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Technology of Production of Land Surveying Plots

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Abstract: In this article considers the technology of production of land surveying, which includes the geodetic and cartographic foundations of the GCF, coordinate systems with certain parameters for their transition to a single state coordinate system, various technologies for performing cadastral surveys, calculating the area of the land plot, control of geodetic measurements. The research method used is a quantitative juridical research method, which is directed at finding the normative accuracy of land parcels that must meet statutory requirements. The results of this research explain that there are three ways to carry out a cadastral survey and normative accuracy surveys based on land gradations. Thus, each established land survey plots production technology must meet the requirements of statutory regulations, such as civil law, land regulations, forestry regulations, water regulations, urban planning regulations and other requirements for land plots established in accordance with the legislation of the Republic of Uzbekistan.

Keywords: Land Surveying Plots; Production; Technology;

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INTRODUCTION

As a form of development over time, technology has a huge influence on all aspects of human life, including in the geodetic field which is still being demonstrated numerous inaccuracies in the comparative analysis of the information contained in the cadastre and the land survey plots production technology. In fact, the land use constitutes a key form of cadastral data. The geodetic basis of the state cadastre of real estate is the state geodetic network and geodetic networks of special purpose created in accordance with the procedure established by the Government of the Russian Federation.[1] The cartographic basis of the state real estate cadastre is maps, plans created in forms and scales determined by the regulatory authority in the field of cadastral relations.[2] To maintain the state cadastre of real estate,[3] local coordinate systems established in relation to cadastral districts are used with the parameters of transition to a single state coordinate system defined for them,[4] and in cases

[1] Mohamed Eleiche and Ahmed Hamdi Mansi, 'Exact and Heuristic Formulae to Compute the Geodetic Height from the Ellipse Equation', *Geodesy and Geodynamics*, 15.2 (2024), 150–55 <https://doi.org/10.1016/j.geog.2023.05.007>.

[2] N. Shuygina and others, 'Russian VLBI Network "Quasar": Current Status and Outlook', *Geodesy and Geodynamics*, 10.2 (2019), 150–56 <https://doi.org/10.1016/j.geog.2018.09.008>.

[3] Jesper M. Paasch and Jenny Paulsson, 'Trends in 3D Cadastre – A Literature Survey', *Land Use Policy*, 131.April (2023), 106716 <https://doi.org/10.1016/j.landusepol.2023.106716>.

[4] Przewięźlikowska Anna, 'Legal Aspects of Synchronising Data on Real Property Location in Polish Cadastre and Land and Mortgage Register', *Land Use Policy*, 95.June 2019 (2020), 104606 <https://doi.org/10.1016/j.landusepol.2020.104606>.

established by the regulatory authority in the field of cadastral relations, a single state coordinate system is used.[5]

To date, there are various technologies for performing cadastral surveys. First, shooting with traditional equipment.[6] Second, laser scanning (ground and air) is a promising technology. Third, measurements using GPS equipment. All technologies used to produce land plots must meet the requirements of civil legislation, land regulations, forestry regulations, water regulations, urban planning regulations and other requirements for land plots established in accordance with the legislation of the Republic of Uzbekistan. If according to the law the formation of land plots must be carried out taking into account the land survey project, land survey project or land plots or other documents determined by law, then the location of the land boundaries. the plot is determined taking into account the document.

METHOD

The research method used is a quantitative juridical research method, which is directed at finding legal arguments and formulating the number of data about land through analysis of the articles has demonstrated numerous inaccuracies in the comparative analysis of the information contained in the cadastre and the land survey plots production technology. This research uses secondary data in the form of primary, secondary, and tertiary legal materials. The data collected from the research results were analyzed using the quantitative description analysis method to produce analytical descriptive data, then analytical descriptive analysis departs from systematic juridical analysis.

RESULT AND DISCUSSION

Various Technologies for Performing Cadastral Surveys for Production of Land Surveying Plots

To date, there are various technologies for performing cadastral surveys. First, shooting with traditional equipment.[7] The use of modern total stations, laser rangefinders, greatly simplifies the shooting process.[8] But when shooting large territories, objects far from each other, the time to complete the work is long, it is necessary to use a large number of devices and field crews to reduce it, which is unacceptable.[9] The most effective way is to use traditional equipment in conjunction

[5] Deepika Raghu, Martin Juan José Bucher, and Catherine De Wolf, 'Towards a "Resource Cadastre" for a Circular Economy – Urban-Scale Building Material Detection Using Street View Imagery and Computer Vision', *Resources, Conservation and Recycling*, 198.June (2023), 107140 <https://doi.org/10.1016/j.resconrec.2023.107140>.

[6] Agnieszka Cienciała, Katarzyna Sobolewska-Mikulska, and Szymon Sobura, 'Credibility of the Cadastral Data on Land Use and the Methodology for Their Verification and Update', *Land Use Policy*, 102.August 2020 (2021) <https://doi.org/10.1016/j.landusepol.2020.105204>.

[7] Cienciała, Sobolewska-Mikulska, and Sobura.

[8] Qingyu Li and others, 'Identification of Undocumented Buildings in Cadastral Data Using Remote Sensing: Construction Period, Morphology, and Landscape', *International Journal of Applied Earth Observation and Geoinformation*, 112.July (2022) <https://doi.org/10.1016/j.jag.2022.102909>.

[9] Eftychia Kalogianni and others, 'Refining the Survey Model of the LADM ISO 19152–2: Land Registration', *Land Use Policy*, 141.February (2024), 107125 <https://doi.org/10.1016/j.landusepol.2024.107125>.

with GPS receivers.[10] Total stations are used at almost all stages of engineering and geodetic surveys.[11] These are the creation of support networks, networks of condensation and survey justification, topographic works to create a terrain plan, breakdown of construction axes, removal to the design position of construction objects, constant control of geometry and actual the position of the structures under construction, control of the installation of individual technological elements and equipment, executive survey and subsequent control of displacements and monitoring of deformations of structures.[12] Second, laser scanning (ground and air) is a promising technology. But at the moment it is quite expensive and requires the participation of highly qualified personnel.[13]

Third, measurements using GPS equipment. To carry out work in the districts, it is advisable to use dual-frequency GPS equipment, since single-frequency has a relatively Based on the classification of the three technologies used for performing cadastral surveys, especially in the Measurements using GPS equipment have several options section. To measurements using GPS equipment have several options. First, static GPS shooting (without a controller) is currently used for shooting. It is performed to obtain the exact coordinates of the point. In its execution, at least two GPS receivers must be installed at known and valuable points throughout the entire survey. Before shooting, it is necessary to install the receiver at the point being shot, which must be carefully centered and brought to the horizon, after which the receiver must be turned on to accumulate GPS data for 20-60 minutes. At the same time, it is necessary that the receiver does not move from the observed point during the measurement process. At the end of the observation session, turn off the receiver and remove it from the observed point.

Static photography is usually performed by two or more receivers, because the more receivers are used, the more points can be measured during one observation session, and the larger the survey area can be covered. For the best coverage of the work area, it is necessary to perform several observation sessions. Observations at all points must be performed at least twice or more times. It is also necessary to have more than one known point in the project. These conditions ensure that you collect enough information for each point of the project. With enough data, you can use the program to equalize the network and detect problematic data and gross errors in actions in the field.

Second, the purpose of static shooting with a controller is the same as without a controller.[14] Shooting with a controller allows you to store the necessary information

[10] Trias Aditya, I. Ketut Gede Ary Sucaya, and Fajar Nugroho Adi, 'LADM-Compliant Field Data Collector for Cadastral Surveyors', *Land Use Policy*, 104 (2021), 105356 <https://doi.org/10.1016/j.landusepol.2021.105356>.

[11] Omid Memarian Sorkhabi and others, 'Deep Learning of GPS Geodetic Velocity', *Journal of Asian Earth Sciences: X*, 7.April (2022), 100095 <https://doi.org/10.1016/j.jaesx.2022.100095>.

[12] Ali Özkan, Hasan Hakan Yavaşoğlu, and Frédéric Masson, 'Present-Day Strain Accumulations and Fault Kinematics at the Hatay Triple Junction Using New Geodetic Constraints', *Tectonophysics*, 854.March (2023) <https://doi.org/10.1016/j.tecto.2023.229819>.

[13] Maria Mrówczyńska and Jacek Sztubecki, 'The Network Structure Evolutionary Optimization to Geodetic Monitoring in the Aspect of Information Entropy', *Measurement: Journal of the International Measurement Confederation*, 179.April (2021) <https://doi.org/10.1016/j.measurement.2021.109369>.

[14] Mrówczyńska and Sztubecki.

about the points directly in the controller instead of recording it in a field log. There is no need to manually enter this information into the program. It is enough to simply transfer it from the controller directly to the project.[15] Using such devices in static mode, the "device-base" is located at a fixed point with known coordinates, and the "mobile" device moves along the defined points, making measurements on each for several hours), allows you to obtain the coordinates of points with millimeter accuracy.[16] One of the main advantages of GPS receivers is the ability to make measurements at any time and in any weather. The condition of line of sight to the reflector-rack-hanger does not matter for GPS: measurements can be made by receivers located tens of kilometers apart from each other.

Thrid, static initialization. When performing Both types of initialization can also be used at the end of shooting. Various problems may arise during shooting, which can be solved by initializing the completed shooting. If you are working on a large project, initialization can be performed if there are problems in the field. For single-frequency cinematic photography, it is important not to lose captured satellites upon initialization. If the receiver has lost satellite capture, it is necessary to perform initialization immediately or re-perform observations at the point after which satellite capture was lost. If these actions are not performed, it will greatly affect the final shooting results (there will not be sufficient accuracy) and the solution of ambiguity.

A good way to complete the survey may be to perform initialization at the end of the survey, in case any loss of satellite capture turned out to be unnoticed. This action is similar to the one described above. Do not turn off the receiver while performing kinematic shooting. When shooting, it is necessary to use various improvised tools (nails, dowels, railway crutches, since in case of loss of satellite capture, you can always return to the previous point, without having to return to the point of the first initialization. To increase the reliability and accuracy of the work performed, it is necessary to reinitialize at a previously measured point.

The location of the boundaries of land plots is subject to mandatory coordination with interested parties in accordance with the established procedure if, as a result of cadastral work, the location of the boundaries of the land plot in respect of which the relevant cadastral work was carried out has been clarified,[17] or the location of the boundaries of adjacent land plots, information about which is entered into the state real estate cadastre, has been clarified. The subject of agreement with the interested

[15] Dimitris Kouzoupis and others, 'Direct Multiple Shooting for Computationally Efficient Train Trajectory Optimization', *Transportation Research Part C: Emerging Technologies*, 152.October 2022 (2023), 104170 <https://doi.org/10.1016/j.trc.2023.104170>.

[16] P. Dabove, 'The Usability of GNSS Mass-Market Receivers for Cadastral Surveys Considering RTK and NRTK Techniques', *Geodesy and Geodynamics*, 10.4 (2019), 282–89 <https://doi.org/10.1016/j.geog.2019.04.006>.

[17] G. Aaron Alexander and others, 'Simulating Land-Atmosphere Coupling in the Central Valley, California: Investigating Soil Moisture Impacts on Boundary Layer Properties', *Agricultural and Forest Meteorology*, 317.March (2022), 108898 <https://doi.org/10.1016/j.agrformet.2022.108898>.

person when performing cadastral work is to determine the location of the boundary of such a land plot, which is simultaneously a boundary.[18]

The agreed boundaries of land plots are fixed with boundary markers that fix the location of the turning points of the boundaries of the land plot on the ground. The need to establish long-term boundary markers is determined by the customer of the survey. He also approves the type of boundary mark from among the samples recommended by the contractor. An outline is drawn up for a boundary mark (signs) that belongs to three or more land plots and if there are at least three clearly identifiable objects within 40 meters (elements of buildings, structures, structures, power transmission poles, etc.). The planned position of the boundaries of the land plot on the ground is characterized by flat rectangular coordinates of the centers of boundary markers calculated in the local coordinate system.

Normative Accurancy of Land Surveying

The surveying of land plots for various purposes of land is carried out with an accuracy not lower than the accuracy given in the following Table 1. Satellite, geodetic, photogrammetric and cartometric methods provided for in the technical design are used to determine the flat rectangular coordinates of boundary markers. The heights of boundary markers are determined in accordance with the requirements of the work assignment. The area of the land plot is calculated from the coordinates of the turning points of the boundaries of the land plot.[19]

Table 1. Normative Accurancy of Land Surveying

No.	Land gradation	Root mean square error Mt of position boundary sign relative to the nearest point of the original geodetic basis is not more, m	Acceptable differences when monitoring land surveying, m	
			DSдоп	f доп
1	Lands of settlements (cities)	0,10	0,2	**0,3**
2	Lands of populated areas (settlements, rural settlements points); lands provided for personal farming, gardening, gardening, country and individual housing construction	0,20	0,4	**0,6**
3	Industrial and other lands special purpose	0,50	1,0	**1,5**

[18] Michiel N. Daams and others, 'Consistent Metropolitan Boundaries for the Remote Sensing of Urban Land', *Remote Sensing of Environment*, 297.August (2023), 113789 <https://doi.org/10.1016/j.rse.2023.113789>.

[19] Volker Von Groß and others, 'Transformation Scenarios towards Multifunctional Landscapes : A Multi-Criteria Land-Use Allocation Model Applied to Jambi Province , Indonesia', *Journal of Environmental Management*, 356.October 2023 (2024), 120710 <https://doi.org/10.1016/j.jenvman.2024.120710>.

4	Agricultural lands (except for lands specified in paragraph 2), lands of specially protected areas and objects	2,50	5,0	**7,5**
5	**Forest lands, lands water fund, land reserve**	**5,00**	**10,0**	**15,0**

Based on Table 1. There is the marginal error of the boundary marker position is equal to twice the value of m. The area of the land plot, the boundaries of which are described by reference to geographical objects, is calculated with an accuracy not lower than the graphical accuracy of the cartographic material, the numerical scale of which is equal to the numerical scale of the corresponding cadastral map (plan) of the land plot (territory). The area of a land plot is the area of a geometric shape formed by the projection of the boundaries of the land plot onto a horizontal plane. When specifying the boundaries of a land plot, their location is determined based on the information contained in the document confirming the right to the land plot, or in the absence of such a document from the information contained in the documents determining the location of the boundaries of the land plot at its formation. If these documents are missing, the boundaries of the land plot are the boundaries that have existed on the ground for fifteen years or more and have been fixed since.[20]

Then, the land plots formed must comply with the requirements of civil legislation, land legislation, forestry legislation, water legislation, urban planning legislation and other requirements for land plots established in accordance with the legislation of the Republic of Uzbekistan.[21] If, in accordance with the law, the formation of land plots must be carried out taking into account the project of land surveying, the project of land surveying or land plots or other document provided for by law, the location of the boundaries of these land plots is determined taking into account such a document. In the process of monitoring geodetic measurements, boundary markers are examined in kind and control measurements are performed.[22]

The control of geodetic works can be carried out by comparing the horizontal laying of the SM line between non-adjacent boundary markers installed on the ground, measured with a steel calibrated tape (tape measure) or an electronic total station (LED number), with its horizontal laying of the SC, calculated from the values of the flat rectangular coordinates of the same boundary markers, written out from the corresponding catalog. The absolute discrepancy in the length of the controlled line should not exceed the established standard values. The control can be carried out selectively by independent re-determination of the position of boundary markers installed on the ground by geodetic methods from the nearest points of the OMS and (or) by laying control polygonometric (teodolite) passages with accuracy ensuring the determination of the position of controlled boundary markers with an average square

[20] Edmond Totin and others, 'Property Rights and Wrongs: Land Reforms for Sustainable Food Production in Rural Mali', *Land Use Policy*, 109 (2021) <https://doi.org/10.1016/j.landusepol.2021.105610>.
[21] Totin and others.
[22] Dina Najjar, Rachana Devkota, and Shelley Feldman, 'Feminization, Rural Transformation, and Wheat Systems in Post-Soviet Uzbekistan', *Journal of Rural Studies*, 92.April 2021 (2022), 143–53 <https://doi.org/10.1016/j.jrurstud.2022.03.025>.

error of Mt not lower than the standard one. According to the results of the control, the flat rectangular coordinates of the me are calculated.

The result of surveying a land plot is a boundary plan, which is a document that is drawn up on the basis of a cadastral plan of the relevant territory or a cadastral statement about the relevant land plot and in which certain information entered into the state real estate cadastre is reproduced and information about the land plot or land plots being formed, or about part or parts of the land plot, or new information about a land plot or land plots required for entering into the state real estate cadastre. The boundary plan specifies information about the land plot or land plots being formed in the case of cadastral works, as a result of which documents are prepared for submission to the cadastral registration authority of an application for registration of a land plot or land plots, information about a part or parts of a land plot in the case of cadastral works, as a result of which. If the location of the boundaries of land plots is subject to mandatory coordination, the boundary plan must contain information about such coordination.

In the boundary plan prepared in relation to the land plot, the right ownership of which is considered to have arisen by virtue of federal law, regardless of the moment of state registration of this right in the Unified State Register of Rights to Immovable Property and Transactions with it, information is provided that allows such a land plot to be classified as property, the right to which arises by virtue of federal law, regardless of the moment of state registration of this right. The specifics of preparing a boundary plan for such a land plot are established by the regulatory authority in the field of cadastral relations.

CONCLUSION

In this case there are three types of technology for conducting cadastral surveys for the production of land survey plots, (1) First, shooting with traditional equipment, (2) laser scanning (ground and air) is a promising technology, and (3) measurements using GPS equipment. To measurements using GPS equipment have several options. (1) static GPS shooting (without a controller) is currently used for shooting. (2) the purpose of static shooting with a controller is the same as without a controller. and (3) static initialization. Then, to survey technology of production of land plots, a normative approach is used by collecting data based on normative accuracy which also considers the suitability of the technology and techniques used based on the requirements of civil legislation, land legislation, forestry legislation, water legislation, urban planning legislation and other requirements for land plots established in accordance with the legislation of the Republic of Uzbekistan.

DECLARATION OF CONFLICTING STATEMENTS

The author(s) stated that this work is original and has not been previously published in another journal or publication. The author(s) also declared that there is no conflict of interest in the publication of this article.

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