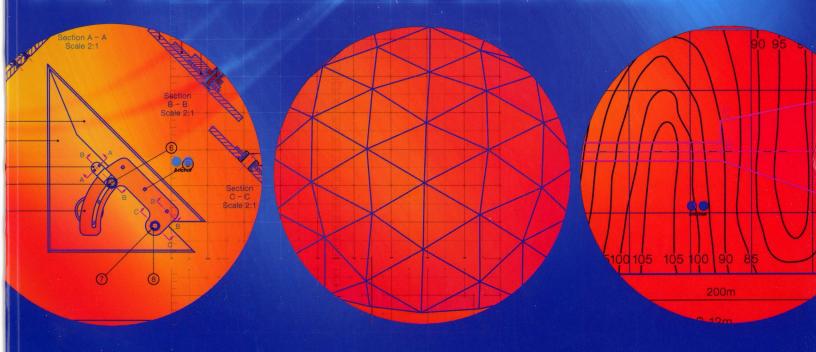


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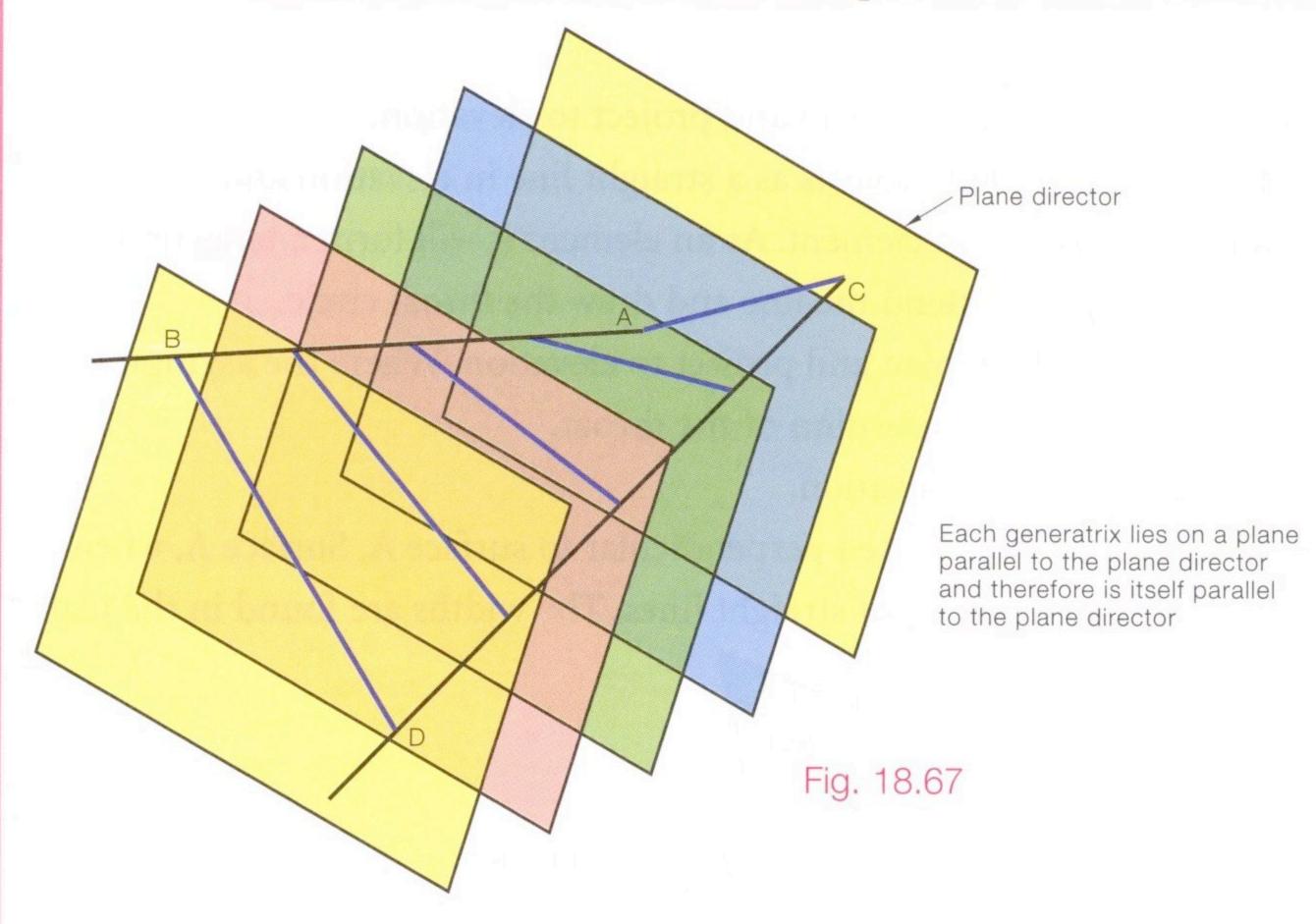
CAD AND APPLIED GRAPHICS



DAVID ANDERSON

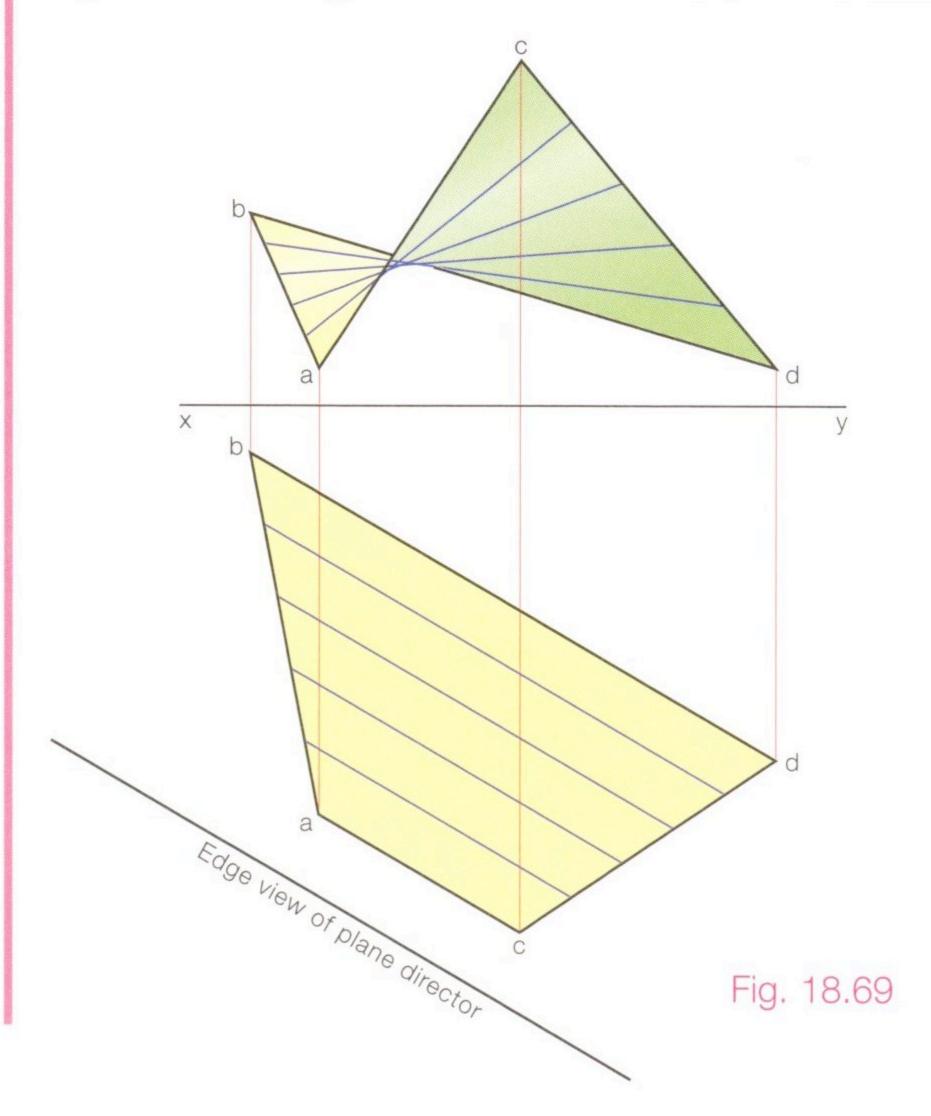
Hyperbolic Paraboloid (contd.)

The hyperbolic paraboloid is a warped surface and therefore cannot be developed. It can also be referred to as a warped quadrilateral. We have seen earlier that it can be considered to be a surface generated by a straight line. The straight line is called a **generatrix**. This straight line moves along two non-parallel, non-intersecting lines (skew lines) called **linear directrices**. All this can be clearly seen from the previous work on this surface. What perhaps is not so clear is that the



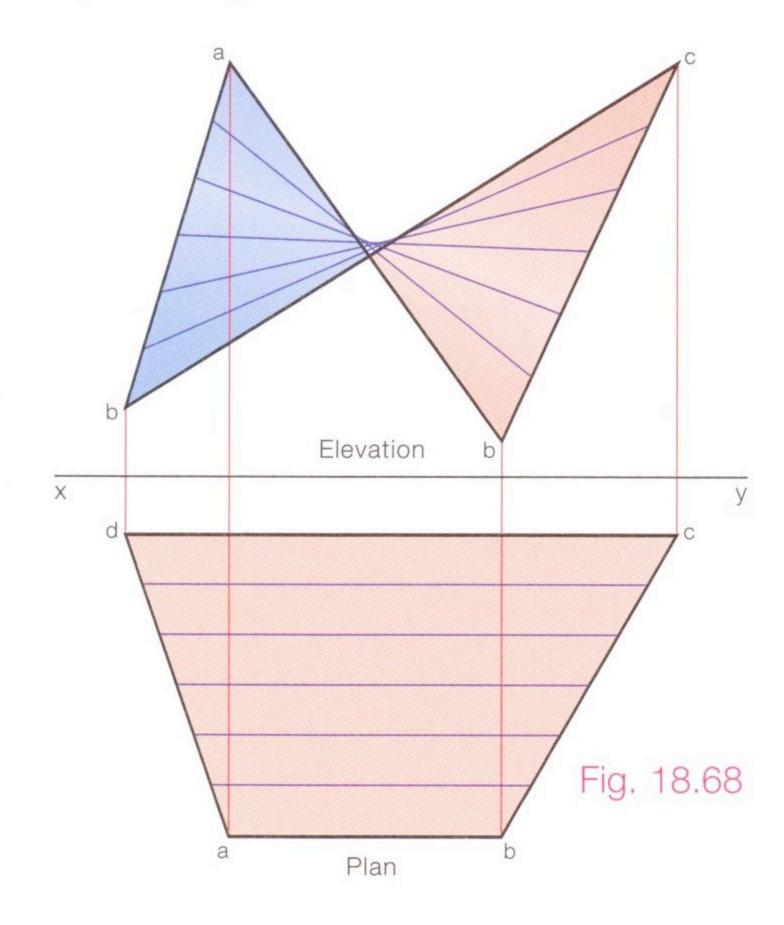
No matter what hyperbolic paraboloid we have, we can get an edge view of its plane director by getting auxiliary views which will show its generatrices as parallel.

The plane director need not be one of the reference planes. In Fig. 18.69 the plane director is a vertical plane that is simply inclined. In plan we see the edge view of the plane director and all the elements appear parallel to it.



generatrix, as it slides along the linear directrices, must always stay parallel to a plane, called the **plane director**. In fact, because the hyperbolic paraboloid is a doubly ruled surface, it has two sets of generatrices, two sets of linear directrices and two sets of plane directors.

Fig. 18.68 shows the plan and elevation of a hyperbolic paraboloid having two linear directors and therefore is itself parallel to the plane director director. Since the xy line in plan represents the edge view of the vertical plane, all the generatrices will be parallel to the xy line in plan.

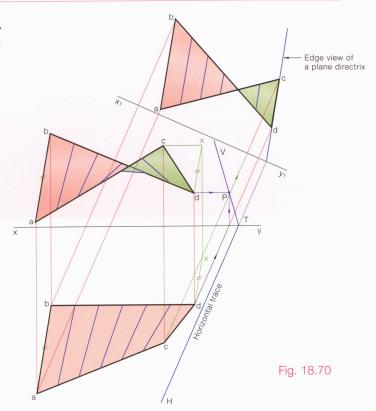


In both Figures 18.68 and Fig. 18.69 the elements of the structure appear parallel either in plan or elevation. If the plane director is an oblique plane, the elements will not appear parallel in either of these views and the use of an auxiliary view is required.

Fig. 18.70 shows an example of such a hyperbolic paraboloid. In order to find the plane director we must find a view of the structure that will show the generatrices as appearing parallel. The extreme elements ab and cd are used in Fig. 18.69 to find this view. The construction used is exactly that used in skew lines problems to show the two lines as parallel.

Generatrices ab and cd

- (1) Draw a level line from c and from d draw a line parallel to ab to intersect at x.
- Project x down to plan. In the plan draw a line from d (2) parallel to ab in plan to intersect at x in plan.
- Join c to x and view in this direction to project a view of the structure showing all elements as parallel.
- The plane director can be drawn in the auxiliary. It is seen as an edge view and will be parallel to the generatrices.



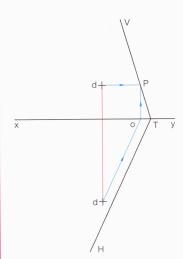


Fig. 18.71

- In Fig. 18.70 the plane director is containing element cd. Extend the edge view of the plane director to hit the x_1y_1 . This point is a point view of the horizontal trace. Project the horizontal trace back to plan.
- The vertical trace is found by using a point on the plane director, e.g. point c or (6)point d. We have point d in plan and elevation, we have the horizontal trace and we require the vertical trace.
- (7) Project d in plan, to the xy line, parallel to the horizontal trace to give point o.
- Project vertically and from d in the elevation project horizontally to give point p. Point p is a point on the vertical trace.

There is an infinite number of plane directors for any hyperbolic paraboloid surface. They will all be parallel to each other but their position can vary.

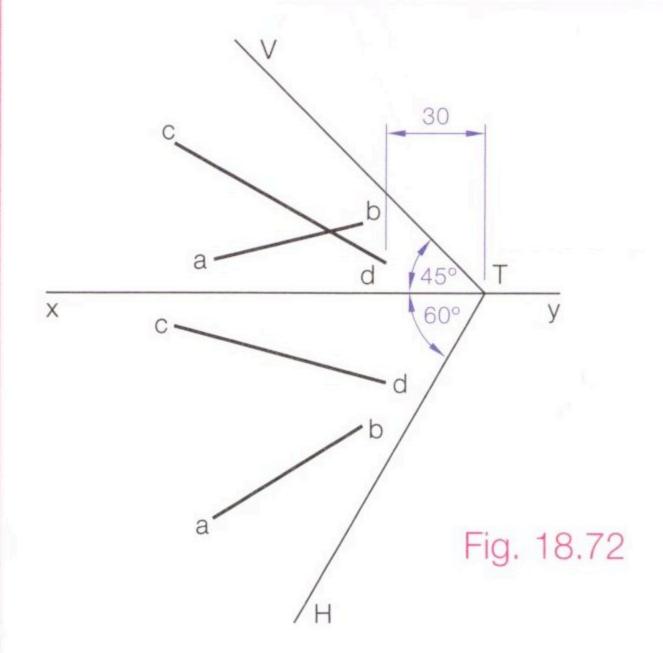
Given two skew line directrices ab and cd and the traces of the plane director of a hyperbolic paraboloid. To determine the elements of the surface.

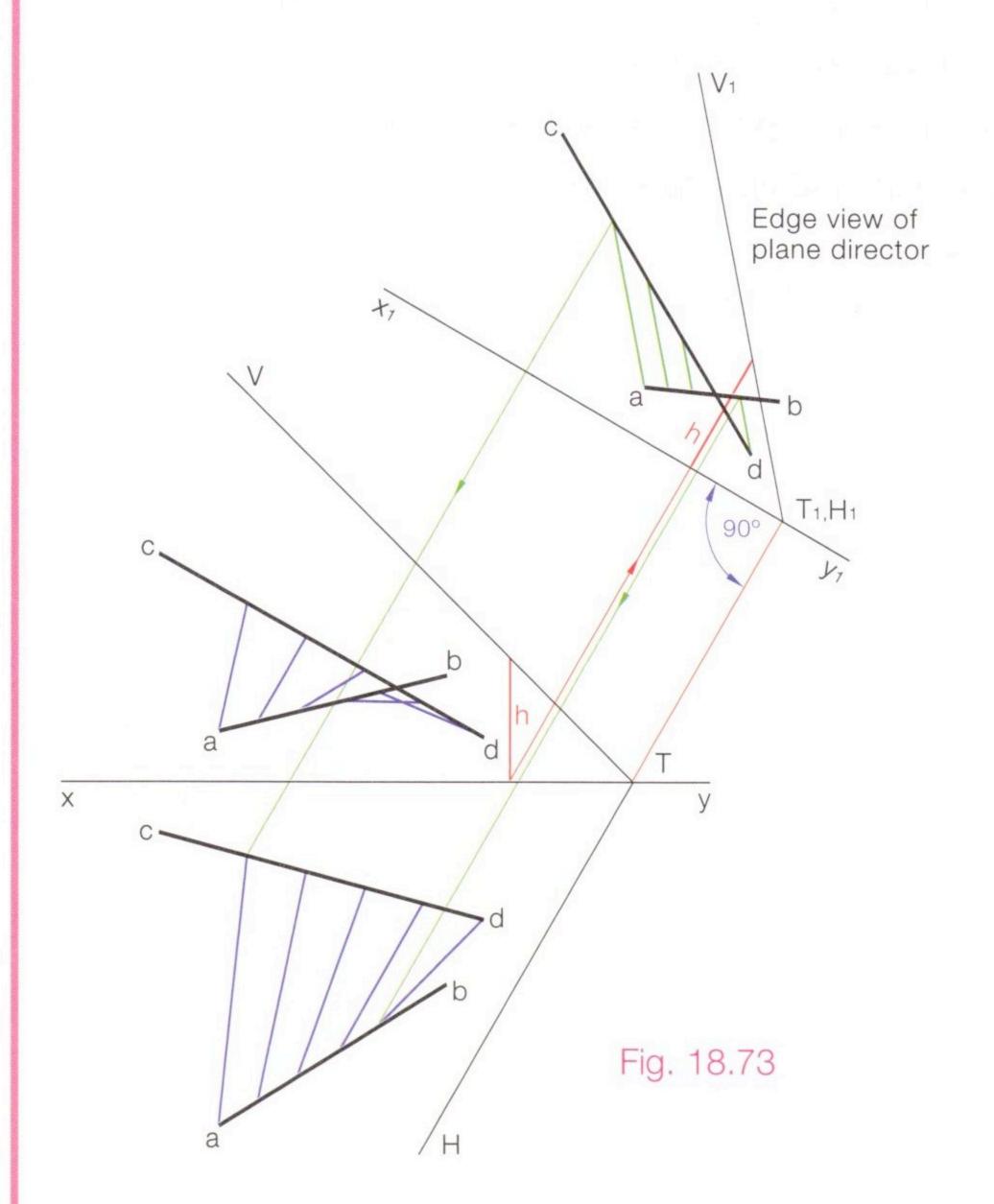
a = 30, 10, 68

b = 75, 21, 40

c = 18, 45, 10

d = 82, 9, 27





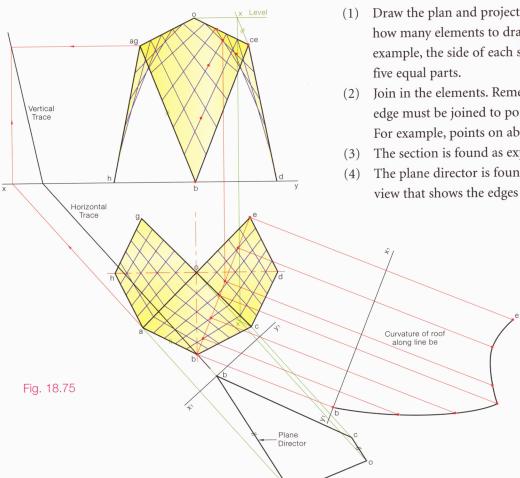
- (1) Find the edge view of the plane director by projecting an auxiliary view in the direction of the horizontal trace.
- (2) Draw the directrices ab and cd in this auxiliary.
- (3) The elements can now be drawn in the auxiliary, parallel to the edge view of the plane director. The most extreme elements are found first and further elements spaced out evenly between these.
- (4) Project the elements back to plan and project to elevation.

Fig. 18.74

Fig. 18.74 shows the outline plan of a rain shelter. The structure is in the form of four hyperbolic paraboloid surfaces, abco, cdeo, efgo and ghao. Points b, d, f and h are at ground level. Points a, c, e and g are 5 m above ground level and point o is 6 m above ground level.

- Draw the plan and elevation of the surfaces ghao, abco and cdeo.
- Find the curvature of the roof along the line joining b to e. (ii)
- Find the traces of the plane director for the edges ab and co and having (iii) its horizontal trace containing point b.

Scale 1:50



- (1) Draw the plan and project the elevation. Decide on how many elements to draw on each surface. In this example, the side of each structure was divided into
- Join in the elements. Remember that points on one edge must be joined to points on its opposite side. For example, points on ab join to points on oc.
- The section is found as explained before.
- The plane director is found by finding an auxiliary view that shows the edges ab and co as parallel. This

is a skew lines problem and the construction is as explained earlier.

- (5) Where the plane director meets the x₁y₁ gives the horizontal trace which is projected back to plan.
- (6) Point 'a' which is also on the plane director is used to find the vertical trace.

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