(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.

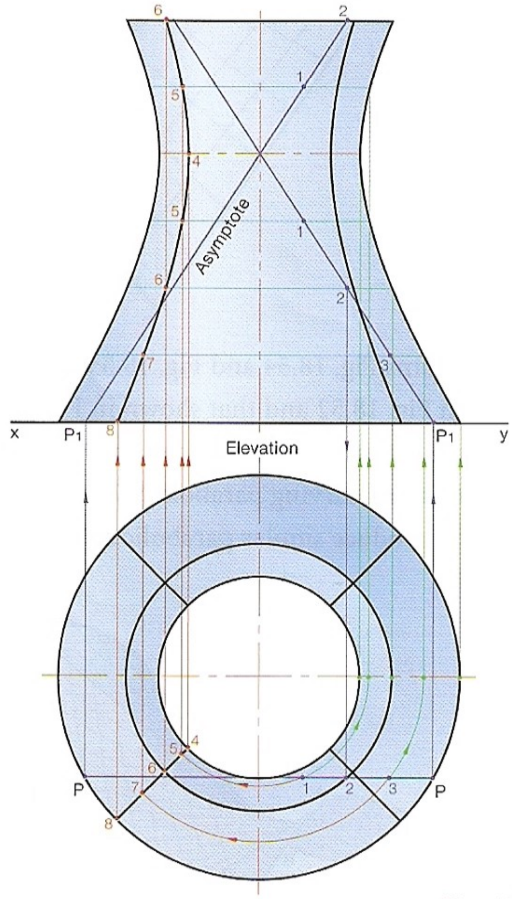

Fig. 18.51

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.

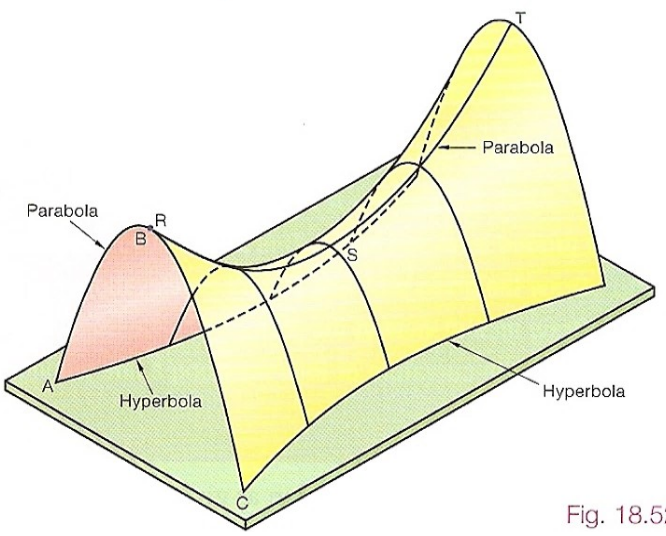

Fig. 18.52

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

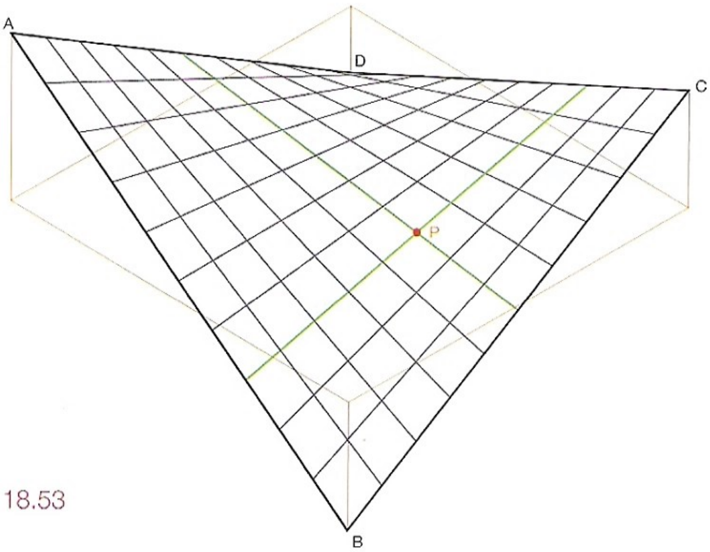

Fig. 18.53

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.

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.

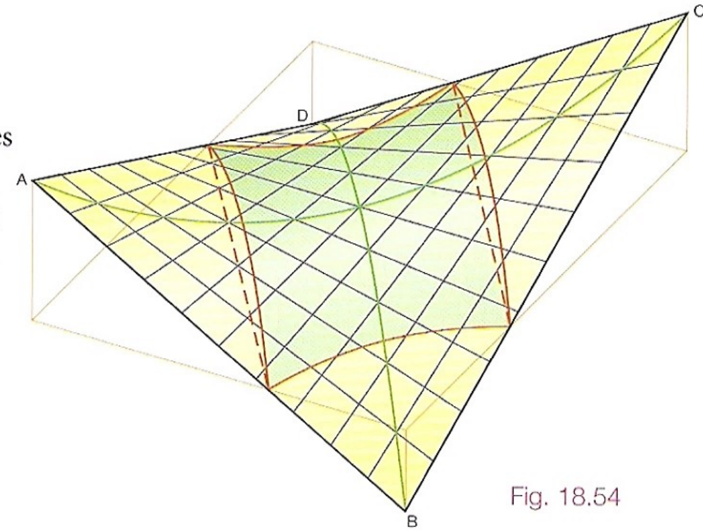

Fig. 18.54

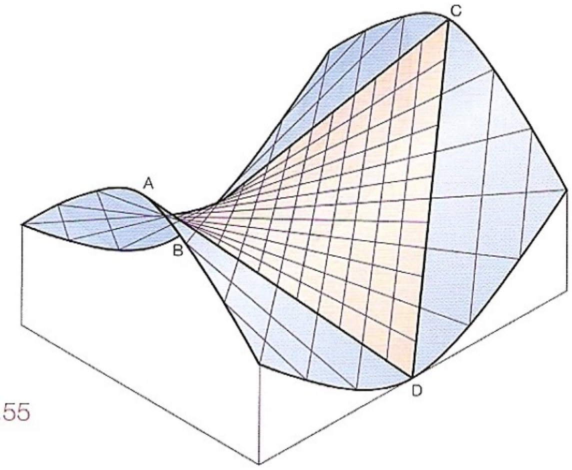

Fig. 18.55

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

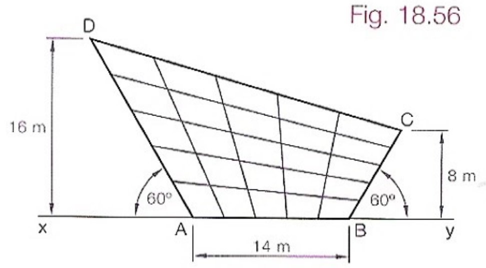

Fig. 18.56

(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.

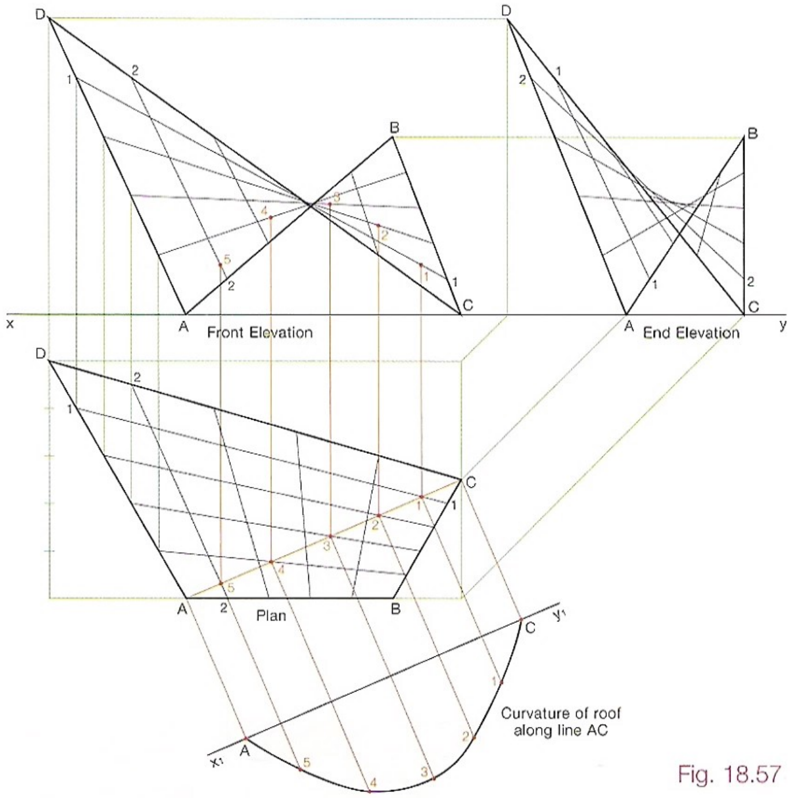

Fig. 18.57

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.

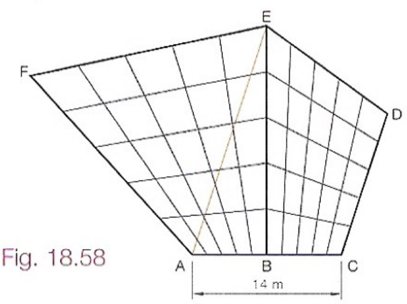

Fig. 18.58

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

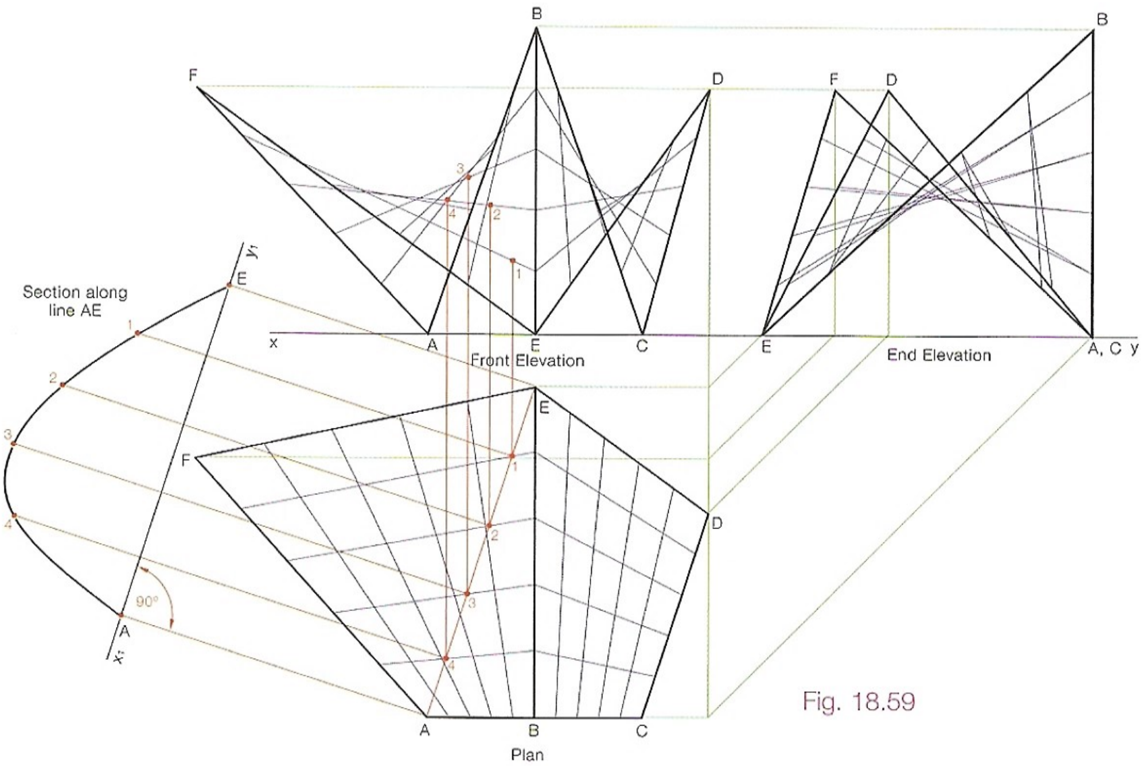

Fig. 18.59

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

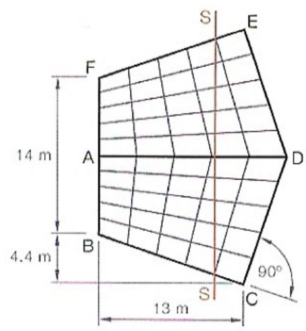

Fig. 18.60

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.