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DETERMINING THE LINE INTERSECTIING PLANES BY MEANS OF GENERAL POSITION PLANES AS INTERMEDIARIES

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Abstract *– The paper provides an example of using general position planes as intermediaries while determining the intersection line of two general position planes.*

Key words *– Intersection of surfaces, intersection line, intermediate planes, intermediaries, surfaces, non-intersection zones.*

Problem statement. According to current curricula at many faculties, students are not supposed to deal with using intermediate general position planes while determining the intersection line of two surfaces. But the studies dedicated to this are of a great interest among the students studying additional units of descriptive geometry and engineering graphics.

The state of theme research. Using intermediate general position planes while determining the intersection line of two surfaces is a quite tricky issue. Solving such problems is connected to laborious drawing and the heightened attention of the student doing the research in this direction. Therefore, any problem of this issue appeals to scientific community members.

Task statement. The students willing to learn additional units of descriptive geometry and engineering graphics in depth get an opportunity to broaden their horizons and prepare for professional construction activity better. Dealing with the intersection of two oblique general position cylinders has the same goal.

The main material.

General position planes are used as intermediaries in case that the given surfaces are also of general position [1, 3]. These are oblique cylinders and cones, prisms and pyramids.

The authors investigate the general approach to solving such problems through the example of two oblique elliptic cylinders. Figure 1 illustrates the possibilities of application of intermediate general position planes.

We take an arbitrary point ***A*** apart from the main drawing (Fig. 1). We draw line ***s*** parallel to the left cylinder generators and line ***l*** parallel to the right cylinder

generators through this point. We find the horizontal traces of these lines ***M*** and ***N*** and connect them. This is how we have found the horizontal trace of auxiliary plane ∑ ***(s*** x ***l)***. All the traces of the intermediate general position planes parallel to the horizontal trace of this plane will intersect both given cylinders in their generators (Fig. 2).

In order to solve this problem we start with drawing extreme planes tangent to one of the cones and intersecting the other. It lets us determine the kind of the intersection line.

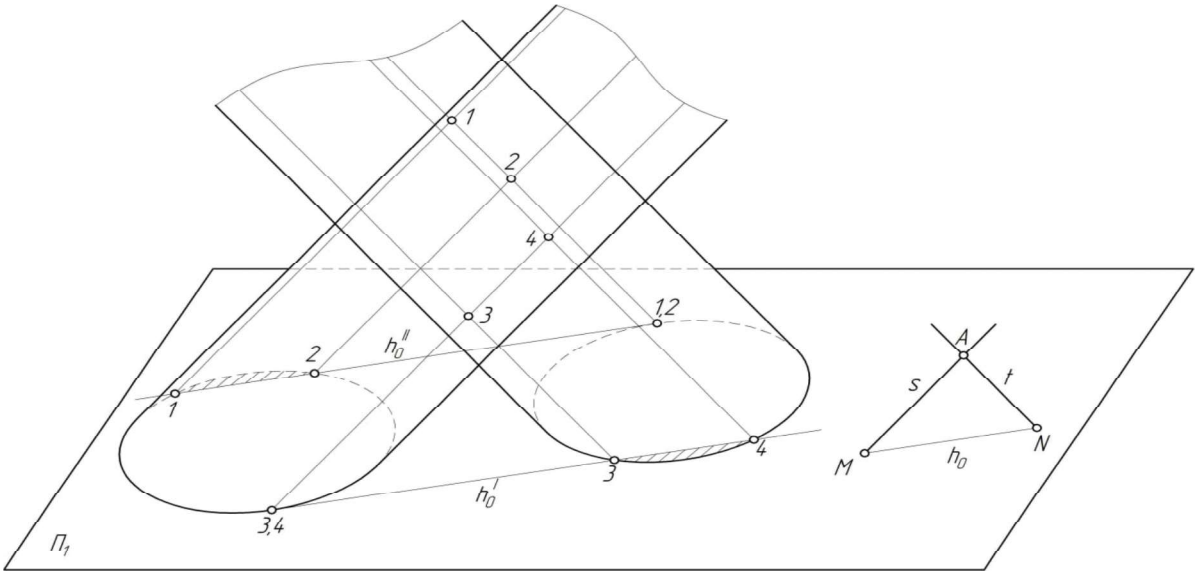

Figure 1. Using general position planes as intermediaries to draw the intersection line of 2 elliptic cylinders.

Such cases of position (Fig. 2) of extreme traces of intermediate planes in relation to the bases of intersecting bodies are possible [6, 4].

If one extreme plane trace tangent to the first body base intersects the base of the second one in two points and the other extreme plane trace intersects the base of the first body in two points and is tangent to the base of the second one (Fig. 2a), the surfaces of two such bodies intersect in one closed curve. This case is called “notch”.

If the traces of two extreme auxiliary planes are tangent to the base of one body and intersect the base of the other, the surfaces of these bodies intersect in two closed curves (Fig. 2b). This case is called “penetration”.

If the trace of one extreme plane is tangent to both bodies and the trace of the other plane is tangent to the base of the first body and intersects the base of the second body, these two intersection curves have a common point (Fig. 2c).

And if the traces of the extreme planes are tangent to the bases of both bodies, the surfaces of such bodies intersect in two flat curves with two common points (Fig. 2d).

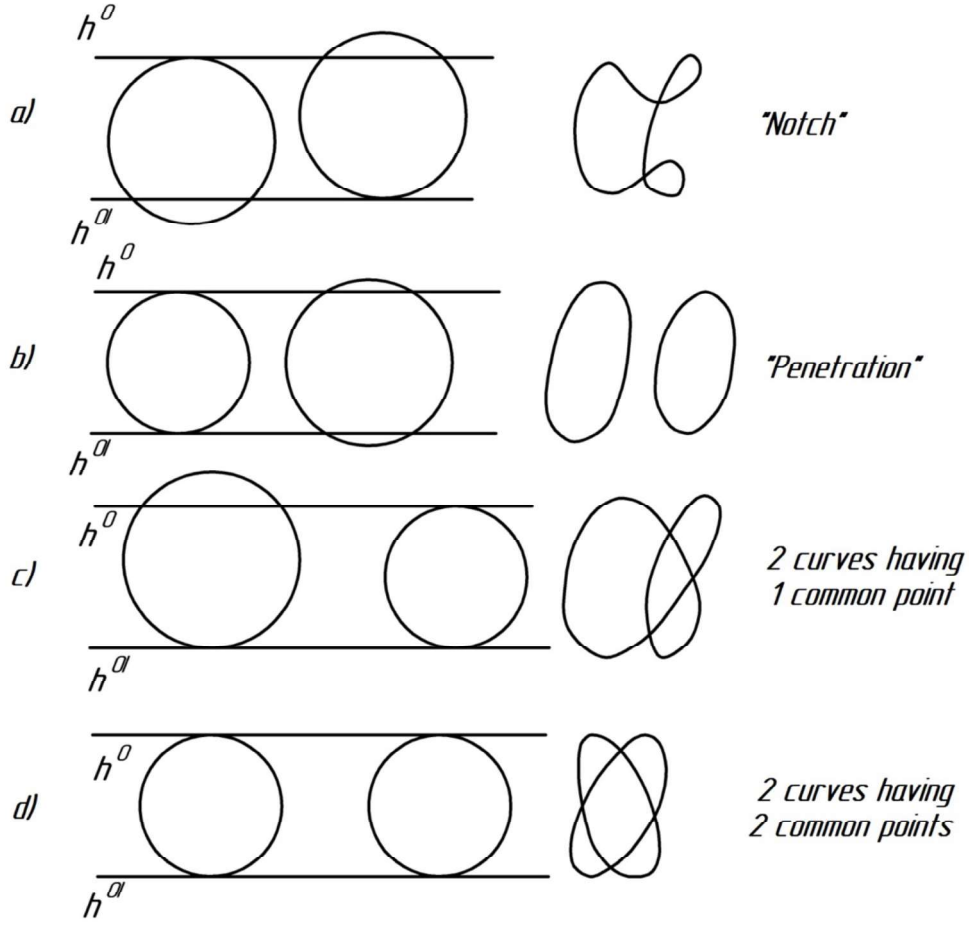

Figure 2. The classification of intersection surfaces cases

In the given example (Fig. 1) we get one spatial line of intersection.
This drawing also shows the algorithm of constructing points that are incident to the intersection line of the cylinders.
We investigate the algorithm of determining the intersection line of the two oblique cylinders in the multidrawing (Fig. 3).
We draw two lines ***s*** ***(s_1; s_2)*** and ***l*** ***(l_1; l_2)*** that are parallel to the generator of both given cylinders through arbitrary point ***A***. In this way we get the plane of parallelism and determine its horizontal trace ***MN*** ***(M_1N_1; M_2N_2)***. All the auxiliary intermediate planes will be parallel to the plane of parallelism. Accordingly, all the horizontal traces of these auxiliary intermediate planes must be parallel to the horizontal trace of the plane of parallelism.
We define the limits of existence of the section planes.
We start with drawing extreme planes that are tangent to the surfaces of the cylinders. We draw the trace of the first extreme auxiliary plane tangent to the base of the first cylinder and the trace of the second extreme plane – to the base of the second cylinder. By means of these two planes we get points 1, 2 and 3, 4 on the horizontal projection plane.

We have omitted the indexes giving information on the desired points lying in the corresponding projection plane because of a big number of symbols and lines in the corresponding construction.

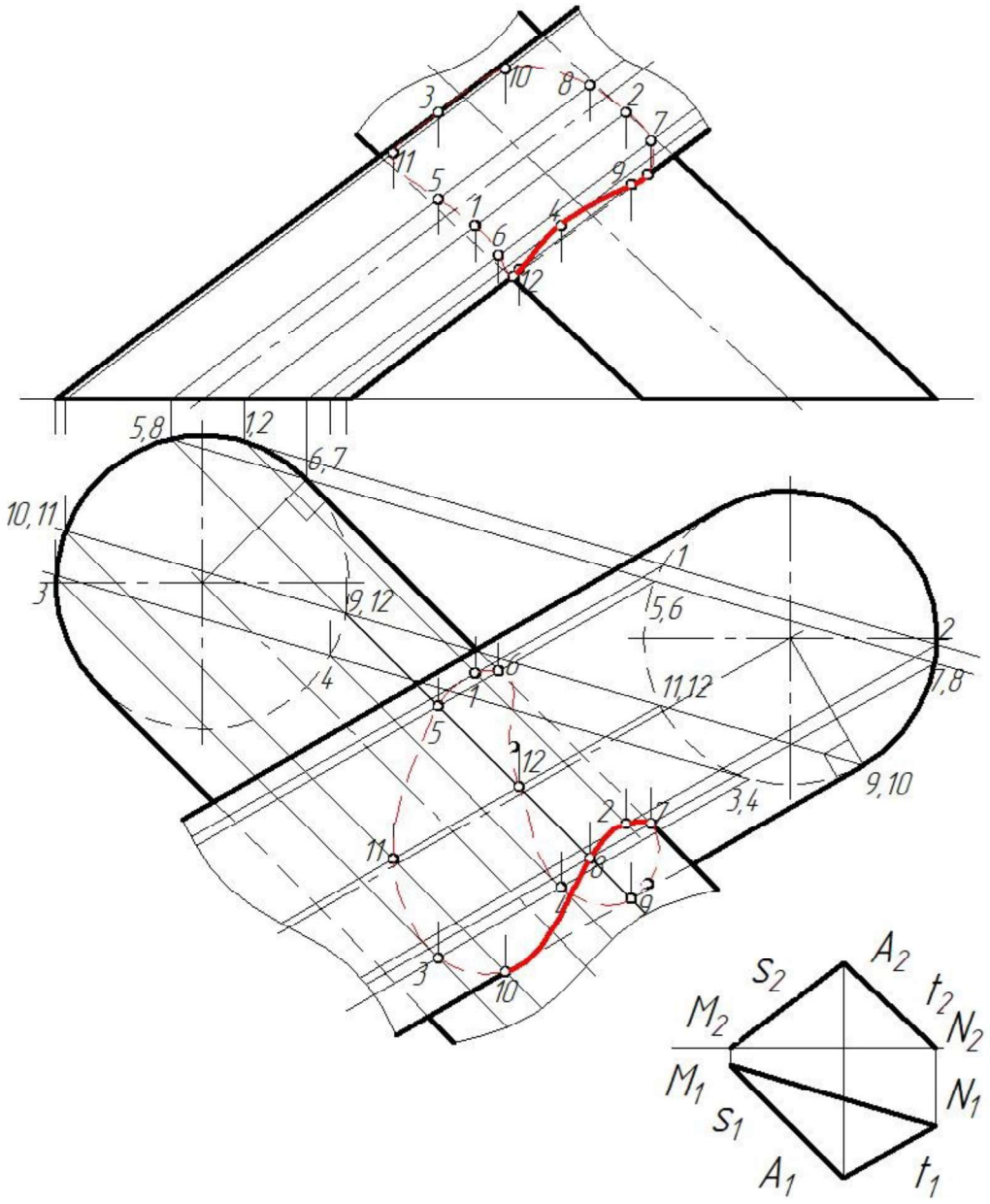

Figure 3. Constructing the intersection line of the surfaces of the elliptic cylinders in the multidrawing.

We find other points of the intersection line by means of a row of auxiliary planes that are positioned between the extreme planes. From each extreme plane we get four points that belong to the desired line intersecting the surfaces of the cylinders. Figure 3 illustrates the position of corresponding horizontal projections of points 5, 6, 7, 8 and 9, 10, 11, 12.

By means of the projections of points 1, 2, 5, 6 …, 4 we have constructed their frontal projections on the condition that these points lie in the surface of the first cylinder.

The authors have found it necessary to omit the indexes near the frontal projections to get a clearer image.

After finding the necessary number of points from the intersection line, we must set the order of their connection and define the visibility of the intersection line and the surfaces. We have used the method of digital designation [2, 5] in order to do this.

We set the sequence of connection according not to the points but to their projections based on the shapes on the horizontal projection plane. We define the sequence of connection by means of bypassing the points projections by the bases of the given cylinders. We start the bypass from the common point and lead it in one direction without entering the non-intersection zone.

After setting the sequence of connection of horizontal projections of the determined points which make the designed line of intersection, we define the visibility of particular sections of the curve.

1 - 5 - 11 - 3 - 10 - 8 - 2 - 7 - 9 - 4 - 12 - 6 - 1

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Analogically we define the visibility of frontal projection sections of the intersection line.

Conclusions. The results indicate that working on such complicated problems the student not only gains experience in solving problems like this and broadens their horizons but also obtains the engineering and special thinking skills. It develops creativity and expands the understanding of the geometry methods applications, thus, increasing the efficiency of basic preparation for professional construction activity.

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