STUDY OF ENGINEERING-GEOLOGICAL CONDITION OF THE TERRITORY OF BAKU CITY IN ORDER TO DETERMINE THE LEVEL OF SEISMIC HAZARD

Z.S.Aliyeva[1], L.T.Fattahova[1], L.A.Ibrahimova[1], I.N.Djalilova[1], S.S.Hajıyeva[1], A.G.Rahimli[1]

Introduction. Earthquakes are the most dangerous natural phenomena and are often accompanied by great disasters. Seismic hazard is mainly caused by seismic waves propagating in the epicenter of earthquakes. The severity of a seismic hazard varies depending on the magnitude of the earthquake, its depth and the distance to the study area. When the magnitude (M) of the earthquake is large, the depth (H) is small and the distance to the research area is close (Δ), the intensity of the hazard increases.

Studies show that, in addition to the above mentioned parameters, the level of seismic hazard is significantly influenced by the physical and mechanical parameters of the ground, hydrogeological and geomorphological conditions. Sometimes these factors can increase the level of seismic hazard to 1 (one) point, which has a significant impact on the seismic stability of civil and industrial facilities built there. For this reason, the study of physical and mechanical parameters, hydrogeological and geomorphological conditions of the ground in seismically active areas is important.

Seismic zoning and micro-zoning research is one of the important directions in modern seismology and these studies are conducted to ensure the seismic and environmental safety of industrial and civil facilities. If the micro-zoning works are carried out competently and accurately, then it may be possible to minimize seismic risk in the areas as well. These research works should be a reliable basis for seismic construction.

Seismic hazard assessment is related to the strong earthquakes, that is, earthquakes with the maximum magnitude should be selected from the strongest earthquakes in each region, and the highest level of seismicity should be determined for that region and the tectonic conditions, geological structure, lithological composition, seismological and hydrogeological conditions of each construction site should be carefully studied. Accurate information about the location of buildings and facilities should be obtained.

Analysis of historical and modern, macroseismic and instrumental data on earthquakes in Azerbaijan shows that no earthquake with a magnitude of higher than 7 points according to the MSK-64 scale has been recorded in the Absheron Peninsula, including Baku city.

In order to determine the spatial position of potential source zones in Azerbaijan, the regularities of the distribution of strong earthquakes on space (both lateral and vertical) and their connection with large depth faults have been studied [Mammadli, 2011]. It was revealed that, the greatest seismic hazard for the Absheron Peninsula, including the Baku city is expected to arise from potential source zones in the highly active Adjichay-Alyat, Palmir-Absheron, Goychay, Vandam, Siyazan and Makhachkala-Turkmenbashi depth faults.

In general, the background level of seismic hazard in different regions of Azerbaijan is currently assessed on the basis of the "Temporary seismic zoning map of the territory of the Azerbaijan Republic" [Ahmedbeyli et al. 1991]. (Fig.1).

According to this map, the background level of seismic hazard in the Absheron Peninsula, including Baku city, is 8 points on the 12-point MSK-64 scale. As mentioned above, in addition to the background level, the level of seismic hazard is also greatly influenced by the engineering-geological and hydrogeological conditions of the field.

These conditions are not identical in Baku. That is why the fact that the strong Caspian (Baku) earthquake on 25.11.2000 (M=6,2) was felt differently in different parts of Baku [Hasanov, Mammadli, 2008]. The earthquake occurred mostly in the areas where coastal areas are soft, wetlands are widespread and the groundwater levels are close to the surface.

In order to study the impact of engineering-geological and hydrogeological conditions on the level of seismic hazard in the territory of Baku city, during the last 15 years, the data of

[1] *Republican Seismic Survey Center of Azerbaijan National Academy of Sciences*

engineering-geological wells drilled in the areas where high-rise buildings were built have been analyzed

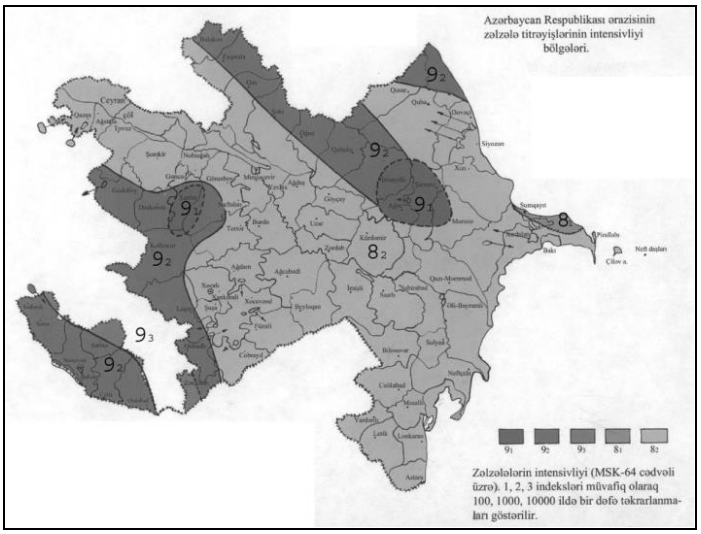

Figure.1. Seismic zoning map of the territory of Azerbaijan (1991)

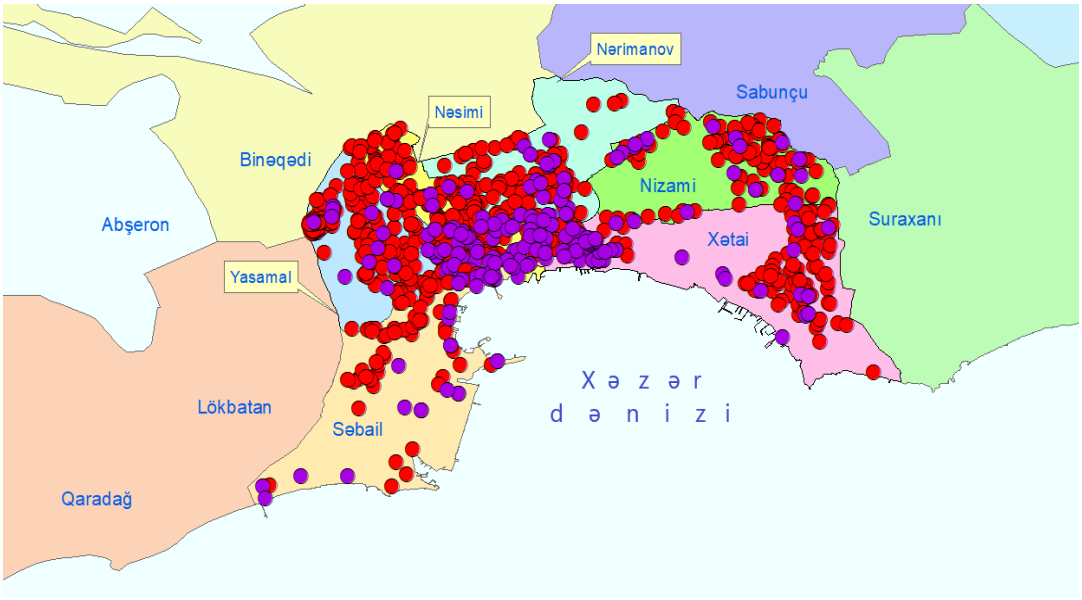

Figure 2. The distribution map of the areas with specified seismicity in the territory of Baku

Symbols

- zones with low-intensity -8 (eight) point
-zones with high-intensity -9 (nine) points

The results of the analysis show that the specified seismicity is estimated with 9 (nine) points, taking into account the engineering-geological and hydrogeological data of local soils in 30 construction sites of Sabayil district. These areas are mainly close to the seaside area of Sabayil district or 1.0-1.50 km away from the seashore. In these areas, the waters are mainly formed in the cast soil layer.

The majority part of Sabayil district belongs to the 8 points zone. In general, Sabayil district is assessed by 8 points.

The information obtained in Narimanov district belongs to the southern part of the area. Areas of high and relatively low-intensity are located chaotically in this area. Relatively low-intensity areas are in the majority and in general, Narimanov district belongs to the 8 (eight) points zone.

Groundwater is found at different depths in the area and has no effect on seismicity. There are very few fields with 8 (eight) points in the upper part of the district. It is impossible to make a conclusion about the intensity in that part.

A total of 27 research areas in Yasamal district have been assessed by 9 (nine) points, and the remaining areas with 8 (eight) points. Groundwater is mostly in one horizon, rarely found in two horizons, and have had little effect on ground composition. The seismicity of Yasamal district is estimated with magnitude of 8 (eight) points.

Both engineering-geological and hydrogeological conditions have a great influence on the level of intensity in Khatai district. In particular, the impact of existing waters on the so-called "White City" and coastal areas is great. Groundwater is mostly formed in sands and plastic clays and are found at at different depths of the ground. However, in some areas there is no groundwater at all. As a result, the area called "White City" and coastal areas are assessed by high-magnitude earthquake. In general, 37 research areas in the district are assessed with 9 (nine) points. In the rest part of area, the level of seismic hazard is estimated with 8 (eight) points.

27 research areas in Nasimi district are assessed with high magnitude. 25 of these areas are located in the south-eastern part of the region. Groundwater is mainly formed in cast and moist, wet sandy soils and has an effect on seismicity (in the area with 9 (nine) points zones).

The rest of the district was assessed by a relatively low magnitude. Almost weak grounds in Nasimi district are mainly developed compeletely in the south-eastern part of the district. Thus, Nasimi district is divided into two parts: the south-eastern part - high-magnitude zones and the rest zones - low- magnitude zones.

Both weak and strong grounds are found in lithological sections in Nizami district.The most common grounds are limestone and clay. The role of groundwater affecting seismic intensity in this region is great. There are two types of groundwater in Nizami district: pressurized groundwater - found at depths of 30, 50 and 80 m; unpressurized groundwater is found in two horizons and at different depths (5,0-10.0 m).

Artesian (pressurized) groundwater is located in the northwest of the region - near the lake "Boyuk Shor" (source of artesian water). This is a dangerous situation for the area, that is, it is an unsuitable for construction.

In the north-eastern part of Nizami district, unpressurized groundwater is found. These groundwater is formed in a thick sandy ground. The seismicity of the area is estimated with high-magnitude. In the rest part of area, the groundwater is found at different depths and is less in thickness. This part is estimated by low magnitude.

Grounds typical of the fourth period are found in the territory of Baku city and the grounds in the sections are shown below:

1. Solid consistency, semi-solid consistency, hard, hard plastic clays
2. Fine-grained, dusty, wet and moist sand soils
3. Solid consistency and plastic sandy loam
4. Solid consistency, solid plastic, hard plastic, soft plastic sandy loam grounds
5. Medium-durable and less durable limestone grounds
6. Weakly durable sandstone
7. Gravel is rarely found

There are semi-solid clay rocks that are widespread in the area and have a large thickness (4,50 – 50m).This ground is considered to be the standard soil and is widespread in 5 (five) districts of Baku. Limestone ground predominates only in Yasamal district. (Fund of RSSC of ANAS. Reports, 2003-2018).

According to AzSCS (AzDTN) - 2,3-1, semi-solid clay ground – standart ground of the fourth period, belonging to the II class with natural moisture, has the following seismic hardness indicators:

In case of natural moisture-Medium

Volume weight (density) - $\rho 0 = 1.60$ g / cm3

The average velocity of transverse seismic wave propagation in the ground -

V0 = 550 m / sec

It is a widespread limestone soil in Yasamal district: its thickness varies from 4.50 to 25.0 m and its main parameters are as follows:

ρo = 2.0 q / cm3

Vo = 800 m / sec.

The composition of grounds, especially clay grounds, may vary depending on the season. It is seasonal: when atmospheric precipitation occurs, the rocks are moistened, irrigated, and the cement of the ground is broken down or the ground is swollen. In dry hot weather, grounds dry out and fractures may form in them. And this increases the negative impact on the seismicity of the area.

Conclusion

1. Totally it has been determined that, the reference standart ground for the 5 (five) district of Baku city (Sabayil, Nasimi, Narimanov, Nizami and Khatai) is semi-solid clay according to AzSCS2.3-1, and only for Yasamal district the standard ground is limestone.
2. Seismic hazard is estimated with the high-magnitude in coastal areas (mainly Sabayil and Khatai districts).
3. The level of potential seismic hazard has been specified for six districts of Baku based on fund materials.

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