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Application of Mathematics in Geodesy

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Abstract: This article discusses the role and importance of mathematics in surveying. In geodetic measurements, the degree of importance of processing the measurement results is indicated.

Keywords: Mathematics, geodesy, triangulation, trilat, polygonometry, segmentation, measurements.

INTRODUCTION

In this article, we will analyze the need for mathematics to study geodesy. In support of this, we turned to the rector of the Siberian State Geodetic Academy A.P. Here is a statement by Karpik. "There are a number of concepts for the location and location of the survey. On the one hand, it is the science of determining the position of objects on the Earth's surface, the size, shape and gravitational field of the Earth and other planets. On the other hand, it is a branch of applied mathematics closely related to geometry, mathematical analysis, classical potential theory, mathematical statics and computational mathematics."

We chose this topic for a reason, because it is closely related to our land and property relations.

The purpose of our work is to show the importance of mathematics in the development of geodesy today.

Let's focus on the sources of the origin of geodesy. Geodesy originated in ancient times. Its development was influenced by the development of natural and exact sciences, the invention of the pendulum and the telescope. But over the past half century, geodesy has made great progress thanks to the use of satellite data, the advent of electronic computers and electronic measuring instruments. The development of information technology has made it possible to analyze a large amount of data and apply new mathematical developments in geodesy.

Thus, we will give a definition of geodesy (from Greek.geodaisía, geo - earth and daio - to divide, divide) is a science that studies the shape and size of the earth's surface or its individual parts through measurements and maps, drawing up

plans, as well as ways to use measurement results and constructions in solving various problems [1].

Geodetic works are carried out on three levels:

1) a planned survey of the area consists in determining the position of points on the Earth's surface relative to control points for making topographic maps used in the construction of dams and roads.

2) Taking a survey of the entire country; the area and shape of the surface are determined relative to the global reference network, taking into account the curvature of the Earth's surface.

3) high-precision geodesy determines the shape of the Earth, its position in space and examines the gravitational field [3].

Geodesy as a science is considered in geometric and physical aspects. Geometric problems are solved by gravitational methods, that is, by measuring and calculating distances, angles and directions. Physical tasks are related to measuring gravity. Geodetic measurements use a coordinate system that includes latitude, longitude, and altitude. The flat surfaces that determine the height of a point are not parallel due to changes in gravity on the Earth's surface due to terrain features (distribution of mountains, valleys, depressions, etc.) and rock density. For these reasons, the parallelism of surfaces having the same width or length is violated.

In geodesy, a theodolite and a thermometer measuring height are used to measure angles and directions, the axes of the degrees of installation of which must be parallel to the surface of the plane, always perpendicular to the direction of gravity.

There is a geometric alignment designed to determine redundancy. To implement it, the degree is located approximately in the middle between two completed rods at points A and B. The viewing beam indicates the readings on rods A' and B'. Then find the difference in the lengths of the segments AA 'and BB', which is the difference in the heights of points A and B, i.e. the height of point B above point A [3].

The main task of geodesy is to determine the location of selected points on the Earth's surface. In this case, the height position varies within narrow limits relative to the horizontal and can be determined by a simple mathematical apparatus.

The triangulation method is used to determine the distance between two points. All angles are measured by theodolite. The distance between two points is calculated using planimetry or spherical geometry methods.

Let's choose a geodetic reference grid, which means a system of points, the planned position and height of which are determined in a single coordinate system based on geodetic measurements.

Three methods are used to create a geodetic reference network:

1) triangulation is the construction of systems of adjacent triangles, in which angles are measured, and the lengths of the sides are calculated from the length of at least one precisely measured base side;

2) polygonometry is the distance at the base of systems of polygonal lines (polygonometric lines), in which the angles and lengths of each segment connecting two segments are sequentially measured.

In triangulation and trilateration, it is enough to know the values of two angles and one side or the length of three sides. In the planned networks, the length of the sides of the triangles does not exceed 15 km; in large cities, where network thickening is required, they are much shorter. All three angles are measured, and then the resulting sum is reduced to a known sum of the angles of the triangle (for spherical triangles, the component is slightly more than 180°). The planned linear characteristics of the grid are obtained by determining one side of the triangle; in addition, other measurements are carried out for control purposes [3].

In conclusion, I want to say that using mathematical formulas and measurements, you can calculate the size of the Earth, the area of objects, measure distances and angles. In addition, it allows you to calculate coordinates, process the results obtained, analyze data and make topographic maps and plans. Therefore, mathematics is of great importance in the study of geodesy.

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