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Current status of assessment for accuracy characteristics of topocartographic products formation

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Аңдатпа. Топографиялық-геодезиялық жұмыстардың күрделілігі жер бетінің қалыптасу шарттары алдын-ала келісілген, әр түрлі құрылымды құрылыспен сипатталатын ықтималдылық-эмпирикалық жаратылыс нәтижесі болып табылады. Қазіргі таңда көптеген элементтердің түрлілігі және жер бетінің белгілері өзара байланысты топографиялық бетті кездейсоқ күрделі геоморфологиялық жүйе түрінде құрылған биіктіктер жазығы ретінде тануға мүмкіндік береді.

Кілт сөздер: *топографиялық-геодезиялық жұмыстар, ықтималдылық-эмпирикалық жаратылыс, топографиялық бет, геоморфологиялық жүйе, жер беті, биіктіктер жазығы.*

Аннотация. Сложность топографо-геодезических работ обусловлена условиями формирования земной поверхности, как результат вероятностно-эмпирической природы, характеризующаяся разнообразным структурным строением. На сегодня подтверждено такое положение, что разнообразие множества элементов и признаков земной поверхности, взаимосвязанных между собой позволяет представлять топографическую поверхность как случайное поле высот, структурированную в виде сложной геоморфологической системы.

Ключевые слова: *топографо-геодезические работы, вероятностно-эмпирическая природа, топографическая поверхность, геоморфологическая система, земная поверхность, поле высот.*

Abstract. The complexity of land works due to the conditions of formation of the Earth's surface as a result of probabilistic and empirical nature, characterized by a variety of structural construction. Today, this situation confirmed that the diversity of the plurality of elements and features of the Earth surface, interconnected allows you to represent the topographic surface as a random field heights, structured in the form of a complex geomorphological system.

Key Words: *Surveying, probabilistic and empirical nature, topographic surface, geomorphological system, the earth's surface, the field height.*

In the course of development of market mechanisms in the country, including fields of industrial, agricultural, housing construction, the land acquires value more and more. In this case design and construction works and processes of industrial exploitation and

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sustainable land and subsoil management acquire important socio-economic value. One of the important tasks for increasing the efficiency of topo-geodetic support for processes of construction and roads, drafting for them, is the task of counting the volumes of earthworks.

Thus, the efficiency of use of counting results is largely dependent on reliability, accuracy and operability of used method for counting volumes of excavations and mound of earth mass with vertical layout, is primarily connected with the preparation of topographical plans and other schedules according to surveys of studied areas of the earth surface that differ by reliefs with sufficient complexity. Basis of qualimetric index for assessing the effectiveness of technology for identification and assessment of effectiveness of topographical products while developing and forming are practically guided by several important requirements, which include accuracy, reliability, complex formation of qualimetry and characteristics of topographic products that make up their initial values [1].

1.1. Criteria of accuracy is assessed by degree of assurance of reliable and comparable results while using this parameter characteristics of plans and maps that express quantitative root-mean-square and relative errors of measurement. However, practically, in all plans, maps and topographical models, related methods the values of root-mean-square error of determination are very different and vary from 10 to 200%.

1.2. The main requirement for topographic products is the accuracy of their parametric characteristics. Compared to criteria of accuracy that primarily reflects the qualities of measurements of initial values, term of authenticity comprises the essence itself and real basis for technology of formation of topocartographic products.

1.3. Criteria of qualimetric usefulness of initial values of component parameter characteristics should be understood as creation of qualimetric parameter characteristics of topocartographic products that in complex provide them with high information usefulness, production and market and tradable value.

Main influence on deformation of model is made by errors of earlier considerations, it can be assumed that the accuracy of topographic map will be provided, if mean square error of mutual position of elevation spots will be and less than specified height of contour interval.

Mean square mistakes of error of mutual position of elevation spots necessary for geodetic orientation can be 20-25% more than that listed in Table *1*.

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Table 1: Mean square error of mutual disposition

Scale of maps	Contour interval (m)	Mean square error of standard elevation
1:2000 – 1:5000	0,5	0,05–0,06
1:1000 – 1:10000	1,0	0,10 – 0,12
1:1000 – 1:25000	2,5	0,25 – 0,31
1:10000 – 1:25000	5,0	0,50 – 0,63
1:10000 – 1:25000	10,0	1,00 – 1,25

Influence of mutual equalization of coordinates of land marks and distances between them to the accuracy of calculation of the area can be defined as relation of root-mean-square error. Their ratio before and after equalization will help to determine the influence of management on accuracy of calculation of the plot area [2].

Table 2: Results of model studies

Dependence of root-mean-square error of the area of isoscales triangle on its configuration ($P = 390 \, м^2$, $m_{x(y)} = 5$ cm)				
К	m_P, $м^2$	m_{P_i} / m_{P_1}	Pre calculated m_P, $м^2$	$\sqrt{\dfrac{1,75 + K^2}{1,73K}}$
$\sqrt{3/2}$	1,326	1,000	1,299	1,000
1/2	1,389	1,047	1,397	1,08
1	1,330	1,003	1,307	1,01
2	1,532	1,155	1,521	1,17
3	1,792	1,351	1,780	1,37

Table 3: Results of model studies

$P_i, м^2 (P_i / P_1)$	390,505 (1)	1562,021 (4)	3514,548 (9)
m_{P_i}, $м^2 \left(m_{P_i} / m_{P_1} \right)$	1,889 (1)	3,803 (2,013)	5,616 (2,973)

Table 4

Plot	Side	Length				
		tape-measured S_p	calculated according to coordinates $S_k = \sqrt{\Delta x^2 + \Delta y^2}$	Measured according to aerial photograph of scales		
				1:500	1:1000	1:2000
334	1-2	36,82	36,85	36,75	36,8	36,6
	2-3	17,28	17,25	17,25	17,4	17,8
	3-4	36,87	36,84	36,70	36,6	36,6
	4-1	16,85	16,90	16,85	16,8	16,6

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Table 5

Category	a_{min}, mm					$\sigma(a)$, mm
Stage	1	2	3	4	5	
I	8	7,2	6,4	5,6	4,8	0,4
II	5,4	4,8	4,2	3,6	2,7	0,0,3
III	4	3,5	3	2,5	1,8	0,25
IV	3	2,4	2	1,4	1	0,2

Analysis of initial components of accuracy for determination of volumetric parameters of earth works gives an opportunity to make analytical conclusions that the accuracy of calculation of areas (volumes) of land plots directly depends on:

• scales of ratio and tightness of interconnection of initial volumetric parameters $(\frac{L}{h}, \frac{V}{\eta}, r_{ij})$;

• complexity of toposurface geometry – degree of variability (fluctuations) of relief irregularities(H_{ro}, γ, φ).

Degrees of mistake in determination of each initial value of model ($a_1 a_2$, a_3, a_4).

Given regulatory morphometric parameters of topographical massif of region can be used as basis for formation of analytical structures of methods for qualimetric standardized accuracy characteristics of plans and maps with different complexity.

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