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FEATURES OF BAYIL LANDSLIDE OF BAKU CITY IN 2011

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ABSTRACT. There are several areas prone to landslides in the city of Baku. Landslide area in Bayil settlement is considered the most dangerous area. In that area landslides occurred many times (1847, 1877, 1919, 1927, 1929, 1932, 1953, 1968, 1969, 1973, 1974, 1996, 2000), which led to the collapse of various constructions and facilities, caused serious damage to the communication lines, as well as to the road infrastructure. The landslide, happened in 2000, covered 150-160 thousand m^2 area and approximately 5 million m^3 of soil had been in the process of a landslide.

In general a landslide is an exogenous geological process (EGP). Landslides occur mainly in mountain slopes, ravines and etc. are similar slopping areas by the seismic shakes, the weight of the sliding mass, washing away the underside of the slope, extreme humidity and other processes as a result of the displacement along the slope under the influence of the gravity of rock mass.

The last landslide in Bayil (on March 2000) has happened in the left slope of Chambarakand ravine and is environed wide area, as well as, the main part of Neftchiler avenue and shipyard. According to the researches of the specialists about this landslide, the reasons are the unsewered illegal buildings in the top parts of the ravine, interrupting down part of the ravine, intensive movement of the traffic near the landslide territory [1]. According to A.Sh.Shixalibayli [2], who researched the tectonics of the Bayil slope, Bayil landslide slope is located in surrounding of 2 different directional tectonic faults - Bibiheybat-Garadagh-Gurgan and Shubani-Garagush. One of them is Shubani Garagush tectonic fault with direction of NW and SW - affecting to the morphostructure. This tectonic fault ramifies on the earth surface and its various sleeves cause the landslide [1].

In order to determine the causes of landslide-forming process and to monitor dynamics of this process in the Bayil landslide area in 2011, have been carried out extensive seismological, seismological-engineering and geophysical investigations.

Seismological studies. During the day and in the near term in the surrounding areas where the process took place was not registered any earthquake and because of this the connection between seismicity and landslide is excluded. With the aim of registering the possible weakest seismic shocks in the landslide area four mobile seismic stations were installed (Fig. 1). Each station consists of three components: CVG-6T velocimeter, Guralp Systems, analog-digital converters and GPS receiver.

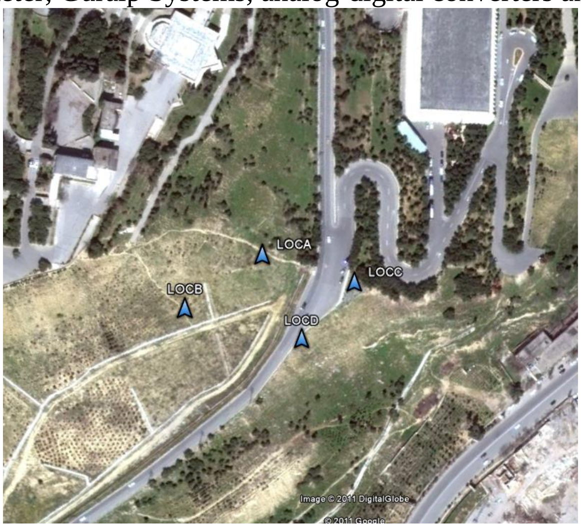

Figure 1. The scheme of mobile seismic stations in the Bayil landslide area.

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Seismological-engineering researches. To determine the lithological composition and thickness of the rocks of the research area has been established velocity section of seismic waves of the three profile (Fig. 2). For this purpose, have been used seismographs Seistronix RAS-24, for recording seismic waves of 12 channel geophones, 60-meter seismic spit.

Figure 2. The scheme of arrangement of the profiles.

Gravimetric researches. For carrying out geophysical studies in the research area were conducted high-precision gravimetric measurements on three profile using GNU-KS (ГНУ-КС) gravimeter by the method of repeated observations of the force of gravity (Fig 3).

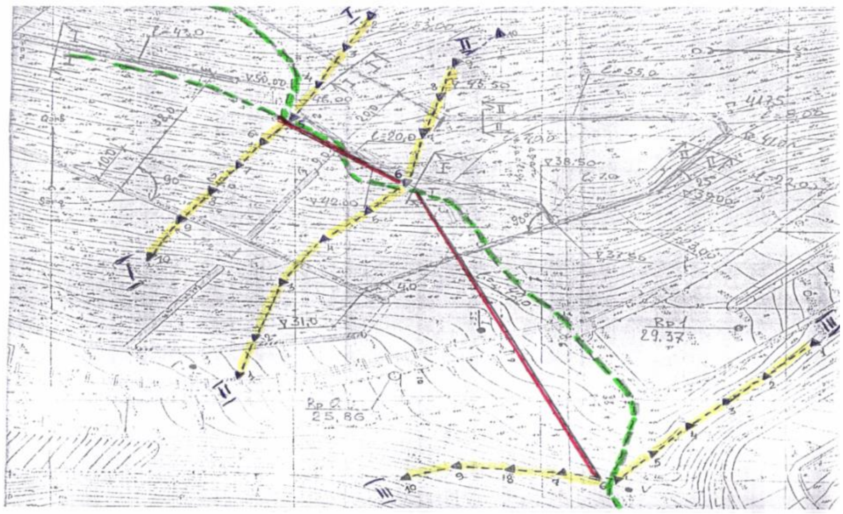


Figure 3. The map-scheme of gravimetric research area.

I-II-III - gravimetric profile

- A line of abnormal changes of gravity

Analysis of the results. Any even weak seismic shake have not been registered during the two months of continuous seismic monitoring in Bayil landslide zone. On the other hand, based on data from seismic stations it was determined that from nearby transportation, construction works and a variety of other sources different frequency vibrations occur in the landslide zone and the area is exposed to constant vibrations in night and day time.

On the other hand analysis of the spatial situation of strong earthquakes source zones of Eastern Azerbaijan and the characteristics of the manifestation of this earthquakes show that the main seismic hazard in Baku is expected from source zones of nothern Absheron peninsula Azerbaijan, Caspian Sea and Shamakhi [3]. According to the macroseismic field equation [4] the seismic waves emitted from this source zones depending on the magnitude of earthquake (M), depth of source zone (H), the epicentral distance (Δ) can shake up Absheron Peninsula, including Baku city with 6-8 points by MSK-64 intensity scale.

Hypocenters of strong Caspian Sea earthquakes (M≥5) are located deeper (H = 30-40 km) and this causes those earthquakes to be felt in a wide area. The earthquake happened in 25.11.2000 was also felt in all the territory of Azerbaijan. The highest intensity (I = 6-7 points) was observed in the coastal regions, including Baku and Absheron [5].

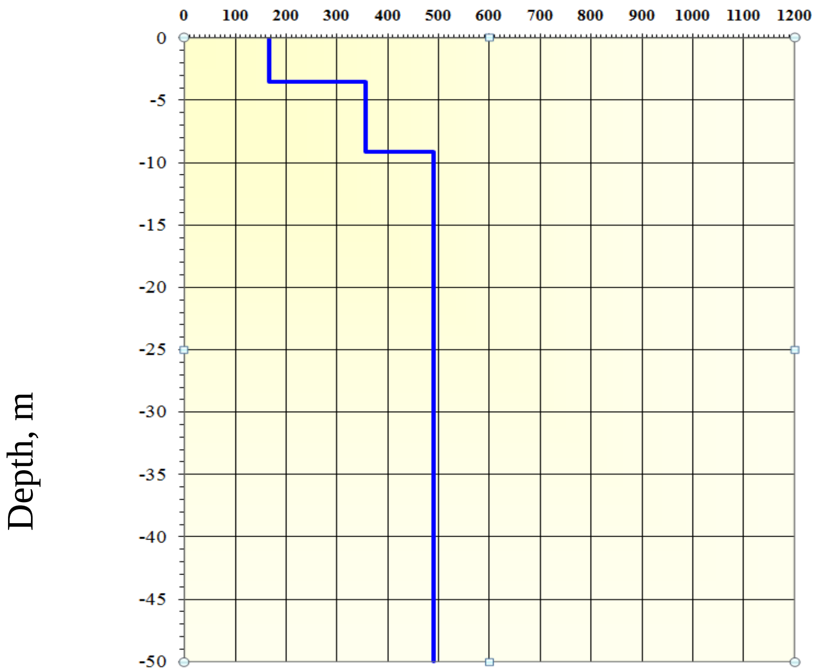
One of the areas with the highest risk level on "Baku's seismic risk" map-scheme [6] is Sabail district. If one of the main reasons for this is the high intensity of the seismic hazard (8 points and above) and unfit soil conditions, another reason is the existence of Bayil Landslide area in this zone and the possibility of activation process of landslide during strong earthquakes and increase of the scale of destruction.

The results of analysis of sections of seismic wave velocities based on three profile in research area give grounds to say that the area is formed from man-made soils, clay, and clayey soils. According to three profile, their thickness is described as:

1. Casting soil (man-made layer) (thickness: between 3,00-8,50 m).
2. Clayey soil (thickness: between 5,50-42,0 meters).
3. Clay soil (thickness: between 22,0-41,0 meters).

Also, it was determined that the soil is moist and very moist.

Velocity of transverse waves, m/s



Figur. 4. Velocity of transverse waves obtained by profile I-I.

Velocity of transverse waves, m/s.

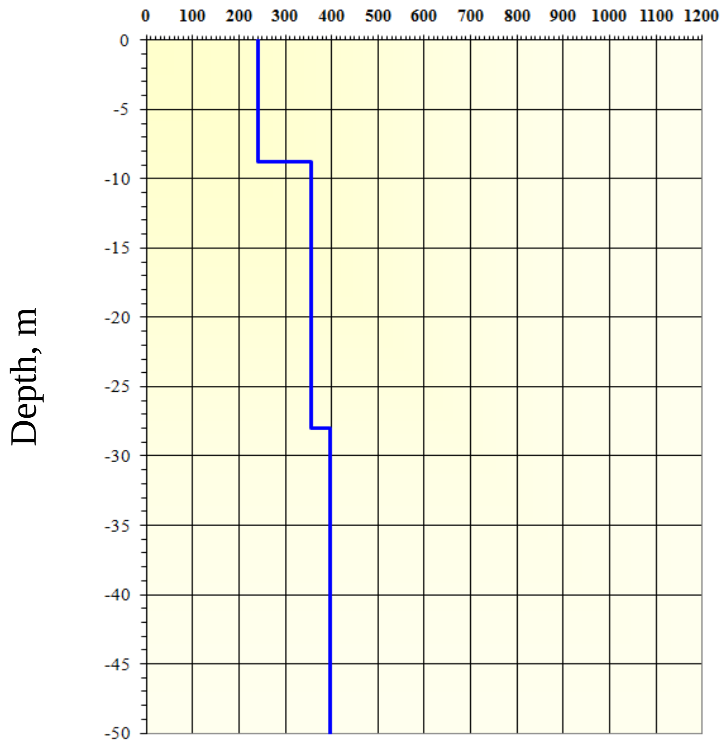


Figure 5. Velocity of transverse waves obtained by profile II-II

Velocity of transverse waves, m/s.

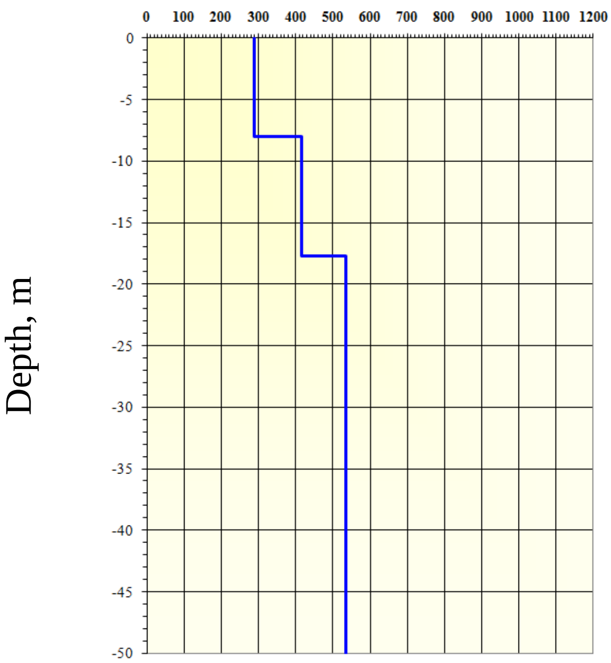


Figure 6 .Velocity of transverse waves obtained by profile III-III.

To visualize the change in gravity between the observation points, according to data obtained on the three profiles, were constructed diagrams of the change of gravity (Fig. 7,8,9).

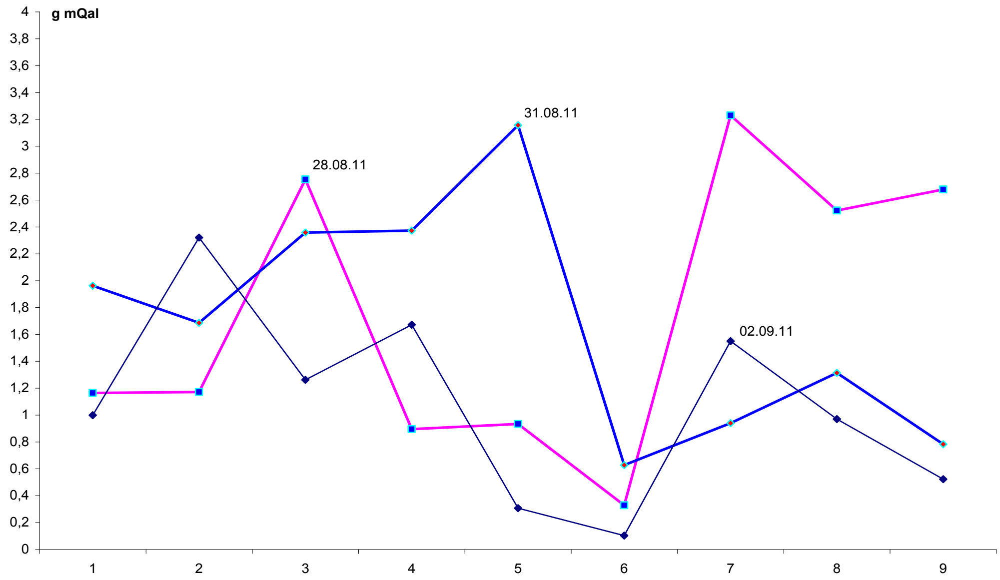


Figure 7. Diagram of changing the values of Δg on the profile I- I.

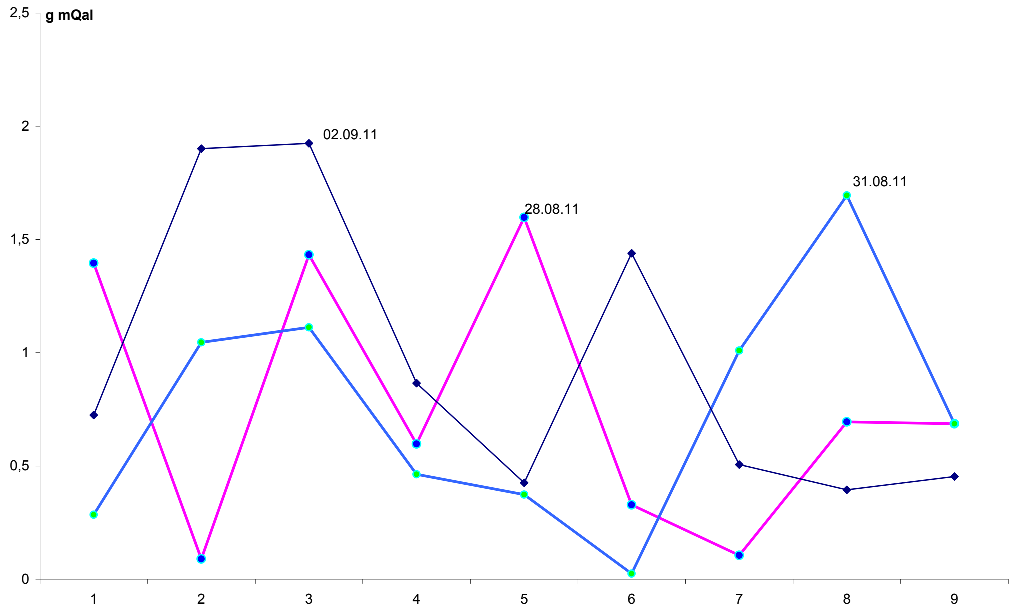


Figure 8. Diagram of changing the values of Δg on the profile II- II.

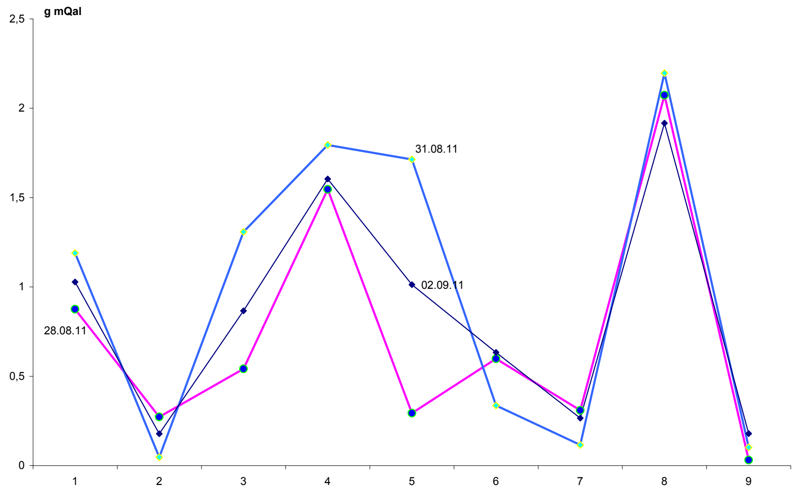


Figure 9. Diagram of changing the values of Δg on the profile III- III.

Intensive changes of the force of gravity are observed at 5-6-7 points of I profile and at 6-7-8 points of II profile, and it reflects the mismatch in the value of repeated measurements of the force of gravity [5].

Thus, a sharp decrease in gravity values observed during the transition from point 5 to point 6 on the profile I, confirms the presence of flatness border of the landslide in this zone.

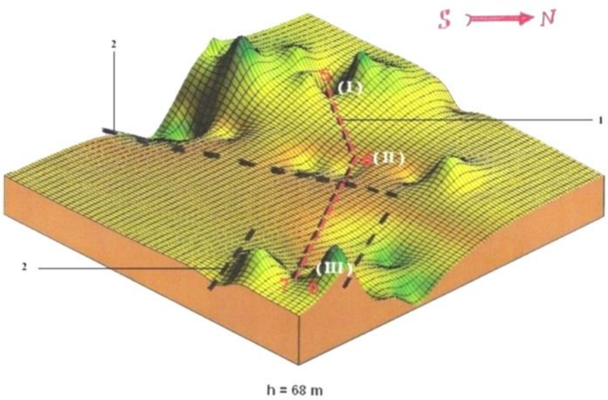
The analogical situation is observed during the transition from point № 5 to point № 7 on II profile. Here is observed a sharp mismatch of value of the force of gravity.

Thus we can assume that the direction of the landslide boundary extends from point 5 on profile I to point 6 on profile II. Horizontal movement decreases at the direction of 6-7 points of III profile. Repeated measurements changes of the force of gravity in that area were not significant.

Based on the obtained data we can make conclusions that moving area of Bayil slope is located between 5-9 points on the profile I and between 3-6 points on the profile II.

Summarizing the results of gravimetric studies we can conclude that the current sliding fault (crack) line (1-red shredded lines) passes through the zone where a rapid change of the force of gravity is observed (high gradient) [8] (Fig.10).

The method of calculating the gravitational field's upper half space [9] shows that the sliding soil's depth is about 68 meters.



1. Crack line determined by the gravimetrical data

2. Forecasted crack line

Figure 10. 3D model of the distribution of gravity shows the areas (black lines) possible formation of cracks in Bayil landslide area.

Similar gradient zones (2-black shredded lines), observed on 3D model of area of distribution of values of gravity force, can be regarded as areas where a potential landslide fractures can arise [10,11].

Layers of high-density rocks (in the form of tides on the model) in the eastern and western part of the area are pressuring layers of low-density rocks in the south-east part of the area. The area may be exposed to landslides.

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