Technical assignment
for conducting engineering-geological survey

Site name – Gelati Monastery Complex Rehabilitation Project.

Site location – 11 km northeast of Kutaisi, in the Tskaltsitela River gorge.

Monastery Complex class according to liability - Georgian architectural monument.

Possible types of foundations used in the construction of the buildings of the complex - strip footing/foundation.

Loads on foundation - within 100-300 kN/m.

Foundation material – mortared lime and stone.

The engineering-geological report must contain the information on the engineering-geological conditions of the site (including the section of the project road adjacent to the northeast); the foundations of buildings (including the enclosure/fence) must be uncovered and their sizes and types as well as foundation soils types must be determined - a total of 27 exploratory workings (see the attached topographic map).

Laboratory study of foundation soils should be carried out and estimated standard values (ρ, c, φ, E, R, Rc) of their physical-mechanical properties should be established.

Three (3) copies of the engineering-geological survey documentation must be submitted, each in bound form.

Annex: Topographic plan of the Gelati Monastery Complex, with the indication of exploratory workings (test pits) (scale 1500 and its reduced digital version).

Chief constructor of the project Gigla Chanukvadze

Results
of engineering geological survey conducted
on the Gelati Monastery Complex site

Chapter I. Introduction

At the invitation of the Union "Heritage of Georgia", a group of geologists from the Engineering Research Department of JSC "Sakkalakmshenproekti" conducted an engineering-geological survey at the Gelati Monastery Complex site during August-September 2008.
The aim of the survey:

- Characterization of the engineering geological conditions of the Gelati Monastery Complex and surrounding areas (enclosure/fence and project road strips);
- Specification of the buildings and structures foundation types included in the complex (determination of types, sizes and foundation-soils of the buildings and structures foundations).

The engineering geological survey of the site was conducted based on the technical assignment and in accordance with the requirements and recommendations of normative documents (CNR 1.02.07-87, CNR 2.02.01-83, state standard 25100-82).

The exploratory workings were initially assigned in such a volume that the conditions for the foundation of the complex buildings were determined as much as possible. Upon arrival at the site, adjustments were made in terms of the number and location of the test pits. Some of the test pits, due to objective reasons, either could not be dug (test pits ##6, 7), or were dug partially (test pits ##1_5, 19, 21, 22). Two additional test pits (##34, 35) were dug near the tomb of David the Builder, which, also due to objective reasons, could not be completed.

The excavation of test pits was carried out under the control of archaeologist R. Isakadze.

All test pits are indicated on a 1:500 scale topographic map with corresponding numbers.

The table below provides the numbering and depths of the excavated pits, separating individual buildings, fences, and lanes of the project road.

Table 1

Seq. Number ##	Test pits ##	Test pit depth h, m	Name of buildings and structures	Note
1	1	1,7	Old monastery building	Partially completed
2	2	1,0		
3	3	2,0	Old and new monastery building	Partially completed
4	4	1,5		
5	5	1,0		
6	6	-	Monks' residence	Not completed
7	7	-		
8	8	1,4	Academy building	
9	9	1,6		
10	10	0,8		
11	11	1,5	Church of St. Nicholas	
12	12	0,5		
13	13	0,6	Main Church of the Blessed Virgin Mary	
14	14	1,0		
15	15	0,35		
16	16	1,0		
17	17	1,5	Church of St. George	
18	18	1,0		
19	19	0,4	Refectory	Partially completed
20	20	1,5		
21	34	1,5	Tomb of David the Builder	Partially completed
22	35	1,6		
23	21	2,1	Monks' residence	Partially completed
24	22	0,6		
25	23	1,3	Enclosure/fence	
26	24	0,5		
27	25	0,75		
28	26	1,0		
29	27	1,0		
30	28	0,75		
31	29	0,75	Project road strip	
32	30	0,50		
33	31	0,75		
34	32	0,75		
35	33	0,50		
Total footage		34,7		

To study the physical-mechanical properties of the foundation soils, 13 samples were collected, of which 10 small samples were from clayey soil (difficulties in sampling due to large inclusions in the soil) and 3 samples were from the bedrock - limestone (rock chips from the massif).

The table below shows the locations of soil sampling by test pit, types of soil and laboratory tests.

Table 2

Seq. Numb. ##	Test pit ##	Sampling depth, h m	Soil type		Laboratory test type	
			Clayey soil	Bedrock – limestone	Physical complex	Physical-mechanical (density and shear strength)
1	13	0,4	+	_	+	_
2	14	0,5	+	_	+	_
3	14	1,0	+	_	+	_
4	15	0,2	_	+	_	+
5	16	0,5	+	_	+	_
6	16	1,0	+	_	+	_
7	17	0,6	+	_	+	_
8	17	1,2	+	_	+	_
9	18	0,7	+	_	+	_
10	18	1,0	_	+	_	+
11	20	0,8	+	_	+	_
12	20	1,2	+	_	+	_
13	20	1,4	_	+	_	+

Laboratory tests on clayey soil samples were carried out in the Engineering Research Laboratory of JSC “Sakkalakmshenproekti”, and on bedrock samples - in the laboratory of the Department Rock Properties and Physical Processes in the Massif Research Laboratory of the

G. Tsulukidze Mining Institute, under the leadership of Doctor of Technical Sciences G. Baliashvili. The data of soils laboratory studies are summarized in the table and attached to the conclusion.

Chapter II. General description of the area/site (location, brief historical information, borders, climate, geomorphology, general geological and hydrogeological conditions)

Gelati Monastery Complex, a monument of Georgian architecture, is located 11 km north-east of the city Kutaisi, in the Tskaltsitela River Gorge. Elevation above sea level varies within 400,0 – 405,0 m range. The monastery was founded in 1106 by King David the Builder. The architectural ensemble of Gelati was built in the era of the economic, political and cultural revival of feudal Georgia on the initiative of the great statesman David the Builder. Initially, the Academy was founded in Gelati - the most important center of Georgian scientific creative thought. It has reached us in the form of ruins. In the center of the monastery ensemble stands the Cathedral of the Virgin Mary (Main Church), the construction of which was begun by David the Builder from the very foundation of the monastery and was completed after his death, already during the reign of Demetrius I - in 1130. To the east of the main church is located the Church of St. George, built in the 13th century, and to the west the Church of St. Nicholas, built in the 13th-14th centuries. Along the fence of the monastery complex are the monks' residence, refectory and other buildings. At the southern gate of the ensemble is the tomb of David the Builder.

The construction of the Gelati monastery ensemble was mainly carried out in the 12th-13th centuries and at the beginning of the 14th century. During the political decline of the united feudal Georgia, as a result of invasions by external enemies, the construction of the monastery was suspended. At the beginning of the 16th century, the restoration of Gelati began on the initiative of the kings of Imereti. The works continued in the 17th-18th centuries. The monastery complex is bounded by a 2.0-4.0 m high lime-stone mortar fence, which is bordered on two sides - from the east and south - by forested slopes, and from the north and west - by the land plots of the villagers - mainly areas covered with orchards. There is a road to the north-east of the monastery ensemble. It meanders along the left slope of the Tskaltsitela River gorge, crosses the named areas of the village and joins the Kutaisi-Tkibuli highway.

The Gelati Monastery Ensemble is located on a foothill plain and is distinguished by its

excellent location.

The region is climatically included in the humid climate zone of the Colchis Plain, with warm winters and hot summers. The average annual air temperature is 14.6°C, the absolute maximum is 42°C, the absolute minimum is 19°C. The annual total precipitation is 1818 mm, which is almost evenly distributed throughout the year, depending on the months. Snow is not uncommon, and snowy winters are possible, when the snow cover can reach 1.0 m. Summer and winter are characterized by long-lasting Foehn type winds, with prevailing winds from the west (Westerlies) and east (Easterlies). The average annual wind speed is 1.6 m/s, maximum 27 m/s (data are taken from the collection of climatic data for mass design and construction in the territory of Georgia for the Kutaisi zone and may differ slightly from the climatic conditions of the Gelati micro-district).

Geomorphologically, the area is located in the middle part of the left slope of the Tskaltsitela River gorge, on a foothill plain. The distribution area of the monastery ensemble main buildings is almost horizontal, with a general relief slope to the west. Near the fence strip (from the north and west) the slope of the relief increases, with an inclination angle within 10-20□, in local areas even more.

From a tectonic point of view, the study area is located in the Kutaisi subzone of the Western Subsidence Zone of the Georgian Block.

The geology of the region is represented by the Upper Jurassic-Lower Cretaceous (I3 +Cr1) thick and massively bedded dolomitized limestones and their overlying thin clayey soil of diluvial genesis. Limestone outcrops are observed on the slopes nearby the study area and on the slope cuts of the access road. Thin marl intercalations are frequently observed in the limestones as well.

The above-mentioned bedrocks are characterized by underground fissure waters. Their surface runoffs near the monastery complex are noted in the form of low debit springs. Two such springs are observed near the road leading to the Gelati Complex, in a small erosion depression (one of them is tapped spring).

Chapter III Visual description of the buildings of the Gelati complex, geological structure of the site, physical and mechanical properties of the soils, description of the buildings' foundations.

III-1. Visual description of the buildings

The main building of the monastery ensemble - the main church of the Virgin Mary - is a magnificent ecclesiastical building, with three angular apses projecting to the east. The following additions were built to the main building at different times: a stoa from the west, and chapels from the south and north. The area of the church, including the outbuildings, is approximately 34x36 m, and the height is up to 36 m. The church is faced with cut Eklari stone.

The temple/church square is characterized by a straight, almost horizontal surface. The absolute elevation of the inner part (floor) of the temple is 404.46 m. The difference in the elevations of the inner and outer perimeters of the building is insignificant in the eastern part (0.04-0.46), and in the western part - up to 1.0 m, which is due to the slight slope of the terrain of the area.

No deformation cracks are observed on the church building.

The Church of St. George is located 14 m east of the main church. In terms of plan and forms/shapes, it repeats the main church, but is smaller. The building is built of large hewn stone on a lime mortar. The church floor level is 405.49 m. The difference between the outer and inner perimeter levels is insignificant (0.29 m).

No deformation cracks are observed on the church walls.

A small two-story church of St. Nicholas is located 9 m west of the main church. The rectangular ground floor is open on all four sides with arches, and the second floor represents a small church with a cross-shaped outline.

The building is also built out of cut limestone and lime-stone mortar. The absolute height of its floor (first floor) is 403.15 m. The difference between the internal and external perimeters of the building is insignificant (0.35 m). No deformation cracks are observed on the walls of the building.

To the north-east of the main church is a bell tower, the lower part of which is open with arches. Under the building, in the middle part, there is a spring, which is brought in through a channel from one of the springs outside the territory (according to archaeologist R. Isakadze).

The building is also built of cut limestone stones and a lime mortar, and no deformation cracks are observed.

Up to 30 m west of the main church is the building of the Gelati Academy. It is built of large dry stones and lime mortar. Large cut stones/quadrs are used in cants and in some other

places. Large cut stones are used for the arches and architraves of the doors and window openings. A portico is built on the building from the east, and a small building from the west. The building currently has no roof.

Penetrating cracks were observed on the load-bearing walls of the building, especially on the northern and western walls. The walling is wind-eroded/weathered both from the inside and outside. Buttresses were built in several places on the western wall to strengthen the deformed wall.

The floor level of the building is 401.70 m. The difference between the internal and external perimeter levels along the western load-bearing wall is significant - 3.9 m and is due to the relief factor. The tomb of David the Builder is located in the southern gate of the monastery ensemble. The building is mainly rectangular in shape, measuring 8.0 x 17.5 m and is also built of cut limestone stones and lime mortar (dry stone walling). No deformation cracks are observed. The floor level of the building is 401.97 m, the external relief levels are 402.6-403.4 m. The difference between the internal and external levels is 0.63-1.4 m.

To the west of the David the Builder's Tomb is a refectory - a dry-stone walling structure with a basement/substructure (up to 2.0 m). The western part of the structure is based on the wall of the old building. No significant deformation cracks are observed here.

The floor level of the first floor of the structure is 402.98 m, the basement level - 401.00 m. The relief level around the structure is 400.0-402.4 m.

To the east of the tomb of David the Builder is a monks' residence - a one-story building made of mixed materials, with a basement. The front side of the building (balcony) is made of wood. The torso and rear load-bearing walls are made of dry-stone, brick is partially used (the brickwork is visible near the southeastern corner of the building). The building is based on the wall of the old building. The basement is filled with garbage.

The floor level of the building is 406.5 m, the basement level is 403.50 m (approximate), the relief level of the outer perimeter is 405.0-408.0 m. On the long wall of the rear facade of the building, near the southeast corner, a deformational-vertical inclined crack (shrinkage) is noted.

To the north of the main church, there is of dry-stone building of a complex configuration (monks' residence).

The building is a combination of the old and later (new) buildings. The new building is partially built on the arched walls of the old building.

Under the old building is an arched basement (half-basement). The floor level of the first floor is 406.67 m. The basement level is 401.95 m. The floor level of the new building is 404.62 m. The relief mark around the building is 403.2-404.6 m.

There are no signs of deformation on the building.

To the west of the same building is a small (7.0x10.5 m) rectangular building. The building is roofless, only the dry-stone walls have survived. The floor mark of the building is 400.94 m. The external relief marks are 401.0-403.0 m.

III-2. Geological structure of the territory

According to the conducted field work and laboratory data on the soils physical-mechanical properties, the following have been compiled:

- Geological-lithological logs of the test pits, with foundation cross-sections. (sheets №№ 3-10);
- Longitudinal and transverse geological cross-sections of the complex area (sheets №№ 11-16).

The cross-section lines are drawn on all the main buildings of the monastery ensemble, in order to better represent the geological and foundation conditions. The geological cross-sections are also oriented on the bedding elements - dip and strike of the bedrock, and accordingly, the rock inclination on the cross-section is shown without distortion along the strike - horizontally, along the dip - with maximum inclination (the cross-section lines are slightly rotated relative to the strike and the correction angle is also insignificant).

According to the excavated/dug pits and the presented graphic material, 3 layers of soil are established on the strip of the monastery complex, the fence and the project road: technogenic and clayey soils and bedrock.

Technogenic soil is represented by a mixture of gravel, boulders, pebbles and clayey soil (tQ_{IV}, layer 1).

The thickness of technogenic soil is variable - within 0.2-2.0 m and is not present everywhere (on the design road strip). Its maximum thickness is expected inside the fence/enclosure. Considering its age, the made ground is consolidated - compacted.

The made ground is mainly homogeneous, although a variation in clayey soil (from 10 to 40%) is observed in it, but in the test pit № 34 (near the tomb of David the Builder) it almost lacks a clayey admixture and is represented by limestone boulders (size 0.3-0.5) and coarse gravel mixture.

The clayey soil is represented by the brown clay of hard plastic consistency (stiff to firm consistency clay) of diluvial genesis, with inclusions of gravel, pebbles and individual boulders (up to 0.3 in size) of various fractions. The content of large inclusions (gravel, boulder, pebble) in the soil is within 30-40%.

The clayey soil is of small thickness (0.2-1.0 m) and is not present everywhere.

The bedrock is represented by Upper Jurassic - Lower Cretaceous (I_3 + Cr_1) carbonate rock - dolomitized limestone (layer 3). The limestone is thick and massively bedded, fractured on the erosion surface (the fractures are filled with clay material). The weathering fractures are of different directions, although their orientation mainly coincides with bedding.

The limestone is intersected by test pits at a shallow depth (0.2-0.3 m) from the erosion surface; along the access road to the monastery complex and on the adjacent slopes from the east, numerous limestone massif outcrops are observed. In these outcrops thin intercalations of marl (0.1-0.3 m) are often observed.

The bedrock dip and strike were measured at the mentioned outcrops and are as follows: the dip direction SE 105-110°, the dip angle 18-25° (average 22°). These data are plotted on geological cross-sections (as mentioned above, the cross-sections are oriented to the bedding elements and the rock inclination is seen undistorted - at a true angle).

According to geological data, the thickness of the rock of this age is several hundred meters.

III-3. Physical and mechanical properties of soils

As mentioned in the survey conclusion, soil samples were collected for laboratory testwork:

- 10 small samples of intact structure - from the clayey soil of the layer 2;
- 3 samples from the bedrock (layer 3) - from the limestone;

Laboratory tests on the samples taken determined:

For the clayey soil of the layer 2 - a full set of physical properties (due to the small distribution of the clayey soil and the presence of large inclusions in it, mechanical properties were not determined).

For the bedrock of the layer 3 - physical and mechanical properties - density and shear strength limits, in dry and water-saturated conditions.

Specific depths for soil sampling are given in the graphic appendix - geological-lithological logs of the test pits.

Laboratory testwork data for the clayey soil (layer 2) are presented in a summary table and are attached to the conclusion.

For illustration, Table 3 below shows the range of variation of the main physical properties of the clayey soil and estimations of their average (standard) values.

Table 3

# #	Physical properties			Meas. unit	Range of variation	Average (standard) value
1	Plasticity index		I_p	-	0,19- 0,22	0,21
2	Moisture content		W	%	24,0- 28,8	26,7
3	Density	Soil	ρ	g/cm3	1,82- 1,99	1,93
		Dry soil	ρ_d		1,43- 1,57	1,52
		Soil particles	ρ_s		2,73	2,73
4	Porosity		n	%	42,5- 47,6	44,3
5	Porosity coefficient		e	-	0,750- 0,909	0,796
6	Liquidity index		I_L	-	0,30- 0,40	0,36
7	Degree of Saturation		S_r	-	0,81- 1,00	0,92

According to the table, the tested soil is clay (Ip_{av} =0.21) of hard-plastic consistency (I_{Lav} =0.36). The natural moisture content of the soil is within 24.0-28.8% (Wav=26.7%). When considering moisture content, it is worth noting that in the conditions of its small thickness and superficial distribution the clayey soil is in the aeration zone, which determines the seasonal variation of soil moisture content, taking into account the alternation of dry and rainy periods at a certain period of the year. Accordingly, at different periods of the year it may differ from the moisture content values established during the study.

Soil porosity n=42.5-47.6% (n_{av} =44.3%), at the corresponding values of the porosity coefficient e=0.750-0.909 (e_{av} =0.796).

The density of the clay is within 1.82-1.99 g/cm³ (ρ =1.93 g/cm³), at a dry soil density ρd =1.52 g/cm³. The density of soil particles is stable and equal to ρs=2.73 g/cm³. The relatively high density of clayey soil is caused by the influence of the weight of buildings - the soil is compacted. Depending on the degree of moisture content, clayey soil is water-saturated, since Sr_{av} =0.92>0.8.

The average values given in the table are used in calculations as standard - estimated, if necessary.

As mentioned above, the mechanical properties of the soil have not been determined. With a significant content of large inclusions (gravel, boulder, pebbles) in the soil, it is difficult to take a large-sized intact structure sample (monolith) and then cut out samples from it using cutting sample rings.

The mechanical properties of the soil will be presented in the final part, based on the laboratory-determined physical properties, using Tables 2 and 3 of Appendix 1 and Table 3 of

Appendix 3 of SNR 2.02.01-83.

The bedrock limestone was tested by 3 samples. The test data are summarized in a summary table and attached to the conclusion.

Below, Table 4 shows the values of the densities and strength limits obtained by laboratory tests under uniaxial compression in a water-saturated state. The softening coefficient is also estimated here.

Table 4

Seq.numb ##	Test pit ##	Sampling depth, h m	Density ρ g/cm³	Uniaxial Compressive Strength R_c mPa (kgF/cm²)		Softening Coefficient k_{sof}
				Dry (Room temperature)	Saturated	
1	15	0,2	2,45	27 (270)	15 (150)	0,56
2	18	1,0	2,48	27 (270)	18 (180)	0,67
3	20	1,4	2,54	35 (350)	25 (250)	0,72
Average value			2,49	30 (300)	19 (190)	

According to the values given in the table, according to Appendix 1 of SNR 2.02.01-83, limestone belongs to:

- rocky soil, since the density limit in a water-saturated state R_c=19 mPa (190 kgf/cm²)>5 MPa (50 kgf/cm²);

- medium-strength soil, since the value of the strength limit is within the range of 15 MPa (150 kgf/cm²) <19 MPa (190 kgf/cm²) <50 MPa (500 kgf/cm²);

- prone to softening soil, since k_{sof}=0.56-0.72;

- soil density ρ=2.45-2.54 g/cm³ (ρ_{av} =2.49 g/cm³).

The physical and mechanical properties of the technogenic soil (layer 1) have not been determined due to its specificity, and in the final part, the characteristics will be given using Table 5 of Appendix 3, of SNR 2.02.01-83 and technical and reference literature.

After reviewing the laboratory testwork data, the soil layers identified at the monastery complex site and on the enclosure and project road lanes will be combined into independent engineering geological elements.

III-4. Characterization of the foundations of buildings and structures

All three layers of soils (three engineering geological elements) allocated in the study area were used for the buildings and structures of the monastery ensemble and are founded on:

- The main building of the monastery complex - the main Church of Virgin Mary - on the clayey soil and bedrock;

- The Church of St. George, the Church of St. Nicholas and the Academy building - on the bedrock - limestone;

- Old and new monastery buildings, refectory, monks' residences, David's tomb - on all three layers of soil (technogenic, clay, limestone). In some cases, the exact location of the foundation cannot be determined and the foundation conditions are given based on geological cross-sections.

- The fence/enclosure of the monastery ensemble - on limestone.

The types of foundations are, in all cases, strip footings. The material used is large stone (both angular and rounded) with lime mortar and is in normal condition.

All information about the foundations (dimensions, configuration, base-soil) is given in the graphic material (sheets №№ 3-10) - under the geological-lithological logs of the test pits - on the drawings of the foundations, made on a scale of 1:50. The foundations of the buildings are also indicated on geological cross-sections.

Chapter IV. Conclusion and Recommendations

Based on the abovementioned, the following conclusions can be made:

1. From an engineering-geological point of view, the monastery ensemble site, the enclosure and the project road strips with the adjacent areas are in satisfactory conditions, since no unfavorable physical-geological events are observed here.

The erosion surface of the bedrock is located close to the ground surface, and the bedding dip direction is opposite to slope inclination - in depth, and in this respect, it is a favorable factor as well.

According to Appendix 10 of SNR 1.02.07-87, due to the complexity of the engineering geological conditions, the surveyed area belongs to category I (simple).

2. The soil layers established in the area, based on the relationship between buildings and the geological environment, represent independent engineering-geological elements (EGE):

EGE I - technogenic - consolidated made ground (layer 1);
EGE II - diluvial clayey soil (layer 2);
EGE III – bedrock - dolomitized limestone (layer 3).

3. The soil of all three EGE is used as the foundation for the buildings and structures of the monastery ensemble. The foundations are made of rubble stone, on lime mortar and, despite their age, are in normal condition. The foundations are strip footings/foundations.
4. The deformation of the academy building is not caused by the shrinkage of the foundation soil. Deformation cracks are exogenous (impact of solar radiation and atmospheric factors, frost cracks). The long-lasting impact of seismic shocks on a roofless cannot be ruled out.
The shrinkage of the rear facade wall of the monks' residence located east of the David the Builder tomb is caused by structural features - the old and new structures of the building (underground, aboveground) were built in different periods. (In some parts of it, the walls of the old building were used).
5. In order to structurally strengthen the academy building, it is advisable to take measures - to build up a new buttress or retaining wall from the west. A reinforced concrete band/tie-beam should be arranged along the entire perimeter of the building.
In the case of arranging a strut rail roof, it may be necessary to arrange a buckle.
There is no need to take any additional measures on other buildings of the monastery ensemble (including the enclosure).
6. The main buildings of the monastery ensemble (the main part of the main cathedral, the churches of St. Nicholas and St. George, the academy building, the enclosure and some old buildings) are founded on the bedrock - limestone.
The strength of the limestone, with the loads transmitted from the strip foundations of the buildings, under the conditions of the given width of the foundations, is realized insignificantly and its bearing capacity does not cause doubt.
7. The physical-mechanical standard-estimated properties of the soil layers - engineering - geological elements identified in the survey area are given below, in Table 4.

Table 4

# #	Physical-mechanical properties (standard-estimated)		Meas. unit	I **EGE** **(Layer 1)**	II **EGE** **(Layer 2)**	III **EGE** **(Layer 3)**
1	Density	ρ	g/cm^3	1,90	1,93	2,50
2	Cohesion	c	kPa (kgf/cm^2)	_	46 (0,46)	_
3	Internal friction angle	φ	degree	_	16	_
4	Deformation modulus	E	mPa (kgf/cm^2)	15 (150)	20 (200)	_
5	Relative design resistance	R_0	kPa (kgf/cm^2)	200 (2,0)	280 (2,8)	_
6	Saturated uniaxial compressive strength (UCS saturated)	R_c	mPa (kgf/cm^2)	_	_	19 (190)
7	Coefficient of Subgrade Reaction	k	kgf/cm^3	3,0	4,0	80,0
8	Poisson's ratio	μ	_	0,30	0,42	0,20
9	Concrete Friction Coefficient	*f*	_	0,45	0,25	0,75

Note: In the table, the values of the subgrade reaction coefficient and Poisson's ratio are given from the "Designer's Calculation-Theoretical Reference Book", the coefficient of friction for concrete soil is from Doroshevich's "Footings-Foundations".

8. According to the corrected scheme of seismic zoning of the territory of Georgia, the city of Kutaisi and its surroundings are located in the 8-point seismicity zone.
The soils distributed in the area of the Gelati Monastery Complex, according to the seismic properties, according to the Table 1 of SNR II-7-81, belong to the II category.
The estimated seismicity of the territory is established as 8 points.
9. According to the complexity of processing, according to the Table 1-1 of SNR IV–2-82, the soils distributed in the area belong to:
a) Technogenic soil (layer 1) - for all three types of processing (with a single-bucket excavator, bulldozer, manually) - group III, with an average density of 1900 kg/m^3 (seq. number №24^b);
b) Clayey soil (layer 2) - when processed with a single-bucket excavator and manually - group II, with an average density of 1930 kg/m^3 (seq. number № 8^f);
c) Limestone (layer 3) - 50% of the total mass to be processed manually - group VI, 50% _ group VII, with an average density of 2500 kg/m^3 (seq. number № 15^{b,f});

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JSC Sakkalakmshenproekti Tbilisi #74, I. Chavchavadze Ave.				Soils' laboratory tests results														Engineering Survey Department
				Site name	Gelati Monastery Complex Rehabilitation Project														
Seq. number #	Working #	Sampling depth	Sample type	Lab. #	Plasticity			Nat. content	Density			Porosity	Porosity Index		Consistency index	Saturation	Saturation index	Soil Type
					Liquid limit	Plastic limit	Index		Soil	Dry soil	Soil particles		Initial	Liquid limit				
		h			W_L	W_p	I_p	W	ρ	$ρ_d$	$ρ_s$	n	e	e_L	I_L	S_r	I_{ss}	
		m			–	–	–	%	g/cm³			%	–	–	–	–	–	
1	Tp #13	0,4	mon.	84	0,42	0,20	0,22	26,5	1,98	1,57	2,73	42,5	0,739	1,147	0,30	0,98	0,23	Clay
2	Tp #14	0,5	mon.	85	0,39	0,20	0,19	27,2	1,99	1,56	2,73	42,9	0,750	1,065	0,38	0,99	0,18	Clay
3		1,0	mon.	86	0,39	0,18	0,22	24,6	1,93	1,55	2,73	43,2	0,761	1,065	0,30	0,88	0,17	Clay
4	Tp #16	0,5	mon.	87	0,41	0,20	0,21	28,5	1,95	1,52	2,73	44,3	0,796	1,119	0,40	0,98	0,18	Clay
5		1,0	mon.	88	0,39	0,19	0,20	25,8	1,96	1,56	2,73	42,9	0,750	1,065	0,34	0,94	0,18	Clay
6	Tp #17	0,6	mon.	89	0,41	0,20	0,21	27,9	1,83	1,43	2,73	47,6	0,909	1,119	0,38	0,83	0,11	Clay
7		1,2	mon.	90	0,42	0,20	0,22	28,8	1,97	1,53	2,73	44,0	0,784	1,147	0,40	1,00	0,20	Clay
8	Tp #18	0,7	mon.	91	0,38	0,19	0,19	26,6	1,92	1,52	2,73	44,3	0,796	1,037	0,40	0,91	0,13	Clay
9	Tp #20	0,8	mon.	92	0,37	0,17	0,20	24,0	1,92	1,55	2,73	43,2	0,761	1,010	0,35	0,86	0,14	Clay
10		1,2	mon.	93	0,41	0,19	0,22	27,0	1,82	1,43	2,73	47,6	0,909	1,119	0,36	0,81	0,11	Clay

Engineer N. Surguladze Leading Engineer Geologis D. Akhobadze

Rocks physical-mechanical properties study results in connection with the rehabilitation of the Gelati Monastery Complex

- The work was performed under the contract (# 4-2/07) signed with JSC Sakkalakmshenproekti
- Table 1-2 shows the sampling location, rock names, average values of the investigated properties and rock classification.
- Table 3-4 shows the values of the investigated properties by sample

Table 1. Average values

Sample №	Test pit №	Depth interval m	Rock	Compression strength, mPa		Softening Coefficient	Density, g/cm³
				Dry samples	Water saturated samples		
1	15	0.2	Limestone dolomitized	27	15	0.56	2.45
2	18	1.0	Limestone dolomitized	27	18	0.67	2.48
3	20	1.4	Limestone dolomitized	35	25	0.72	2.54

Table 2. Classification

Sample №	Rock	By strength (water saturated)	By density	By softening
1	Limestone dolomitized	Low strength	Dense	Prone to softening
2	Limestone dolomitized	Moderate strength	Dense	Prone to softening
3	Limestone dolomitized	Moderate strength	Highly dense	Prone to softening

Table 3. Density

Sample №	Tested sample						
	№	Weight, g			Volume, cm^3		Density, g/cm^3
		In the air	Paraffin		of the paraffin	of the sample	
			In the air	In the water			
1	1	60.15	63.84	35.28	4.10	24.46	2.46
	2	62.18	65.88	36.39	4.11	25.38	2.45
2	1	58.19	61.66	34.25	3.85	23.56	2.47
	2	55.10	58.43	32.60	3.70	22.13	2.49
3	1	60.00	63.61	35.97	4.01	23.63	2.54
	2	61.29	64.96	36.76	4.07	24.13	2.54

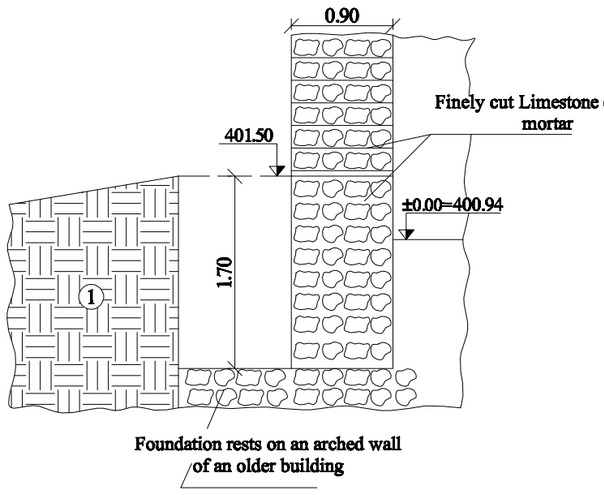
Table 4. Strength, regular shaped samples

Sample№	Tested Sample								
	№	Length cm	Width, cm	Height cm	Area cm^2	Scale factor	Distructive force kg/f	Strength mPa	Condition when tested
1	1	3.80	4.00	6.15	15.20	0.94	4000	24.7	Room temperature
	2	4.10	4.12	6.52	16.90	0.94	5375	29.9	
	3	4.02	4.03	6.89	16.20	0.96	5500	32.5	
	4	4.00	4.00	8.01	16.00	1.00	4125	25.8	
	5	4.10	4.09	7.00	16.77	0.96	3875	22.2	
	1	3.85	3.87	5.79	14.90	0.92	1625	10.0	Water saturated
	2	3.87	3.89	5.82	15.05	0.92	2000	12.2	
	3	3.90	4.00	5.46	15.60	0.90	2625	15.1	
	4	3.77	3.79	6.81	14.29	0.97	2652	17.8	
	5	3.25	3.27	6.52	10.63	1.00	2125	20.0	
2	1	4.10	4.11	5.33	16.89	0.88	5000	26.0	Room temperature
	2	4.12	4.11	5.77	16.93	0.90	5875	31.2	
	3	4.00	3.98	7.59	15.92	0.99	4375	27.2	
	4	4.05	4.07	6.71	16.48	0.94	4125	23.5	
	5	4.20	4.19	6.72	17.60	0.94	5250	28.0	
	1	4.22	4.20	5.90	17.72	0.90	4375	22.2	Water saturated
	2	4.25	4.27	6.39	18.15	0.92	3000	15.2	
	3	4.19	4.18	6.49	17.51	0.93	3375	17.9	
	4	4.23	4.23	8.04	17.89	0.99	3875	21.4	
	5	4.22	4.20	7.55	17.72	0.97	2625	14.4	
3	1	3.22	3.21	6.42	10.34	1.00	3375	32.6	Room temperature
	2	3.31	3.30	5.19	10.92	0.94	4000	34.4	
	3	3.24	3.25	5.45	10.53	0.95	4125	37.2	
	4	3.29	3.30	4.61	10.86	0.90	4875	40.4	
	5	3.23	3.22	4.59	10.40	0.91	3375	29.5	
	1	3.20	3.21	4.22	10.27	0.88	2375	20.4	Water saturated
	2	3.19	3.20	4.52	10.21	0.91	3125	27.8	
	3	3.95	3.94	5.50	15.56	0.90	4000	23.1	
	4	3.98	3.97	5.20	15.80	0.88	4500	25.1	
	5	3.96	3.91	5.57	15.48	0.91	5125	30.1	

Shaft №1

№№	Layer depth from	Layer depth to	Layer intensity	Ground surface and base point level	Section მ-ბ0 1:50	Humidity	groundwater level and measurement date ბან.	groundwater level and measurement date დამწ.
				401.50				
1	0.00	1.70	1.70	399.80	1			

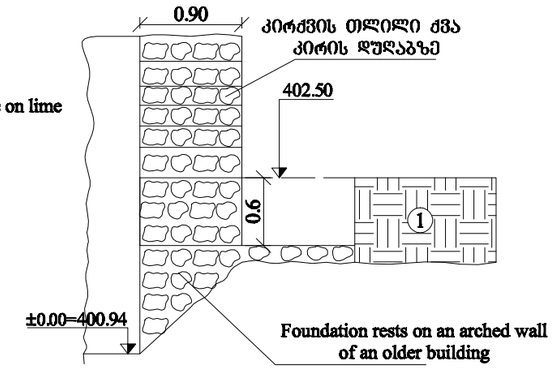
Section of the foundation
scale 1:50



Shaft №2

№№	Layer depth from	Layer depth to	layer intensity	Ground surface and base point level	Section მ-ბ0 1:50	Humidity	groundwater level anbd measurement date ბან.	groundwater level anbd measurement date დამწ.
				402.50				
1	0.00	1.00	1.00	401.50	1			

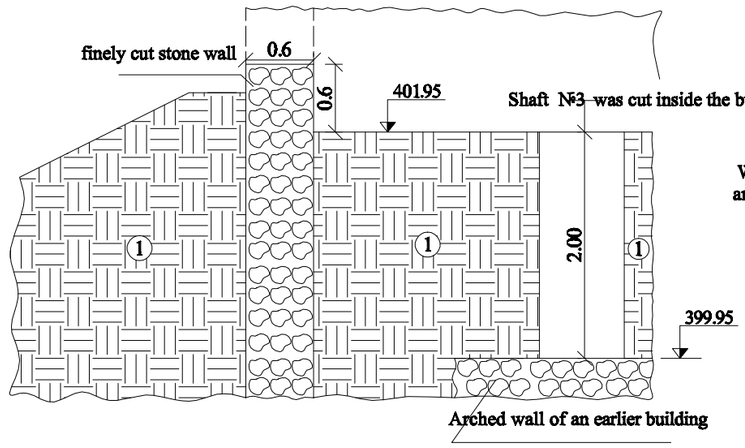
Section of the foundation
scale 1:50



Shaft №3

№№	Layer depth from	Layer depth to	layer intensity	Ground surface and base point level	Section მ-ბ0 1:50	Humidity	groundwater level anbd measurement date ბან.	groundwater level anbd measurement date დამწ.
				401.95				
1	0.00	2.00	2.00	399.95	1			

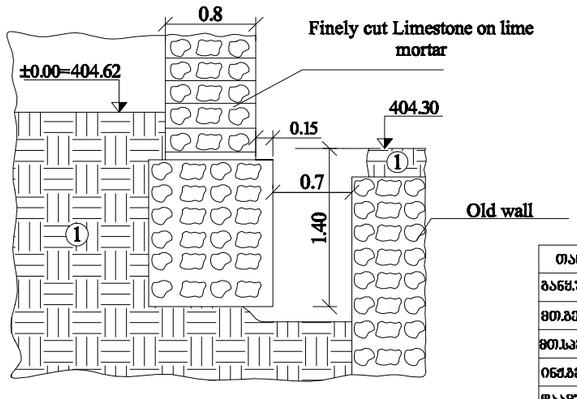
Section of the foundation ა-ა
scale 1:50



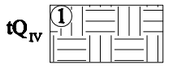
Shaft №4

№№	Layer depth from	Layer depth to	Layer intensity	Ground surface and base point level	Section მ-ბ0 1:50	Humidity	groundwater level anbd measurement date ბან.	groundwater level anbd measurement date დამწ.
				404.30				
1	0.00	1.50	1.50	402.80	1			

Section of the foundation
scale 1:50



Legend



loose gravel – clay, gravel mix

თანამდებობა	გვარი	ხელმოწერა	
გან.უფროსი	ს. სირაძე		
მთ.გეოლოგი	ზ. კვაჭანტირაძე		
მთ.სპეციალისტი	ბ. შუსტოვი		
ინჟ.გეოლოგი	ზ. კვაჭანტირაძე		
დაამუშავა	ნ. შერვაშიძე		
შეამოწმა	მ. ბურდული		
ტოპოგრაფი	მ. მამუკაშვილი		

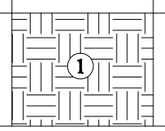
გელათის სამონასტრო კომპლექსის რეაბილიტაცია

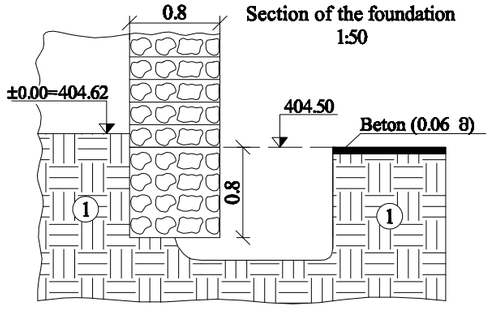
სტადია	მასა	მასშტაბი
მ		1:50
ფურცელი 3	ფურცლები 16	

გამონამუშევრების გეოლოგიური და გაფიქვლებული საძირკვლის ჭრილები

ქ. თბილისი

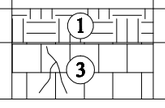
Shaft №5

№№	Layer depth from	Layer depth to	layer intensity	Ground surface and base point level	Section მ-ბ0 1:50	Humidity	groundwater level anbd measurement date	
				404.50			ბაშ.	დაშმ.
1	0.00	1.00	1.00	403.50				

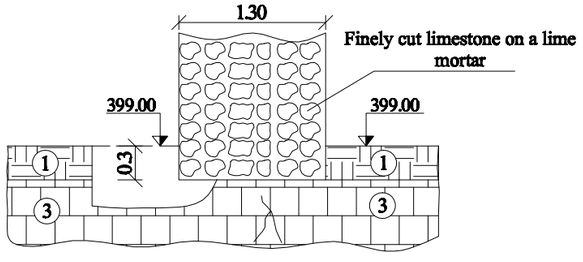


Section of the foundation
1:50

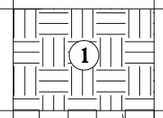
Shaft №10

№№ ორმოები	Layer depth from	Layer depth to	layer intensity	Ground surface and base point level	Section მ-ბ0 1:50	Humidity	groundwater level anbd measurement date	
				399.00			ბაშ.	დაშმ.
1	0.00	0.30	0.30	398.70				
2	0.30	0.80	0.50	398.20				

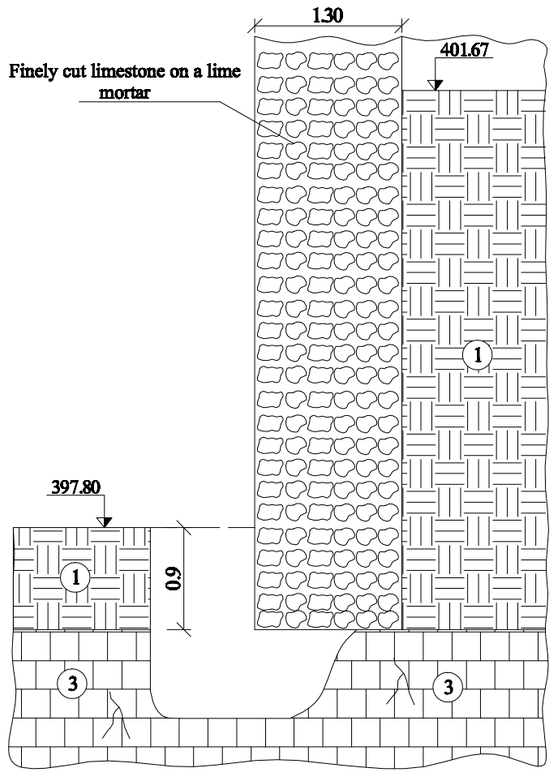
Section of the foundation
1:50



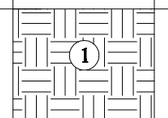
Shaft №8

№№	Layer depth from	Layer depth to	layer intensity	Ground surface and base point level	Section მ-ბ0 1:50	Humidity	groundwater level anbd measurement date	
				397.80			ბაშ.	დაშმ.
1	0.00	0.90	0.90	396.90				
2	0.90	1.40	0.50	396.40				

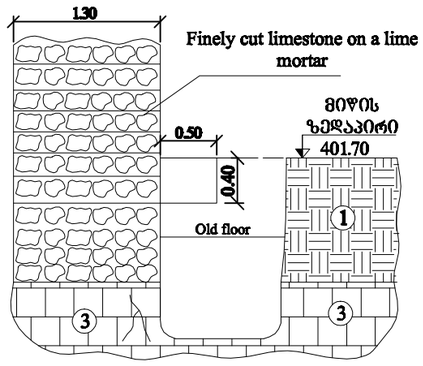
Foundation section
1:50



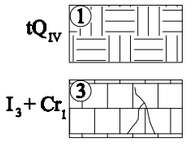
Shaft №9

№№ ჭაბურღილების				Section მ-ბ0 1:50	Humidity	groundwater level anbd measurement date	
			401.70			ბაშ.	დაშმ.
1	0.00	1.10	1.10	400.60			
2	1.10	1.60	0.50	400.10			

Section ა – ა
მ-ბ0 1:50



Legend



Loose Gravel with clay and gravel mix

main rock - limestone, dolomitized, with kracks

თანამდებობა	გვარი	ხელმოწერა		
გან.უფროსი	ს. სირაძე			
მთ.გეოლოგი	ზ. კვაჭანტირაძე			
მთ.სპეციალისტი	გ. შუხტომი			
ინჟ.გეოლოგი	ზ. კვაჭანტირაძე			
დაამუშავა	ნ. შერვაშიძე			
შეამოწმა	მ. ბურდული			
ტოპოგრაფი	მ. მამუკაშვილი			

გელათის სამონასტრო კომპლექსის რეაბილიტაცია

სტადია	მასა	მასშტაბი
მ		1:50
ფურცელი 4	ფურცლები 16	

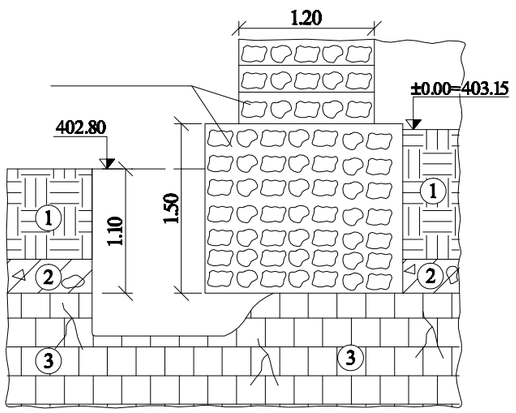
გამონამუშევრების გეოლოგიური და გამოშვლებული საძირკვლის ჭრილები

ქ. ობილისი

Shaft №11

№№	Layer depth from	Layer depth to	layer intensity	Ground surface and base point level	Section მ-ბ0 1:50	Humidity	groundwater level anbd measurement date გამ.	groundwater level anbd measurement date დამწ.
				402.80				
1	0.00	0.80	0.80	402.00				
2	0.80	1.10	0.30	401.70		მწარჯლასტ.		
3	1.10	1.50	0.40	401.30				

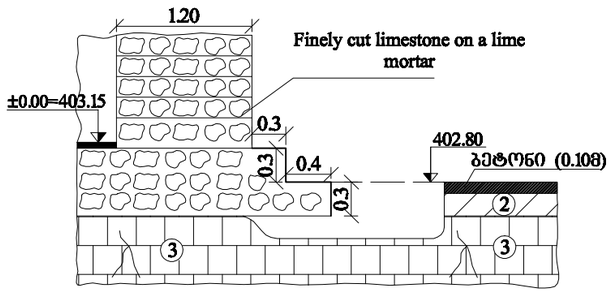
Section of the foundation
1:50



Shaft №12

№№ ლითოლოგ	Layer depth from	Layer depth to	layer intensity	Ground surface and base point level	Section მ-ბ0 1:50	Humidity	groundwater level anbd measurement date გამ.	groundwater level anbd measurement date დამწ.
				402.80				
1	0.00	0.10	0.10	402.70				
2	0.10	0.30	0.20	402.50		მწარჯლასტ.		
3	0.30	0.50	0.20	402.30				

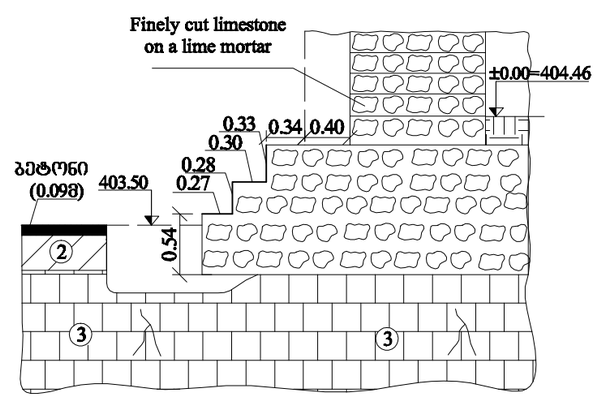
Section of the foundation
1:50



Shaft №13

№№ ლითოლოგ	Layer depth from	Layer depth to	layer intensity	Ground surface and base point level	Section მ-ბ0 1:50	Humidity	groundwater level anbd measurement date გამ.	groundwater level anbd measurement date დამწ.
				403.50				
1	0.00	0.09	0.09	403.41				
2	0.09	0.40	0.31	403.10		მწარჯლას-ტიკური		
3	0.40	0.60	0.20	402.90				

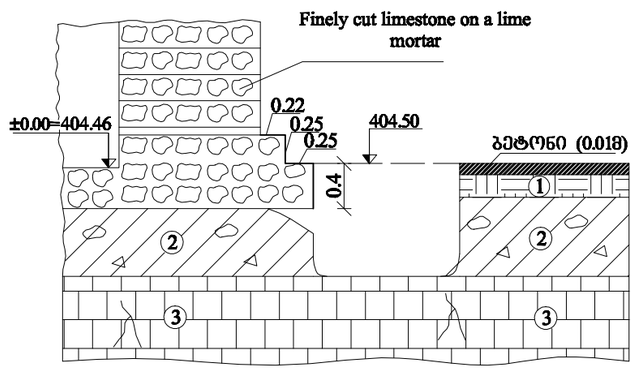
Section of the foundation
1:50



Shaft №14

№№ ლითოლოგ	Layer depth from	Layer depth to	layer intensity	Ground surface and base point level	Section მ-ბ0 1:50	Humidity	groundwater level anbd measurement date გამ.	groundwater level anbd measurement date დამწ.
				404.50				
1	0.00	0.10	0.10	404.40				
2	0.10	0.30	0.20	404.20				
3	0.30	1.00	0.70	403.50		მწარჯლას-ტიკური		

Section of the foundation
1:50



Legend

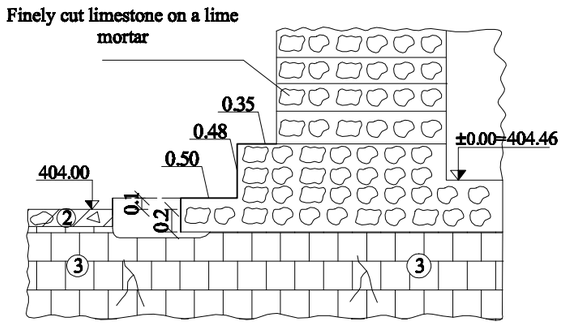
tQ_{IV} (1)	Loose Gravel with clay and gravel mix
dQ_{IV} (2)	Clay brown, halfsolid-plastic with gravel and single strones (30-40%)
$I_3 + Cr_1$ (3)	main rock - limestone, dolomitized, with kracks
■	soil sample spot

თანამდებობა	გვარი	ხელმოწერა				
გან.უფროსი	ს. სირაძე					
ფთ.გეოლოგი	ზ. კვაჭანტირაძე		გელათის სამონასტრო კომპლექსის რეაბილიტაცია	სტადია	ფასა	მასშტაბი
ფთ.სპეციალისტი	ბ. შუსტოვი			მ		1:50
ინჟ.გეოლოგი	ზ. კვაჭანტირაძე					
დაამუშავა	ნ. შერვაშიძე			ფურცელი 5	ფურცლები 16	
შეამოწმა	მ. ბურდული					
ტოპოგრაფი	მ. მამუკაშვილი		ბამონამუშევრების გეოლოგიური და გაუშვლებული საძირკვლის ჭრილები	ძ. თბილისი		

Shaft №15

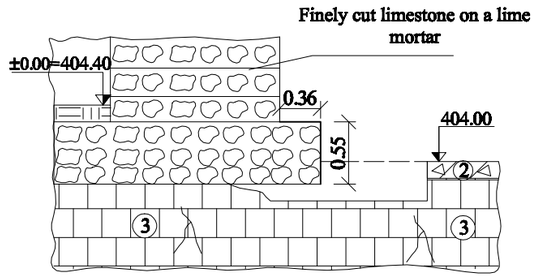
№№ ფენები	Layer depth from	Layer depth to	layer intensity	Ground surface and base point level	Section მ-ბ0 1:50	Humidity	groundwater level anbd measurement date	
				404.00			გაბ.	დამწ.
1	0.00	0.15	0.15	403.85	②	მშარპლასტ.		
2	0.15	0.35	0.20	403.65	③			

Section of the foundation
1:50



Section of the foundation
1:50

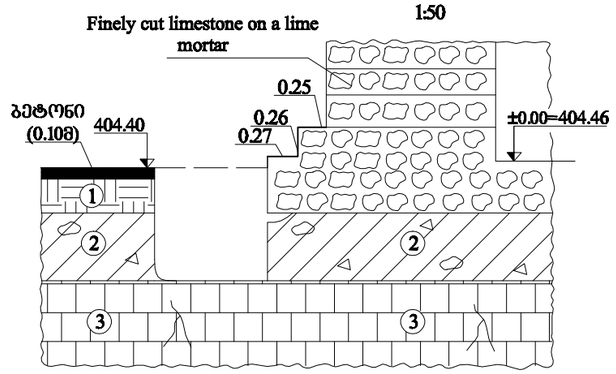
ბ - ბ



Shaft №16

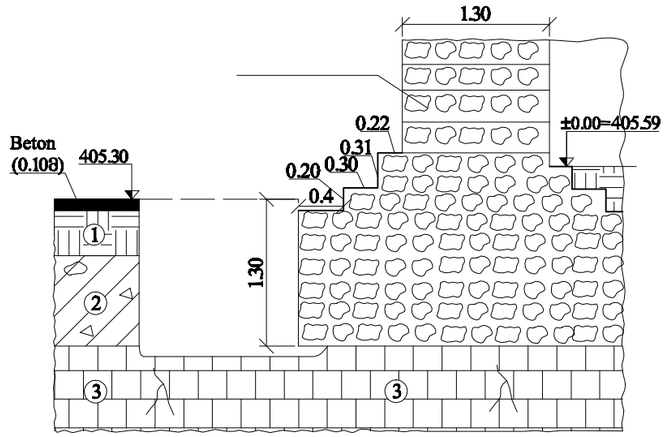
№№ ფენები	Layer depth from	Layer depth to	layer intensity	Ground surface and base point level	section მ-ბ0 1:50	Humidity	groundwater level anbd measurement date	
				404.40			გაბ.	დამწ.
1	0.00	0.10	0.10	404.30	①			
2	0.10	0.40	0.30	404.00	②	მშარპლას-ტიკური		
3	0.40	1.00	0.60	403.40	③			

Section of the foundation
1:50



Shaft №17

№№	Layer depth from	Layer depth to	layer intensity	Ground surface and base point level	Section მ-ბ0 1:50	Humidity	groundwater level anbd measurement date	
				405.30			გაბ.	დამწ.
1	0.00	0.10	0.10	405.20				
2	0.10	0.50	0.40	404.80	①			
3	0.50	1.30	0.80	404.00	②	მშარპლას-ტიკური		
4	1.30	1.50	0.20	403.80	③			



Legend

tQ_{IV} ①	Loose Gravel with clay and gravel mix
dQ_{IV} ②	Clay brown, halfsolid-plastic with gravel and single strones (30-40%)
$I_3 + Cr_1$ ③	main rock - limestone, dolomitized, with kracks
■	soil sample spot

თანამდებობა	გვარი	ხელმოწერა				
გან.უფროსი	ს. სირაძე					
მთ.გეოლოგი	ზ. კვაჭანტირაძე		გელათის სამონასტრო კომპლექსის რეაბილიტაცია	სტადია	ვასა	მასშტაბი
მთ.სპეციალისტი	ბ. შუხტოვი			მ		1:50
ინჟ.გეოლოგი	ზ. კვაჭანტირაძე					
დაამუშავა	ნ. შერვაშიძე			ფურცელი 6	ფურცლები 16	
შეამოწმა	მ. ბურდული					
ტოპოგრაფი	მ. მამუკაშვილი		გამონამუშევრების გეოლოგიური და გაუმჭვლებული საძირკვლის ჭრილები	ძ. თბილისი		

Shaft №18

№№	Layer depth from	Layer depth to	layer intensity	Ground surface and base point level	Section მ-ბ0 1:50	Humidity	groundwater level anbd measurement date	
				405.30			გაბ.	დამყ.
1	0.00	0.10	0.10	405.20				
2	0.10	0.40	0.30	404.90				
3	0.40	0.95	0.55	404.35		მყარპლას-ტიკური		
4	0.95	1.00	0.05	404.30				

Shaft №19

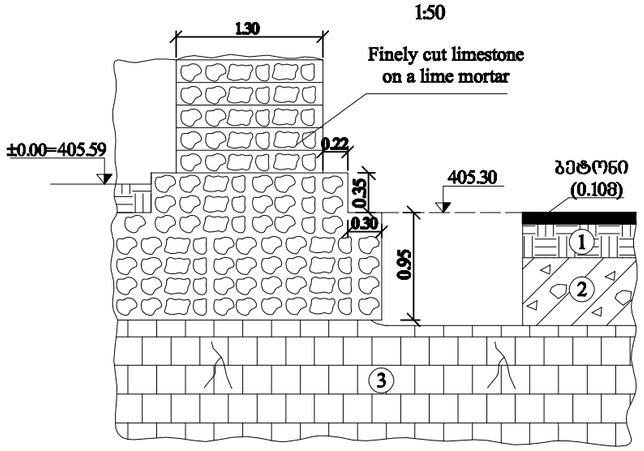
№№	Layer depth from	Layer depth to	layer intensity	Ground surface and base point level	Section მ-ბ0 1:50	Humidity	groundwater level anbd measurement date	
							გაბ.	დამყ.
1	0.00	0.40	0.40					

The shaft was not cut deep due to the presence of the earlier building foundation

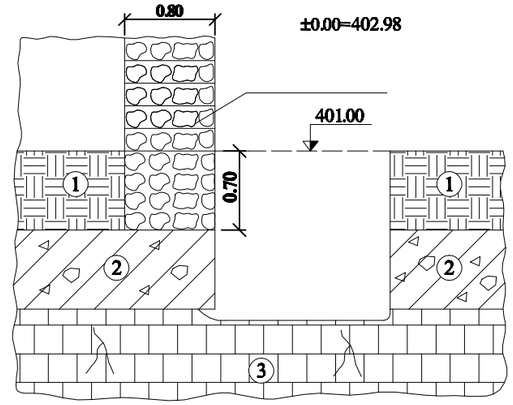
Shaft №20

№№	Layer depth from	Layer depth to	layer intensity	Ground surface and base point level	Section მ-ბ0 1:50	Humidity	groundwater level anbd measurement date	
				401.00			გაბ.	დამყ.
1	0.00	0.70	0.70	400.30				
2	0.70	1.40	0.70	399.60		მყარპლას-ტიკური		
3	1.40	1.50	0.10	399.50				

Section of the foundation
1:50



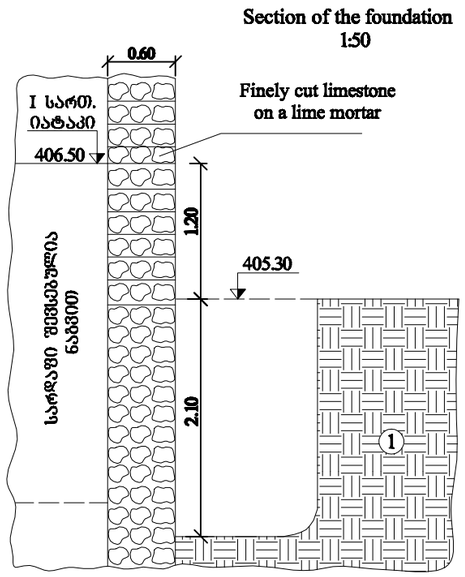
Section of the foundation
1:50



Shaft №21

რებრის №№	Layer depth from	Layer depth to	layer intensity	Ground surface and base point level	Section მ-ბ0 1:50	Humidity	groundwater level anbd measurement date	
				405.30			გაბ.	დამყ.
1	0.00	2.10	2.10	403.20				

Section of the foundation
1:50



Legend

tQ_{IV} 1	Loose Gravel with clay and gravel mix
dQ_{IV} 2	Clay brown, halfsolid-plastic with gravel and single strones (30-40%)
$I_3 + Cr_1$ 3	main rock - limestone, dolomitized, with kracks
■	soil sample spot

თანამდებობა	გვარი	ხელმოწერა				
განყ.უფროსი	ს. სირაძე					
მთ.გეოლოგი	ზ. კვაჭანტირაძე		გელათის სამონასტრო კომპლექსის რეაბილიტაცია	სტადია	მასა	მასშტაბი
მთ.სპეციალისტი	ბ. შუსტოვი			მ		1:50
ინჟ.გეოლოგი	ზ. კვაჭანტირაძე					
დაამუშავა	ნ. შერვაშიძე			ფურცელი 7	ფურცლები 16	
შეამოწმა	მ. ბურდული					
ტოპოგრაფი	მ. მამუკაშვილი		ბამონამუშევრების გეოლოგიური და გაშიშვლებული საპირკვლის ჭრილები	ს.ს. „საძეკალაძემშენპროექტი" ქ. თბილისი		

Shaft №22

ნომერი №№	Layer depth		layer intensity	Ground surface and base point level	Section მ-ბ0 1:50	Humidity	groundwater level anbd measurement date	
	from	to		407.50			ბაშ.	დამწ.
1	0.00	0.60	0.60	406.90	1			

Shaft №23

ნომერი №№	Layer depth		layer intensity	Ground surface and base point level	Section მ-ბ0 1:50	Humidity	groundwater level anbd measurement date	
	from	to		395.50			ბაშ.	დამწ.
1	0.00	0.60	0.60	394.90	1			
2	0.60	1.10	0.50	394.40	2	მწარკლასტ.		
3	1.10	1.30	0.20	399.20	3			

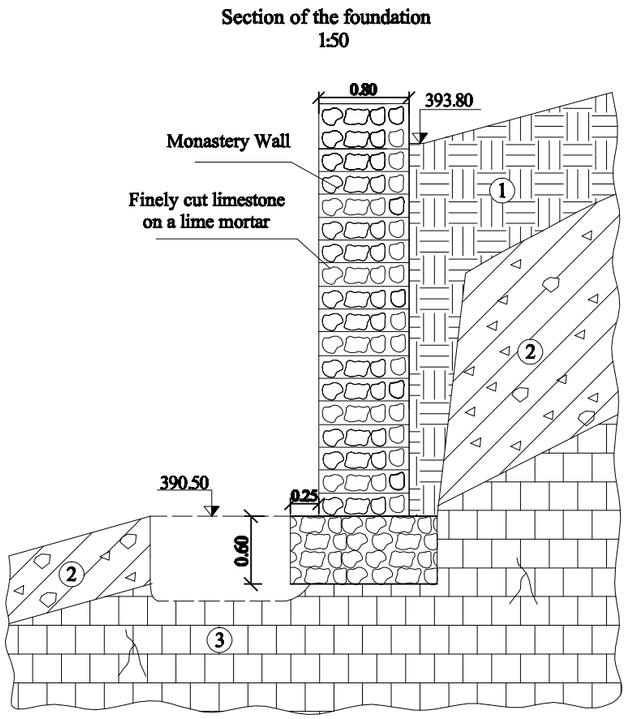
Shaft №24

ნომერი №№	Layer depth		layer intensity	Ground surface and base point level	Section მ-ბ0 1:50	Humidity	groundwater level anbd measurement date	
	from	to		391.60			ბაშ.	დამწ.
1	0.00	0.30	0.30	391.30	2	მწარკლასტ.		
2	0.30	0.50	0.20	391.10	3			

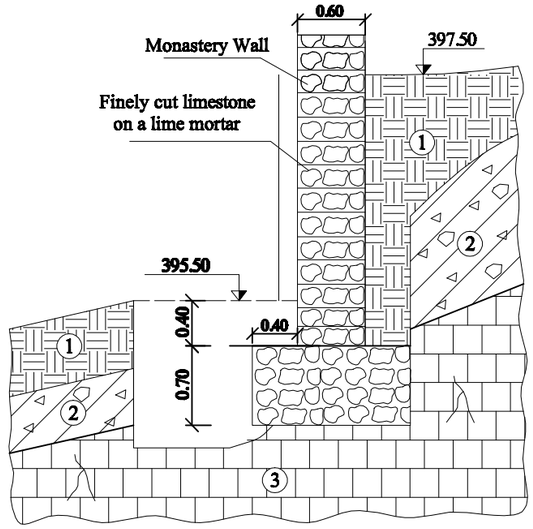
Shaft №25

ნომერი №№	Layer depth		layer intensity	Ground surface and base point level	Section მ-ბ0 1:50	Humidity	groundwater level anbd measurement date	
	from	to		390.50			ბაშ.	დამწ.
1	0.00	0.60	0.60	389.90	2			
2	0.60	0.75	0.15	389.75	3			

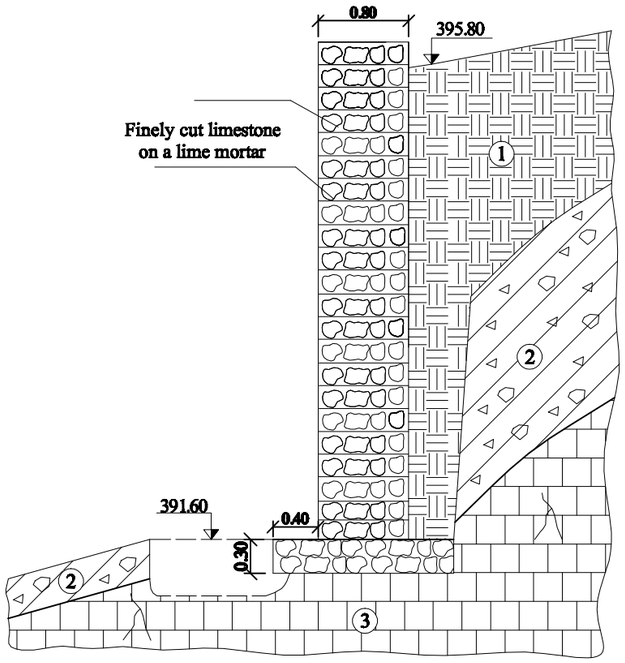
Section of the foundation
1:50



Section of the foundation
1:50



Section of the foundation
1:50



Legend

tQ_{IV} 1	Loose Gravel with clay and gravel mix
dQ_{IV} 2	Clay brown, halfsolid-plastic with gravel and single strones (30-40%)
$I_3 + Cr_1$ 3	main rock - limestone, dolomitized, with kracks
■	soil sample spot

თანამდებობა	გვარი	ხელმოწერა				
განყ.უფროსი	ს. სირაძე					
მთ.გეოლოგი	ზ. კვაჭანტირაძე		გელათის სამონასტრო კომპლექსის რეაბილიტაცია	სტადია	მასა	მასშტაბი
მთ.სპეციალისტი	ბ. შუსტოვი			მ		1:50
ინჟ.გეოლოგი	ზ. კვაჭანტირაძე					
დაამუშავა	ნ. შერვაშიძე			ფურცელი 8	ფურცლები 16	
შეამოწმა	მ. ბურდული					
ტოპოგრაფი	მ. მამუკაშვილი		გამონამუშევრების გეოლოგიური და გაშიშვლებული საპირკვლის ჭრილები	ქ. თბილისი		

Shaft №26

ფენის №№	Layer depth from	Layer depth to	layer intensity	Ground surface and base point level	Section მ-ბ0 1:50	Humidity	groundwater level anbd measurement date გაბ.	groundwater level anbd measurement date დამყ.
				389.00				
1	0.00	1.00	1.00	388.00	②			
2	1.00	1.10	0.10	387.90	③			

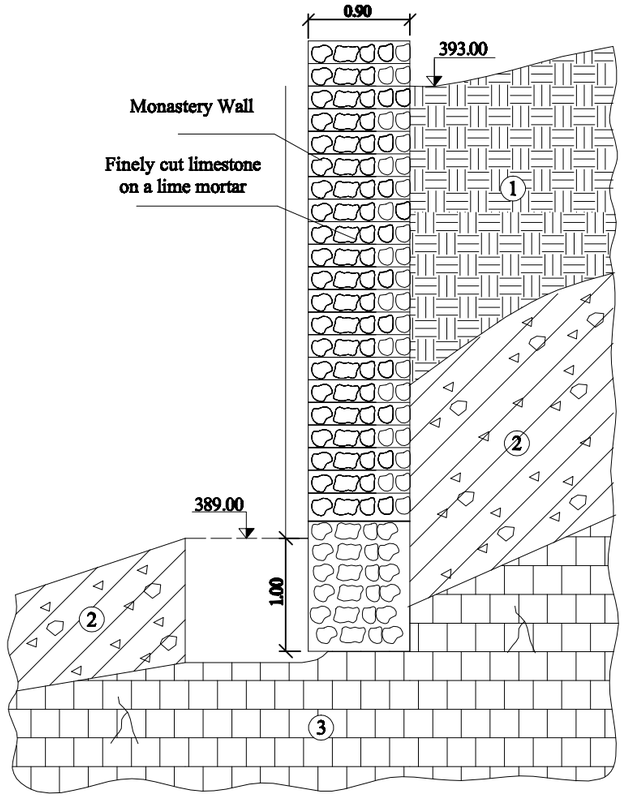
Shaft №27

ფენის №№	Layer depth from	Layer depth to	layer intensity	Ground surface and base point level	Section მ-ბ0 1:50	Humidity	groundwater level anbd measurement date გაბ.	groundwater level anbd measurement date დამყ.
				394.60				
1	0.00	0.80	0.80	393.80	②	მყარკლასტ.		
2	0.80	1.00	0.20	393.60	③			

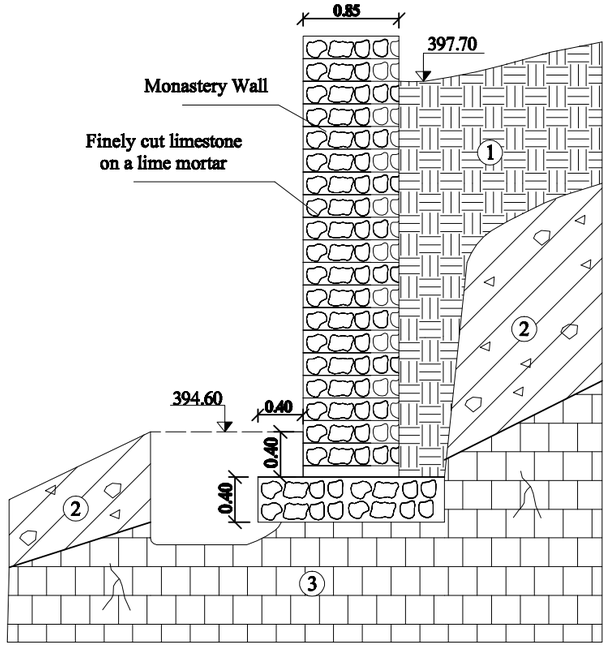
Shaft №28

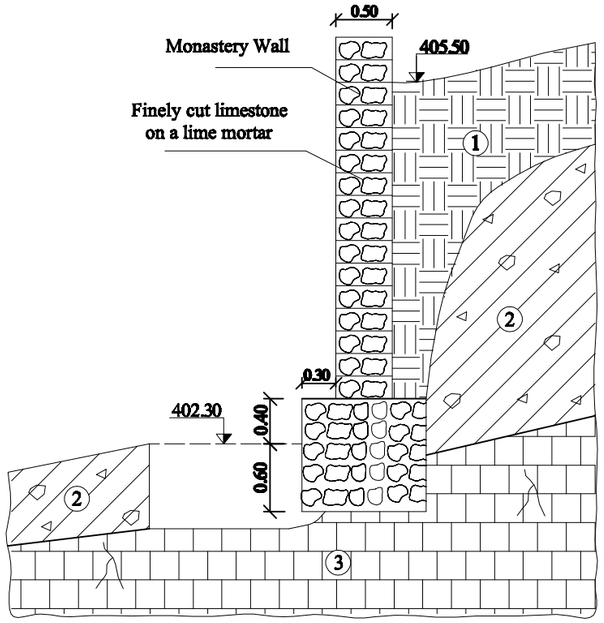
ფენის №№	Layer depth from	Layer depth to	layer intensity	Ground surface and base point level	Section მ-ბ0 1:50	Humidity	groundwater level anbd measurement date გაბ.	groundwater level anbd measurement date დამყ.
				402.30				
1	0.00	0.60	0.60	401.70	②	მყარკლასტ.		
2	0.60	0.75	0.15	401.55	③			

Section of the foundation
1:50



Section of the foundation
1:50





Legend

tQ_{IV} ①	Loose Gravel with clay and gravel mix
dQ_{IV} ②	Clay brown, halfsolid-plastic with gravel and single strones (30-40%)
$I_3 + Cr_1$ ③	main rock - limestone, dolomitized, with kracks

თანამდებობა	გვარი	ხელმოწერა				
გან.უფროსი	ს. სირაძე					
ფთ.გეოლოგი	ზ. კვაჰანტირაძე		გელათის სამონასტრო კომპლექსის რეაბილიტაცია	სტადია	ფასა	მასშტაბი
ფთ.სპეციალისტი	ბ. შუსტოვი			მ		1:50
ინჟ.გეოლოგი	ზ. კვაჰანტირაძე					
დაამუშავა	ნ. შერვაშიძე			ფურცელი 9	ფურცლები 16	
შეამოწმა	მ. ბურდული					
ტოპოგრაფი	მ. მამუკაშვილი		გამონამუშევრების გეოლოგიური და გაშიშვლებული საპირკვლის ჭრილები	ქ. თბილისი		

Shaft №29

ორგანო №№	Layer depth from	Layer depth to	layer intensity	Ground surface and base point level	ჭრილი მ-ბი 1:50	Humidity	groundwater level anbd measurement date	
				415.80			გამ.	დამყ.
1	0.00	0.50	0.50	415.30	②	მყარპლასტ.		
2	0.50	0.75	0.25	415.05	③			

Shaft №30

ორგანო №№	Layer depth from	Layer depth to	layer intensity	Ground surface and base point level	ჭრილი მ-ბი 1:50	Humidity	groundwater level anbd measurement date	
				421.00			გამ.	დამყ.
1	0.00	0.30	0.30	420.70	②	მყარპლასტ.		
2	0.30	0.50	0.20	420.50	③			

Shaft №31

ორგანო №№	Layer depth from	Layer depth to	layer intensity	Ground surface and base point level	ჭრილი მ-ბი 1:50	Humidity	groundwater level anbd measurement date	
				423.20			გამ.	დამყ.
1	0.00	0.60	0.60	422.60	②	მყარპლასტ.		
2	0.60	0.75	0.15	422.45	③			

Shaft №32

ორგანო №№	Layer depth from	Layer depth to	layer intensity	Ground surface and base point level	Section მ-ბი 1:50	Humidity	groundwater level anbd measurement date	
				427.80			გამ.	დამყ.
1	0.00	0.60	0.60	427.20	②	მყარპლასტ.		
2	0.60	0.75	0.15	427.05	③			

Shaft №33

ორგანო №№	Layer depth from	Layer depth to	layer intensity	Ground surface and base point level	ჭრილი მ-ბი 1:50	Humidity	groundwater level anbd measurement date	
				437.00			გამ.	დამყ.
1	0.00	0.40	0.40	436.60	②	მყარპლასტ.		
2	0.40	0.50	0.10	436.50	③			

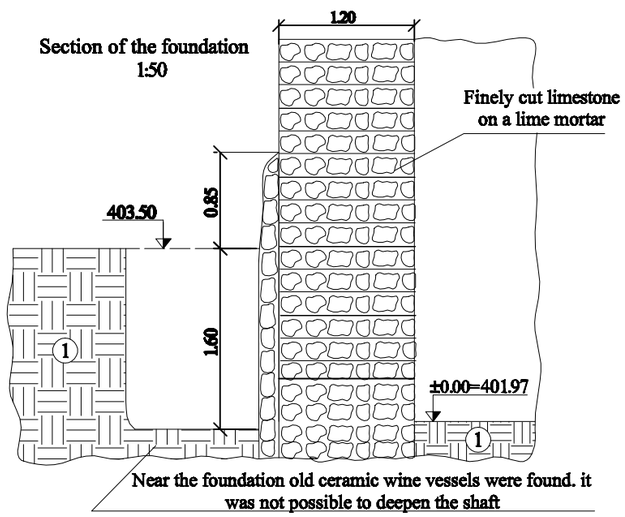
შურფი №34

ორგანო №№	Layer depth from	Layer depth to	layer intensity	Ground surface and base point level	ჭრილი მ-ბი 1:50	Humidity	groundwater level anbd measurement date	
				402.60			გამ.	დამყ.
1	0.00	1.50	1.50	401.10	①			

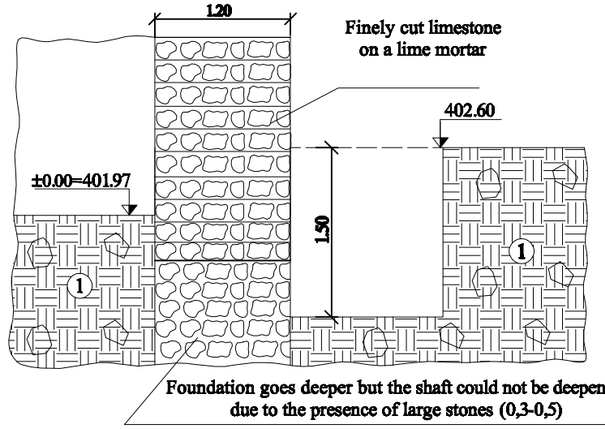
Shaft №35

ორგანო №№	Layer depth from	Layer depth to	layer intensity	Ground surface and base point level	Section მ-ბი 1:50	Humidity	groundwater level anbd measurement date	
				403.50			გამ.	დამყ.
1	0.00	1.60	1.60	401.90	①			

Section of the foundation
1:50



Section of the foundation
1:50



Legend

tQ_{IV} ①	Loose Gravel with clay and gravel mix
dQ_{IV} ②	Clay brown, halfsolid-plastic with gravel and single strones (30-40%)
$I_3 + Cr_1$ ③	main rock - limestone, dolomitized, with kracks

თანამდებობა	გვარი	ხელმოწერა	გელათის სამონასტრო კომპლექსის რეაბილიტაცია	სტადია	ფასა	მასშტაბი
გან.უფროსი	ს. სირაძე			მ		1:50
მთ.გეოლოგი	ზ. კვაჭანტირაძე			ფურცელი 10		ფურცლები 16
მთ.სპეციალისტი	გ. შუხტოშვი					
ინჟ.გეოლოგი	ზ. კვაჭანტირაძე					
დაამუშავა	ნ. შერვაშიძე					
შეამოწმა	მ. ბურდული		გამონამუშევრების გეოლოგიური და გაშიშვლებული საპირკვლის ჭრილები	ქ. თბილისი		
ტოპობრაში	მ. მამუკაშვილი					

Legend

tQ_{IV}	1	Loose Gravel with clay and gravel mix
dQ_{IV}	2	Clay brown, halfsolid-plastic with gravel and single strones (30-40%)
$I_3 + Cr_1$	3	main rock - limestone, dolomitized, with kracks

თანამდებობა	გვარი	ხელმოწერა				
განყ.უფროსი	ს. სირაძე					
მთ.გეოლოგი	ზ. კვაჭანტირაძე		გელათის სამონასტრო კომპლექსის რეაბილიტაცია	სტადია	მასა	მასშტაბი
მთ.სპეციალისტი	გ. შუსტოვი			მ		1:200
ინჟ.გეოლოგი	ზ. კვაჭანტირაძე					
დაამუშავა	ნ. შერვაშიძე					
შეამოწმა	მ. ბურდული			ფურცელი 11	ფურცლები 16	
ტოპოგრაფი	მ. მამუკაშვილი		უბნის გეოლოგიური ჭრილი	ქ. თბილისი		

Legend

tQ_{IV}	1	Loose Gravel with clay and gravel mix
dQ_{IV}	2	Clay brown, halfsolid-plastic with gravel and single strones (30-40%)
$I_3 + Cr_1$	3	main rock - limestone, dolomitized, with kracks

თანამდებობა	გვარი	ხელმოწერა				
განყ.უფროსი	ს. სირაძე					
მთ.გეოლოგი	ზ. კვაჭანტირაძე		გელათის სამონასტრო კომპლექსის რეაბილიტაცია	სტადია	მასა	მასშტაბი
მთ.სპეციალისტი	ბ. შუსტოვი			მ		1:200
ინჟ.გეოლოგი	ზ. კვაჭანტირაძე					
დაამუშავა	ნ. შერვაშიძე					
შეამოწმა	მ. ბურდული			ფურცელი 12	ფურცლები 16	
ტოპოგრაფი	მ. მამუკაშვილი		უბნის გეოლოგიური ჭრილი	ქ. თბილისი		

Section III – III[1]

Legend

tQ_{IV}	1	Loose Gravel with clay and gravel mix
dQ_{IV}	2	Clay brown, halfsolid-plastic with gravel and single strones (30-40%)
I_3+Cr_1	3	main rock - limestone, dolomitized, with kracks

თანამდებობა	გვარი	ხელმოწერა				
განყ.უფროსი	ს. სირაძე					
მთ.გეოლოგი	ზ. კვაჭანტირაძე		გელათის სამონასტრო კომპლექსის რეაბილიტაცია	სტადია	მასა	მასშტაბი
მთ.სპეციალისტი	გ. შუსტოვი			მ		1:200
ინჟ.გეოლოგი	ზ. კვაჭანტირაძე					
დაამუშავა	ნ. შერვაშიძე					
შეამოწმა	მ. ბურდული			ფურცელი 13	ფურცლები 16	
ტოპოგრაფი	მ. მამუკაშვილი		უბნის გეოლოგიური ჭრილი	ს.ს. „საქქალაქმშენპროექტი" ქ. თბილისი		

Section IV – IV[1]

Legend

tQ_{IV}	1	Loose Gravel with clay and gravel mix
dQ_{IV}	2	Clay brown, halfsolid-plastic with gravel and single strones (30-40%)
$I_3 + Cr_1$	3	main rock - limestone, dolomitized, with kracks

თანამდებობა	გვარი	ხელმოწერა
განყ.უფროსი	ს. სირაძე	
მთ.გეოლოგი	ზ. კვაჭანტირაძე	
მთ.სპეციალისტი	ბ. შუსტოვი	
ინჟ.გეოლოგი	ზ. კვაჭანტირაძე	
დამუშავა	ნ. შერვაშიძე	
შემოწმა	მ. ბურდული	
ტოპოგრაფი	მ. მამუკაშვილი	

გელათის სამონასტრო კომპლექსის რეაბილიტაცია

სტადია	მასა	მასშტაბი
მ		1:200
ფურცელი 14	ფურცლები 16	

უბნის გეოლოგიური ჭრილი

ქ. თბილისი

Legend

tQ_{IV}	1	Loose Gravel with clay and gravel mix
dQ_{IV}	2	Clay brown, halfsolid-plastic with gravel and single strones (30-40%)
$I_3 + Cr_1$	3	main rock - limestone, dolomitized, with kracks

თანამდებობა	გვარი	ხელმოწერა				
განყ.უფროსი	ს. სირაძე					
მთ.გეოლოგი	ზ. კვაჭანტირაძე		გელათის სამონასტრო კომპლექსის რეაბილიტაცია	სტადია	მასა	მასშტაბი
მთ.სპეციალისტი	გ. შუსტოვი			მ		1:200
ინჟ.გეოლოგი	ზ. კვაჭანტირაძე					
დაამუშავა	ნ. შერვაშიძე					
შეამოწმა	მ. ბურდული			ფურცელი 15		ფურცლები 16
ტოპოგრაფი	მ. მამუკაშვილი		უბნის გეოლოგიური ჭრილი	ქ. თბილისი		

Legend

tQ_{IV}	1	Loose Gravel with clay and gravel mix
dQ_{IV}	2	Clay brown, halfsolid-plastic with gravel and single strones (30-40%)
$I_3 + Cr_1$	3	main rock - limestone, dolomitized, with kracks

თანამდებობა	გვარი	ხელმოწერა				
განყ.უფროსი	ს. სირაძე					
მთ.გეოლოგი	ზ. კვაჭანტირაძე		გელათის სამონასტრო კომპლექსის რეაბილიტაცია	სტადია	მასა	მასშტაბი
მთ.სპეციალისტი	გ. შუსტოვი			მ		1:200
ინჟ.გეოლოგი	ზ. კვაჭანტირაძე					
დაამუშავა	ნ. შერვაშიძე					
შეამოწმა	მ. ბურდული			ფურცელი 16	ფურცლები 16	
ტოპოგრაფი	მ. მამუკაშვილი		უბნის გეოლოგიური ჭრილი	ს.ს. „საქქალაქმშენპროექტი" ქ. თბილისი		