"Environmental Engineering" 10th International Conference
Vilnius Gediminas Technical University
Lithuania, 27–28 April 2017
http://enviro.vgtu.lt

eISSN 2029-7092 / eISBN 978-609-476-044-0

Article ID: enviro.2017.166
DOI: https://doi.org/10.3846/enviro.2017.166

Final Results of Establishment of the Geodetic Vertical Second Order Network of Lithuania

Rosita Birvydienė, Algirdas Butkus, Arūnas Būga, Ramūnas Dedela, Ričardas Kolosovskis, Boleslovas Krikštaponis, Arvydas Musteikis, Algirdas Neseckas, Romuald Obuchovski, Eimuntas Paršeliūnas, Marius Petniūnas, Petras Petroškevičius, Vytautas Puškorius, Raimundas Putrimas, Gediminas Skuodis, Jadvyga Stepanovienė, Dominykas Šlikas, Tautvydas Šorys, Eglė Tumelienė, Simonas Valotka, Povilas Viskontas, Evelina Zigmantienė

Institute of Geodesy, Vilnius Gediminas technical university, Vilnius, Lithuania
E-mails: gi@vgtu.lt

Abstract. The methodology of all kinds of geodetic measurements of the Geodetic Vertical Second Order Network, the information on the observation data received and main results of the accuracy estimation and adjustment of the network are presented.
In 2006 the development of the Geodetic Vertical First Order Network of Lithuania was completed. It was the basis to adopt the Height System of Lithuania (LAS07). The densification of the Geodetic Vertical First Order Network started in 2010 by development of the Geodetic Vertical Second Order Network. The Second Order Network consists of 74 levelling lines, and total length of them is 3087 km. In the period of 2010–2013 the 16 levelling lines (814 km) were observed. Rest of levelling lines were observed in 2013–2016. Total number of benchmarks is 2099. The levelling was executed by digital levels Trimble DiNi12 and coded rods Nedo LD13. All ground benchmarks were positioned by GPS receivers Trimble 5700 and Trimble Zephyr Geodetic antennas. LitPOS stations served as fiducial points. The gravity accelerations at all benchmarks were observed by gravimeters Scintrex CG-5.
The levellings of the Second Order Network carried out is characterized by high precision: the double run of one kilometre levelling RMS error does not exceeds 0.7 mm. The adjustments of the second order levelling lines applying least square method were executed separately in each region outlined by the First Order network lines and border of a country.

Keywords: levelling, digital level, vertical network, height system.

Conference topic: Technologies of Geodesy and Cadastre.

Introduction

Activities of Lithuanian National Geodetic Vertical Reference Network (NGVRN) establishment are going on since 1998 (Petroškevičius, Paršeliūnas 1998; Lithuanian National Geodetic… 2001; Petroskevicius *et al.* 2005a, 2005b, 2005c; Mäkinen *et al.* 2005; Buga *et al.* 2005; Būga *et al.* 2006, Putrimas *et al.* 2008; Krikstaponis, Tumeliene 2011; Kazakevičius *et al.* 1999). The goal of NGVRN establishment is a creation of new Lithuanian height reference, based on the European Vertical Reference System, and which could be suitable for present period practical and scientific needs (Augath *et al.* 2000; European Vertical Reference… 2000; Krikstaponis *et al.* 2007; Paršeliūnas 2008a). The NGVRN consists of five polygons. Perimeter of the network is ca. 1900 km. Its development was finished in 2006. Connections of the first order vertical network with the vertical networks of neighbouring countries were established (one – with Polish vertical network, three – with Latvian vertical network) (Parseliunas 2008a; Aleksejenko *et al.* 2011). All this creates good preconditions for determination of relations between height systems and for introduction of a new Lithuanian geodetic vertical (height) system. But this network is not dense enough to transfer the geodetic vertical system to the all territory of Lithuania and to improve the linkage of the geoid model to GPS/levelling points. So it is necessary to dense existing NGVRN by developing the Second Order Geodetic Vertical Network. The project of the Second order network was prepared in 2005–2006 (Krikštaponis *et al.* 2014; Kazakevicius, Tumeliene 2005), therefore its implementation was stopped by economic crisis. Nowadays the works to develop the Second Order Geodetic Vertical Network of Lithuania are completed.

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Design of the Second Order Geodetic Vertical Network

The territory of Lithuania (65.3 th.sq.km) is divided in to five regions. Borders of the regions are First Order Network levelling lines and lines connecting Lithuanian national Vertical Network to the corresponding networks of the neighbouring countries (Aleksejenko *et al.* 2012; Krikstaponis, Tumeliene 2011). Lines of Second Order Geodetic Vertical Network are arranged in such way that any point inside or outside the polygon will be in less than 30 km away from benchmarks of First and Second Order Network. Were possible levelling lines were projected through gravimetric points of first class, existing National levelling benchmarks and National GPS Network points (which are mounted in appropriate way).

The project of Second Order Network of each region was created individually, based on the benchmarks of First Order Network which are in territory of this region. Existing road network, relief and specific conditions of locality was taken into account (Fig. 1).

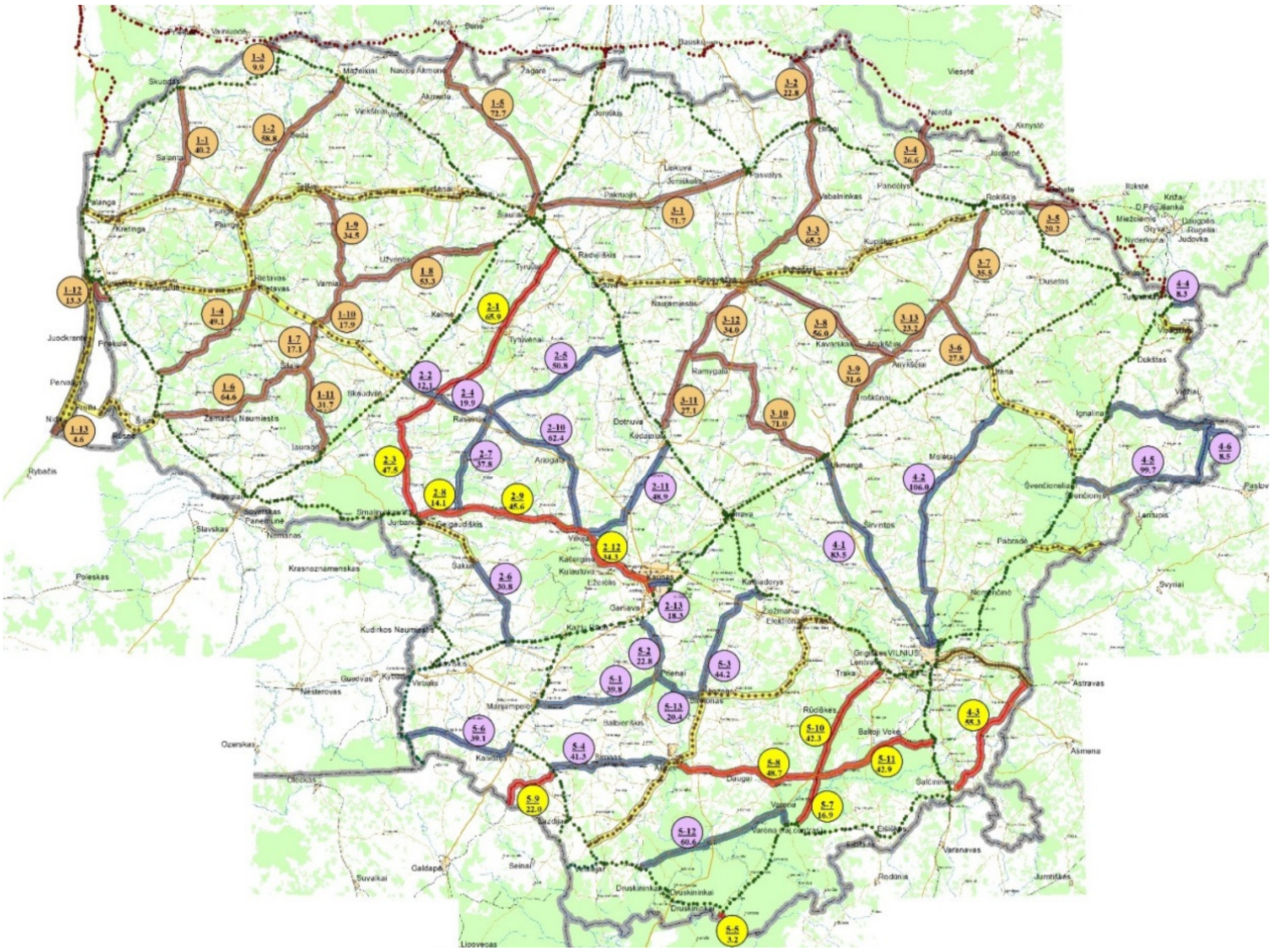

Fig. 1. Scheme of Second Order Geodetic Vertical Network of Lithuania (lines in bold; the lines codes and lengths are presented in circles; observed in 2006–2012 coloured in yellow, in 2013 – red, in 2014 – blue, in 2015, 2016 – brown)

Design of the Network

Design of the Geodetic Vertical Second Order Network was done according to requirements of (Lithuanian National Geodetic… 2001). Some levelling lines consist with the existing levelling lines of different epochs. It was necessary to establish more than 50% new benchmarks. The types of new ground and wall benchmarks are presented in Fig. 2 and 3.

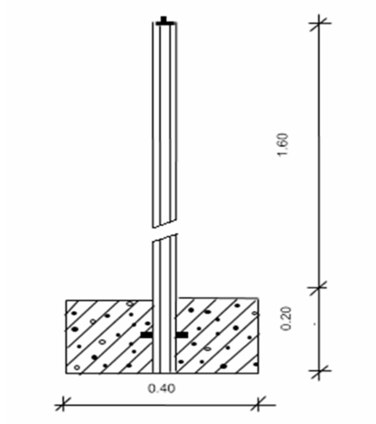

Fig. 2. Scheme of Ground benchmark (type 155)

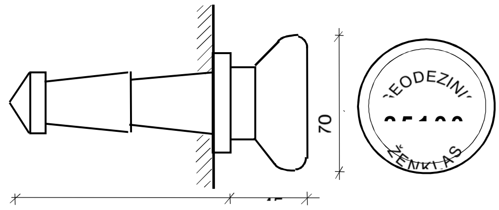

Fig. 3. Scheme of Wall benchmark (type G-10)

An information on all levelling lines and benchmarks of the Geodetic Vertical Second Order Network is presented in Table 1.

Table 1. An information on levelling lines and benchmarks of the Geodetic Vertical Second Order Network

Code of line	Title of line	Length, km	Number of stops	Year of observa-tions	Benchmarks					
					Newly mounted		Existing			Total num-ber
					Ground benchmarks	Wall bench-marks	Fund. benchm	Ground benchmarks	Wall bench-marks	
1	2	3	4	5	6	7	8	9	10	11
1	Palanga–Kretinga	13.15	194	2006	1	2	–	3	5	11
2	Kužiai–Telšiai	58.12	714	2006	7	15	1	3	16	42
3	Šeduva–Panevėžys	48.91	684	2006	4	17	–	6	6	33
4	Kiduliai–Šakiai	24.86	296	2006	9	8	–	1	3	21
5	Klaipėda–Rietavas	52.54	664	2006	12	16	–	–	9	37
6	Gudeliai–Alytus	44.03	724	2006	11	14	–	1	6	32
7	Vievis–Elektrėnai	12.02	190	2006	1	5	2	–	1	9
8	Šilutė–Nida–Klaipėda	102.80	1160	2010	11	15	–	22	16	64
9	Rokiškis–Panevėžys	84.43	1236	2011	34	–	2	4	14	54
10	Telšiai–Plungė–Kret-inga	74.28	1072	2011	30	3	1	4	14	52
11	Alytus–Elektrėnai	80.57	1160	2012	26	7	4	4	7	48
12	Vilnius–Šumskas	36.37	460	2012	34	7	–	1	1	43
13	Pabradė–Gelednė	25.37	294	2012	2	5	–	6	1	14
14	Utena–Švenčionėliai	49.18	588	2012	–	11	–	8	3	22
15	Visaginas–Varniškiai	21.70	324	2012	–	–	–	22	–	22
16	Plungė–Rietavas–Stul-giai	85.83	1136	2012	1	13	–	12	16	42
2-1	Mankiškiai–Viduklė	65.94	728	2014	62	1	–	1	–	64
2-2	Kryžkalnis–Viduklė	12.05	180	2014	–	4	–	2	–	6
2-3	Jurbarkas–Viduklė	47.46	614	2014	16	7	–	8	2	33
2-4	Viduklė–Raseiniai	19.94	294	2014	2	2	–	3	6	13
2-5	Raseiniai–Skėmiai	50.78	722	2014	9	9	–	7	6	31
2-6	Šakiai–Pilviškiai	30.80	422	2014	1	7	–	7	5	20
2-7	Šilinė–Raseiniai	37.83	518	2014	5	8	–	9	2	24
2-8	Šilinė–Jurbarkas	14.10	168	2013	–	4	–	3	2	9
2-9	Vilkija–Šilinė	45.60	582	2013	1	11	1	8	12	33
2-10	Raseiniai–Ariogala–Vilkija	62.38	910	2014	10	6	–	7	17	40
2-11	Vilkija–Kėdainiai	48.88	688	2014	7	10	–	8	5	30
2-12	Kaunas–Vilkija	34.25	448	2013	–	7	–	9	8	24
2-13	Kaunas	18.26	266	2014	–	1	–	5	7	13
5-1	Prienai–Marijampolė	39.79	482	2014	11	10	1	–	–	22

End of Table 1

1	2	3	4	5	6	7	8	9	10	11
5-2	Pagiriai–Prienai	22.81	340	2014	4	6	–	2	–	12
5-3	Kaišiadorys–Verbyliškės	44.20	648	2014	8	3	–	7	11	29
5-4	Alytus–Šeštokai	41.31	540	2014	3	7	–	7	7	24
5-5	Margionys–Baltarusijos siena	3.18	36	2014	4	–	–	–	–	4
5-6	Kalvarija–Vištytis	39.06	536	2014	8	6	–	5	3	22
5-7	Naujieji Valkininkai–Varėna	16.91	180	2014	17	–	1	2	–	20
5-8	Naujieji Valkininkai–Alytus	48.73	568	2014	6	8	–	4	2	20
5-9	Šeštokai–Lenkijos siena	21.80	288	2016	13	3	–	–	–	16
5-10	Lentvaris–Naujieji Valkininkai	42.30	520	2014	40	–	–	5	2	47
5-11	Jašiūnai–Naujieji Valkininkai	42.92	570	2014	3	10	–	9	1	23
5-12	Varėna–Merkinė–Leipalingis	60.57	760	2014	10	15	–	8	12	45
5-13	Verbyliškės–Prienai	20.43	310	2014	1	2	–	3	7	13
4-1	Vilnius–Ukmergė	83.46	1304	2015	5	22	–	23	20	70
4-2	Vilnius–Molėtai–Kuk-tiškės	106.04	1672	2015	4	23	–	35	18	80
4-3	Šalčininkai–Šumskas	55.28	952	2014	6	9	–	10	9	34
4-4	Kazimieravas–Baltarus-ijos siena	8.28	144	2015	–	1	3	11	1	16
4-5	Ignalina–Didžiasalis–Švenčionėliai	99.74	1394	2014	15	16	–	19	17	67
4-6	Marijampolis–Lazinkos	8.54	112	2014	–	1	–	2	–	3
3-1	Šiauliai–Pakruojis–Pasvalys	71.69	940	2015	18	8	–	9	10	45
3-2	Biržai–Latvijos siena	22.84	306	2015	3	3	–	7	1	14
3-3	Panevėžys–Vabalninkas–Biržai	65.17	872	2015	10	7	–	18	6	41
3-4	Pandėlys–Latvijos siena	26.63	376	2015	1	1	–	8	7	17
3-5	Obeliai–Latvijos siena	20.16	250	2015	13	1	–	1	3	18
3-6	Utena–Svėdasai	27.82	430	2015	6	4	–	4	5	19
3-7	Svėdasai–Rokiškis	35.50	518	2015	8	1	–	7	6	22
3-8	Panevėžys–Anykščiai	55.98	748	2015	11	7	1	6	6	31
3-9	Anykščiai–Kavarskas–Radiškis	31.56	496	2015	2	3	–	9	11	25
3-10	Ukmergė–Krekenava	71.03	970	2015	10	11	–	19	12	52
3-11	Kėdainiai–Krekenava	27.08	384	2015	5	3	–	6	5	19
3-12	Krekenava–Panevėžys	34.00	486	2015	2	4	1	9	10	26
3-13	Anykščiai–Svėdasai	23.16	342	2015	4	3	–	2	3	12
1-1	Skuodas–Kulupėnai	40.26	506	2016	6	7	–	5	10	28
1-2	Plungė–Mažeikiai	57.90	654	2016	9	12	–	10	2	33
1-3	Lūšė–Latvijos siena	9.90	140	2015	4	2	–	–	–	6
1-4	Rietavas–Saugos	50.04	622	2016	9	5	–	8	12	34
1-5	Šiauliai–N. Akmenė–Latvijos siena	72.18	800	2016	17	10	–	9	11	47
1-6	Šilalė–Šilutė	64.54	832	2016	12	4	–	17	15	48
1-7	Šilalė–Laukuva	17.69	276	2016	1	2	–	5	4	12
1-8	Bubiai–Varniai	53.34	650	2016	14	5	–	5	6	30
1-9	Varniai–Telšiai	34.69	448	2016	7	5	–	5	7	24
1-10	Varniai–Laukuva	16.85	242	2016	–	4	–	6	1	11
1-11	Šilalė–Tauragė	31.47	434	2016	3	2	–	14	3	22
1-12	Klaipėda	13.50	182	2014	–	2	–	–	6	8
1-13	Nida–Rusijos siena	4.53	70	2016	1	–	`–	1	–	2
	Σ	3087.29	41766		630	473	18	516	462	2099
					1103 – 52.5%			996 – 47.5%		100%

In total it was established 1103 new ground and wall benchmarks (52.5%) in the Geodetic Vertical Second Order Network, used existing – 996 (47.5%). There are 1164 ground benchmarks (55.5%) and 935 (44.5%) in the network. It is necessary to stress, that into network was included the big part of main geodetic reference points: zero order GPS points Meškonys, Šašeliai and Akmeniškiai, 290 GPS points of other orders, LitPOS stations, 13 points of first order gravimetric network.

Precise levelling

The precise levelling of the Geodetic Vertical Second Order Network was executed according to requirements of (Lithuanian National Geodetic… 2001).

The two level's sets Trimble DiNi12 were used. They were researched, calibration of coded staffs was done, additional equipment was checked preparing to field expeditions.

Height differences between benchmarks of vertical network were measured forward and backward. Number of stations between neighbouring benchmarks was always even. Staffs were interchanged when direction of levelling was changed. For the mean reading from the staff about 5 readings with the accuracy of 0.01 mm were done. Height difference at station measured twice did not exceed 0.25 mm. Distances to the staffs were measured in every station with accuracy of 0.01 m. Length of sight did not exceed 50 m. Difference of sight length in the station was less than 0.5 m. Accumulation of such differences between neighbouring points was below 1.0 m. Temperature of invar bands was measured by contact electronic thermometers Ama-digit ad 30th with 0.1 °C accuracy. Staff invar band temperature was determined at the height 1.5 m.

Final height differences and geopotential numbers between benchmarks were calculated by special computer programs, developed by Institute of Geodesy, Vilnius Gediminas Technical University.

Finally could be stated, that there are 2239 levelling runs between all benchmarks of the Vertical Second Order Network. Average length of lines is 1.38 km, average distance from level till rods is 37 m.

Gravity measurements

The gravity accelerations measurements were executed at the benchmarks of the Geodetic Vertical Second Order Network to estimate the gravity field non-homogeneity what should be taken into account in the calculations of the most reliable geopotential numbers (Petroškevičius *et al.* 2008; Petroškevičius, Popovas 2010). The two relative gravimeters SCINTREX CG-5 were employed for observations. The gravimeters were calibrated at calibration base EIŠIŠKĖS, VILNIUS, PANEVĖŽYS, SALOČIAI (Paršeliūnas *et al.* 2013). The first and second order gravity points were served as fidutial stations (Birvydienė *et al.* 2009; Paršeliūnas *et al.* 2010). Average distance between fidutial stations is about 10 km.

The average value of the standard deviations of the gravity accelerations at the benchmarks of the Geodetic Vertical Second Order Network equal to 13.6 μGal was received. The accuracy was calculated analysing the double measurements differences.

Ground benchmarks positioning

The ground benchmarks of vertical network were positioned by 6–8 GPS receivers Trimble 5700 with Trimble Zephyr Geodetic antennas. LitPOS stations served as fiducial points (Paršeliūnas *et al.* 2008, 2008a, 2008b). Inclined antenna height from three antenna sides was measured in meters and in inches for control. Data registration interval was 10 seconds and cut off angle was 5°. Depending on observation conditions and distances from the GPS stations, measurement sessions lasted for 2.5–4 hours. Baselines connecting National Geodetic Vertical and GPS networks were computed and adjusted by Trimble Total Control software package. Typical scheme of GPS measurements is presented in Fig. 4.

Quality evaluation of the precise levelling

Quality of the precise levelling of the Geodetic Vertical Second Order Network is controlled according to height difference tolerances computed for the levelling run. All discrepancies of height difference should do not exceed:

$$\delta = 3.0\ mm\sqrt{L}, \tag{1}$$

where L – length of levelling line in km.

After finishing the precise levelling based on double (forward and backward) run the levelling discrepancies distribution was be estimated. Levelling results are correct if they satisfy formula (1). The discrepancies of formulae (1) were distributed into intervals from 0 increasing every ±0.5 mm: $|0-0.5|mm\sqrt{L}$, $|0.5-1.0|mm\sqrt{L}$, $|1{,}0-1{,}5|mm\sqrt{L}$, $|1.5-2.0|mm\sqrt{L}$, $|2.5-2.0|mm\sqrt{L}$ and $\geq|2.5|mm\sqrt{L}$. Histograms are presented in Fig. 5–6.

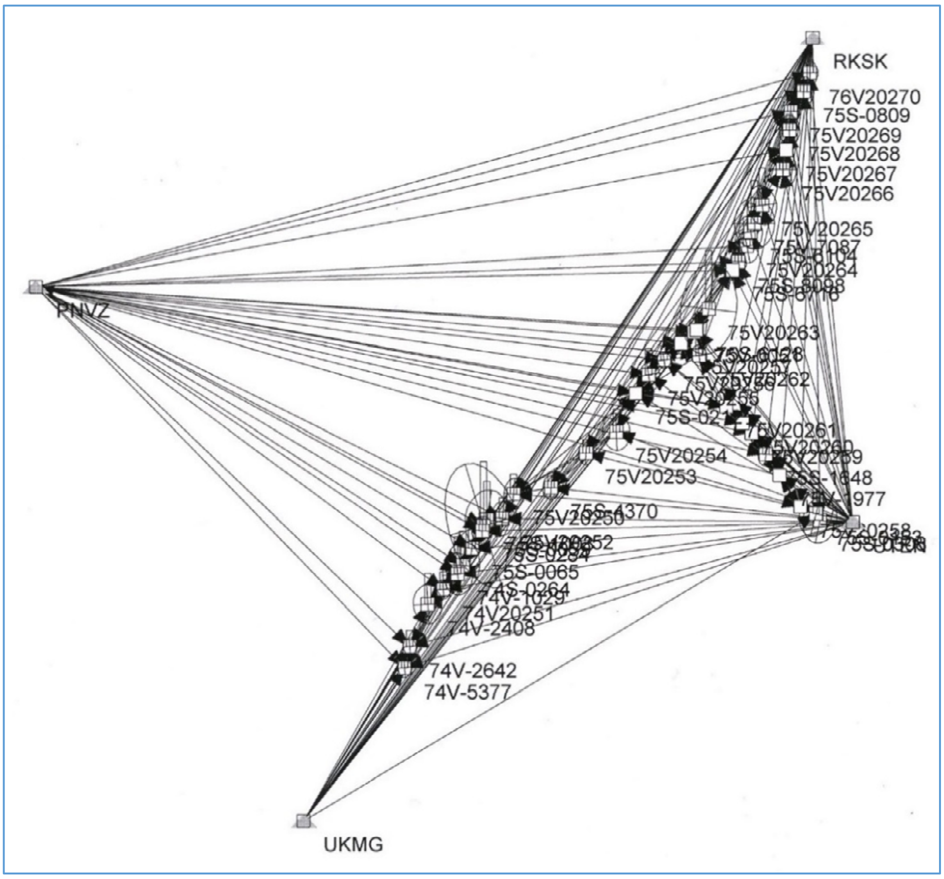

Fig. 4. Typical scheme of ground benchmarks positioning

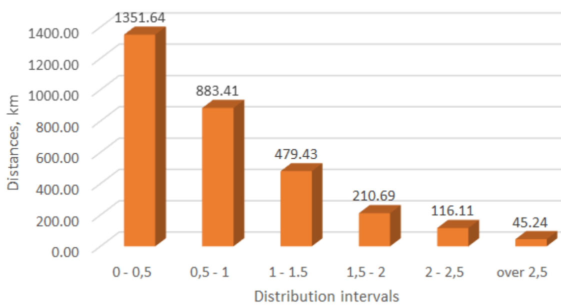

Fig. 5. Results of quality evaluation of precise levelling

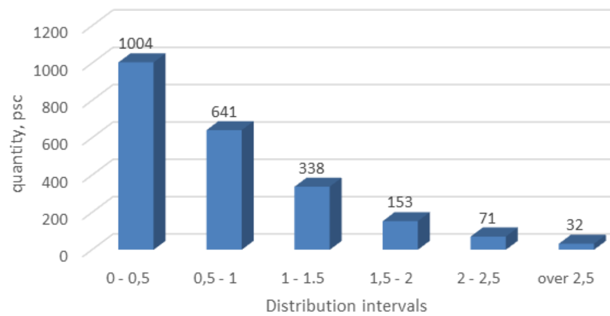

Fig. 6. Results of quality evaluation of precise levelling

RMS error of weight unit of levelling run (one kilometre) is computed from formula (8)

$$\mu = \sqrt{\frac{[pd^2]}{2n}}, \tag{2}$$

where $p = 1/L$ – weight of height difference, L – distance between points in kilometres, d – discrepancy of double levelling height difference, n – number of discrepancies.

RMS error of double levelling of one km length run is computed according to formula:

$$m_{km} = \frac{\mu}{\sqrt{2}}. \tag{3}$$

The systematic errors were calculated following the formula

$$\delta_s = \frac{[pd]}{[p]} \tag{4}$$

and their influence was estimated according to inequality

$$\left| \left[d\sqrt{p} \right] \right| \leq 0.25 \left[\left| d\sqrt{p} \right| \right]. \tag{5}$$

When inequality (5) is satisfied, the systematic errors could be ignored. Characteristics of the precise levelling accuracy are presented in Table 2.

Table 2. Characteristics of the precise levelling accuracy

Code of line	Title of line	δ_s	$\left\| \left[d\sqrt{p} \right] \right\|$	$0.25\left[\left\| d\sqrt{p} \right\| \right]$	m_{km}, mm
1	2	3	4	5	6
1	Palanga–Kretinga	0.27	4.1	1.6	0.31
2	Kužiai–Telšiai	0.27	13.7	6.1	0.32
3	Šeduva–Panevėžys	0.24	28.3	12.2	0.35
4	Kiduliai–Šakiai	0.20	7.9	2.5	0.31
5	Klaipėda–Rietavas	0.29	12.9	6.9	0.46
6	Gudeliai–Alytus	0.23	7.1	4.6	0.35
7	Vievis–Elektrėnai	0.12	3.6	1.1	0.25
8	Šilutė–Nida–Klaipėda	0.03	13.2	3.7	0.12
9	Rokiškis–Panevėžys	–0.04	0.6	4.5	0.35
10	Telšiai–Plungė–Kretinga	0.03	21.3	14.0	0.36
11	Alytus–Elektrėnai	0.01	1.3	7.1	0.37
12	Vilnius–Šumskas	0.02	4.3	6.2	0.36
13	Pabradė–Geledne	0.06	0.4	2.4	0.43
14	Utena–Švenčionėliai	–0.46	8.5	3.4	0.35
15	Visaginas–Varniškiai	–0.13	4.2	4.0	0.47
16	Plungė–Rietavas–Stulgiai	0.08	2.6	6.7	0.37
2-1	Mankiškiai–Viduklė	0.34	21.6	16.6	0.62
2-2	Kryžkalnis–Viduklė	0.36	7.4	1.8	0.17
2-3	Jurbarkas–Viduklė	0.40	13.6	7.5	0.51
2-4	Viduklė–Raseiniai	0.69	8.0	3.7	0.62
2-5	Raseiniai–Skėmiai	0.35	11.2	7.0	0.51
2-6	Šakiai–Pilviškiai	0.19	3.3	3.8	0.45
2-7	Šilinė–Raseiniai	0.36	7.9	3.7	0.34
2-8	Šilinė–Jurbarkas	0.05	0.1	0.9	0.26
2-9	Vilkija–Šilinė	–0.03	0.4	4.3	0.34
2-10	Raseiniai–Ariogala–Vilkija	0.01	5.9	6.2	0.38
2-11	Vilkija–Kėdainiai	0.18	3.3	5.7	0.49
2-12	Kaunas–Vilkija	0.07	3.4	3.4	0.32
2-13	Kaunas	0.23	1.8	1.6	0.30
4-1	Vilnius–Ukmergė	0.00	7.6	13.9	0.49
4-2	Vilnius–Molėtai–Kuktiškės	–0.01	4.5	12.2	0.42
4-3	Šalčininkai–Šumskas	0.30	14.1	5.7	0.46
4-4	Kazimieravas–Baltarusijos siena	0.00	1.7	1.8	0.33
4-5	Ignalina–Didžiasalis–Švenčionėliai	0.20	25.9	13.4	0.47
4-6	Marijampolis–Lazinkos	0.18	2.5	0.9	0.68

End of Table 2

1	2	3	4	5	6
5-1	Prienai–Marijampolė	0.27	4.0	3.0	0.33
5-2	Pagiriai–Prienai	0.14	4.7	2.4	0.51
5-3	Kaišiadorys–Verbyliškės	0.13	6.6	4.2	0.33
5-4	Alytus–Šeštokai	0.57	16.2	6.2	0.60
5-5	Margionys–Baltarusijos siena	0.51	5.2	1.3	0.23
5-6	Kalvarija–Vištytis	0.42	7.4	4.2	0.45
5-7	Naujieji Valkininkai–Varėna	0.13	4.3	3.3	0.40
5-8	Naujieji Valkininkai–Alytus	0.32	5.9	4.1	0.41
5-9	Šeštokai–Lenkijos siena	0.43	6.1	2.9	0.36
5-10	Lentvaris–Naujieji Valkininkai	0.29	18.5	9.5	0.44
5-11	Jašiūnai–Naujieji Valkininkai	0.03	0.2	3.9	0.42
5-12	Varėna–Merkinė–Leipalingis	0.01	0.1	7.4	0.47
5-13	Verbyliškės–Prienai	0.41	6.8	2.6	0.40
3-1	Šiauliai–Pakruojis–Pasvalys	0.03	4.4	9.2	0.52
3-2	Biržai–Latvijos siena	0.57	8.3	3.1	0.44
3-3	Panevėžys–Vabalninkas–Biržai	0.30	14.1	8.1	0.46
3-4	Pandėlys–Latvijos siena	0.04	1.7	2.2	0.30
3-5	Obeliai–Latvijos siena	–0.01	2.8	3.8	0.48
3-6	Utena–Svėdasai	0.44	15.5	4.5	0.52
3-7	Svėdasai–Rokiškis	0.20	8.7	4.3	0.48
3-8	Panevėžys–Anykščiai	0.17	10.0	7.0	0.58
3-9	Anykščiai–Kavarskas–Radiškis	0.27	11.2	5.1	0.46
3-10	Ukmergė–Krekenava	0.27	16.4	12.4	0.59
3-11	Kėdainiai–Krekenava	0.13	3.9	2.9	0.40
3-12	Krekenava–Panevėžys	–0.10	4.1	6.8	0.59
3-13	Anykščiai–Svėdasai	0.38	5.1	3.4	0.63
1-1	Kūlupėnai–Skuodas	0.22	4.8	7.4	0.66
1-2	Plungė–Mažeikiai	0.09	9.7	7.7	0.55
1-3	Lūšė–Latvijos siena	0.02	0.4	1.1	0.41
1-4	Rietavas–Saugos	0.25	13.3	7.4	0.47
1-5	Šiauliai–Naujoji Akmenė–Latvijos siena	0.32	16.4	9.9	0.51
1-6	Šilalė–Šilutė	0.16	9.0	10.3	0.51
1-7	Šilalė–Laukuva	0.87	11.6	3.0	0.43
1-8	Bubiai–Varniai	0.21	10.9	7.0	0.58
1-9	Varniai–Telšiai	0.43	13.3	5.1	0.48
1-10	Varniai–Laukuva	–0.06	2.0	2.7	0.57
1-11	Šilalė–Tauragė	0.06	0.2	4.6	0.46
1-12	Klaipėda	–0.23	2.6	1.0	0.30
1-13	Nida–Rusijos siena	–0.75	0.9	0.3	0.34

Based on Table 2 data it is clear that the RMS errors of the double run of one kilometre levelling do not exceed 0.7 mm. We could conclude that the precision levelling carried out is characterized by high accuracy and fits to requirements of (Lithuanian National Geodetic… 2001).

The adjustments of the second order levelling lines applying least square method were executed separately in each region outlined by the First Order network lines and border of a country.

Conclusions

The National Second Order Geodetic Vertical Network was developed. The network is composed of 70 lines, and total length is 3087 km. About 2250 benchmarks, 1200 of them newly mounted, were included into the Second Order Network.

RMS errors of the double run of one kilometre levelling do not exceed 0.7 mm. We could conclude that the precision levelling carried out is characterized by high accuracy and fits to requirements of (Lithuanian National Geodetic… 2001).

The National Vertical network and Height System of Lithuania (LAS07), adopted on its basis, fits to requirements of a modern country.

Acknowledgements

The research was supported by a grant No. 1DPS-(4.27)-1675/10552 of the National Land Service of Lithuania.

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