International Journal of Education, Social Science & Humanities. FARS Publishers
Impact factor (SJIF) = 6.786

Volume-11| Issue3| 2023 **Research Article**

GEODETIC SURVEY NETWORKS (CREATING LEVEL-HEIGHT GEODETIC SURVEY NETWORKS IN ENGINEERING-GEODETIC RESEARCH FOR CONSTRUCTION)

https://doi.org/10.5281/zenodo.7789407

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Abstract: This article, along with the initial geodetic data, highlights the main geodetic works on the construction of state geodetic networks in accordance with the "Basic State Geodetic Rules" and issues related to the requirements for them.

Keywords: . reference ellipsoid, geodetic coordinates, triangulation network, point coordinate, directional angle, starting point, initial directionsб, width, longitude, geodetic azimuth, initial geodetic dates, .

Received: 22-03-2023
Accepted: 22-03-2023
Published: 22-03-2023

INTRODUCTION

Initial geodetic data. It is not considered possible to determine the parameters of the reference ellipsoid, to prevent it, the geoid body needs the correct disease, that is, the reference ellipsoid should be oriented.

As a result of projecting the geodetic measurements onto the production of the reference ellipsoid, it is possible to obtain the forecast relative position of the specified points (points) in these physical parts on the surface. According to the reduced geodetic measurements, for the geodetic coordinates of these points, it is necessary to know the coordinates of at least one point and the azimuth in the direction above this point.

such a point, where the coordinates of the points are calculated, is considered the Control or main reference point, and one of the directions from all three points is considered the main reference direction [1-6].

Geodetic coordinates of the main reference point, i.e, - latitude and - length, head base direction - geodesic azimuth and corresponding reference at the base point-above the surface of the ellipsoid - geoid height is called initial geodetic data. Initial geodetic data determine the orientation of the appropriate reference ellipsoid on the Earth's body and the planes of the main astronomical and geodetic coordinate systems.

Until 1942, the processing of the astronomic-geodetic grid was carried out on the surface of the Bessel ellipsoid. The Bessel ellipsoid is oriented according to the astronomical data of Pulkovo, the city of Svobodny. According to astronomical data, the orientation of the ellipsoid in practice is given as follows: determining the astronomical latitude, longitude and azimuth at the base point, the geodetic latitude, longitude and azimuth are assumed to be equal, i.e. , , and on the ellipsoid of the geoid at this point - height is assumed to be zero. Such orientation is used in many countries and fully meets the requirements of practice for countries with a small area [7-11].

The geometric meaning of such a simple orientation of the reference ellipsoid is as follows. Astronomical of the main base va and geodetic and the equality of the coordinates means that at this point the direction of the Shawn line and the normals passing to the surface of the corresponding reference ellipsoid coincide. - astronomical and - the equality of geodetic azimuths means that the planes of the geodetic and astronomical meridians lie in the same plane at this point.

If these conditions are met, the position of the appropriate reference ellipsoid relative to the geoid will be very clear. In this case, the minor axis and the plane of the equator of the reference ellipsoid are parallel to the axis of rotation of the Earth and the plane of the Earth's equator, respectively.

However, in this orientation of the reference ellipsoid, significant deviations of its surface from the geoid surface may occur. The values of these deviations depend on the values of the deviations of the show lines at the main reference point and the distances to the main reference point.

For more correct orientation of the reference ellipsoid, the deviation of the Shawn line at the main support point is determined and its geodetic coordinates and the azimuth of the main support are calculated. The height of the geoid from the surface of the reference ellipsoid is set by the astronomic-gravimetric leveling method without taking into account other initial geodetic data [12-16].

The most perfect method of orientation was developed by Russian surveyors and used in orientation of the Krasovsky ellipsoid. It has been used in practice since 1942. Since then, geodetic grids are projected onto the surface of the Krasovsky reference ellipsoid, and geodetic coordinates are called the 1942 coordinate system[1].

THE MAIN PART

Krasovsky reference ellipsoid. The physical surface of the Earth is very complex, especially in mountainous areas. Its equation is unknown, therefore, for mathematical processing of geodetic measurement results, an auxiliary surface is selected that is geometrically simple and has a good orientation on the Earth's body. All measurements performed on the surface of the earth: horizontal angles and directions, distances between points, azimuths of ground objects, etc., are transferred to this selected surface, i.e. reduced, and this surface is called the displacement surface. When choosing this or that transfer surface, it is necessary to take into account the following.

The transfer surface should be simple in shape and well-studied from a geometric point of view.

The transfer surface should not be significantly different from the quasigeoidal surface of the selected country or several countries; the difference in height should be minimal.

The transfer surface should be oriented on the Earth's body in such a way that the transition from the measured elements to their projections on the transfer surface and vice versa from the projection of the elements to their measured values is performed in the same way [17-23].

When solving topographical-geodesic and cartographic issues at the scale of one or several countries, a reference ellipsoid of certain dimensions and oriented on the Earth's body, called a reference ellipsoid, is usually accepted as a displacement surface.

When choosing the shape, dimensions and orientation of the reference ellipsoid, the following requirements must be met:

1) The parameters of the reference ellipsoid should not differ as much as possible from the parameters of the general earth ellipsoid;

2) The rotation axis of the reference ellipsoid should be parallel to the Earth's rotation axis, and the equatorial plane should be parallel to the Earth's equatorial plane;

3) The sum of the squares of the deviations of the selected reference ellipsoid surface from the quasigeoid (geoid) surface for a country or several countries should be the smallest (minimum).

The dimensions of the reference ellipsoid differ from the dimensions of the general earth ellipsoid, whose center O1 does not overlap with the center O of the general earth ellipsoid

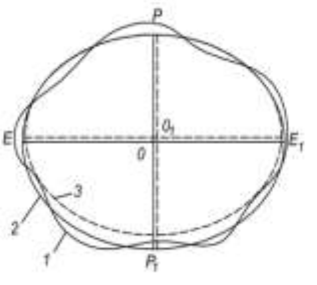


Figure 1. Transfer surfaces

1- geoid; 2 - general earth ellipsoid; 3 - reference ellipsoid

(Fig. 1).

In 1940, Professor F.N. Krasovsky, with the participation of Professor A.A. Izotov, calculated the parameters of the earth's ellipsoid, which were accurate for that time, using degree measurements and gravimetric measurements made in the USSR, the USA, and Western European countries:

a =6378245 m,

a=1:298,3.

In 1946, the ellipsoid of the earth with these dimensions was accepted as the reference ellipsoid for the country and was named Krasovsky. The Krasovsky ellipsoid is currently used in all CIS countries.[2]

Geodetic grids. The system of points fixed on the surface of the earth, the position of which is determined in the general coordinate and height systems, is called a geodetic network.

Geodetic networks can be established on small and large areas of the earth's surface. They are according to their territorial character and function:

-global (covering the entire globe);

- established by each state on its territory in the uniform coordinates and height systems adopted by the national state;

- densification (intended to build the base of the survey during the topographic survey);

- the basis of the picture is divided into branches.

It is divided into planar, height and spatial geodetic networks in terms of geometric essence. The coordinates of the points are determined on the displacement level adopted as a result of the processing of measurements in planar grids (on the ellipsoid level or on the plane); in height (leveling) grids, the height of points relative to the initial surface is obtained, for example, relative to the quasigeoid surface; three-dimensional mutual position of points is determined from the processing of measurements in spatial grids [24-28]. Global geodetic networks are currently established using satellite observation of the earth using space geodetic methods, so it is called a satellite or space geodetic network. The position of the points in this grid is calculated in the geocentric rectangular coordinate system X,Y,Z, the coordinate origin is with the center of the Earth's mass, the Z axis is with its axis of rotation, and the ZY plane is superimposed with the initial meridian plane. it falls over.

Global geodetic networks are used to solve scientific and scientific-technical problems, as well as problems of higher geodesy, geodynamics, astronomy and other sciences. As the accuracy of global geodetic networks increases, opportunities for solving new scientific problems and issues of geodesy, applied cosmonautics, geodynamics, astronomy and many other sciences gradually increase.

National geodetic networks, as mentioned above, are divided into three types: state geodetic network (plan), state leveling network (elevation), state gravimetric network.

In the state geodetic network, it is envisaged to determine the position of the geodetic points in the cross-plan at the selected displacement level (reference-ellipsoid or plane) with high accuracy; the height of branch points is determined with relatively low accuracy, especially in mountainous regions, the accuracy is even lower.

The state leveling network serves to determine the height of each point relative to the quasigeoid surface with high accuracy; the planned position of these network points is determined approximately on the surface of the transfer.

The state gravimetric network is designed to determine the acceleration of gravity at its points with high accuracy; the plan and elevation of these points should be determined with the required accuracy.

State geodetic networks established in the territory of each individual country are designed for the following purposes:

- Detailed study of the Earth's shape and gravity field and their changes over time (within the country's territory);
- creation of uniform coordinates and height systems in the territory of the country;
- creation of maps of the country at different scales in a single system of coordinates and heights;
- solving various scientific and engineering-technical issues of national economy importance by geodetic methods.

All types of state geodetic networks are established separately, but they are strongly interconnected and complement each other. Separate points can be common to all types of grids, which allows to solve geodesy, geodynamics and many other problems with high efficiency. [2], [3]

The main methods of establishing the state geodetic network. The main methods of establishing state geodetic networks are triangulation, polygonometry and trilateration. In each specific case, the choice of one or another method is determined by the necessary accuracy and economic efficiency of network construction.

The method of triangulation. The method of triangulation is considered to have been proposed for the first time by the Dutch scientist Snellius. This method is widely used in all countries. The essence of the method is as follows. Geodesic points forming a system of triangles are fixed at the highest points of the place.

The triangulation method is most often used in the establishment of state geodetic networks.

Polygonometry method. Although this method has been known for a long time, due to the complexity of measuring lines using invar wires, it has not been used in the construction of state geodetic networks until recently. Starting from the 60s of the 20th century, the introduction of accurate radio-radio surveyors into geodetic production developed the method of polygonometry and began to be widely used in the construction of geodetic networks [29-31]. The essence of this method is as follows. Geodetic points forming a single network in the form of a long single road or a system of intersecting roads are fixed at the site. The length of the sides between the adjacent points of the road S_i and the turning angles at the points are measured. Azimuthal orientation of polygonometric roads with the help of determined or given azimuths is carried out by measuring adjacent angles g at their end points. Sometimes polygonometric paths are made between known points of the coordinates of geodetic grids of high class accuracy.

Polygonometry method is more convenient and economically acceptable than triangulation method in populated areas, large cities, forests and other cases.

The ability of the polygonometry method to establish geodetic networks with high accuracy is limited compared to triangulation.

Trilateration method. This method, like the method of triangulation, involves the construction of geodetic networks in places in the form of a chain of triangles, a geodetic rectangle and a central system, or in the form of a complete network of triangles, in which the lengths of all sides are measured (angles are not measured).In trilateration, as in triangulation, to orientate the network, some of the sides of the row must be determined in azimuth.

The trilateration method is gaining great importance due to the production and increasing accuracy of distance measuring light and electronic distance measuring techniques, especially in the practice of engineering and geodetic works.

The accuracy of azimuth transmission in grids for measuring angles and lines with appropriate accuracy is much lower than for triangulation in trilateration grids and grids.

Linear-angular geodesic grids. A linear-angular network is a form of triangulation or trilateration in which the angles and sides of triangles are measured at the same time. In them, after a certain number of triangles, the Laplace azimuths needed to orient the network are measured [1-6]. Linear-angular grids are built in cases where it is required to establish geodetic grids with maximum accuracy.

Combined geodetic grids. If the area where the geodetic work is being carried out has a relief of different shapes, or is covered with different plants, in such cases, based on technical and economic aspects, geodetic networks are established in one of the plots, polygonometry in another, and trilateration in the third.

In other words, so-called combined geodetic networks are established in regions with different conditions.

The scheme and method of construction of combined geodetic networks can be different and they should be chosen based on the specific conditions of the area.

Construction of state geodetic grids according to the "Basic State Geodetic Rules".

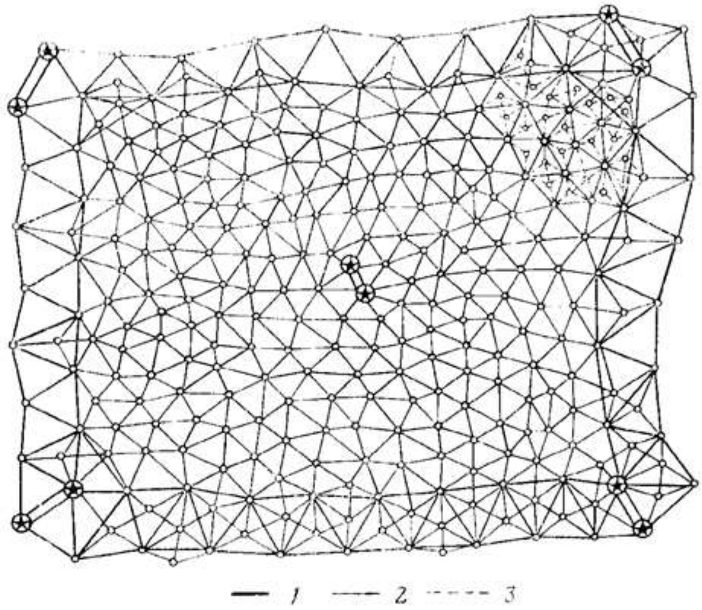


Figure 2. Drawing of construction of 2-4 class triangulations within the 1st class triangulation polygon

1 - 1 class triangulation side; 2 - class 2 triangulation side; 3 is the side of a class 3 triangulation.

Tayanch geodezik tarmoqlarini barpo etishning boshqa quyidagi usullari ham qoʻllaniladi:

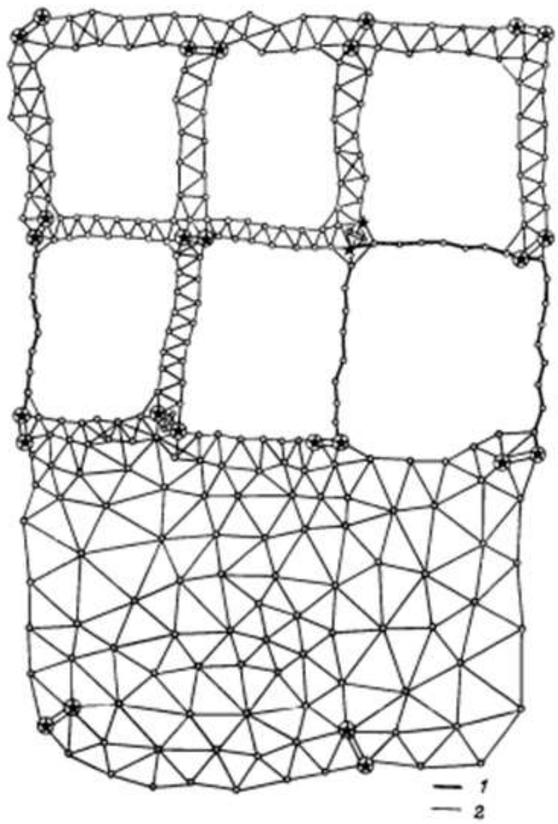
-Astronomik punktlardan tashkil topgan tayanch tarmoqlar;

-Dinamik triangulyatsiya yoki harakatlanuvchi vizir nishonli triangulyatsiya;

- Geodezik tarmoqlarni barpo etishning Su’niy yoʻldoshli (YeSY) usuli.

- Oʻta uzun bazali radiointerferometrlash (OʻUBR).

"Davlat geodezik asosiy qoidalari" ga ko'ra astronomik-geodezik to'r qurish



1-I Polygonometry side of class ;
2-I class triangulation side.

sxemasi

REQUIREMENTS FOR THE ESTABLISHMENT OF THE REVISED STATE GEODESIC GRIDS NAMED "BASIC STATE GEODESIC RULES" ACCORDING TO THE PROGRAM OF F.N. KRASOVSKY AND BASED ON ASTRONOMO-GEODESIC WORKS [2],[3], [4], [5].

The class**** or rating of the network	The length of the link is at most km	astronomical points and main Laplace	side length, km	Permissible root mean square error of protractor at a point	from tha: Actual accuracy of angle measurement	triangles	Base sides allowable root mean square error	root mean square error of the weakest part of the network sides	triangles	creation and function of the network	Polygonometric road limit length, km	from that: Separately	and the connecting point	Between connecting points	in polygonometry, of the polygon - length), km	in polygonometry	sides of the base, pcs	in polygonometry, a road or polygon misalignment error
I	200	65-120	20 – 25	±0",7	±0",65	3,0"	$\frac{1}{400000}$	$\frac{1}{200000}$	40°	A								
II			7 – 20	±1",0	±0",75	4,0"	$\frac{1}{300000}$	$\frac{1}{150000}$	30°	B							25	
II			5 – 8	±1,5"	±1I"	6,0"	$\frac{1}{200000}$	$\frac{1}{120000}$	20°	S								

I																		
IV			2 – 5	±2,0″	±1,5″	8,0′	$\frac{1}{200000}$	$\frac{1}{70000}$	20⁰	S							25	
1			2 – 5	±5,0″		20,0′	$\frac{1}{100000}$ (- $\frac{1}{50000}$)	$\frac{1}{50000}$ (- $\frac{1}{20000}$)	30⁰								10	
2			0,5 – 3	±10,0″		40,0′	$\frac{1}{50000}$ (- $\frac{1}{20000}$)	$\frac{1}{25000}$ (- $\frac{1}{10000}$)	20⁰								10	
I	200	65-120	20 – 25	±0″,4*	±0″,65	-	$\frac{1}{300000}$	-								10		$1''\sqrt{n}$
II	60		7 – 20	±1″,0**	±0″,75	-	$\frac{1}{250000}$	-								6 gacha		$2''\sqrt{n}$
II	30		5 – 8	±1,5″**	±1,1″	-	-	$\frac{1}{150000}$ ***								6		$3''\sqrt{n}$

I								$\frac{1}{200000}$								gacha		
IV	15-11		0,25 – 5 2.0-0.25 -0.50)	±2,0′ **	±1,5″	-	-	$\frac{1}{100000}$ *** $\frac{1}{150000}$ $1/25000$				10	7	5	30	15		$5'\sqrt{n}$
1			0.80-0.12 -0.30)	±5,0″		-	$1/10000$				5	5	3-2)		15	<15		$10''\sqrt{n}$
2			0.35-0.08 -0.20)	±10,0″		-	$1/5000$				3	3	2-1,5)		10	<15		$20''\sqrt{n}$
II I			5 – 8	-	-	6,0″	$\frac{1}{200000}$	$\frac{1}{120000}$										

IV			2 – 5	-	-	8,0″	$\frac{1}{150000}$	$\frac{1}{70000}$	20°							10 ta tomon		
1			0,5 – 5						20°							10 ta tomon		
2			0,25 – 3						20°							10 ta tomon		

CONCLUSION

"Basic state geodetic rules" of 1954-1961 - these rules increased the accuracy of geodetic grids, provided large-scale topographic maps, and gained wide-scale scientific, national economic, and defense significance in geodetic methods. Focused on solving a number of new tasks;

*-according to the results of measurements at the station;

**-closed polygons due to non-connection error;

***- according to the smallest limit length of the side;

A-polygon is a geodetic network of the 1st class created in the form of an astronomic-geodetic network - for conducting scientific research related to the study of the shape and size of the earth, the external gravity field, as well as for the distribution of a unified coordinate system throughout the country. Designed, the design of geodetic grids of this accuracy is performed on topographic maps on a scale of 1:100,000; class I networks consist of polygons of up to 800 km, located in the meridian and parallel directions, consisting of no more than 200 km of links by triangulation or polygonometry. It is allowed to build geodetic rectangles and central systems with angles not smaller than 300 in areas with complex topography. In some regions of the country, instead of polygons, it is also allowed to build a class I integrated triangulation network consisting of triangles with angles of 300 and side lengths of not less than 20 km. astronomical latitude is the latitude minus the mean square error of the longitude and azimuth - distance - AND azimuth- is equal to

Class B-II astronomic-geodetic polygons are built in the form of solid triangles with the accuracy of the triangulation method, the design of geodetic grids with this accuracy is performed on topographic maps with a scale of 1:100,000; it is recommended to place one basis side in the center of a class I polygon and create a Laplace point on one side of this basis with class I accuracy.

It is carried out by developing and densifying class III and IV points with the required accuracy in S-II class networks, the design of geodetic grids with this accuracy is performed on topographic maps with a scale of 1:50,000-10,000;

****At each point of the State geodetic network of all classes, at a distance of 0.5-1 km from it - in forests, not more than 250 m and less than 250 m) there is an underground centering device called a point of determining the direction - orientation) is installed. (orienting) points are intended for azimuthal connection of the track roads and can be used for other purposes as well. All classes differ from each other in the accuracy of angle and distance measurements, side lengths, and order of development sequence..

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