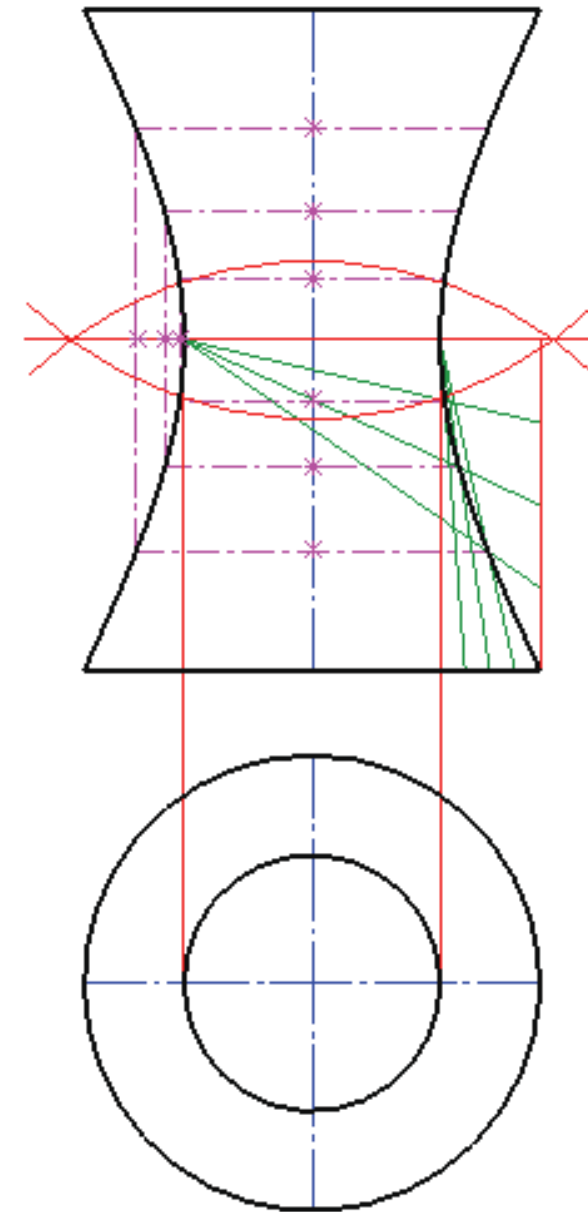
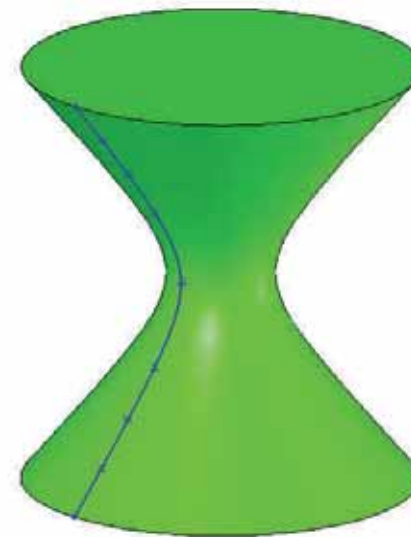
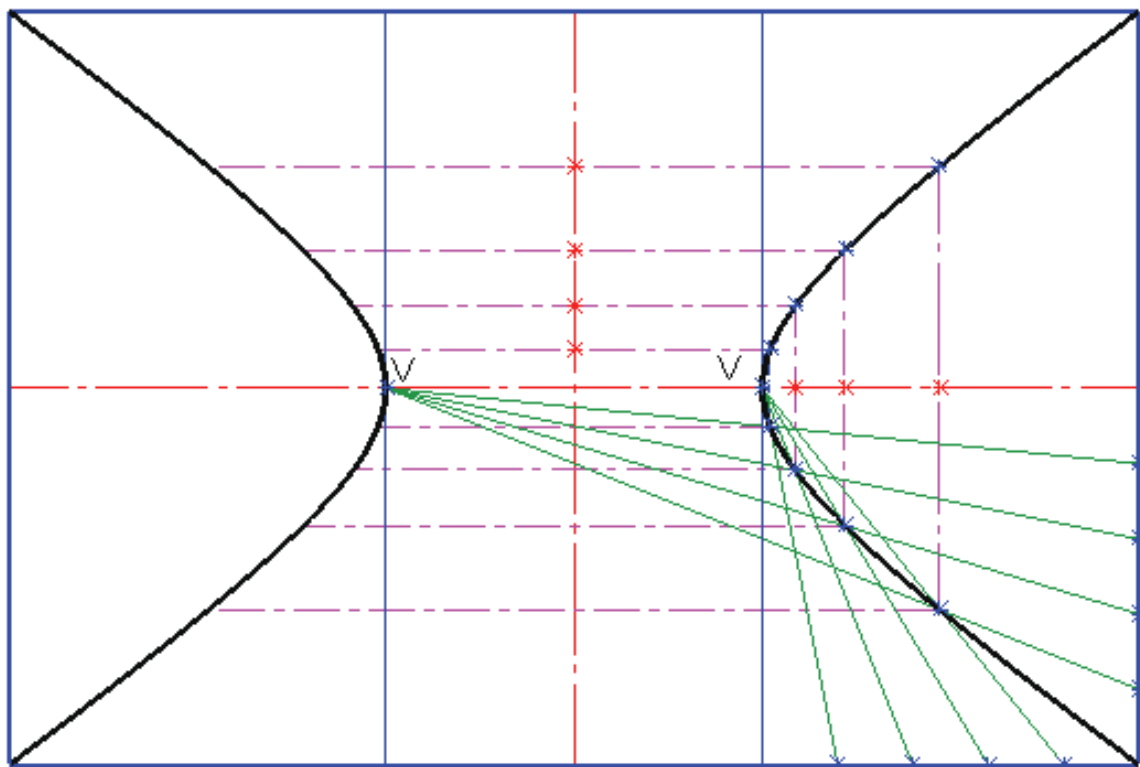


### Key principles

- The hyperboloid of revolution is a **Surface** and may be generated by revolving a **Hyperbola** about its conjugate axis.
- The outline of the elevation will be a **Hyperbola**.
- When the conjugate axis is vertical all horizontal sections are **circles**.
- The horizontal section at the mid point of the conjugate axis is known as the **Throat**.

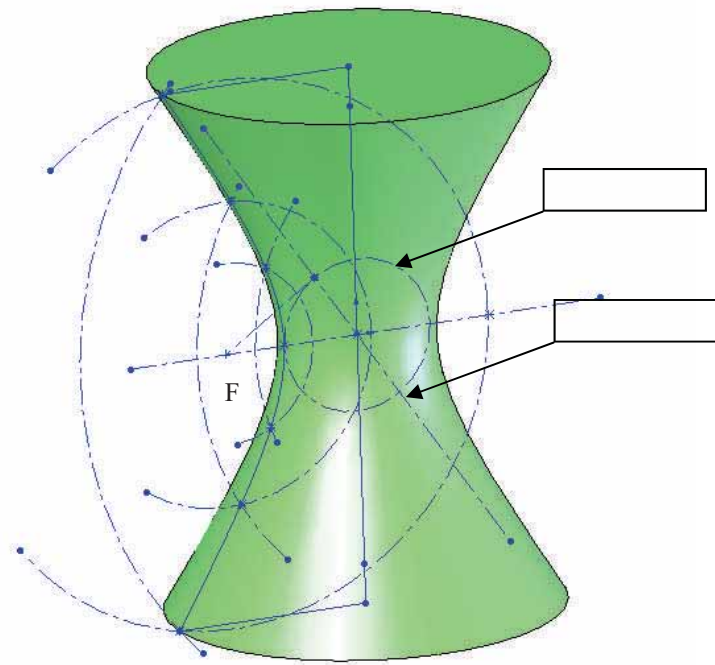
The diagram shows the incomplete construction for drawing a hyperbola in a rectangle.

- (a) Draw the outline of the both branches of the double hyperbola in the rectangle.



The diagram shows the incomplete Elevation of a hyperboloid of revolution.

- (a) Determine the position of the throat circle in elevation.  
 (b) Draw the outline of the both branches of the double hyperbola in elevation.



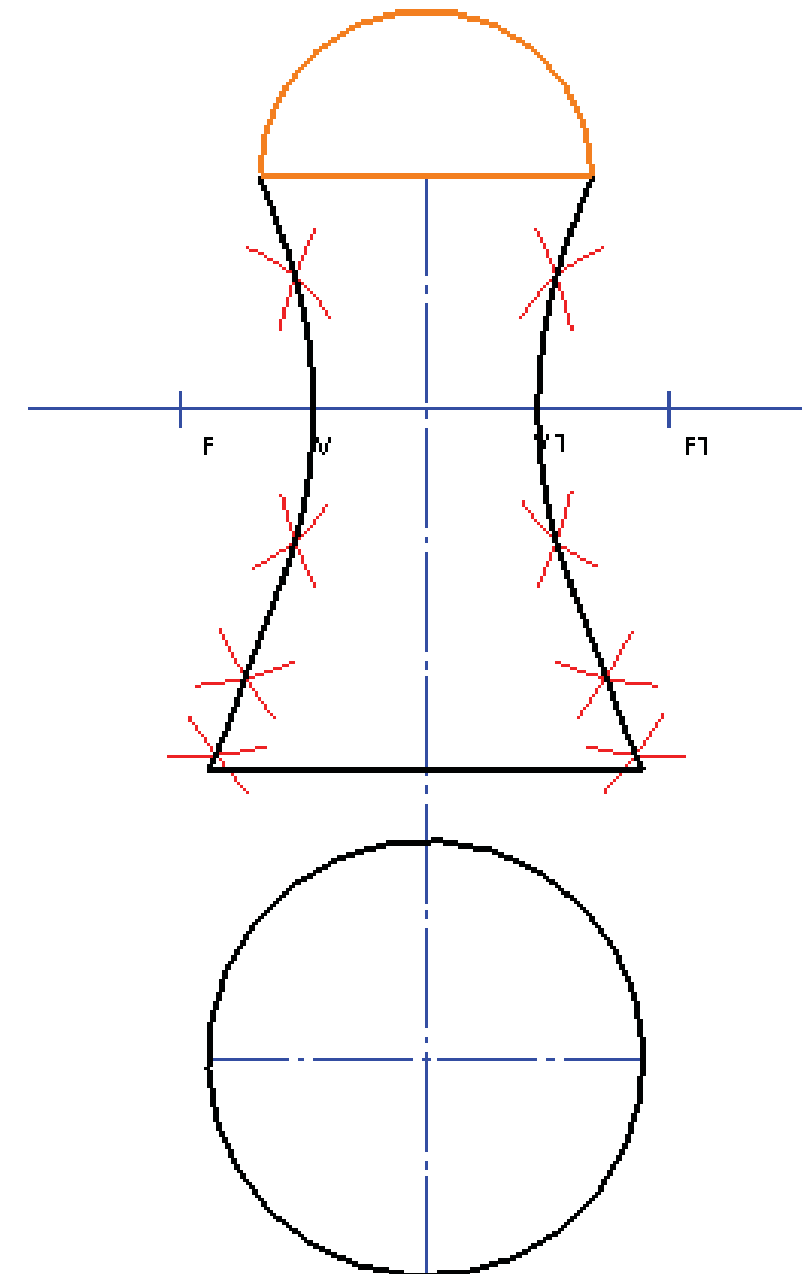
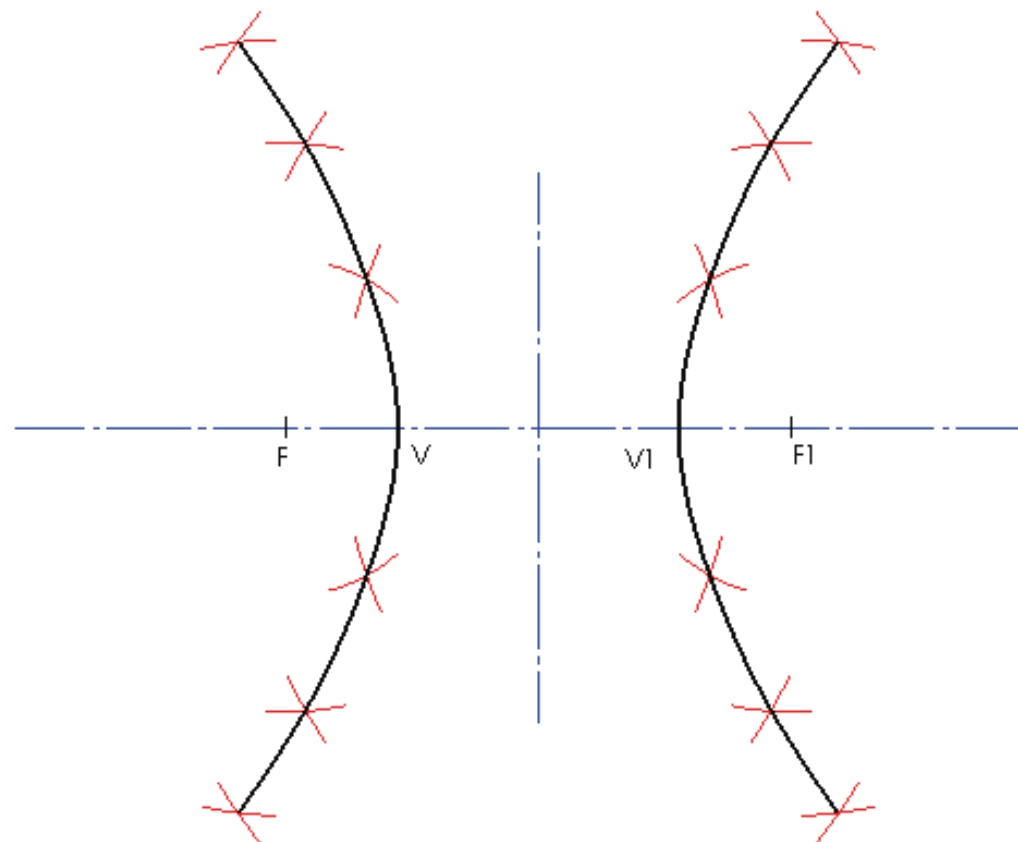
The diagram shows the plan and incomplete elevation of an object based on the hyperboloid of revolution. The focal points and transverse axis of the hyperbola are also shown.



(a) Using the given information draw the outline of the elevation..

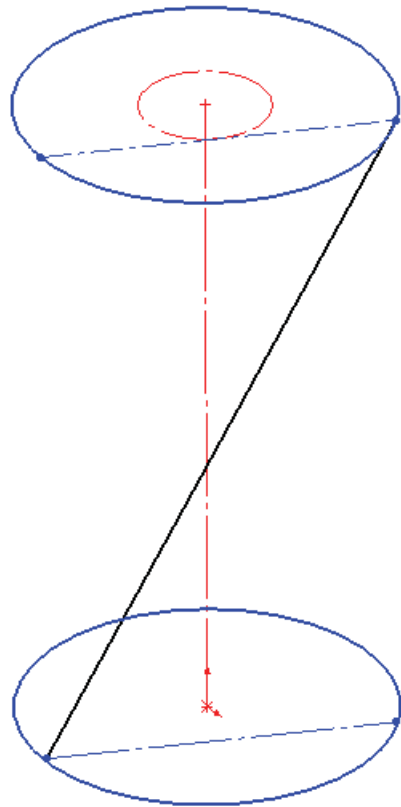
The diagram shows the axis, focal points and transverse axis of a double hyperbola.

- (a) Draw the outline of both branches of the double hyperbola.
- (b) The difference between the focal distances for any point on a double hyperbola is constant and equal to the length of the **transverse** axis.
- (c) Indicate this principle on the drawing below.



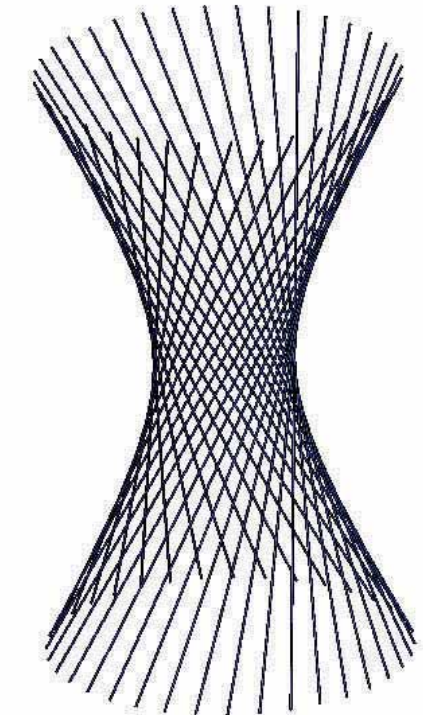
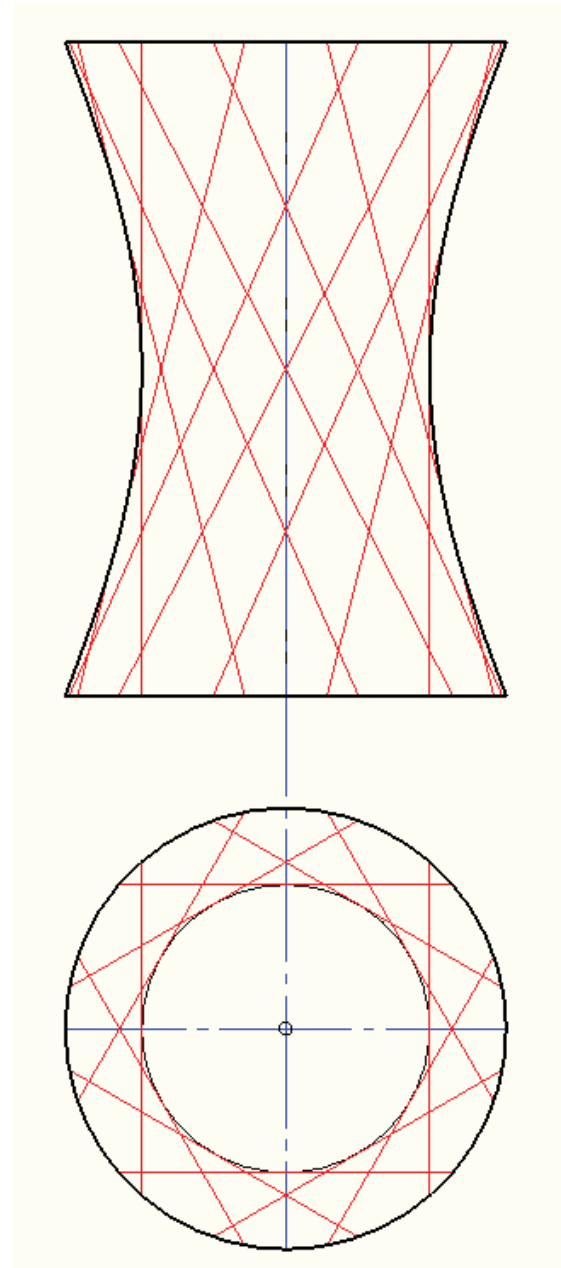
## Key principles

- The hyperboloid of revolution may also be generated by revolving one skew line about another.
- The hyperboloid of revolution is made up of an infinite number of straight line elements which are inclined to the conjugate axis.
- Each element in plan will be tangential to the throat circle.



The diagram shows the plan and incomplete elevation of a hyperboloid of revolution.

Using 12 elements draw the outline of the elevation.



TECHNOLOGY  
SUBJECTS  
SUPPORT  
SERVICE

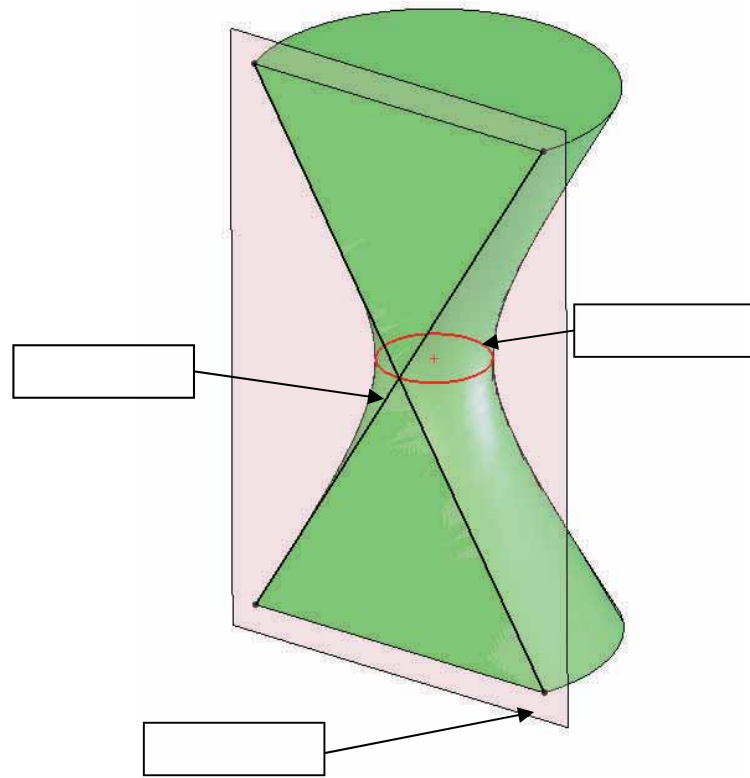
DESIGN & COMMUNICATION GRAPHICS

Structural forms 3

NAME: \_\_\_\_\_ DATE: \_\_\_\_\_

## Key principles

- All elements are **tangential** to the throat.
- Any section perpendicular to the axis is a **circle**
- The asymptotes are the elements which are seen as true **lengths** in elevation.

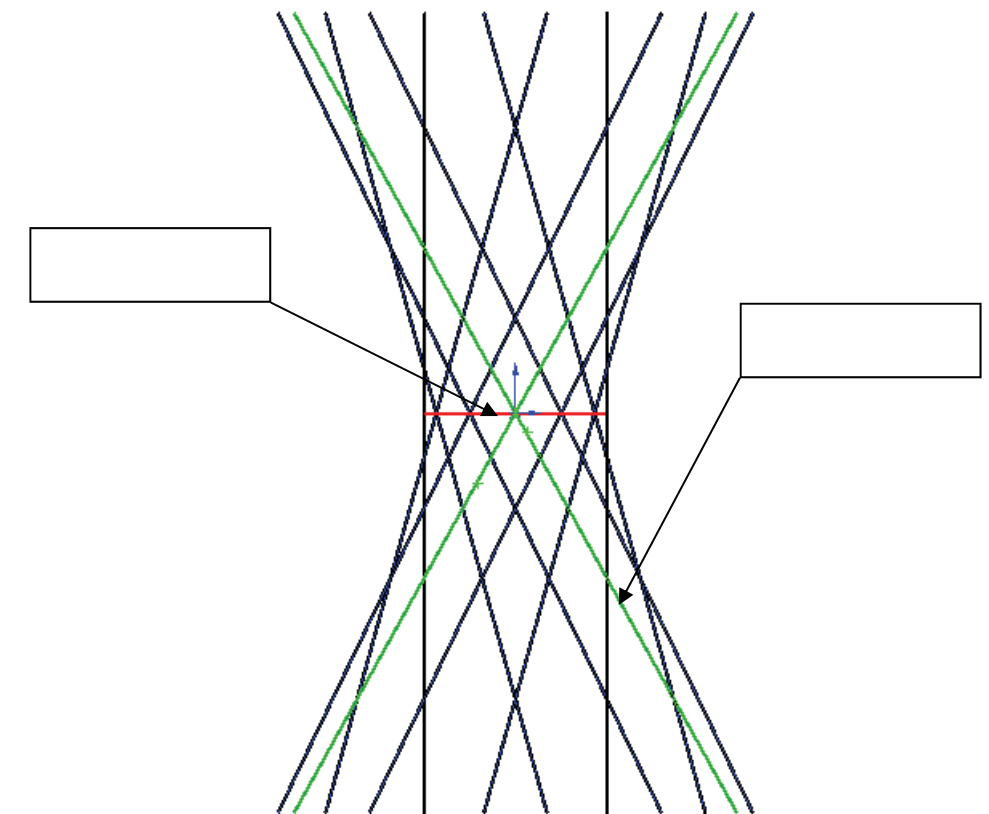
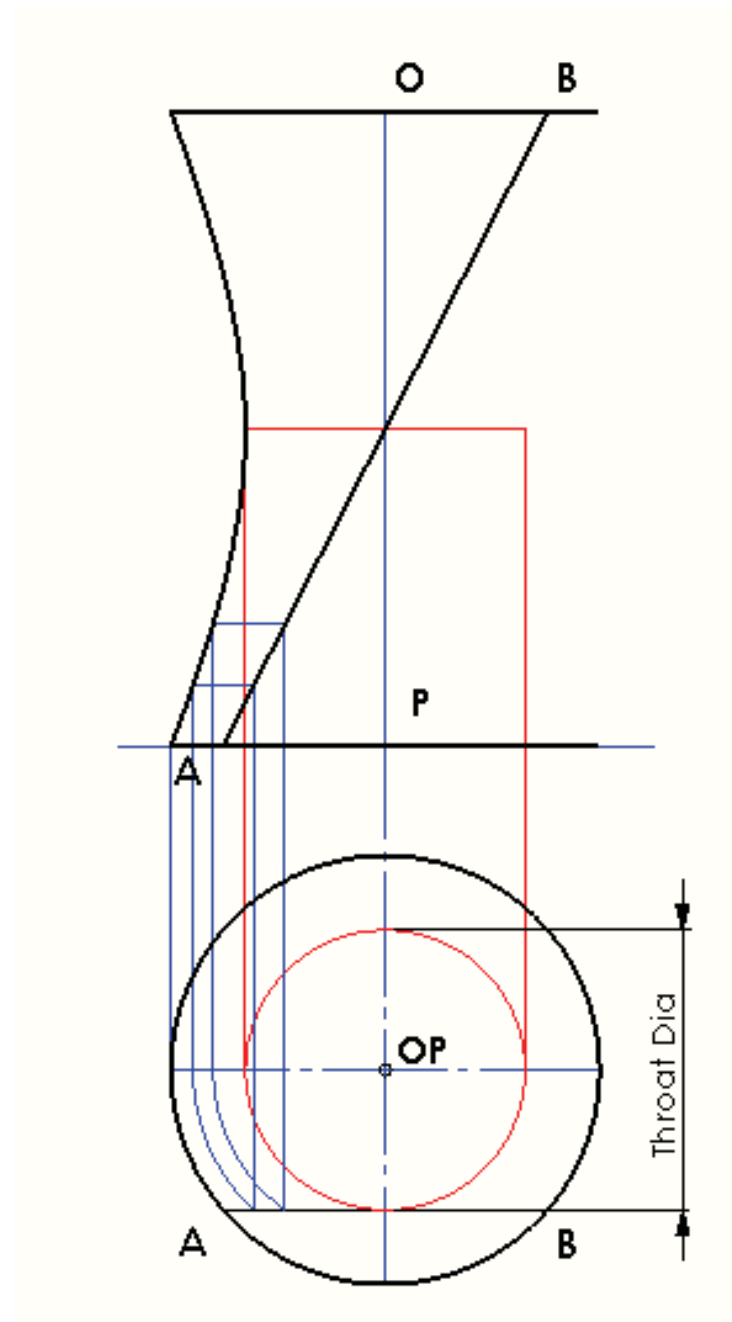


A photograph of a car show room is shown . Part of the structure is in the shape of a hyperboloid of revolution. The projections of the base and one element AB are shown in the diagram below.

(a) Rotate point A in a clockwise direction about the axis OP on to the section plane S-S.

(b) Using a series of points on the element AB produce one branch of the double hyperbola.

(c) Indicate the position and size of the throat circle.



TECHNOLOGY  
SUBJECTS  
SUPPORT  
SERVICE

DESIGN & COMMUNICATION GRAPHICS

Structural forms 4

NAME: \_\_\_\_\_ DATE: \_\_\_\_\_





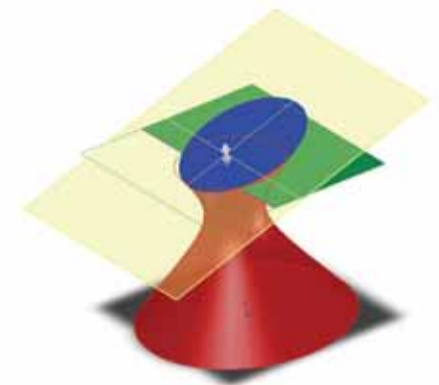
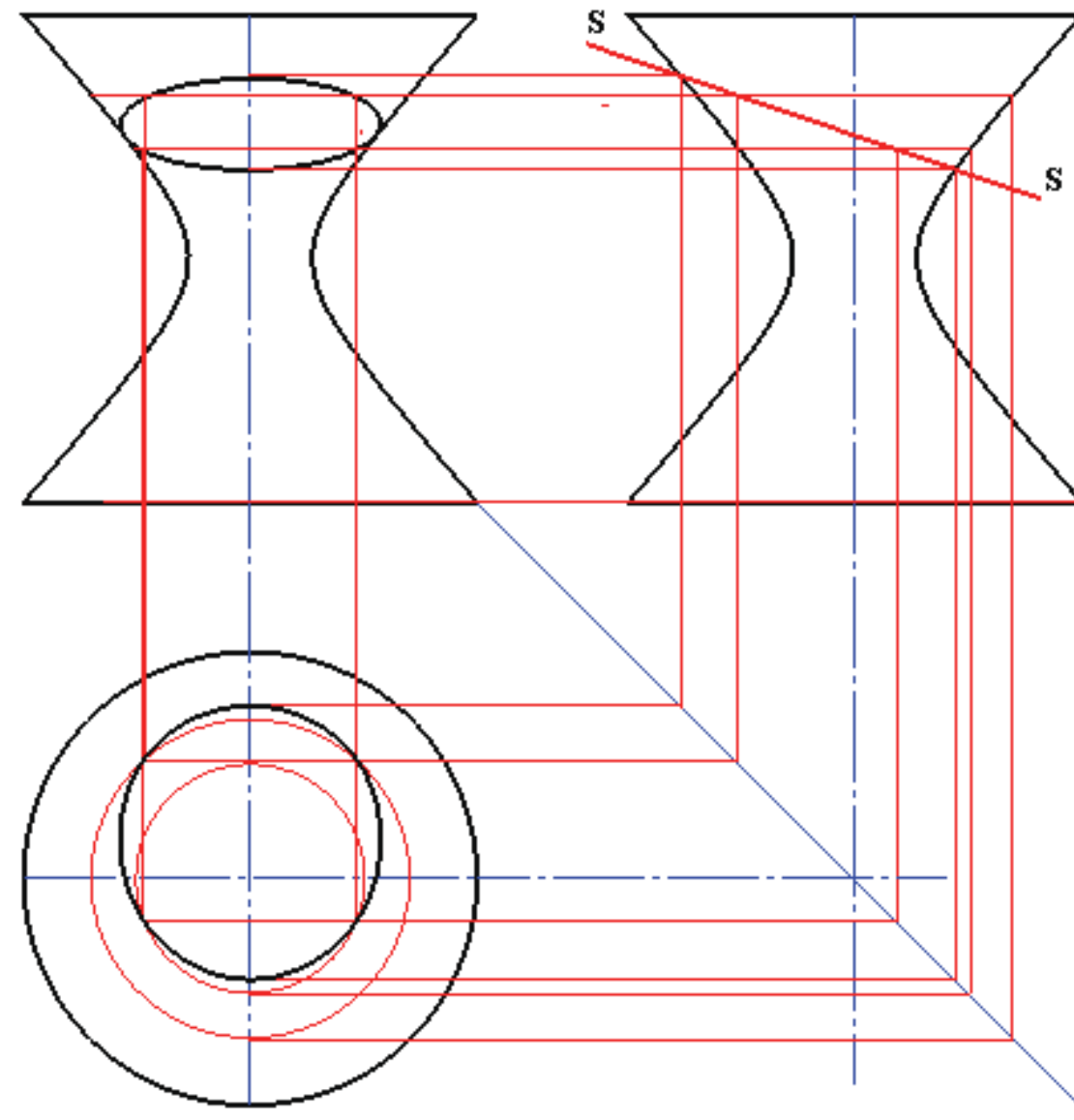
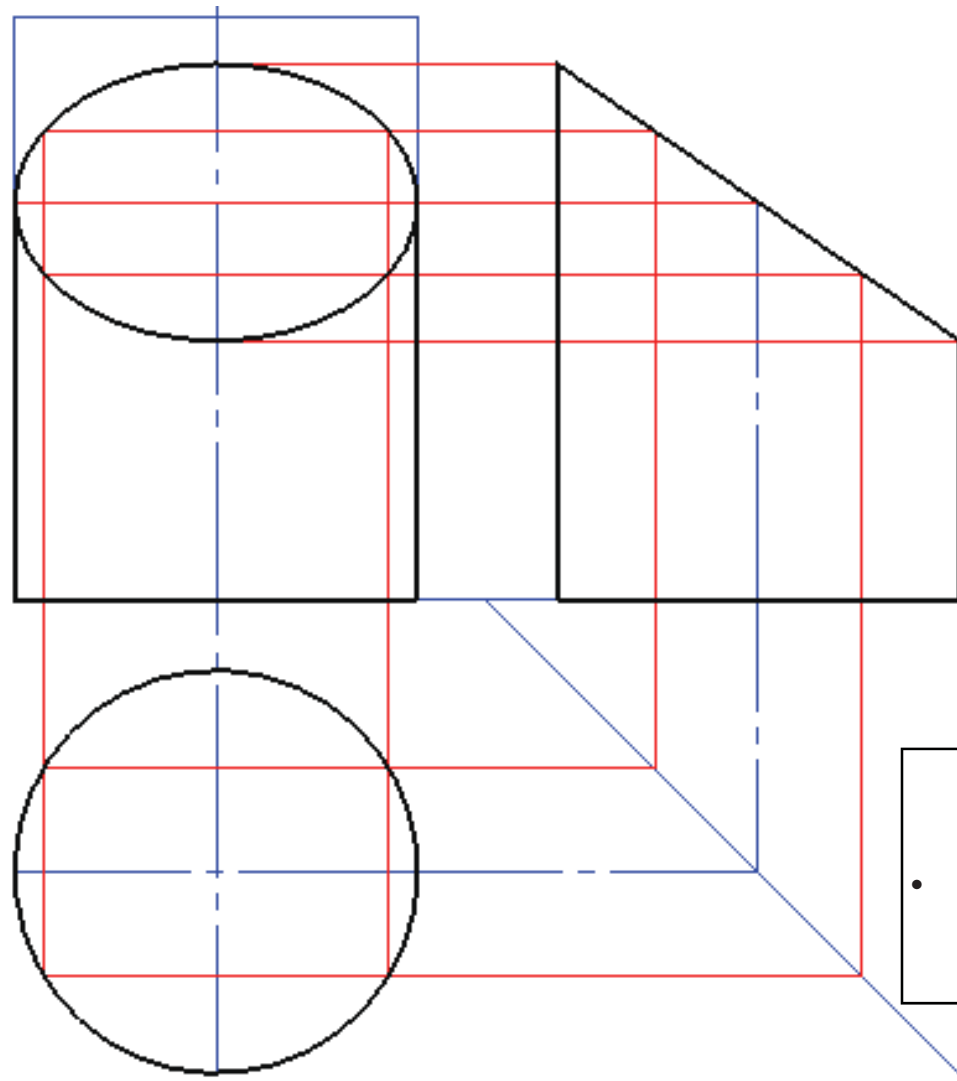
The diagram shows the incomplete orthographic views of a truncated hyperboloid of revolution

Draw the elevation and project the plan.



The diagram shows the incomplete orthographic views of a truncated cylinder.

- (a) Draw the elevation of the cylinder.
- (b) Identify the curve that is generated in the elevation

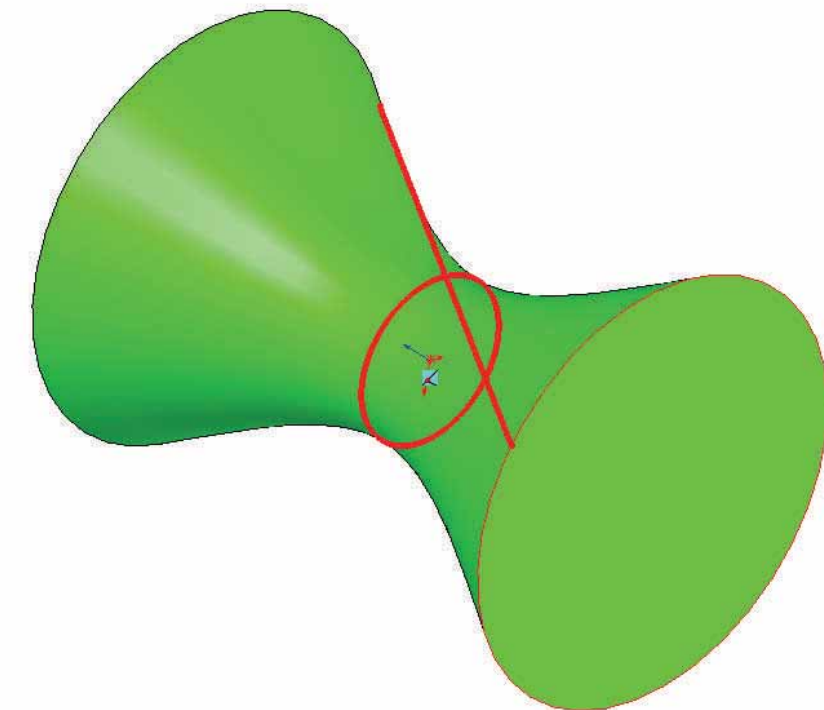
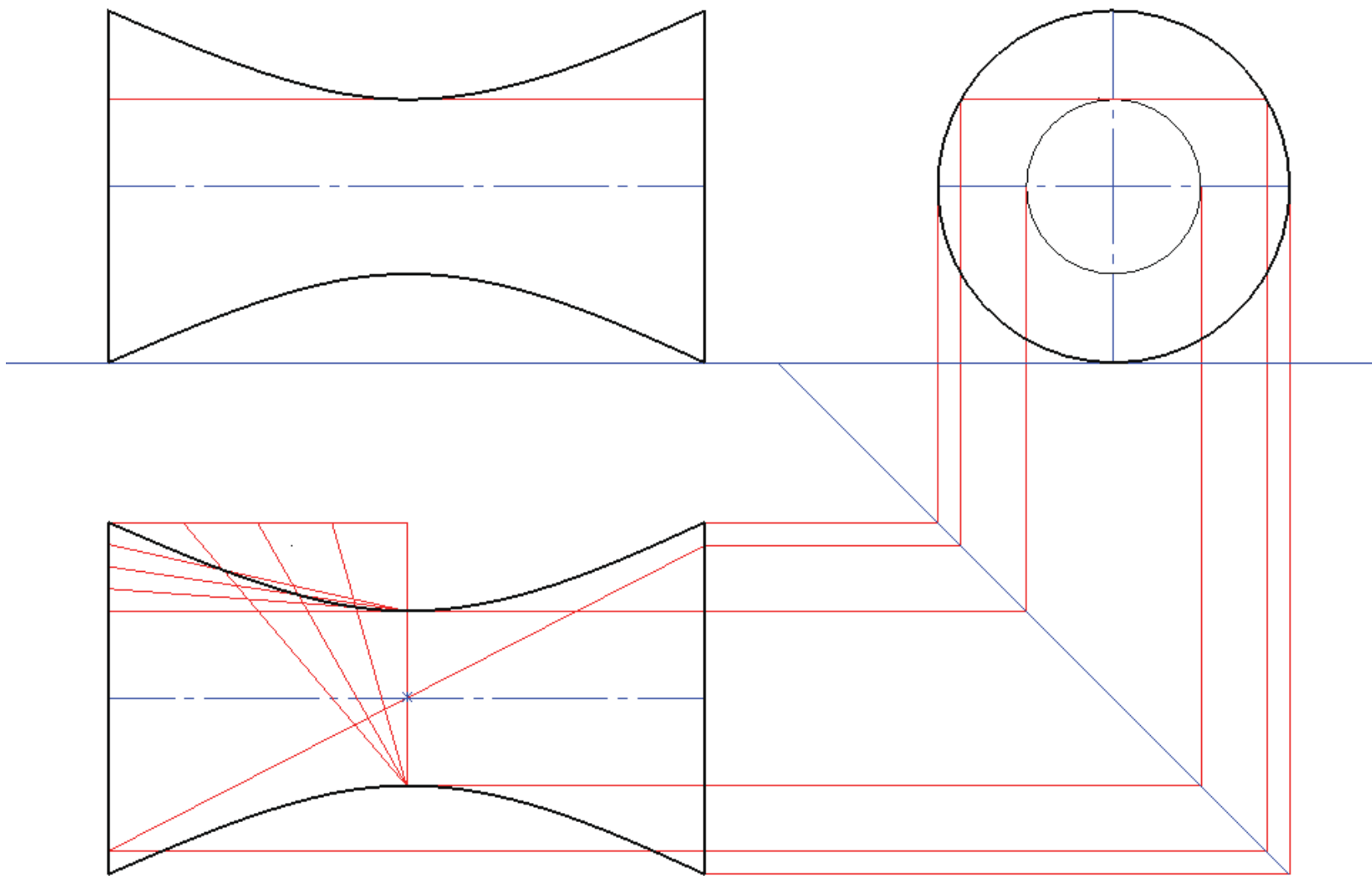


### Key principles

- Any section taken perpendicular to the axis of a cylinder or hyperboloid of revolution will produce a circular curve.

A photograph of an interconnecting bridge between two buildings is shown . It is in the form of a hyperboloid of revolution. The projections of both ends of the bridge are shown. The line AB shows true length of each element of the hyperboloid of revolution.

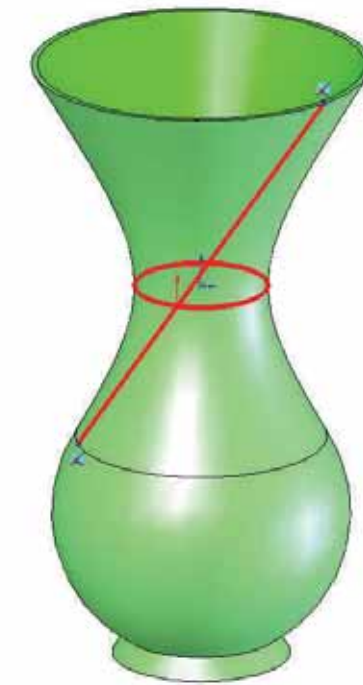
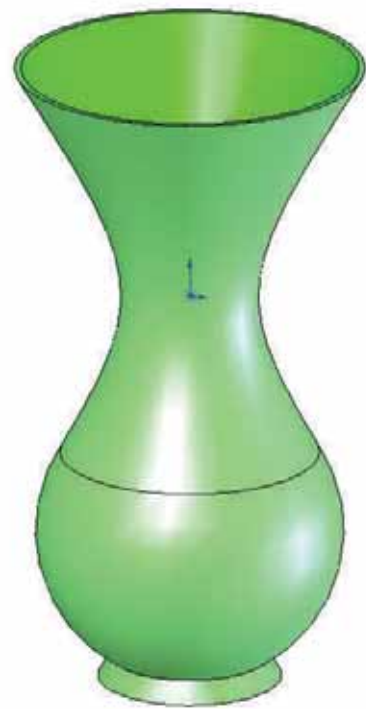
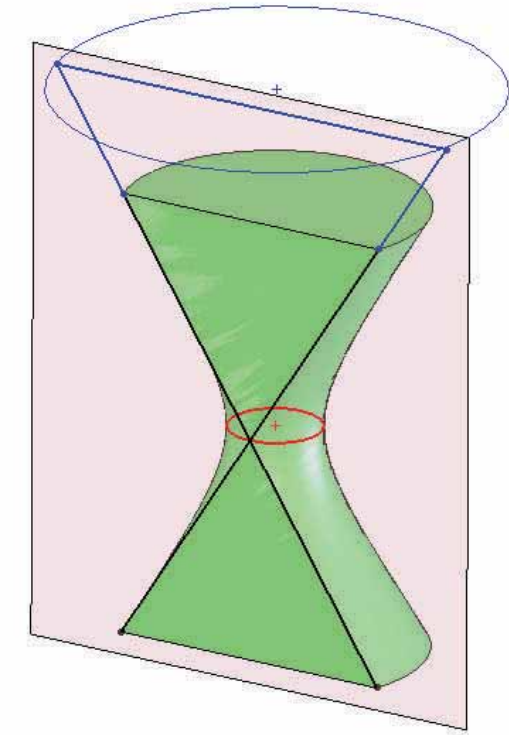
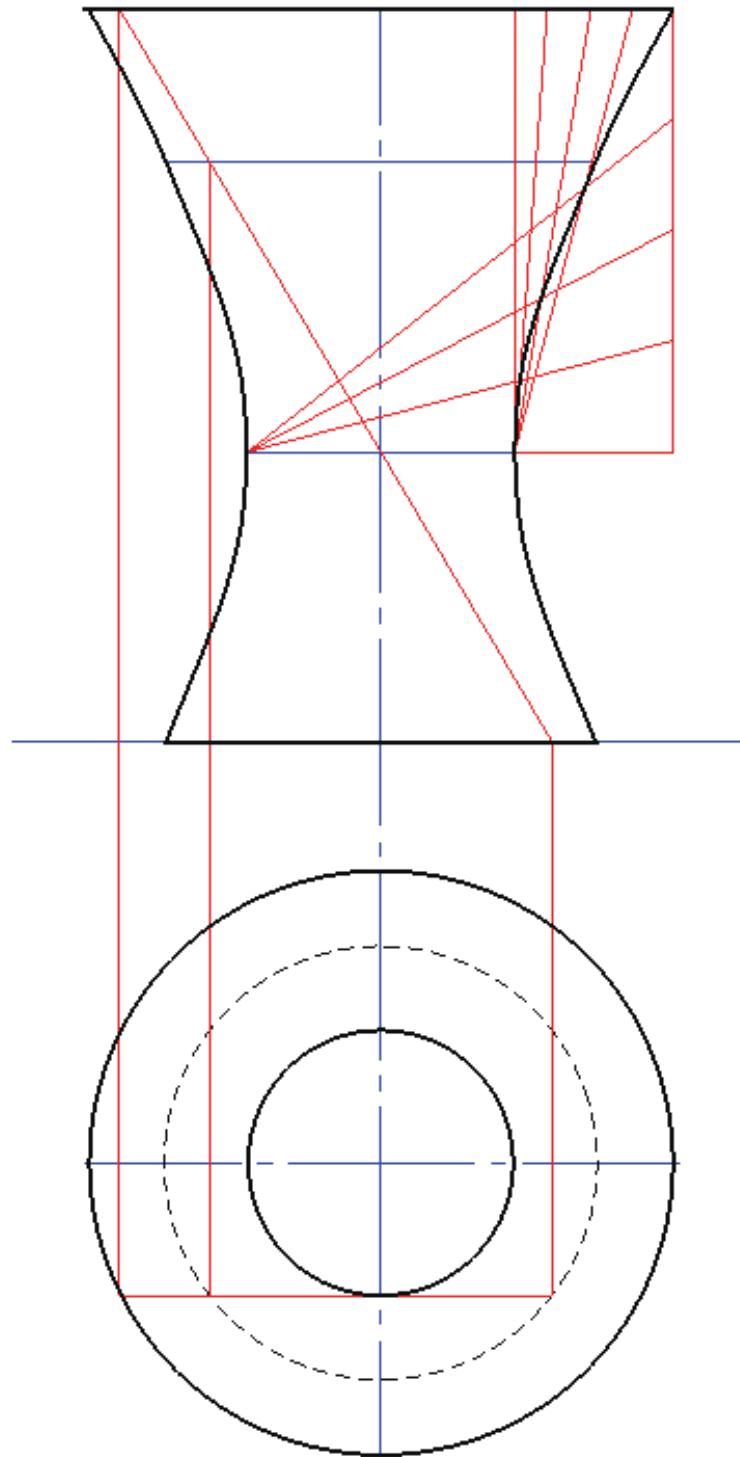
- (a) Use the true length of the element to find the diameter of the throat circle.
- (b) Complete the projections of the hyperboloid of revolution.



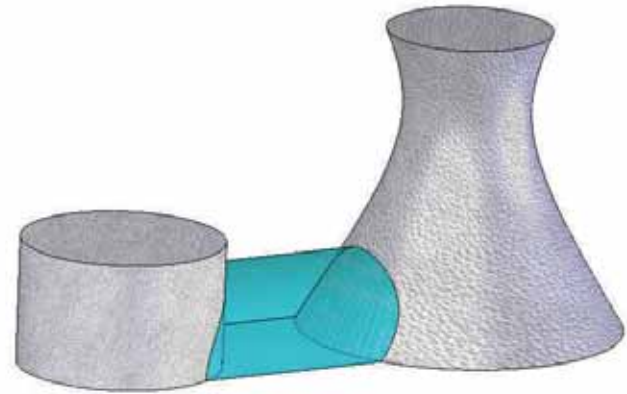


An image of a vase for holding flowers is shown . It is comprised of a truncated conical base and a part spherical, part hyperboloid of revolution top. It is created by extending a hyperboloid of revolution in a vertical direction . The plan of the hyperboloid of revolution portion is shown. The elevation of the base and the throat are shown.

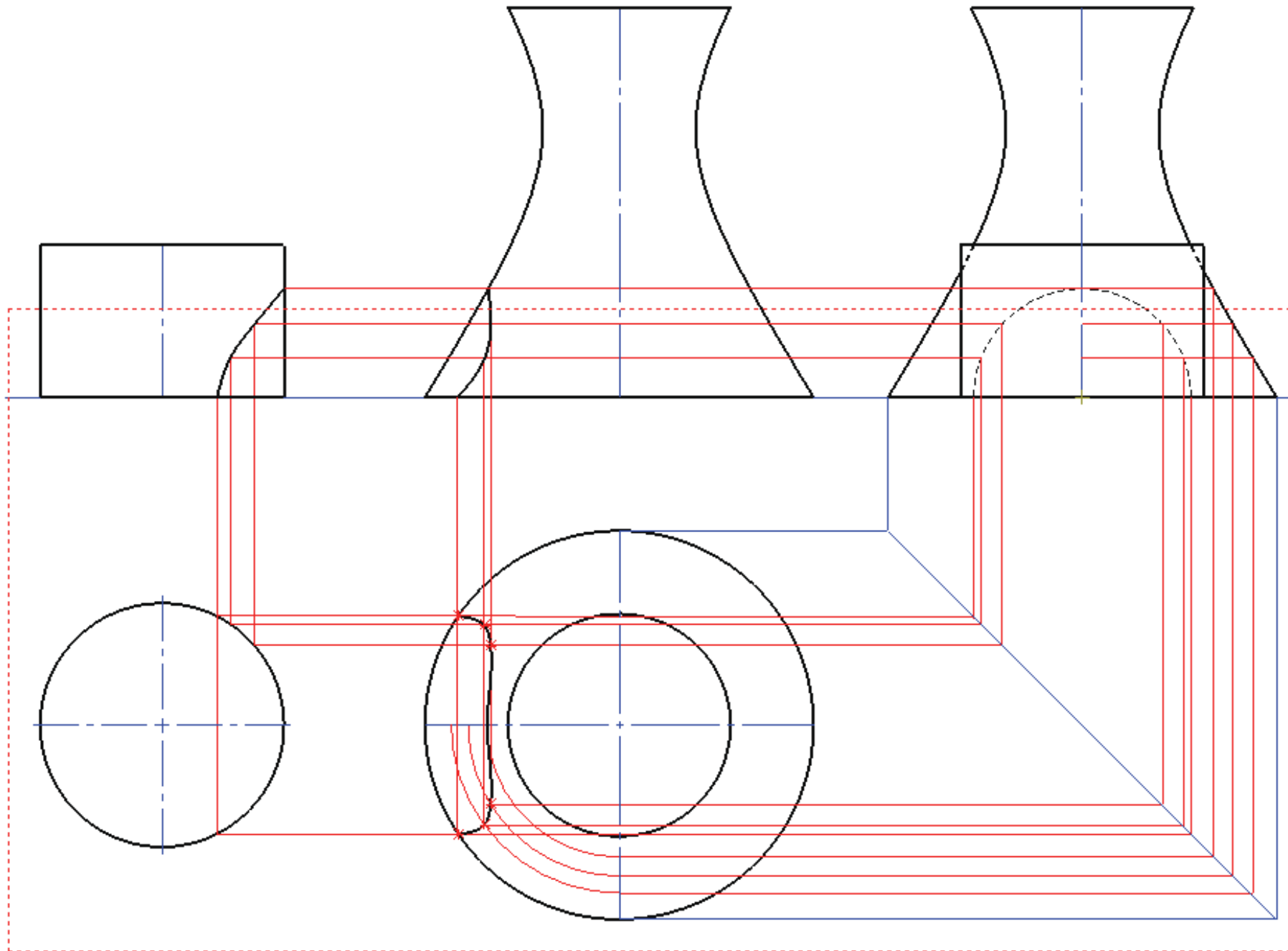
- (a) Find the altitude of extended hyperboloid of revolution..
- (b) Complete the elevation.





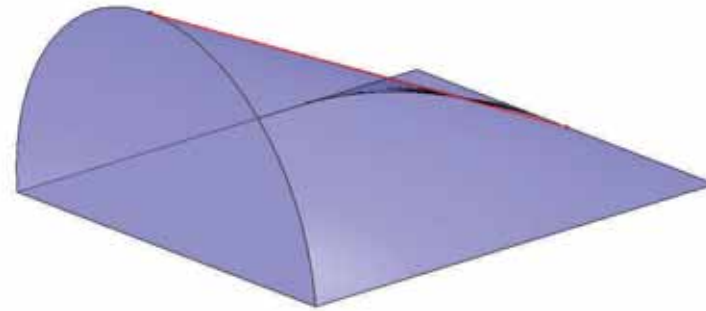
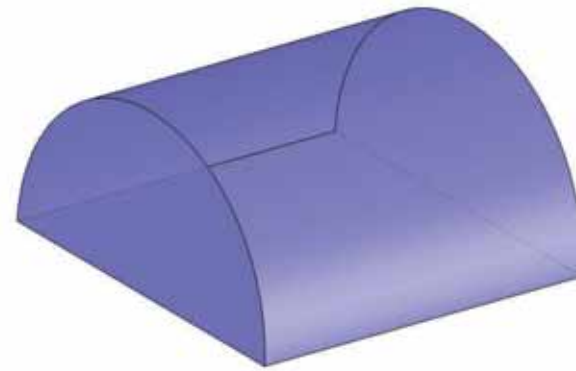


The photograph shows a chimney stack and a storage tank. It is proposed to connect both with a maintenance shaft of semi-circular cross-section as shown in the graphic on the left. The projections of the chimney stack and the storage tank are shown below. The end elevation shows the projections of the maintenance shaft. Draw the plan and elevation of the maintenance shaft showing clearly how to find its lines of intersection with the chimney stack and the storage tank.



Draw a 3 dimensional sketch of the connecting maintenance tunnel between the cylindrical unit on the left and the tower on the right.



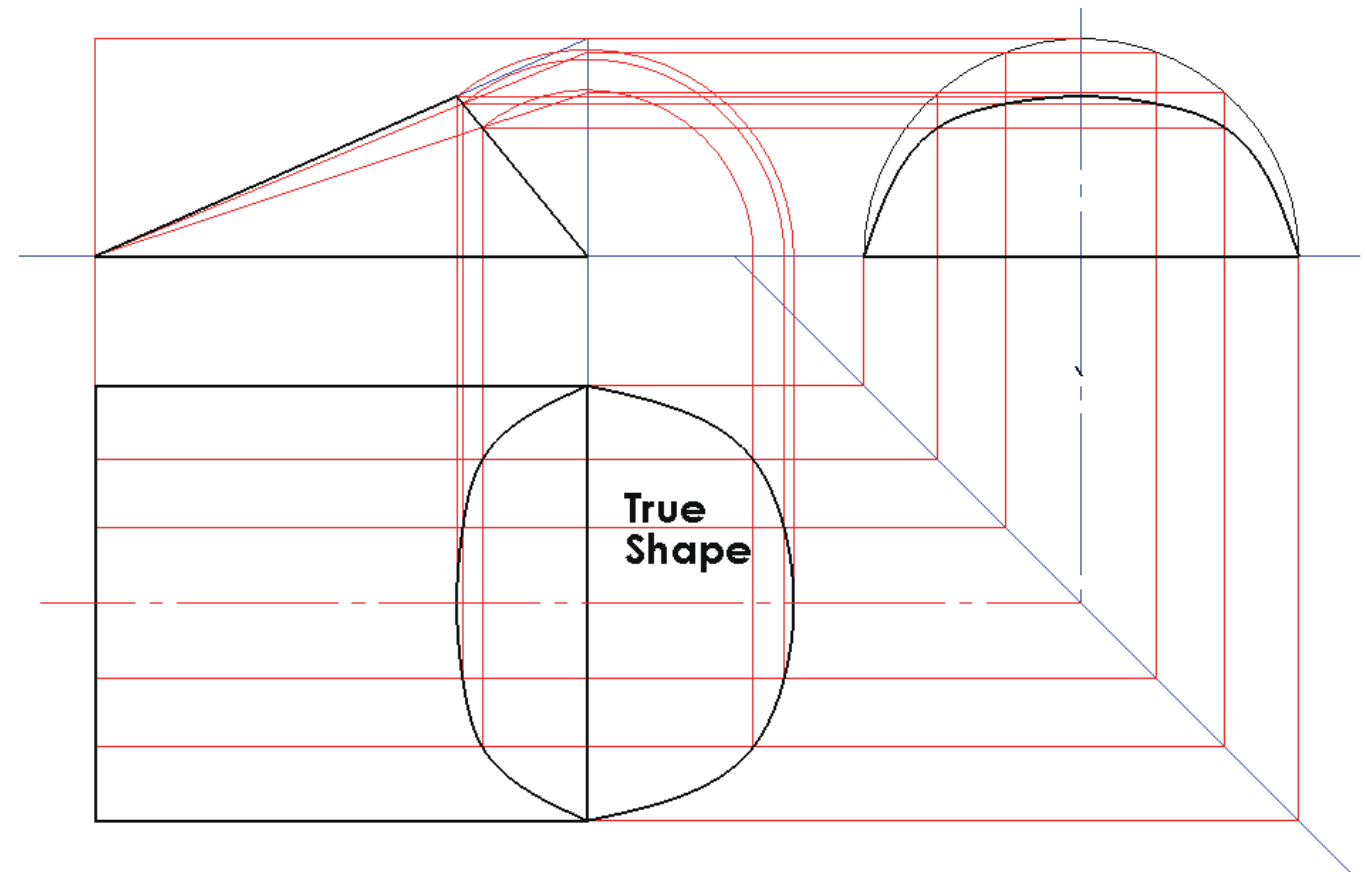
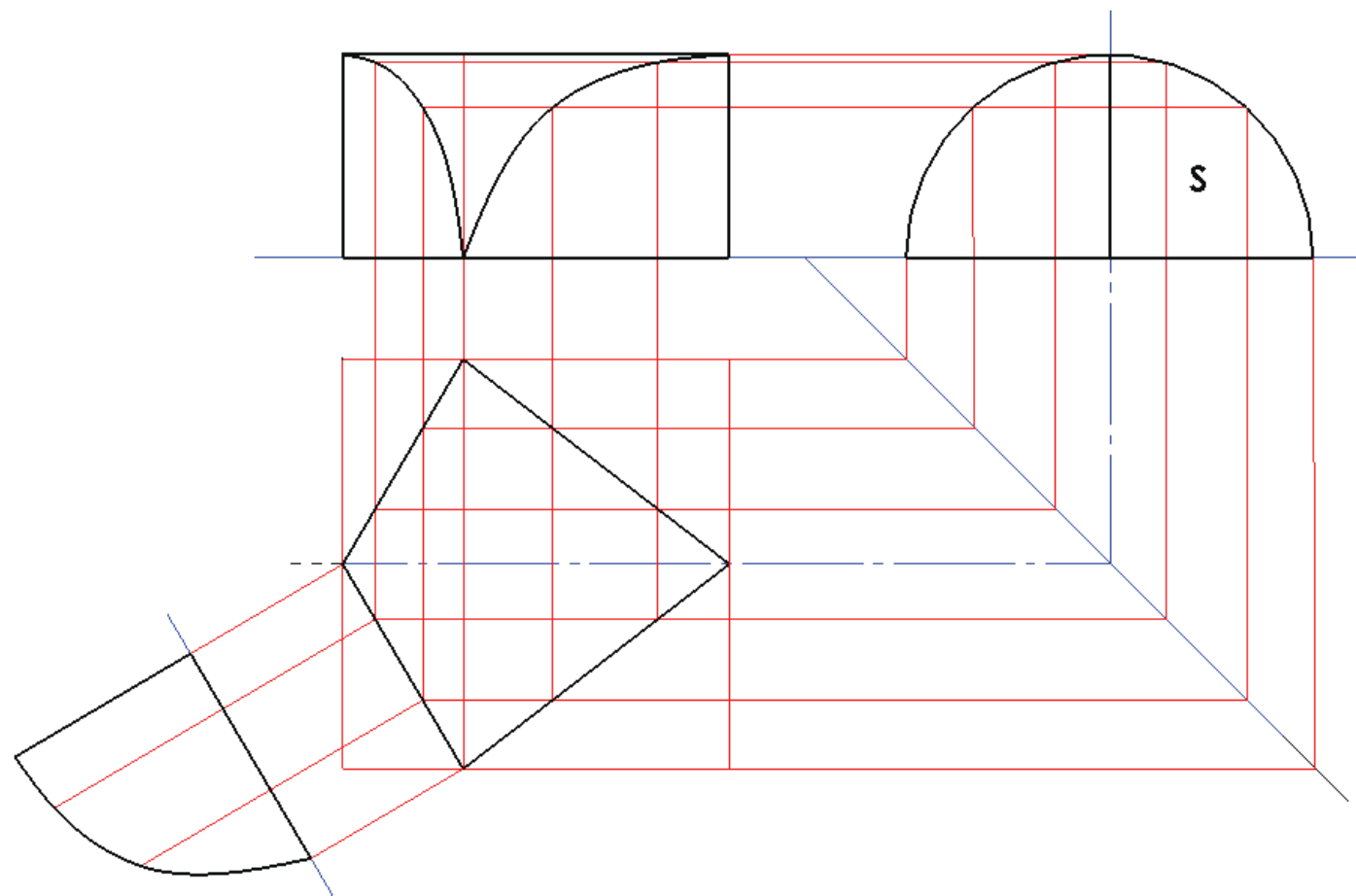


The photograph shows a roofing structure which is comprised of a series of cylindrical surfaces. The surfaces are cut by vertical cutting planes as shown. The plan and end elevation of one sectioned cylinder is shown.

- (1) Project the elevation from the given plan.
- (2) Project the true shape of the cut surface S

The photograph shows a roofing structure which is based on a conoid. It is cut by a simply inclined plane as shown. The elevation of the sectioned conoid is shown. The end elevation and plan of the conoid before it is sectioned are shown

- (1) Complete the plan and end elevation.
- (2) Show the true shape of the cut surface.



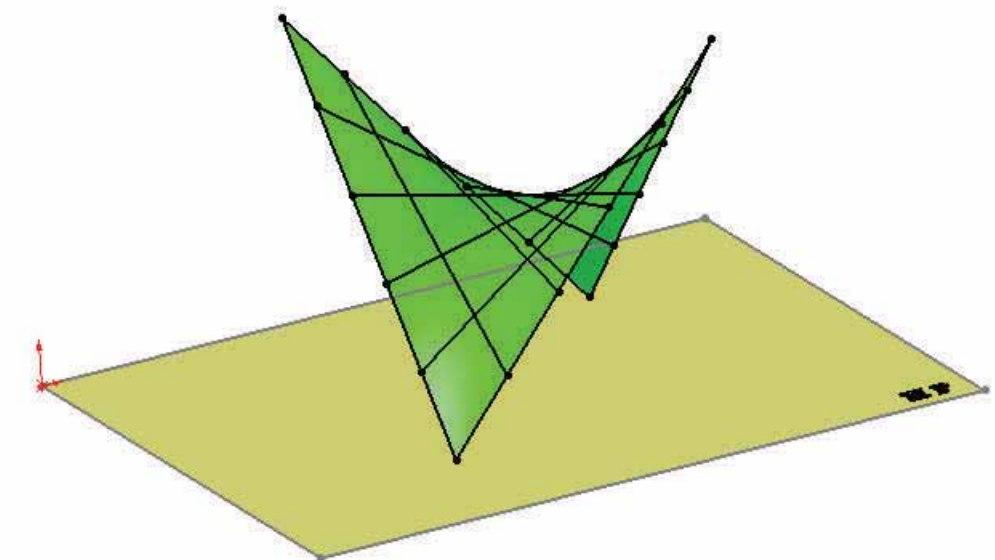
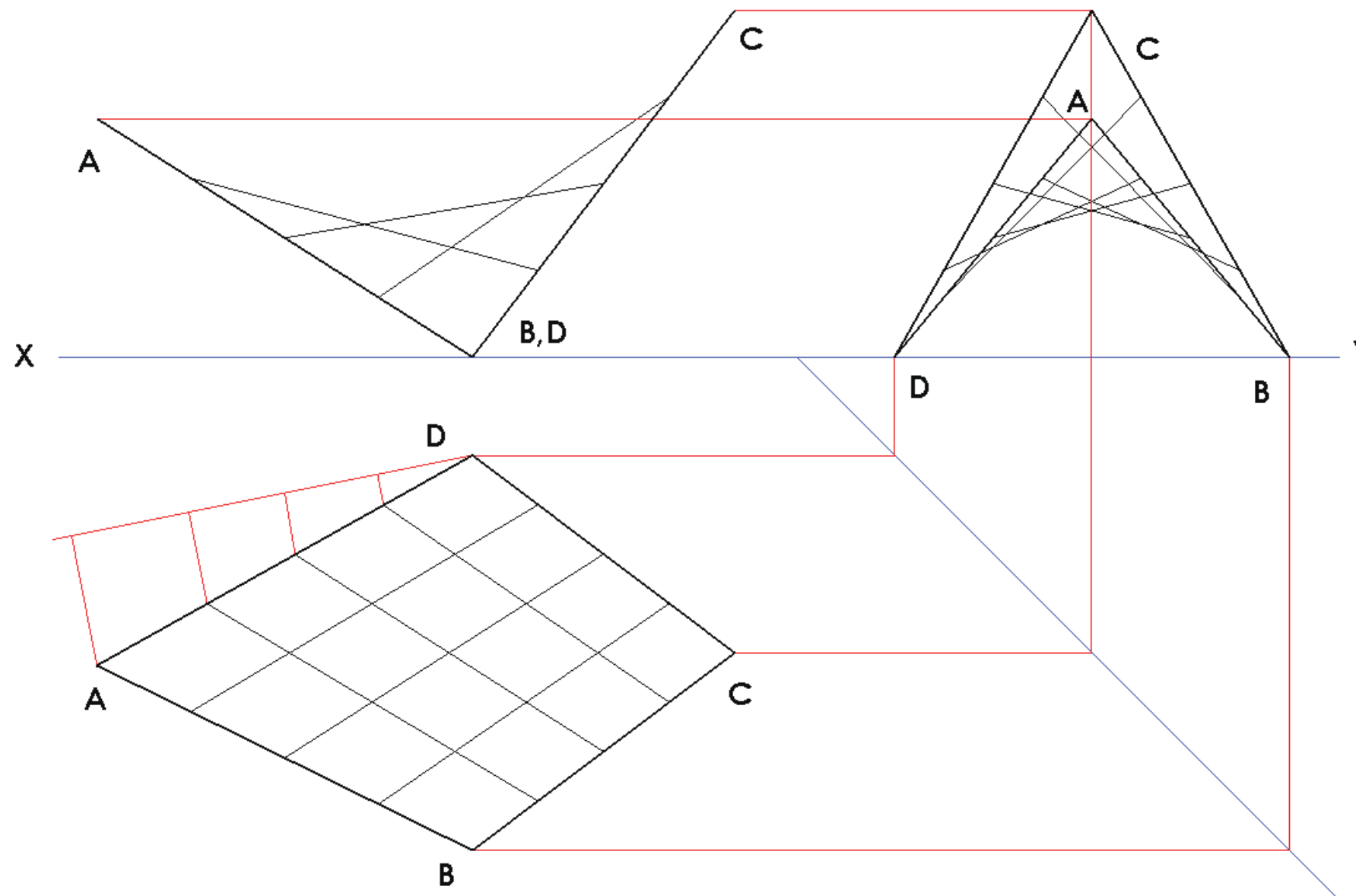
The photograph shows a house with a hyperbolic paraboloid roof. The diagram below shows the outline plan and incomplete elevation of the roof structure.

- (1) Using five elements in each direction complete the elevation and plan of the roof.
- (2) Project an end elevation of the roof.



## Key Principles

- A hyperbolic paraboloid is a **doubly ruled** surface.
- It is comprised of **two** sets of elements.
- Any point on a hyperbolic paraboloid roof surface has **two** elements passing through it.



TECHNOLOGY  
SUBJECTS  
SUPPORT  
SERVICE

DESIGN & COMMUNICATION GRAPHICS

Structural forms 10

NAME: \_\_\_\_\_ DATE: \_\_\_\_\_

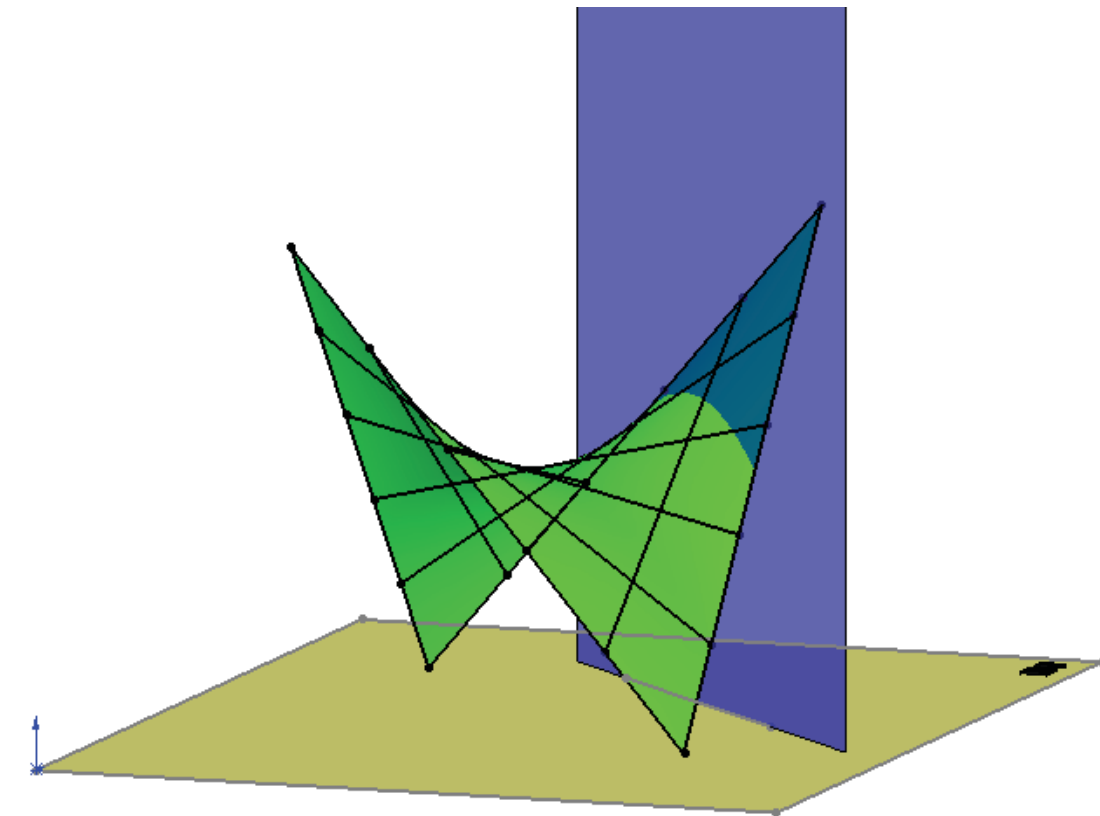
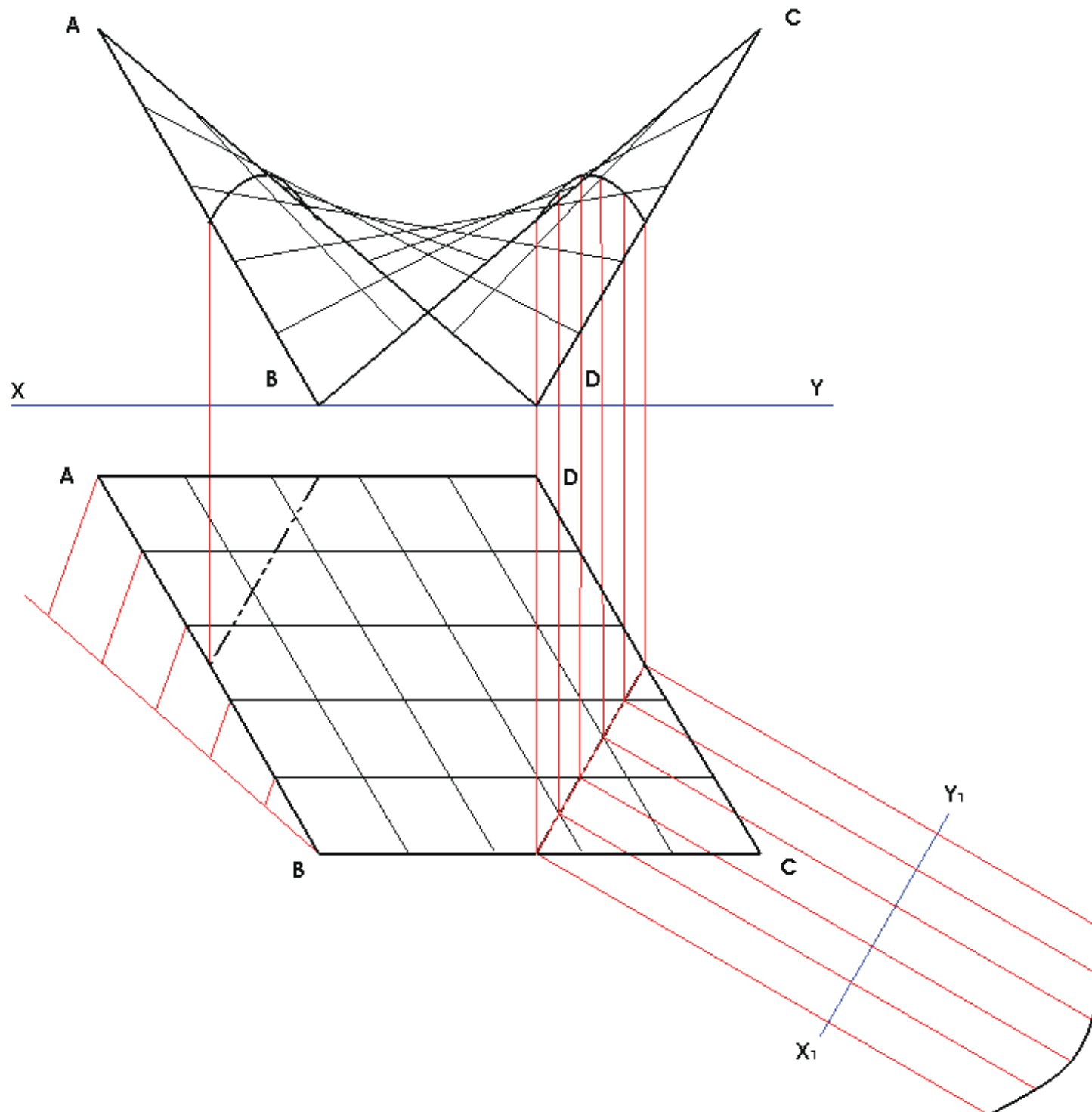
A photograph of a church is shown. Its outline in plan is a regular hexagon and its roof is based on a sectioned hyperbolic paraboloid. The projections of the hyperbolic paraboloid ABCD are shown.

- (1) Using six elements in each direction complete the elevation and plan of the hyperbolic paraboloid ABCD.
- (2) Vertical cutting planes section the roof along the broken lines in plan. Show the elevation of these sections.
- (3) Show the curvature of the roof along one of the broken lines in plan.



## Key Principles

- Any cutting plane not containing an element produces a curved section.
- The true shape of the curvature is seen by projecting the true shape of the cutting plane that produced the cut section.



TECHNOLOGY  
SUBJECTS  
SUPPORT  
SERVICE

DESIGN & COMMUNICATION GRAPHICS

Structural forms 11

NAME: \_\_\_\_\_ DATE: \_\_\_\_\_

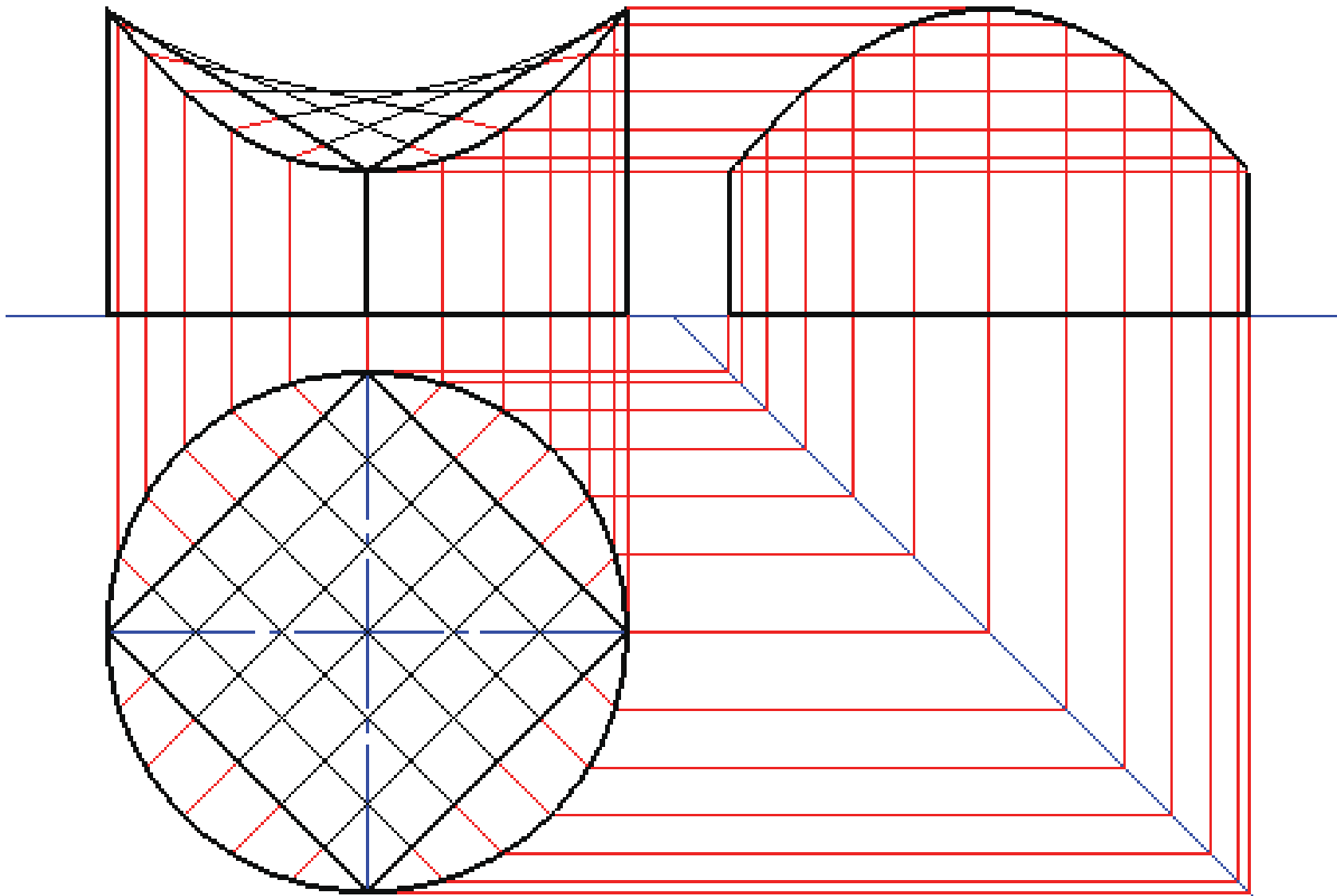




A photograph of a sports arena is shown. The roof is created by extending a hyperbolic paraboloid. The perimeter of the roof is circular in plan.

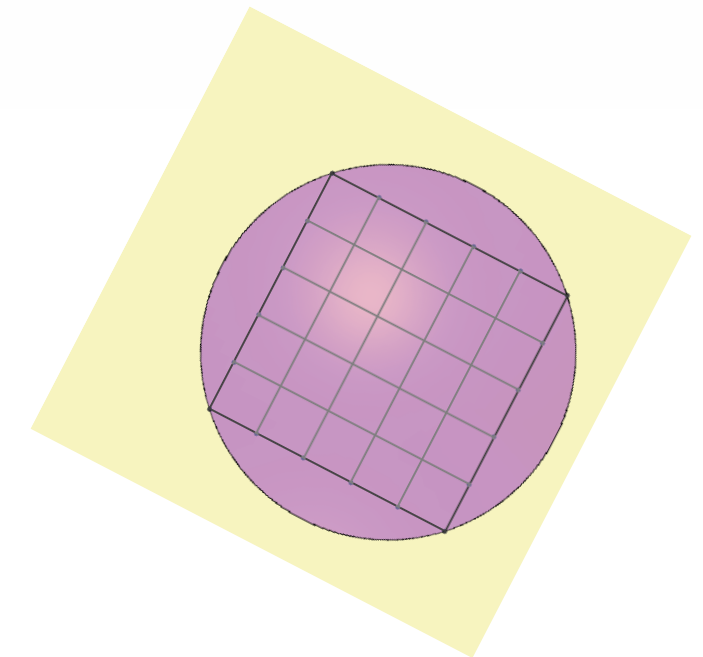
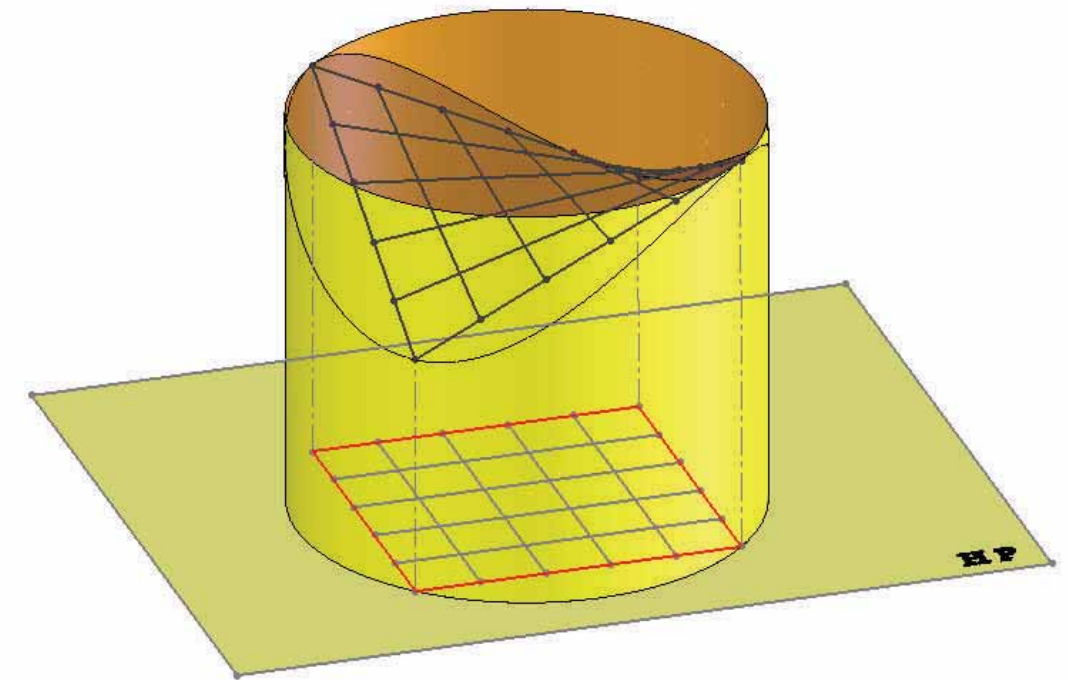
The diagram shows the outline elevation and plan of the hyperbolic paraboloid. The plan of the circular perimeter is shown.

- (1) Using seven elements in each direction complete the projections of the hyperbolic paraboloid.
- (2) Complete the elevation by extending the elements.
- (3) Project an end elevation of the structure.



## Key Principles

- A hyperbolic paraboloid can be enlarged by extending its elements to the surface which defines its new perimeter.
- The elements can be extended to a planar or a non-planar surface.



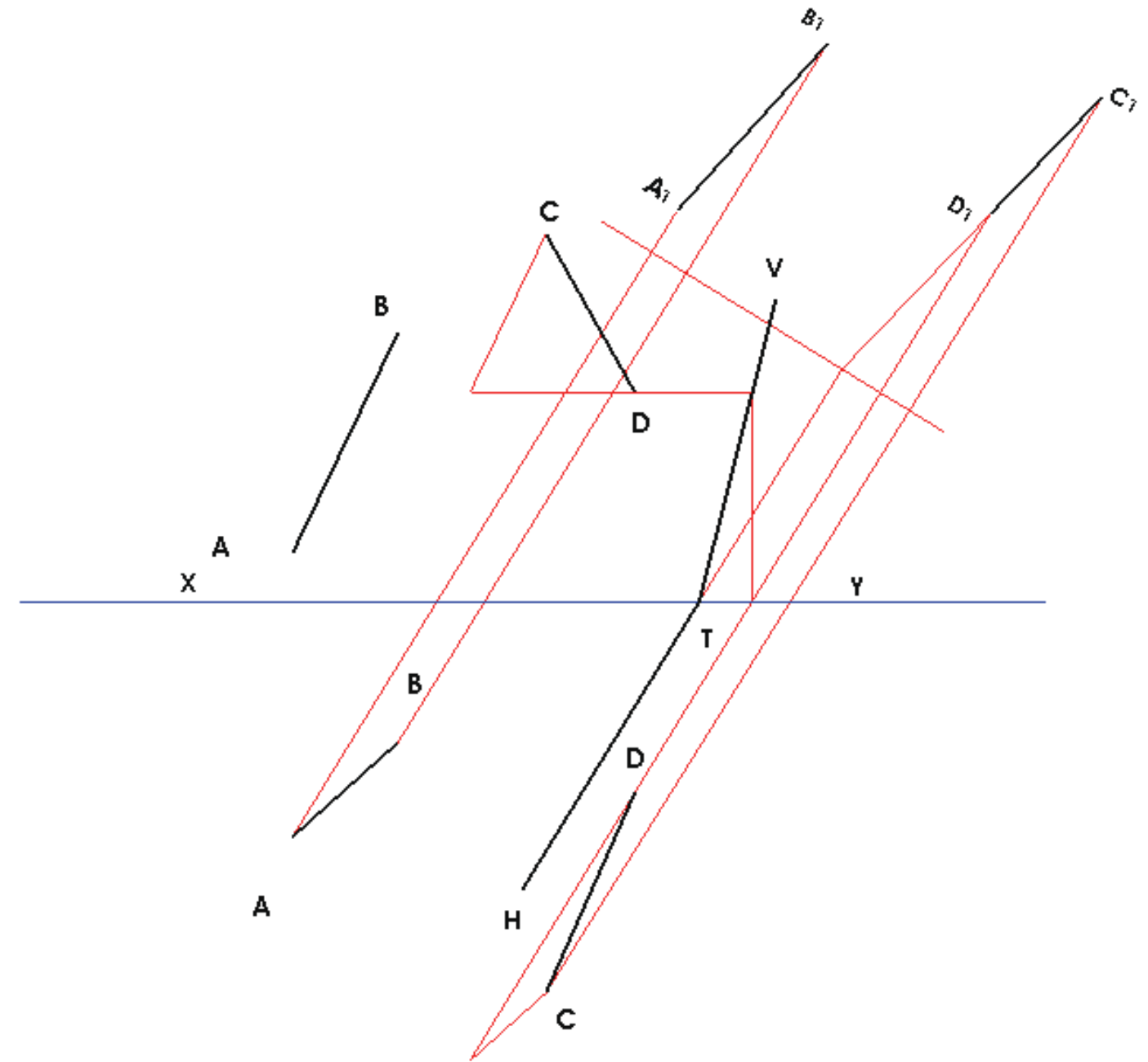
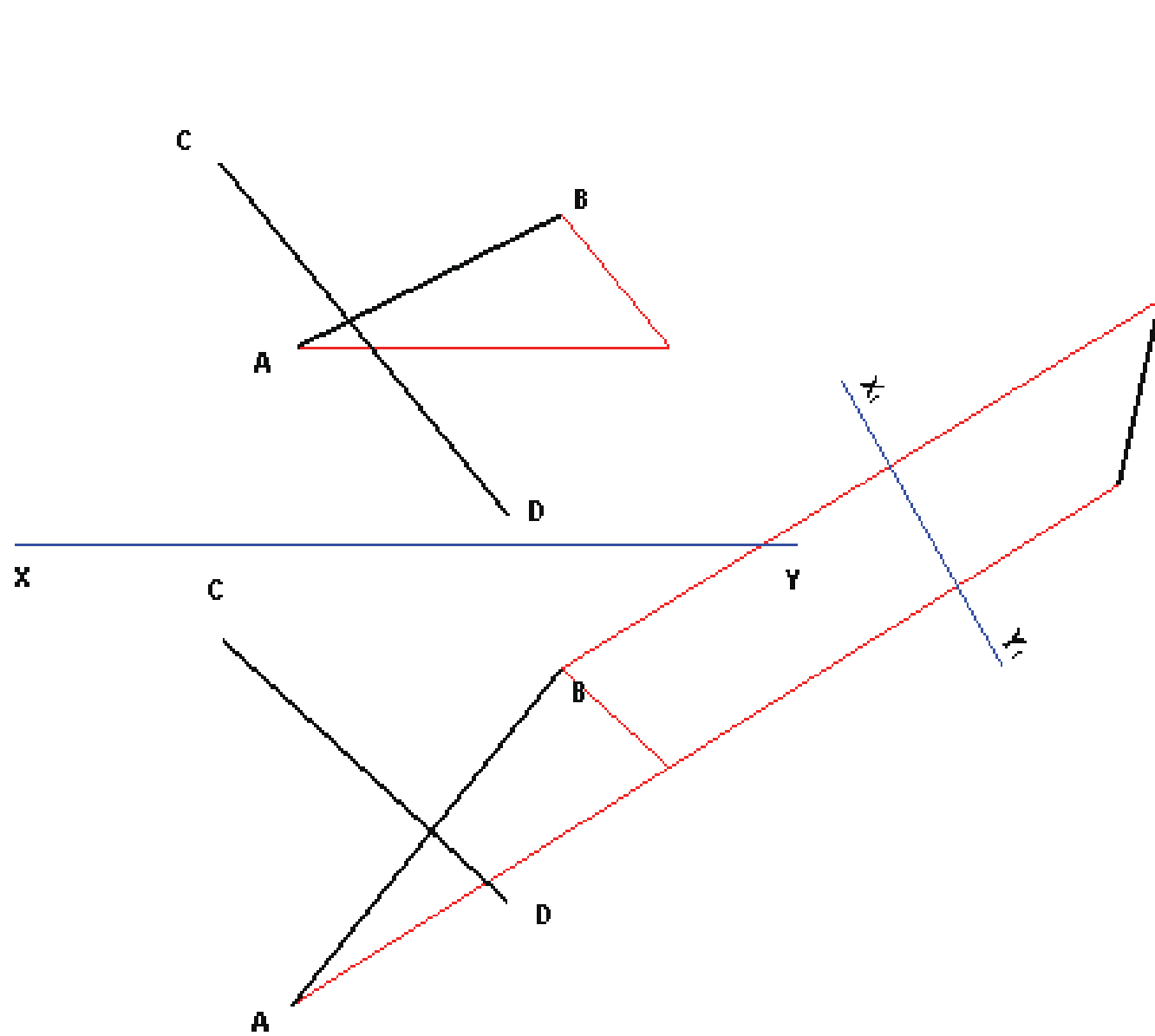
Shown are the projections of the two skew lines AB and CD.

- (1) Create a plane which contains AB and is parallel to CD.
- (2) Project this plane as an edge.

### Key Principles

- Two intersecting lines create a **plane**
- A plane projects as an edge when any line on that plane projects as a **point**.
- The traces of a plane are its lines of **intersection** with the planes of references

Shown are the projections of two skew lines AB and CD. Show the traces of a plane which is parallel to AB and contains CD.



TECHNOLOGY  
SUBJECTS  
SUPPORT  
SERVICE

DESIGN & COMMUNICATION GRAPHICS

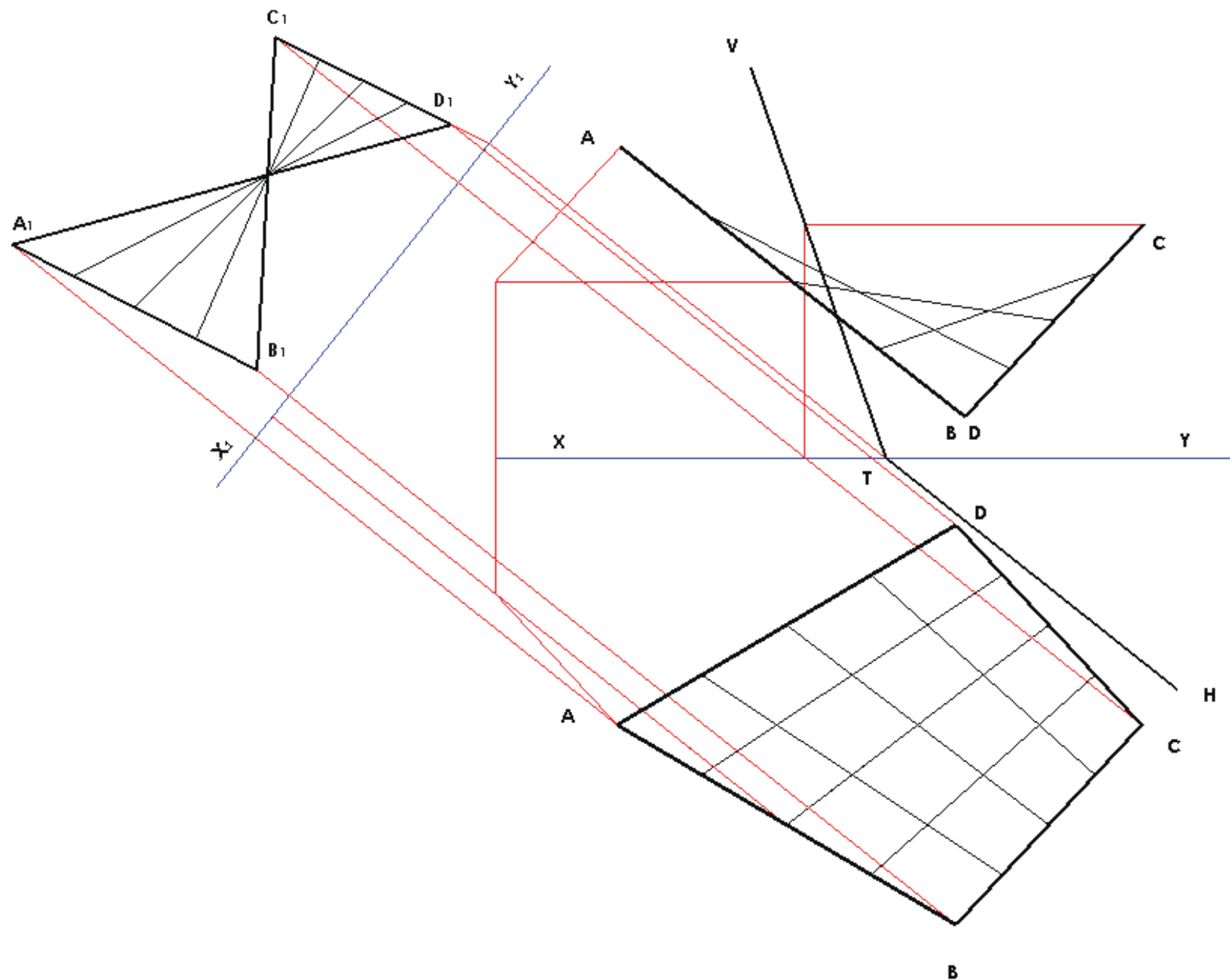
Structural forms 13

NAME: \_\_\_\_\_ DATE: \_\_\_\_\_



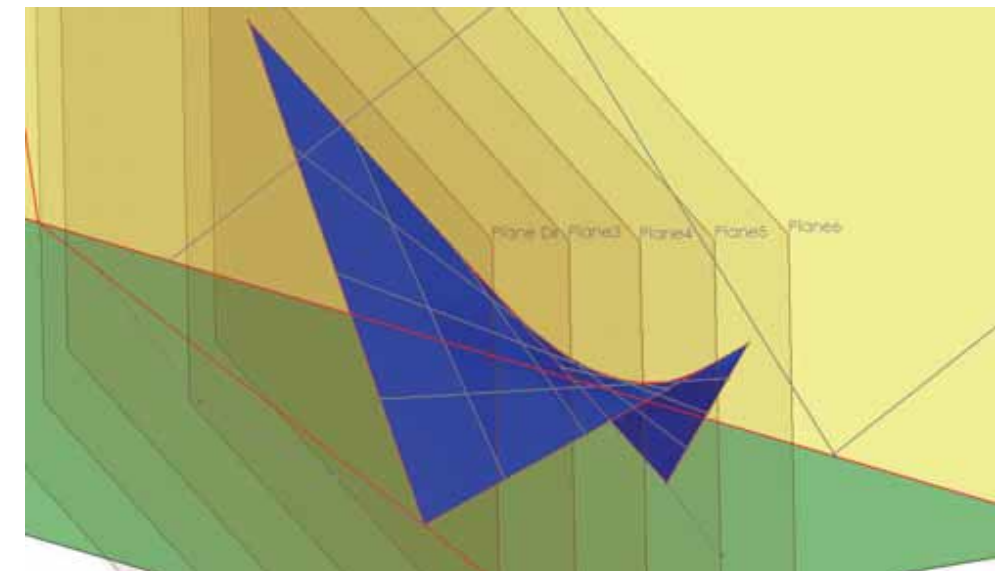
The photograph shows a building which has a roof in the shape of a hyperbolic paraboloid. The diagram shows the outline plan and elevation of the hyperbolic paraboloid.

- (1) Using five elements in each direction complete the elevation and plan.
- (2) Project an auxiliary elevation of the roof which shows the skew lines AB and CD as parallel.
- (3) Show the traces of the plane director for the elements AB and CD which contains point C.



## Key Principles

- The plane director is a plane which directs the movement of an element along a pair of skew lines
- All elements are parallel to the plane director for that set of elements
- When a plane director is seen as an edge, its set of elements appear parallel
- The orientation of the plane director controls the direction of the elements.



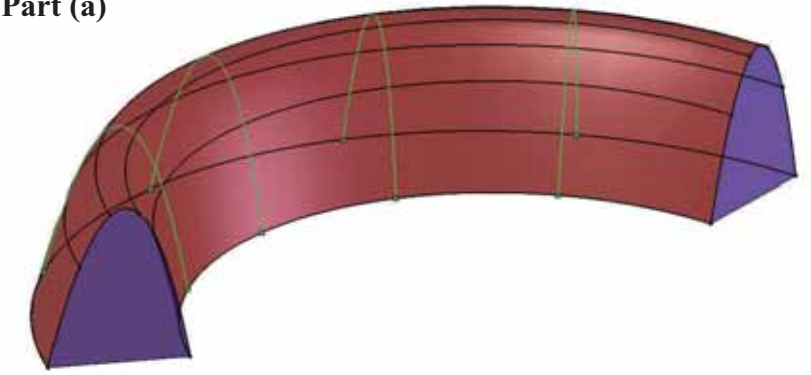




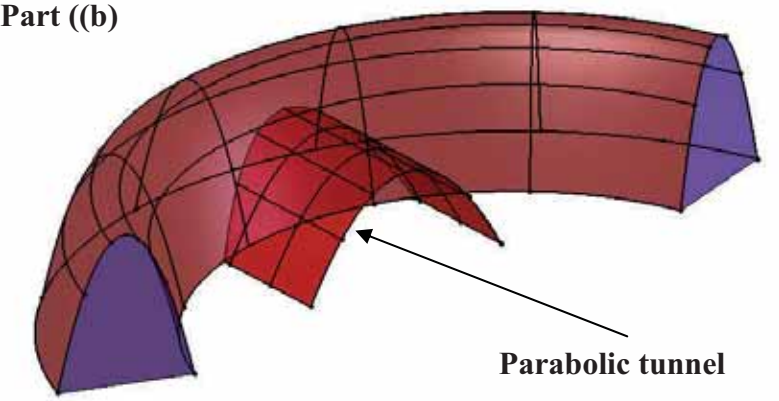
The photograph shows the Olympic Agora in Athens. The surfaces is generated by moving the parabola abc in a vertical position along the circular profile in plan. The plan and incomplete elevation of the structure are shown

- (a) Project the elevation from the given plan.
- (b) It is proposed to create a parabolic tunnel over the water connecting the walk way to the structure as shown. The elevation and incomplete plan are shown. Draw the plan of the connecting tunnel.
- (c) Make a 3 dimensional freehand sketch in the space provided of the principle used to locate the curve of intersection in plan.

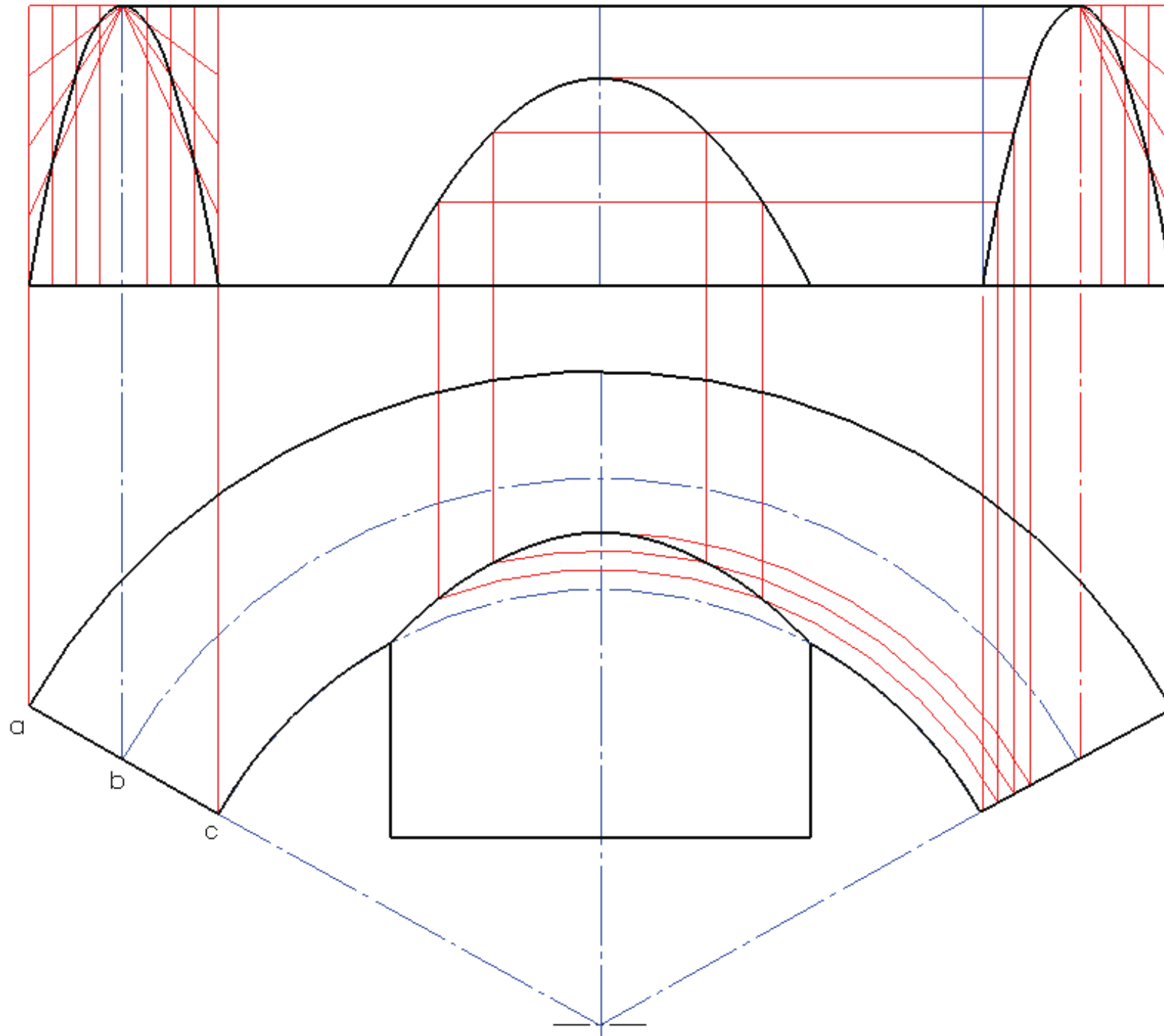
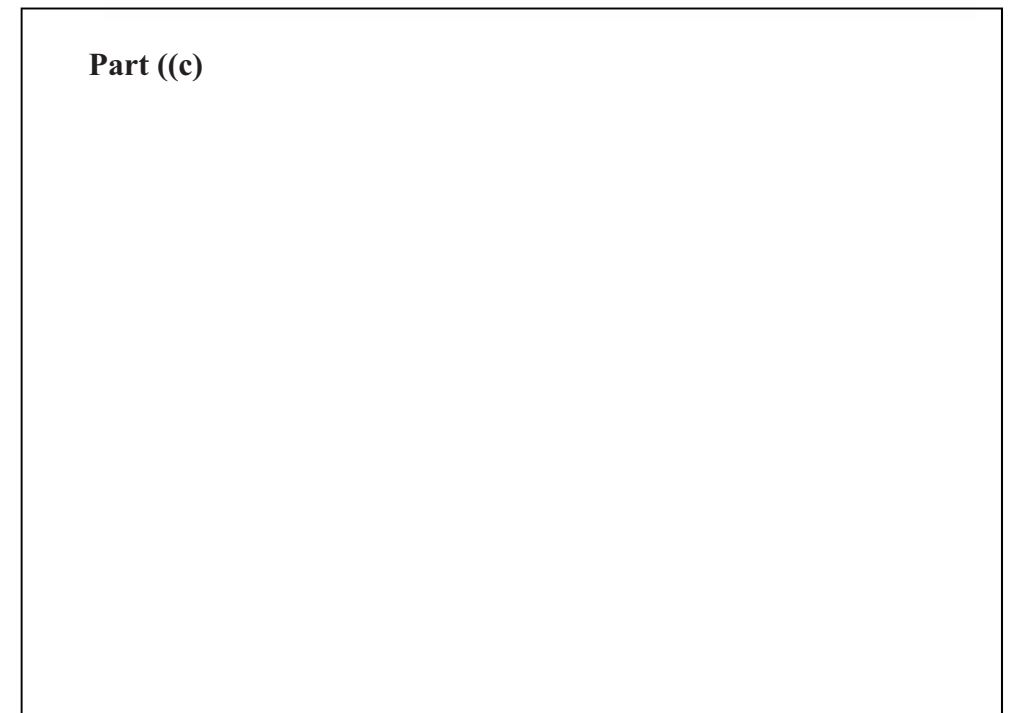
Part (a)

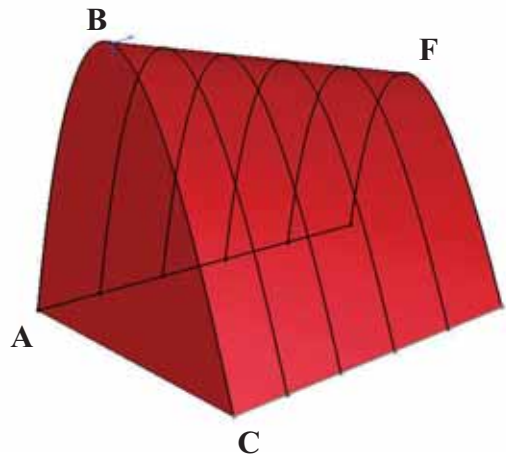


Part ((b))



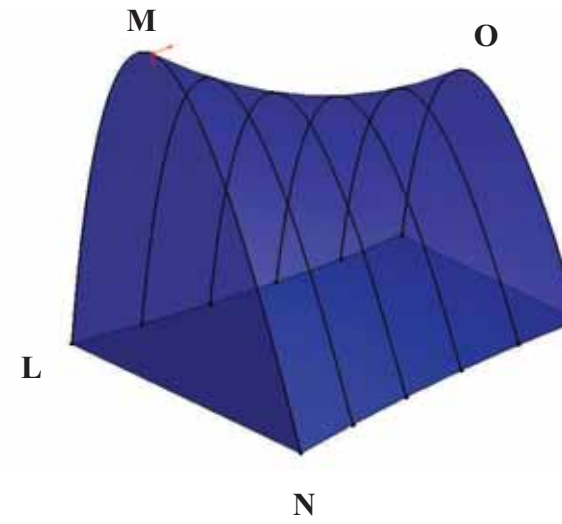
Part ((c))





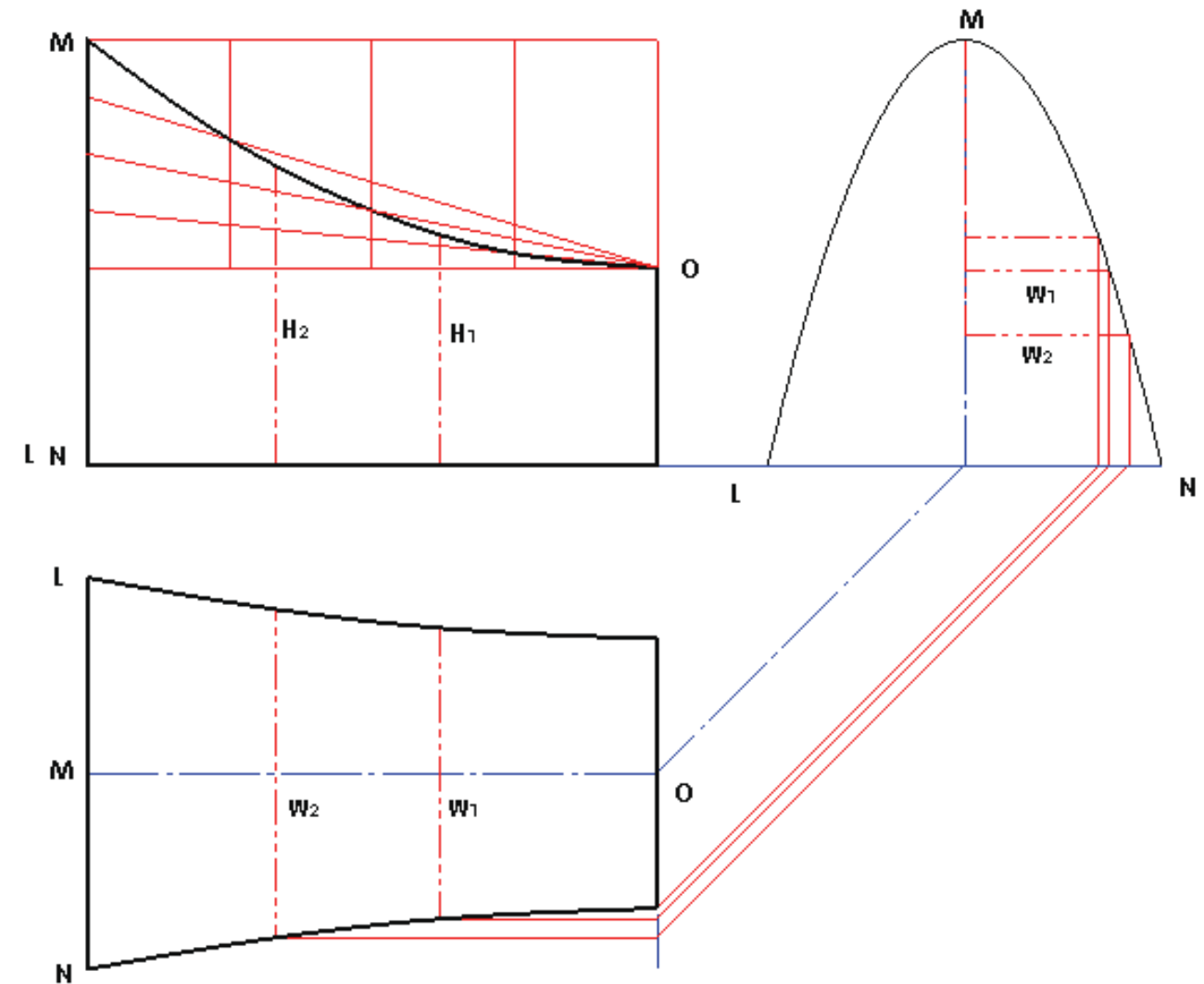
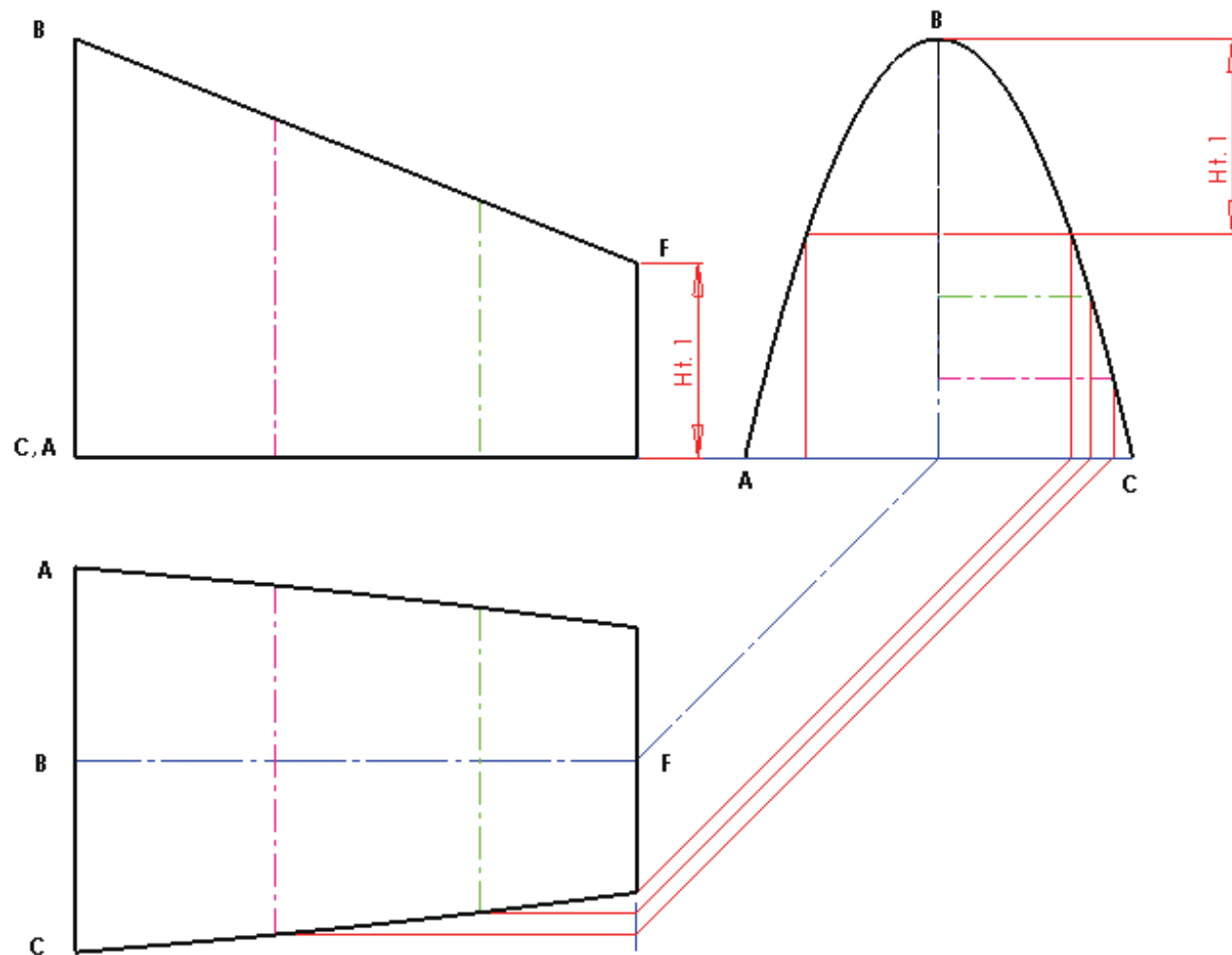
The surfaces shown is generated by moving the parabola ABC in a vertical position along a straight line BF. Also shown is the elevation and incomplete plan and end elevation of the structure.

(a) Complete the plan and project an end elevation of the structure.



The surfaces shown is generated by moving the parabola LMN in a vertical position along the parabola MO whose vertex is at O. Also shown is the incomplete elevation and plan of the structure.

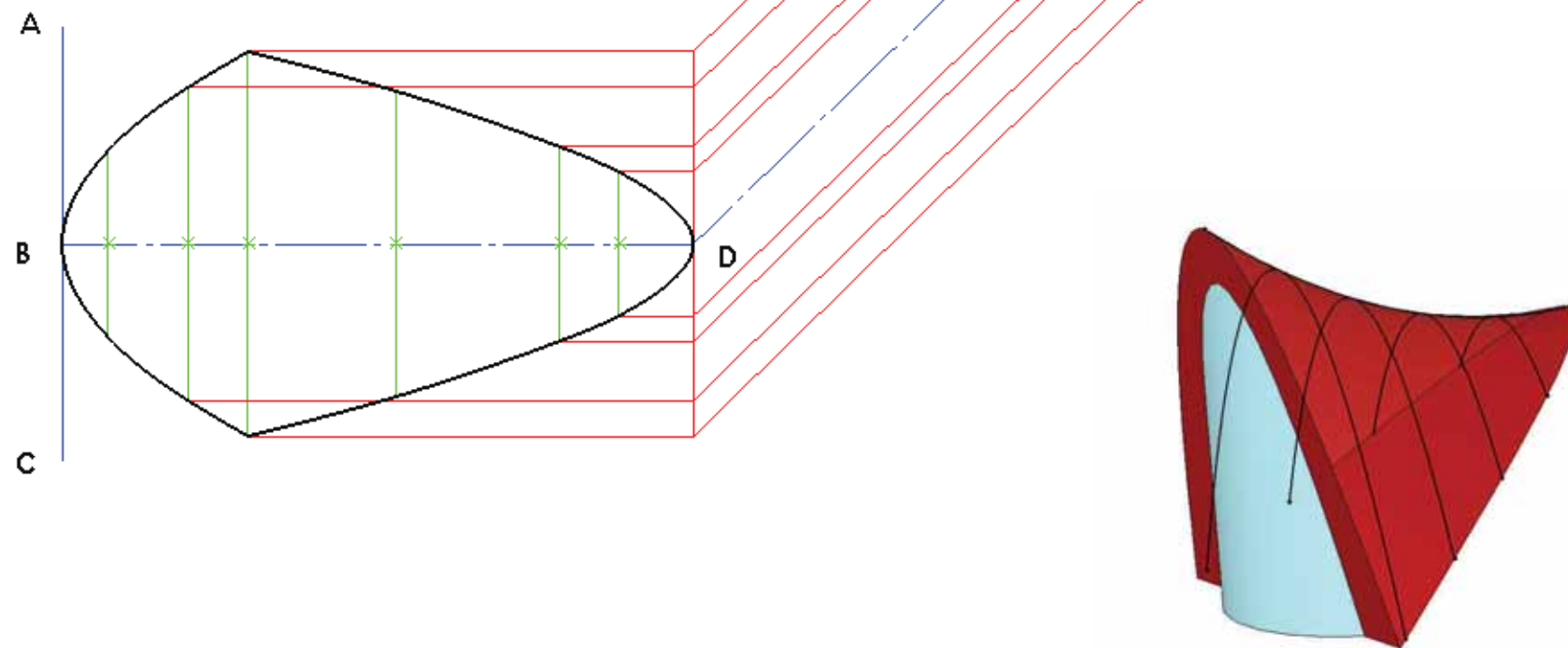
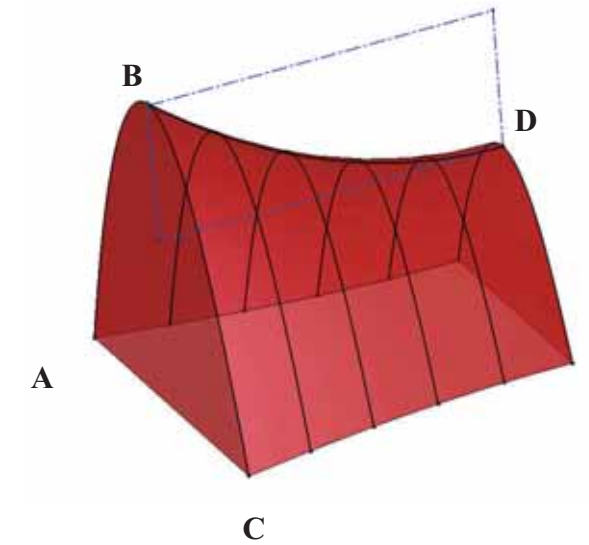
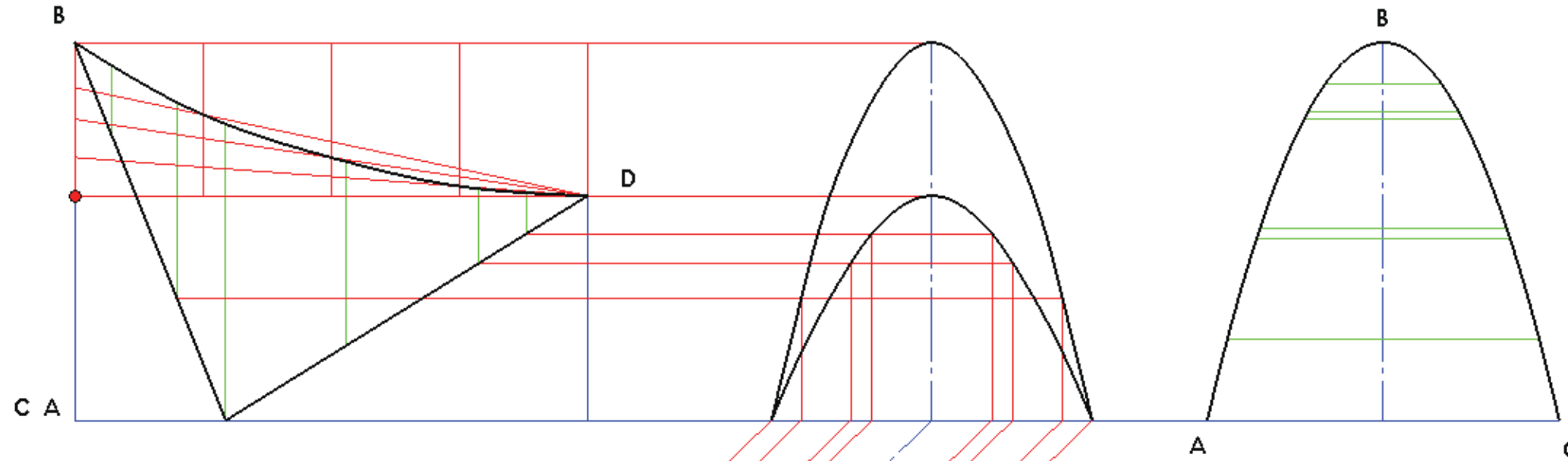
(a) Complete the plan and elevation of the structure.





The photograph shows the entrance building to L'Oceanografic centre in Valencia. The surface is generated by moving the parabola ABC in a vertical position along the parabola BD whose vertex is at D. Also shown is the incomplete elevation and plan of the structure.

- (a) Make a freehand sketch in the space provided of the plan of L'Oceanografic centre.
- (b) Complete the plan and elevation and project an end elevation of the structure.



Part A



TECHNOLOGY  
SUBJECTS  
SUPPORT  
SERVICE

DESIGN & COMMUNICATION GRAPHICS

Structural forms 17

NAME: \_\_\_\_\_ DATE: \_\_\_\_\_