Technical Report about Engineering-Geological Studies Conducted with regards of the Technical Condition of the Cable Way Lower Old Station linked to Mtatsminda Part in Tbilisi City

Tbilisi

2016

Contents

Scope of Work

Regarding to implementation of engineering-geological studies

1. The title of the project - Technical Report about Engineering-Geological Studies Conducted with regards of the Technical Condition of the Cable Way Lower Old Station linked to Mtatsminda Part in Tbilisi City
2. The foundations shall be uncovered by the pits on the places spotted on the schematic plan of the construction by the constructor, three wells were made for identification of the lithological cut
3. The samples of the ground shall be taken from the bottom of the foundation and the samples of the water will be taken in case of identification of the ground water and relevant laboratory studies shall be carried out.
4. The technical analysis shall be conducted based on the implemented works

An expert Constructor: (signature) A. Kaipanjiani

I. General Part

I.1. Introduction

Based on the appeal of March 16 # 1001999816 to the Technological Development Fund, Levan Samkharauli Forensics Bureau, Kiriak Zavriev Construction mechanical engineering expertise department conducted the engineering and geological study works for technical condition of the Tbilisi Mtatsminda Part connecting cable way lower old station.

The goal of the study was:

- Study of the engineering and geological condition of the lower old station construction square;
- Identification of the parameters of the building foundation type, depth, foundation-ground types and their physical mechanical features;

The building has three floors. It is constructed in the 50s of the previous century. The shape of Ellipse in the plan. There is nothing known about conducted engineering and geological research regarding to the building construction. The material of the conducted geological and engineering-geological studies by former "Sakgeologist" and "Sainggeo" ltd and published literature are referred in the mentioned report.

For solution of the problem the following types and volume of the work are planned: before starting field work observation of all the adjacent area of the station building took place, geodynamic location was defined, three pits with entire volume 17.95 l. meter was made in the indicated places by the constructor

for the purpose of identification of the depth foundation-grounds. For identification of the district lithological cut, nearby are of the construction contour, including one 11 m, two of 12 m depth with total volume 35 m. The drilling took place by mechanical-column method. By non-stop take out of kern, dry drilling way, by drill УРБ2А2б 112-131mm diameter. During removal of mountain-remainders, the grounds were checked. 15 samples of destroyed and no-destroyed structures and 3 samples of ground water were taken. The study of the ground samples was conducted in the technical and experimental research lab chief specialist, T. Jajanidze. Making of pits and wells, accompanied field engineering-petrological description, as well as chemical analysis of water samples are made based on the agreement concluded with the engineering expertise department by the "Geotechservice" ltd. Topo-planning of the station construction in the scale 1:500, attaching of the wells and pits with the planned height was conducted by the engineering expertise department topographers.

The presented report is based on the field works, laboratory study data and above-mentioned fund and literature materials. The report is developed in Georgia, in accordance to the applied normative documents, s.n.and ts. 1.02.07-87 (engineering studies for constuction); s.n. and ts. – "the foundations of the buildings and constructions" (pn 02.01-08); s.n. and ts – "Seism-resistant construction" (pn 01.01.-09); state standard 25100-82 (grounds). The report is accompanied by summary table of the physical and mechanic characters of the study results and the results of the chemical analysis of the ground water; topographic plan of the lower station of the cable road, with the station construction contour wells and engineering and geological cut lines; well lithological columns; cuts of the pits, engineering and geological cuts of the studied square and photo documentation. Engineering and geological study was conducted in April 2016.

I.2 Location

The building of the lower station of the cable way connecting to the Mtastminda Park is located nearby the building of the Scientific Academy of Georgia. From the north it is bordered by the internal yard of the building of academy and station building, and from the east and south there are cement blocks and iron railings. There is the entrance for transportation to the construction from the eastern side.

1.3. Climate condition

Climate condition of the district is taken from the construction climatic norm pn 01.05.-08 according to the closest meteorological point to the district, according to the norm table 3, the construction area

belongs to the sub-district III. Average annual temperature is 12.7 ^{0}C. Annual total of the deposits is 560mm, daily maximum of deposits is 147mm.The weight of the snow cover is 0.5kpa, the number of the days with snow cover is 14, and relative average annual humidity of the air is 66%. There are more north-western, northern and southern-eastern winds on the district. The total number of the observations on the wind is 33%. The normative meaning of the wind pressure is 0.48kpa per 15 years. The highest speed of the wind per 20 year is 28m/sc. The normative depth of the ground seasonal freeze equals to 0.

1.4. Geomorphological Conditions

From the geomorphological prospective of cable way lower station building is located in the lower part of the sloped of the Mamadaviti northern–east exposition foothill and includes the part of the r. Mtkvari II upper valley, so called Saburtalo-Vake AVlabari terrace upper part, which is characterized artificial evened surface, with weak layer to the north. The land surface around the station building is within the frame of the absolute index 431.80-432.64m.

1.2.From the tectonic point of view the station square is located within the northern wing of Mamadaviti anticlinics. Upper Eocene (P23) age, the so-called Numulite Suite flysch sedimentary rocks participate in the formation of the station square and adjacent area geological composition, which are demonstrated by large and medium light grey granular sandstones and dark blackish argillite layers in turn. The azimuth of the inclination of the layers is 345^0. The inclination corner is 25-30^0. The strength of the layer is about 1250 m. The main layers in upcoming cut is covered by alluvial (aQrv), delluvial -prolluvial (dpQrv) and technogenic (tQrv) grounds. The strength of covering layer is about 9.2 m.

II. Special Part

II.1. Engineering-geological conditions

After observation of the nearby area of the station construction, no dangerous geological development emerging and development sign was noticed. The area is sustainable and it is in the satisfactory engineering and geological conditions in accordance to the s.n. and ts. 1.02-07-87 Annex 10. According to the complexity of the engineering-geographic conditions it belongs to the II (medium) complexity category.

According to the field and laboratory study results, 6 varieties or layers of the ground according to genesis, composition and status in the geological environment of the lower station square are distinguished: Layer # 1 - Bulk

Primer (tQIV); Layer # 2 - clay semi-solid (dpQIV); Layer # 3 - loam

d-plastic (dpQIV); Layer # 4 - gravel soils (aQIV); Layer # 5 - weathered

Sandstones and mudstones ($P2^3$); Layer # 6 - slightly weathered sandstones and

Mudstones ($P2^3$);

Detailed description of the mentioned layers is given below.

The description of the layers, depth intervals are given in the well lithologic columns.

II.2 Physical and mechanical characteristics of the ground

Layer # 1. Bulk ground (tQrv) is spread on the entire study square as the first layer from the land surface and cellar surface. The period of self-condensation has been completed. It is solved in all mountain-remainder, presented by gravel and in the form of construction material waste, fillers of the clay-garvelds. The layer is higher than the foundation of the station, therefore it is not tested in accordance to the fund material, the layer density is within p=1,8 g/cm³. The layer is waterless, the capacity of the layer is 0.4-5.9m.

Layer 2- brown clay, semi-solid (doQrv), carbonate, with rusty spots, thin layers of clayey sand, spread within the contour of the building and adjacent to the spoil, opened with well # 2 and pit # 2 accordingly on the depth of 0.6 and 4.6. The layer is checked by 2 samples of by inviolable structure. In the table # 1 below is given the variability range of the laboratory study results of the physical properties with the main characteristics and their average normative values.

Table #1.

#	Physical characteristics			dimension	Range the received volumes	Arithmetic means (normative)
1.	The number of plasticity		Ip	-	10.5-13.4	12
2.	Natural humidity		W	%	22.7-24.0	23.4
3.	Density	ground	p	g/cm³	1.86-1.96	1.93

		Dry ground	pd		1.50-1.62	1.56
		Pieces of ground	ps		2.69-2.70	2.70
4.	Pores		n	%	39.9-44.2	12.1
5.		Coefficient of Pores	e	-		0.729
6.		Indicator of the flow	IL	-	0.02-0.10	0.06
7.		Quality of humidity	Sr	-		0.868

According to the volumes given in the table the layer is classified as clay, semi-solid, as Ip-12, while indicator of the flowing is I_L=0.06.

According to the humidity quality given in the table the clay is saturated by water Sr>0.8. The volumes given in the table can be used for calculation.

Compression testing of 1 sample of natural humidity was conducted by one curve method, by loading gradually from 1.0kg/cm² up to 4.0 kg/cm². On 3.0kg/cm² water was supplied. Clay does not react on the water actually, relative sticking indicator E_{se}=0,0032. The module of the relative sticking Lp=61mm/m, according to which the clay belongs to the strong compressing Category IV. The meaning of the accepted deformation module by the experiment is low.

The test on the movement of the natural humidity of the ground was conducted by fast movement scheme 1.0; 2.0; 3.0 kgP.for loading. Experimentally obtained specific traction is unrealistic (too high). Deformation module (E) strength (Φ) C) values are taken from the physical characteristics (e; IL) according s.n. And sec."Buildings and structures bases" (PN 02.01-08) of Appendix 3 tables and comprising: Deformation module E=180 kg/cm2. Optional reporting resistance value is calculated by double interpolation method using the formula Ro = 2,4 kgf / cm 2. The strength of the layer is 0.9-4.6 meters.

Layer # 3 – clay brown, hardly plastic (dpQrv), carbon, with middle thick layers of clay-sand, spread under the bulk ground, opened by the wells ##1 and 3, on the nearby space of the station construction contour. The layer is tested by 3 samples the non-ruined structure. In the table #2 below is given the variability range of the laboratory study results of the physical properties with the main characteristics and their average (normative) values.

Table #2

#	Physical characteristics			dimension	Range the received volumes	Arithmetic means (normative)
1	The number of plasticity		Ip	-		13.1
2	Natural humidity		W	%		27.3
3	Density	Ground	p	g/cm³		1.95
		Dry ground	pd			1.53
		Pieces of ground	ps			2.70
4	Pores		n	%		43,1
5		Coefficient of Pores	e	-		0.759
6		Indicator of the flow	IL	-		0.33
7		Quality of humidity	Sr	-		0.973

According to the volumes given in the table the layer is classified as clay, hard plastic, as Ip-13.1,, while indicator of the flowing is I_L=0.33.

According to the humidity quality given in the table the clay is saturated by water Sr>0.8. The volumes given in the table can be used for calculation.

Compression testing of 3 samples of natural humidity was conducted by one curve method, by loading gradually from 1.0kg/cm² up to 4.0 kg/cm². On 3.0kg/cm² water was supplied. Clay does not react on the water actually, relative sticking indicator E_{se}=0,0007-0,0034. Demonstrating not-sticking character of the clay. The sticking module Lp 3.0 kg/cm2 is within Lp=62-77mm/m according to which the clay belongs to the strong compressing Category IV. The meaning of the accepted deformation module by the experiment is low.

Strength of the layer (Φ; C), deformation module values are taken from the physical characteristics (e; IL) according s.n. And sec."Buildings and structures bases" (PN 02.01-08) of Appendix 3 tables and comprising: Deformation module E=140 kg/cm². Optional reporting resistance value is calculated by double interpolation method using the formula Ro = 2,2 kgf / cm 2. The strength of the layer is 4.5-4.9 meters.

Layer # 4 – gravel ground with clay-sand fillers, spread within the station building contour and on the nearby area, opened by the pits ##1 and 2 and by all three wells in 4.7 and 5.9 m depth above surface. Fractured material is well elaborated. There are deposits, metamorphic and effusive rock variety. The layer is checked by the 4 samples of the ruined structure.

In the table #3 below is given the variability range of the laboratory study results of the physical properties with the main characteristics and their average (normative) values.

Table # 3

#	Physical characteristics			dimension	Range the received volumes	Arithmetic means (normative)
1	The number of plasticity		Ip	-	4.0-5.8	5.1
2	Natural humidity		W	%	1.0-5.9	3.6
3	Density	Ground	p	g/cm^3	2.05-2.10	2.08
		Dry ground	pd		1.95-2.07	2.0
		Pieces of ground	ps		2.51-2.54	2.53
4	Pores		n	%	18.2-23.4	20.9
5		Coefficient of Pores	e	-	0.233-0.206	0.265
6		Indicator of the flow	IL	-	-1.14-2.40	-2.07
7		Quality of humidity	Sr	-	0.114-0.490	0.334

According to the granulometer, the layer is classified as the gravel ground with clay-sand filler. The table gives the flow index and the values of plasticity number for the filler.

Strength of the layer (Φ; C), deformation module values are taken from the physical characteristics and for consolidated ground: the internal friction corner Φ=27^0; Specific traction kgf C = 0,08 / cm^2; Kgf deformation modulus E = 536 / cm^2; Optional reporting resistance value is taken from the s.n. and ts "The Foundations of the Buildings and Constructions" (pn 02.01-08 from the table of the Annex 3, Ro=4,5 kg/cm2.

(e; IL) according s.n. And sec."Buildings and structures bases" (PN 02.01-08) of Appendix 3 tables and comprising: Deformation module E=140 kg/cm^2. Optional reporting resistance value is calculated by

double interpolation method using the formula Ro = 2,2 kgf / cm 2. The strength of the layer is 3.1-3.6 meters.

Layer # 5 – Weathered sandstones and argillites ($P2^3$), open to all three wells under the gravel ground (layer 4) on the 9, 0-9,2 m depths. It is represented by fissured bluish-gray, thin and middle layer poly-mixture sand-stones and dark greyish fissured blackish to blue color thin layers with sheet argillites. Correlation of mentioned lithological varieties in the geological cut is within the 70:30%. From the erosive surface up to 1.0-2.0m the level of the weathered depth is decreasing gradually. Argillites are easily reacting on the weathering agents, while sandy stones are resistant to it. The layer is watered. The capacity of the layer is up to 1.5-2.0 m.

Layer # 6 – Consequence of the weakly infertile and argillite (P_2^3), weakly fissured thin and average layer poly-mixture sandy stones, clay cement and thin layer and thin layer sheet argillites. All three wells are opened on 8.4-10.5 m depth. It was impossible to take the sample due to argillite structure and fractured structures 7 samples are taken from the sand-stones. In the table #4 below is given the results of the laboratory tests of the sandy-stone samples.

Well ##	Interval of the sampling	Density p g/cm³	The range of the firmness on the one-axis compression Rk mpa (kgf/cm²)		Softening coefficient Ksof
			Natural	Water saturated	
1	9.5-9.7	2.50	492	362	0.74
1	11.3-11.5	2.43	276	159	0.58
2	9.5-9.7	2.56	582	433	0.74
2	10.8-11.0	2,51	253	152	0.60
3	10.0-10.2	2.50	564	408	0.72
3	11.3-11.5	2.58	550	394	0.72
3	11.8-12.0	2.60	598	446	0.75
Average values		2.53	474	336	0.69

As it is shown from the table, the limit of the firmness one-axis compression is changing for the sand-stones in the condition of the natural humidity within the range of 253-298 kgf/cm², Average value is 474kgf/cm². In the water saturated condition, the value of Rc of the sand –stones is changed within the

frame 152-408 kgf/cm², average Rc is 336kgf/cm², the Ksof is within the 0.58-0,.75, average value equals to 0.69. According to the State standards 25100-82, the ground belongs to:

- Rocky rock, as in the water saturated condition the value of the ground is within 150-500 kgf/cm². Softening ground, as the Ksof ii<0.75. Average density of the ground p=2.53 kg/cm². as it was impossible to take the sample of the argillites and to test them. The value of argillite firmness in water saturated condition is taken in the section of Barnov and Brothers Kakabadzes streets, by the "Sainjigeo" ltd in 2003 from the engineering and geological study technical report related to construction of multifunctional complex and it is Rc=12.8 kgf/cm². In the geological cut due to san-stone and argillite balance the layer firmness, during calculation of the normative value we carefully take the lowest value of the sandstone firmness received experimentally in the water saturated condition.

  Rc=152x0.7+10.8x0.3=110 kgf/cm²

  The layer is watered/ the saturated capacity of the layer is 1.5-2.6 meters.

III. 1. The chemical composition of the ground water and aggressiveness to the concrete

For defining the aggressiveness to the concrete construction constructions the chemical analysis of three samples of ground water from the wells took place. The degree of their aggressiveness to the iron-concrete constructions was defined. According to the sulphate component demonstrates various kind of aggressiveness on the portlandcement (state standard 1017876) produced cementum with the mark W4, W6 and W 8. During applying sulhate-resistant cement it is not aggressive to W4, W6 and W8 marks. It is not aggressive to the reinforcement in case of constant being in the water. And slightly aggressive during periodical moistening. The aggressiveness rate of the rocks on the carbon steel below ground water level, with the filtration coefficient KΦ>0,1m/day, is medium.

Conclusions and Recommendations

1. In Tbilisi city, the territory of the lower station of the cable way is constructed by the upper Eocene age (P_2^3) sand stones and argillites, which are covered by the Quaternary Alluvial

gravel soil (aQIV), dealluvial-proalluvial clay (dpQIV) and bulk ground (tQIV). The capacity of the covering rocks is up to 9.2 m.

2. Ground water is found in all three wells on the depth of 5.5-6.0m. The rate of the strengthening is up to 4.3-4.8m (April, 2016). The rate fluctuation of the ground water level is not studied, for orientation ±1,0 m can be accepted for relative strengthening level.
3. Sulphate-resistant cement shall be applied for the concrete steel constructions below the ground water level.
4. In the studies area composing grounds, except bulk ground (layer # 1), which is spread above basis considering genesis, composition, varieties, condition 4 engineering-geological elements (e.g.e.) are as follows:

   I e.g.e.- clay semi-solid (dpQrv) layer #2

   II e.g.e.- clay hard-palstic (dpQrv) layer #3

   III e.g.e.- gravel ground with clay-sand (aQrv) layer #4

   IV e.g.e.- slightly weathered sand stone and argillites (P_2^3) layer #6

   Engineering-geological elements are shown in the engineering and geological cuts of the studied area.

In the table #5 below is given all the necessary physical mechanical characteristics of e.g.e laboratory accepted accounting-normative values in accordance to the s.n. and ts. "The foundations of the Buildings and Constructions" (pn 02.01.-08) Annex 2 and 3 tables and as well available methodology "„Методика оценки прочности и сжимеемости крупнообломочных грунтов с пылеватым и глинистым заполнителем и пылеватых и глинистых грунтов с крупнообломочными включениями" ДальНИИС Гостроя СССР 1989 г. And by means of references, which are applied in the projecting calculation.

Table # 5

##	Features of the grounds	Accounting values			
		I e.g.e. layer # 2	II e.g.e. layer # 3	III e.g.e. layer # 4	IV e.g.e. layer # 6
1.	Density p g/cm^3	1.93`	1.95	2.08	2.53
2.	Internal friction angle ϕ^0	23	21	27	-

3.	Specific traction C kgf/cm²	0.25	0.23	0.08	-
4.	Deformation module E kgf/cm²	180	140	536	-
5.	Conditional accounting resistance R_0 kgf/cm²	2.4	2.2	4.5	-
6.	The firmness limit on one-axis compression in the water saturated condition Rc/r mpa (kgf/cm²)	-	-	-	110
7.	Bed ratio kgf/cm²	3	2	6	100
8.	Poisson ratio m	0.35	0.35	0.27	0.20

5. The foundation of the lower station construction was opened by pits. It appears that the building is based on the pointed foundation and with the tile III e.g.e. deepening and geometrical sizes are given on the cut of the pits.
6. During implementation of the building reinforcement and strengthening project the maximal possible inclination of the artificial slopes of the dikes shall be made based on the s.n. and ts. 3.02.01-87, 3.11; 3, 12 and s.n. and ts. III-4-80 requirements.
7. S.n. and ts. "Seismo-resistant construction" (pn 01.01-09) according to the seismic risk map Tbilisi belongs to 9 point seismic zone.

   According to the same normative document table # 1, according to the seismic characteristics, the grounds composing the studied area layer # 1 belongs to the category III; layer ##2, 3 and 4 to the category II; layer # 5 to the category II; Layer # 6 to the category I. The district accounting seismicity is considered as 8 points.
8. The ground clusters composing the district according to the complexity is given in the table 1.1. in the s.n. and ts IV-2-82 and belong to

   Layer # 1 to 24a

   Layer # 2 and # 3- 33g

   Layer # 4 -6 g

9. For arrangement of the filled pillars by drilling classification of the ground according to the drilling method and complexity based on the 4th summary table of the 45 of s.n. and ts. IV-282

Engineering-geologist (signature) Gabriel Chincharauli

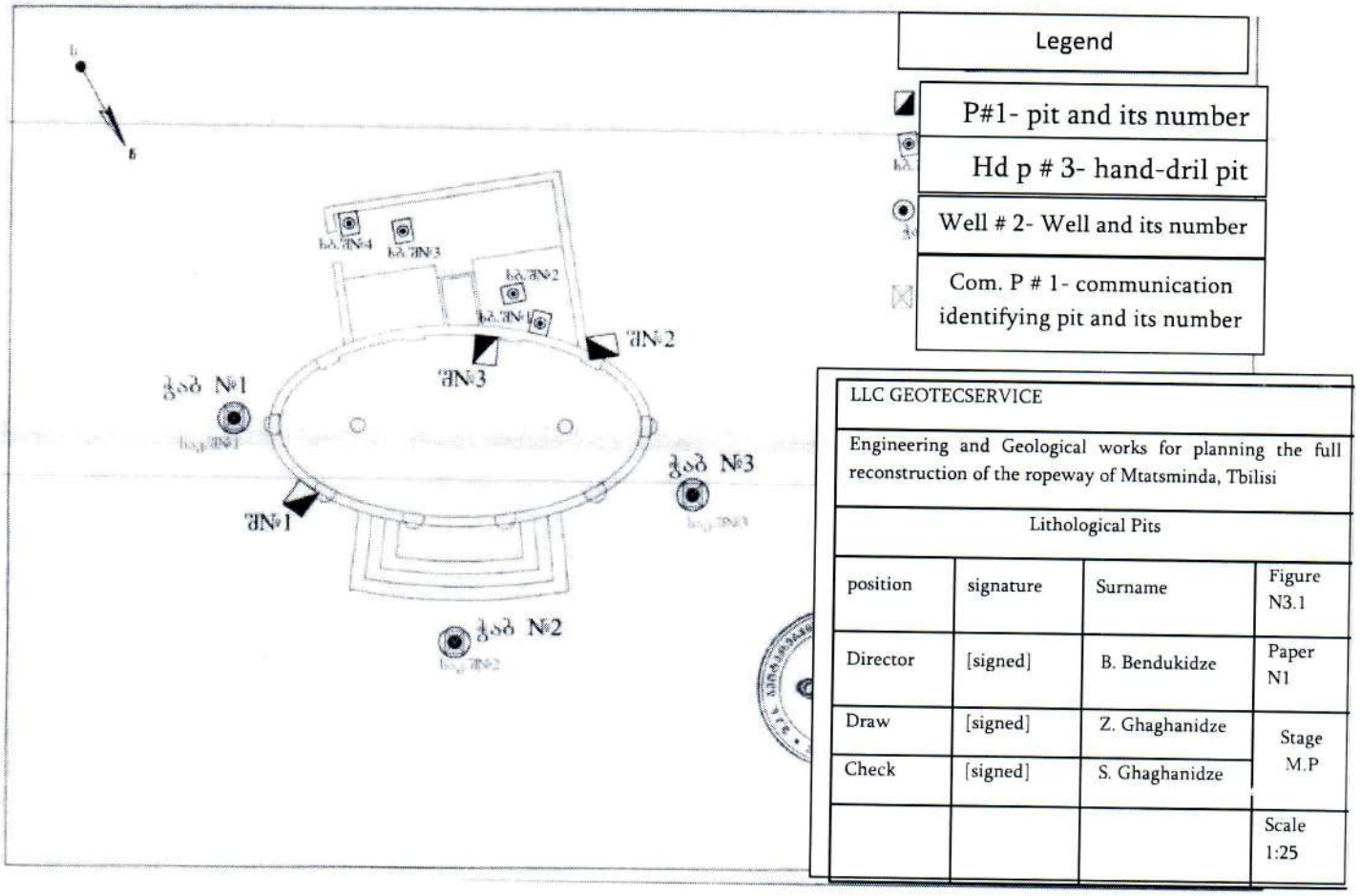
Field and Laboratory research Results

1. Topographic Plan

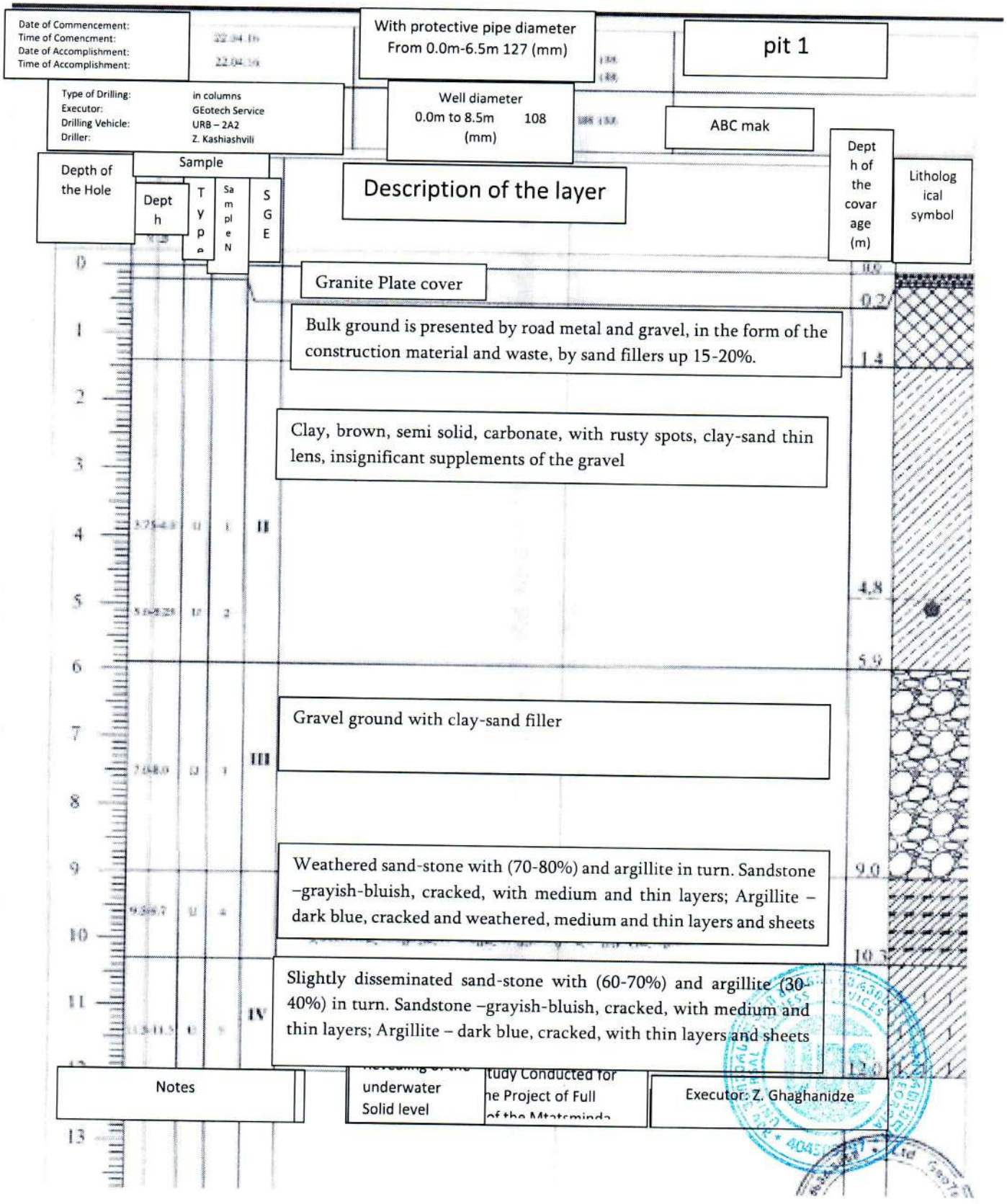
52 Rustaveli Avenue, Tbilisi, Lower station of the cable road linking with Mtastminda Park

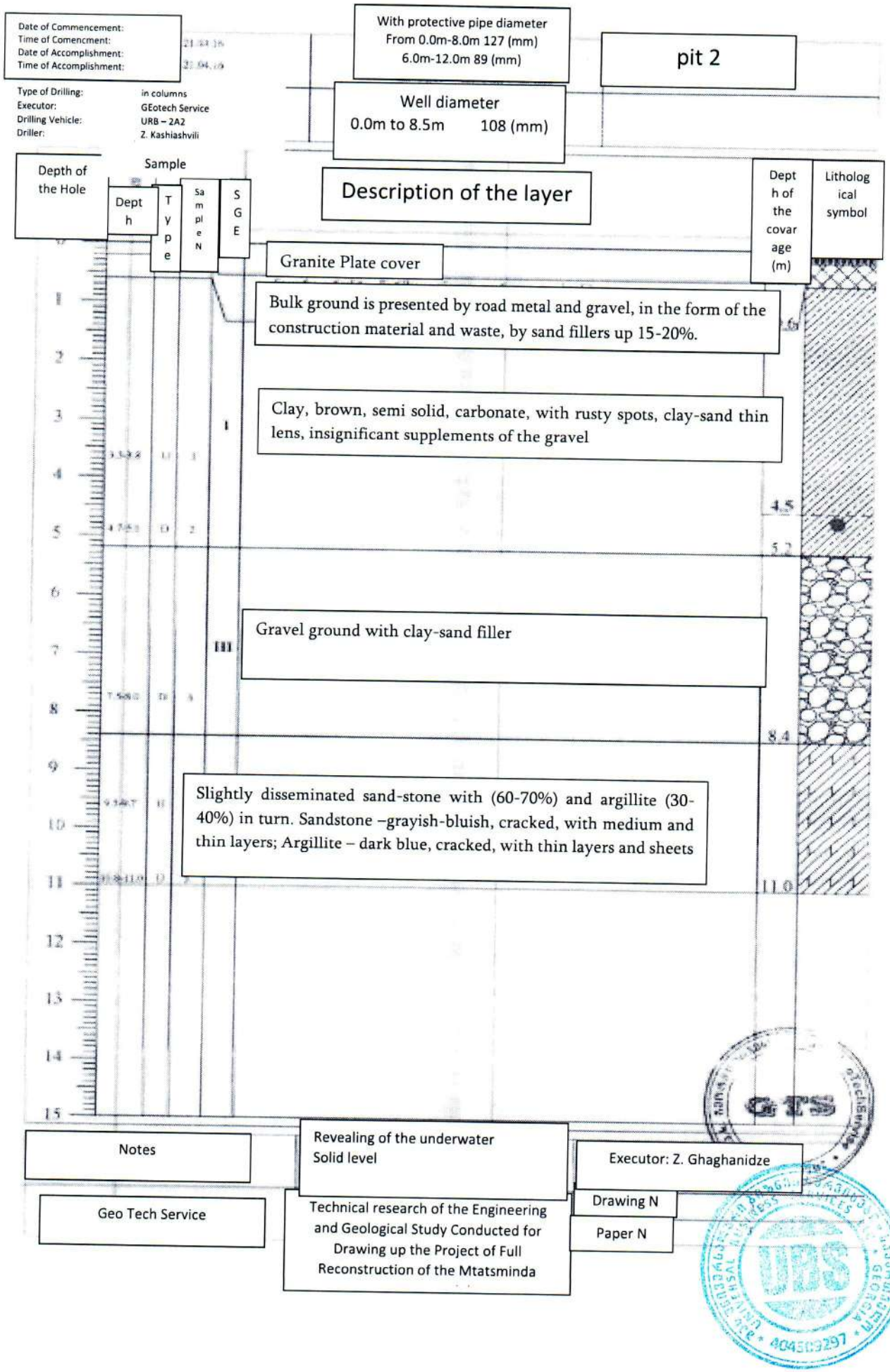
Legends		

				LEPL Levan Samkharauli National Bureau forensic Expertise Kiriak Zaeriev construction machinery, seismic resistance and engineering expertise center (department)
WGS 84 coordinate system UTM projection, the height marks are conditional				
1. Residential building 2. Non-residential building 3. Stall 4. Greenhouse 5. Ruined construction 6. Reservoir	7. borders 8. Asphalt road 9. Railway 10. Water contour 11. Dry gorge 12. (Illegible) 13. (illegible)	14. Concrete fence 15. Metal fence 16. Wooden fence 17. Barbed fence 18. Bulk ground 19. Support wall 20. Contour line 21. Tree line 22. (illegible)	19. border of the land plot 20. transformer, el. Sub-station 21. trees, palm, bush 22. electricity farm, pillar 23. illumination pillar 24. tap, observation well 25. petrol station	measured by(signature) E. Lomidze Drawn by (signed) I. Ivanishvili (signed) E. Lomidze M 1:500 12.06.2016



LLC GEOTECSERVICE			
Engineering and Geological works for planning the full reconstruction of the ropeway of Mtatsminda, Tbilisi			
Lithological Pits			
position	signature	Surname	Figure N3.1
Director	[signed]	B. Bendukidze	Paper N1
Draw	[signed]	Z. Ghaghanidze	Stage M.P
Check	[signed]	S. Ghaghanidze	
			Scale 1:25


Date of Commencement:
Time of Comencment:
Date of Accomplishment:
Time of Accomplishment:
With protective pipe diameter From 0.0m-6.5m 127 (mm)
pit 1
Type of Drilling: in columns
Executor: GEotech Service
Drilling Vehicle: URB – 2A2
Driller: Z. Kashiashvili
Well diameter 0.0m to 8.5m 108 (mm)
ABC mak
Depth of the Hole
Sample
Depth
Type
Sample N
SGE
Description of the layer
Depth of the covarage (m)
Lithological symbol
Granite Plate cover
Bulk ground is presented by road metal and gravel, in the form of the construction material and waste, by sand fillers up 15-20%.
Clay, brown, semi solid, carbonate, with rusty spots, clay-sand thin lens, insignificant supplements of the gravel
Gravel ground with clay-sand filler
Weathered sand-stone with (70-80%) and argillite in turn. Sandstone –grayish-bluish, cracked, with medium and thin layers; Argillite – dark blue, cracked and weathered, medium and thin layers and sheets
Slightly disseminated sand-stone with (60-70%) and argillite (30-40%) in turn. Sandstone –grayish-bluish, cracked, with medium and thin layers; Argillite – dark blue, cracked, with thin layers and sheets
0.2
1.4
4.8
5.9
9.0
10.7
12.0
Notes
underwater
Solid level
tudy Conducted for
he Project of Full
Executor: Z. Ghaghanidze


Date of Commencement:
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With protective pipe diameter
From 0.0m-8.0m 127 (mm)
6.0m-12.0m 89 (mm)
Well diameter
0.0m to 8.5m 108 (mm)
pit 2
Depth of the Hole
Sample
Dept h
T y p e
Sa m pl e N
S G E
Description of the layer
Dept h of the covar age (m)
Litholog ical symbol
Granite Plate cover
Bulk ground is presented by road metal and gravel, in the form of the construction material and waste, by sand fillers up 15-20%.
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4.5
5.2
8.4
11.0
Notes
Revealing of the underwater Solid level
Executor: Z. Ghaghanidze
Geo Tech Service
Technical research of the Engineering and Geological Study Conducted for Drawing up the Project of Full Reconstruction of the Mtatsminda
Drawing N
Paper N

Date of Commencement:
Time of Comencment:
Date of Accomplishment:
Time of Accomplishment:

With protective pipe diameter
From 0.0m-6.5m 127 (mm)

Well diameter
0.0m to 8.5m 108 (mm)

pit 3

Type of Drilling: in columns
Executor: GEotech Service
Drilling Vehicle: URB – 2A2
Driller: Z. Kashiashvili

Depth of the Hole	Sample				Description of the layer	Depth of the covarage (m)	Lithological symbol
	Depth	Type	Sample N	SGE			
0					Granite Plate cover		
1					Bulk ground is presented by road metal and gravel, in the form of the construction material and waste, by sand fillers up 15-20%.	0.7	
2							
3				II	Clay, brown, semi solid, carbonate, with rusty spots, clay-sand thin lens, insignificant supplements of the gravel		
4						4.4	
5							
6						5.6	
7				III	Gravel ground with clay-sand filler		
8							
9						9.2	
10					Weathered sand-stone with (70-80%) and argillite in turn. Sandstone –grayish-bluish, cracked, with medium and thin layers; Argillite – dark blue, cracked and weathered, medium and thin layers and sheets	10.5	
11				IV	Slightly disseminated sand-stone with (60-70%) and argillite (30-40%) in turn. Sandstone –grayish-bluish, cracked, with medium and thin layers; Argillite – dark blue, cracked, with thin layers and sheets		
12						12.0	
13							
14							
15							

Notes

Revealing of the underwater Solid level

Executor: Z. Ghaghanidze

Geo Tech Service

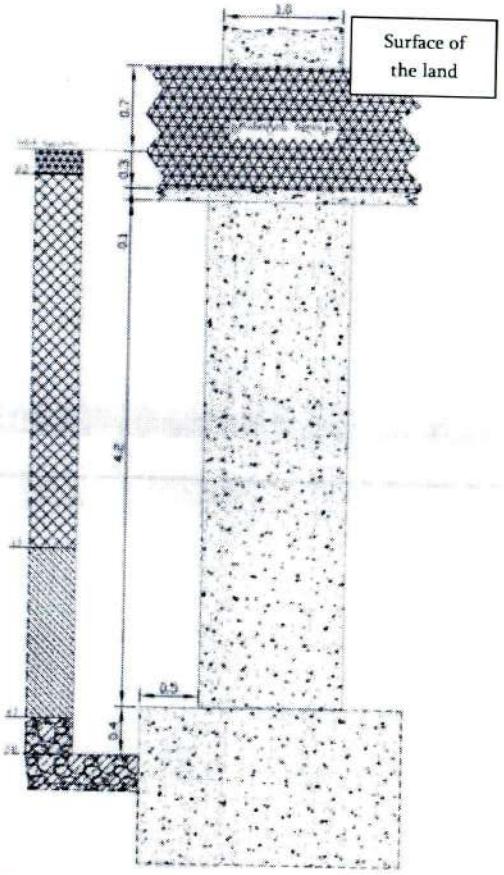
Technical research of the Engineering and Geological Study Conducted for Drawing up the Project of Full Reconstruction of the Mtatsminda

Drawing N

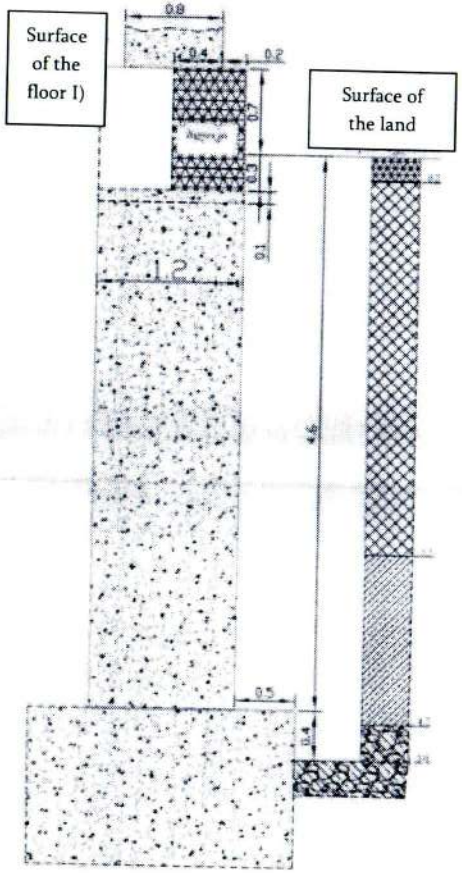
Paper N

Pit #1

I Cut (left)



II cut (right)



legend

	Concrete
	Bulk ground is presented by road metal and gravel, in the form of the construction material
	Clay, brown, semi solid, carbonate, with rusty spots, clay-sand thin lens, insignificant
	Stones, medium and small-sized greyish and green, difficult to plaster, carbonate clayish fillers up to 20-30%.

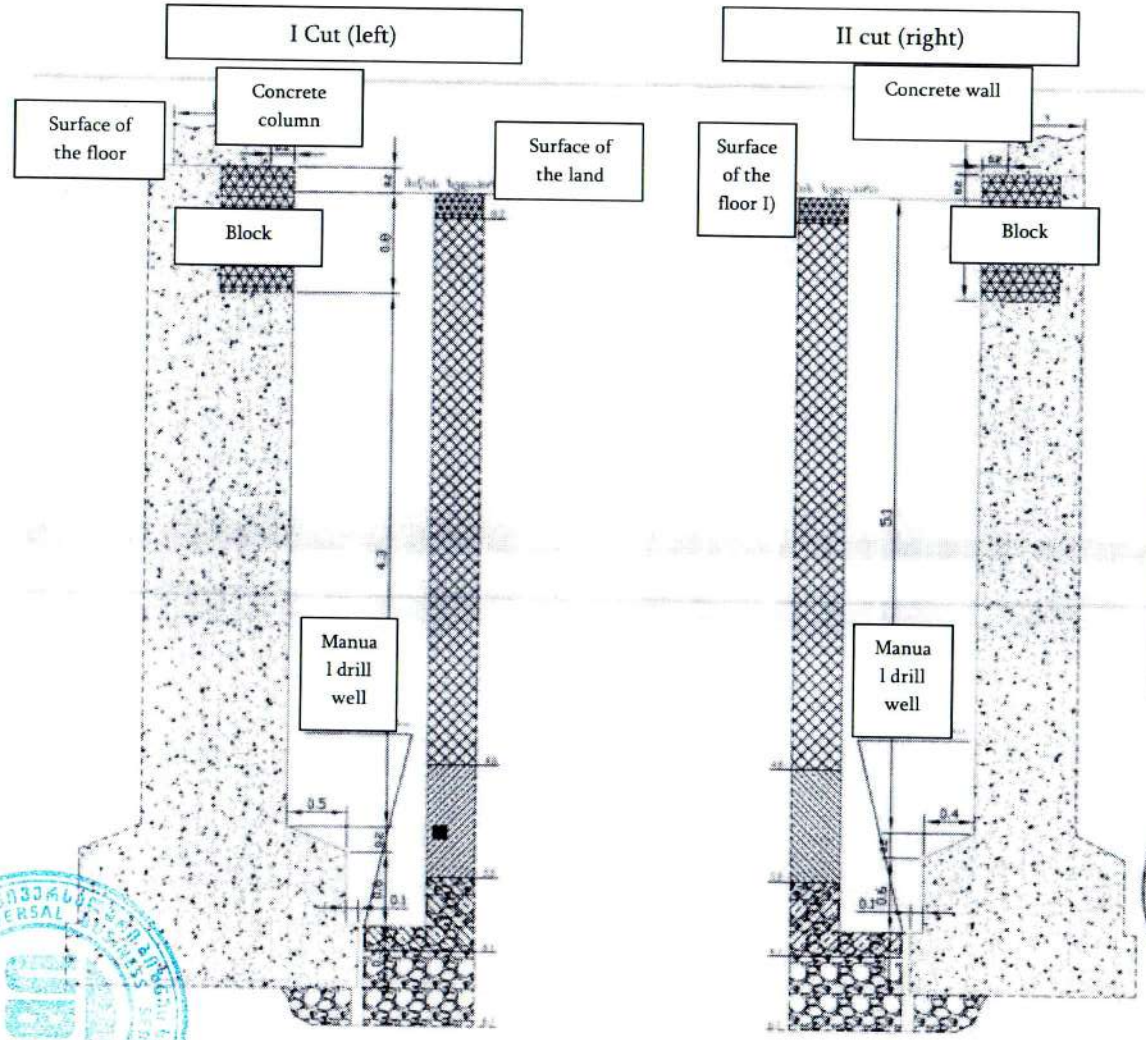
LLC GEOTECSERVICE

Engineering and Geological works for planning the full reconstruction of the ropeway of Mtatsminda, Tbilisi

Lithological Pits

position	signature	Surname	Figure N3.1
Director	[signed]	B. Bendukidze	Paper N1
Draw	[signed]	Z. Ghaghanidze	Stage M.P
Check	[signed]	S. Ghaghanidze	
			Scale 1:50

Pit #2



legend

- Concrete
- Bulk ground is presented by road metal and gravel, in the form of the construction material and waste,
- Clay, light brownish-yellowish, heavy, semi-solid, carbonated
- Stones, medium and small-sized greyish and green, difficult to plaster, carbonate clayish fillers up to 20-30%.
- Stones, medium and small-size, large and rough-granular, with greyish and brownish
- The place of taking sample of the ground

Note

Given pit was made outside of the construction on the western wall, where there is the connection place of two units of the study building

Given pit up to 5.9 was made by means of a tractor, later on, it was deepened by manual drill and other means till the bottom of the foundation (6.4m)

The bottom of the foundation from the surface of the land – 6.4m

The bottom of the foundation from the floor of the building – 6.6m

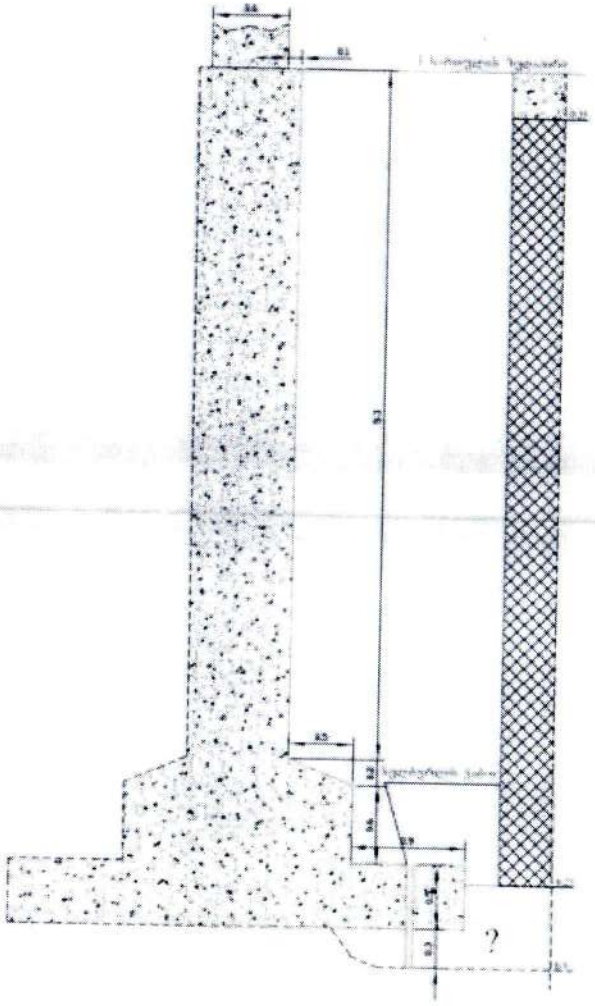
LLC GEOTECSERVICE

Engineering and Geological works for planning the full reconstruction of the ropeway of Mtatsminda, Tbilisi

Lithological Pits

position	signature	Surname	Figure N3.1
Director	[signed]	B. Bendukidze	Paper N1
Draw	[signed]	Z. Ghaghanidze	Stage M.P
Check	[signed]	S. Ghaghanidze	
			Scale 1:50

Pit #3



Legend

Concrete

Bulk ground is presented by road metal and gravel, in the form of the construction material and waste, by sand fillers up 20-40%.

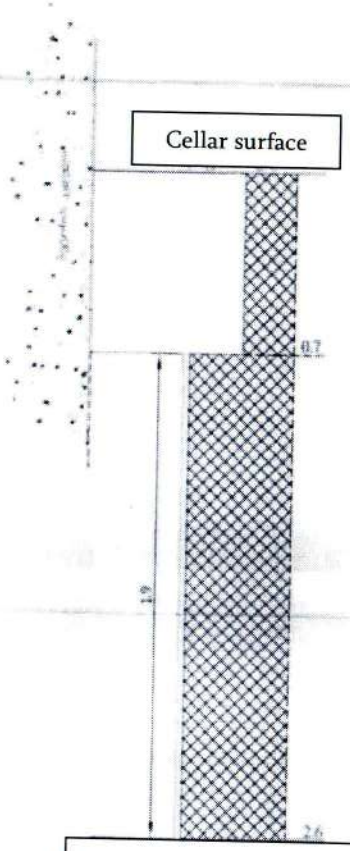
Note

Given pit was made inside of the building on the mid wall, where two-layer construction of the foundation revealed, where the width of the second layer (cushion) of the foundation occurred by means of the electric manual drill.

The bottom of the foundation from the floor of the building – 6.6m

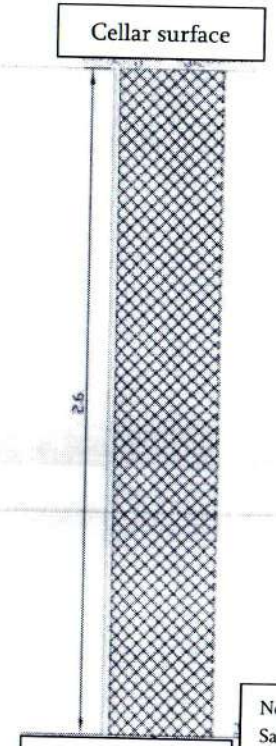
LLC GEOTECSERVICE			
Engineering and Geological works for planning the full reconstruction of the ropeway of Mtatsminda, Tbilisi			
Lithological Pits			
position	signature	Surname	Figure N3.1
Director	[signed]	B. Bendukidze	Paper N1
Draw	[signed]	Z. Ghaghanidze	Stage M.P
Check	[signed]	S. Ghaghanidze	
			Scale 1:50

Manual drill pit # 3



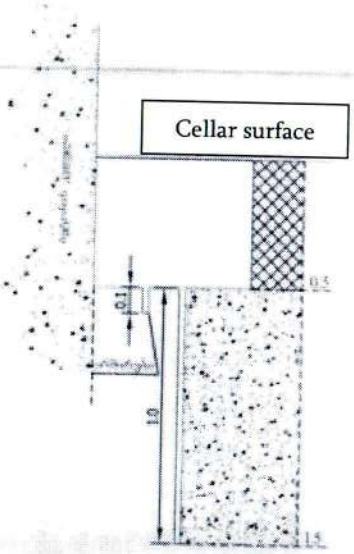
concrete

Manual drill pit # 4

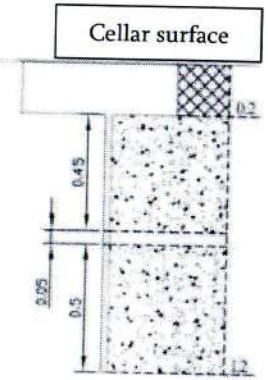


Concrete

Manual drill pit # 1



Manual drill pit # 1



Legend

Concrete

Bulk ground is presented by road metal and gravel, in the form of the construction material and waste, by sand fillers up 20-40%.

Note

Said manual drill pits were made inside of the study construction

In this part of the construction there is the cellar with the deepest place (concrete player), located on 5.3 m from the floor of the building ground 1.

By means of the made manual drill pit, it was revealed that on the given spots there is the concrete layer, the width (capacity) was defined in the manually drilled pits # 1 and # 2, from where it was defined that in the pit 1 on 10 cm there is a concrete layer, while in the pit 2 it is on 45cm. There is 5 cm of emptiness, after which drilling process was continued in the unknown material of the same firmness.

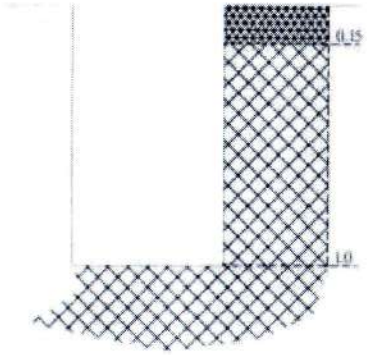
LLC GEOTECSERVICE

Engineering and Geological works for planning the full reconstruction of the ropeway of Mtatsminda, Tbilisi

Lithological Pits

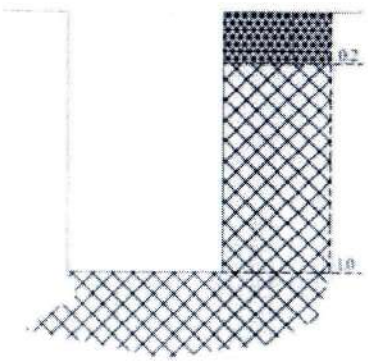
position	signature	Surname	Figure N3.1
Director	[signed]	B. Bendukidze	Paper N1
Draw	[signed]	Z. Ghaghanidze	Stage M.P
Check	[signed]	S. Ghaghanidze	
			Scale 1:50

pit # 1



pit # 2

pit # 1



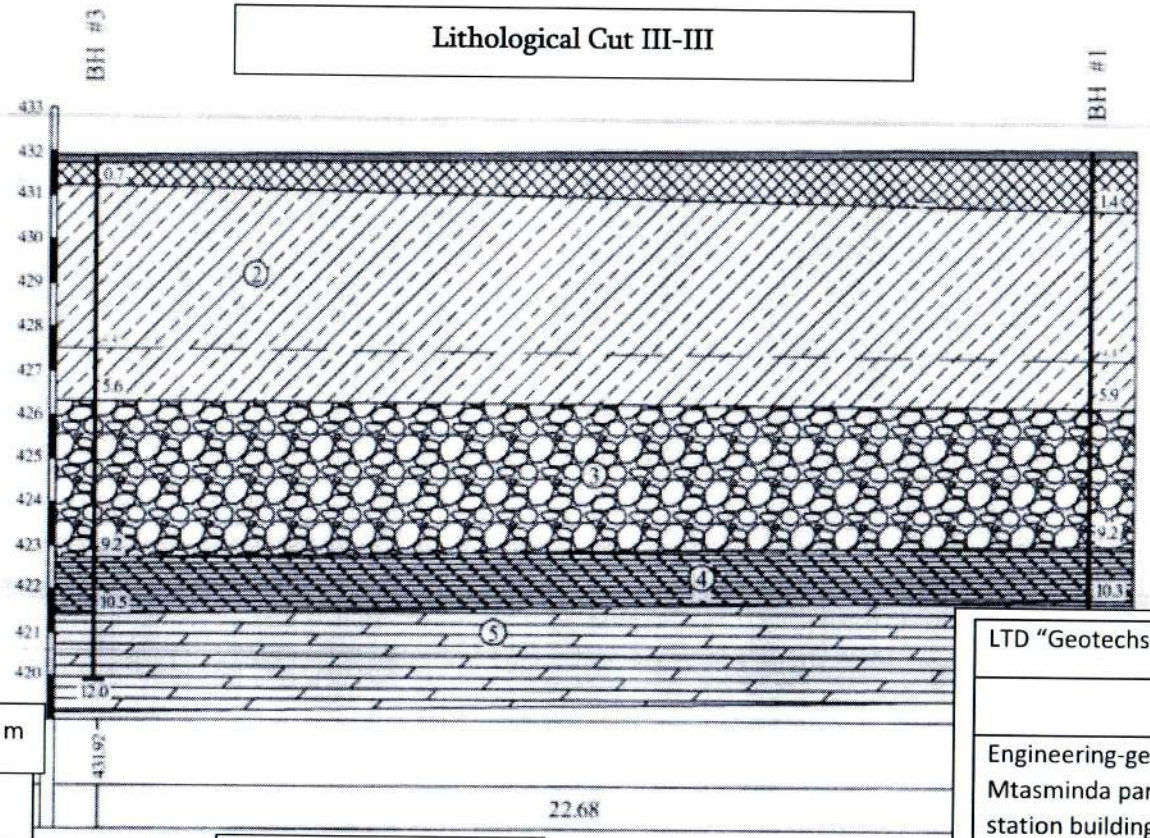
Legend

Basalt tile with mats

Bulk ground is presented by road metal and gravel, in the form of the construction material and waste, by sand fillers up 20-40%.

LLC GEOTECSERVICE			
Engineering and Geological works for planning the full reconstruction of the ropeway of Mtatsminda, Tbilisi			
Lithological Pits			
position	signature	Surname	Figure N3.1
Director	[signed]	B. Bendukidze	Paper N1
Draw	[signed]	Z. Ghaghanidze	Stage M.P
Check	[signed]	S. Ghaghanidze	
			Scale 1:50

Lithological Cut III-III



Land surface mark, m

Distance, m

Legend

Granite plate, with cover

Bulk ground is presented by sand 10-15%

2 — Clay, brown, semi solid, hard to plaster, carbonate, with rusty spots, clay-sand thin lens, insignificant supplements of the gravel.

3 — Gravel ground with the clay=sand filler

4 — Weathered sand-stone with (60-70%) and argillite (30-40%) in turn. Sand-stone, grayish-bluish, cracked, medium and thin layers; argillite- from light blue to dark blue, cracked, with thin layers and sheets

5 — Slightly weathered sand-stone with (60-70%) and argillite (20-30%) in turn. Sandstone –grayish-bluish, cracked, with medium and thin layers; Argillite – dark blue, cracked, with thin layers and sheets

Ground water level m.

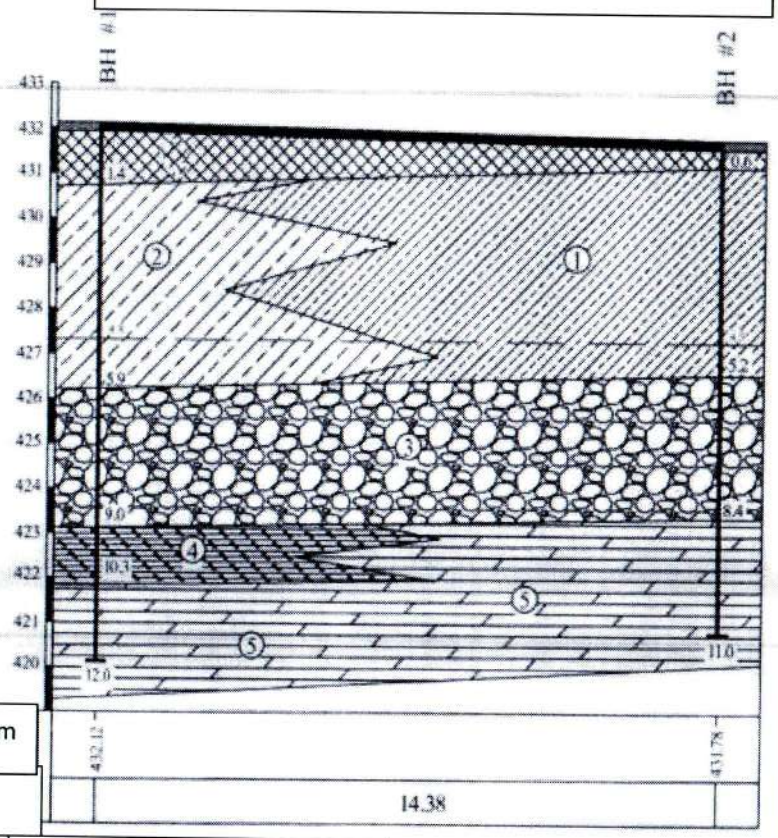
Depth and N of the Pit

LTD "Geotechservice"

Engineering-geological study of Tbilisi Mtasminda park connecting cable way lower station building

Lithological cut	signature	Surname	Figure N3.1
Scale	[signed]	B. Bendukidze	Paper N1
Horizontal: 1:00	[signed]	Z. Ghaghanidze	Stage M.P
LTD "Geotechservice"	[signed]	S. Ghaghanidze	
			Scale 1:50

Lithological Cut II-II



Land surface mark, m

Distance, m

Legend

Granite plate, with cover

Bulk ground is presented by sand 10-15%

1 — Clay, brown, semi solid, hard to plaster, carbonate, with rusty spots, clay-sand thin lens, insignificant supplements of the gravel.

2 — Clay, brown, semi solid, hard to plaster, carbonate, with rusty spots, clay-sand thin lens, insignificant supplements of the gravel.

3 — Gravel ground with the clay=sand filler

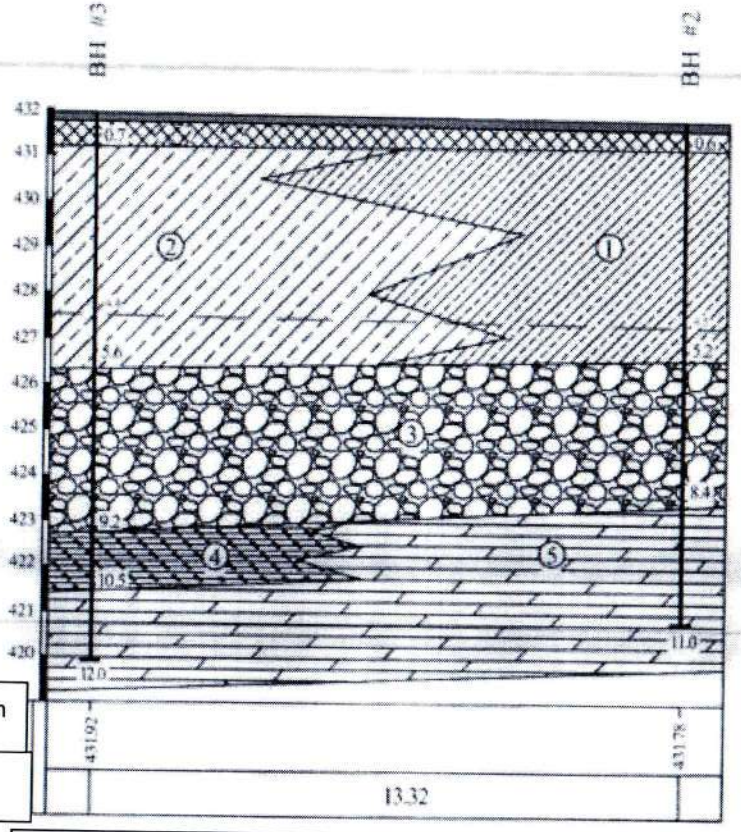
4 — Weathered sand-stone with (60-70%) and argillite (30-40%) in turn. Sand-stone, grayish-bluish, cracked, medium and thin layers; argillite- from light blue to dark blue, cracked, with thin layers and sheets

5 — Slightly weathered sand-stone with (60-70%) and argillite (20-30%) in turn. Sandstone –grayish-bluish, cracked, with medium and thin layers; Argillite – dark blue, cracked, with thin layers and sheets

Ground water level m.

LTD "Geotechservice"			
Engineering-geological study of Tbilisi Mtasminda park connecting cable way lower station building			
Lithological cut	signature	Surname	Figure N3.1
Scale	[signed]	B. Bendukidze	Paper N1
Horizontal: 1:00	[signed]	Z. Ghaghanidze	Stage M.P
LTD "Geotechservice"	[signed]	S. Ghaghanidze	
			Scale 1:50

Lithological Cut I-I



Land surface mark, m

Distance, m

Legend

Granite plate, with cover

Bulk ground is presented by sand 10-15%

1 Clay, brown, semi solid, hard to plaster, carbonate, with rusty spots, clay-sand thin lens, insignificant supplements of the gravel.

2 Clay, brown, semi solid, hard to plaster, carbonate, with rusty spots, clay-sand thin lens, insignificant supplements of the gravel.

3 Gravel ground with the clay=sand filler

4 Weathered sand-stone with (60-70%) and argillite (30-40%) in turn. Sand-stone, grayish-bluish, cracked, medium and thin layers; argillite- from light blue to dark blue, cracked, with thin layers and sheets

5 Slightly weathered sand-stone with (60-70%) and argillite (20-30%) in turn. Sandstone –grayish-bluish, cracked, with medium and thin layers; Argillite – dark blue, cracked, with thin layers and sheets

Ground water level m.

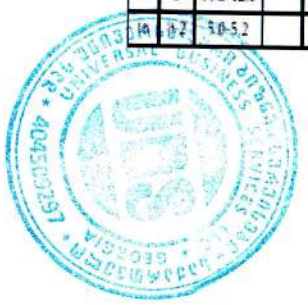
LTD "Geotechservice"

Engineering-geological study of Tbilisi Mtasminda park connecting cable way lower station building

Lithological cut	signature	Surname	Figure N3.1
Scale	[signed]	B. Bendukidze	Paper N1
Horizontal: 1:00	[signed]	Z. Ghaghanidze	Stage M.P
LTD "Geotechservice"	[signed]	S. Ghaghanidze	
			Scale 1:50

Summary Table of the Grounds Laboratory Study

#	Workout #	Internal for sampling	Size of the fraction													Natural humidity, W%			Flow indicator, Ip				Natural, p	Of frame	Porousness,	Coef. of porousness,	Humidity level, s	intermd fraction		Deformation module, kgf/cm	Firmness unit per compression, Rc, kgf/cm2		Softening coef. Ksof	Descript. Of the ground
			>60.0	60,0-40.0	40.0-30.0	20.0-10.0	100.-5.0	5.0-2.0	2.0-1.0	0.5-0.25	0.25-0.1	0.1-0.5	0.05-0.01	0.05-0.01	0.01-0.005	<0.005		Upper	Lower	Plastidity		of the mineral													
1	1	3.75-4.0					1.2	3.0	2.9	6.1	6.1	11.0	10.8	25.4	21.0	12.5	25.4	32.2	19.9	12.3	0.45	2.69	2.00	1.59	40.7	0.687	0.995	9	0.52	61				Clay, hardly plastering
2	1	5.0-5.25						0.2	0.3	0.4	0.2	0.3	17.7	30.0	28.6	22.3	28.6	38.8	24.7	14.1	0.28	2.70	1.94	1.51	44.1	0.790	0.978	26	0.24	50				Clay, hardly plastering
3	1	7.0-8.0		33.0	25.7	19.5	7.9	2.7	1.5	2.3	1.5	1.0	4.9				3.6	18.0	14.0	4.0	-2.40	2.55	2.05	1.98	22.4	0.289	0.318	27	0.06	609				Gravel ground, clay-sand fillers
4	1	9.5-9.7																					2.50								492	362	0.74	Sand-stone, medium firmness
5	1	11.3-11.5																					2.43								276	159	0.58	Sand-stone, medium firmness
6	2	3.5-3.8					0.3	0.8	0.7	0.4	0.9	2.4	18.7	35.1	19.8	20.9	22.7	35.8	22.4	13.4	0.02	2.70	1.99	1.62	39.9	0.665	0.922	16	0.84	61				Clay, semi-solid
7	2	4.7-5.0		23.0	22.4	12.1	8.2	3.2	2.6	4.9	4.6	2.8	16.2				5.9	21.4	15.6	5.8	-1.14	2.54	2.06	1.95	23.4	0.306	0.490	26	0.10	406				Gravel ground, with clay –sand fillers
8	2	7.5-8.0	4.8	12.3	27.4	24.0	11.1	5.5	4.1	3.1	2.2	0.9	4.6				4.0	23.7	18.0	5.7	-1.58	2.51	2.10	2.02	19.6	0.243	0.413	27	0.08	595				Gravel ground, with clay –sand fillers
9	2	9.5-9.7																					2.56								582	433	0.74	Sand-stone, mid. Firmness
10	2	10.8-11.0																					2.51								253	152	0.60	Sand-stone, mid. Firmness
11	3	3.7-4.0					0.5	0.5	1.9	2.9	1.9	3.4	15.6	25.6	27.8	19.9	28.0	37.6	24.7	12.9	0.26	2.70	1.92	1.50	44.4	0.800	0.945	12	0.70	55				Clay hardly plastered
12	3	6.5-7.0	6.7	11.9	28.1	16.1	10.4	6.1	5.1	5.2	2.6	1.8	6.0				1.0	21.8	16.8	5.0	-3.16	2.53	2.09	2.07	18.2	0.223	0.114	27	0.09	535				Gravel ground with sand-clay fillers
13	3	10.0-10.2																					2.50								564	408	0.72	Sand-stone, mid. Firmness
14	3	11.3-11.5																					2.58								550	394	0.72	Sand-stone, mid. Firmness
15	3	11.8-12.0																					2.60								598	446	0.75	Sand-stone, mid. Firmness
16	3	3.0-5.2					8.4	3.8	1.6	1.7	0.9	3.5	22.1	20.7	22.6	14.7	24.0	33.4	22.9	10.5	0.10	2.69	1.86	1.50	44.2	0.793	0.814							Clay, semi-solid



A chief specialist: (signed) Tatia Jajanidze

The Results of the Ground Movement

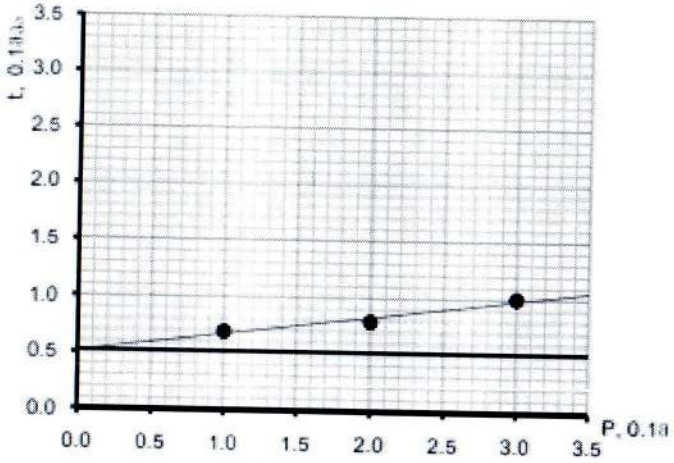
Location	Tbilisi City	Project	Engineering-geological study of Tbilisi Mtasminda park connecting cable way lower station building
Description of the ground	Clay, hardly plastering	W/Pit #	1
		Depth	3.75-4.0m
		date	24.06.2016

Vertical loading, P kgf/cm²	Moving power, t, kgf/cm²	Internal traction coef., tgϕ	Internal traction angle, ϕ	Countertraction , C kgf/cm²
In natural condition				
1 2 3	0.690 0.790 1.000	0.2	9	0.52

Defined	Natural humidity, W %	Mineral part. Firmness, ps	Firmness, g/cm³		Porous, n%	Porous coef., e	Humidity level, Sr	Plasticity ranges%		Plasticity #, Lp,	Flowing ind, Ll
			For natural, p	For frame				Upper, Wl	Lower, Wp,		
Natural cond.	25.4	2.69	2.00	1.59	40.7	0.687	0.995	32.2	19.9	12.3	0.45

A chief Specialist (signed) Tatia Jajanidze

Granular-metric composition, %			
Gravel (large)	Gravel	Dust	Clay
>2.0	2.0-0.05	0.05-0.005	<0.0054.2
4.2	26.1	57.2	12.5



The Results of the Ground Movement

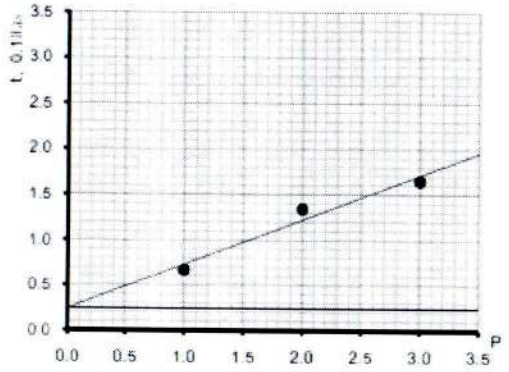
Location	Tbilisi City	Project	Engineering-geological study of Tbilisi Mtasminda park connecting cable way lower station building
Description of the ground	Clay, hardly plastering	W/Pit #	1
		Depth	5.0-5.25m
		date	24.06.2016

Vertical loading, P kgf/cm²	Moving power, t, kgf/cm²	Internal traction coef., tgφ	Internal traction angle, φ	Countertraction, C kgf/cm²
In natural condition				
1 2 3	0.670 1.340 1.650	0.5	26	0.24

Defined	Natural humidity, W %	Mineral part. Firmness, ps g/cm3	Firmness, g/cm³		Porous, n%	Porous coef., e	Humidity level, Sr	Plasticity ranges%		Plasticity #, Lp,	Flowing ind, Ll
			For natural, p	For frame				Upper, Wl	Lower, Wp,		
Natural cond.	28.6	2.70	1.94	1.51	44.1	0.790	0.978	28.8	24.7	14.1	0.28

A chief Specialist (signed) Tatia Jajanidze

Granular-metric composition, %			
Gravel (large)	Gravel	Dust	Clay
>2.0	2.0-0.05	0.05-0.005	<0.0054.2
0.2	1.2	76.3	22.3



The Results of the Ground Movement

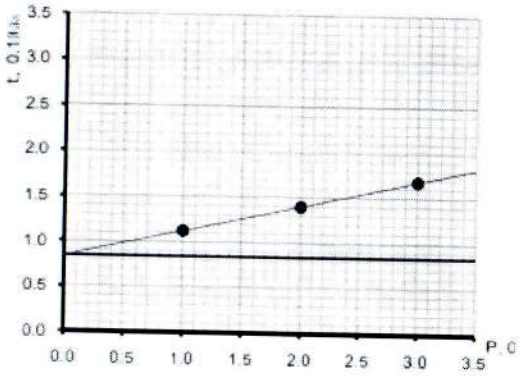
Location	Tbilisi City	Project	Engineering-geological study of Tbilisi Mtasminda park connecting cable way lower station building
Description of the ground	Clay, semi-solid	W/Pit #	2
		Depth	3.5-3.8
		date	24.06.2016

	Vertical loading, P kgf/cm²	Moving power, t, kgf/cm²	Internal traction coef., tgφ	Internal traction angle, φ	Countertraction, C kgf/cm²
In natural condition					
1	1.120	0.3	16	0.84	
2	1.400				
3	1.680				

	Defined	Natural humidity, W %	Mineral part. Firmness, ps g/cm3	Firmness, g/cm³		Porous, n%	Porous coef., e	Humidity level, Sr	Plasticity ranges%		Plasticity #, Lp,	Flowing ind, Ll
				For natural, p	For frame				Upper, Wl	Lower, Wp,		
1	Natural cond.	22.7	2.70	1.99	1.62	39.9	0.665	0.922	35.8	22.4	13.4	0.02

A chief Specialist (signed) Tatia Jajanidze

Granular-metric composition, %			
Gravel (large)	Gravel	Dust	Clay
>2.0	2.0-0.05	0.05-0.005	<0.0054.2
1.1	4.4	73.6	20.9



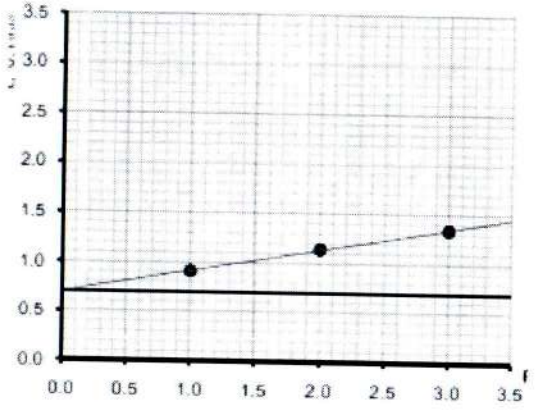
The Results of the Ground Movement

Location	Tbilisi City	Project	Engineering-geological study of Tbilisi Mtasminda park connecting cable way lower station building
Description of the ground	Clay, hardly plastering	W/Pit #	3
		Depth	3.7-4.0
		date	24.06.2016

	Vertical loading, P kgf/cm²	Moving power, t, kgf/cm²	Internal traction coef., tgφ	Internal traction angle, φ	Countertraction, C kgf/cm²
In natural condition					
1	0.910	0.2	12	0.70	
2	1.140				
3	1.340				

	Defined	Natural humidity, W %	Mineral part. Firmness, ps g/cm3	Firmness, g/cm³		Porous, n%	Porous coef., e	Humidity level, Sr	Plasticity ranges%		Plasticity #, Lp,	Flowing ind, Ll
				For natural, p	For frame				Upper, Wl	Lower, Wp,		
	Natural cond.	28.0	2.70	1.92	1.50	44.4	0.800	0.945	37.6	24.7	12.9	0.26

Granular-metric composition, %			
Gravel (large)	Gravel	Dust	Clay
>2.0	2.0-0.05	0.05-0.005	<0.0054.2
1.0	10.1	69.0	19.9



The Results of the Ground Testing on Compression

		Project	Engineering-geological study of Tbilisi Mtasminda park connecting cable way lower station building
Location	Tbilisi City	W #	1
Description of the ground	Clay, hardly plastering	Depth	3.75-4.0m
		date	25.05.2016

Defined	Equipment #	Natural humidity, W %	Mineral part. Firmness, ps g/cm3	Firmness, g/cm³		Porous, n%	Porous coef., e	Humidity level, Sr	Plasticity ranges%		Plasticity #, Lp,	Flowing ind, Ll
				For natural, p	For frame				Upper, Wl	Lower, Wp,		
Natural cond.	1	25.4	2.68	2.00	1.59	40.5	0.680	1.001	32.2	19.9	12.3	0.45
I water saturated condition,	1	25.2		2.01	1.60	40.2	0.672	1.005				0.43

Trial condition	Loading, P. kgf/cm2	Equipment #	Absolute deformation, mm,	Relative deformation	Porous coefficient	Fixing module, 1	Firmness coef. A, kgf/cm²	Deformation lab module, E, kgf/cm2	Empirical coefficients		Deformation module, E, gf.cmc2
									b	m²	
In natural condition	0.0	1	-	0.000	0.680	-	-	-	0.62	1.0	
	1.0		0.920	0.046	0.603	46	0.077	22			
	2.0		1.170	0.059	0.582	59	0.021	76			
	3.0		1.360	0.068	0.566	68	0.016	99			61
	3.0		1.400	0.070	0.563	70	-	-			
	4.0		1.500	0.075	0.554	75	0.008	186			

Dependence Esl=f(p)			
P	1	2	3
Esl	-	0.0034	-

Granular-metric composition, %			
Gravel (large)	Gravel	Dust	Clay
>2.0	2.0-0.05	0.05-0.005	<0.0054.2
4.2	26.1	57.2	12.5

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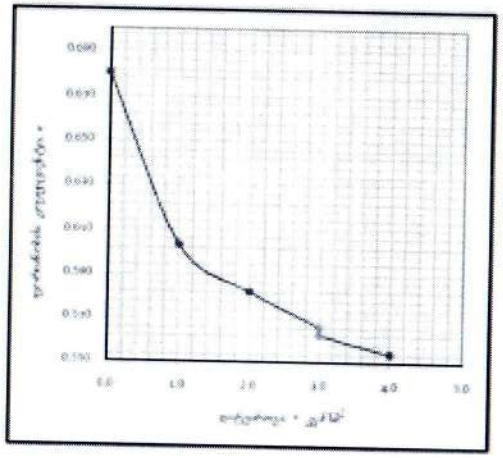
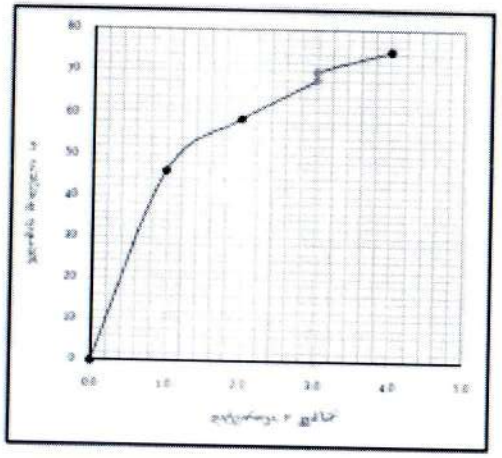




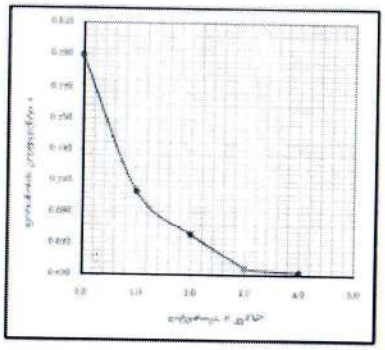
The Results of the Ground Testing on Compression

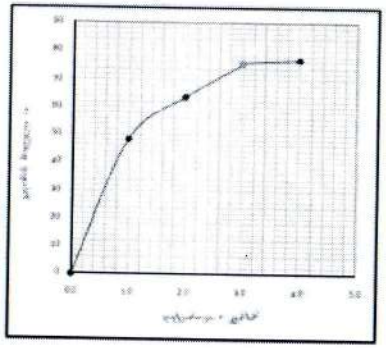
		Project	Engineering-geological study of Tbilisi Mtasminda park connecting cable way lower station building
Location	Tbilisi City	W #	1
Description of the ground	Clay, hardly plastering	Depth	5.0-5.25 m
		date	25.05.2016

Defined	Equipment #	Natural humidity, W %	Mineral part. Firmness, ps g/cm3	Firmness, g/cm³		Porous, n%	Porous coef., e	Humidity level, Sr	Plasticity ranges%		Plasticity #, Lp,	Flowing ind, Ll
				For natural, p	For frame				Upper, Wl	Lower, Wp,		
Natural cond.	2	28.6	2.70	1.94	1.51	44.1	0.790	0.978	38.8	24.7	14.1	0.28
I water saturated condition,	2	26.2		1.96	1.52	43.6	0.772	0.983				0.24

Trial condition	Loading, P. kgf/cm2	Equipment #	Absolute deformation, mm,	Relative deformation	Porous coefficient	Fixing module, l	Firmness coef. A, kgf/cm²	Deformation lab module, E, kgf/cm2	Empirical coefficients		Deformation module, E, gf.cmc2
									b	m²	
In natural condition	0.0	2	-	0.000	0.790	-	-	-	0.62	1.0	
	1.0		0.967	0.048	0.703	48	0.087	21			
	2.0		1.271	0.064	0.676	64	0.027	63			
	3.0		1.505	0.075	0.655	75	0.021	80			
	3.0		1.517	0.076	0.654	76	-	-			50
	4.0		1.538	0.077	0.554	77	0.002	880			

Dependence Esl=f(p)			
P	1	2	3
Esl	-	0.0011	-





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The Results of the Ground Testing on Compression

Defined	Equipment #	Natural humidity, W %	Mineral part. Firmness, ps g/cm3	Firmness, g/cm³		Porous, n%	Porous coef., e	Humidity level, Sr	Plasticity ranges%		Plasticity #, Lp,	Flowing ind, Ll
				For natural, p	For frame				Upper, Wl	Lower, Wp,		
Natural cond.	3	22.7	2.70	1.99	1.62	39.9	0.665	0.922	35.8	22.4	13.4	0.02
I water saturated condition,	3	22.5		2.00	1.63	39.6	0.656	0.925				0.01

		Project	Engineering-geological study of Tbilisi Mtasminda park connecting cable way lower station building
Location	Tbilisi City	W #	2
Description of the ground	Clay, semi-solid	Depth	5.0-5.25 m
		date	25.05.2016

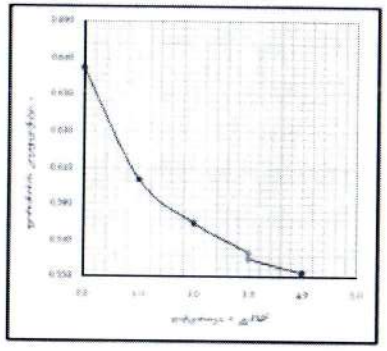
Trial condition	Loading, P. kgf/cm2	Equipment #	Absolute deformation, mm,	Relative deformation	Porous coefficient	Fixing module, l	Firmness coef. A, kgf/cm²	Deformation lab module, E, kgf/cm2	Empirical coefficients		Deformation module, E, gf.cmc2
									b	m²	
In natural condition	0.0	3	-	0.000	0.665	-	-	-	0.62	1.0	

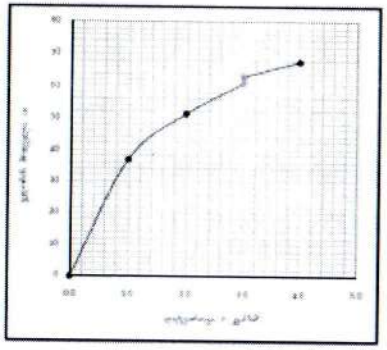
Granular-metric composition, %

Gravel (large)	Gravel	Dust	Clay
>2.0	2.0-0.05	0.05-0.005	<0.0054.2
0.2	1.2	76.3	22.3

	1.0		0.737	0.037	0.603	37	0.061	27			
	2.0		1.024	0.051	0.580	51	0.024	67			
	3.0		1.218	0.061	0.563	61	0.016	98			61
	3.0		1.256	0.063	0.560	63	-	-			
	4.0		1.350	0.068	0.552	68	0.008	119			

Dependence Esl=f(p)			
P	1	2	3
Esl	-	0.0032	-





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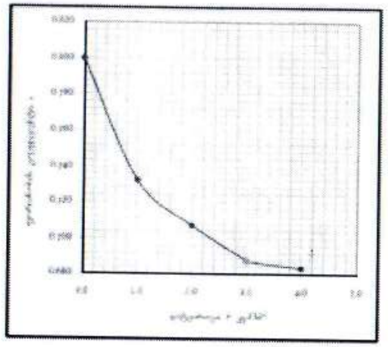
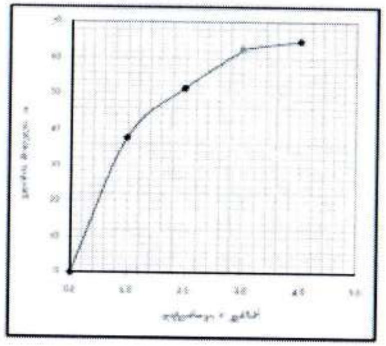
The Results of the Ground Testing on Compression

		Project	Engineering-geological study of Tbilisi Mtasminda park connecting cable way lower station building
Location	Tbilisi City	W #	3
Description of the ground	Clay, hardly plastering	Depth	3.7-4.0
		date	25.05.2016

Trial condition	Loading, P. kgf/cm2	Equipment #	Absolute deformation, mm,	Relative deformation	Porous coefficient	Fixing module, l	Firmness coef. A, kgf/cm²	Deformation lab module, E, kgf/cm2	Empirical coefficients		Deformation module, E, gf.cmc2
									b	m²	
In natural condition	0.0	4	-	0.000	0.800	-	-	-	0.62	1.0	
	1.0		0.753	0.038	0.732	38	0.068	27			
	2.0		1.032	0.052	0.707	52	0.025	69			
	3.0		1.244	0.062	0.688	62	0.019	89			55
	3.0		1.252	0.063	0.687	63	-	-			
	4.0		1.294	0.065	0.684	65	0.004	446			

Dependence Esl=f(p)			
P	1	2	3
Esl	-	0.0007	-





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The results of the normative value definition for ground firmness and deformation characteristics

Defined	Equipment #	Natural humidity, W %	Mineral part. Firmness, ps g/cm3	Firmness, g/cm³ For natural, p	Firmness, g/cm³ For frame	Porous, n%	Porous coef., e	Humidity level, Sr	Plasticity ranges% Upper, Wl	Plasticity ranges% Lower, Wp,	Plasticity #, Lp,	Flowing ind, Ll
Natural cond.	4	28.0	2.70	1.92	1.50	44.4	0.800	0.945	37.6	24.7	12.9	0.26
I water saturated condition,	4	28.0		1.94	1.52	43.9	0.781	0.967				0.26

#	W#	Interval of sampling	# of plasticity	Flow indicator	Ground firmness, g/cm3	% of the fraction less than 2mm	% of the fraction more than 2mm	Firmness of the supplements, kgf/cm2	Ground normative firmness	Rounding coef. Of larger pieces, for internal traction	Specific traction of Rounding coef. Of larger	Physical equivalent of the ground	Coef. In case of M2 indicator	Coefficient depended on the firmness of the ground	Coefficient for m: equivalent indicator		□□□37(0.234)	c□□□□□□□□□□□□ □□□□kg/cm	□□□□□01/(0.088M-0.15MI+0.017), kgf/cm2	Ground name
			Ip	IL	P	P1	P2	□	pn	K1	K2	M2	□	□□	□	□				
1	1	7.0-8.0	0.040	0	2.05	11.2	88.8	200	1.94	0.872	0.9	0.005 0	0.8414	1.1	0.964	1	27	0.06	609	Gravel ground with clay-sand filler
2	2	4.7-5.0	0.058	0	2.06	31.1	68.9	220	2.24	0.874	0.9	0.262	0.8442	0.8	0.967	1	26	0.10	406	Gravel ground with clay-sand filler

Granular-metric composition, %

Gravel (large)	Gravel	Dust	Clay
>2.0	2.0-0.05	0.05-0.005	<0.0054.2
1.1	4.4	73.6	20.9

3	2	7.5-8.0	0.057	0	2.10	14.9	85.1	250	2.02	0.874	0.9	0.100	0.8414	1.1	0.963	1	27	0.08	595	Gravel ground with clay-sand filler
4	3	6.5-7.0	0.050	0	2.09	20.9	79.3	210	2.14	0.882	0.9	0.031	0.8414	1.00.967	0.965	1	27	0.09	535	Gravel ground with clay-sand filler

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GeotechService

Chemical Analysis of Water Sample

Project	Cable way (lower station)	Well #	1
Sample #	1017	Depth, m	4.8
Sampling date	23.04.2016	Trial date	27.04.2016

Anions	Per liter			Micro-components mg/l		Other parameters		
	Mg	Mg equiv	Mg equiv %	Micro components mg/l		Rigidity degree mg.equiv.		
CI	38.6	1.09	4.40	Cu				
SO	996.6	20.75	83.86	Zn	Total		56.28⁰ 20.1	
HCO	177.2	2.90	11.74	Cd	Carbonate		7.6⁰3.1.	
CO				Pb	Ph		7.5	
NO_2				Fe	Free Co_2			
NO_2				Co	Aggressive Co_2	Mg/l		
Total	1212.4	24.74	100.00	Ni	Oxidation O_2	Mg/l		
Cations (K)				Mn	NH_2	Mn		
	Content per 1 liter			Sr	Li	Mg/l		
	mlg	Mg. equiv.	Mg.equiv.%	Li	NO_3	Mg/l		
Na++K+	70.3	3.06	12.33	I	Physical characteristics			
Ca^{**}	428.6	21.39	86.30	Br	Transparency		Transparent	
Mg^{**}	4.1	0.34	1.36	B	Taste		Was not tested	
NH_n^*				F	Color		Colorless	
				SiO	Deposit	Significant number on the bottom		
Total	503	24.78	100.00					
Total mineralization		Mg/l		1600.3				
Firm balance, dried t=105⁰C		g/l		1.614	Notes:			
Formula of water chemical composition					Made by	Minadze		
$M_{1^6}\frac{So4^{**}83}{Ca^{**}86}$					Reviewed Verified	Tedliashvili Natsvlishvili		

Granular-metric composition, %

Gravel (large)	Gravel	Dust	Clay
>2.0	2.0-0.05	0.05-0.005	<0.0054.2
1.0	10.1	69.0	19.9

GeotechService

Chemical Analysis of Water Sample

Project	Cable way (lower station)	Well #	2
Sample #	1018	Depth, m	4.5
Sampling date	22.04.2016	Trial date	27.04.2016

Anions	Per liter			Micro-components mg/l		Other parameters	
	Mg	Mg equiv	Mg equiv %	Micro components mg/l		Rigidity degree mg.equiv.	
CI	37.1	1.05	4.23	Cu			
SO	995.2	20.72	83.81	Zn	Total		58.28⁰ 20
HCO	180.4	2.96	11.96	Cd	Carbonate		7.8⁰3.2.
CO				Pb	Ph		7.5
NO_2				Fe	Free Co_2		
NO_2				Co	Aggressive Co_2	Mg/l	
Total	1212.7	24.72	100.00	Ni	Oxidation O_2	Mg/l	
Cations (K)				Mn	NH_2	Mn	
	Content per 1 liter			Sr	Li	Mg/l	
	mlg	Mg. equiv.	Mg.equiv.%	Li	NO_3	Mg/l	
Na++K+	75.8	3.30	13.34	I	Physical characteristics		
Ca**	420.5	20.98	84.93	Br	Transparency		Transparent
Mg**	5.2	0.43	1.73	B	Taste		Was not tested
NH_4*				F	Color		Colorless
				SiO	Deposit	Significant number on the bottom	
Total	501.5	24.71	100.00				
Total mineralization		Mg/l		1610.2			
Firm balance, dried t=105⁰C		g/l		1.628	Notes:		
Formula of water chemical composition					Made by	Minadze	
$M_{1\cdot6}\frac{So4\cdot\cdot83}{Ca\cdot\cdot84}$					Reviewed Verified	Tedliashvili Natsvlishvili	

GeotechService

Chemical Analysis of Water Sample

Project	Cable way (lower station)	Well #	3
Sample #	1019	Depth, m	4.4
Sampling date	22.04.2016	Trial date	27.04.2016

Anions	Per liter			Micro-components mg/l		Other parameters		
	Mg	Mg equiv	Mg equiv %	Micro components mg/l		Rigidity degree mg.equiv.		
CI	35.5	1.00	4.10	Cu				
SO	980.8	20.42	83.62	Zn	Total		59.36⁰ 21.2	
HCO	183.0	3.00	12.28	Cd	Carbonate		8.4⁰3	
CO				Pb	Ph		7.5	
NO_2				Fe	Free Co_2			
NO_2				Co	Aggressive Co_2	Mg/l		
Total	1199.3	24.42	100.00	Ni	Oxidation O_2	Mg/l		
Cations (K)				Mn	NH_2	Mn		
	Content per 1 liter			Sr	Li	Mg/l		
	mlg	Mg. equiv.	Mg.equiv.%	Li	NO_3	Mg/l		
Na++K+	73.6	3.20	13.11	I	Physical characteristics			
Ca**	416.8	20.80	85.23	Br	Transparency		Transparent	
Mg**	4.9	0.40	1.63	B	Taste		Was not tested	
NH_n*				F	Color		Colorless	
				SiO	Deposit	Significant number on the bottom		
Total	503	24.78	100.00					
Total mineralization		Mg/l		1600.3				
Firm balance, dried t=105⁰C		g/l		1.614	Notes:			
Formula of water chemical composition					Made by	Minadze		
$M_{1.6}$ $\frac{SO_4^{--}83}{Ca_5^{++}86}$					Reviewed Verified	Tedliashvili Natsvlishvili		

Order #	Workout #			Water aggressiveness quality to construction

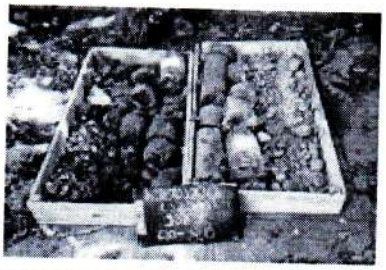
		Depth of the sampling	Indicator of aggressiveness	CHuП 2.03.11-85 (table 5)					
				Located in the rocks K_f>0.1m/d			Located in the rocks K_f<0.1m/d		
				Concrete mark for water resistance					
				W4	W6	W8	W4	W6	W8
1018	W #2	4.50	Bicarbonate --, mg equiv.	No	No	No	No	No	No
			Hydrogenous value	No	No	No	Weak	No	No
			Content of the aggressive H_2CO_3	-	-	No	-	-	No
			Magnesite salt content, mg/l	No	No	No	No	No	No
			Ammonium salt, mg/l	-	-	-	-	-	-
			high alkali content, mg/l	No	No	No	No	No	No
			Sulphates for concretes CHuП 2.03.11-85 (table 6)						
			Portand cement (GOST10178-76)	medium	medium	medium	medium	medium	weak
			Tsida portlandcement	No	No	No	No	No	No
			Sulphate-resistant cement	No	No	No	No	No	No

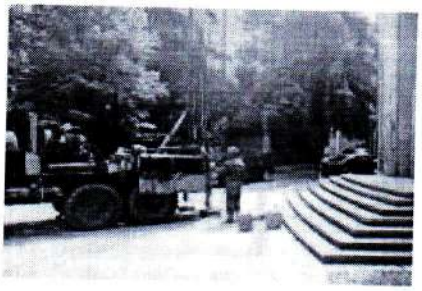
Order #	Workout #	Depth of the sampling	Indicator of aggressiveness	Water aggressiveness quality to construction CHuП 2.03.11-85 (table 5)					
				Located in the rocks K_f>0.1m/d			Located in the rocks K_f<0.1m/d		
				Concrete mark for water resistance					
				W4	W6	W8	W4	W6	W8
1019	W #3	4.40	Bicarbonate --, mg equiv.	No	No	No	No	No	No
			Hydrogenous value	No	No	No	Weak	No	No
			Content of the aggressive H_2CO_3	-	-	No	-	-	No
			Magnesite salt content, mg/l	No	No	No	No	No	No
			Ammonium salt, mg/l	-	-	-	-	-	-
			high alkali content, mg/l	No	No	No	No	No	No

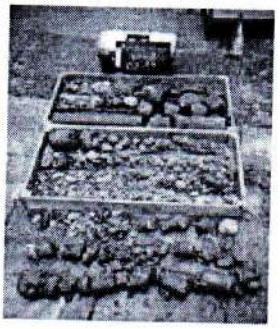
			Sulphates for concretes CHuП 2.03.11-85 (table 6)						
			Portand cement (GOST10178-76)	medium	medium	medium	medium	medium	weak
			Tsida portlandcement	No	No	No	No	No	No
			Sulphate-resistant cement	No	No	No	No	No	No

Order #	Workout #	Depth of the sampling	Water aggressiveness degree on iron-concrete construction СНиП 2.03.11-85 (table 5)		The level of the rock aggressive impact on the carbon steel, below the level of ground water for the rocks with filtration rate >0.1m/d СНиП 2.03.11-85 (table 28)
			In running water	By periodic wetting	
1017	W # 1	4.8	No	Weak	Medium
1018	W # 2	4.5	No	Weak	Medium
1019	W # 3	4.4	No	Weak	Medium

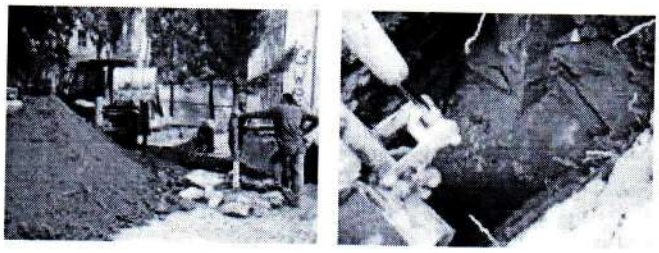
Photo Documentation







Pit # 1



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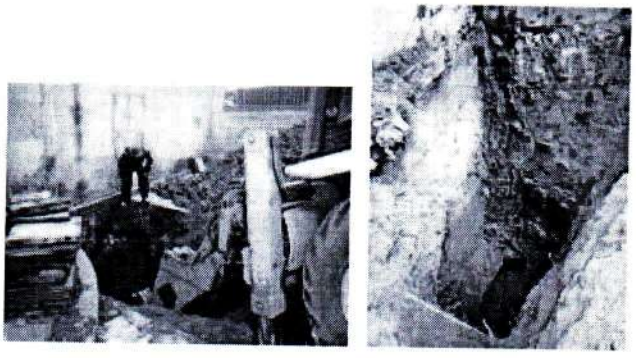

Pit # 3