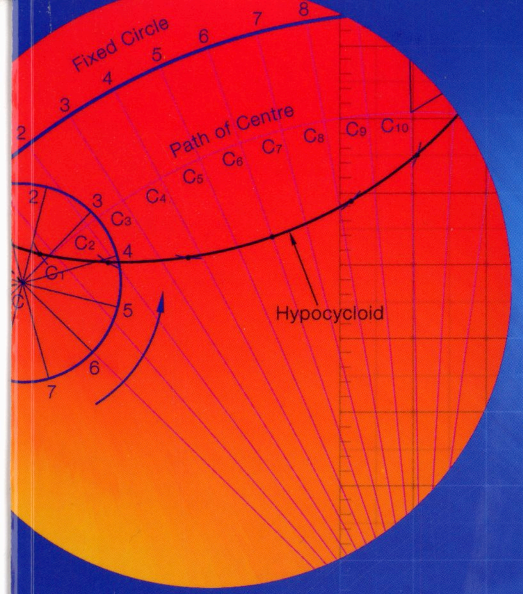
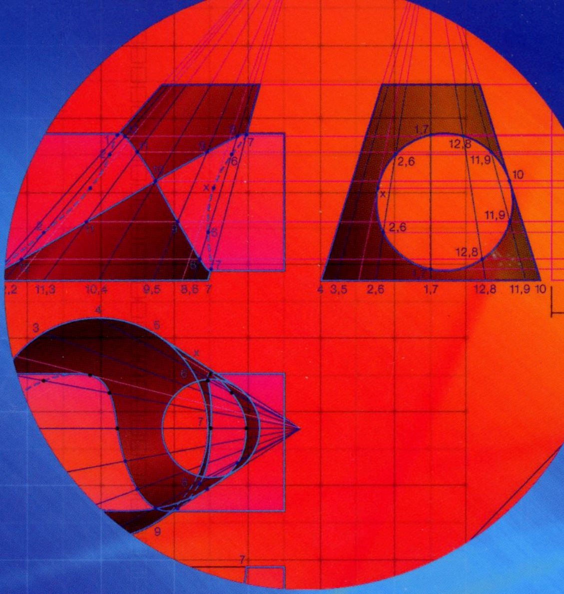
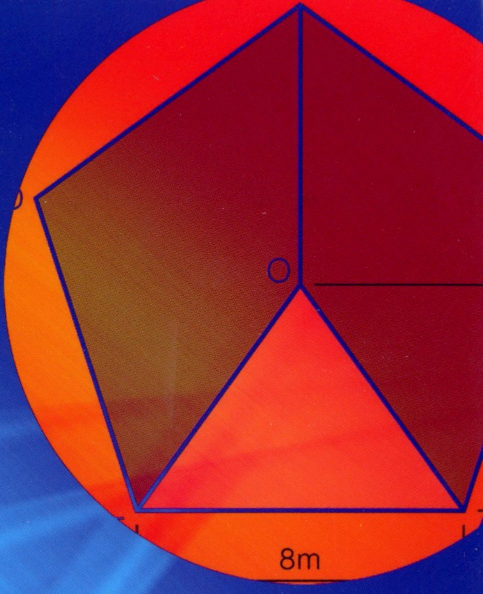


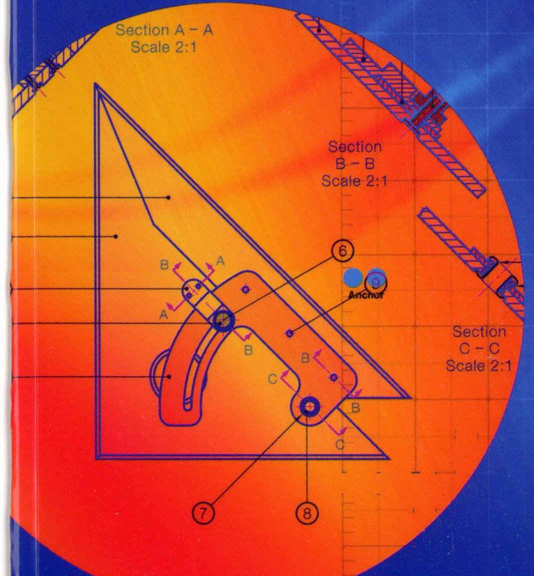


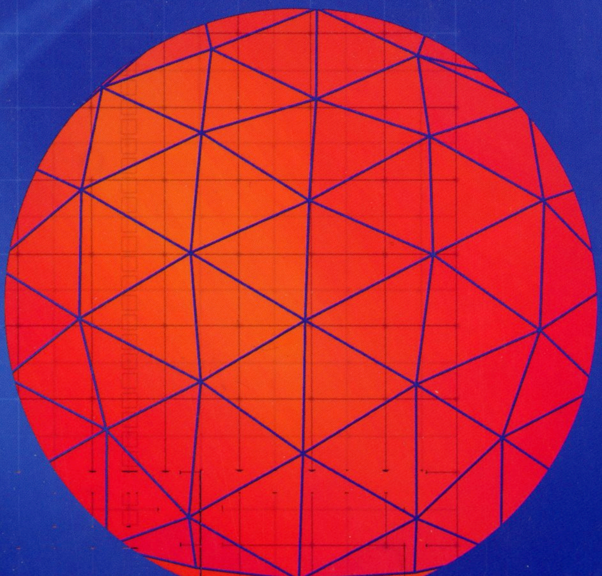


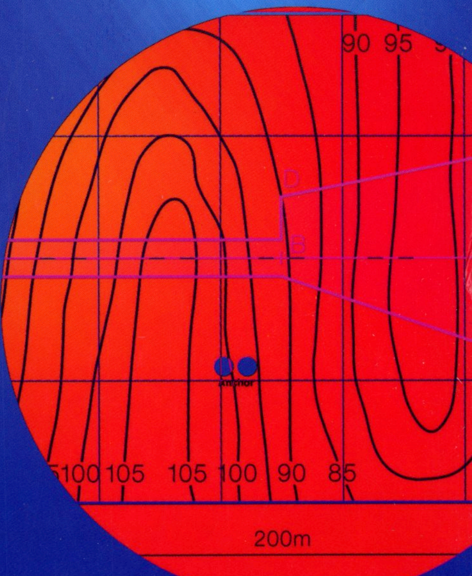
GRAPHICS IN DESIGN & COMMUNICATION

2

CAD AND APPLIED GRAPHICS







DAVID ANDERSON

(6) Construct the outer curves of the elevation as explained before.

(7) Where the asymptote meets the top surface at 2 is projected down to point 2 on the asymptote in plan. This is a point on the medium-sized circle. Draw the circle.

JOINT LINES

(1) Rotate points 1, 2 and 3 on the asymptote in plan onto the joint line, giving 5, 6 and 7. These points on the joint line, because they are on the same horizontal section, can be projected to elevation as shown.

(2) Points 4 and 8 are on the throat circle and base circle respectively and can be projected to elevation. The right joint line is a symmetrical image of the left.

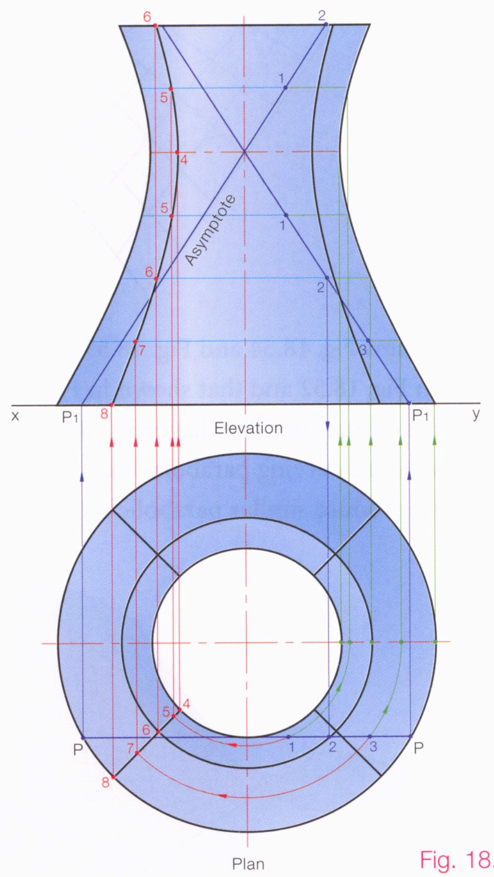


Fig. 18.51

Hyperbolic Paraboloid

A hyperbolic paraboloid surface is obtained by translating a parabola with a downward curvature (ABC) along a parabola with an upward curvature (RST). The vertex of parabola ABC stays in contact with the parabola RST and the parabola hangs vertically at all times.

Horizontal sections produce a double hyperbola while vertical sections produce a portion of the parabola ABC.

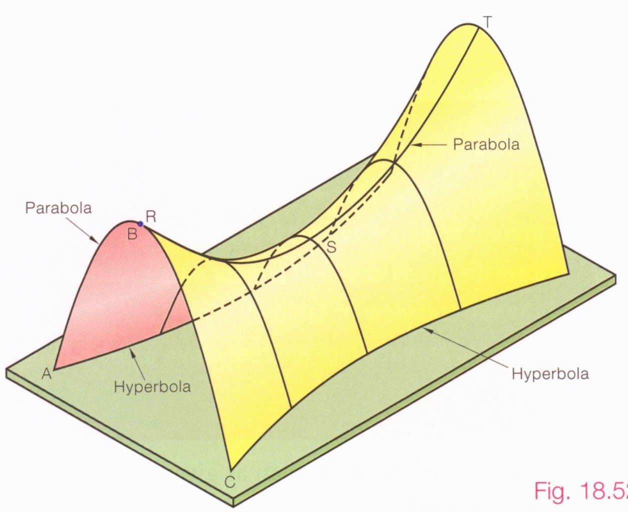


Fig. 18.52

The hyperbolic paraboloid surface can also be generated by straight lines as shown in Fig. 18.53. It is called a **doubly ruled**

surface. A singly ruled surface is one in which a point on the surface can have a straight line drawn through it which lies on the surface. A cone, for example, is a singly ruled surface as any point on the curved surface can have a straight line drawn through it from the apex. This straight line rests on the cone surface throughout its length. A hyperbolic paraboloid has two such lines running through any point on its surface and is thus doubly ruled.

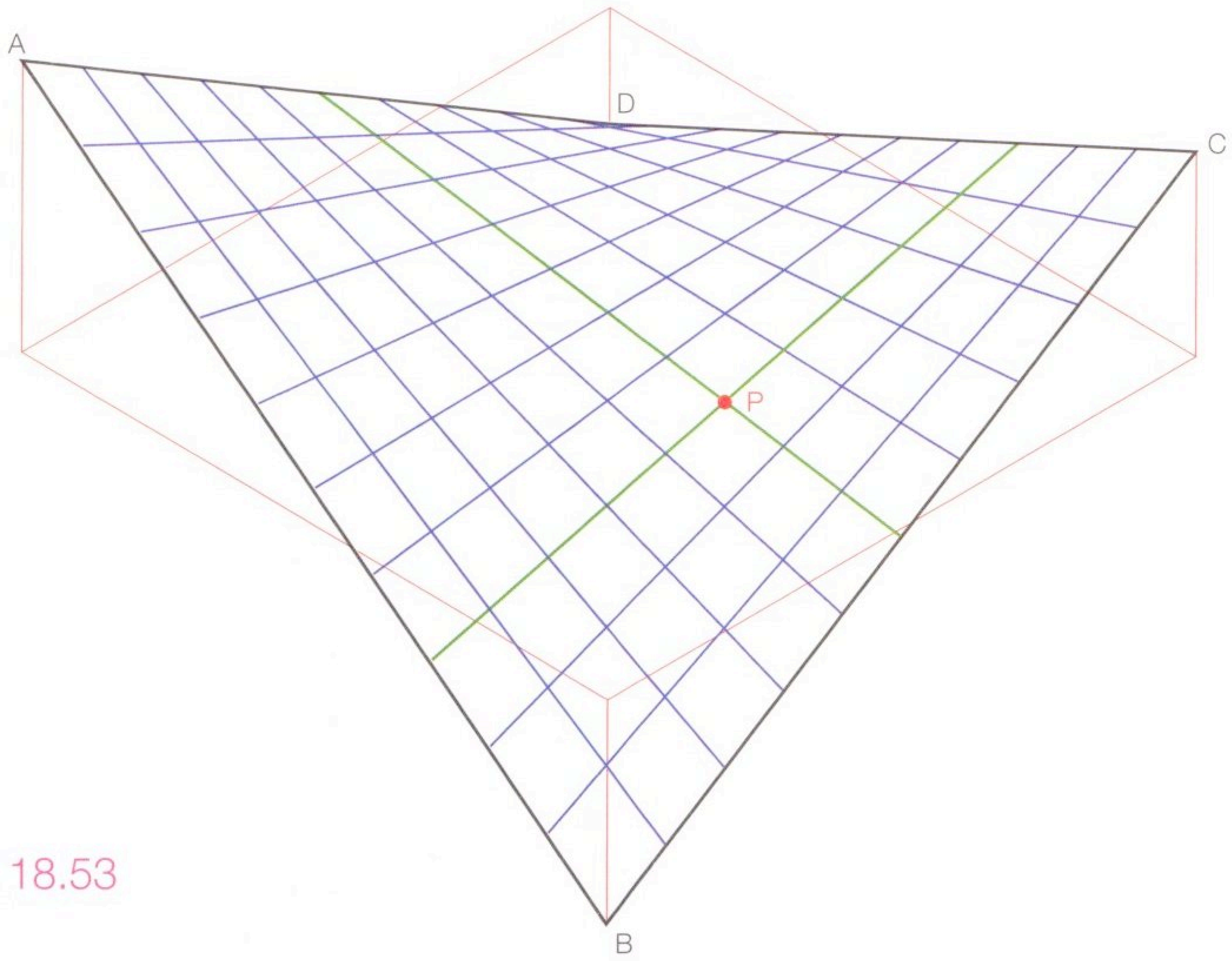


Fig. 18.53

The diagrams Fig. 18.54 and Fig. 18.55 show that the structures shown in Fig. 18.52 and that shown in Fig. 18.53 are portions of the same structure. The diagonals AC and BD form upward and downward curving parabolas. Vertical sections parallel to these will produce similar parabolic sections.

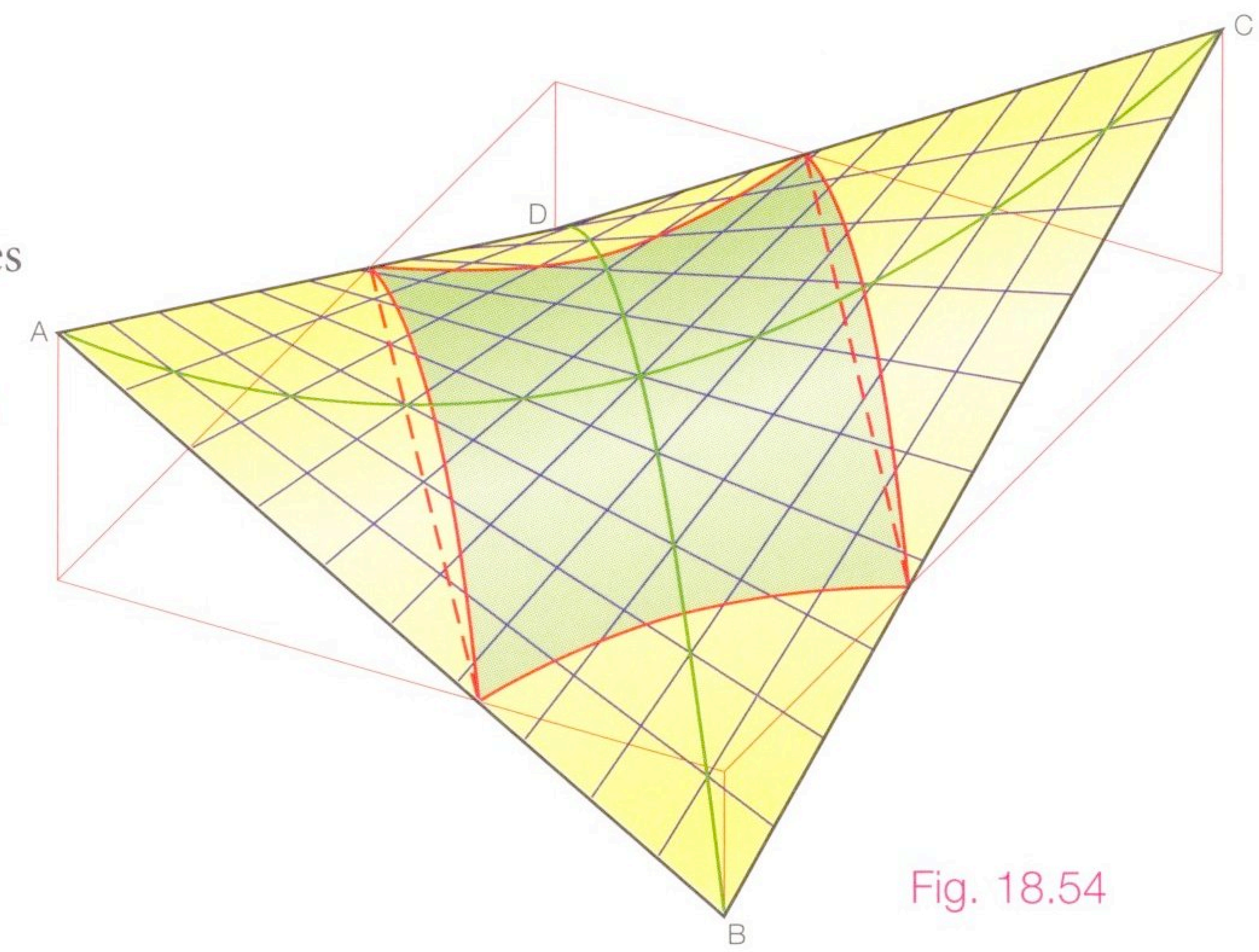


Fig. 18.54

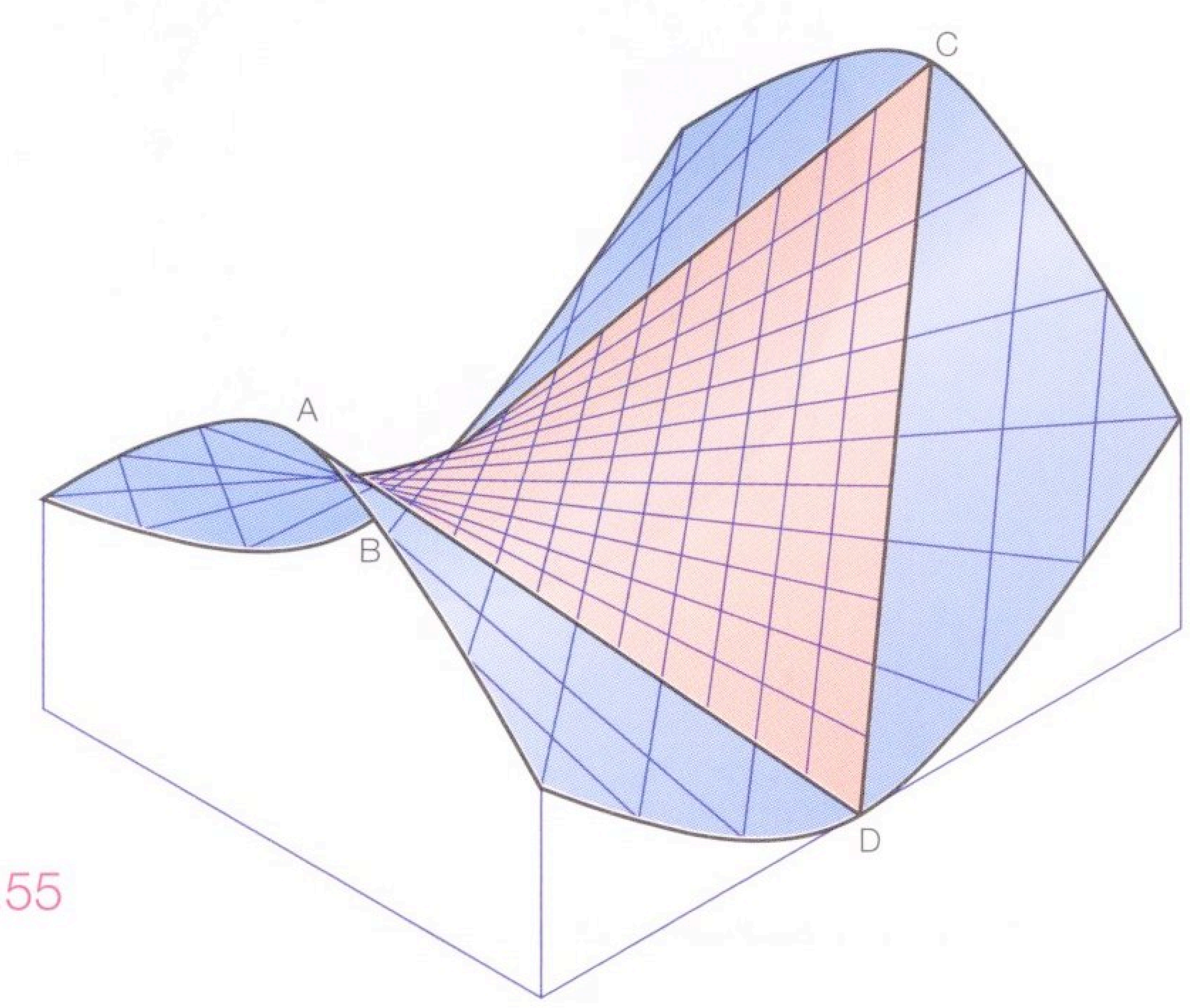


Fig. 18.55

The hyperbolic paraboloid shown in Fig. 18.54 is often referred to as a **low saddle type** and that shown in Fig. 18.55 as a **high saddle type**.

Fig. 18.56 shows the outline plan of a hyperbolic paraboloid roof surface ABCD. The corners A and C are at ground level. Corner B is 12 m above ground level and corner D is 20 m above ground level.

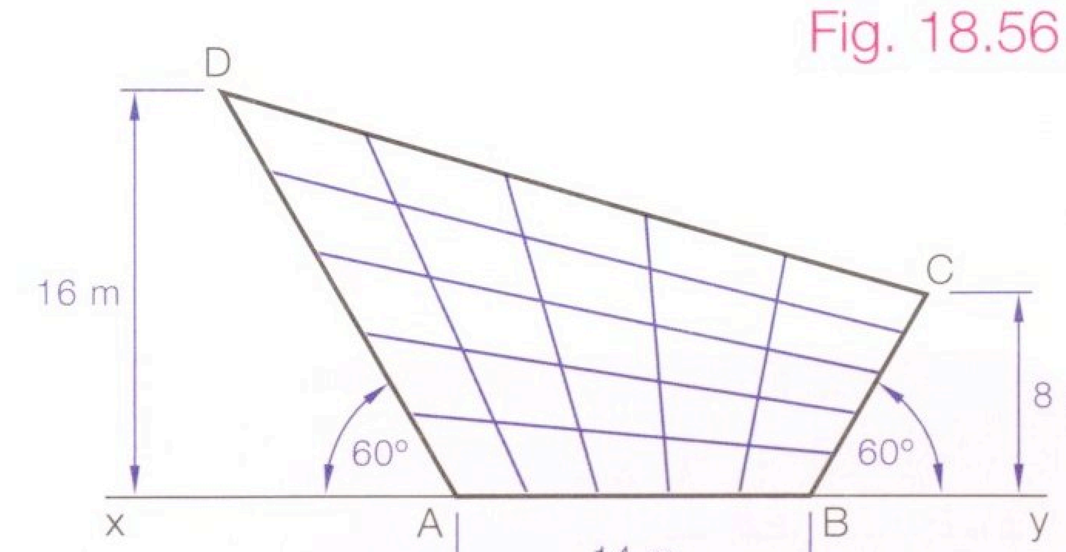
(i) Draw the given plan and project an elevation.

(ii) Draw an end view of the roof.

(iii) Show the curvature of the roof along a line joining A to C.

Scale 1:200

Fig. 18.56



(1) Draw the outline of the plan as given.

(2) Each of the sides must be divided into five equal spaces as shown. This can be done by measuring or by division of lines as described before.

(3) Join the elements as shown. It is worth noting here that these structures must have four sides. The division marks on one edge must be joined to division marks on an opposite side, e.g. AB divisions join to CD divisions, and BC divisions join to AD divisions.

(4) Project the elevation of the corners using the heights given in the question. A joins to B to C to D back to A.

(5) The sides in the elevation can be divided by projecting the divisions up from the plan or by measuring.

(6) By indexing the first in a set of elements in plan the corresponding element in elevation can easily be found.

(7) Complete the elevation.

(8) The end view is found in the same way with the division points being found by projection from the front elevation, from the plan or by measuring.

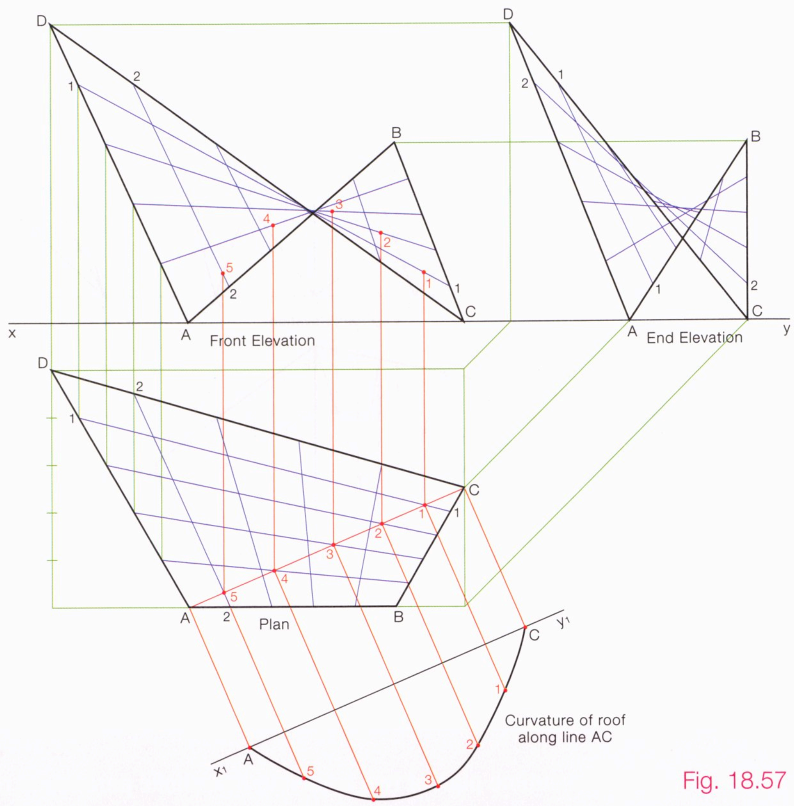


Fig. 18.57

CURVATURE

(1) Join A to C in plan and identify points 1 to 5 where the section lines cross the elements. The more horizontal elements in plan are most suitable.

(2) Draw an x_1y_1 line parallel to the AC line.

(3) Project points AC and 1 to 5 out onto the sectional view. The projection lines must be perpendicular to the AC line and the x_1y_1 line.

(4) The heights of each point must be found from the elevation. Point 1 in plan on element 1, must be projected to elevation onto element 1. The height of this point is taken from elevation and transferred to the sectional view.

(5) Repeat for the other points and join to give the curve.

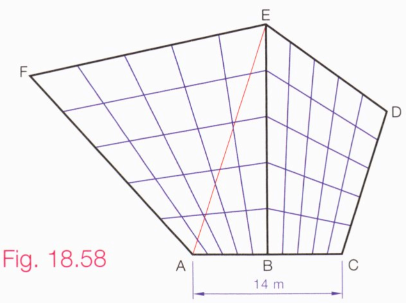


Fig. 18.58

Two adjoining hyperbolic paraboloid roof surfaces ABEF and BCDE are shown in plan. BCDE makes up half a pentagon and AEF is an equilateral triangle. The corners A, C and E are at ground level. Corners D and F are 16 m above ground level and corner B is 20 m above ground level.

(i) Draw the plan and project an elevation.

(ii) Project an end elevation.

(iii) Show the curvature of the roof along the line AE.

Scale 1:200

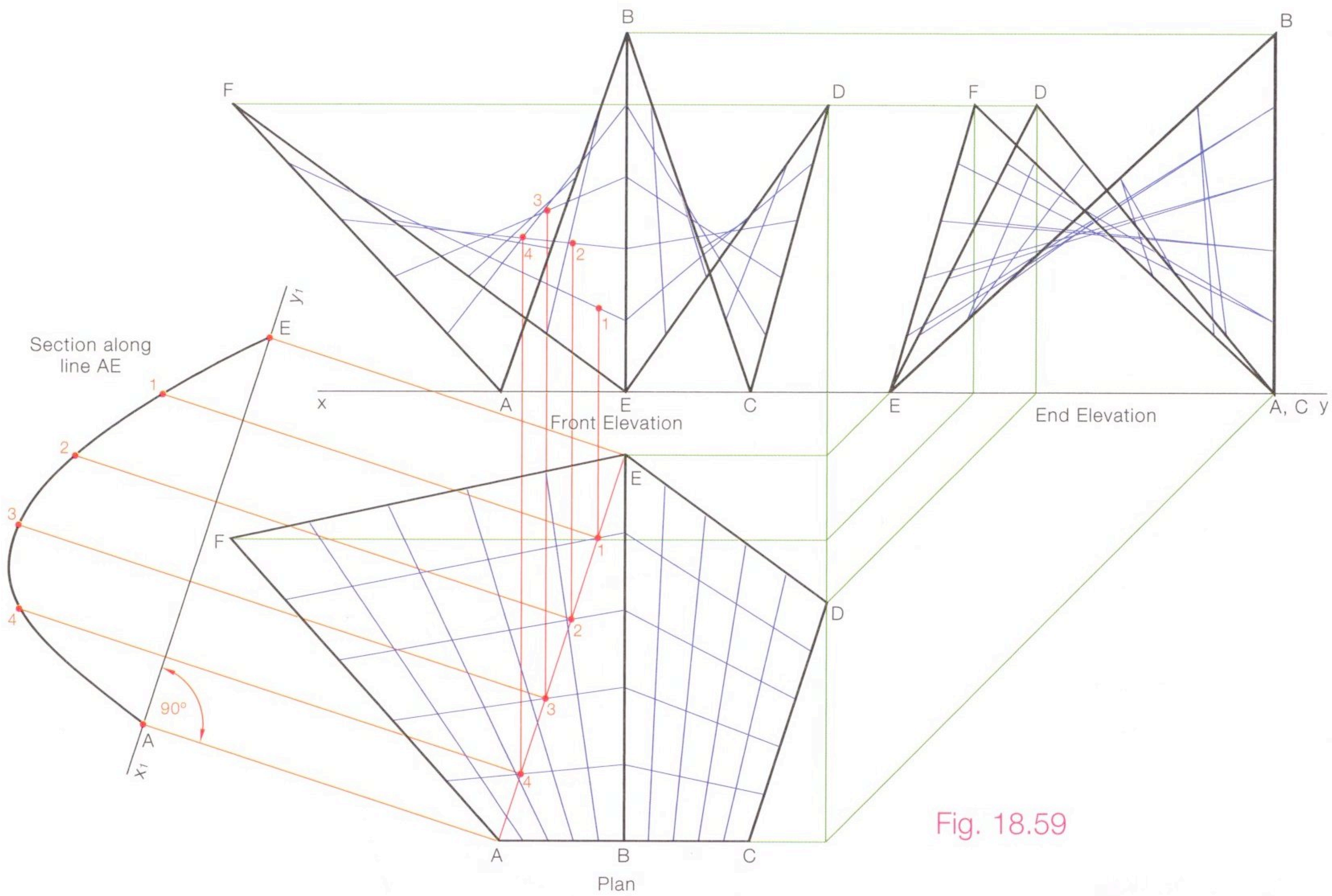


Fig. 18.59

The construction is very similar to that for the previous example. It is worth noting that in the solving of these problems we do not concern ourselves with finding hidden lines. The whole framework is considered during drawing as a wire frame and hence has no hidden lines.

Fig. 18.60 shows the outline plan of two adjoining hyperbolic paraboloid roof surfaces ABCD and ADEF. The corners B, C, E and F are at ground level. The corner A is 3 m above ground level and the corner D is 20 m above ground level.

(i) Draw the given plan and project the elevation.

(ii) Project an end elevation of the roof.

(iii) Find the true shape of the section S–S.

(iv) Draw a new auxiliary of roof ABCD that will show the true length of edge CD.

Scale 1:200

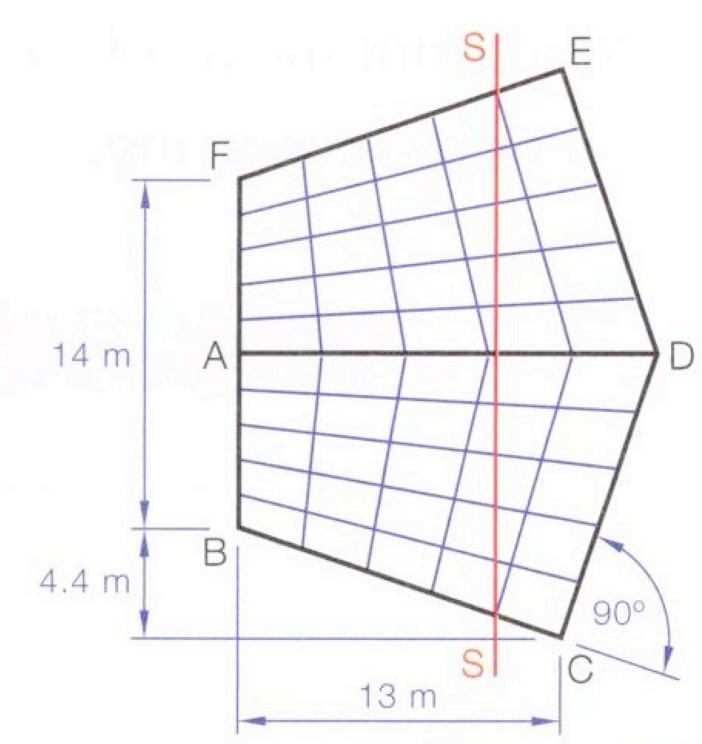


Fig. 18.60

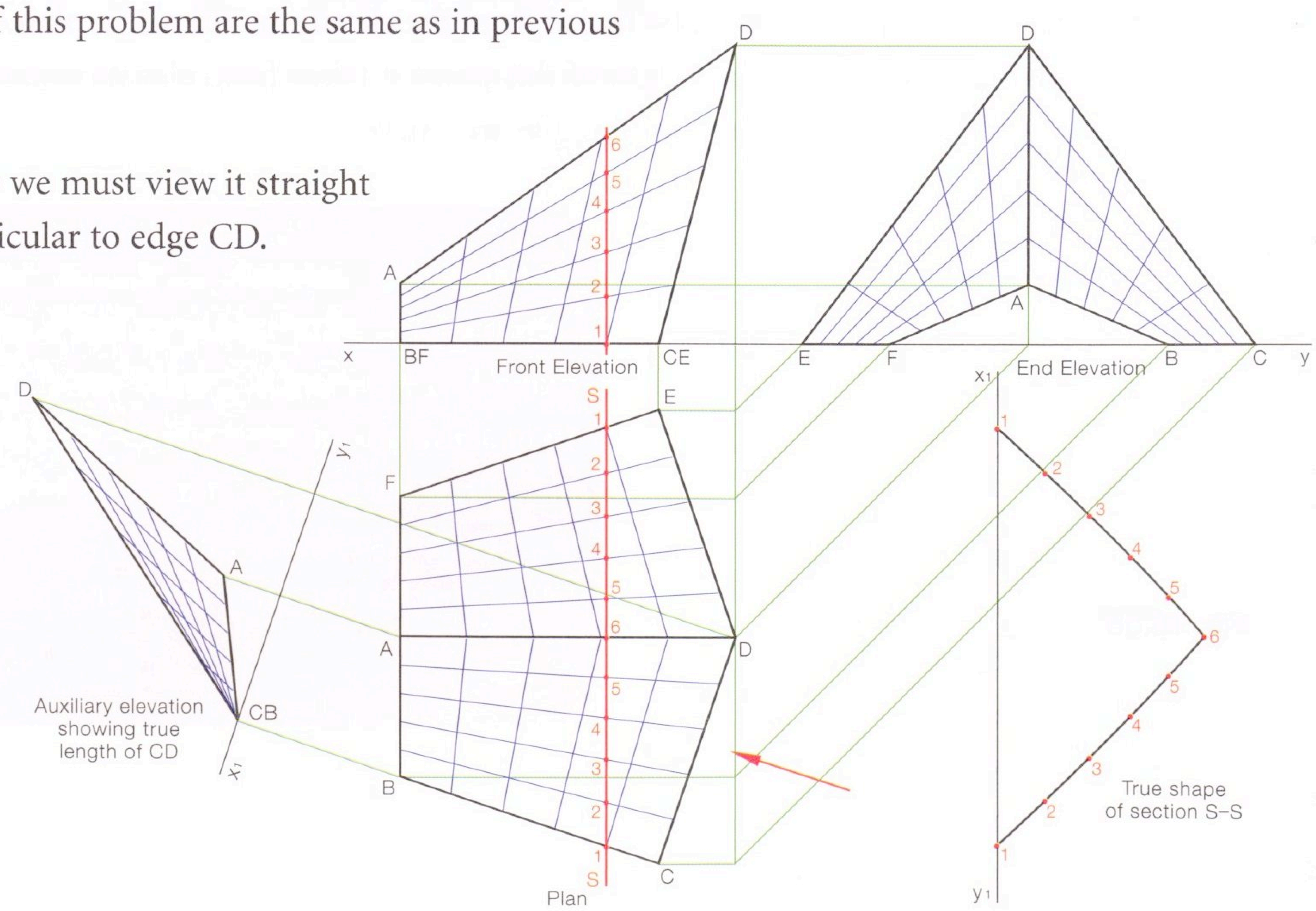
The solving of parts (i), (ii) and (iii) of this problem are the same as in previous examples.

New elevation showing true length.

(1) To see the true length of edge CD we must view it straight on. The viewing angle is perpendicular to edge CD.

(2) Draw an x_1y_1 which runs parallel to CD in plan.

(3) Project the corners in the direction of the arrow. Draw the outer frame and insert the elements. It can be seen from the auxiliary that edge CB is seen as a point view and that one set of elements will appear parallel in this view.



Hyperboloid of Revolution (contd.)

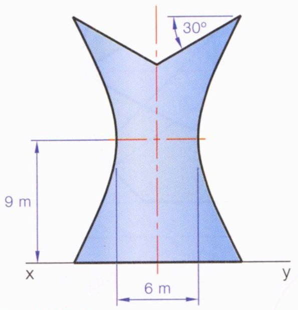


Fig. 18.61

Fig. 18.62 shows the elevation of a hyperboloid of revolution which has been cut at the top. The true length of all full elements on the surface of this structure is 21 m.

(i) Draw the plan and elevation of the building.

(ii) Project an end view.

(iii) Find the true shape of one side of the cut section.

Scale 1:100

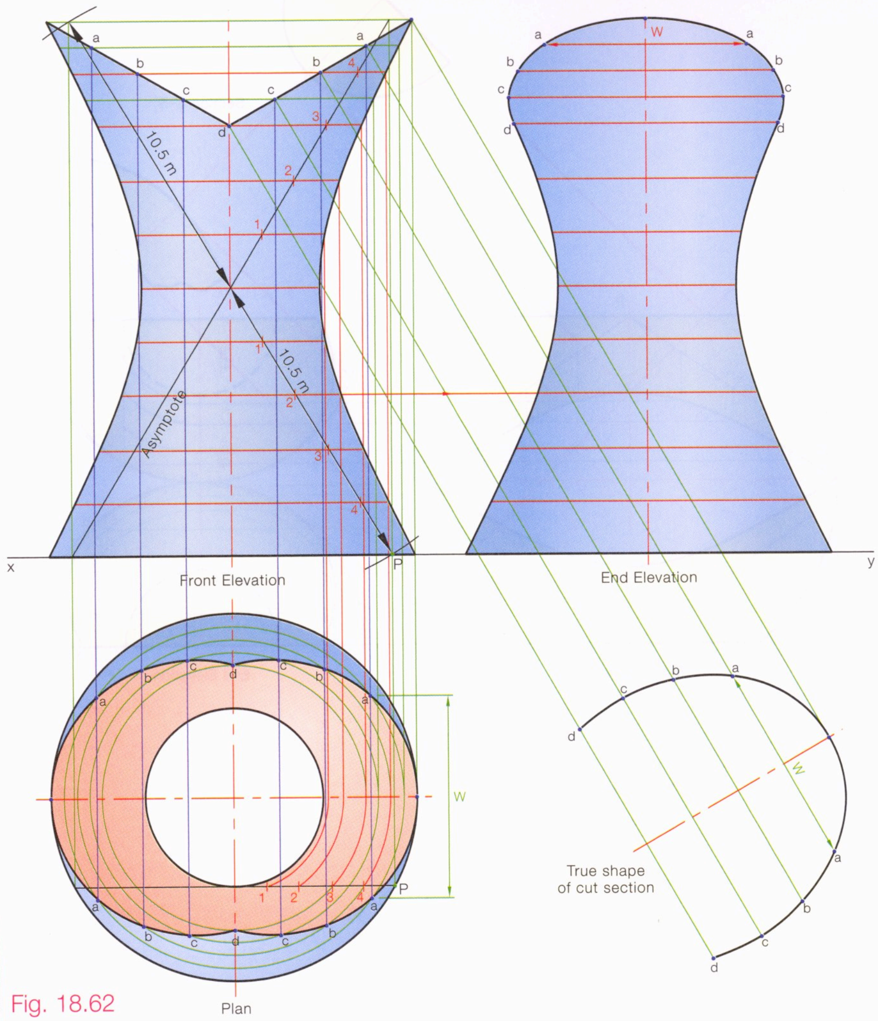


Fig. 18.62

(1) Set up the xy line, axis, throat line and overall height in elevation.

(2) Draw the throat circle in plan.

(3) The true length of all full straight line elements is 21 m. The asymptotes are elements and are seen as true lengths in elevation. The asymptotes always cross in the middle of the throat. Set the compass to half the length of the asymptote, place it at the centre of the throat and draw an arc to hit the xy line at P. Draw a horizontal line tangential to the throat circle in plan. Project P onto this line. Point P is on the base circle.

(4) Draw the hyperboloid as explained earlier.

(5) To find the points on the section in plan we take horizontal sections which produce circles in plan onto which the appropriate points are projected.

(6) The end view and auxiliary are found by taking widths from the front elevation and plan.

The elevation of a piece of sculpture is shown in Fig. 18.63. It is in the form of two solid semi-hyperboloids of revolution. Any straight line element on the full hyperboloid of revolution would measure 17 m.

(i) Draw the front elevation, end elevation and plan of the sculpture.

(ii) Determine the true shape of section S–S.

Scale 1:100

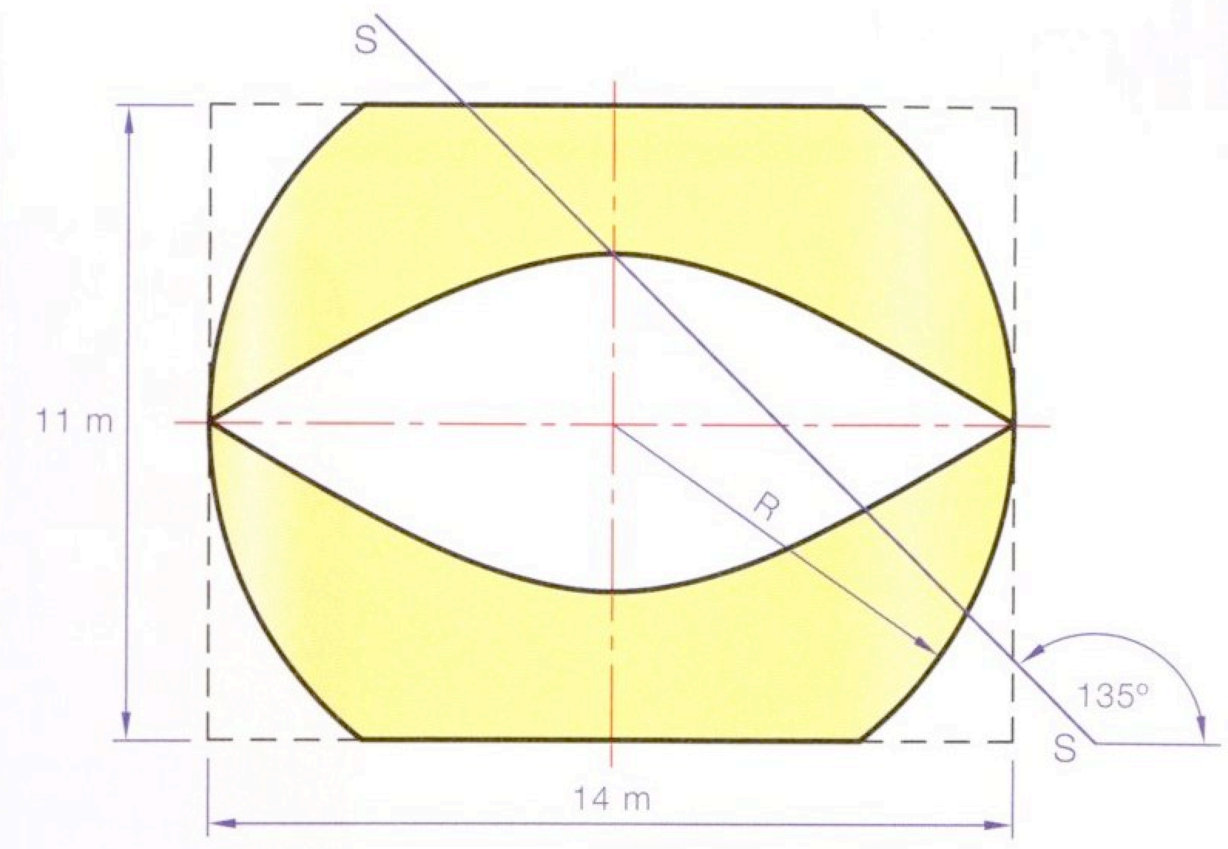


Fig. 18.63

(1) The asymptotes will be 17 m long. Since they are only semi-hyperbolic paraboloids we only use half of this distance. Swing an arc from P to cut the side at Q. Point P is projected to the end view and the asymptote is drawn vertically. The throat circle is tangential to the asymptote in end view.

(2) The hyperboloid is constructed in the usual way.

(3) The shaped ends are found in end view and plan by taking sections perpendicular to the axes which appear as circles in end view.

(4) The section S–S is also found by using sections (construction not shown).

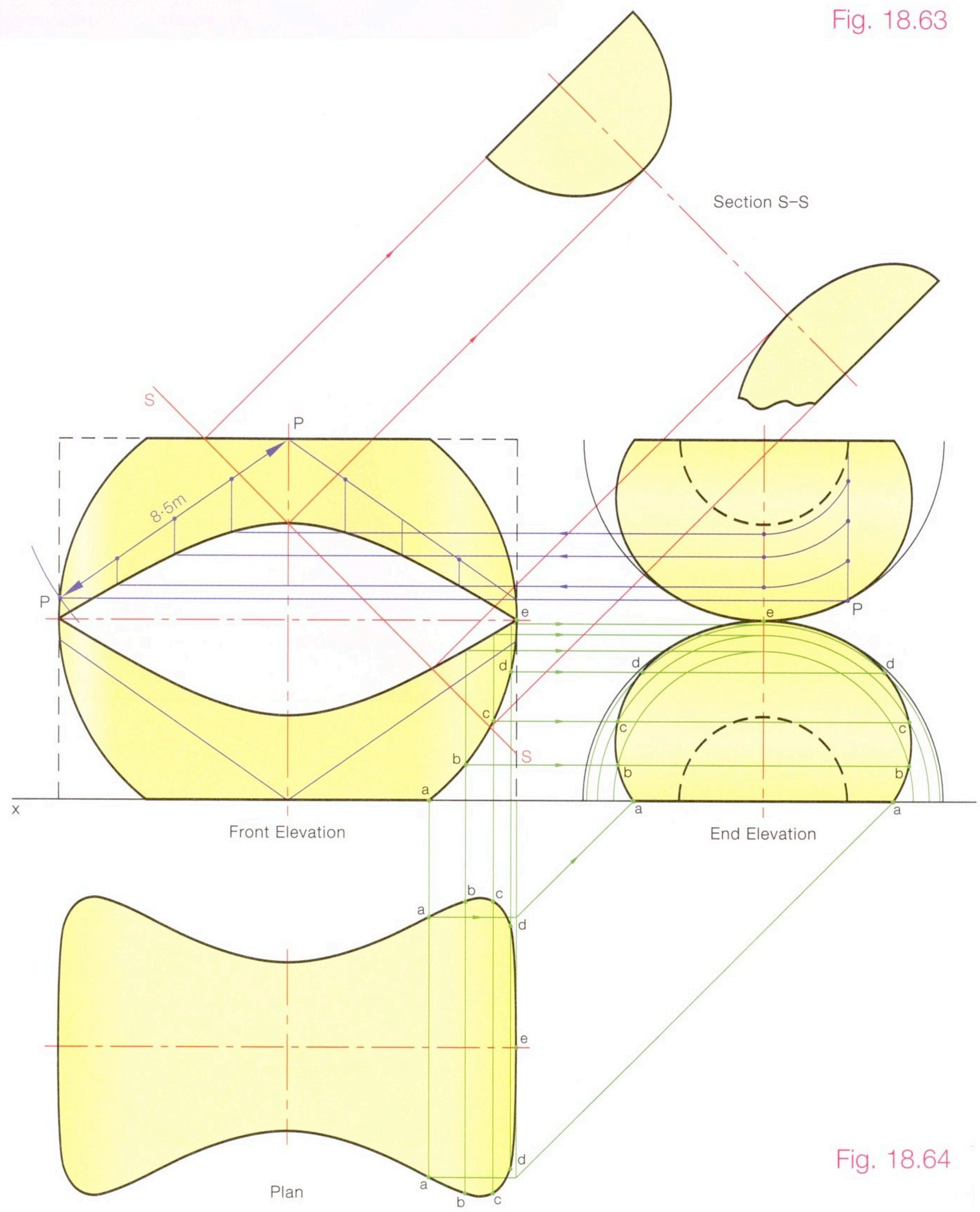


Fig. 18.64

HIGHER LEVEL

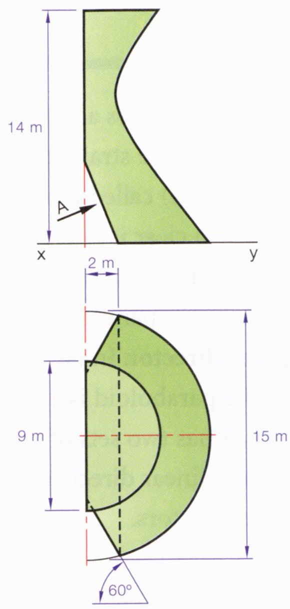


Fig. 18.65

Fig. 18.65 shows the plan and elevation of a semi-hyperboloid of revolution.

(i) Draw the plan and elevation of the structure.

(ii) Project a new elevation that will show the true shape of surface A.

Scale 1:100

(1) Draw the two semicircles in plan and project to elevation.

(2) The straight line in plan projects as a straight line in elevation and is therefore a portion of an element. As an element it will form a tangent to the throat circle in plan. Extend the line and draw the throat circle.

(3) Draw the asymptote in plan and project to elevation. Where the asymptote crosses the axis gives the position of the throat.

(4) Complete the plan and elevation.

(5) The new elevation is projected perpendicular to surface A. Surface A, when projected, will be made up of straight lines. The widths are found in the plan.

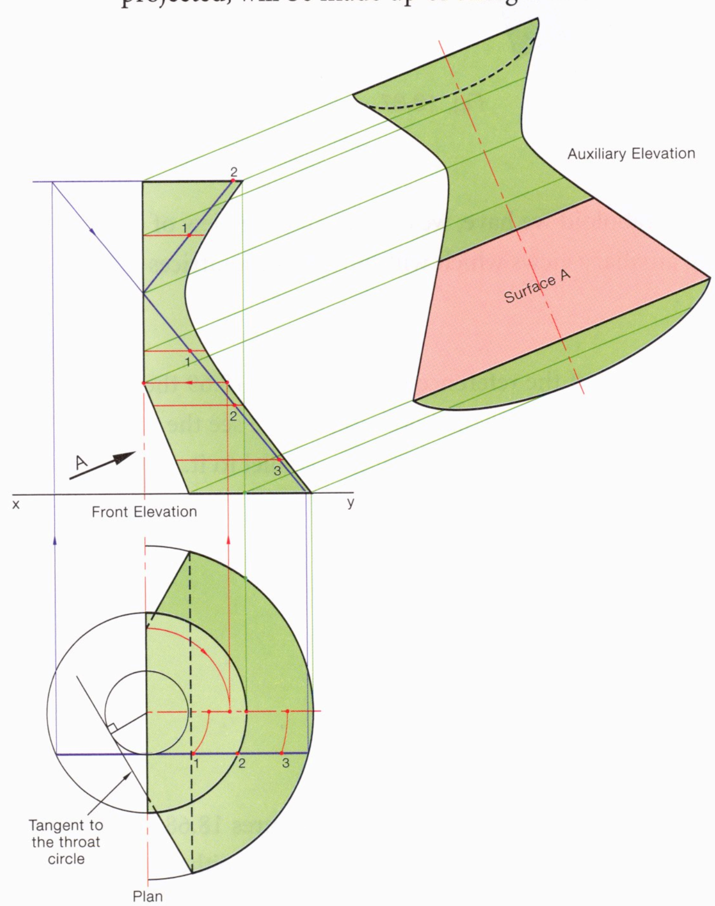


Fig. 18.66