International Journal of Psychosocial Rehabilitation, Vol. 24, Issue 08, 2020
ISSN: 1475-7192

PROHIBITION OF ANGULAR AND DISTANCE MEASUREMENT ERRORS OF ELECTRONIC TAXIMETERS, WHICH ARE WIDELY USED IN UZBEKISTAN

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ABSTRACT--*This article analyzes the results of the study of two electronic taximeters (angle and distance without reflectors) included in the fleet of geodetic instruments of Uzbekistan, ie errors in measuring angles and distances, and develops recommendations as a result. The research methods developed for electronic tachometers allow the user to evaluate its accuracy in measuring angles and distances without reflectors under production conditions, selecting the instrument that best suits the type of project.*

Keywords--*Electronic tacheometer, Reflector (prism), Angle and distance measurement, Survey of geodetic instruments, base - treyger.*

I. INTRODUCTION

At present, geodetic measuring instruments and tools are widely used in various geodetic works. They focus on current issues: increasing measurement speed, reducing labor and material costs, time and human resources.

Classical geodetic instruments - theodolites and levels - are lagging behind modern electronic devices in terms of demand, and instruments with electronic tachometers and GPS / GNSS satellite systems are becoming increasingly popular. Electronic tacheometers and global navigation satellite systems (GNSS) receivers are currently among the most in-demand tools in the production of topographic and geodetic works.

They allow us to automate the process of collecting geodetic data, minimize errors and, consequently, increase the accuracy of geodetic work [1].

Purpose of the study: The aim of this work is to study the operation of electronic taximeters in angular measurement, to change the position of the base (treger) on the tripod and to measure the distance without reflectors, to compare data, study and develop the necessary instructions.

When the accuracy of the device is seen by the traditional method, the set of specific errors of its parts, nodes (knots), devices and their relative positions are analyzed 2,3. We can divide all the errors of electronic taxometers into several groups: violation of the geometric scheme of the instrument and the error of orientation; target correction error; error of direction and angle calculation systems; svetodalnomer block error; an error caused by the reflector or the reflective surface of the object.

In the collimation and in the plane perpendicular to it, single- and double-axis slope sensors compensate for random errors caused by the slope of the tool. In this case, the measured horizontal directions and vertical angles

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Received: 02 Jan 2020 | Revised: 12 Feb 2020 | Accepted: 17 Mar 2020

are corrected for the slope of the vertical axis of the instrument using microcomputers of the instrument before the results are tabulated or recorded.

These include: the error of the vertical axis slope sensor of the instrument, the error of the automatic targeting system; the error entering from the reflector is a deformation error caused by dynamic and temperature effects. In the tracking mode, it is necessary to take into account the errors that affect the measurement accuracy. That is: an error in the indeterminate determination of the slope of the vertical axis of the tool due to the vibration of the refractive surface of the fluid in the inclination sensor, which is introduced by a circular prism; svetadalnomer error due to non-uniformity of the phase front in the cross section of the laser beam, errors due to the influence of temperature and time factors, surface slope when measuring the distance without reflector, visibility error of the viewing tube. In the tracking mode, it is not possible to make a precise adjustment to the center of the tripelprism reflector. A persistent systematic error remains constant when measured with a concrete electronic taximeter, and in most cases can be detected from special studies and corrected by making appropriate corrections to the measurement results. The variable systematic constituent error varies with each new measurement, and the value varies over a certain range over a given deterministic relationship. The random constitutive errors of an electronic tacheometer consist of the sum of a series of independent errors.

When measuring horizontal angles with precise optical theodolites to achieve maximum accuracy, the measurement is performed in several stages, by changing the position of the limb by the method of reception. Modern electronic theodolites and taxometers do not change the position of the limb, but this operation can display any angle of the limb on the screen by imitation.

II. RESULT

As an equivalent of limb displacement in optical theodolites, this can be done by changing the position of the base (treyger) on the tripod between receptions for the non-repeating axis system of electronic tacheometers. These studies have shown that Gura D.A. is the basis of his dissertation "Evaluation of the accuracy of measurement and research methods of measuring horizontal angles with electronic tacheometers in industrial conditions." Unexpected results and other similar studies have emerged in studies with changes in the position of the base.

Research Method: Research of electronic taximeters is important not only for manufacturers, instrument maintenance centers, research institutes, but also for the user who can determine which electronic taximeters can be measured more accurately when needed. The following types of work, including high-precision angle measurements, are widely used today:

creation of state geodetic and base networks, accurate identification and fixation of key axes during construction,application of geodetic methods in the process of monitoring buildings and structures, ensuring the operational safety of unique engineering structures, etc. At the same time, no normative and technical documents have been developed, including the order of programs for studying the measurement errors of electronic taximeters. To make sure the results are reliable, many scientists suggest researching electronic taxometers to reduce errors in measuring distances, vertical and horizontal angles. Much attention is paid to identifying the causes and sources of measurement errors. Various stationary metrological stands are offered for instrument research.

To test geodetic instruments, it is necessary to know the reference angle. High-precision instruments are used to measure the angles. The optical theodolite T1 and the Leica TPS 1100 electronic taxometer (mn = 0.5 ") were adopted. All vertical angles were measured at twelve receivers. 4].

Table 1: The optical theodolite T1 and the Leica TPS 1100 electronic taxometer Tool	Theodolite T1				Taxeometer TPS 1100			
n	+40	+250	+450	-450	+40	+250	+450	-450
mn	2,9”	2,6”	2,3”	3,8”	3,2”	2,6”	3,1”	2,6”

The development of light-reflecting distance tachometers led to a revolution in instrumentation. This means that the problems of measuring high ceilings, long measurements on stairs and places where technical access is not possible seem to have been solved. But as we mentioned above, the same problem with electronic tacheometers as measuring distances without reflectors, such as measuring angles, is that the measurement technology is not perfect.

EB Mikhalenko in his work "Research work on electronic tacheometers in the measurement of distances without reflectors":

- When working without a reflector, the technical specifications given in the instrument passport do not correspond to the experimental data. This is due to environmental influences and the different reflection of light by different building materials.

- The slope of the light return surface in different samples is 60 ° and 30 °

in which case the light return is slowed down and it is the following percentages: 50% and 25% for concrete; For 50% and 0% silicate bricks; 25% and 25% for ceramic bricks; 25% and 0% wood; For 25% and 0% plastic; and 75% and 75% for rusted metal.

Silicate bricks, plastics and wood can be considered as suitable materials for measuring distance without reflectors, while measuring distance from rusted metal surfaces poses some problems.

The accuracy of distance measurement during non-reflective operation depends on the inclination of the beam to the surface, the color of the surface and the signal strength, which are reflected in the above results [5].

Analysis of the obtained results: Based on the results of the above research, tests were conducted with Japanese-made SOKKIA SET5 30RK3 and Swiss LEICA TS 06 electronic taximeters, which are widely used in geodetic, cartographic and cadastral surveys in the Republic of Uzbekistan.

Table 2: SOKKIA SET5 30RK3 and Swiss LEICA TS 06 electronic taximeters

№	SOKKIA SET5 30RK3	S, м	Measurement difference, mm	LEICA TS 06	S, мм	Measurement difference, mm
1	Metal	19.405	-0,003	Concrete	18.688	0,005
	Light reflector	19.408		Light reflector	18.685	
2	Brick	18.876	-0,003	Brick	18.863	0,015
	Light reflector	18.879		Light reflector	18.878	
3	Tile	19,164	-0,004	Metal	19.391	0,015
	Light reflector	19,168		Light reflector	19.406	
4	Concrete	18.661	0,023	Tile	19,144	-0,021
	Light reflector	18.684		Light reflector	19,165	

In both types of electronic taximeter, the measured distance from the reflector is 1-2 mm. is formed. As the slope of the light-reflecting surface increases, the difference in the measured distance increases.

III. CONCLUSION

The resulting errors can be written in general, in the form of the sum of constant systematic errors, variable systematic errors, and random errors [6]. $\Delta_{\sum} = \sum_{i=1}^{n} \Delta_{si} \pm \sqrt{\sum_{i=1}^{m} \Delta_{si}^2 + \sum_{i=1}^{p} k_i^2 \sigma_i^2}$,

here $\Delta_{si} - i$ - constant systematic errors of the angle measuring device; n is the number of constant systematic constituents; Δ_{si} – *i*- the finite value of the distribution function defined in inches; *m* - the number of variable systematic components; σ_i -random of tools *i*- standard deviation of constituent errors; *p*- the number of random organizers; k_i - from the standard deviation of random constitutive errors V_i a coefficient that takes into account the transition to a finite error. Systematic errors can be calculated using the above formula, but the above studies have proven that various unexpected situations can occur during the measurement process.

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