A viewing direction inclined to the HP.
(ii) An auxiliary plane (AP) positioned at right angles to the inclined viewing direction.
(iii) The auxiliary plan of the unit obtained by projecting points on the object perpendicularly onto the AP and joining them in order.

The planes are rotated into one plane allowing the views to be transferred to a sheet of paper as shown below.

The line of intersection between the auxiliary plane and the vertical plane is called the $X_1Y_1$ line.

Note that the widths in the auxiliary plan are the same as those in the plan. This facilitates an efficient method of constructing auxiliary plans as shown in the following example.
1. The elevation and plan are drawn in the normal manner.
2. Draw the $X_1Y_1$ line in any convenient position at right angles to the viewing direction for the auxiliary plan.
3. Project all points on the object from the elevation at right angles to the $X_1Y_1$ line.
4. Transfer the widths from the plan to the auxiliary plan as indicated below, left.
5. Line in the auxiliary plan as shown below, right.

**Example**
The elevation and plan of a solid which forms the basis for a **corner unit** is shown over.
(a) Draw the given views.
(b) Draw an **auxiliary plan** of the solid with the viewing direction as indicated by the arrow.

**Exercises**
1. The figure over shows the elevation and plan of the **Toblerone box** which is based on an equilateral triangular prism.
   (a) Draw the given views.
   (b) Draw an **auxiliary plan** of the box using the viewing direction indicated by the arrow.
2. The elevation and plan of a tea box are shown over.
   (a) Draw the given views.
   (b) Draw an auxiliary plan of the box using the viewing direction indicated by the arrow.

3. The elevation and plan of two solids are shown below. In each case:
   (a) Draw the elevation and plan as given.
   (b) Draw an auxiliary plan of the solid on the X₁Y₁ line shown.

**Determining True Shape using Auxiliary Plans**

Earlier we determined the true shape of surfaces using auxiliary elevations having noted that:

> A surface will appear in true shape in a view in which the viewing direction is at right angles to that surface.

The same principles can be applied to auxiliary plans.

**Example**
The elevation and plan of a solid are shown over.
   (a) Draw the given views.
   (b) Draw an auxiliary plan of the entire solid, which will show the true shape of the surface S.
1. The elevation and plan are drawn as shown below.
2. The true shape of surface S will appear in an auxiliary plan in which the viewing direction is at right angles to that surface as illustrated over. Accordingly, the viewing direction will be \( \perp \) to surface S in elevation.
3. Draw the \( X_1Y_1 \) line in any convenient position \( \perp \) to the viewing direction (parallel to the elevation of surface) and project points on the object from the elevation at right angles to the \( X_1Y_1 \) line.
4. Transfer the widths from the plan to the auxiliary plan and complete the new view as shown below.

**Exercises**

The figure below shows the elevation and plan of two solids. In each case:
(a) Draw the given elevation and plan.
(b) Draw an **auxiliary plan** of the *entire solid*, which will show the true shape of the surface S.
Circles in Auxiliary Plans

Circles appear elliptical in auxiliary plans.

**Example**
The elevation and plan of a **bin** are shown over.
(a) Draw the given views.
(b) Draw an **auxiliary plan** of the entire bin which will show the true shape of the surface S.

1. The elevation and plan are drawn as shown over.
2. The viewing direction for the auxiliary plan will be \( \perp \) to the elevation of surface S. Draw the \( X_1Y_1 \) line \( \perp \) to the viewing direction (parallel to the elevation of surface S).
3. Complete the auxiliary plan of the object, excluding the curves, in the normal manner.
4. Locate additional points on the plan of the curves (use 30° divisions for convenience) and project them to the elevation.
5. Then locate these points in the auxiliary plan by transferring the appropriate widths and draw smooth curves to pass through them as shown over.

**Exercises**
The elevation and plan of two objects are shown below. In each case:
(a) Draw the given elevation and plan.
(b) Draw an **auxiliary plan** of the **entire object** which will show the true shape of the surface S.

**Answer Worksheet 18G**