THEORY AND PRACTICE OF CONSTRUCTION OF AXONOMERTIC PROJECTS

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ABSTRACT

This article describes and discusses the first developed model-apparatus for the legitimate creation of axonometric projections. This apparatus consists of the coordinate axes of the preliminary basic view (OX, OY, OZ), an axonometric plane superimposed on the V plane, and the plane of motion of the OY axis (bisectors of the XOY-N and YOZ-W coordinate planes). Using this apparatus, axonometric projections of the coordinate axes, non-standard dimetries and standard isometry and dimetry are generated as a result of twisting (turning) the OY axis in the plane of motion. In this case, trimetric projections are formed if the OY axis deviates from its plane of motion during the turning process. It is also indicated that it is possible to build a graphical diagram of the relationship between the value of the axonometric axes and the angle of inclination of the axis OY using an axonometric apparatus and with its help determine the main parameters of the axonometry in a graphical way.

Keywords: Axonometry, theory, practice, image, existing abstract, image, canvas, vivid image, painter, engineer, building, architectural monument, technique, work of art, plan, facade, profile, coordinate plane, awakening period, graphic geometry, two and three dimensional projection, view, sketch, Monge method, In front of A", the recovery property, the axonometric model-apparatus, the coefficient of variation, the axonometric axes, the angle, the standard isometry and dimetry, the axonometry diagram.

INTRODUCTION

It would not be wrong to say that the creation of images began at the beginning of the era of human development. Every talented person of his time conveyed information to each other through straight and curved lines carved into the bark of flat trees or stones, the surrounding stones, the plant world, i.e. the images of existing beings [1].

Such images were then made on flat, elongated leather, and then on canvas (specially treated fabric) and paper, after humanity had discovered fabric and paper.

During the development of human society, the demand for images increased. That is why the high good intentions, dreams and hopes, such as leaving the history of the past to future generations, have had a great impact on the development of vivid images.

As a result, great artists, engineers, architects and folk masters of each period, especially the Renaissance, have created works of fine art that amaze people, and memorials and monuments have been erected.

By the eighteenth century, with the rapid development of science and technology, it became clear that the possibilities of vivid images were insufficient.

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This was due, firstly, to the fact that production techniques consisted of hundreds and thousands of details, the components of which were much smaller in size than buildings and memorials.

Second, the need to provide information about the invisible components of the interior began to arise because almost no clippings were given in order to show the interiors of the items in the drawings.

It should also be noted that in the case of construction drawings, their plan had to be executed separately from the top view, front view of the facade and left profile view.

In each of these views, only two dimensions of the piece are described, the length and width of the facade, respectively, the length and height of the facade, and the profile, the width and height.

Moreover, each view was considered as a special image of a clearly depicted building, that is, a two-dimensional flat image of a three-dimensional building in space, either a view, or a projection, or a sketch.

In the late 18th century, Gaspar Monge, the great French mathematician and scientist and statesman, who was well versed in all the scientific and technical achievements of the time, reformed the individual drawings of objects and placed them in a projection connection to the coordinate planes, laying the foundations of descriptive geometry.

This approach led to a sharp easing of the problems of designing and developing textile and light industry machinery, mechanisms and lathes during this period. That is, instead of creating vivid images that require hard work and innate ability on the part of the sought-after engineers and designers, it has led to a wide range of possibilities for easier execution of two-dimensional images of objects.

This wonderful Gaspar Monge method still has an advantage over images in images, and because it has a wide range of possibilities for setting the size of objects, it still retains its advantage and will remain so.

This article describes a creative approach to the Gaspar Monge method and an innovative method of reading point A charts.

Any work of fine art can include the coordinate planes of the Monge method (XOY-N, XOZ-V and YOZ-W). Figure 1 shows the inclusion of such planes in a clear image of point A. Its position in space is determined by the broken line of coordinates X_A, Y_A, Z_A. Coordinate planes can be obtained at any point in relation to point A in space. In Figure 1, the coordinate heads of the coordinate planes are drawn to the right of point A (at a distance of X_A), at the back (at a distance of Y_A), and at a lower distance (at a distance of Z_A).
If the X, Y, Z axes pass through point A, then the point O is at A.

$A \equiv O \Rightarrow X_A = Y_A = Z_A = 0.$

If X passes through the axis A, i.e. $A \supset X \Rightarrow A \in X$ and $XA > 0$; $YA = ZA = 0$.
If Y passes through the arrow A, i.e. $A \supset Y \Rightarrow A \in Y$ and $Y A > 0$; $XA = ZA = 0$.
If Z passes through the axis A, that is, $A = Z \Rightarrow A \in Z$ and $ZA > 0$; $YA = ZA = 0$.

If the plane passes from A to V, $A \in V$, i.e. $A \supset V \Rightarrow A \in V$ and $YA = 0$; XA and ZA are> 0.

If the plane passes from A to N, A∈N, that is, A⊃N => A∈N and ZA = 0; XA and YA> O.

If the plane passes from A to W, then A∈W, i.e. A⊃W => A∈W and XA = 0; YA and ZA are> 0.

If the coordinate head is taken in front of or to the right of A, or to the left or above, point A will be located in the other octants.

Now let us consider carving on a straight line by spreading the coordinate plane in the clear image of point A as shown in Figure 1.

It is known that in this case the plane XOZ-V remains in place, and the remaining planes XOY-N and YOZ-W are placed in its plane, Fig. 2.

In this case, the plane N rotates 90° around the axis OX and the plane W rotates around the axis OZ.

By analyzing this picture, we can determine the following:

1. The frontal projection of point A is A”, directly connected to it’s A' horizontal, A”’ profile and point A in space by the projected beam and connecting lines. That is why the frontal projection A of point A is called its principal projection.

2. The coordinates XA, YA, ZA of point A in space determine the coordinates of its projections as follows: A'(XA, YA); A” (XA, ZA); A’’’(YA, ZA);

3. Point A in space is at a distance UA in front of its frontal projection A (perpendicular to it). If YA = 0, point A lies on top of A in the plane B. If YA <0, i.e. if YA is negative, it will be behind A” and B, i.e. in the second quarter.

If a clear image of point A in Fig. 2 is transferred to a straight line as in Fig. 3, we obtain orthogonal projections of point A.

Then point A in space will lie opposite each other with its frontal projection, but at a distance YA from it:|A·A”|= YA

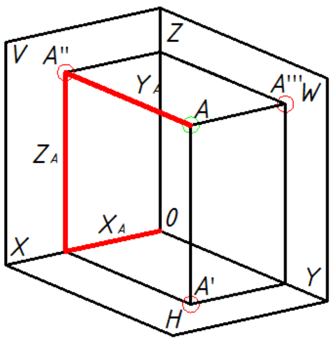

Figure 1

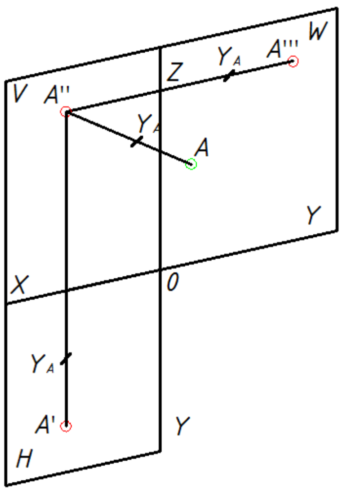

Figure 2

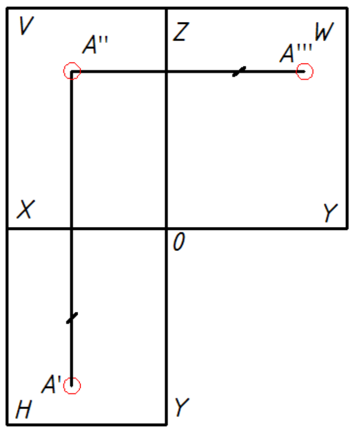

Figure 3

Therefore, conditional point A can be thought to lie on top of its frontal projection or point A is hidden in its frontal projection. From this, in the process of reading the drawing of point A, it is concluded that it is restored at a distance YA exactly opposite the projection of the frontal A” (perpendicular to the output from A).

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Later in the nineteenth and twentieth centuries, the Monge method was used by the general public, students, students, and engineers as designers, i.e., those who did not have unique abilities such as painters. the inverse problem has given rise to a practical problem, such as making it easier to read their drawings by making clear representations of the objects whose theoretical sketches have been made.

It is known that this problem was solved by performing standard axonometric projections, constructing projections that are close to the clear images of the objects, and still is. But axonometric projections had their following stages of development until they were standardized.

The first axonometric views were also referred to as the wavy perspective. Because axonometry is depicted in the same plane as the perspective (the plane of axonometry), this image represents a three-dimensional space, and the images are made according to vague rules, depending on the convenience or clarity of appearance. In this case, parallel lines are drawn in parallel situations. The images in axonometry are drawn so that they retain their dimensions. Such images were primarily needed by cartographers and the military. From the time of Ptolemy (I century) to the XVIII century, the plan of cities is described from the flight of birds. In this case, the images of the buildings are placed in a vertical position. Such imagery can also be seen in book miniatures. From the 16th century onwards, technical drawings and sketches began to appear, resembling modern axonometry. The axonometric images drawn by the great scientist Kepper in his 1619 work The Harmony of the World are shown in Figure 4. From this picture it can be seen that the isometric projection of the cube is in the form of a regular hexagon [2]. The existence of such a regular isometric image of a hexagonal cube has also been noted in foreign literature [3]. Figure 4 depicts the cube and the octahedron inside it in Kovaler projections. But the scientist did not write down the theory of making these images.

In 1738, the famous French architect Frese, in his book “The Cutting of Stone”, proved that a right-angled projection of a cube in a plane perpendicular to its diagonal is a regular hexagon. In this play he cites all the imaging methods and apparatus known at the time. That is, the orthogonal projections of the figures in the two planes described their axonometric projections to create perspectives of architectural fragments, to create vivid images of straight curves, intersecting surfaces, arches, blocks.

The word axonometry is Greek and means axon-arrow and metreo-measure. That means I measure by arrows. This, of course, involves measuring along exactly three X, Y, and Z axes.

Our analysis of the literature led us to the conclusion that “the model and laws of formation of axonometric projections have not yet been sufficiently and convincingly developed graphically.”

Main Part

In our research, we believe that if we can develop a model-apparatus for graphically determining the laws of formation of axonometric projections, that is, the values of compression (coefficients of variation) along the axes and along the axes, it will be easier and more convenient for students to understand the content. we have conducted our research and studies to advance the hypothesis.

To do this:

1. The plane of axonometric RAK in space is taken as a plane parallel to or adjacent to the plane of frontal projections-anterior view: $V \parallel P_{AK}$ or $V \equiv P_{AK}$.

2. In order to provide indication in the formation of axonometric projections, a three-dimensional geometric figure instead of a point was obtained from the front view of the cube, i.e. the head view. In this case, the coordinate axis is as in Figure 5, OX = OY = OZ = 100 mm; Since the moon is perpendicular to the axis V, i.e. the axonometric R_{AK} plane, it is described to the point.

3. The projection direction lies in the bisector plane of the XOZ plane, and the axonometric plane is perpendicular to the R_{AK}, i.e. V. Figure 1 shows its trace V_V. Figure 6 shows the coordinate axes in the direction perpendicular to the bisector plane of the XOZ plane, the axonometric, and the V-plane from the side head.

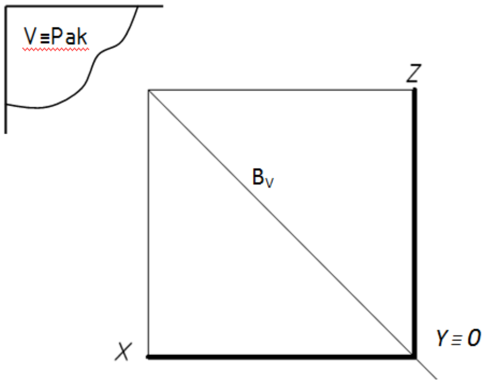


Figure 5

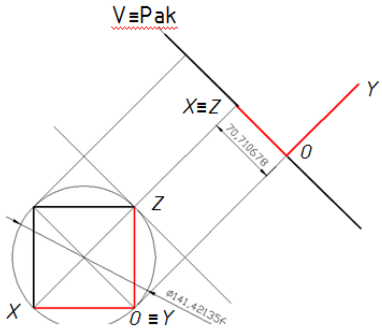


Figure 6

If the OY axis is tilted in the Y_1 or Y_2 or Y_3 directions in Figure 3 relative to the axonometric, i.e., Vga, the flat image of the two-dimensional cube is transferred to the clearly three-dimensional image, i.e., the axonometric projection, Figures 7, 8, and 9. That is, the three axes OX, OY, and OZ are represented in the axonometric plane, and the volumetric properties of the objects in the image along these axes are easily understood and read as in the picture. [4], [5].

If the axis is rotated in the direction Y_1, since it lies in the bisector plane of the XOZ plane, the OX and OZ axes are tilted at equal angles to the axonometric plane (they can be observed in Figure 7), with equal coefficients of variation and the angles formed by the OY axis. This can be seen in the clear image of the cube shown in Figure 8.

In this case, when the Moon axis is rotated in right or left directions such as Y_2 or Y_3, as noted in the first chapter, the trimetry, i.e. the coordinate axes deviate at different angles to the axonometric plane, forming different coefficients of variation and intermediate angles, Figures 9 and 10.

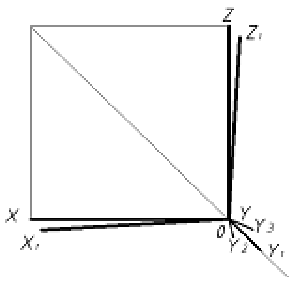


Figure 7

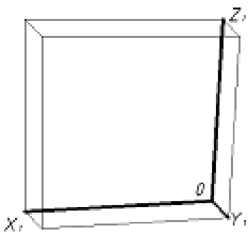


Figure 8

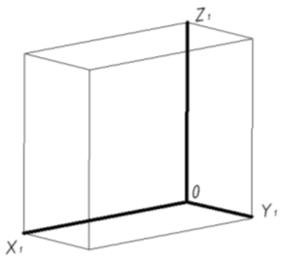


Figure 9

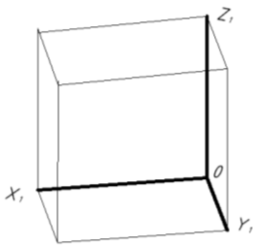
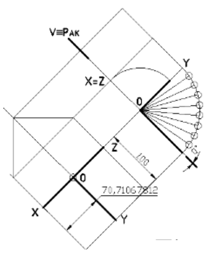


Figure 10

If β=0, that is, if the angle of inclination of the OY axis with respect to the axonometric plane is reduced from 90°, to 0 every 10 degrees, then Y remains in the axonometric plane as shown



in Fig. 11. As a result, Y = 100 mm and X = Z are √2 / 2 = 70.71 mm and are depicted in the axonometric plane.

If the angle of deflection of the OY axis in the bisector plane of the XOZ plane relative to the axonometric plane exceeds 10°, there are also standard dimetric and isometric projections of the axonometric projections. In other cases, non-standard dimetric projections are formed. In this process, it will be possible to determine the values of the angle of inclination of the OY axis relative to the axonometric plane graphically:

1. The coefficient of variation along the OY axis is the angle along the OX and OZ axes, i.e., the angle at which the coefficients of variation along the three axes are equal; This creates a standard isometric projection.

2. The coefficient of change along the OY axis is an angle that is twice smaller than the change along the OX and OZ axes. This creates a standard dimetric projection.

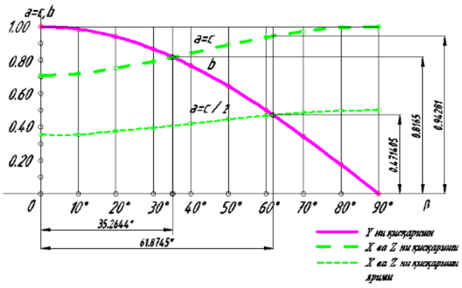
The angle corresponding to the isometric and dimetric projections of axonometry and the coefficients of variation along the corresponding axes were determined graphically on the basis of the following methodology:

1. Increasing the OY axis every 10 degrees, the coefficients of variation of the axonometric axes in the range of 0-90 degrees are determined, Table 1;

Table 1

β	b	a=c	β	b	a=c
0	1	70.71067812	50	64.27876097	89.08799446
10	98.48077530	71.77503427	60	50	93.55342457
20	93.96926208	75.16488234	70	34.2020143	97.04007428
30	86.60254038	79.05694150	80	17.36481777	99.35759416
35	81.91520443	81.53148964	90	0	100
40	76.60444431	83.98222465			

2. A graphical-connection diagram is performed between the angles of inclination of the OY axis to the axonometric plane and the coefficients of variation along the corresponding axes, Fig. 12.



From this diagram we can determine the following:

1. The curve representing the coefficients of variation of the OX and OZ axes intersects with such a curve of the OY axis, and the coefficients of variation along the three axes determine the angle of inclination of the OY, OX and OZ axes to the axonometric plane, which is equal to 0.8165. This angle is 35.2644 degrees, forming a standard isometric projection, Fig. 13.

2. The curve, which represents half of the coefficients of variation of the OX and OZ axes, intersects with the curve of the OY axis, forming a coefficient of variation along the OY axis (0.4714), which is twice smaller than the coefficients of variation of the OX and OZ axes

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(0, 94281). determines the angle of inclination of the axis to the axonometric plane. It can be seen from the diagram that this angle is equal to 61.8745 degrees. The resulting axonometric projection is a standard dimetric projection as shown in Figure 14 [6].

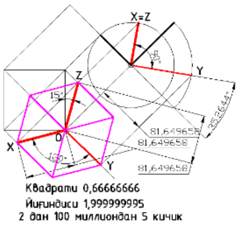

Figure 13

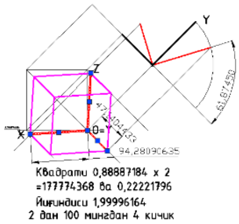

Figure 14

CONCLUSION

Thus, our research and studies have shown that there is a model for the formation of axonometric projections, and with its help, it is possible to graphically determine theoretically determined axonometric parameters in a graphical way.

The first developed model consisted in the process of rotation of the OY axis in the bisector of the XOZ angle (planes N and W) with the system of planes N, V and W relative to the axonometric plane, in which OX, OY and OZ the presence of a graph-graph of interaction relative to the angle between the axis and axonometric plane, and using this diagram, you can theoretically and practically determine the main parameters of axonometry.

That is, in standard isometry, the angles between the axonometric axes are **120°** and their coefficients of variation are mutually equal, with a value of **0.82** (0.8165). The angular values of the axes OY, OX, and OZ are also equal to the axonometric plane, which is 35.2644 degrees.

In standard dimetry, the angles between the axonometric axes relative to the horizontal line deviate from the axis OX **7°10**' and the axis OY **41°25'**, and their coefficients of variation along the X and Z axes are equal to **0.94** (0.9428165). , Along the y-axis, is equal to **0.47** (0.4714). The value of the angle of inclination of the moon axis to the axonometric plane is **62** (61.8745) degrees. The angles of inclination of the axes OX and OZ to the axonometric plane are mutually equal, which is **19°28'16**".

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