
# Mtatsminda Park

## Engineering-Geological Investigation of Ropeway Station Foundation

**Tbilisi 2012**

# Mtatsminda Park

## Engineering-Geological Investigation of Ropeway Station Foundation

"GeoTechService" Ltd.

Director G. Bendukidze

Project Manager S. Gaganidze

Tbilisi 2012

## Content:



**Drawings:**

Drawing 1. Litological Sections of Test Pits .

**Textual Annexes:**

Annex 1 Total Table of Physical and Mechanical Properties of Soils;

Annex 2 Unconfined Compressive Strength;

Annex 3 Photos.

## 1. Introduction

On basis of the Contract drawn up with Old Tbilisi Development Fund on April 27, 2012 "GeoTechService" Ltd. received an assignment to carry out engineering-geological investigation of ropeway station foundation at Mtatsminda Park territory.

According to the assignment 2 test pits (TP #1, TP #2) were excavated for outcropping existing pier foundation and taking samples from the foundation, but at the adjacent territory Test Pit #3 was excavated within future approximate construction site areas. Received assignment foresees laboratory investigation of undisturbed soils samples taken from soils and rocks observed in test pits for establishment of their physical and mechanical properties.

Test pit escavation was conducted from May 08 to May 10, 2012 (geological engineer: M. Kipshidze; Technician: J. Basilidze).

Laboratory investigations were conducted from May 10 to May 15, 2012 (G. Natsvlishvili, Ts. Martiashvili, L. Minadze, B. Khatiashvili, I. Kokolashvili, K. Tedliashvili).

Chamber works were conducted from May 12 to May 19, 2011 (S. Gaganidze, G. Natsvlishvili, G. Bendukidze, Z. Gaganidze, N. Jorjadze; Interpreter – E. Jijiashvili).

References and volumes of provided works are given in Table 1.1.

Table 1.1

| Job Reference | Dimension | Quantity |
|---|---|---|
| **Field Works** | | |
| Excavating 3 test pits to 2.0m depths | Linear m | 3.5 |
| Sampling | Sample | 5 |
| **Laboratory Investigation** | | |
| Moisture content | Test | 5 |
| Atterberg limits | Test | 2 |
| Density | Test | 5 |
| Particle density | Test | 5 |
| Unconfined compressive strength at natural state (Rc) | Test | 3 |
| Unconfined compressive strength at saturated state (Rcw) | Test | 3 |
| **Chamber Works** | | |
| Searching and treating fund geological, meteorological and engineering-geological materials | Site | 1 |
| Working up field and laboratory investigation results by Computer and drawing up engineering-geological report | Report | 1 |

## 2. Climate

Climate condition estimation for investigation site is based on meteorological station data of Tbilisi – Mtatsminda. The data are obtained by construction climatological standard (pn 01.05-08).

According to climate regionalization map of Georgia the region belongs to III climatic and III-g subregion. Average temperature in January is from $0^0$ to $+2^0$ but average temperature in July is within $+25^0$C and $+28^0$C boundaries.

Air temperature parameters are given below, in Tables.

Air average temperature according to months – Table 2.1

| Months | | | | | | | | | | | | Year Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| I | II | III | IV | V | VI | VII | VIII | IX | X | XI | XII | |
| -0.6 | 1.6 | 4.4 | 9.7 | 15.0 | 18.8 | 22.1 | 22.2 | 17.7 | 12.3 | 6.2 | 1.5 | 10.8 |

Air temperature - Table 2.2

| Absolute Minimum | Absolute Maximum | Average Maximum of the Hottest Month | Average of the Coldest 5-Day Period | Average of the Coldest Day | Average of the Coldest Period | Average Temterature at 1 p.m | |
|---|---|---|---|---|---|---|---|
| | | | | | | The Coldest Month | The Hottest Month |
| -24 | 38 | 27.9 | -9 | -12 | -0.7 | 1.3 | 25.9 |

Air Relative Moisture - Table 2.3

| Months | | | | | | | | | | | | Year Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| I | II | III | IV | V | VI | VII | VIII | IX | X | XI | XII | |
| 74 | 72 | 68 | 66 | 68 | 62 | 59 | 57 | 65 | 73 | 77 | 75 | 68 |

- Quantity of atmosphere precipitation a year is – 635 mm;
- Maximum Duration of Precipitation a day – 154 mm;
- Snow cover weight – 0.50 kpa;
- Quantity of days with snow cover – 21;

➢ Wind with 21m/sec velocity is supposed once a year;

➢ Wind with 23m/sec velocity is supposed once in 5 years;

➢ Wind with 27m/sec velocity is supposed once in 10 years;

➢ Wind with 28m/sec velocity is supposed once in 15 years;

➢ Wind with 29m/sec velocity is supposed once in 20 years.

Wind Peculiarities – Table 2.4

| Repetition (%) of wind direction – January, July | | | | | | | | Average, biggest and smallest velocity of wind, m/sec | |
|---|---|---|---|---|---|---|---|---|---|
| N | NE | E | SE | S | SW | W | NW | January | July |
| 10/18 | 1/2 | 1/4 | 22/27 | 5/6 | 7/3 | 5/2 | 49/38 | 5.6/1.7 | 6.7/2.7 |

Wind Peculiarities – Table 2.5

| Repetition of wind direction and calm in a year; (%) calm | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| N | NE | E | SE | S | SW | W | NW | Calm |
| 10 | 1 | 3 | 32 | 7 | 5 | 3 | 39 | 22 |

Normative depth of soils' seasonal freezing;

Clayey and lean clay – 18 cm;

Fine and silty sand/silty sand – 22 cm;

Coarse and medium grained gravelly sand – 23 cm;

Coarse fragmental – 27 cm.

## 3. Geological and Geomorphologic Structure, Seismicity

Tbilisi is located at crossing of East longitude 41°42' and North latitude 44°48', in Tbilisi cavity, which is elongated from North to South. River Mtkvari divides Tbilisi in two asymmetrical parts. On the right slope of the river Mtkvari the following mountain ridges are disposed from North to South: Armazi, Lisi, **Mama Daviti**, Mtabori, Teleti, Ialghuja. Hollows of Digomi, Saburtalo, Krtsanisi and Koda-Tsalaskhuri are located between these mountain ridges. It should be mentioned that mountain ridges coincide with positive structures or anticlines, but hollows coincide with negative structures or synclines. Narrow elongated fold system was created at the region orogenic development stage being dismembered by separate blocks on base of many drags at North part. Fan-like folds are observed; they are spread in Tbilisi and its surrounding territory.

Tbilisi and its surrounding territory are located at East of Adzharia-Trialeti deepening system. It is characterized by strong sheets of Paleogene-Eocene deposits and volcanogenic soils**.** In most part they are covered with Quaternary deposits. Due to high discontinuance of relief outcrops of bedrocks are often observed, giving possibility for their observation and characterization. Sandstones, tuffogenic sandstones, argilites, tuff breccias, limestones and etc. take essential part in Tbilisi and its surrounding territory structure.

Upper Eocene thick and medium bedded sandstones ($P_2^3$) take part in structure of the investigation site.

Investigation territory belongs to 8 scale seismic zone according to the seismic hazard map of Georgia. Undimensioned coefficient of seismicity is 0.17 (Construction Norms and Rules "Seismic Resistant Construction" – pn 01.01-09).

## 4. Laboratory Investigation Results of Soils

Laboratory investigation was carried out on 5 samples taken from test pits excavated at the investigation territory.

Laboratory investigations were provided in the geotechnical laboratory belonged to "GeoTechService" Ltd, according to State Standards eligible in Georgia.

At the investigation site 3 geological elements (**GE**s) were selected on base of provided field and laboratory investigations:

**GE 1** – Earth fill soil;

**GE 2** – Quaternary deluvial genesis lean clay;

**GE 3** – Upper Eocene weathered sandstone.

GE 1 Earth fill soil was not studied by laboratory due to its nonuniformity and unequal distribution.

GE 2 Lean clay, brown, stiff, slightly carbonate was observed only in Test Pit #3 from the surface to 1.5m depth. It was studied on base of test result analyses carried out on 2 samples.

GE 3 Sandstone, brown, weathered, fractured, was observed in all three Test Pits applicably at 0.5-0.7m and 1.5m depths; it was studied by 3 rock samples.

Laboratory investigation results of soils are given in Total Table – Annex 1. Results are grouped according to geological elements. Their average meanings are calculated here too.

Test results of unconfined compressive styrength of rocks (GE 3) are given in Annex 2. Rc is 50.4mpa at natural state, but it is 40.6mpa at saturated state. Softening coefficient is 0.8.

Excavation photos are given in Annex 3.

## 5. Conclusion

On basis of provided field and laboratory investigations 3 geological elements (**GE**s) were selected at the investigation site

- ✓ GE 1 – Earth fill soil;
- ✓ GE 2 – Quaternary deluvial genesis lean clay;
- ✓ GE 3 – Upper Eocene weathered sandstone.

According to the obtained results we can conclude the following:

1. GE 1 – Earth fill soil is useless for setting foundation on it;
2. Due to small thickness of GE 2 soils (1.5m) setting foundation is desirable on GE 3 soils;
3. According to seismicity the studied soils belong to: GE 1 and GE 2 – III category, GE 3 - II category (pn 01.01-09);
4. Seismicity of the construction site is determined by 8 scale in case of setting foundation on GE 3 soils;
5. At the construction site recent dangerous geological processes and events that will prevent construction process are unexpected;
6. All calculating indexes for studied soils required for construction are given in Table 5.1.

Calculated Indexes of Soils

Table 5.1

| GE # | Soil Category according to Excavation (СНиП-IV-5-85) | Soil Category according to Excavation СНиП-IV-2-82) | Soil Category according to Seismicity (pn 01.01-91) | Temporal Cut Slope | | | Density **ρ**, g/cm$^3$ | Particle Density **ρs**, g/cm$^3$ | Moisture Content **W, %** | Voids Ratio **e** | Internal Friction Angle **φ**, Degree | Cohesion C, kpa | Total Deformation Modulus $E_0$, kpa | Unconfined Compressive Strength, Rc mpa | Soil Strength (pn 02.01-08) **$R_0$**, kpa |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 1.5 m | 3. m | 5. m | | | | | | | | | |
| 1 | 24b-III | - | III | 1:0.67 | 1:1 | 1:1.25 | 1.90 | - | - | - | - | - | - | - | 1.5* |
| 2 | 33v-II | - | III | 1:0 | 1:0.5 | 1:0.75 | 1.68 | 2.70 | 18.4 | 0.905 | 22* | 12* | 25000* | - | 1.8* |
| 3 | 28b-VI | 29b-VI | II | 1:0 | 1:0 | 1:0.2 | 2.49 | 2.72 | 4.2 | 0.137 | 28* | 900* | - | 40.6 | - |

*- Parameters are given according to standard literature.