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Surface Formation and its Assignment on the Monge Plot

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Abstract: *By the variety of shapes and properties, by their significance in the formation of various geometric shapes, by the role they play in science, technology, architecture, fine art, surfaces have no equal among other geometric shapes. It is natural that descriptive geometry as a science that transfers the results of its theoretical research to the disposal of an engineer for their practical use.*

Keywords: *forms. geometric shapes, science, technology, architecture, fine arts, surface.*

The world of surfaces is diverse and limitless. It extends from an elementary plane, characterized by simplicity and mathematical rigor, to the most complex, bizarre shapes of curved surfaces that cannot be accurately described mathematically.

It is no exaggeration to say that by the variety of shapes and properties, by their significance in the formation of various geometric shapes, by the role they play in science, technology, architecture, fine art, surfaces have no equal among other geometric shapes. Naturally, descriptive geometry, as a science that transfers the results of its theoretical research to the engineer for their practical use, cannot ignore such important geometric shapes as surfaces. In mathematics, a surface means a continuous set of points, between the coordinates of which a dependence can be established, defined in the Cartesian coordinate system by an equation of the form F (x, y, z) = 0, where F (x, y, d) is a polynomial of the nth degree, or in the form of some transcendental function. In the first case, the surfaces are called algebraic, in the second - transcendental. If an algebraic surface is described by an equation of the nth degree, then the surface is considered to be of the nth order. Any arbitrarily arranged secant plane intersects the surface along a curve of the same order (sometimes decaying or imaginary) as the surface itself. The order of a surface can also be determined by the number of points of its intersection with an arbitrary line that does not belong entirely to the surface, counting all points (real and imaginary). In descriptive geometry, geometric shapes are defined graphically, so it is advisable to consider the surface as a set of all successive positions of a line moving in space. The formation of a surface using a line allows us to give a different definition of a surface based on basic elementary geometric concepts, such as a point and a set. Indeed, if we assume that the position of a line moving in space will continuously change over time t, and take t as a parameter, then the surface can be considered as a continuous one-parameter set of lines. In turn, a line is defined as a continuous one-parameter set of points, so the following definition of a surface can be given: a surface is a continuous two-parameter set of points. It was noted earlier that the surface can be considered as a set of consecutive positions of a certain line gj moving in space according to a certain law.

The surface from the position of the kinematic method of its formation is considered as the set of all positions of a moving line (or surface). With this approach to the formation of a surface, it can be argued that the surface will be defined if its position and shape are known at any moment of the motion of the generatrix, and this, in turn, will allow us to unequivocally answer the question whether a point in space belongs to a given surface or not.

The kinematic method of surface formation leads us to the concept of a determinant, by which we will mean a necessary and sufficient set of geometric shapes and connections between them that uniquely define the surface. The conditions included in the determinant must include:

1. A list of geometric shapes involved in the formation of the surface.

2. The algorithmic part indicating the relationship between these figures.

So, the determinant of the surface consists of two parts: a set of geometric shapes (the first part) and additional information about the nature of the shape change of the generatrix and the law of its movement (the second part). To distinguish the first (geometric) part of the determinant from the second (algorithmic) part, we agree to enclose the first — in round, and the second — in square brackets; then, in general, the surface determinant will have the following structural form: F(G); [A], where (G) is the geometric part, [L] is the algorithmic part.

In order for the determinant to relate to a specific type of surface, it is necessary to enclose specific content in each part of the determinant. It should be borne in mind that when specifying a surface, it is possible in some cases to set numerical parameters instead of geometric elements. For example, any sphere will differ from all other spheres only by the magnitude of the radius R, therefore, by specifying a number indicating the value of R, we define a single sphere. Obviously, the numerical parameter of the conical surface of rotation can be $\angle\varphi°$ — the angle between the generatrix and the axis of the conical surface.

There are two types of surface parameters: shape parameters and position parameters. The parameters whose change causes a change in the shape of the surface are called shape parameters. The parameters whose change leads to a change in the position of the surface in space are called position parameters. The sum of the conditions determining the totality of all independent parameters of the surface is called its parametric number. Form parameters. In the cases just discussed, the parameter R for a sphere and $\angle\varphi°$ for a conical surface refer to the shape parameters. The number of parameters that change the shape of the surface can be any positive integer starting from zero. So, for example: the number of shape parameters for a plane is zero; for a sphere — one. If a surface is defined by its equation in canonical form, all shape parameters are included in this equation.

Position parameters. The number of parameters characterizing the position of the surface in space cannot be less than three and more than six. So, for example: for a plane it is equal to three, for a triaxial ellipsoid — six. If the equation defining the surface is composed for an arbitrary position of the surface, then it contains not only all the shape parameters, but also all the position parameters, i.e. the number of independent parameters of the equation in this case is equal to the parametric number of the surface.

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