



New Methods and Technologies in Engineering and Geodetic Examination for Project Documentation for Residential Buildings

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Abstract: Engineering and geodetic examination is a part of the construction and reconstruction in major construction work projects. Such kind of examination is implemented with the usage of special geodetic equipment or instruments such as

- high-precision optical-mechanical: theodolites and levels,
- high-precision optoelectronic,
- precise and technical optical-mechanical and mechanical,
- precise and technical with a digital device.

Nowadays it's more widespread to use navigational equipment of utilitarian purpose, which simplify this process and provides the most accurate engineering and geodetic examining. This article describes an example of how this kind of equipment can be used for engineering and geodetic examination in order to prepare project documentation for residential buildings.

Key words: engineering examination, project documentation, navigation receiver, geodata, residential building, horizontal and vertical control (compilation examination).

I. INTRODUCTION

On the basis of item 1 of Art. 47 of the town-Planning code of the Russian Federation [1] engineering surveys are carried out for preparation of project documentation, construction, reconstruction of capital facilities. Preparation of project documentation, as well as construction, reconstruction of capital construction projects, in accordance with such project documentation, are not allowed without performing certain engineering research.

II. PROPOSED METHODOLOGY

On the basis of clause 4.1 " SP 47.13330.2016. Set of rules. Engineering examination for construction.

Fundamentals. Updated version of SNiP 11-02-96 "Construction Standards and Regulations [5] - engineering examining is a mandatory part of urban development, providing a comprehensive research of the natural conditions of the territory (region, district, site, route) and factors of anthropogenic impact on the territory of capital construction projects in order to solve the special issues presented in figure 1.

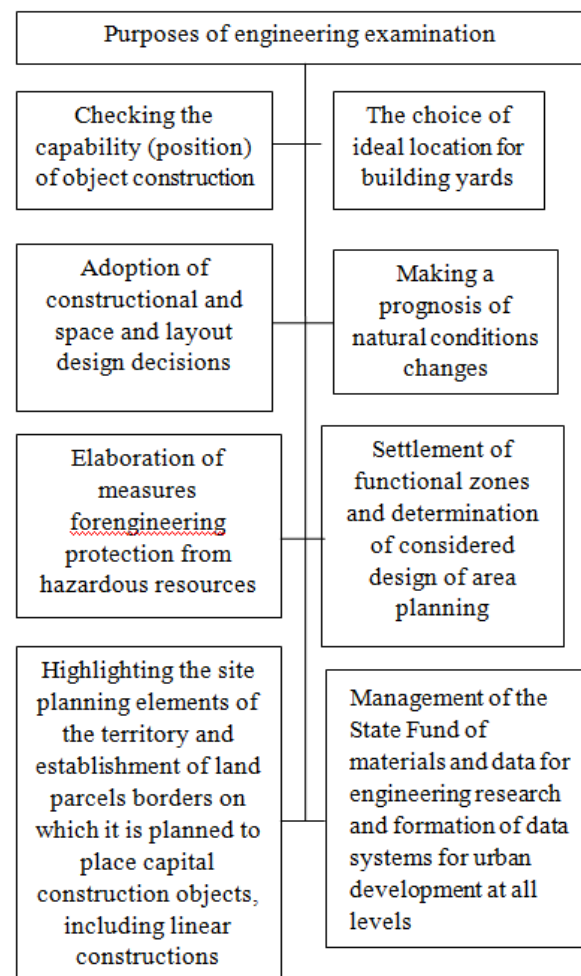


Figure 1 - Purposes of engineering examination

Algorithm

To perform engineering and geodetic examining for the preparation of project documentation of residential buildings in recent years they began to use navigation receivers of general purpose - GPS receivers "Garmin",

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which belong to a new generation of geodetic class receivers and have an obvious advantage over its predecessor by new features [8]. The receiver uses a new chipset with support for more channels and types of satellite signals, as well as a new high-precision geodetic antenna. The object of research for performance of the examination was an apartment block at the address: Kirov region, Vyatskopolyansky district, Krasnaya Polyana village was selected for the examination, Druzhba str., 1. They were performed engineering and geodetic examinations for the preparation of project documentation of residential buildings. The methods and results will be presented in this article.

The research area is located on the territory provided by the points of the State Geodetic Network. Near the research area there are points of triangulation of class 1 "Vyatka Glades", class 2 "Zastrugi", "Laka-Tyzhma", "Ust-Luga". An extract from the catalogue of coordinates and heights of initial geodetic points is presented in Table 1. The starting points of the planned horizontal and vertical geodetic control procedure were the points of triangulation of class 1 "Vyatka Polyani", class 2 "Zastrugi", "LACA-Tyzhma", "Ust-Luga".

Flow Chart

Table 1 is an extract of the initial GEODATA of the object - apartment block at the address: Druzhba str.1, Vyatskopolyansky district, village. Krasnaya Polyana, Kirov region.

Types and numbers of points of triangulation	Coordinates		Height, m.	commentary
	X	Y		
point of tr. "Zastrugi"	324839,50	2289751,74	162,080	
point of tr. "LAKA-Tyzhma"	320424,57	2311010,35	201,500	
point of tr. "Ust-Luga"	318634,04	2297724,04	101,040	
point of tr. "Vyatka Polyani"	315876,01	2283786,63	204,560	Center P

Coordinate system-MSK-43 (zone 2)
System of heights-Baltic, 1977

From the initial points of triangulation using satellite receivers system SOK-KIA GRX-2 №1169-10544, №1169-10552 created a compilation research (horizontal and vertical control), taking into account its further usage directly in the survey area.

Before start of creation a compilation examination (horizontal and vertical control), its design was carried out. For this purpose it was made the reconnaissance of SGS-State Geodetic Network points on the ground with the usage of navigation receivers of general civil purpose ("Garmin"). Planning and adjustment of satellite observations in the work area was carried out with the usage of the software module Planning Version 4.12 license number GCT00825 №0827U42100A09, which is a part of Spectrum Research Version 3.3, using the almanac transmitted from satellites as a part of the navigation file. After the completion of the planning, the creation of the compilation examination (horizontal and vertical control) was carried out.

III. RESULT ANALYSIS

Planning-altitude justification compilation examination (horizontal and vertical control) is based on the points of the State Geodetic Network, isotropic in accuracy spatial geodetic construction, consisting of a system of points fixed on the ground. The number of determined points in the network-2 (vol. 1, vol. 2), measured vectors - 11. Each point of the network is defined by at least three vectors.

The location of the geodetic basis points is chosen to provide the smooth and reliable transmission of radio signals between receivers and satellites.

Satellite definitions were made simultaneously by two satellite receivers of the SOKKIA GRX - 2 system No. 1169-10544, No. 1169-10552. Observations at the sites consisted of dual, equal-time sessions performed by the network method using static mode, with simultaneous observation of at least 4 satellites. The duration of the sessions ranged from 45 minutes to 1.5 hours, depending on the visibility conditions of the satellite, interference at the station and the value of the baseline.

The value of the positional factor of PDOP – position (3D) dilution of precision did not exceed 2.4. The satellite receivers have a registration interval of 5 seconds and a mask of elevation above the horizon of 150. [9] true height of the receiver was calculated by the formula:

$$H = \sqrt{Sh^2 - R^2}; \text{ where}$$

Sh – inclined height of the tool;

R – radius of the receiver (89mm). [6]

Mathematical processing of measurement results was performed using Topcon Tools 8.2.3 software. Technical characteristics of the network construction are given in table 2.

Table 2 - Technical characteristics of compilation examination (horizontal and vertical control)

Point	failures in plan		failures in height		Status
	received	acceptable	received	acceptable	
point of tr. «Blini»	-	-	-	-	Initial
point of tr. «Krasava»	-	-	-	-	Initial
point of tr. «Ogarkovi»	-	-	-	-	Initial
point of tr. «Star. Ukazna»	-	-	-	-	Initial
T.1	0,017	0,020	0,019	0,025	designated
T.2	0,015	0,020	0,022	0,025	designated

In the production of works at the facility identified points of permanent survey justification (ppso) as temporary benchmarks BP.1, BP.2 (angle of the observation well shell).



By results of works are made:

1. Scheme of compilation examination (horizontal and vertical control) geonet (Annex 1)

2. Statement of examination of the initial State Geodetic Network points

Table 3 - points of triangulation « Vyatka Polyani »


Technical characteristics of the point	Type of sign, class		
	Class 1 triangulation point		
			
Description of external sign, year of bookmark	Signal destroyed (disabled)	Condition of exterior decoration	The trench is partially destroyed the identification mark is destroyed
Suitability for observation	Suitable	Outline status	-
The state of the center	Center II type 29 gr. 0.90 m below ground level, in good condition	Deposit of the item	-

Table 4 - points of triangulation « Zastrugi »


Technical characteristics of the point	Type of sign, class		
	Class 2 triangulation point		
			
Description of external sign, year of bookmark	Signal destroyed (disabled)	Condition of exterior decoration	The trench is save; the identification mark is destroyed
Suitability for observation	Suitable	Outline status	-
The state of the center	Center II type gr. 0.40 m below ground level, in good condition	Deposit of the item	-

Table 5 - points of triangulation « LAKA-Tyzhma »



Technical characteristics of the point	Type of sign, class		
	Class 2 triangulation point		
			
Description of external sign, year of bookmark	Signal destroyed (disabled)	Condition of exterior decoration	The trench is save; the identification mark is absent
Suitability for observation	Suitable	Outline status	-
The state of the center	Center II type gr. 0.30 m below ground level, in good condition	Deposit of the item	-

Table 6 - points of triangulation « Ust-Luga »

Technical characteristics of the point	Type of sign, class		
	Class 2 triangulation point		
			
Description of external sign, year of bookmark	Signal destroyed (disabled)	Condition of exterior decoration	The trench is save; the identification mark is absent
Suitability for observation	Suitable	Outline status	-
The state of the center	Center II type gr, 0.50 m below ground level, in good condition	Deposit of the item	-

3. Catalog of coordinates and heights of points of permanent examination justification (temporary control points) [7].
On the object “ Apartment building at the address: Druzhba str.1, Vyatskopolyansky district, village. Krasnaya Polyana, Kirov region.”
System of heights-Baltic, 1977

Table 3 – Catalog of coordinates and heights of points of permanent examination justification

№ of sign	Height, m	Notes
Bp. 1	64,91	Angle of a rim rope clip inside the traprock of public water supply
Bp. 1	64,86	Angle of a rim rope clip inside the traprock of public water supply

4. Cards for attleof temporary benchmarks [2] is presented in Appendix 2.

IV. CONCLUSION

Therefore, with the help of satellite receivers system SOK-KIA GRX-2 №1169-10544, №1169-10552 created a plan-altitude justification (SGSS) [3], taking into account its further use directly in the research area. For this purpose the reconnaissance of State Geodetic Network points on the ground with the use of navigation receivers of General civil purpose ("Garmin") was made. Planning and adjustment of satellite observations in the work area was carried out using the software module Planning Version 4.12 license number GCT00825 №0827U42100A09, which is part of Spectrum Survey Version 3.3, using the almanac transmitted from satellites as part of the navigation file.
After the completion of the planning, the construction of the compilation examination (horizontal and vertical control) was carried out. [4].

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