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# PRELIMINARY GEOPHYSICAL STUDIES ON THE PLANNED CONSTRUCTION SITE

***A.M.Salamov[1], A.H.Zamanova[1]***

ABSTRACT: As a result of preliminary geophysical studies, the peculiarities of the geological-lithological section, including compartmentalization, up to 50 m depth were determined by the vertical electrical sounding method (VES). The boundaries, distribution limit and scales of commercial deposits were determined within the research site. The seismological conditions of the planned construction site were analyzed also and relevant recommendations were developed.
Keywords: construction area, geomorphological, geological, hydrogeological, seismological condition, geophysical exploration methods, , geophysical data, earthquake

**Introduction.** The recent decades have seen rapid growth of the construction industry for different purposes in the Republic of Azerbaijan. Therefore the geophysical methods are widely used in studying of the engineering-geological, engineering-geophysical and seismic conditions of the planned construction sites.


1. Scheme of location of geophysical profiles
1 Vertical Electrical Sounding points and their numbers;
2-engineering - geological boreholes and their numbers.



[1] *Institute of Geology and Geophysics of Azerbaijan National Academy of Sciences – AZ1143, Baku, Azerbaijan, ave. H.Javid 119 – avazsalamov@yandex.ru; aynur-zamanova@rambler.ru*
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The planned construction area locates in the northern part of Baku. The vertical electrical sounding (VES) research method was used for the engineering-geophysical assessment of the planned construction area. The following geological problems should be solved by interpretation of the geophysical data: peculiarities of the geological-lithological section, including compartmentalization, up to 50 m depth; determination of the assumed density of the industrial layer; detection of the assumed distortion lines and their tracking.

**The climatic conditions of the area**

The climatic condition of the planned construction area is a component of the Absheron Peninsula. A complex of the atmospheric processes that form the Eurasian arid zone has a real impact on this zone. The frequent changes of the air mass and atmospheric pressure is observed in the Absheron peninsula in all seasons of the year.

The long-term average annual temperature in peninsular is 14.6 ° C with the minimum averege temperature is 3.8 ° C in January and maximum is 25.7 ° C in July. The values of the absolute maximum temperature is 42 ° C and absolute minimum is -13 ° C here. During the summer season the soil temperature reaches 46 - 47 ° C The soil temperature increases to 46 - 47 ° C, and in some cases up to 65 ° C . During the year the number of days on which temperature above-zero vary from 255 to 293 [4].

**Geomorphological, geological, and hydrogeological conditions of the area**

The research site is located on the north synclinal limb of the Baku trough in the central part the Absheron peninsula.

From geomorphological point of view, geophysical explorations were carried out in the area, which is belong to the Absheron-Gobustan region of the Greater Caucasus and reflects the relief characteristics inherent in this region. Eol activity along with the general condition of the area and role of the Caspian Sea play an important role in formation of the peninsula relief.

Molasse sediments are mainly in the geological section of the area. Surface sediments are represented by Quaternary marine and continental lithological derivatives of Paleogene and Neogene systems [4]. Quaternary sediments consist of gray and brown clays with a little thickness, and loamy sands.

From hydrogeological point of view, the research area is referred to as the central district of the western part of the Absheron peninsula. The Cretaceous and Miocene - The Paleogene sediments, that are prevalent in this area, are mostly characterized with an unsuitable condition in terms of the groundwater formation. So, the fresh drinking water sources are almost absent in the area. It is possible to find drinking water sources within dealluvial - proluvial deposits and current caspian sediments in the different areas, where exist the Quaternary collectors and aquiferous stratum.

The diversity of the lithological composition of rocks, their filtration characteristics and different sources of water formation caused the diversity of chemical composition of groundwater. Generally, the salinity level of the rocks varies depending on their age, lithological composition and the bedding depth. An excessive infiltration of atmospheric sediments from salt rocks of different composition, salts fluviraption cause the variation of chemical composition of groundwater as a result of groundwater motion [4].

**Seismological condition of the area**

As the site located in the Absheron peninsula, seismological condition of the site is a component of seismological condition of the peninsula.

The Absheron Peninsula is characterized by having the most complex geological and tectonic structure and locates at the intersection of the South Caspian depression and in the south-eastern dipping of the Greater Caucasus megastructure. This kind of complex geological-structural conditions of the peninsula, manifests itself in high seismic activity of the area along with its geological-tectonic and geomorphological condition.



According to Mesozoic basin, the peninsula is characterized as an area of big tectonic block, where neotectonic processes intensively occurred. As a result, a number of active earthquake foci were determined in boundaries of the peninsula and in the Caspian Sea regions. As the earthquake foci locate in the upper part of the Miocene layer, depth of local earthquake foci comes up to 5 km in most cases. As a result of simultaneously conducted researches it was determined, that in most cases local earthquake foci locate in layers andconsist of plastic clays . The water horizon bottom on the top of these layers has a significant

impact on the seismic conditions of the peninsula area.

A great attention should be paid to seismological along with the engineering-geological and geophysical conditions during the construction work projecting within the different areas of peninsula.

As the Absheron seismically active zone borders with the Caspian Sea, so the earthquakes occurred in this zone don't have the closed macroseismic areas. According to isoseismic maps, some earthquakes occurred in the Caspian sea and the Absheron peninsula have V-VI-VII intensity on XII MSK-64 seismic scale.

Essentially, the seismicity of the Absheron peninsula is characterized by the influence of close and far foci. Based on the macroseismic data of earthquake foci it is fair to say, that the perceptible earthquakes occurred on June 6, 1910; March 31, April 8, May 2; July 24, 1935; August 7, 1937; February 23, 1938 in this zone. The most of foci are located in Nargin and Chilov islands, Surakhany, Sabunchu, Mashtagha regions and in the west of Baku. The zone of influence for the Absheron earthquakes (their hypocenters mainly located at the depths of 3-8 km) doesn't cover large areas and has a local character.

**Geophysical exploration methods**

First of all, experimental works were conducted to increase efficiency of explorations, that will be conducted by VES method, and to isolate correctly the lithological compositions of the geological section. As a result, nourishing AB electrodes and the distances between observation points were identified.

Field works were conducted on the topographically pre-prepared profiles (I-I - IX-IX) by VES method.

The number of measurements at the observation points were increased in three times in comparison with the general VES method measurements to define the boundaries of rock layers in the geological section. During the field works the current source of the output voltage of 200 V was used by VES method as a power supply. AE-72 type measurement device was used to measure the potential difference and current strength in measurement line [5]. The electrical strength intensity was provided to control the quality of field work and given to the measurement line between 150,0-950,0 mA, which resulted in a change of voltage differences in the extent of 1,0-1000 mV.

As a result of the field works, the obtained measurements were included into a computer and processed with the AVAZ-2002 software

In consequence of processing the rock values of $\rho_a$ - assumed electrical resistance (a.e.r.) and $\rho$ - specific electrical resistance (s.e.r.) of the area were defined [4].

Based on the results of the field works conducted by VES method on the 9 profile, the geoelectric sections on the basis of the specific electrical resistivity values were compiled in the scale of 1:1000. Field measurement works were conducted in the NE - SW direction on profiles I - I, II - II, III - III and IV - IV, V - V, VI - VI, and in the NW - SE direction on profiles IX - IX (Fig.1).

**Interpretation of geophysical data**

The geophysical exploration works were carried out on a scale of 1:1000 on the site, which is located in Baku. The purpose of the electrical prospecting by VES method is to divide lithological compositions of the geological section up to 50 m depth and to define their a.e r. and s.e.r. According to the a.e.r. and s.e.r. rocks' values (that compose the geological section ), the section mainly consists of clayey composition, sandy clay with a little thickness and poorly cemented sandstone sediments.

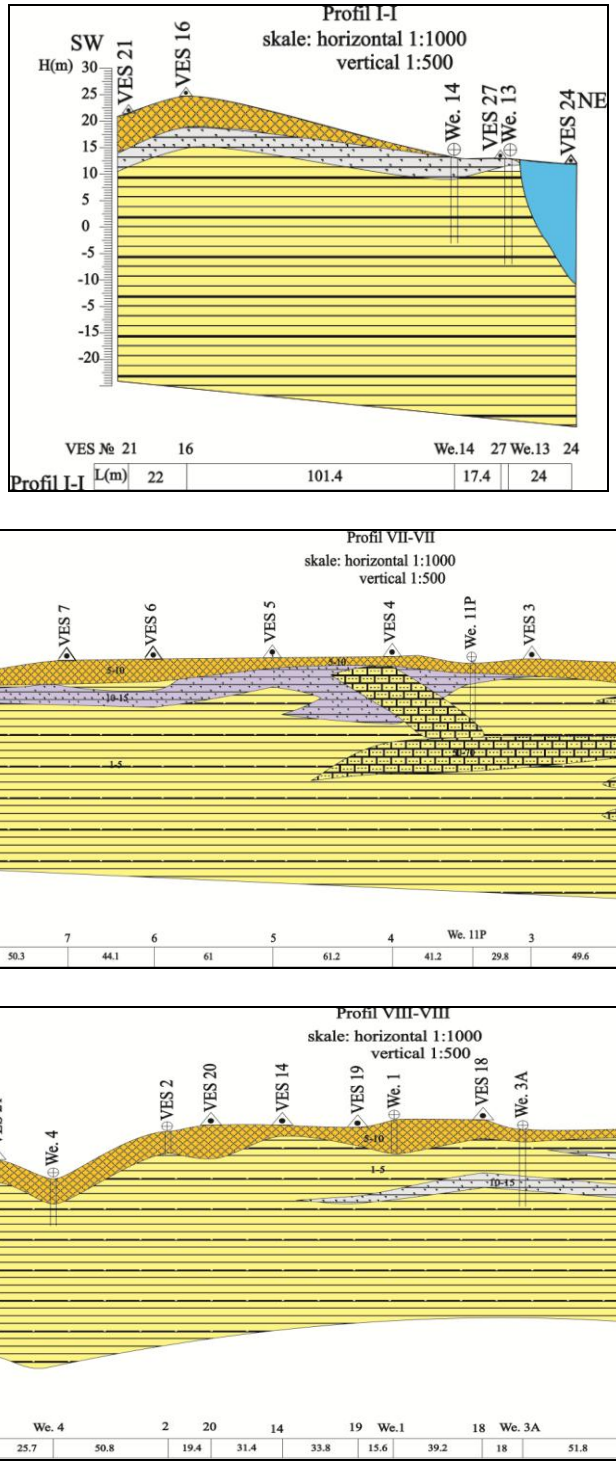
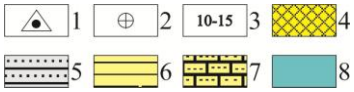



Figure. 2. Geophysical- lithological sections on profiles I-I, VII-VII, VIII and VIII.




1 - VES points and their numbers; 2 -engineering-geological boreholes and their numbers; 3-s.e.r. of rocks that build up the geological section - i; 4 - technogenic rock layer; 5 - sandy clay layer; 6 - clay layer; 7 - poorly cemented sandstone layer; 8 - highly hydrated and mineralized clay.

S.e.r. of the first layer that makes up the geological section is 10,0-15,0 Om·m towards the depth from the Earth surface, and its density varies between 0,5 - 8,5 m and it is assumed that this layer was consisted of sediments of technogenic type. Based on the result of the geophysical explorations is determined, that the second layer mainly consists of clays. S.e.r. of this layer varies between 1-5 Ohm · m and was observed within the studied area up to 50 m depth. The sandy clays with a little thickness and poorly cemented sandstone layers were found in research area at different depths. Their specific electrical resistance varies in accordance with 10-15 and 70-85 Ohm · m (Figure 2).

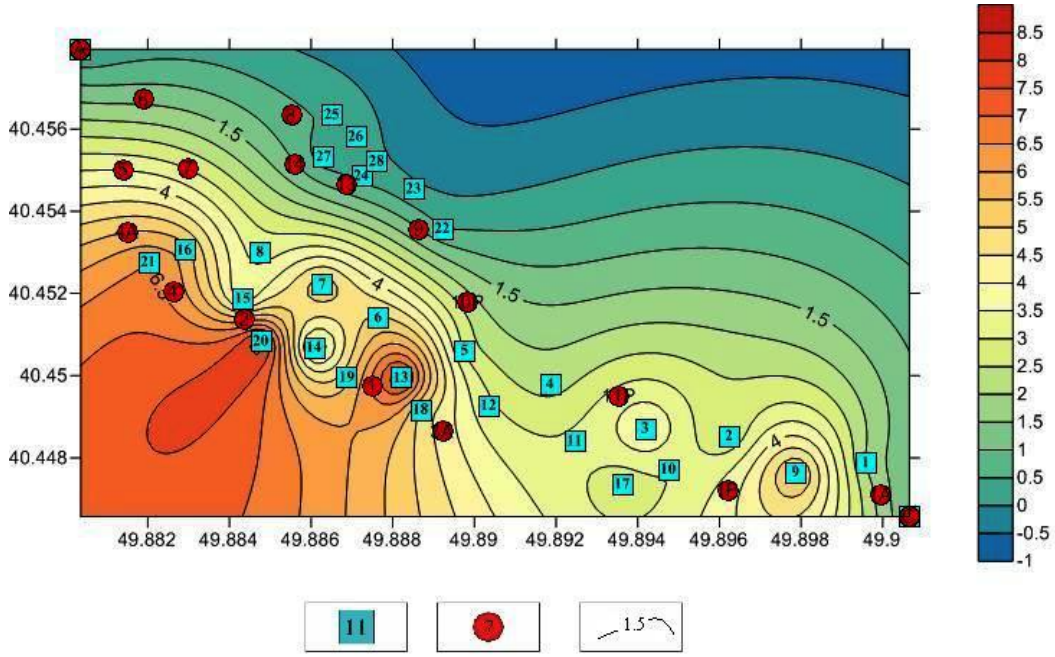



Figure. 3 Thickness map of the area on technogenic layer
1 - VES points and their numbers; 2 - Engineering - geological boreholes;
3 - man-made sediment thickness isopleths.

As it is seen, thickness of technogenic layer varies between 6,5-8,2 m in the South-Western part of the area. The thickness of technogenic layer decreases towards the North-East and makes 0,2 - 0,5 m (Fig. 3.).

**Summary**

- Thickness of technogenic layer varies between 0,5 - 8,2 m within the researched area;
- Lithological composition of layers in the geological section mainly consist of clay sediments;
- According to s.e.r., in composition were detected some layers relatively represented by high indicators. It was confirmed by the drilled boreholes in the area, where layers were made of sandy clays and poorly cemented sandstones;
- Lithological compositions in the geological section are characterized by high moisture;
- High degree of moisture content of lithology and peculiarity of the seismic conditions of the area should be considered during the projecting of construction works.



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