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ABOUT IMPROVING THE METHOD OF PRODUCING LARGE-SCALE TOPOGRAPHIC SURVEYING IN CITIES

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The aim of this study is to compare topographic survey methods (GPS RTK, Total Station). At the same time, a topographic survey was carried out on the territory of the National University of Uzbekistan by two different methods. The coordinates of points of clear contours were compared with each other. Based on the survey results obtained by both methods, a digital terrain model (plan) was created in AutoCAD 2015. The horizontal and vertical coordinates of points determined by two different survey methods were compared. At the same time, the total difference in the horizontal position of clear contour points amounted to a maximum of 5.0 cm, and in height - 5.4 cm. Given the small difference in the coordinates and heights of the exact contour points, GPS surveys can be used. However, the survey control for performing a Total Station survey can be determined by GPS measurements in closed areas of the city area. This allows reducing the work associated with creating a traditional survey control and referencing it to control points.

Keywords: *topographic survey methods, GPS RTK, total station, digital terrain model.*

О СОВЕРШЕНСТВОВАНИИ МЕТОДА ПРОИЗВОДСТВА КРУПНОМАСШТАБНОЙ ТОПОГРАФИЧЕСКОЙ СЪЕМКИ В ГОРОДАХ

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Целью данного исследования является сравнение методов топографической съемки (GPS RTK, тахеометр). При этом, на территории Национального университета Узбекистана, была проведена топографическая съемка двумя разными методами. Координаты точек четких контуров сравнивались между собой. По результатам съемки, полученной

обоими методами в AutoCAD 2015, была создана цифровая модель (план) местности. Сопоставлены плановые и высотные координаты точек, определенные двумя разными методами съемки. При этом суммарная разница в плановом положении точек четкого контура составила максимум 5,0 см, а по высоте - 5,4 см. Учитывая небольшую разницу в координатах и высотах точек четких контуров, GPS съемки можно использовать на открытых участках города. Однако для выполнения тахеометрической съемки закрытой местности съемочное обоснование может быть определено с помощью GPS измерениями. Это позволяет сократить работу, связанную с созданием традиционного съёмочного обоснования, и привязкой его к опорным точкам.

Ключевые слова: *методы топографической съемки, GPS RTK, электронный тахеометр, цифровая модель местности.*

Introduction. In surveying, specifically in the area of engineering projects, more sophisticated instruments are employed (total station, laser scanner and GPS) to improve the efficiency and accuracy. Individual surveying techniques has been commonly used in the history of surveying area to collect data from field measurements for various applications with different accuracy capabilities and requirements. The significant development of surveying techniques enabled surveying professionals to evaluate precision and accuracy of different surveying techniques. As a result of this evaluation, many advantages has been gained; basically such as improving the efficiency and accuracy of the results. The accuracy of surveying measurements can be improved almost indefinitely with increased cost (time, effort and money) [1].

Today advanced Surveying techniques are improving accuracy of measurements of distance, height, area and positional information of an area. Total station is an advanced instrument which is mainly used for measuring horizontal distance, slope distance, remote objects height and area of a land parcel now a days this instrument is majorly used for determining the land area information [2].

Modern GNSS receivers are wide-spread and compact measuring instruments. These devices are constantly being improved in the recent decades. They can provide reliable results when one needs high accuracy in determining the coordinates of points, when a proper measurement method is chosen and performed carefully.

A fundamentally new geodetic instruments and methods of geodetic measurements, such as total stations, GPS geodetic receivers, which are actively used in large-scale topographic survey, were made. It is also important that

modern instruments, such as Total Stations, are not only more accurate than their ancestors, but is also more immune to errors in reading by the observer [3].

The article considers the improvement of topographic survey methods. At the same time, a topographic survey was carried out on the territory of the National University of Uzbekistan by two different methods. The coordinates of points of clear contours were compared with each other.

Main part. Initially, the survey was carried out in RTK mode via satellite observations using a Stonex S900T GPS rover (S902131800700). The reference point was the GPS base Stonex S900T (S902131800713), fixed on the roof of the building of the Tashkent city and regional branch of UzGASHKLITI. In RTK mode, 84 detail points were captured on a GPS survey. 41 of them are clear contour points. The corrections were transmitted using GSM mobile networks. The positioning specifications of the Stonex S900T GNSS receiver are given in Table 1 [4].

Table 1. – Technical specifications of Stonex S900T system.

Specifications	Stonex S900T	
Real Time Kinematic surveying single baseline <30 km	Fixed RTK Horizontal	8 mm + 1 ppm RMS
	Fixed RTK Vertical	15 mm + 1 ppm RMS
	Initialization time	typically <8 seconds
	Initialization reliability	typically >99.9%
Internal radio	Frequency Range	410 - 470 MHz
Internal modem	Band	GSM/GPRS/EDGE LTE/UMTS/WCDMA
Environmental performance	Operating temperature range	–30 °C to +65 °C (–22 °F to +149 °F)

The survey justification for the total station survey was determined using GPS (figure). The Focus 8 total station was installed at point 2 (T-2), found by GPS, and the orientation was made at points T-1 and T-3. The survey of the situation (solid contours) of the terrain was carried out using the polar method. The technical specifications of the total station used in the creation of the network are given in Table 2 [5].

Based on the survey results obtained by both methods, a digital terrain model (plan) was created in AutoCAD 2015.

The coordinates and heights of points determined by two different survey methods were compared (Table 3). At the same time, the total difference in the horizontal position of clear contour points amounted to a maximum of 5.0 cm, and in height - 5.4 cm.

Table 2. Technical specifications of Focus 8 system.

Specifications	Focus 8 5”
Telescope Effective diameter of objective, mm Magnification, ×	 45 30
Distance precision: Precise mode	± (3 + 2 ppm × D) mm (–10 °C to +40 °C)
Angle measurement Reading system DIN18723 accuracy	Absolute encoder Diametrical reading on HA/VA 5''/ 1.5 mgon
Level Electronic level Circular level vial	 Displayed on the LCD Sensitivity 10'/2 mm
Optical plummet: Image / Magnification / Field of view / Focusing range	 Erect / 3× / 5° / 0.5 m (1.6 ft) to infinity
Operating temperature range	–20 °C to +50 °C (–4 °F to +122 °F)

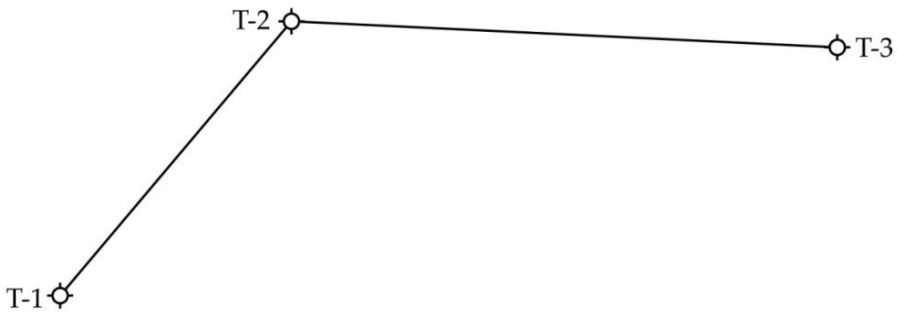

Figure. – Control Network of Total Station

Table 3. – Difference in coordinates and heights obtained in two different methods

Points	Differences, mm			The overall difference in the plan	Points	Differences, mm			The overall difference in the plan
	Δx	Δy	Δz			Δx	Δy	Δz	
1	-4	18	-13	18	9	2	8	7	8
2	1	2	-8	20	10	-8	-22	-2	23
3	-11	2	-14	11	11	19	33	17	38
4	-1	8	2	8	14	0	17	26	17
5	-5	18	-8	19	25	0	5	-54	5
6	1	25	6	25	35	-18	-2	12	27
7	-4	3	-5	30	38	3	24	-14	38
8	13	24	1	27	39	-13	-48	-27	50

Conclusions. Given the small difference in the coordinates and heights of the exact contour points, GPS surveys can be used in open areas of the city. At

the same time, based on total station surveys performed in closed areas of the city, the coordinate of a point in the required density near the work site (in an open area) can be determined by connecting to the Tashkent city system by performing GPS measurements. This allows you to reduce the work associated with creating a traditional survey control and linking it to control points.

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