Engineering-geological survey

Technical report

Tkibuli municipality, Gelati village, cadastral/code 39.07.31.362

The Gelati Monastery, the survey project of the study area

Tbilisi

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The Gelati Monastery, the survey project of the study area

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1. Introduction

In response to the order of the LEPL Patriarchate of Georgia, geologists of the Geological Service LTD conducted engineering-geological survey in Tkibuli Municipality, Gelati village, c/c 39.07.31.362, in order to investigate the study area in the vicinities of the Gelati Monastery complex. The engineering-geological survey aimed to establish engineering-geological and hydrogeological conditions of the site, to study physical-mechanical properties of soils constructing the site and to assess the hazardous geodynamic events spread in the area.

The following types and scopes of work have been carried out in the survey area: Investigations conducted by the Geology Department of the National Environmental Agency in 2024 "Results and forecast of the development of natural geological processes in Georgia in 2025", were found and used in the conclusion, for the purpose of engineering-geological assessment of the site, the surrounding area was inspected; 2 drillholes with 30 l/m depth each and with total depth 60 l/m were drilled in order to determine the lithological section and for sampling. Core drilling with continuous core extraction was carried out using owned by Geological Service LTD drill rig УРБ 2-А2. Soil sampling was undertaken to study their physical-mechanical properties; testwork on soil samples was conducted at the geotechnical laboratories of Geological Service LTD and Ltd. Water and Soil. The planar and elevational connection of the drillholes was carried out instrumentally on the topo plan provided by the client. After the fieldwork completion, the drillholes were backfilled with the extracted material. The investigations have been carried out and the conclusion has been worked out in accordance to the requirements of the normative documents currently in force in Georgia (construction norms and rules): CNR 1.02.07-87 (Engineering surveys for construction), PN 01.05-08 (Building climatology), PN 02.01-08 (Foundations of buildings and structures), CNR IV-5-82 (Earth works), CNR 2.02.03-85 (Pile foundations), CNR 3.02.01-87 (Earthen structures, footings and foundations), PN 01.01.-09 (Earthquake / seismic resistant construction), CNR 2.03.11-85 (Corrosion

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protection of building constructions), state standard 25100-82 (soils, classification). Engineering-geological survey was undertaken in March-April, 2026.

2. Physical-geographic description, tectonic setting, geology and hydrogeology

The study site is located in western Georgia, near Kutaisi City; the general climatic conditions of the area are moderately continental. According to the construction climate zoning scheme of the territory of Georgia it belongs to the III ბ /III b (#146) climatic sub-zone. Average annual air temperature is 14.5°C, absolute annual minimum - 17°C, absolute annual maximum - 40°C. Average relative humidity is 70%, average relative humidity of the coldest month - 60%, average relative humidity of the hottest month - 58%. Annual precipitation is 1394 mm, precipitation daily maximum – 166 mm. Snow cover weight is 0,50 kpa, number of days with snow cover – 26. Normative value of wind pressure is 0,73 kpa once in five/5 years, normative value of wind pressure 0,85 kpa once in 15 years. Maximum wind speed once in 1, 5, 10, 15, and 20 years is accordingly 31, 35, 37, 38, and 39 m/sec. Soils seasonal freezing normative depth any type of soils is 0 cm.

For earthquake-resistant construction, village Gelati of the Tkibuli district is rated as 8 points, and A - the dimensionless coefficient of seismicity - is 0.14.

From the geomorphological point of view, the study area is located on the accumulation plain of the of the alluvial and proluvian plains sub-zone of the intermountain lowland/depression zone with undulating terrain (National Atlas, 2012). The relief of the area is represented by the moderately inclined towards the west surface. The study area is bordered by the the Gelati Monastery gate from the east, a steep slope from the west, registered land plots from the north, and a deciduous forest and cemetery from the south. Absolute elevations vary between 387,0 – 402,5 m range.

According to the tectonic subdivision scheme of Georgia (Adamia, Sh., 2004) the study area is located in the Mesozoic-Cenozoic precollison tectono-stratigraphic unit of the Georgian Block (Fig.1)

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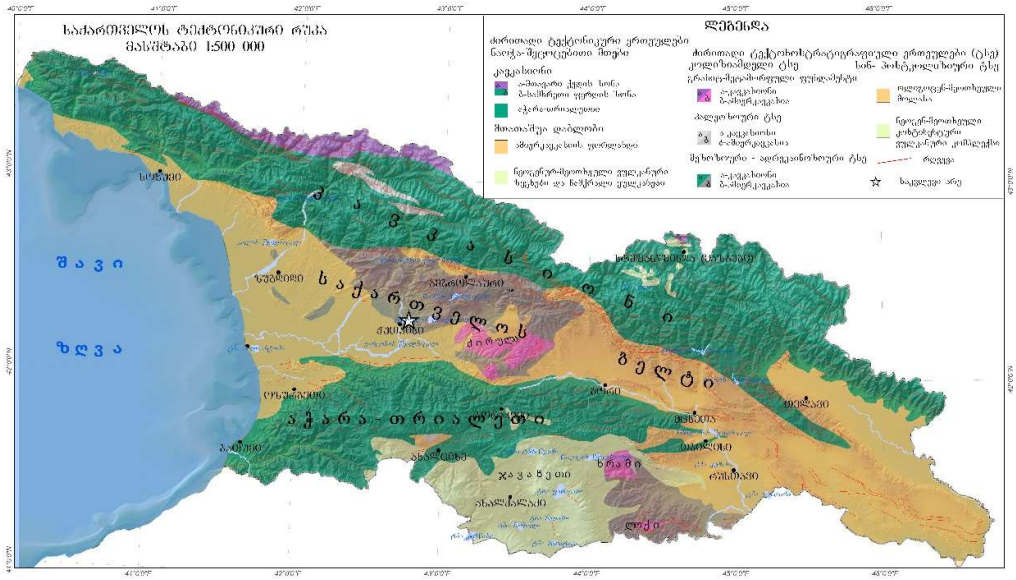

Figure 1. The location of the study area on the tectonic map of Georgia (Adamia, Sh., 2004).

The construction site is located on the Quaternary proluvial-deluvial sediments represented by dark-brown clay with inclusions of limestone gravel. Quaternary sediments lie over the bedrocks represented by urgonian facies limestones of the Berriasian-Valanginian and Hauterivian-Barremian Askhi Suite. (Fig. 2).

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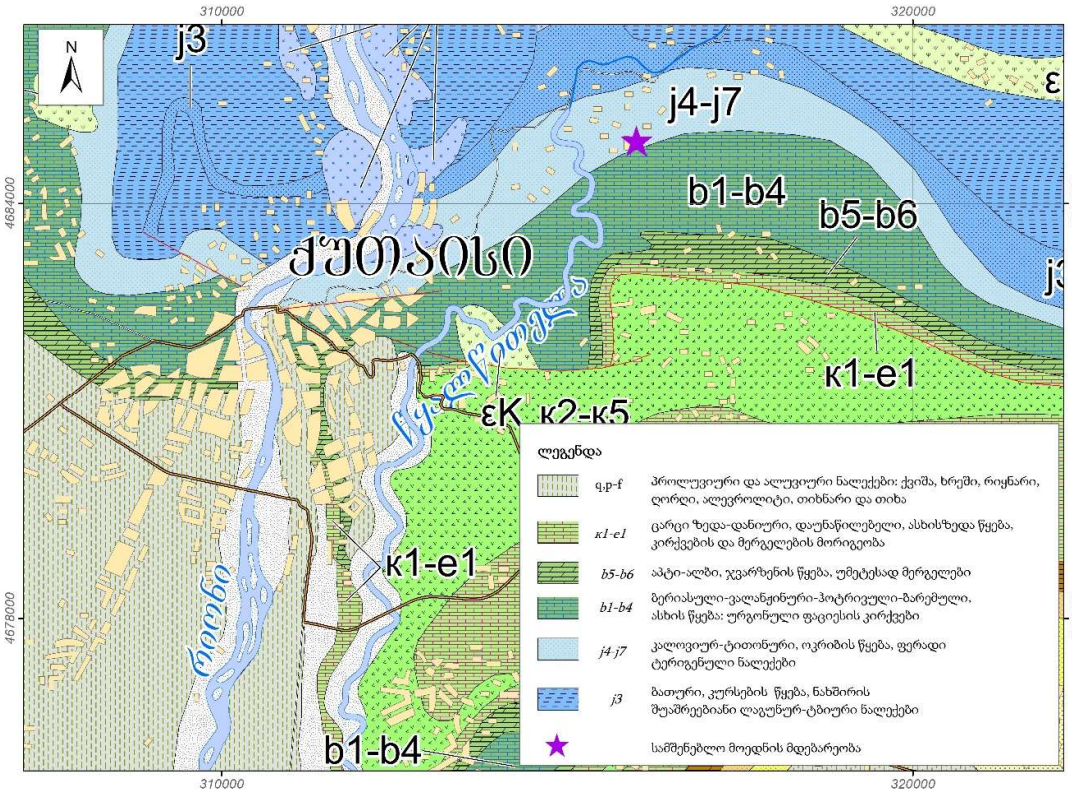

Figure 2. The location of the study area on the geological map of Georgia (Papava et. al., 1971/Папава и др. 1971)

The main hydrographic element of the study area is the Tskaltsitela river. The river Tskaltsitela headwaters are located on the mountain Nakerala slopes of the Racha range, at an altitude of 1080 m above sea level. The Tskaltitela river is the right tributary of the Kvirila river. It is 49 km long and its basin covers the 221 km^2 area. It is fed mainly by rain water and is characterized by flood events throughout the year. The Tskaltsitela river flows within the study area from the north to the south. The width of the river bed is generally 70 m. The river is 1100-1200 m away from the study site.

According to the hydrogeological map of Georgia the study area belongs to the Tskaltubo artesian basin of porous, fracture and fracture-karst groundwaters of the hydrogeological district of the Georgian Block's artesian basins. It is characterized by weak water affluence D<0.1m/s and weak mineralization degree (less than 1g/l; Buachidze & Zedgenidze, 1970).

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3. Soils physical-mechanical properties

Due to the complexity of the engineering-geological conditions, according to the Annex 10 of the CNR 1.02.07.-87 the site belongs to the II (moderate) engineering-geological category of complexity. In order to obtain an engineering-geological picture of the construction site, 2 drillholes with maximum depth of 30 m each were drilled on the site. Based on the analysis of conducted field work and laboratory studies, four layers were distinguished on the site. Below the description of these layers is presented.

Layer #1 Backfill soil - pdQ_{IV} – Clayey mass with inclusions of gravel and pebbles, compacted. In the study area the layer thickness is 0,3-0,6 m, while on the slope located to the west it has relatively big thickness.

According to treatment complexity the soil belongs to 24-a-II category

Layer #2 Clay - pdQ_{IV} – Dark-brown, with gravel inclusions, low plasticity. The layer has local distribution on the construction site and is observed in the eastern part of the site (drillhole N2) within the 0,6-2,5 m interval. The layer was tested by 3 soil samples. Soil physical-mechanical properties were studied: density, moisture content, plasticity limits and according to their values porosity, porosity index and liquidity index were estimated. According to their values soil strength and deformation properties were estimated according to tables №№ 2 and 3 of the Annex 2 and table № 3 of the Annex 3 of PN 2.02.01-83. Standard values of soil physical-mechanical properties are given in Table 1. The laboratory tests results are demonstrated in the summary test-sheet.

Table1

#	Types of physical-mechanical properties	Index	Meas. unit	Standard value
1	Density	ρ	g/cm³	1,78
2	Bulk density	ρδ	g/cm³	1,26
3	Mineral particles density	ρs	g/cm³	2,74
4	Natural moisture content	W	N/division	0,413
5	Porosity	n	%	54
6	Porosity index	e	N/division	1,176

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7	Moisture content at liquidity limit	W_L	N/division	0,665
8	Moisture content at plastic limit	Wp	N/division	0,231
9	Plasticity index	Ip	N/division	43,4
10	Liquidity index	I_L	N/division	0,42
11	Degree of saturation	Sr	N/division	0,96
12	Poisson's ratio	μ	N/division	0,42
13	Deformation modulus	E	kgf/cm²	100
14	Internal friction angle	φ	degree	11^0
15	Specific cohesion	C	kgf/cm²	0,32
16	Relative design resistance	R_0	kgf/cm²	1,9

According to treatment complexity the soil belongs to 8-в-III category.
According to its seismic properties the soil belongs to the III category of soils

Layer #3 Limestone - b1-b4 – Strongly weathered, jointed, disintegrated into gravelly soil. The rock is strongly weathered and widely jointed, the joints are filled by clay and weathering products. In the massif the layer preserved bedding, although the extracted core is disintegrated and clayey/argillaceous. Therefore, the layer is considered as a gravelly soil with clayey filler. The particle size distribution in soils was studied using sieve analysis. Physical properties of the filler – natural moisture content, plastic and liquidity limits were estimated. Particle size distribution test results are shown in Table 2, the laboratory tests results are demonstrated in the summary test-sheet.

Table 2

Particle size, mm	.>40.0	40.0-20.0	20.0-10.0	10.0-5.0	5.0-2.0	2.0-1.0	1.0-0.5	0.5-0.25	0.25-0.1	0.1-005	0.05-0.01	0.01-0.005	<0.005
Average % amount	15.1	22.2	25.1	12.3	8.1	2.8	1.2	0.7	0.4	0.5	0.1	4.6	6.8
Total % amount	15.1	37.3	62.4	74.8	82.9	85.7	86.9	87.6	88.0	88.5	88.6	93.2	100.0

According to values shown in the table particles of more than 10 mm sieve size exceed 50% in the soil mass which in accordance with table 2 of the Appendix 1 (PN 02.01-08) is classified as a gravelly soil. The filler content in the soil mass is up to 20- 30% and therefore the filler mechanical properties were studied. To determine the mechanical properties of

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the soil the "Methodology for assessing the strength and compressibility of coarse-grained soils. DalNIIS 1989" ("методика оценки прочности и сжимаемости крупнообломочных грунтов. ДальНИИС 1989") was used. Standard values of soil physical-mechanical properties are given in Table 3.

Table 3

Natural moisture content of the filler	W	N/division	0,330
Liquidity limit of the filler	W_L	N/division	0,507
Plastic limit of the filler	Wp	N/division	0,230
Plasticity index	Ip	N/division	27,7
Liquidity index	I_L	N/division	0,34
Standard density	ρ	g/cm³	1.96
Internal friction angle	φ	degree	35º
Specific cohesion	C	kPa	10
Deformation modulus	E	kgf/cm²	410
Poisson's ratio	μ		0,27
Relative design resistance	R_0	kgf/cm²	4,5

According to treatment complexity the soil belongs to 6-г-IV category.

According to its seismic properties the soil belongs to the II category of soils.

Layer #4 Limestone - b1-b4 – Greyish-creamy, weakly jointed, moderate strength. The layer was tested by 6 samples. Density and strength in dry and saturated conditions, deformation modulus were estimated in the samples. Direct shear strength tests were conducted on the samples in order to establish internal friction angle and specific cohesion. Physical-mechanical properties of the layer are shown in the table 4, laboratory tests data and results tables are presented in annexes.

Table 4

#	Types of physical-mechanical properties	Index	Meas. unit	Standard value
1	Density	ρ	g/cm³	2,51
2	Strength in saturated conditions	Rcw	mPa	30,0

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3	Softening coefficient	k		0,66
4	Specific cohesion	C	mPa	7,2
5	Internal friction angle	φ	Degree °	32°
6	Deformation modulus saturated	E	mPa	6900
7	Poison's ratio	μ		0,20

According to the state standard 25100-82, the soil is classified as sedimentary, cemented, rocky, prone to softening (expansive) rock of moderate strength.

According to treatment complexity the soil belongs to 15-б-VI category.

According to its seismic properties the soil belongs to the II category of soils.

Groundwater was established (water strike) at the construction site in the drillhole №2 at the depth of 20,0-21,0 m. The rest water level was established at absolute depth of 394,9 m. As for the water sample from the drillhole №2, it is technical water used during drilling and its chemical composition and mineralization is shown in the "Results of water samples chemical analyses". Groundwater sampled from the drillhole №2 belongs to fresh/sweet water category and M = 0.82-0.97 g/l. The water is of the hydrocarbonate-sulfate sodium-magnesium-calcium type in chemical composition. The water is not aggressive towards any brand of concrete, is not aggressive towards reinforcement in conditions of permanent immersion of reinforced concrete structures, and is weakly aggressive during periodic wetting.

4. Conclusions and recommendations

1. Tkibuli Municipality, Gelati Village, Gelati Monastery, c/c 39.07.31.362 is located on a moderately sloping to the west terrain. Based on the conducted detailed engineering-geological survey, it was determined that the land plot is stable, currently, there are no dangerous geological events (landslides, mudflows, avalanches, karst, suffosion, etc.) developed here as well as in the surrounding area.

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2. Three engineering-geological elements were identified on the construction site (the backfill layer is not taken into account): the normative/standard and reference values of these elements (EGE) are given in Table 5.

Table 5

EGE	Standard and reference values	Density g/cm³	Specific cohesion X kgf/cm²	Internal friction angle, φ degree	Filtration coefficient kf m/day	Relative design resistance R_0, kgf/cm²	Deformation modulus E MPa	Poisson's ratio μ	Soil type
I	A_n	1.78	0.32	11º		1.9	10	0.42	Low-plasticity dark-brown clay
II	A_n	1.96	0.10	35º		4.5	41	0.27	Limestone disintegrated into gravelly soil
	α =0,85	1.95	0.10	35º					
	α =0,95	1.94	0.07	31º					
III	A_n	2.51	73.4 (7.2 mPa)	32º	30.0		6900	0.20	Limestone with moderate strength
	α =0,85	2.50			26.0				
	α =0,95	2.49			23.2				
Note: the reliability of the probability when determining the reference characteristics of the soil is considered - α=0.95 when calculating the bearing capacity of the base, α=0.85 when calculating the deformation									

3. According to the analysis of obtained field and laboratory studies results EGE I defined on the construction site is a low-plasticity clay. The soil has low strength and deformation properties. The layer is locally distributed at the construction site and is observed only in its eastern part.

4. II EGE is a strongly weathered and jointed limestone, which is clayey/argillaceous in some parts and disintegrated into gravelly soil. The soil has good deformation and strength properties.

5. III EGE is a weakly jointed limestone. The soil has high grade deformation and strength properties.

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6. The groundwater strike on the construction site was established at 20,0-21,0 m depth, the rest water level elevation is 377,6 m. Water is not aggressive towards any brand of concrete.

7. The maximum allowable cut slope inclination of the pit on the site should be adopted taking into account paragraphs 3.11, 3.12, 3.15 of SNR 3.02.01-87 and in accordance with the requirements of Chapter 9 of SNR 3.02.01-87.

8. Tkibuli municipality, Gelati village, according to Annex of Seismic risks map PN 01.01.-09 (Earthquake / seismic resistant construction) is attributed to the 8 points seismic hazard zone, with dimensionless coefficient of seismicity A - 0.14; Constructing the site soils due to their seismic properties are attributed to the II category according to the Table # 1 of the same collection.

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მისამართი: ტ.ტაბიძის ქ.30, თბილისი, საქართველო. ტელეფონი: 595 595915
Address: 30, T.Tabidze str., Tbilisi, Georgia. Cell phone: 595 595915. e-mail: info@geologicalservice.ge

Technical assignment

for conducting engineering-geological survey

1. Client LEPL Georgian Patriarchate

(Name of organization)

2. Construction site name: Engineering-geological survey of the Gelati Monastery territory

3. The site address: Tkibuli Municipality, Gelati Village, C/C 39.07.31.362, vicinities of the Gelati Cathedral

4. Construction type: Reconstruction

(New construction, reconstruction, development)

5. Design stage: working project

(Pre-project, project, working project)

Note: Two drillholes should be drilled to a depth of 30.0 m. An engineering-geological cross-section with indication of the location, thickness and distribution of the underlying soils of the survey area should be prepared. Laboratory testwork should be carried out in accordance with the construction norms and rules in force in Georgia. Based on the data obtained, a Georgian-English technical report of the engineering-geological survey should be prepared.

Signature of the responsible person:

D-H. №1

396,4

D-H. №2

398,6

72,0

I

Position	Last Name	Signature	Tkibuli Municipality, Gelati Village, C/C 39.07.31.362, Engineering-geological survey of the Gelati Monastery territory
Director	N. Sadradze		
Engineer-Geologist	G. Sadradze		Drillholes distribution scheme
Implementer	G. Sadradze		

LTD Geological Service	GEOLOGICAL SERVICE	desing stage	sheet	sheets	Scale
		working project	1	2	Without scale

LEGEND

Backfill: clayey soil mass with gravel and pebbles inclusions, compacted.

I — Dark brown clay with gravel inclusions, slightly plastic.

II — Strongly weathered limestone, disintegrated, into gravelly soil.

II — Greyish-creamy limestone, weakly jointed, moderate strength.

21,0(377,6) — Groundwater level

Lithological Boundary

Position	Last Name	Signature	Tkibuli Municipality, Gelati Village, C/C 39.07.31.362, Engineering-geological survey of the Gelati Monastery territory			
Director	N. Sadradze					
Engineer-Geologist	G. Sadradze		Engineering-Geological Section I-I			
Creator	G. Sadradze					
LTD Geological Service		GEOLOGICAL SERVICE	desing stage	sheet	sheets	Scale
			working project	2	2	1:200

ჭაბურღილის გეოლოგიურ- ლითოლოგიური სვეტი/Geological-lithological log of the drillhole

ბურღვის თარიღი: 31.03. 2026/ Drilling date: 31.03. 2026

ჭაბურღილი/Drillhole #1 მასშტაბი/ Scale: 1:25 აბს.ნიშნ.მ/Absolute d 396.4

სიღრმე, მ /Depth, m.	სგე/EGE	სტრატიგრაფიული ინდექსი/Stratigraphic index	ლითოლოგიური ჭრილი/Lithological log	ძრის სავლის სიღრმე მ /Depth of the bed bottom, m	ძრის სიმძლავრე მ/ Bed thickness, m	აბს. ნიშნული მ/Abs. depth	გრუნტის აღწერა/Soil description	წყლის გამოჩენა,მ /Water strike, m	წყლის დამყარებული დონე, მ / Rest water level, m	ნიმუშის აღების სიღრმე მ /Sampling depth, m
1		2	3	4	5	6	7	8	9	10
		tQIV		0.3	0.3	396.1	Backfill: clayey soil mass with gravel and pebbles compacted			
1 2 3 4 5 6 7 8 9	III	b1-b4		9.8	9.5	386.6	კირქვა მონაცრისფრო-კრემისფერი, სუსტად ნაპრალიანი, საშუალო სიმტკიცის Greyish-creamy limestone, weakly jointed, moderate strength			3.5
10	II	b1-b4		10.7	0.9	385.7	კირქვა ძლიერ გამოფიტული, დაშლილი ღორღოვანი გრუნტის მდგომარეობამდე Strongly weathered limestone, disintegrated into gravelly soil			10.3
11 12 13 14 15 16	III	b1-b4		16.4	5.7	380.0	კირქვა მონაცრისფრო-კრემისფერი, სუსტად ნაპრალიანი, საშუალო სიმტკიცის Greyish-creamy limestone, weakly jointed, moderate strength			13.0
17	II	b1-b4		17.0	0.6	379.4	Strongly weathered limestone, disintegrated into gravelly soil.			
18 19 20	III	b1-b4		20.9	3.9	375.5	კირქვა მონაცრისფრო-კრემისფერი, სუსტად ნაპრალიანი, საშუალო სიმტკიცის Greyish-creamy limestone, weakly jointed, moderate strength			20.0
21	II	b1-b4		21.3	0.4	375.1	Strongly weathered limestone, disintegrated into gravelly soil.			
22 23	III	b1-b4					კირქვა მონაცრისფრო-კრემისფერი, სუსტად ნაპრალიანი, საშუალო სიმტკიცის Greyish-creamy limestone, weakly jointed, moderate strength			

24 25				25.0	3.7	371.4				
	II	b1-b4		25.5	0.5	370.9	Strongly weathered limestone, disintegrated into gravelly soil.			25.2
26 27 28 29 30	III	b1-b4		30.0	4.5	366.4	კირქვა მონაცრისფრო-კრემისფერი, სუსტად ნაპრალიანი, საშუალო სიმტკიცის Greyish-creamy limestone, weakly jointed, moderate strength			29.5

ჭაბურღილის გეოლოგიურ- ლითოლოგიური სვეტი/Geological-lithological log of the drillhole

ბურღვის თარიღი: 03.04.2026 Drilling date 03.04. 2026

ჭაბურღილი/Drillhole #2 მასშტ./Scale: 1:25 აბს.ნიშნ.მ/Absolute d 398.6

სიღრმე, მ /Depth, m.	სგე/EGE	სტრატიგრაფიული ინდექსი/Stratigraphic index	ლითოლოგიური ჭრილი/Lithological log	ფენის საგების სიღრმე მ /Depth of the bed bottom, m	ფენის სიმძლავრე მ/ Bed thickness, m	აბს. ნიშნული მ/Abs. depth	გრუნტის აღწერა/Soil description	წყლის გამოჩენა,მ /Water strike, m	წყლის დამყარებული დონე, მ / Rest water level, m	ნიმუშის აღების სიღრმე მ /Sampling depth, m
1		2	3	4	5	6	7	8	9	10
		tQIV		0.6	0.6	398.0	Backfill: clayey soil mass with gravel and pebbles compacted			
1 2	I	pdQIV		2.5	1.9	396.1	თიხა მუქი-ყავისფერი, ღორღის ჩანართებით, ძნელპლასტიური Dark brown clay with gravel inclusions, slightly plastic.			1.0 1.5 2.1
3 4 5	II	b1-b4		5.8	3.3	392.8	კირქვა ძლიერ გამოფიტული, დაშლილი ღორღოვანი გრუნტის მდგომარეობამდე Strongly weathered limestone, disintegrated into gravelly soil			3.0 5.0
6 7 8 9 10 11	III	b1-b4		11.9	6.1	386.7	კირქვა მონაცრისფრო-კრემისფერი, სუსტად ნაპრალიანი, საშუალო სიმტკიცის Greyish-creamy limestone, weakly jointed, moderate strength			7.4
12	II	b1-b4		12.4	0.5	386.2	Strongly weathered limestone, disintegrated into gravelly soil.			
13 14	III	b1-b4		14.2	1.8	384.4	კირქვა მონაცრისფრო-კრემისფერი, სუსტად ნაპრალიანი, საშუალო სიმტკიცის Greyish-creamy limestone, weakly jointed, moderate strength			
15	II	b1-b4		15.9	1.7	382.7	კირქვა ძლიერ გამოფიტული, დაშლილი ღორღოვანი გრუნტის მდგომარეობამდე Strongly weathered limestone, disintegrated into gravelly soil			15.0
16										

17 18 19 20 21	III	b1-b4		21.4	5.5	377.6 377.2	კირქვა მონაცრისფრო-კრემისფერი, სუსტად ნაპრალიანი, საშუალო სიმტკიცის Greyish-creamy limestone, weakly jointed, moderate strength		21.0	
22	II	b1-b4		22.0	0.6	376.6	Strongly weathered limestone, disintegrated into gravelly soil.			
23 24 25 26 27 28	III	b1-b4		28.4	6.4	370.2	კირქვა მონაცრისფრო-კრემისფერი, სუსტად ნაპრალიანი, საშუალო სიმტკიცის Greyish-creamy limestone, weakly jointed, moderate strength		26.0	
29	II	b1-b4		29.1	0.7	369.5	Strongly weathered limestone, disintegrated into gravelly soil.			28.7
30	III	b1-b4		30.0	0.9	368.6	კირქვა მონაცრისფრო-კრემისფერი, სუსტად ნაპრალიანი, საშუალო სიმტკიცის Greyish-creamy limestone, weakly jointed, moderate strength			

Project name: kibuli Municipality, Gelati Village, Gelati Monastery Area, Plot No. 39.07.31.362

The survey results of soils composition and physical-mechanical properties

№	Boreholes #	Sampling run/interval, m	Particle size, mm													Moisture content W%		Plasticity %			Liquidity index I_L	Density, gr/cm^3			Porosity, n%	porosity coefficient , e	Degree of saturation, Sr	Subsoil name
			60-40	40-20	20-10	10-5	5-2	2-1	1-0.5	0.5-0.25	0.25-0.1	0.1-0.05	0.05-0.01	0.01-0.005	< 0.005	Natural	Infill	Upper Limit, W_L	Lower limit, Wp	Plasticity index I_P		Mineral particles rs	Natural, r	Bulk, r_d				
1	2	1.0														42.5		67.2	23.7	43.5	0.43	2.74	1.77	1.24	55	1.206	0.97	Clay slightly plastic
2	2	1.5														40.3		65.5	22.4	43.1	0.42	2.74	1.79	1.28	53	1.148	0.96	Clay slightly plastic
3	2	2.1														41.2		66.7	23.3	43.5	0.41	2.74	1.78	1.26	54	1.174	0.96	Clay slightly plastic
4	1	10.3	43.6	16.2	16.6	7.4	4.1	1.4	0.6	0.4	0.2	0.3	0.1	4.3	5.0		43.5	64.11	23.9	40.2	0.49		1.80					Limestone gravel with clay
5	1	25.2	22.7	28.1	20.9	9.5	5.4	1.8	0.8	0.4	0.3	0.3	0.1	2.5	7.5		38.3	48	19.5	28.5	0.66		1.90					Limestone gravel with clay
6	2	3.0	24.2	32.4	15.6	7.2	3.5	1.2	0.5	0.3	0.2	0.1	0.1	5.0	10.0		29.5	44.9	27.9	17.0	0.09		2.01					Limestone gravel with clay
7	2	5.0	0.0	32.1	22.7	18.7	10.6	3.4	1.3	0.9	0.4	0.4	0.1	2.0	7.6		24.8	44.3	21.7	22.6	0.14		2.04					Limestone gravel with clay
8	2	15.0	0.0	0.7	35.8	20.5	14.7	5.6	2.7	1.7	0.9	1.0	0.2	6.0	10.5		35.8	46.8	22.3	24.5	0.55		2.00					Limestone gravel with clay
9	2	28.7	0.0	23.9	39.3	10.9	10.5	3.6	1.6	0.8	0.7	0.9	0.1	7.8	0.0		26.1	56.2	22.7	33.5	0.10		1.98					Limestone gravel with clay

Geological service LtD,

Head of Geotechnical Laboratory N.Sadradze

17.04.2026

ობიექტის დასახელება:ტყიბულის მუნიციპალიტეტი,სოფელი გელათი, გელათის ტაძარი, ნაკვ.#39.07.31.362 Site name: Tkibuli Municipality, village Gelati, Gelati Monastery, land Plot#39.07.31.362

ქანის ერთღერძა კუმშვაზე გამოცდის შედეგები The rock uniaxial con ხელსაწყო/Device NCC 5002 Automatic Compression testing machine

გამოყენებული სტანდარტები: Standards used:

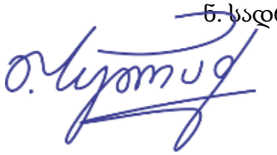
гост 5180-84	გრუნტების ფიზიკური მახასიათებლების განსაზღვრის ლაბორატორიული მეთოდები Laboratory methods for soil mechanical properties identification
гост 21153.2-84	ქანების ერთღერძა კუმშვაზე სიმტკიცის ზღვარის განსაზღვრის ლაბორატორიული მეთოდები Laboratory methods for rocks strength identification at ı
гост 21153.5-88	სიმტკიცის განსაზღვრის მეთოდი ქანების ძვრაზე გამოცდით Direct shear test for determining the rocks strength
гост 28985-91	ქანების დეფორმაციული მახასიათებლების კვლევა ერთღერძა კუმშვაზეStudy of rocks deformation characteristics under uniaxial compression
гост 25100-82	გრუნტების კლასიფიკაცია Soils classification

სინჯის Sample #	ჭაბ/შურDrillhole/test pit #	სიღრმე მ Depth m	ქანის დასახელება Rock name	სიმტკიცე ჰაერშმრალ მდგომარეობაში Strength at air-dry conditions Rc mpa	სიმტკიცე წყალნაჯერ მდგომარეობაში Strength in water saturated conditions Rcw mpa	დარბილების კოეფიციენტი Coefficient of softening k	დრეკადობის (იუნგის) მოდული წყალნაჯერ. მდგომ. Elasticity (Young's) modulus , water-saturated	შიგა ხახუნის კუთხე, გრადუსი/Internal friction angle, degree	შეჭიდულობა/Cohesion, მეგპა/Mpa, C	სიმკვრივე/density ρ g/sm3
1	1	3.5-3.8	კირქვა მონაცრისფრო-კრემისფერი/Limestone greyish-creamy	36.4	20.9	0.57	6400	34	6.2	2.50
2	1	13.0-13.3	კირქვა მონაცრისფრო-კრემისფერი/Limestone greyish-creamy	39.7	18.8	0.47	6200	33	6.6	2.47
3	1	20.0-20.3	კირქვა მონაცრისფრო-კრემისფერი/Limestone greyish-creamy	43.2	38.9	0.90	7900	29	8.5	2.51
4	1	29.6-30.0	კირქვა მონაცრისფრო-კრემისფერი/Limestone greyish-creamy	71.4	38.2	0.54	7800	30	8.0	2.50
5	2	7.0-7.7	კირქვა მონაცრისფრო-კრემისფერი/Limestone greyish-creamy	38.8	29.1	0.75	6900	35	7.3	2.52
6	2	26.0-26.3	კირქვა მონაცრისფრო-კრემისფერი/Limestone greyish-creamy	46.8	34.2	0.73	6200	28	6.4	2.56
saSualo				46.1	30.0	0.66	6900	32	7.2	2.51

შ.პ.ს. გეოლოგიური სამსახურის გეოტექნიკური Head of the Geological Service LTD Laboratory

ლაბორატორიის ხელმძღვანელი: ნ. სადრაძე N.Sadradze

თარიღი/Date: 17.04.2026



Results of soil particle size distribution test

Results of soil particle size distribution test			
Gelati Village, Gelati Monastery Area,	Stage	Project stage	
Plot No. 39.07.31.362	Date	16.04	2026
Rock description	Borehole/test pit #	1	
Limestone gravel clayey infill	Sample #	1	
Moist	Depth m	10.3	10.5

Soil salinity

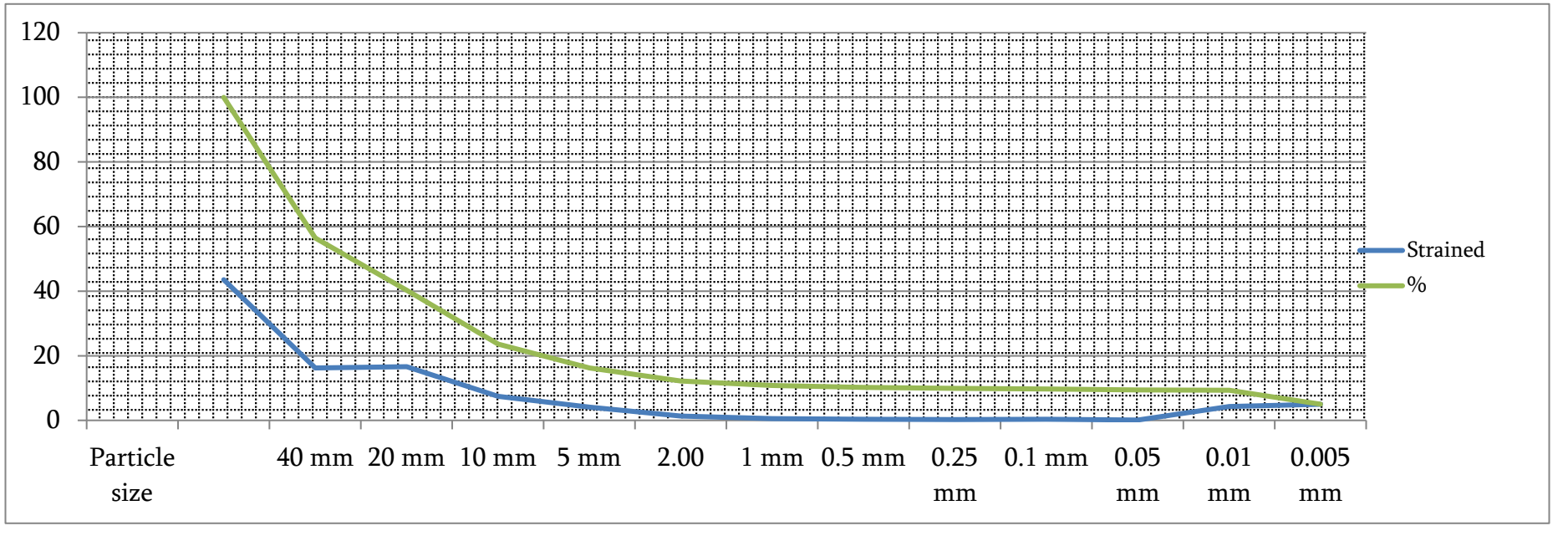
Gypsum %		Carbonates %	
SO4	CaSO4	CaCO3	CO2

Values of filler physical properties

Name	Test conditions	Device #	Moisture content W%	Density g/cm³	Density, min. part size g/cm³	Bulk density g/cm3	Porosity n%	Porosity index e	Upper plastic limit W%	Lower plastic limit W%	Plasticity index I_P	Liquidity index I_L	Saturation rate Sr
Filler physics	Natural		19.00	2.32					26.30	18.30	8.0	0.09	

Results and plot of particle size distribution test

Particle size		40 mm	20 mm	10 mm	5 mm	2.00	1 mm	0.5 mm	0.25 mm	0.1 mm	0.05 mm	0.01 mm	0.005 mm	>0.005 mm
Strained		43.6	16.2	16.6	7.4	4.1	1.4	0.6	0.4	0.2	0.3	0.1	4.3	5.0
Total		43.6	59.8	76.4	83.8	87.9	89.2	89.8	90.1	90.3	90.6	90.7	95.0	100.0
%		100.0	56.5	40.3	23.7	16.3	12.2	10.8	10.3	9.9	9.7	9.4	9.3	5.0



Results of soil particle size distribution test

Location	Stage	Pre-Project stage	
Gelati Village, Gelati Monastery Area,	Date	16.04	2026
Rock description	Borehole/test pit #	1	
Limestone gravel clayey infill	Sample #	2	
Moist	Depth, m	25.2	25.4

Soil salinity

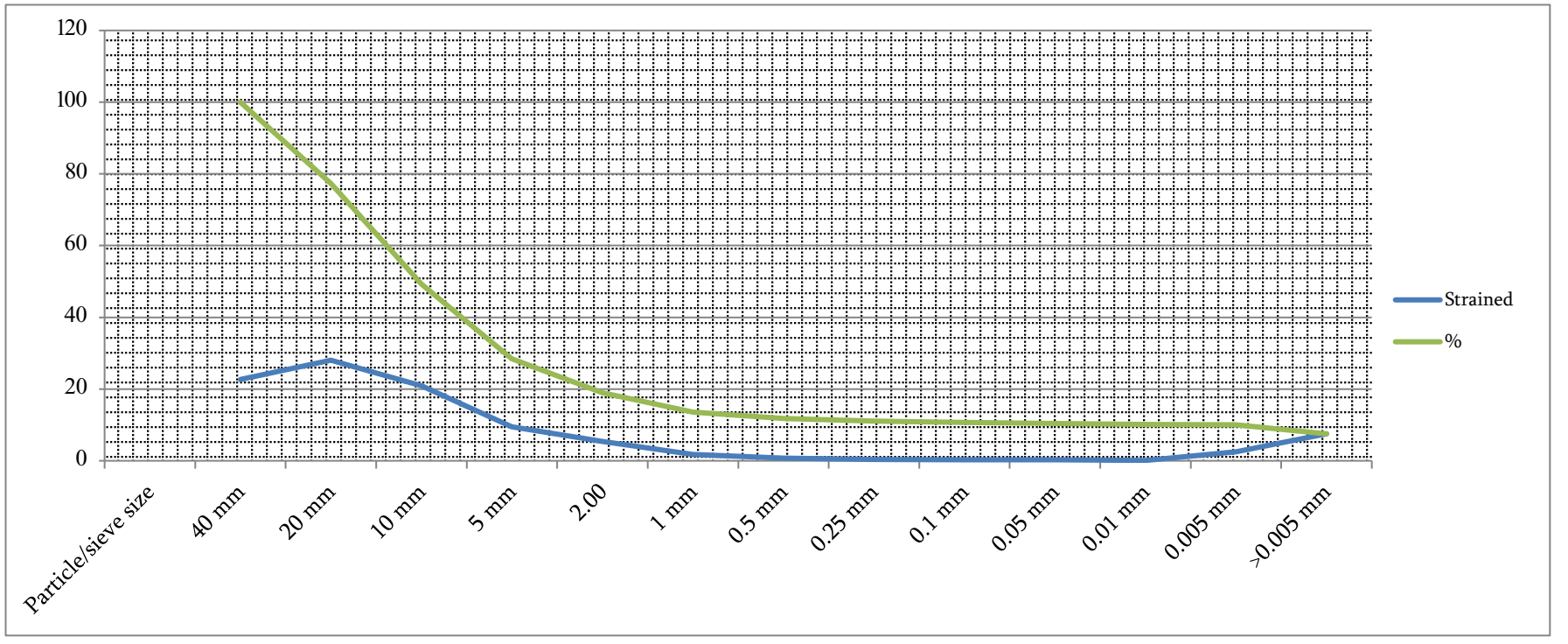
Gypsum %		Carbonates %	
SO4	CaSO4	CaCO3	CO2

Values of filler physical properties

Name	Test conditions	Device#	Moisture content W%	Density g/cm³	Density, min. part. g/cm³	Bulk density g/cm3	Porosity n%	Porosity index e	Upper plastic limit W%	Lower plastic limit W%	Plasticity index I_P	Liquidity index I_L	Saturation rate Sr
Filler physics	Natural		18.80	2.36					27.50	17.20	10.3	0.16	

Results and plot of particle size distribution test

Particle/sieve size		40 mm	20 mm	10 mm	5 mm	2.00	1 mm	0.5 mm	0.25 mm	0.1 mm	0.05 mm	0.01 mm	0.005 mm	>0.005 mm
Strained		22.7	28.1	20.9	9.5	5.4	1.8	0.8	0.4	0.3	0.3	0.1	2.5	7.5
Total		22.7	50.7	71.6	81.1	86.4	88.2	89.0	89.4	89.6	89.9	90.0	92.5	100.0
%		100.0	77.4	49.3	28.4	19.0	13.6	11.8	11.1	10.7	10.4	10.1	10.0	7.5



Results of soil particle size distribution test

Location	Stage	Pre-Project stage	
Gelati Village, Gelati Monastery Area,			
Plot No. 39.07.31.362	Date	16.04	2026
Rock description	Borehole/test pit #	2	
Limestone gravel clayey infill	Sample #	3	
Moist	Depth m	3.0	3.2

Soil salinity

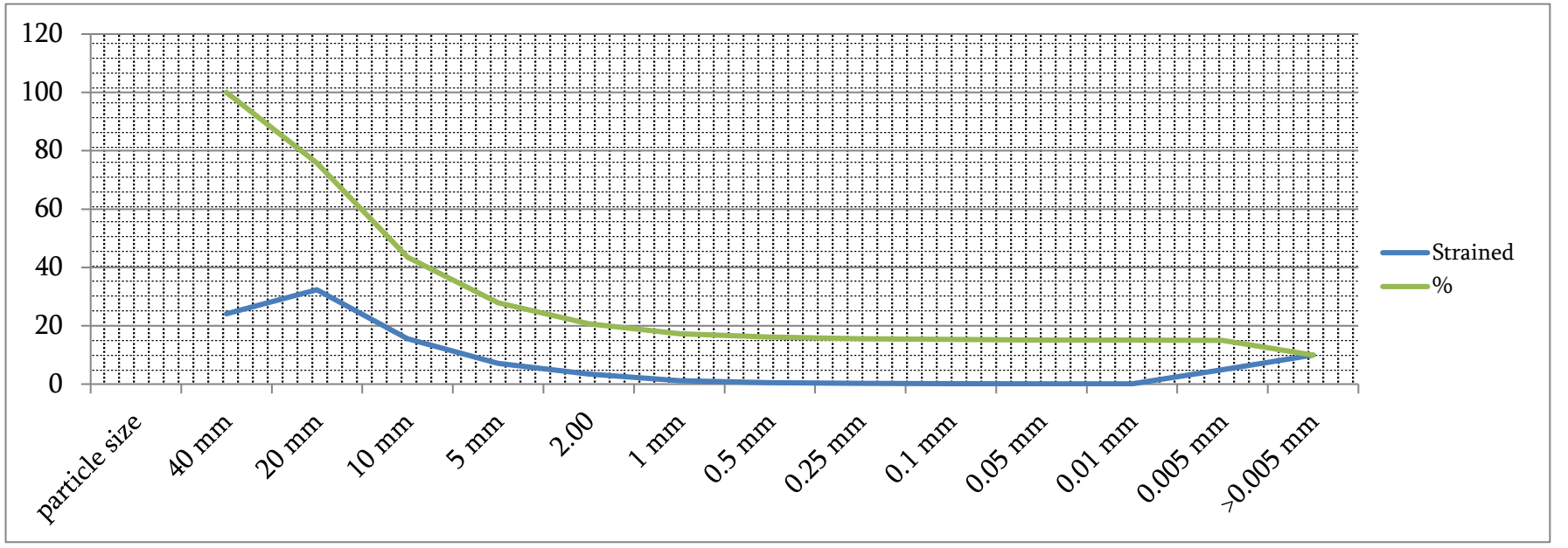
Gypsum %		Carbonates %	
SO4	CaSO4	CaCO3	CO2

Values of filler physical properties

Name	Test conditions	Device #	Moisture content W%	Density g/cm³	Density, min. part. size g/cm³	Bulk density g/cm3	Porosity n%	Porosity index e	Upper plastic limit W%	Lower plastic limit W%	Plasticity index I_P	Liquidity index I_L	Saturation rate Sr
Filler physics	natural		19.30	2.28					28.70	19.10	9.6	0.02	

Results and plot of particle size distribution test

	particle size	40 mm	20 mm	10 mm	5 mm	2.00	1 mm	0.5 mm	0.25 mm	0.1 mm	0.05 mm	0.01 mm	0.005 mm	>0.005 mm
Strained		24.2	32.4	15.6	7.2	3.5	1.2	0.5	0.3	0.2	0.1	0.1	5.0	10.0
Total		24.2	56.5	72.1	79.3	82.8	83.9	84.4	84.7	84.9	85.0	85.1	90.1	100.0
%		100.0	75.9	43.5	27.9	20.8	17.3	16.1	15.6	15.4	15.2	15.1	15.0	10.0



Results of soil particle size distribution test

Location	Stage	Pre-Project stage	
Gelati Village, Gelati Monastery Area,			
Plot No. 39.07.31.362	date	16.04	2026
Rock description	Borehole/test pit #	2	
Limestone gravel clayey infill	sample #	4	
Moist	Depth m	5.0	5.2

Soil salinity

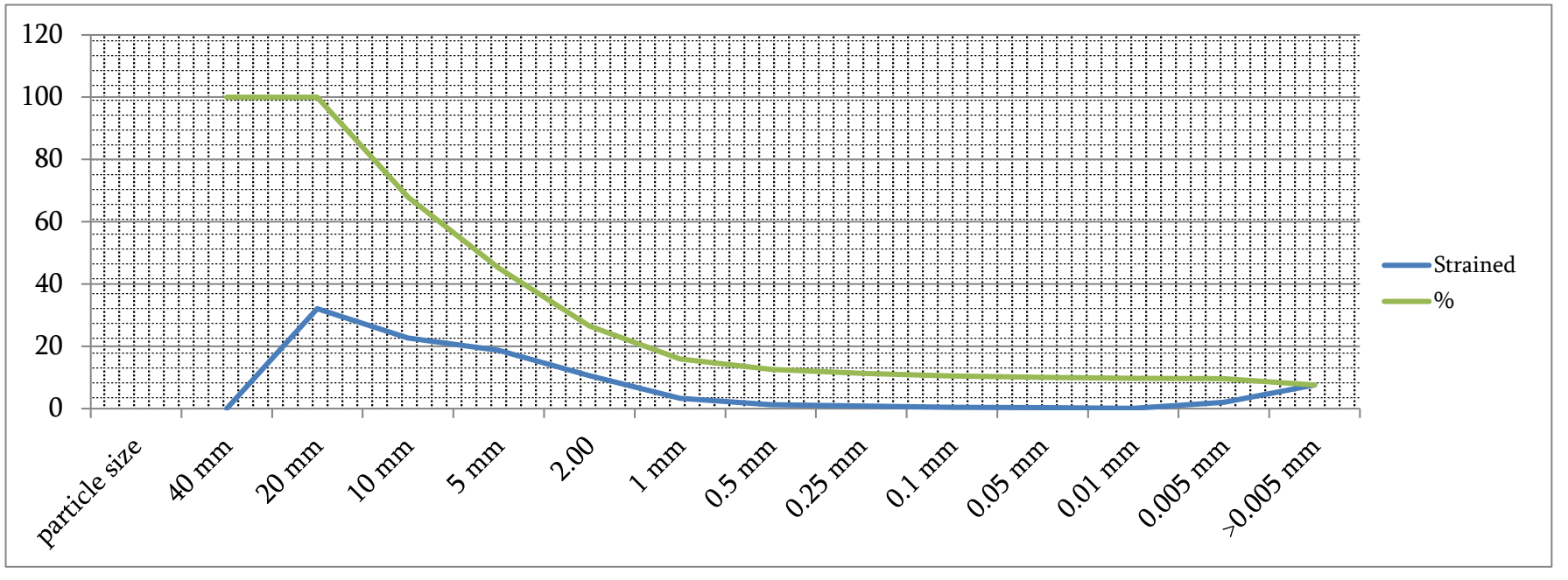
Gypsum %		Carbonates %	
SO4	CaSO4	CaCO3	CO2

Filler physical properties values

Name	Test conditions	device #	moisture W%	density g/cm³	density, min. part. g/sm³	bulk density g/cm3	Porosity n%	Porosity index e	upper plasticity limit W%	lower plasticity limit W%	plasticity index I_P	Liquidity index I_L	saturation rate Sr
Filler physics	Natural		20.10	2.32					26.90	19.30	7.6	0.11	

Results and plot of particle size distribution test

	particle size	40 mm	20 mm	10 mm	5 mm	2.00	1 mm	0.5 mm	0.25 mm	0.1 mm	0.05 mm	0.01 mm	0.005 mm	>0.005 mm
Strained		0.0	32.1	22.7	18.7	10.6	3.4	1.3	0.9	0.4	0.4	0.1	2.0	7.6
Total		0.0	32.1	54.8	73.5	84.1	87.4	88.7	89.6	90.0	90.3	90.4	92.4	100.0
%		100.0	100.0	67.9	45.2	26.5	16.0	12.6	11.3	10.5	10.1	9.7	9.6	7.6



The results of soil particle size distribution test

Location	Stage	Pre-Project stage	
Gelati Village, Gelati Monastery Area,			
Plot No. 39.07.31.362	Date	16.04	2026
Rock description	Borehole/test pit #	2	
Limestone gravel clayey infill	Sample #	5	
Moist	Depth, m	15.0	15.2

Soil salinity

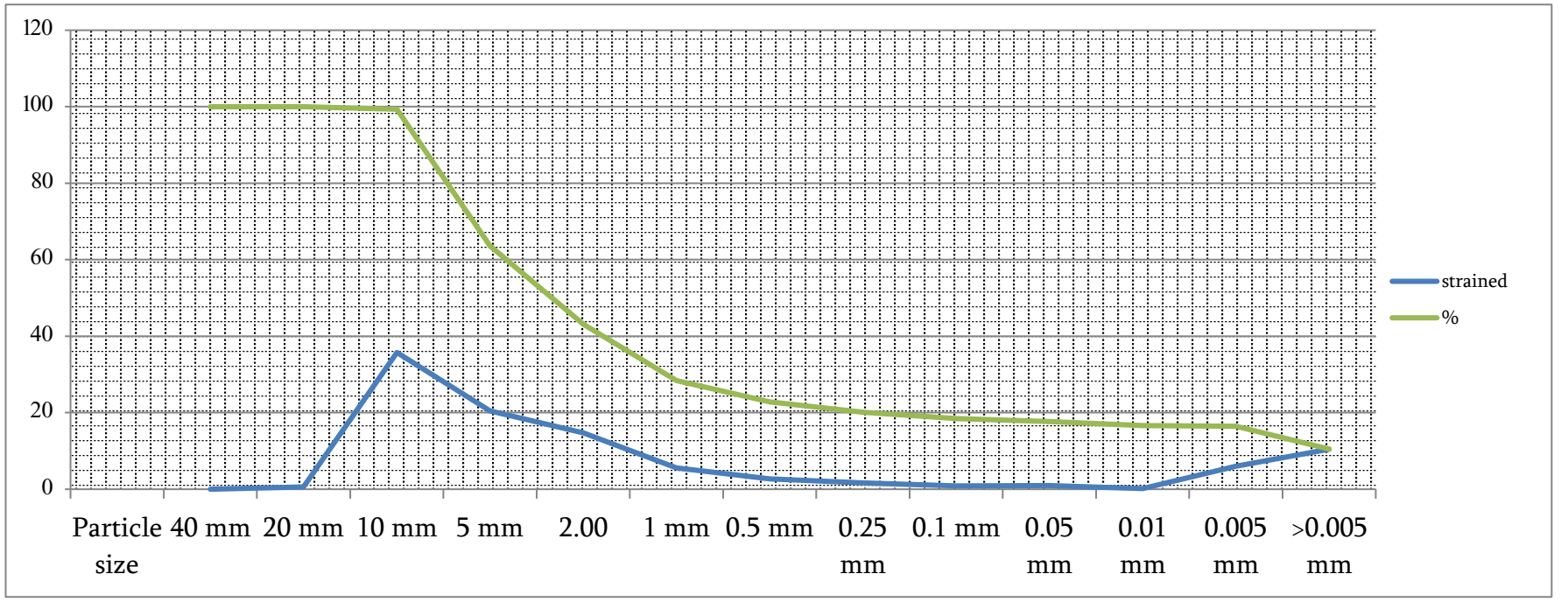
Gypsum %		Carbonate %	
SO4	CaSO4	CaCO3	CO2

Filler physical properties values

Name	Test conditions	Device #	Moisture content W	density g/cm³	density, min. part.size g/cm³	Bulk density g/cm3	Porosity n%	Porosity index e	upper plastic limit W%	lower plastic limit W%	plasticity index I_P	Liquidity index I_L	saturation rate Sr
Filler physics	natural		18.60	2.34					27.40	17.70	9.7	0.09	

Results and plot of particle size distribution test

	Particle size	40 mm	20 mm	10 mm	5 mm	2.00	1 mm	0.5 mm	0.25 mm	0.1 mm	0.05 mm	0.01 mm	0.005 mm	>0.005 mm
strained		0.0	0.7	35.8	20.5	14.7	5.6	2.7	1.7	0.9	1.0	0.2	6.0	10.5
Total		0.0	0.7	36.4	56.9	71.6	77.2	79.9	81.5	82.4	83.4	83.5	89.5	100.0
%		100.0	100.0	99.4	63.6	43.2	28.5	22.9	20.2	18.5	17.7	16.7	16.5	10.5



The results of soil particle size distribution test

Location	Stage	Pre-Project stage	
Gelati Village, Gelati Monastery Area,			
Plot No. 39.07.31.362	Date	16.04	2026
Rock description	Borehole/Test pit #	2	
Limestone gravel clayey infill	Sample #	6	
Moist	Depth m	28.7	28.9

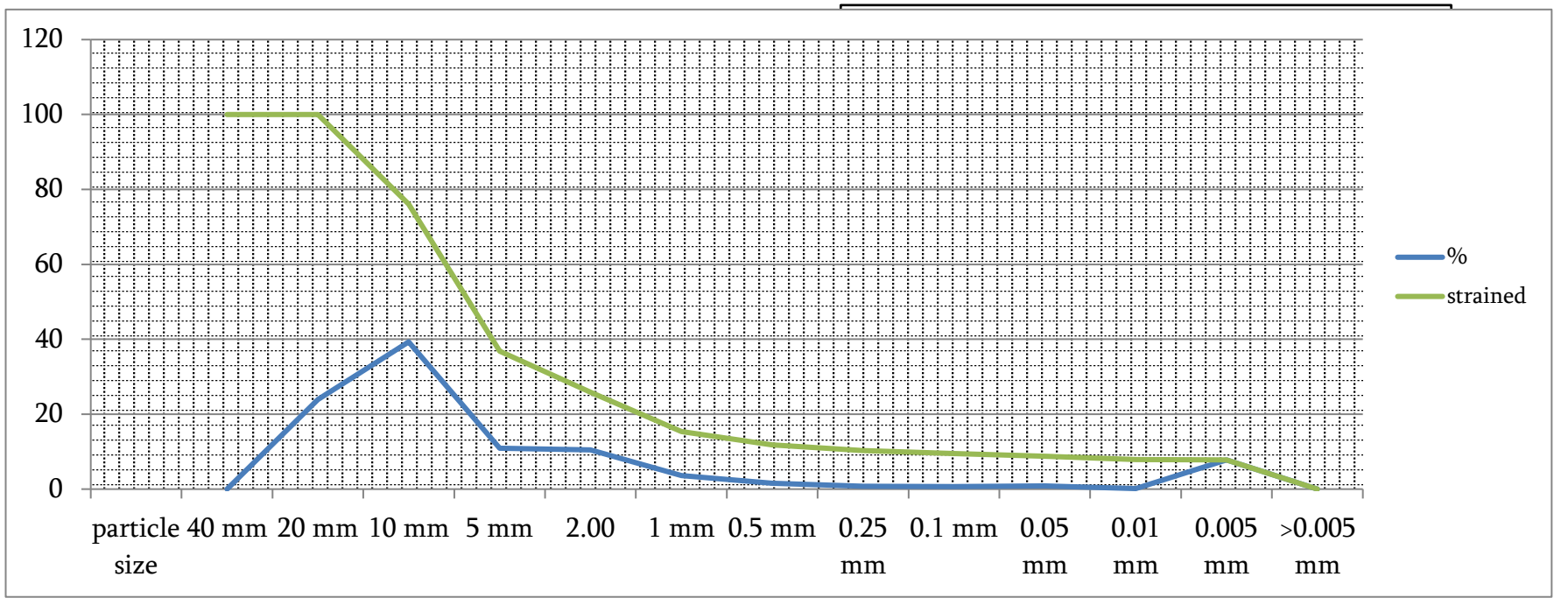
Soil salinity

Gypsum %		Carbonates %	
SO4	CaSO4	CaCO3	CO2

Name	test conditions	device #	moisture content W	density g/cm³	density, min. part. size g/cm³	bulk density g/cm3	Porosity n%	Porosity index e	upper plastic limit W%	lower plastic limit W%	Plasticity index I_P	Liquidity index I_L	saturation rateSr
Filler physics	natural		18.30	2.32					26.30	18.00	8.3	0.04	

Results and plot of particle size distribution test

	particle size	40 mm	20 mm	10 mm	5 mm	2.00	1 mm	0.5 mm	0.25 mm	0.1 mm	0.05 mm	0.01 mm	0.005 mm	>0.005 mm
%		0.0	23.9	39.3	10.9	10.5	3.6	1.6	0.8	0.7	0.9	0.1	7.8	0.0
Total		0.0	23.9	63.2	74.1	84.6	88.2	89.8	90.6	91.2	92.1	92.2	100.0	100.0
strained		100.0	100.0	76.1	36.8	25.9	15.4	11.8	10.3	9.5	8.8	7.9	7.8	0.0



I ს.გ.ე. ფიზიკური თვისებების ნორმატიული მნიშვნელობები/Standard values of EGE I physical properties

№	ფორიანობის კოეფიციენტი Porosity index e	მიწ. ნაწილის სიმკვრივე Min. part. size density ρs	ჩონჩხის სიმკვრივე Bulk density ρd	პლასტიურობის ზედა ზღვარი Liquidity limit WLL	პლასტიურობის ქვედა ზღვარი Plastic limit Wp	პლასტიურობის რიცხვი Plasticity index Ip	დენადობის მაჩვენებელი Liquidity index ILL	ფორიანობა Porosity n	ტენიანობის ხარისხი/Saturation ratio Sr	პუასონის კოეფიციენტი/Poisson's ratio μ	საანგარიშო წინაღობა/Relative design resistance Ro
		გ/სმ³ g/cm³	გ/სმ³ g/cm³	ერთ.ნაწ.N/division	ერთ.ნაწ.N/division	ერთ.ნაწ.N/division	ერთ.ნაწ.N/division	ერთ.ნაწ.N/division	ერთ.ნაწ.N/division		კგძ/სმ² kgf/cm²
1	1.176	2.74	1.26	0.665	0.231	43.4	0.42	0.540	0.96	0.35	1.90

Tkibuli Municipality, Gelati Village, Gelati Monastery Area, Plot No. 39.07.31.362

II IGE, Standard and estimation values of mechanical properties for granular soils c,ф, E

"Методика оценки прочности и сжимаемости крупнообломочных грунтов…" ДальНИИС, 1989г

$\varphi_n = K_1 K\varphi * 46(0,3)^{\mu T}$ (5)

$c_n = K_2 K\rho * 79 * \mu_т^{0,32}/(1+I_L)^{3,62}$ (8)

Files (5), (8) - Consolidated shear strength scheme

$\varphi_n = K_1 K\varphi * 37(0,234)^{\mu T}$ (10)

$c_n = K_2 * K\rho * 87 * \mu_т^{0,51}/(1+I_L)^{3,85}$ (12)

Files (10), (12) - unconsolidated shear strength scheme

$E_n = K_E * K\rho * K_L * 1,0/(0,088 * \mu_т - 0,15 \mu_т * I\rho + 0,017)$ (14)

$\mu\tau = \rho_1/\rho_2 * I_\rho(1+I_L)$ - Physical equvalent of soil

ρ_1 - %Particles<2 mm

ρ_2 - % particles >2 mm

Coefficients:

K_1, K_2 - angular =1,0; rounded =0,9.

K_E -shear strength, table.8

$K\varphi$ -shear strength Table 5

$K\rho$ -density Table.6

K_L - Liquidity index table 9

Consolidated shear strength scheme

K_1	K_2	K_φ	K_ρ	K_E	K_L	ρ_1	ρ_2	I_ρ	I_L	$\mu_т$	$\varphi_{n,гр}$	$\varphi_{II,гр}$	$\varphi_{I,гр}$
0.91		0.92				17.1	82.9	0.277	0.34	0.077	**35.1**	**35.1**	**30.5**
											c_n, кПа	c_{II}, кПа	c_I, кПа
	0.90		0.92			17.1	82.9	0.277	0.34	0.077	**10.0**	**10.0**	**6.7**

Unconsolidated shear strength scheme

K_1	K_2	K_φ	K_ρ	K_E	K_L	ρ_1	ρ_2	I_ρ	I_L	$\mu_т$	$\varphi_{n,гр}$	$\varphi_{II,гр}$	$\varphi_{I,гр}$
0.91		0.92				17.1	82.9	0.277	0.34	0.077	**27.7**	**27.7**	**24.1**
											c_n, кПа	c_{II}, кПа	c_I, кПа
0.91	0.90		0.90			17.1	82.9	0.277	0.34	0.077	**6.2**	**6.2**	**4.1**
		Deformation modulus											
K_1	K_2	K_φ	K_ρ	K_E	K_L	ρ_1	ρ_2	I_ρ	I_L		E_n, Mpa	E_{II},Mpa	
			0.93	0.94	0.97	17.1	82.9	0.277	0.34	0.077	**41.2**	**41.2**	

IIIს.გ.ე. ფიზიკურ-მექანიკური მახასიათებლების საანგარიშო მნიშვნელობები Estimated values of III EGE physical-mechanical properties

##	ურ-მექანიკური Physical-mechanical		რაოდენობა Amount						საანგარიშო მნიშვნელობა stimated value	
	მახასიათებლები Properties	განზომილება Meas. unit	საწყისი Initial	საბოლოო Final	საშუალო კვადრატული გადახრა Mean squared deviation s	საშუალო კვადრატული გადახრის შეფასება Mean squared deviation estimated s cm	ვარიაციის კოეფიციენტი Coefficient of variation n	ნორმატიული მნიშვნ. Standard value An	a=0,85	a=0,95
1	სიმტკიცე წყალნაჯერი Strenght saturated Rc	mpa	6	6	8.639	7.886	0.288	30.0	26.0	23.2
2	სიმკვრივე Density ρ	g/cm³	6	6	0.030	0.027	0.012	2.51	2.50	2.49

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Results of chemical analysis of water sample

The water samples submitted for analysis were taken from wells drilled in the Gelati area. The total mineralization of water samples taken from Gelati in the morning/evening, which is 0.82-0.97 g/l, belongs to the category of fresh water (M<1 g/l). The total mineralization of the water sample taken on the territory of Gelati Monastery is M-1.17 g/l and with this value it falls into the category of salty water (M>1 g/l).

he chemical composition of the samples taken in the morning and evening is almost identical and is of the hydrocarbonate-sulfate sodium-magnesium-calcium type. While the water sample taken from the monastery is of the hydrocarbonate-sulfate-chloride sodium-magnesium-calcium type. The reaction is biased towards alkalinity by the hydrogen ion concentration indicator ($pH = 7.61 - 7.91$).

In terms of aggressiveness, water samples do not show aggressiveness towards Portland cement, slag-portland cement and sulfate-resistant concrete in terms of sulfate content. The aggressive effect of water samples analyzed on the reinforcement of reinforced concrete structures under conditions of constant wetting with water is assessed as “no”, and with periodic wetting – “weak”. The degree of aggressive effect of the same environment on carbon steel, below the groundwater level, according to the instructions of construction norms and rules, is assessed as “medium”.

Director of LLC Water and Soil

Nikoloz Jalagania 29031005175
Digitally signed by Nikoloz Jalagania
Date: 2026.04.27 21:48:52

Nikoloz Jalagania

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Chemical analysis of water sample

Place of sampling		**Gelati (Morning)**			
Waterpoint's type		**Borehole 1, Depth of sampling -20.0 m**		**Sampling data**	06.04.2026
Ions	**Absolute contents, g/l**	**mg.eqv./l**	**mg.eqv.l, %**	**Other data**	
1	2	3	4	5	
Cations				**Colore: Transparent** **Smell: no smell** **Taste: Fresh** **Temperature: 16.1°C**	
$(Na+K)^+$	0.120	5.214	40	**Concentration of hydrogen ions PH:**	7.74
Ca^{2+}	0.070	3.500	26	**Solid residue:**	0.74 g/l;
Mg^{2+}	0.055	4.550	34	**Total hardness:**	8.05 mg.eqv/l;
Total	**0.245**	**13.26**	**100**	**Carbonate hardness:**	3.8 mg.eqv/l;
Anions				**Constant hardness :**	4.25 mg.eqv/l;;
				Free CO_2:	Not detected;
Cl^-	0.018	0.520	4	**aggressive CO_2::**	Not detected;
SO_4^{2-}	0.247	5.144	39	**Ammonium (NH_4^+):**	0.11 mg/l;
HCO_3^-	0.464	7.600	57	**Nitrate (NO_3^-) :**	Not detected;
Total	**0.729**	**13.26**	**100**	**Nitrite (NO_2^-) :**	Not detected;
M g/l	**0.973**	**Kurlov formula**		**Salinity**	0.39 ppt
				Conductivity	782 ppt
				TDS	555 ppt
				$M_{0.97}\frac{HCO_3 57 SO_4 39}{(Na+K)40 Mg 34 Ca 26}$	
Analyst:		T. mikava		**Date:**	20.04.2026

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Chemical analysis of water sample

Place of sampling		**Gelati (Evening)**			
Waterpoint's type		**Borehole 1, Depth of sampling - 21.0 m**		**Sampling data**	06.04.2025
Ions	**Absolute contents, g/l**	**mg.eqv./l**	**mg.eqv.l, %**	**Other data**	
1	2	3	4	5	
Cations				**Colore: Transparent** **Smell: no smell** **Taste: Fresh** **Temperature: 16.1°C**	
$(Na+K)^+$	0.095	4.129	37	**Concentration of hydrogen ions PH:**	7.61
Ca^{2+}	0.048	2.400	22	**Solid residue:**	0.60 g/l;
Mg^{2+}	0.055	4.600	41	**Total hardness:**	7 mg.eqv/l;
Total	**0.198**	**11.13**	**100**	**Carbonate hardness:**	3.6 mg.eqv/l;
Anions				**Constant hardness :**	3.4 mg.eqv/l;
				Free CO_2:	Not detected;
Cl^-	0.018	0.500	4	**aggressive CO_2:**	Not detected;
SO_4^{2-}	0.165	3.429	31	**Ammonium (NH_4^+):**	0.12 mg/l;
HCO_3^-	0.439	7.200	65	**Nitrate (NO_3^-) :**	Not detected;
Total	**0.622**	**11.13**	**100**	**Nitrite (NO_2^-) :**	Not detected;
M g/l	**0.820**	**Kurlov formula**		**Salinity**	0.33 ppt
				Conductivity	653 ppt
				TDS	464 ppt
				$M_{0.82}\frac{HCO_3 65 SO_4 31}{(Na+K)37 Mg 41 Ca 22}$	
Analyst:		T. mikava		**Date:**	20.04.2026

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Chemical analysis of water sample

Place of sampling		**Gelati Monastery**			
Waterpoint's type		**Borehole 2, Depth of sampling - 4.0 m**		**Sampling data**	01.04.2026
Ions	**Absolute contents, g/l**	**mg.eqv./l**	**mg.eqv.l, %**	**Other data**	
1	2	3	4	5	
Cations				**Colore: Transparent** **Smell: no smell** **Taste: Salty** **Temperature: 16.0°C**	
$(Na+K)^+$	0.116	5.029	30	**Concentration of hydrogen ions PH:**	7.91
Ca^{2+}	0.025	1.250	8	**Solid residue:**	0.84 g/l;
Mg^{2+}	0.123	10.250	62	**Total hardness:**	11.5 mg.eqv/l;
Total	**0.264**	**16.53**	**100**	**Carbonate hardness:**	5.5 mg.eqv/l;
Anions				**Constant hardness :**	6 mg.eqv/l;
				Free CO_2:	Not detected;
Cl^-	0.075	2.100	12	**aggressive CO_2:**	Not detected;
SO_4^{2-}	0.165	3.429	21	**Ammonium (NH_4^+):**	0.18 mg/l;
HCO_3^-	0.671	11.000	67	**Nitrate (NO_3^-) :**	Not detected;
Total	**0.910**	**16.53**	**100**	**Nitrite (NO_2^-) :**	Not detected;
M g/l	**1.174**	**Kurlov formula**		**Salinity**	0.59 ppt
				Conductivity	1178 ppt
				TDS	837 ppt
				$M_{1.17}\frac{HCO_3 67 SO_4 21 Cl 12}{(Na+K)37 Mg 41 Ca 22}$	
Analyst:		T. mikava		**Date:**	20.04.2026

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Aggressiveness degree toward the concrete

serial number, №	Waterpoint s type	Sampling' s depth,m	Index of aggressiveness	aggressiveness degree of water toward of buildings					
				In the rocks with K>0.1 m/day			In the rocks with K<0.1 m/day		
				Concrete mark by permeability					
				W4	W6	W8	W4	W6	W8
1	Borehole 1	20.0	bicarbonate hardness, mg.ekv/l	no	no	no	no	no	no
			Concentration of hydrogen ions PH:	no	no	no	weak	no	no
			carbon-dioxide aggressiveness, mg/l	-	-	no	-	-	no
			contents of magnesia salts, mg/l	no	no	no	no	no	no
			contents of ammonia salts, mg/l	no	no	no	no	no	no
			contents of high alkalinity, mg/l	no	no	no	no	no	no
			Sulfate for concrete						
			Portland cement (ГОСТ10178-76)	no	no	no	no	no	no
			slag portland cement	no	no	no	no	no	no
			sulphate-resistant cement	no	no	no	no	no	no

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Aggressiveness degree toward the concrete

serial number, #	Waterpoint s type	Sampling' s depth,m	Index of aggressiveness	aggressiveness degree of water toward of buildings					
				In the rocks with K>0.1 m/day			In the rocks with K<0.1 m/day		
				Concrete mark by permeability					
				W4	W6	W8	W4	W6	W8
2	Borehole 1	21.0	bicarbonate hardness, mg.ekv/l	no	no	no	no	no	no
			Concentration of hydrogen ions PH:	no	no	no	weak	no	no
			carbon-dioxide aggressiveness, mg/l	-	-	no	-	-	no
			contents of magnesia salts, mg/l	no	no	no	no	no	no
			contents of ammonia salts, mg/l	no	no	no	no	no	no
			contents of high alkalinity, mg/l	no	no	no	no	no	no
			Sulfate for concrete						
			Portland cement (ГОСТ10178-76)	no	no	no	no	no	no
			slag portland cement	no	no	no	no	no	no
			sulphate-resistant cement	no	no	no	no	no	no

Aggressiveness degree toward the concrete

serial number, #	Waterpoint s type	Sampling' s depth,m	Index of aggressiveness	aggressiveness degree of water toward of buildings					
				In the rocks with K>0.1 m/day			In the rocks with K<0.1 m/day		
				Concrete mark by permeability					
				W4	W6	W8	W4	W6	W8
3	Borehole 2	4.0	bicarbonate hardness, mg.ekv/l	no	no	no	no	no	no
			Concentration of hydrogen ions PH:	no	no	no	weak	no	no
			carbon-dioxide aggressiveness, mg/l	-	-	no	-	-	no
			contents of magnesia salts, mg/l	no	no	no	no	no	no
			contents of ammonia salts, mg/l	no	no	no	no	no	no
			contents of high alkalinity, mg/l	no	no	no	no	no	no
			Sulfate for concrete						
			Portland cement (ГОСТ10178-76)	no	no	no	no	no	no
			slag portland cement	no	no	no	no	no	no
			sulphate-resistant cement	no	no	no	no	no	no

Aggressive influence of medium on metal constructions

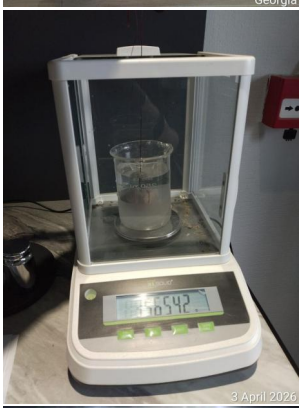
Number №	Serial number, #	Sampling' s depth, m	Degree of aggressive influence of water on iron concrete fitting constructions		Degree of aggressive influence of medium on carbonic steel
			Constantly in the water	periodically wetting	
1	Borehole 1	20.0	no	weak	middle
2	Borehole 1	21.0	no	weak	middle
3	Borehole 2	4.0	no	weak	middle

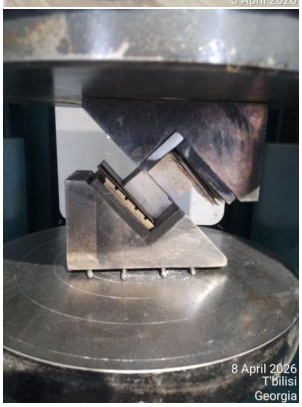
საველე სამუშაოების და კერნის ფოტოფიქსაცია

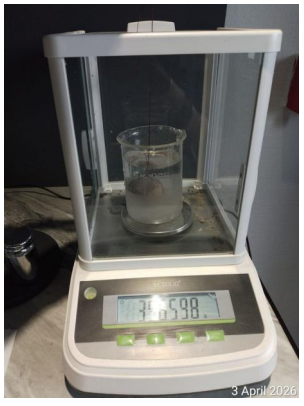
ტყიბულის მუნიციპალიტეტი, სოფელი გელათი, გელათის მონასტერი

ნაკვ#39.07.31.362

ლაბორატორიული სამუშაოების ფოტოფიქსაცია







ტყიბულის მუნიციპალიტეტი, სოფელი გელათი, გელათის მონასტერი

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