DETERMINATION OF THE MEAN SQUARE ERROR OF AN INDIRECT VALUE FUNCTION

DETERMINAREA ERORII MEDII PĂTRATICE A UNEI FUNCŢII DE MĂRIMI MĂSURATE INDIRECT

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Abstract: *The purpose of this work was to determine a medium high of the landing platform in order to be able to calculate the volume of the waste deposited herein and the absolute quotas of the points 105 and 110 and their mean-square errors. The mean-square error of the weight factor is amounting to± 1,897 cm/km.*

Rezumat: *Scopul acestei lucrări a fost determinarea unei înălţimi medii a rampei pentru a putea calcula volumul de gunoi depozitat şi cotele absolute ale punctelor 105 şi 110 şi erorile medii pătratice ale acestora. Eroarea medie pătratică a unităţii de pondere are valoarea de ± 1,897 cm/km.*

Key words: *provisional quotas, probable corrections, absolute quotas*
Cuvinte cheie*: cote provizorii, corecţii probabile, cote absolute*

INTRODUCTION

The information, which forms the concrete necessary data basis for solving the geodesic, photogrammetric and topographic problems, results from the analyses concerning the measurements performed on certain parameters frequently used and which are mainly angles and distances. The quality of the information obtained by measurings directly depends on the volume of observation and on the precision of the measuring equipment and instruments. It is necessary, starting from the purpose for which the measurements are fulfilled, to establish the proper values as concerns size and precision, taking into consideration the economic aspect referring to the volume of observation, necessary and sufficient, which is required.

The theory of errors in measurements intervenes with good results in solving these aspects.

MATERIALS AND METHOD

The research was carried out on the waste landing platform placed in the northern area of the municipality of Arad, Câmpul Linistii street, FN. The purpose of this work was to determine a medium high of the landing platform in order to be able calculate the volume of the waste deposited and the absolute quotas of the points 105 and 110 and their mean-square errors.

In this respect we established the quota 0, the quota 110 m, resulted from the previous measurings, at the level of the playing field placed near by the waste landing platform. We also shaped the alignments A-A, B-B, C-C, D-D parallel towards north and the alignments E-E, F-F and G-G perpendicular to the north direction at a distance of 100 m.

We used the geometrical leveling method based on the points of the already known absolute quotas 101 and 117, $H_{101} = 109,910$ m and $H_{117} = 112,790$ m respectively.

We used the leveling indicator Leica NA 720, which has the following characteristic features: magnification 20 X, angle measurement $360^0/400^0$, standard deviation (per km double round) 2.5 mm, working temperature (- 20^0C… 50^0C).

The absolute quotas of the points were established by using the following relation:

$$H_{105} = H_{105}{}^0 + x_1$$
$$H_{110} = H_{110}{}^0 + x_2, \text{ were}$$

H_{105}, H_{110} = the absolute quotas of the points 105 and 110;
$H_{105}{}^0, H_{110}{}^0$ = the provisional quotas of the points 105 and 110;
x_1, x_2 = the probable corrections of the points 105 and 110.
The provisional quotas were established by using the following relation:

$$H_{105}{}^0 = H_{101} + h_1$$
$$H_{110}{}^0 = H_{117} - h_3, \text{ were}$$

H_{101}, H_{117} = the absolute quotas of the points 101 and 117.
On the basis of these relations we can write the following equations:

$$H_{105}{}^0 + x_1 - (H_{101} + h_1) = V_1, \text{ with the weight } p_1 = \left(\frac{m_0}{m_0 \sqrt{s_1}} \right)^2$$

$$H_{110}{}^0 + x_2 - (H_{105}{}^0 + x_1 - h_2) = V_2, \text{ with the weight } p_2 = \left(\frac{m_0}{m_0 \sqrt{s_2}} \right)^2$$

$$H_{117} - (H_{110} + x_2 + h_3) = V_3, \text{ with the weight } p_3 = \left(\frac{m_0}{m_0 \sqrt{s_3}} \right)^2, \text{ were}$$

h_1, h_2, h_3 = the level differences between the points;
m_0 = the mean-square error of the weight factor;
s_1, s_2, s_3 = the distances between the points.
Taking into consideration the existing relations we can write the following equations:

$$- \quad x_1 + l_1 = V_1$$
$$x_1 - x_2 + l_2 = V_2$$
$$- \quad x_2 + l_3 = V_3, \text{ were}$$

V_1, V_2, V_3 = the probable corrections of the level differences

$$l_1 = H_{101} + h_1 - H_{105}{}^0$$
$$l_2 = H_{105} + h_2 - H_{110}{}^0$$
$$l_3 = H_{117} + h_3 - H_{110}{}^0$$

RESULTS AND DISCUSSION

Table 1 presents the calculus of the parameters and absolute terms of the system of standard equations.

Table 1

The calculus of the coefficients and absolute terms of the system of standard equations

Crt. nr.	p	a	b	l	s
1	1	- 1	0	0	- 1
2	2	1	- 1	3	3
3	1	0	- 1	0	- 1
[ ]	4	0	- 2	3	1
		3	- 2	6	7
			3	- 6	- 5
				18	18
					20

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Taking into consideration the data obtained in the previous scheme it results the following system of standard equations:

$$3x_1 - 2x_2 + 6 = 0$$
$$-2x_1 + 3x_2 - 6 = 0$$

The system of equations was solved by using the successive reduction method, according to the scheme presented in table 2.

Table 2

The scheme for solving the system of standard equations

Symbol	a]	b]	l]	s]	Q_1	Q_2
[a	3	- 2	6	7	- 1	0
	- 1	0,6666	- 2	- 2,3333	0,3333	0
[b	$X_1 = -1,1999$	3	- 6	- 5	0	- 1
		- 1,3332	4	4,6666	- 0,6666	0
		0,6668	- 2	- 0,3334	- 0,6666	- 1
		- 1	1,9999	0,2000	0,3999	0,5999
	$X_2 = 0,4000$		8	18	$Q_{11} = 0,200$	$Q_{22} = 0,5999$
			- 12	- 13,9998		
			- 2,3998	- 0,400		
			3,6002	3,6002		

The absolute quotas of the points 105 and 110 were established by using the following relations:

$$H_{105} = H_{105}^0 + x_1 \pm m_{x1} = 111.470 - 1.1999 = 110.280 \text{ m} \pm 0.848 \text{ cm}$$
$$H_{110} = H_{110}^0 + x_2 \pm m_{x2} = 113.910 + 0.4 = 114.310 \text{ m} \pm 1.469 \text{ cm}$$

$$m_{x1} = \pm m_0 \sqrt{Q_{11}} = \pm 0.848 \text{ cm}$$

$$m_{x2} = \pm m_0 \sqrt{Q_{22}} = \pm 1.469 \text{ cm}$$

The mean-square errors of the weight unit were established as follows:

$$m_0 = \pm \sqrt{\frac{3,6002}{3-2}} = \pm 1,897 \text{ cm / km.}$$

CONCLUSIONS

The quality of the information obtained by measurements directly depends on the volume of observation and on the precision of the measuring equipment and instruments.

The research was carried out on the waste landing platform from the municipality of Arad with a view to establish its medium high and to calculate the volume of the waste deposited in the respective area.

We used the geometrical levelling method based on the points of the already known absolute quotas 101 and 117, $H_{101} = 109,910$ m and $H_{117} = 112,790$ m respectively. The system of equations was solved by using the successive reduction method. The mean-square error of the weight unit is amounting to $\pm 1,897$ cm / km.

The mean-square error of the weight unit is amounting to $\pm 0,848$ cm and $\pm 1,469$ cm.

LITERATURE

1. CALINOVICI, I., Establishing a normal system of equations in indirect measurements of same precision, 42nd Croatian & International Symposium on Agriculture, Opatija-Croatia, February 13-16, 2007, pg. 319-321.
2. CĂLINA, A., CĂLINA JENICA, MUSTAȚĂ, I., CALINOVICI, I., MILUȚ, M., Engineering topography, Reduta Publishing House, Craiova, 2003, pg. 33-83 .

3. DAVID, V., Geodesy, Politehnica Publishing House, Timişoara, 2006, pg. 7-45.

4. DIMA, N., HERBEI, O., VEREŞ, I., Theory of errors and the method of the lowest square, Universitas Publishing House Petroşani, 1999, pg. 92-181.

5. LEU, I. N., IONESCU, P., RĂDULESCU, M., Measurements terestrial for agriculture, Ceres Publishing House, Bucharest, 1990, pg. 99-133.

6. LEU, I., N., BUDIU, V., MOCA, V., RITT, C., CIOTLAUS, ANA, CIOLAC, VALERIA, Topography and agricultural cadastre, Didactical and Pedagogical Publishing House, Bucharest, 1999, pg. 130-178.

6. MILONJIC, Z., BREBU, P., BÂRLIBA, LIVIA LUMINIŢA, Geodesic positioning system, Politehnica Publishing House, Timişoara, 2004, pg. 110-206.

7. MUŞAT, C. C., Theory processing of topo-geodesic measurements, Politehnica Publishing House, Timişoara, 2006, pg. 40-62.