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A MODERN SOLUTION FOR METROLOGICAL PROVISION OF "DIGITAL NIVERLIR – BARCODE RAIL" MEASUREMENT SYSTEMS

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ABSTRACT
The article covers issues related to metrological maintenance and research of geodetic instruments used in leveling. The methods of checking the main metrological parameters of the barcodes of the digital levels and the methods of checking the technological schemes of the barcodes are compared. Determining the deviation of the average length of the bar meter from the nominal value is carried out twice a year, before the beginning of the field season and after its end, using autocollimators. In the article, methods of solving this problem, implemented in field conditions using various methods, were presented.
Keywords- verification, calibration, digital level, barcode staff, heel, level, leveling of classes I and II.

“RAQAMLI NIVELIR – SHTRIX KODLI REYKA” O‘LCHASH TIZIMLARINI METROLOGIK TA‘MINLASHNING ZAMONAVIY YECHIMI

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ANNOTATSIYA
Maqolada nivelirlashda qo‘llaniladigan geodezik asboblarni metrologik ta’minlash va tadqiq qilish bilan bog‘liq masalar yoritilgan. Raqamli nivelirlarning shtrix kodli reykalarining shtrixli

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chiziqlarning asosiy metrologik parametrlarini nazorat qilish vositalari va texnologik sxemalarini tekshirish usullari taqqoslanadi. Shtrixlar metrining o‘rtacha uzunligining nominal qiymatdan og‘ishini aniqlash yiliga ikki marta, dala mavsumi boshlanishidan oldin va u tugaganidan keyin, avtokolimatorlar yordamida amalga oshiriladi. Maqolada ushbu muammoni yechishning dala sharoitda turli usullar yordamida amlga oshirilgan usullari keltirildi.
Kalit so'zlar - tekshirish, kalibrlash, raqamli nivelir, shtrix-kodli reyka, boshmoq, nivelirlash, I va II sinf.
Аннотация
В статье освещены вопросы, связанные с метрологическим обеспечением и исследованием геодезических приборов, используемых при нивелировании. Сравниваются методы проверки основных метрологических параметров штрих-кодов цифровых уровней и методы проверки технологических схем штрих-кодов. Определение отклонения средней длины стержневого метра от номинального значения производят два раза в год, перед началом полевого сезона и после его окончания, с помощью автоколлиматоров. В статье были представлены способы решения данной проблемы, реализуемые в полевых условиях различными методами.
Ключевые слова - поверка, калибровка, цифровой нивелир, штрих-кодовая рейка, пятка, нивелирование I и II классов.

I. Introduction

In this work, the metrological provision and research of measuring systems "digital level - bar-code level" is analyzed. With the appearance of digital levels in Uzbekistan, it led to a change in the technological scheme of production of all classes of leveling. In this regard, it is necessary to study the methods of checking the main metrological parameters of foreign countries' barcode scanners and digital levels, as well as technological schemes [1]. This, in turn, requires the development of new technologies and tools for their metrological verification, calibration and certification. It is urgent to determine the metrological characteristics of digital levels, as well as to ban them in production and field conditions. The need to improve the class I and II leveling method, ie, the results of the measured heights during field work on the "Digital level - barcode level" system, is due to the fact that various sources of errors significantly affect the outer layer of the atmosphere. includes the effect of vertical refraction, different illumination of barcode reticle, and the difference between the actual scale of the "digital level-barcode reticle" system and its theoretical value [3,4].

The task of the science of modern-historical metrology is to clarify the history of units of measurement used in different periods of the historical development of mankind and their compatibility with the units of measurement of the present time, to convey the priceless heritage of our ancestors to future generations [2].

II. VALIDITY OF THE RESEARCH SUBJECT

In order to achieve high accuracy in leveling, it is necessary to study the level and the ruler to determine the technical characteristics of measuring devices. For this purpose, it is necessary to research the levels and slats in a separate specialized laboratory. Special laboratories should have a measurement with a reference value. However, it is not always possible for users to

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check geodetic instruments in a special laboratory [6,8]. In the absence of a special laboratory, it is necessary to check the level and the ruler in field conditions.

The need to improve the class I and II leveling method, ie, the results of the measured heights during field work on the "Digital level - barcode level" system, is due to the fact that various sources of errors significantly affect the outer layer of the atmosphere. includes the effect of vertical displacement, different illumination of barcode reticle and the difference between the actual scale of the "digital level - barcode reticle" system and its theoretical value [5,9].

III. RESEARCH OBJECTIVES AND TASKS

Before carrying out high-precision leveling work, as a result of a thorough examination of the leveler and leveling rods, it is possible to determine the technical characteristics of the tools and individual conditions related to the tool, compliance with the requirements of the technical manual , and possible defects [7, 10].

The following tasks in this research work to accomplish the objective
defined and resolved.

• Analysis of the existing monitoring program in high-precision leveling;
• Monitoring using digital levels during Class I leveling
development and study of programs;
• High precision leveling using digital levels
researching the recommended methods and applying the obtained results to the process;
• The atmosphere is close to the ground to the process of "Digital Level - Barcode Reticle".
to study the effect of vertical refraction on leveling in the layer;

IV. RESULTS AND THEIR DISCUSSION

We will study and analyze 2 methods of checking "Digital level - bar code level".

In method I, the level is set on a solid base at point A, 4-5 m at points V and C. the relative height is measured by setting the level in the distance and changing the level horizon several times [4,12] .

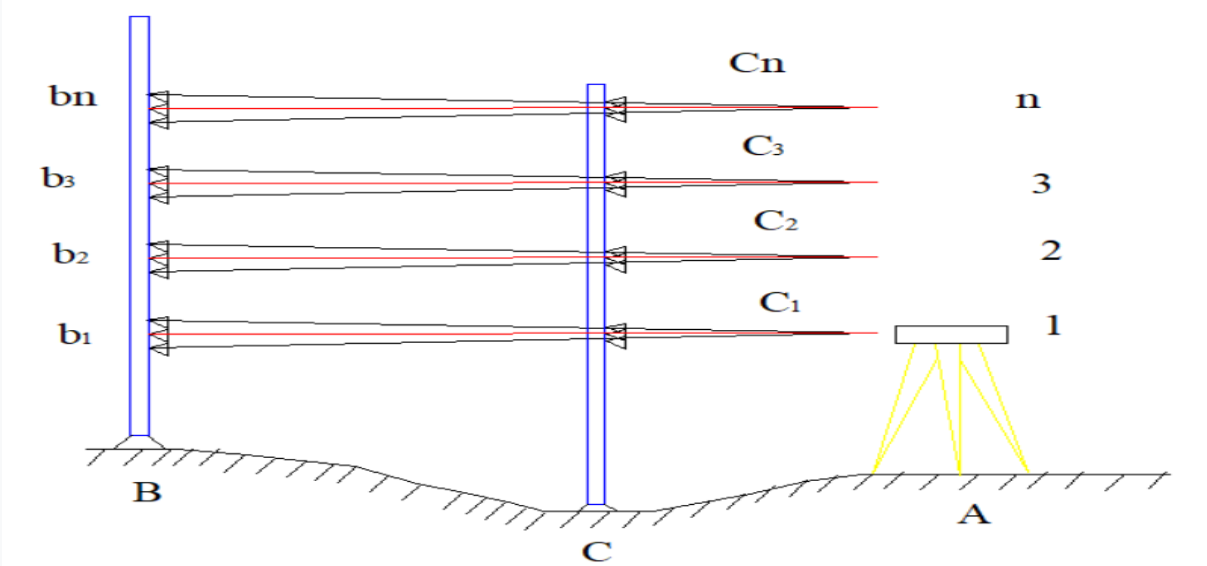

Figure 1. Measure the relative height as a result of changing the level horizon

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The level and reed are first lowered to the minimum possible height so that the lower parts of the reed are measured. After bringing the level to working condition, 15-20 ochets (b1 and c1) are made from the reka, on the basis of which the value of "visibility error" is calculated, as well as the relative height for a certain horizon [11 ,13].

When the "Digital level - barcode level" system works correctly, at different heights of the horizon, and when performing the right and reverse track technology, the measured relative height is equal to each other. should be

$$h_1 = b_{o'rt\,1} - C_{o'rt\,1}$$
$$h_2 = b_{o'rt\,2} - C_{o'rt\,2}$$
$$\dots \dots \dots \dots \dots \dots \dots \dots$$
$$h_n = b_{o'rt\,n} - C_{o'rt\,n}$$
$$h_1 = h_2 = h_3 = \cdots = h_n.$$

Value difference means that it is a quality indicator of the "digital level - bar-coded ruler" system.$h_1 - h_2 = \Delta, h_2 - h_3 = \Delta, \dots, h_{n-1} - h_n = \Delta$

Thus, when using this method, we only need to know exactly the "true" relative height between points B and C.

II - method 10, 20, 30, 40, 50, 60, 70, 80, 90 and Piles are driven at distances of 100 m. Then these points are leveled 2 times: the first time from the center of point A on strictly equal shoulders, that is, the focus of the tube is not changed, and the second time from point V on various shoulders from 10 meters to 100 meters . Leveling is performed two to three times in the right and opposite direction. The middle of the rails when leveled from point A $a_1, a_2 \dots\dots a_{10}$ counts are taken. Then, from point V, it is leveled in a circle $b_1, b_2, \dots\dots b_{10}$ counts are taken [3].

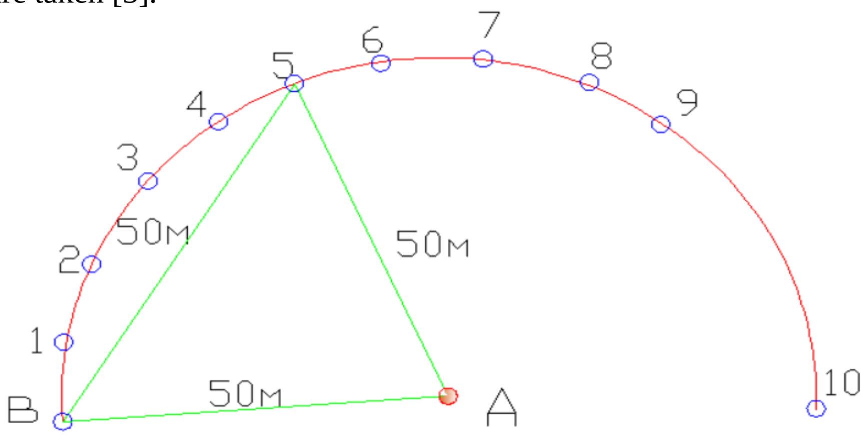

Figure 2. Check diagram of the leveler as a result of changing the focus distance

Horizon height of the instrument at points A and V at the stations

The difference is: $r = b_5 - a_5$

here r instrument horizon difference of points A and V at the station, mm.

Then, from the station at point V, the amount of errors caused by the misalignment of the focusing lens of the viewing tube is determined.

$$\Delta_i = b_i - (a_i + r)$$

Here Δ_i – defined i the count taken from the reica from the misalignment of the focusing lens at the point;

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a_i, b_i - when the center is leveled from station A and V at point i, in a suitable case, the middle counts are set, mm.

Difference of errors Δ_i – the misalignment of the focusing lens should not exceed 2 mm when the distance difference from the level to the rear and front rails is 10 meters. In high precision instruments Δ_i – After the value of is determined, the system of normal equations is created and the solution is determined:

$$\kappa \sum S_i^2 + q \sum S_i - \sum S_i \Delta_i = 0:$$

$$\kappa \sum S_i + qn - \sum \Delta_i = 0,$$

here κ - the coefficient characterizing the direction of the visor axis when the sight tube is focused: q - the difference between the maximum and the average instrument horizon at point V at the station, mm: S_i - Distance from point V to points 1,2,3,…..10, mm: Δ_i - the amount of errors is calculated by the formula (1), mm: n - Δ the number determining the amount of [3,4,14].

The obtained results are presented in the table below.

1 - Table

Table for checking the level.

Point No	According to Reika a_i count				According to Reika b_i count				$a_i + r$ hmm	average error Δ_i, mm.
	method			average	method			average		
	1	2	3	a_i mm	1	2	3	b_i mm		
1	1247	1248	1246	1247	1434	1434	1436	14347	1433	**+1.7**
2	1375	1374	1377	17753	1965	1961	1963	1961	19613	**+1.7**
3	1165	1163	1164	1164	1353	1350	1350	1351	1350	**+1.0**
4	1536	1539	1138	11377	1324	1325	1324	13243	13237	**+0.6**
5	1475	1477	1476	1476	1662	1663	1661	1662	1662	**0.0**
6	1339	1441	1440	1440	1625	1627	1625	16257	1626	**-0.3**
7	1675	1678	1677	16767	1870	1866	1865	1867	18687	**-1.7**
8	1132	1129	1131	11307	1316	1315	1315	13153	13167	**-1.4**
9	1029	1032	1030	10303	1231	1216	1216	1215	12163	**-1.3**
10	1141	1140	1142	1141	1325	1328	1325	1326	1327	**-1.0**
Note: $r_n = b_n - a_n = 1662 - 1476 = +186$ ìì .										

Table 1 is continued

$\grave{a}_{iñð} + r$	mean error Δ_i, mm.		$(\kappa D_i + q)$, ìì .	v_i, ìì	Explanation and account
	Reika from pieces	mm.			
28.6764	-0.050	-2.50	-2.40	-0.10	$r = b_{5ñð} - \grave{a}_{5ñð} = -0{,}7309$
28.8399	-0.034	-1.70	-1.80	+0.10	$14000\kappa + 280q + 0{,}5 = 0$
29.4688	-0.023	-1.15	-1.20	+0.05	$280\kappa + 7q + 4{,}2 = 0$
28.4706	-0.013	-0.65	-0.60	-0.05	

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26.9216	0.0	0.0	0.0	0.0	$\kappa = +0{,}06$
26.7566	+0.014	+0.70	+0.60	+0.10	$q = -3{,}00$
27.6146	**+0.062**	**+1.10**	**+1.20**	**-0.10**	

V. Summary

As a result, there is a need to conduct a number of studies on improving the leveling methodology of class I and II performed by digital levelers, including the refraction effect that occurs in the lower layer of the atmosphere. Considering these conditions, it is necessary to improve the leveling monitoring program at the stations [3,15].

Based on theoretical and practical research, a number of problems were solved on the basis of research results and the practical importance of using a modern digital level in performing high-precision leveling work of I and II classes.

In high-precision leveling, it is possible to reduce the impact of errors by analyzing the existing tracking software

Due to the significant improvement in the technical characteristics of modern digital levels, it is necessary to propose a new value of permissible errors in class I leveling.

In the process of performing leveling of the I class on a digital level, increasing the number of measurements, monitoring programs were developed, as a result, a reduction in systematic error was achieved.

Based on the results of the research, the method of performing class I leveling with a "digital level" was improved, taking into account the effect of refraction in the near-ground layer of the atmosphere.

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