ISSN: 2582-4686 SJIF 2021-3.261,SJIF 2022-2.889, 2024-6.875 ResearchBib IF: 8.848 / 2024

THE MULTIDISCIPLINARY JOURNAL OF SCIENCE AND TECHNOLOGY

VOLUME-4, ISSUE-3

THE IMAGE OF AXONOMETRIC PROJECTIONS IN CONJUNCTION WITH COMPLEX DRAWINGS

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Annotation. While the working drawing of a part is the basis of production, it takes mental effort and time to quickly visualize its shapes and structural structure. And in this case, there is a need for an auxiliary clear image, that is, an axonometric projection of the object. This article presents theoretical material on the graphical construction of an axonometric projection such as a trimetric projection of a part based on a complex drawing of a part and with its binding. At the same time, it relies on an auxiliary projection method.

Keywords. Complex drawing, orthogonal projection, working drawing, image, axonometry, projection direction, axonometry axes, compression ratio, axonometry plane, trimetry, trimetry axes, true axonometry, mentioned axonometry.

Introduction. We all know that in production mainly rely on working and assembly drawings of details and items. These drawings are necessarily based on the orthogonal orthogonal projection type of the parallel projection method. On the basis of the working drawing, the detail is divided into full information about the metric characteristics of all the elements contained in it. A drawing is therefore a constructor document with a restoration property, also holds, because in orthogonal projection, the object is conveniently placed relative to the planes of projections. In orthogonal projective drawings, one can sufficiently determine the interior and exterior of an item using shears and cross sections.

But according to the drawings of the object in orthogonal projections, it is difficult to imagine their spatial forms. In such cases, the need arises to supplement the drawing of an item with its obvious image. Such images can be axonometric projections. But not all axonometric projections are evident. Illustrating the object vividly will depend on the direction of projection and the plane of projections ' other situations. Axonometric projection is briefly referred to as axonometry (axonometry is a Greek word meaning axon – axis, metrien – measure, i.e. measure on axes). [1][1]

Axonometric projections draw trough O‘zDST 2.317:96.[3][2] A projection of an object placed in a Descartes coordinate system and its projections on an arbitrary derived P plane along the direction s given in conjunction with that system is called its axonometry.

The plane P is referred to as the plane of axonometry. Axonometric projections are of two types: right angle axonometric projection (angle φ=90° between plane s and plane P); oblique angle axonometric projection (angle 0°<φ°≠90°between plane s and plane P). [2][3]

[1] Rahmonov I., Qirg‘izboyeva N., Ashirbayev O., Valiyev A., Nigmanov B. Chizmachilik. -Toshkent: "Voris-nashriyot", 2016- y. 162-bet.

[2] Rahmonov I., Abdurahmonov A. -Toshkent: "Alisher Navoiy nomidagi O‘zbekiston Milliy kutubxonasi nashriyoti", 2005-yil, 65-bet.

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The group of vivid images also includes perspective images and technical images. But axonometric projections are standardized, with the types being classified. By constructing an axonometric projection of a detail, an object, a building, it is possible to visualize it in a short time. However the detail, item, buildings are not made through given axonometric projections, but instead serve as an additive-auxiliary image.

The construction of a standard axonometric projection of a detail requires certain knowledge, skills, and is also a somewhat time-consuming process. especially for the construction of real axonometry, mathematical calculations are also murijaat. There is a need for new approaches to perform axonometric projections to reduce the number of these geometric and mathematical operations, to save time, and to attract future engineer, constructor young students to think differently, to develop their scientific worldview.

Methods. The right-angled axonometric projections themselves are further divided into three. These are, right angle isometry (KX=KZ=KY; 1:1:1), right angle dimetry (kx=KZ≠KY; 1:0.5:0.1), right angle trimetry (kx≠KZ≠KY; 0.86:0.58:0.96). In right-angle axonometric projection, the sum of the squares of change coefficients on the axes are 2: KX2+ KY2+ KZ2=2.

In right-angle isometry, the contraction coefficients in all three axes are KX=KZ=KY=0.82, and it is called True axonometry. But scientists, among themselves, called it a Celt axonometry, introducing it into the quoted axonometry and introducing it into the standard. In rectangular quoted isometry, the contraction coefficients in all three axes are taken to be equal to KX=KZ=KY=1, and the detail is described as slightly larger than its actual magnitude. This process follows as follows:

K2x+ K2Y+ K2Z=Equation 2 and KX =KY=kz from equation

K2x+ K2x+ K2x=2;

$3K^2{}_X=2;$

$K^2{}_X=2/3;$

$k_x = \sqrt{\frac{2}{3}};$

$K_X \approx 0,82;$

The actual contraction coefficient kx=KY = KZ≈0.82 follows. From which KX=KY=KZ≈1 is converted to quoted axonometry - isometry.

In rectilinear quoted dimetry, the contraction coefficients of two KX=KZ axes are taken as equal to 1.00 and KY da as equal to 0.5 (KY≠KX/2), and the detail is described as slightly larger than its actual size. This process follows as follows:

K2x+ K2Y+ K2Z=Equation 2 and KX=KZ ≠KY (KY=KX/2) from equality $\mathbf{k_x^2 + k_x^2 + (\frac{k_x}{2})^2 = 2}$;

$k_x^2 + k_x^2 + \frac{k_x^2}{4} = 2;$

$9k_x^2 = 8;$

$$k_x = \sqrt{\frac{8}{9}} = \frac{2\sqrt{2}}{3} \approx 0{,}94$$

The real contraction coefficient $K_X \approx 0{,}94$ follows ($K_X \approx 0{,}94$; $K_Z \approx 0{,}94$; $K_Y \approx 0{,}47$). From it, $K_X = K_Z \approx 1$, $K_Y = 0{,}5$ are transferred to the quoted axonometry - dimetry.

Oblique angle axonometric projections are divided into four. These are the oblique oblique frontal isometry ($K_X = K_Z = K_Y$, $1:1:1$), oblique angle horizontal isometry ($K_X = K_Z = K_Y$; $1:1:1$), oblique angle frontal dimetry ($K_X = K_Z \neq K_Y$; $1:0{,}5:1$), oblique angle trimetry ($K_X \neq K_Z \neq K_Y$, $0{,}88:0{,}55:0{,}95$). In a skew axonometric projection, the sum of the squares of the coefficients of variation on the axes is equal to the sum of the square of the cotangency of the angle of projection by the number 2: $\boldsymbol{K_X^2 + K_Y^2 + K_Z^2 = 2 + ctg^2\varphi}$. [4][4] Even in oblique-angle axonometric projections, the contraction coefficients of the real axonometry axes can be determined as above, and the transition from it to the quoted axonometry.

Results. Drawing axonometric projections according to a given complex drawing requires a lot of work, since it requires determining the actual coordinates of the points of the object, taking into account the shrinkage coefficients, and then moving these coordinates from the complex drawing to the axonometric projection.

In order to calculate real coordinates and get rid of operations to move measurements from complex drawing to axonometry, axonometric images can be constructed directly in relation to their right-angle projections, using the auxiliary projection method.

The axonometric projection is generated by projecting the object in its given direction to an additional plane, the plane of axonometric projections (via the auxiliary projection apparatus), and it is re-projected unchanged to the main (frontal) plane.

Depending on the direction of axonometric projection and the state of the plane of axonometric projections, a diagram of the auxiliary projection method is determined for each type of axonometry.

Consider constructing a diagram of the auxiliary projection method. let a be required to project the additional projection of a straight line onto the auxiliary plane perpendicular to it, and then to descend the resulting image with the drawing plane superimposed.

We give the plane of auxiliary projections at point a through the intersecting horizontal AB and frontal AC (image1). Where the frontal projection of the horizontal line (A"B") and the horizontal projection of the frontal line (A'C') are overlapped. The horizontal projection of the horizontal line (a'B') and the frontal projection of the frontal line (A"C") are perpendicular to *a*' and *a* " respectively. We bring the given plane to the frontal position by rotating it around the AC frontal. We define the new situation of the horizontal line AB using the fixed points A and The moved points B. Where B" point is perpendicular to C" and acting in a state parallel to *a*" B_o determines the situation. Where A"B_o= A'B', because AB is equal to its actual size in a sectional rotated state.

[4] Муродов Ш., Ҳакимов Л., Одилов П., Шомуродов А., Жумаев М. Чизма геометрия курси. -Тошкент: "Ўқитувчи", 1988-йил, 245-бет.

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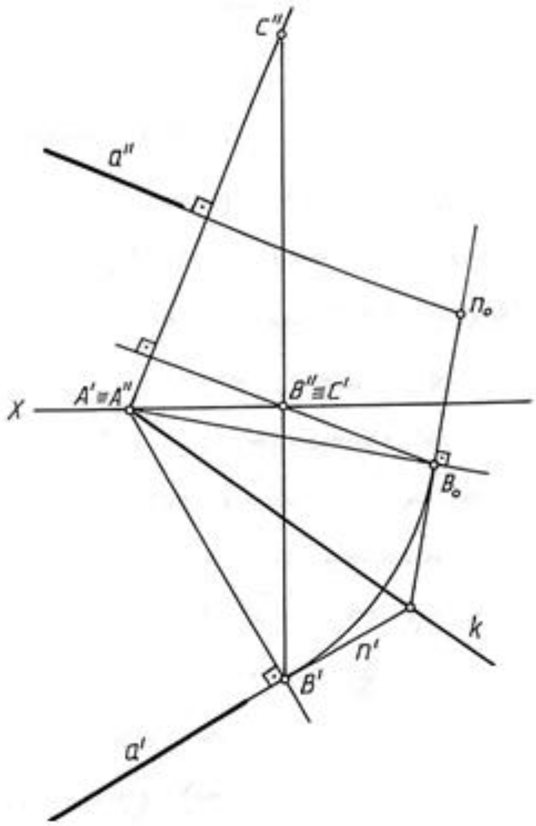

Image 1.

The point at which a straight line ***a*** intersects with the plane of auxiliary projections belongs to the greatest deviation line ***n*** of that plane, the horizontal ***n'*** projection of that line being perpendicular to A'B'.

The situation (n_o) of the line ***n*** overlapped with the plane of the drawing will be perpendicular to the A'B_o line. Where $\boldsymbol{n_o}$ is called the line defining the linear image.

The rotation of the plane of auxiliary (perpendicular) projections can be replaced by the projection onto the bissector plane between that plane and the plane of frontal projections. This line of the bisector plane intersecting the bisector plane of the fourth quarter is described as the bisector of the angle B'A'B_o and determines the *K* axis of the auxiliary projection method.

The auxiliary projective axis is the line passing to the lines that define the images of the horizontal projections of the projective lines.

Now, based on the above theory, consider constructing the axonometry of a cube in right-angle isometry and dimetries in the auxiliary projection method.

The right-angle isometry of a cube can be constructed by auxiliary projection in its diagonal direction, by auxiliary projection perpendicular to that direction.

The second image depicts rectangular (horizontal and frontal) projections of the cube. Where the direction of projection is at an angle of 45º relative to the horizontal line. The image-detecting lines are positioned at an angle of 15º with respect to the vertical line, while the auxiliary projection axis *K* is positioned at an angle of 30º with respect to the horizontal line.

Since the situation of the K axis and all other directions are known, there is no need to build a diagram when applying the auxiliary projection method in practice.

ISSN: 2582-4686 SJIF 2021-3.261,SJIF 2022-2.889,
2024-6.875 ResearchBib IF: 8.848 / 2024

There is also a disadvantage in the construction of right-angle isometry, despite the simplicity and convenience of the auxiliary projection method. This is when isometric images are located in a deviant situation relative to the vertical orientation. This is of course the detail axonometry causes a certain discomfort in being able to see or observe quality, evoking in a person the same feeling as if the detail was partially resting on itself.

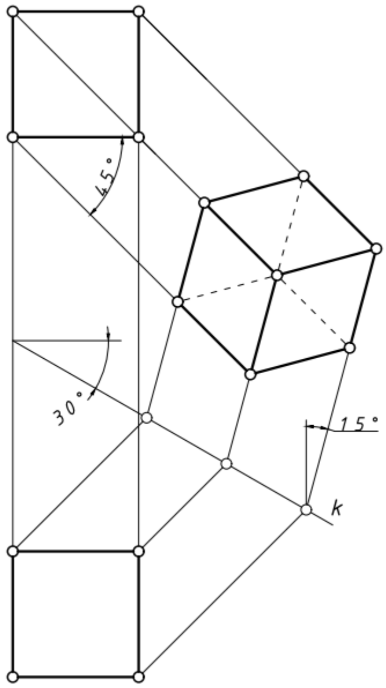

Image 2.

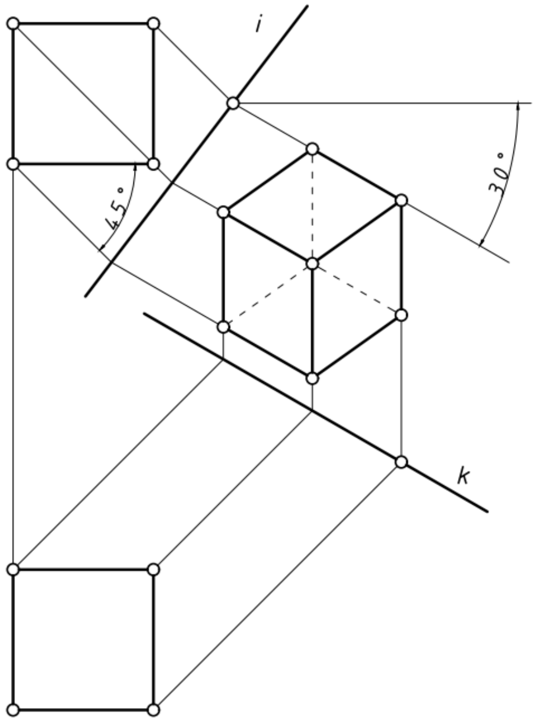

Image 3

To eliminate such inconvenience, additional arrows can be inserted into the projection apparatus that change the direction of the projecting beams.(image 3).

Above the frontal projection of the projection direction, we select point E at an arbitrary position, and through it we pass an arrow so that the projective rays turn 30º relative to the horizontal line. This axis will be the bisector of the angle between the main and twisted directions. The resulting axonometric projection of the Cube will be an image constructed with contraction coefficients.

In order for it to be convenient to measure dimensions from an axonometric drawing, it is advisable to build it with the presented shrinkage coefficients. In this case, it is necessary to use such a scheme of building a right angle isometry, in which the axonometry axes are placed with dimensions that are not reduced.

The fourth drawing shows a scheme for constructing a right-angle isometry of a cube through the quoted contraction coefficients (Image 4).

In this case, the frontal projections of the projective Rays are deflected using the vertical axis obtained at an arbitrary position of the drawing, and they are directed at an angle of 30º with respect to the horizontal line using the horizontal axis. The axis that deflects the horizontal projections of the projective rays is positioned at an angle of ≈9º with respect to the horizontal line. Such an angle is easy to build graphically. To do this, we construct an axonometry of Point A(A') by optionally selecting a point" F". Then we measure the equal cross section A'B 'and pass a vertical line from point B'. This line intersects with the horizontal projection of the projective beam passing through point B' to give point F. The line passing through points E and F will be the deflecting axis.

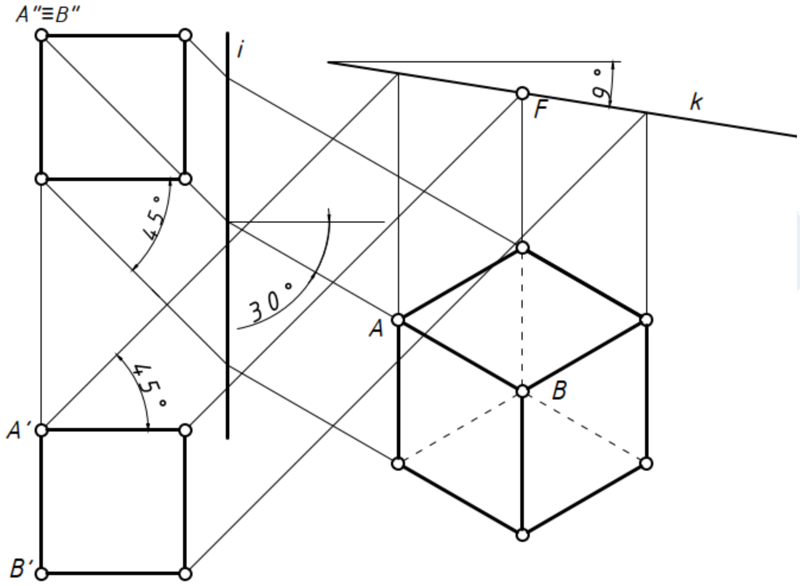

Image 4

A rectangular isometric projection of the detail was constructed using this method in the fifth image (Image 5).

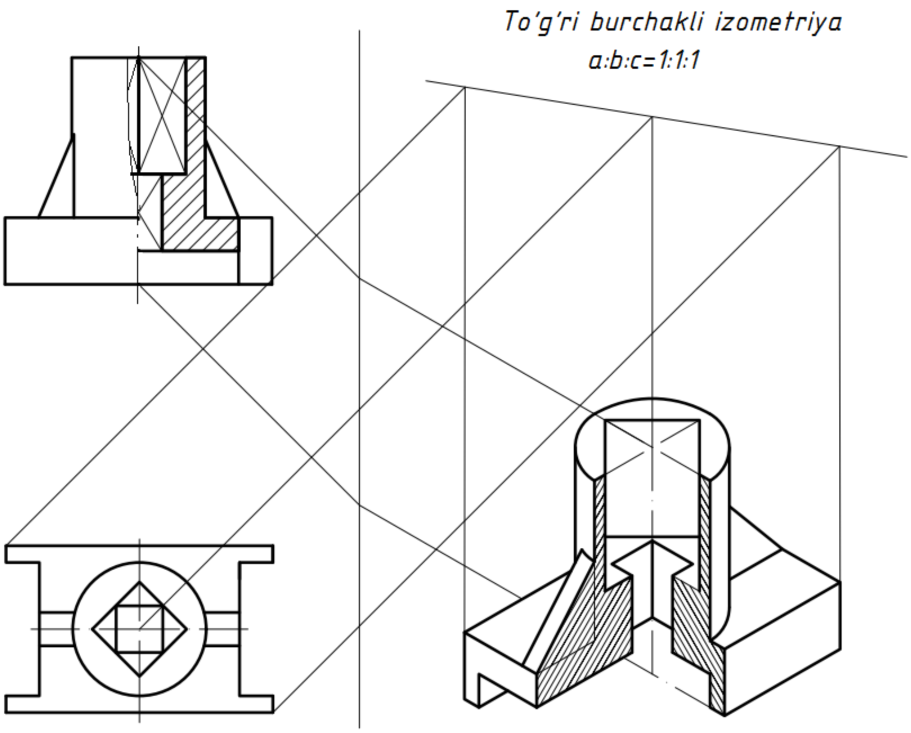

Image 5

When constructing a rectangular diameter projection of a cube in the auxiliary projection method, the frontal and horizontal projections of the projection directions are placed at an angle of 20º42' relative to the horizontal line. The determining line is 7º11' relative to the vertical line, while the *K* axis is positioned at an angle of 41º42' relative to the horizontal line (Image 6).

ISSN: 2582-4686 SJIF 2021-3.261,SJIF 2022-2.889,
2024-6.875 ResearchBib IF: 8.848 / 2024

THE MULTIDISCIPLINARY JOURNAL OF SCIENCE AND TECHNOLOGY

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To produce a dimetric projection with a vertical axis, Arrows are inserted that deflect the direction of the projective rays.

In order to construct a dimetric projection through the induced contraction coefficients,the axis deflecting the frontal projections of the projective rays is taken vertically, while the axis (*K*) deflecting the horizontal projections of the rays is determined by 2 points, as in the construction of a right-angle isometry (image 3). To do this, we select an arbitrary point E in the horizontal projection of light passing through point A' and construct a dimetry of Point A (A', A"). From point A to the line passing at an angle of 7^{o}11' with respect to the horizontal line, we measure the A'B' cross section equal to the actual size of the cube edge and have the AB cross-section dimetry. Then we pass a vertical line from point B and determine the point F, which intersects it with the horizontal projection of the projective beam passing through point B'. The EF line auxiliary projection axis is *k*.

The seventh drawing gives examples of the construction of the rectangular dimetry of the detail (image 7).

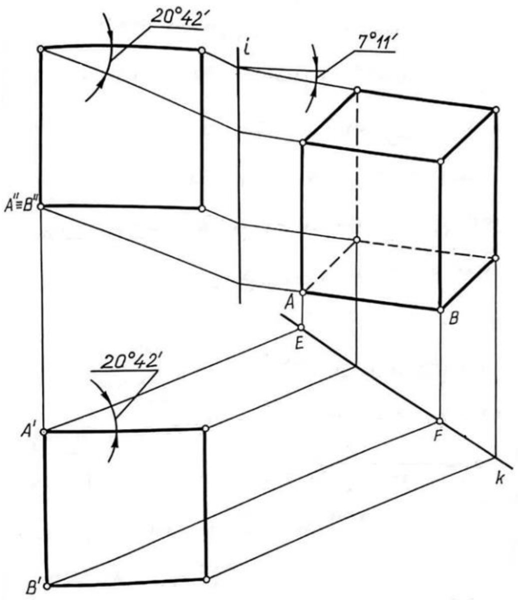

Image 6

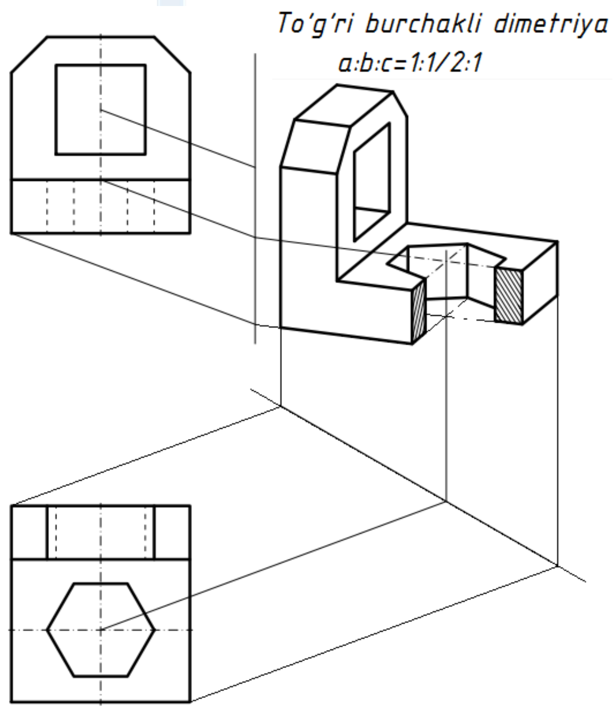

Image 7

Discussion. In general, vivid images are considered auxiliary images that can quickly bring a person to the sight of the origin of an item. There are many references to vivid images in marriage and technique, engineering work, fine arts. For example artists refer to the rules of perspective when they want to depict the painting they are drawing in a realistic direction, and draw a perspective representation of the objects in their work (both the geometric structure of the object and the depth of space in the colors).

Architects, on the other hand, refer to the axnometrics and perspective image of the building. As a result, the project will make changes and adjustments to the structure of the building in the process.

The constructor also paints an axonometric projection of the detail or object he designed in conjunction with working and assembling drawings. It will definitely serve as an auxiliary material for the detail-making worker.

And in the educational process, vivid images, especially axonometric projections, serve to quickly structure the drawing of details and objects of the student and students, and to develop reading skills, to cultivate graphic and technical literacy.

Mastering scientific theoretical materials related to the implementation of standard axonometric projection and its types in combination with their direct connection to a complex drawing will serve as useful material for the future teacher of drawing, constructor, architect.

Conclusion. As a result of communicating, teaching the materials of this scientific article to undergraduate students of higher education, especially at the graduate level, they develop such qualities as scientific thinking and observation. Also their graphic and technical literacy grows, improves.

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