THE MODERNIZATION OF THE RATE OF DESCRIPTIVE GEOMETRY

Nataly KAYGORODTSEVA
Omsk State Technical University
Russia 644050 Omsk, pr. Mira 5, OmGTU

Abstract. Set out the reasons and prerequisites for the need to modernize the training course in descriptive geometry through the introduction of mathematical tools to formalize and algorithmic geometrical graphic preparation for future engineers for the successful solution of modern technical and research tasks.

Keywords: Multidimensional geometry, geometric modeling, engineering education, process optimization, multi-factor processes

1 Introduction

Descriptive geometry as a science, and after that - as an academic discipline, emerged in the XVIII century. For a long time, descriptive geometry was a theoretical basis for the construction of engineering graphics and is considered to start technical discipline, playing the key role of in the theoretical basis of technical knowledge.

Currently, there is a situation when the descriptive geometry stopped being a "handmaiden of engineering graphics". One of the objective causes contributing to the establishment and consolidation of such situation has been the rapid development of information technology and computer-aided design. Planners, designers, inventors and architects have the opportunity to implement their ideas directly into a spatial model of the virtual space. That is, drawing a flat image space object ceased to be paramount.

Descriptive geometry can now pretty much "to merge" with analytical geometry, as Gaspard Monge said in the XVIII century in his textbook "Descriptive geometry" (Moscow: USSR Academy of Sciences, 1947. S. 23), and come to series of mathematical disciplines, thereby obtaining a new stage in its development.

The emergence of information technology may not cause belittling the means and methods of descriptive geometry. In our view, it has been and remains to be a science, having shown no conflict with their tenets, having found no inadequate reflection of its surrounding reality, and information technology are just a new instrument capable in all respects (speed, time, quantity and quality) to improve level of achievement by students of geometrical graphic disciplines. In addition, descriptive geometry has always been and remains a discipline to develop this ability of the human brain, such as spatial thinking. This ability is particularly important in the process of design, invention and the creation of something new. Information technology only supplements the drawing of three-dimensional model of the virtual space, rather than replace it. Therefore, the need to implement a mental transition from the image of three-dimensional model to two-dimensional drawings and back preserved, and thus remains the need for descriptive geometry in the luggage of knowledge of modern engineering.

Today, thanks to computing, the problem of mathematical modeling of objects of different nature and purpose, technology, technological processes, economic dependency, natural phenomena, etc. are highly relevant, which by its nature rye multiparameter. Construction of multivariate processes is possible with wide use of methods of visual

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presentation of initial data and results. However, the graphical solution of problems in a multidimensional space is neither practicable nor feasible. Therefore, 1 O. Ilyasova, V. Volkov the study of methods of solving the basic problems of descriptive geometry, three-dimensional space in synthetic and analytical presentation becomes current, followed by a generalization to the multidimensional space.

2 The essence of modernization

To demonstrate the new approach to solving geometric problems should lead the algorithm workflow.

1. Analysis of specific conditions is given.

At this stage it is necessary to carry out the procedure for calculating the parameters of a given object. This can be done by the formulas set out in a number of references [1, 3, etc.]. So to calculate the dimension of the linear object formula on Grassmann can be used [6]:

$$D_n^m = (n-m)(m+1), \qquad (1)$$

where, n - the dimension of space, which addresses the Grassmann manifold, m - the dimension of the plane forming the Grassmann formation.

2. Parameterization of geometric conditions.

It holds one of the main tasks of enumerative geometry, which plays the role of evidence-based mathematical framework constructions in descriptive geometry. This task consists in the parameterization given geometrical conditions: generalized condition of incidence (belonging and intersection), the condition of varying degrees of parallelism, perpendicularity condition of varying degrees.

For example, to calculate the dimension of the generalized condition of incidence, this formula can be used [1]:

$$Q_{об} = \frac{(2n-m)(m+1)}{2} - \sum_{i=0}^{m} a_i \, . \qquad (2)$$

3. Analysis of the desired result.

Performed counting the number of solutions or the dimension of the object and its algebraic properties.

4. Construction.

The result of solving the problem based on the analysis of conditions and varieties, they determined, is designing a graphical and mathematical algorithms for solving the task.

As seen from the stages of a geometrical problem solving, direct geometric construction is preceded by mathematical computations and calculations that allow reasoned approach to determining the correctness of the task and the choice of the optimal solution algorithm.

The use of enumerative geometry as the basis of calculations performed can be applied in descriptive geometry and its main method - the symbolic representation of geometric conditions. It is proposed to describe the conditions of incidence and to identify appropriate varieties to use the letter ***e*** (pronounced "eshka"), then the generalized condition incidence symbolically represented as [1]:

$$\boldsymbol{e}^{m,\ m-1, \ldots, 1,\ 0}_{a_m,\ a_{m-1}, \ldots, a_1, a_0} \, . \qquad (3)$$

In the notation of the number of upper and lower indices as well as, value m, m–1, …, 1, 0; a_m, a_{m-1}, …, a_1, a_0 – take the values of natural numbers, including "zero" (0, 1, 2, 3, 4, ...), i.e. values of the numbers used to indicate the number of objects. The values of the superscripts identify the unknown dimension of the linear manifold (the actual value m) and dimensions of all its linear submanifolds to the point. Subscripts define the dimension of space or subspace, which belongs to the desired element.

For a detailed understanding of the symbolic representation of the conditions of incidence, we consider the simplest terms of incidence for points, lines and planes of three-dimensional space.

e_2^0 – condition for a point (upper zero) given plane space (lower deuce - the dimension of the plane);

$e_{2,0}^{1,0}$ – the condition of incidence (accessories) direct (first superscript) plane (the first subscript "2"- the dimension of an ordinary plane) and passing through the given point in it (top and bottom "0"). This condition determines the incidence of the beam lines - the set of lines belonging to the plane and passing through a given point of the plane.

Condition $e_{2,1,0}^{2,1,0}$ determines the plane of the coincidence (first superscript) with a given plane (first subscript), and the plane given a line (second index) and the point (third index). In other words: the passage of the desired plane (first superscript) at pre-determined line (second index) and a point not lying on this line (third indices) belonging to a given plane (first subscript). Similarly, define, and other conditions.

Given a formal mathematical apparatus, the symbolism of the conditions, the calculation formulas are described in detail in many textbooks published in recent years [1 – 6 and other]. Additionally, you must specify that the symbolic representation of problem is most urgent is now – while the digital, information and software technology.

3 Conclusions

Thus, the main directions of modernization of the teaching of descriptive geometry in high schools, in our view, should be:

1. Bringing the course structure and contents of descriptive geometry in accordance with a formalized unit study graphic models of spaces of different dimensions, to determine their structural characteristics, the analysis of raw data of the task and determine the number of their decisions. This objective will determine the place of descriptive geometry as a mathematical discipline that ensure not only the course of drawing and engineering drawing, but also a number of math-ray, general engineering and specialized disciplines;

2. Parallel study of graphical and analytical algorithms for solving geometric problems of multidimensional spaces to create a perspective of the integrated course in descriptive, enumerative, differential and analytic geometry as a basis common geometric training specialists with higher technical education.

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O MODERNIZACJI KURSU GEOMETRII WYKREŚLNEJ

Podano propozycję nowego podejścia do nauczania geometrii wykreślnej poprzez wprowadzenie sformalizowanego aparatu matematycznego i symboliczne przedstawianie warunków geometrycznych w celu określenia optymalnego algorytmu graficznego gwarantującego pomyślne rozwiązania współczesnych zagadnień technicznych i badawczych.