Methodology for Teaching the Topic "Points and Their Displays on Drawings"

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ABSTRACT

This article presents the methodology for teaching the topic "points and their manifestations in drawings".

Keywords: Point formation, projection plane, projection axes, point projections, image of a point on a plot, drawing reading rule.

Access. It is known that a point is formed by the intersection of two lines, a line and a plane, a line and surfaces, three planes or three surfaces.

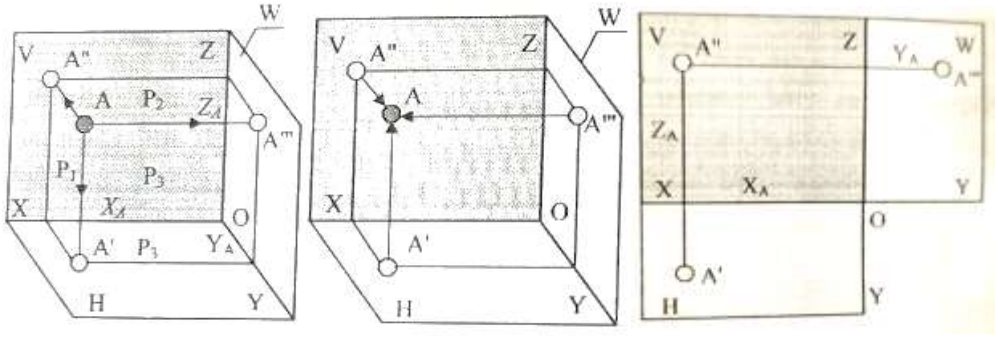
Since descriptive geometry is a part of mathematics, the Cartesian coordinate planes XOY, XOZ, and YOZ are denoted as H, V, and W, respectively, as projection planes. In this case, the origin is taken from the right. Accordingly, it will be possible to make three projections of this point in space.

This implies the following rule: For any given point in space, horizontal, frontal and profile projections are formed from the intersection of the projection rays emanating from it with the planes H, V and W (figure 1). This is called the rule for constructing a drawing of points (geometric shapes and objects). Such projections of a point and itself lie in three planes simultaneously with two pairs of projections. Therefore, such projections have the property of threefold restoration, and such a system is considered to be extremely perfect.

Reference literature analysis. Concept:

- Three projection planes are mutually perpendicular and form a three-sided angle consisting of planes H, V and W, and their elements are named and defined accordingly.

- Cartesian coordinate planes intersect along mutually perpendicular axes OX, OY, OZ, which are called coordinate axes, and in descriptive geometry are called projection axes.



1- figure 2- figure 3- figure

H - plane of horizontal projections, is the XOY coordinate plane.

V- plane of frontal projections, represents the XOZ coordinate plane.

W - profile projection plane, represents the YOZ coordinate plane.

The intersection point of the axes OX, OY and OZ is called the origin.

Figure 1 shows the projection of point A onto three projection planes, and the construction elements in this process are named accordingly:

A - an arbitrary point of a geometric figure or object located in space;

A A', AA'', AA''' - projecting rays or straight lines;

P_1, P_2, P_3 - projecting planes;

A' - horizontal projection or top view of point A;

A '' - frontal projection or frontal view of point A;

A''' - profile projection or left view of point A;

Z_A - applied - distance of point A from H;

Y_A - ordinate - distance of point A from V;

X_A - abscissa - distance of point A from W.

Research Methodology. If we discard from Figure 1 the point A and its projection rays given in space, and rotate the planes H, W by 90^0 around the axes OX and OY, respectively, and attach to the continuation of the plane V, then we get three mutually projected images called point projections or Monge plots or flat dot pattern, (Figure 3).

Since the plane V remains in place in the drawing, the frontal projection of the point is called its main projection.

Now consider determining the position of point A in the mental space, that is, reading its drawing using point projections.

Suppose that a given point A in space and its projection rays are discarded, leaving three interconnected projections of it, Figure 2.

To determine the position of a point in space, draw a perpendicular line from A' to H, from A'' to V, and from A''' to W, and they intersect, forming the only position of point A in space.

Having comprehensively analyzed Figures 1 and 2, it can be determined that a point in space lies opposite its frontal projection. Since the V plane remains in place in the drawing, this property is preserved in the drawing of the point. Thus, it is possible to determine the position of a given point in space, that is, it is easy to read its drawing.

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Analysis and results. Having comprehensively analyzed Figures 1 and 2, it can be determined that a point in space lies opposite its frontal projection. Since the V plane remains in place in the drawing, this property is preserved in the

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1, 2, 3 projections of point A in space with coordinates X_A, Y_A and Z_A will have the following coordinates: A'(X_A; Y_A), A'' (X_A; Z_A), A'''(Y_A; Z_A)

Let's call this expression A'(X_A; Y_A), A'' (X_A; Z_A), A'''(Y_A; Z_A) as an algorithm for creating rectangular images-projections of a point in three mutually perpendicular projection planes. This detail can also be seen in the image of partial point A, Figure 4.

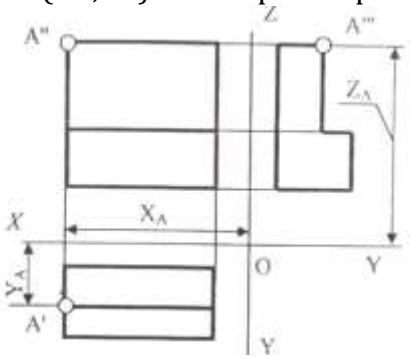


Figure 4

If the profile projection of the plane W and points A in Figures 1 and 2 are discarded, then a drawing is formed, consisting of horizontal and frontal projections lying on the same plane P_1.

Such a pattern satisfies the pattern restoration condition, that is, two images of a point - horizontal and frontal projections can determine its position in space, Figures 5, 6.

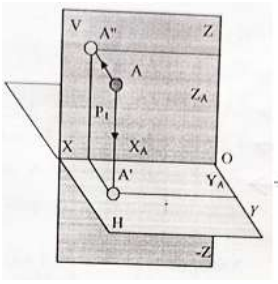


Figure 5

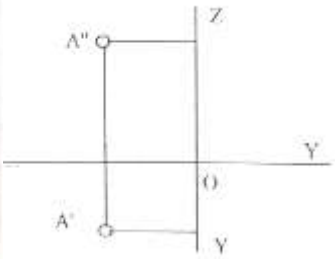
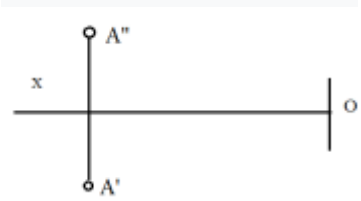


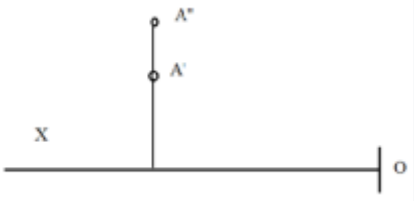
Figure 6

- If we continue the planes H and V, then the space is divided into four parts-quarters:
The upper part H and the front part V in the space of the first quarter;
The upper part H and the back part V in the space of the II quarter;
The lower part H and the back part V in the space of the third quarter;
In the space of the fourth quarter, the lower part is H and the front part is V.
The projections of point A are shown in a flat drawing (Monge diagram) in the following views in quarters.

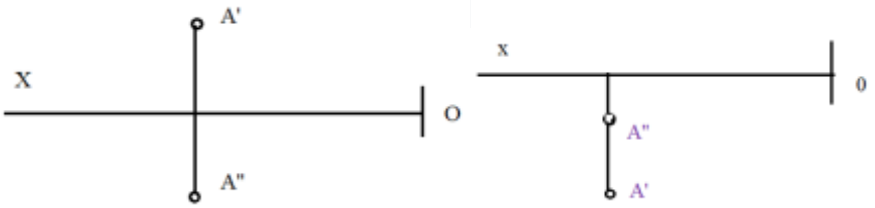
A∈ in the I-quarter



A∈ in the II-quarter



A∈ in III-quarter A∈ in IV-quarter



Projections of points located in quarters are arranged in the following order relative to the OX axis:

- If one or more point coordinates are equal to zero, then the projections of point A lie on one of the planes or projection axes (for point A):

$X_A = Y_A = Z_A = 0 \Rightarrow A \in 0$; $A' \equiv A''' \equiv A'' \equiv A''' \equiv 0$;

$Z_A = Y_A = 0 \Rightarrow A \equiv A' \equiv A'' \in OX$ and $A''' \equiv 0$;

$X_A = Y_A = 0 \Rightarrow A \equiv A'' \equiv A''' \in OZ$ and $A' \equiv 0$;

$X_A = 0 \Rightarrow A \equiv A''' \in W$: $A' \in OY$ and $A'' \in OZ$;

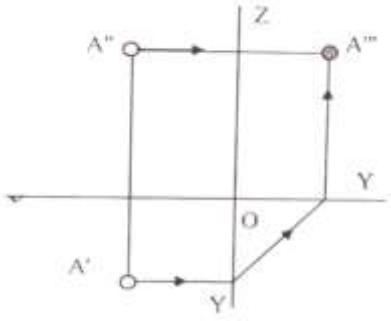
$Z_A = 0 \Rightarrow A \equiv A' \in H$: $A'' \in OX$ and $A''' \in OY$;

$Y_A = 0 \Rightarrow A \equiv A'' \in V$: $A' \in OX$ and $A''' \in OZ$;

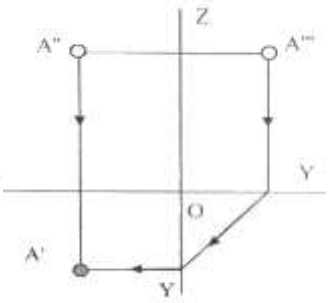
$Z_A = X_A = 0 \Rightarrow A \equiv A' \equiv A''' \in OY$ and $A'' \equiv 0$;

If two arbitrary images of a point are given, then the algorithm for determining its third image is as follows:

- if horizontal and frontal projections of a point are given, its profile projection is determined using ordinates and appliques (Figure 7): $A'''(Y_A, Z_A)$.



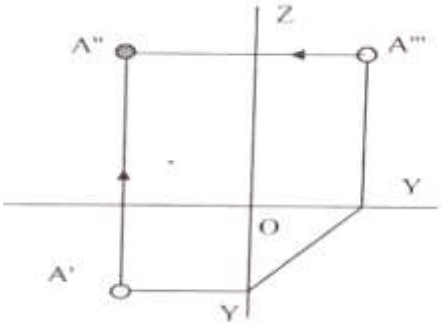
7-figure



8-figure

- if the frontal and profile projections of a point are given, its horizontal projection is determined by the abscissa and ordinate (Fig. 8): $A'(X_A, Y_A)$.

- if horizontal and profile projections of a point are given, its frontal projection is determined by the abscissa axis and applicates $A''(X_A, Z_A)$ (Figure 9).



9-figure

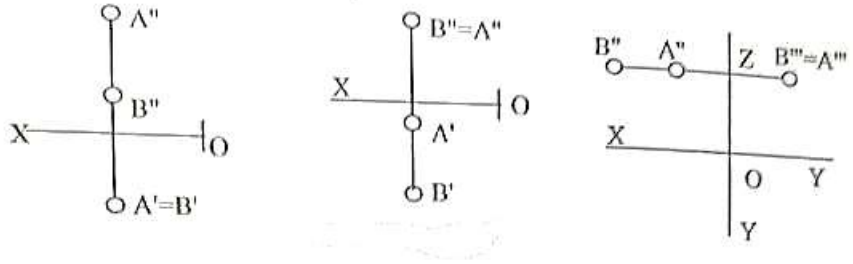
If we extend the H and V planes to the right of the W plane, each quarter of the space will be divided into two right and left parts. They are called octants, four of them I, II, III and IV are called left-handed, V, VI, VII and VIII are called right-handed octants.

The signs of the X, Y and Z coordinates in each octant are as follows:

- for the left octants all abscissas will be positive, and for the right abscissas they will have a negative sign.

In practice, their projections of the same name are often superimposed on each other, and the projections of the distance between them are mapped unchanged onto the plane of unconnected projections.

Conclusions and suggestions. Points whose projections of the same name lie on top of each other are called rival or competing points. With their help, the visible and invisible parts of geometric figures are determined, the projections of which lie on top of each other (Figure 10).



10 - figure

In this case, the point farthest from the projection plane will be visible and recorded first.

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