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ABOUT ADDITIONAL MEASUREMENTS ON A LINEAR BASIS

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In 2009 oneducational andscientificgeodesicpolygon of Lviv NationalAgrarian Universitywas builtlinearbasis of2nd category(Pic.I), intended for metrological certificationof varioussurveyinginstruments. Some preliminaryobservations was made on it.

Key words: Basis, leveling.

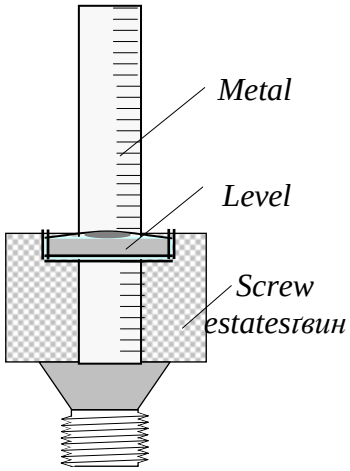
Pic. 1. Panoramic photo of basis

Formulation of the problem. For identification possiblehigh-altitudedisplacements were made a cyclicobservations andwas given ascoreof accuracy of results. In autumn2014the first observations of leveling weremade.

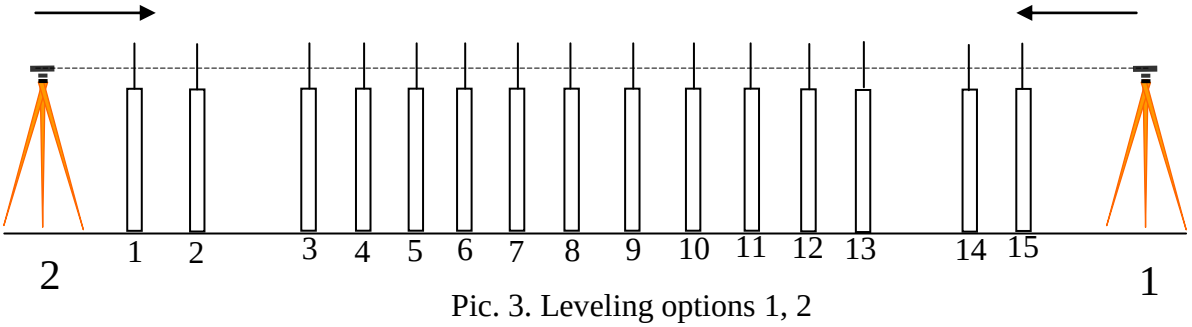
Analysis of recent researchand publications. We know that one of the most effectiveness methods of investigations of measuring equipment is it's standardization on fixed excellence bases [1-4].

Presenting main material.The program of observationsbetween points ofbasis providefiveoptions ofmeasuringexceedances.The first option - levelingalong the direction15-1(Pic.3), the second - in the direction 1-15(Pic.3), third and fourth options - levelingfromone stationfrom the middle part ofthe base,as shownon Pic.4, the fifth option-levelingfromthe middlebetween two neighborpoints (Pic. 5).

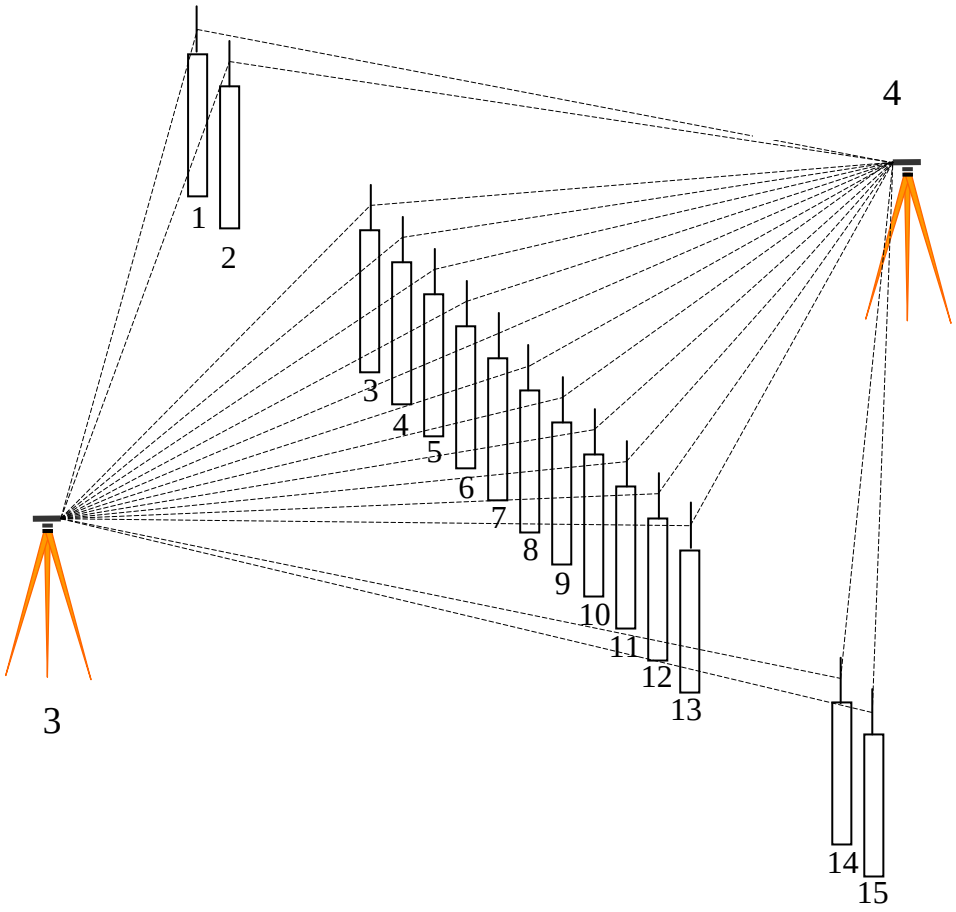
To executethe program we usedleveling instrumentNV(HB)-1 and a special device -a steelrulerwithsphericallevelattached tocastecenteringforcedscrew(Pic.2).



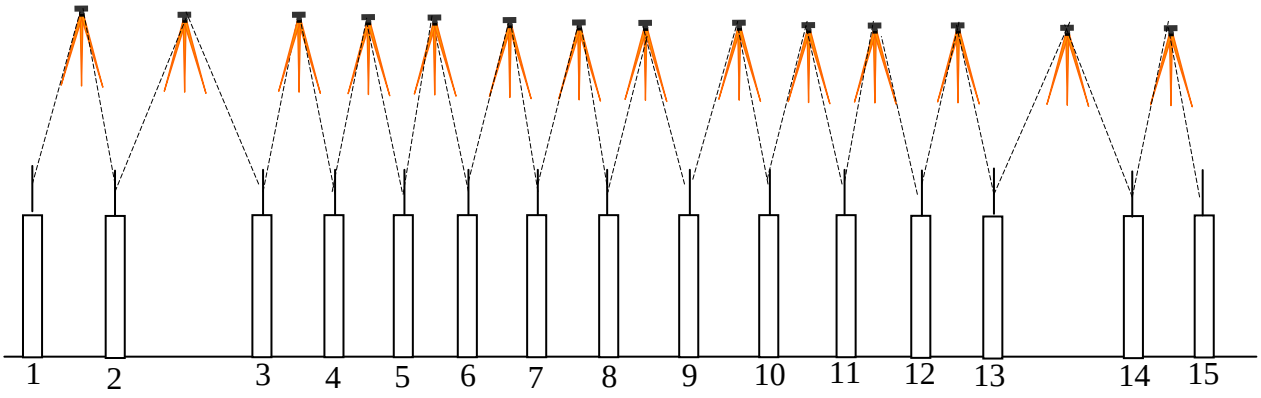
Pic. 2. Measuring device



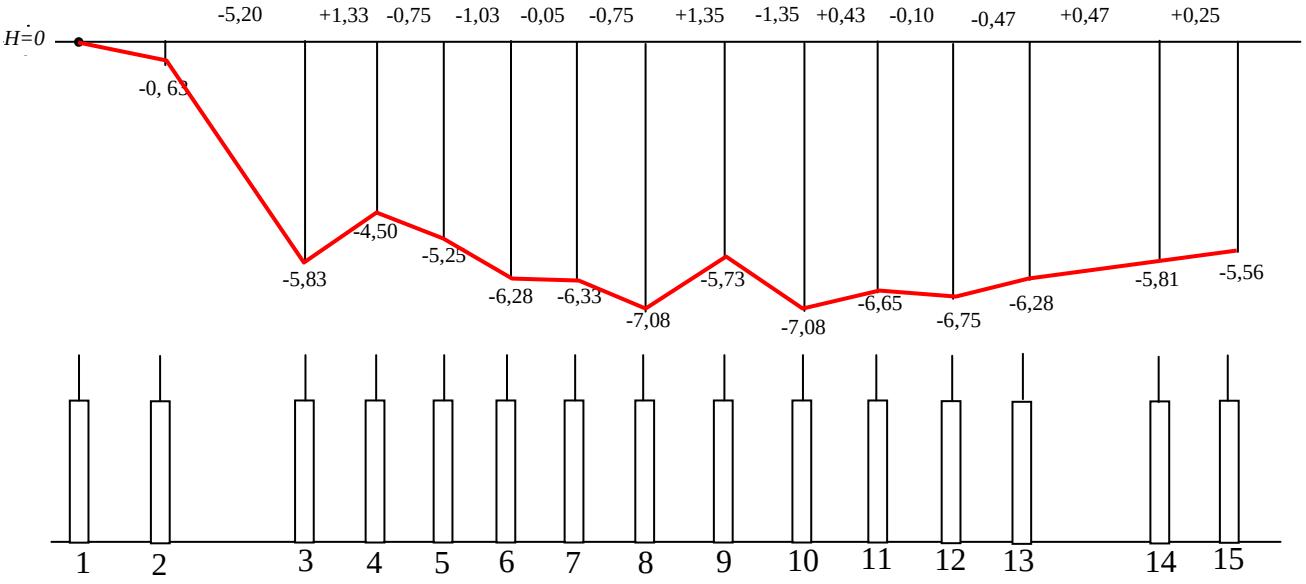
Pic. 3. Leveling options 1, 2



Pic. 4. Leveling options 3, 4



Pic. 5. Leveling options 5



Pic. 6. Longitudiral profile

Pic.6 shows thelongitudinal profilebasis(excessgiven inmm).

Table1 showsbaseexcess between the points, measured byelectronictotal station.

Pic.2 shows adevicewith help of which weenforcedleveling of points.

Table 1

Excess between points, measured by electronic total station

№of points excess	1-2	2-3	3-4	4-5
h	-0,70	-5,50	+2,1	-0,10
№ of points excess	5-6	6-7	7-8	8-9
h	-1,10	-0,20	-0,80	+0,30
№ of points excess	9-10	10-11	11-12	12-13
h	-0,40	-0,30	+0,80	-0,60
№ of points excess	13-14	14-15		
h	-0,30	-0,20		

Data of the fifth option, as the most accurate, is shown in Table 2.

Table 2

The results of leveling from p.15 to p.1

№ of points excess	1-2	2-3	3-4	4-5
h	-0,90	-5,00	1,10	-0,40
№ of points excess	5-6	6-7	7-8	8-9
h	-1,00	0,30	-1,00	1,00
№ of points excess	9-10	10-11	11-12	12-13
h	-1,30	0,00	0,00	-0,40
№of points excess	13-14	14-15		
h	-0,10	-0,20		

Heremeansquare error is *m*=0,5mm.

Thedateofthefirstoption is shown in Table 3.

Table 3

The results of leveling from p.1 to p.15

№ of points excess	1-2	2-3	3-4	4-5
h	2,40	8,50	-2,10	1,40
№of points excess	5-6	6-7	7-8	8-9
h	12-13	13-14	14-15	-2,20
№ of points excess	9-10	10-11	11-12	12-13
h	2,30	-0,20	0,00	0,90
№ of points excess	13-14	14-15		
h	1,20	0,80		

Meansquareerror is *m*=1,29mm.

Theresultsofoption 2 is shown in Table 4.

Table 4

The results of leveling from the middle of p.1 to p.15

№ of points excess	1-2	2-3	3-4	4-5
h	-0,20	0,40	-1,50	0,90
№ of points excess	5-6	6-7	7-8	8-9
h	12-13	13-14	14-15	-1,2
№ of points excess	9-10	10-11	11-12	12-13
h	1,2	-0,2	0,2	1,1
№ of points excess	13-14	14-15		
h	0,2	0,6		

Mean square error is *m*=0,83mm.

TheTable 5 isaboutdateofmeansquarevalue of first two options.

Table 5

Theresultsoflevelingof first two options

№ of points excess	1-2	2-3	3-4	4-5
h	-1,55	-3,05	-0,15	0,55
№ of points excess	5-6	6-7	7-8	8-9
h	0,10	0,50	-0,2	-0,20
№ of points excess	9-10	10-11	11-12	12-13
h	-0,20	0,10	0,40	-0,75
№ of points excess	13-14	14-15		
h	-0,8	0,99		

The middle value of square error is *m*=1,29mm.

Nowlet’s see the leveling from one point from middle from the left side. Data is shown in Table 6.

Table 6

The results of leveling from one point from middle from left side

№ of points excess	1-2	2-3	3-4	4-5
h	5,40	-1,40	0,15	-0,40
№ of points excess	5-6	6-7	7-8	8-9
h	-0,10	-0,20	0,00	0,80
№of points excess	9-10	10-11	11-12	12-13
h	-0,30	0,50	-0,10	0,20
№ of points excess	13-14	14-15		
h	0,60	-0,20		

Meansquareerroris *m*=1,53mm.

Letsseethelevelingfromonepointfromm iddle from right side. Data is shown in Table 7.

Table 7

The results of leveling from one point from middle from right side

№ of points excess	1-2	2-3	3-4	4-5
h	0,30	-0,90	0,00	0,10
№ of points excess	5-6	6-7	7-8	8-9
h	0,20	-0,20	0,60	0,20
№ of points excess	9-10	10-11	11-12	12-13
h	-0,30	0,80	-0,10	0,30
№ of points excess	13-14	14-15		
h	0,20	0,10		

Mean square error is *m*=0,40mm.

General leveling from middle gave us such results, which are show in Table 8.

Table 8

The results of general leveling from the middle

№ of points excess	1-2	2-3	3-4	4-5
h	2,85	-1,15	0,30	-0,15
№ of points excess	5-6	6-7	7-8	8-9
h	0,05	-0,20	0,30	0,50
№ of points excess	9-10	10-11	11-12	12-13
h	-0,30	0,65	-0,10	0,25
№ of points excess	13-14	14-15	13-14	14-15
h	0,40	0,10	0,40	0,10

The middle value of mean square error is *m*=1,29 мм.

Let’s see the impact of the proposedmethods (options) of observations,namely:1."samples in direction";

2. "samplesfrom the middle" on the resultsof observations.

We know thatthe main requirement forgeodeticobservationsisthatthey eitherdid not containsystematic errorsor thoseerrorswereof the same orderand theycan be neglected.This meansthat the accuracyof observationscharacterized bythe same parameter - standard deviation (standard). For this we can examine the homogeneity of the results of observations on the proposed methodology relative to the center grouping (the average value of a desired size) using ANOVA (analysis of variance).

Table 9

The true meaning of observation errors

Methodic	№ of point of basis			
	1	2	3	4
1	-0,65	-0,45	-0,15	0,55
2	-0,10	-0,65	-,30	-0,15
Methodic	№ of point of basis			
	5	6	7	8
1	0,10	0,50	-0,20	-0,20
2	0,05	-0,20	0,30	0,50
Methodic	№ of point of basis			
	9	10	11	12
1	-0,20	-0,20	0,10	0,40
2	-0,30	0,65	-010	0,25
Methodic	13	14		
	-0,75	-0,80		
1	0,40	0,10		
2	13	14		

To test the hypothesisH_0:systematic effect is absentoris of the same order (hypothesis H_0–systemiceffects are significant) we used Fisher criterion $F = \frac{S_1^2}{S_2^2}$ for assess thedifference between thevariancesbyfactor S_1^2 and the residual та залишкової S_2^2 of significance α = 0,01and α = 0,005.

Calculationsare presentedin Table.10 and11.

Table 10

Calculation of variance estimates

Varia-nce compo-nents	Q	Number of deegrees of arbitrai-ness	Esti-mate vari-ance
Inter-group (by factor)	0,321429	1	0,321429
Resi-dual	4,074643	26	0,156717
General	4,396071	27	0,162817

Table 11

Calculation of critical limits area F_α

Level of significance α $P(F > F_\alpha) = \alpha$	$F = \frac{S_1^2}{S_2^2}$	F_α
0,01	2,051012	7,7213
0,02	2,051012	4,2252

From Table 11 we can see, that for all levels of signification $F<F_\alpha$.

Conclusion. So we can say that that the nullhypothesis H_0 is accepted, that effect of above presented observation methods do not have any significant systematic errors, andevaluation ofdifferentvariancesamong ourselvesdue to randomfactors.

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In 2009, the education and research geodesic polygon Lviv National Agrarian University was established linear basis 2nd category, serving a variety of certifications for meteorological surveying instruments. Made some observations.