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Development of Spatial Thinking of Students Based on the Traditions of Eastern Architecture

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Abstract - In this work, the didactic possibilities of using elements of the traditional Eastern principles of constructing forms, combinations, and planes are investigated: developed a system of graphic exercises based on Eastern architectural traditions; determined the ways and methods of their use in the process of teaching the course "Descriptive Geometry" in higher educational institutions of artistic direction. Separate research results are published in scientific and methodical journals and collections of scientific papers.

Keywords - Method, drawing, descriptive geometry, prospect, technology, the form, design introduction, receivership, efficiency, graphic literacy.

The applying of the traditions of Eastern education, the use of historical and national spiritual values, their implementation into the educational process of modern physical and spiritual-enlightenment education makes it possible to improve the quality of education.

The guarantee of improving the quality of higher education students' training, as well as the development of their spatial thinking is the main goal of the engineering graphics direction.

Such disciplines as descriptive geometry and engineering graphics, along with general and general professional subjects of the State educational standard occupy places that determine the level of professional knowledge in secondary, vocational and higher educational establishments. The main purpose of the subject "Descriptive Geometry" is teaching the spatial representation of various objects and shapes, the relationship between them, constructive geometric thinking, virtual representation on the basis of graphic models drawings, as well as the development of such qualities as talent and creativity.

The books of the famous scientist of medicine Avicenna (Ibn Sina), "Criteria of Reason" ("Akl Mezon"), "Book of Knowledge" ("Ilmlar Kitobi") are directly devoted to the problems of geometry, mechanics, construction and architectural sphere.

Another treatise of one more scientist and enlightener of East Abul-Vafo Buzjoni - "The Book about the necessary things, geometric constructions for artisans" consisting of 10 books, in which methods of geometric constructions, ways of making a parabola, rules of execution of various geometric shapes are represented by using a compass and ruler, for example, construction of an equilateral triangle, square, polyhedron in a given length; division of the circle into equal parts; inscribing or describing of various geometric shapes into a circle; division of a triangle, a rectangle and a circle into necessary parts, and much more.

In the book of Al-Hassan Ibn Muso Shukri "The work about the extended circles" are described the surprising methods of ellipse construction. Construction of an ellipse using a thread whose length is equal to the length of the major axis. Tied for the focal point of the ellipse, using pencil where the thread is a guide for the construction of an ellipse. This method is based on the teaching of Apollonius,

where it is said that the sum of the distance of each point to two points, the so-called foci, is a constant dimension equal to the major axis of the ellipse.

In the books of Avicenna "A Book on the construction of three parts", *As-Sijāsīy* "On cone sections and their characteristics" as well as in the *Al-Kukhiya* book "Drawing properties made with a compass" are presented various ways of construction of an ellipse. A prominent scientist of the Ulughbek's astronomy school *Al-Koshiy* is the author of the fundamental work, consisting of five books "The key of Arithmetic". The encyclopedic work of the famous historian *Rashīd ad-Dīn "Asar wa Ahya"* consists of 24 chapters; it contains information about natural science, agricultural engineering, agricultural economics, geology and processing of cultivation, the secrets of architecture, the construction of bridges and ships. The analysis of the sources shows that the Eastern school of descriptive geometry and engineering graphics has a rich scientific and theoretical basis and their use in modern interpretation provides an enrichment of the education module. The development of suggestions for solving some problems arising in the process of teaching students of higher educational institutions such subjects as descriptive geometry and engineering graphics on the basis of traditions of Eastern architecture makes it possible to solve actual problems related to the methods of modern education and upbringing based on national traditions. When solving this issue it is possible to achieve following results:

1. Teaching in higher education establishments, especially the training of students of art faculty, is much influenced by the work of ancient builders. Studying the works of traditional masters gives us a clear picture of how they perfectly mastered such knowledge as descriptive geometry and engineering graphics.

2. Analysis of ancient Eastern buildings and constructions. By studying the priceless heritage of ancient masters, the development in students such qualities as innovation, creativity, preparation for implementation in the national and modern context of buildings and constructions, training of competent specialists in the field of architecture.

3. With the help of graphic education there is an understanding of the problem, spatial representation, and its further embodiment in the drawing. So the drawing, which includes new inventions, is a tool that helps to appearance of new ideas, modern technical means and technologies. Scientific substantiation of this problem enables the teaching staff of higher educational institutions to use the

conclusions and further practical application in classes on descriptive geometry and engineering graphics.

The earliest traces of the human mind can also serve as a means for comprehensive, including scientific, education and spiritual upbringing of the younger generation. So rock graphic images of primitive people have survived to our times. Such images can be seen on the banks of the Yenisei river, in Kazakhstan, Altai and in some cities of Uzbekistan.

The scientist and enlightener of Central Asia *Abu Rayhan Beruni* in his scientific works applied the method of projection and widely used it in practice when making drawings.

It is known that he paid great attention to the projections (views) on the drawings and came to the following conclusion: "The animal mentally placed inside the cube has six main types - front and back, right and left, top and bottom." (1-figure). Drawing tools *Abu Rayhan Beruni* made himself according to his own drawings and carried out his scientific research with the help of them.

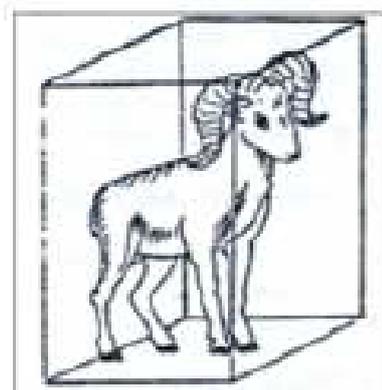


Figure-1.

In the Middle ages, when classical culture passed into a stagnant period, imaging techniques also ceased to develop. And only in XIV-XVI centuries in the Renaissance a new era of development of methods of image began.

The discipline "Descriptive geometry" consists of four parts: orthogonal projection, axonometric projections, projections with numerical marks, perspective. Besides, in order to improve the image shadowing is applied. A fundamental historical turning point in the development of the theoretical and practical side occurred by the end of the XVIII century. The great French scientist *Gaspard Monge*,

summarizing the existing laws of projection, developed a method of orthogonal projection of figures onto planes and a method of projecting onto two mutually perpendicular planes.

In the process of the research on the organization of classes using the traditions of Eastern teachings, the following positive results were achieved in the lessons of engineering graphics and construction of architecture:

- Direct connection between memory and attention has increased;
- Interest in subjects "Descriptive Geometry" and "Engineering graphics" has improved markedly;
- Mutual understanding between teacher and student has accelerated;
- Development of students' spatial thinking;
- Mutual cooperation arises in the process of learning;
- The teacher determines and assesses the level of knowledge;
- The teacher directs the student to perform graphic works independently;
- The teacher motivates students to do independent work;
- The teacher encourages students to be creative, to study special literatures, teaching aids, electronic textbooks and the use of modern information technologies.

Joint work in the classroom gives the student an opportunity for an individual approach to the acquisition of knowledge and events. It has been proved that the activation of students' activities, the enhancement of their spatial thinking based on the traditions of Eastern architecture in the classroom on the subject of "Descriptive geometry" effectively influences the learning process. It is known that, until now, a lot of ancient fundamental handwritten works of scientists and enlighteners of the East have not been fully studied. The investigation and analysis of these works that have come down to us opens up unlimited possibilities for the education and training of highly professional personnel. The pride for the masters and their creations that have come down to us are laid in our mental mind. Having studied the heritage of the masters of the great past, future specialists will acquire deep and solid

knowledge. With modern rapid development of science and technology for solving problems in "Descriptive geometry", the use of digital technology, the implementation of various graphic works, the use of such a discipline as "Descriptive geometry" in practice in various fields of science, increases the efficiency of the task. Preparation of highly professional and competitive experts in their field is our main goal.

For example, designing of objects requires knowledge of the spatial representation of this object, methods of graphic execution of drawings. Without this knowledge, people will not be able to realize their ideas on paper. The application of the traditions of East architecture in the class for "Descriptive geometry", considers the following tasks:

- The study of the theory and practical application of the projection of spatial objects on the plane.
- Reading construction drawings (images).
- Training of methods for solving spatial constructive tasks and their image on a plane.
- Development of spatial thinking of students.

In the process of learning the traditions of East architecture, such qualities as patriotism, love for the Motherland, pride, respect for the rich heritage of our ancestors, masters and enlightenment scholars, who have made their invaluable contribution to the development of national and world culture as a whole, develop.

Another example of the uniqueness of the national architecture is that studying some domes of ancient monuments from a biogeometric point of view: ... when building domes of famous monuments of Samarkand, Bukhara and Khiva, we can assume that the architects of antiquity took these forms from nature. For example, the dome of the shrine of Amir Temur "Gur Amir" resembles a plant cactus in shape (1-figure).

Exploring the surface of the dome geometrically, which consists of a body of rotation, a set of planes $P\lambda$ ($\lambda = 1, 2, 3, \dots$) (2-figure) passing through the axis of the dome.

GE form a section of the dome K. They pass through point C, forming these lines, and are considered to be the lines of the second order (4-figure).



Figure 2

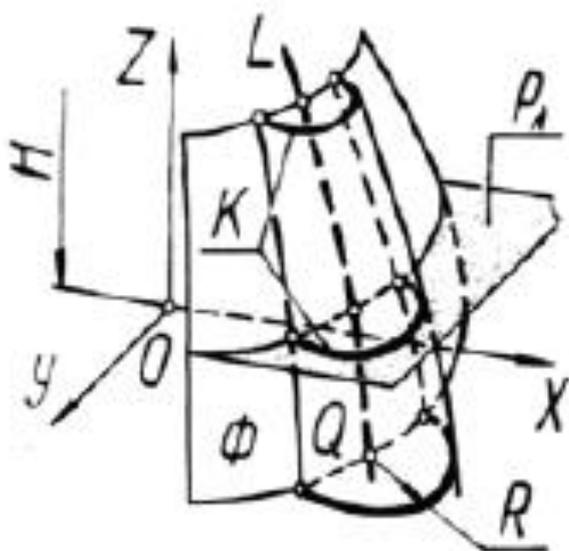


Figure 3

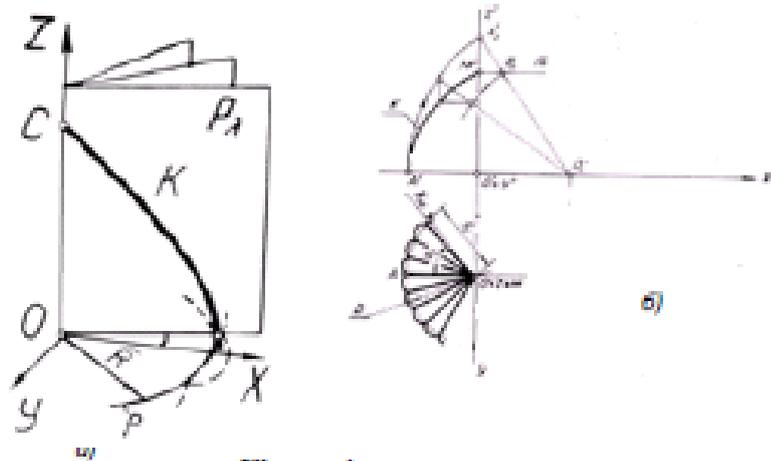


Figure 4

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