

CLARIFICATION OF ENGINEERING-GEOLOGICAL AND ENGINEERING-SEISMOLOGICAL CONDITIONS OF CONSTRUCTION SITES IN THE TERRITORY OF ABSHERON REGION AND SUMGAYIT CITY

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Introduction

Earthquakes are the most dangerous of natural disasters, often causing major disasters, large-scale economic losses and human casualties.

The earthquakes occur in the zones of active depth faults in the Earth's crust and seismic waves propagating from the source expose the surrounding areas to vibrations with one or another intensity. The intensity level of the vibrations depends on the magnitude (magnitude M) of the earthquake, the depth of the source (H) and the distance (Δ) to the study area. Determining the level of intensity is one of the necessary conditions in the construction of seismically resistant buildings and structures.

One of the main goals of seismology is seismic zoning of areas and microzoning of construction sites.

According to the "Temporary seismic zoning map of Azerbaijan territory" [Ахмедбейли Ф. С. и др. 1991] (Fig. 1), the background level of seismic hazard of the Absheron Peninsula, as well as the territory of Baku is estimated at 8 points.

One of the important conditions for the correct compilation or specification of a seismic zoning map is to determine the seismic zones which can be a strong earthquake source, in other words, the activity of tectonic faults and a realistic assessment of their potential [T.Y. Mammadli, 2010].

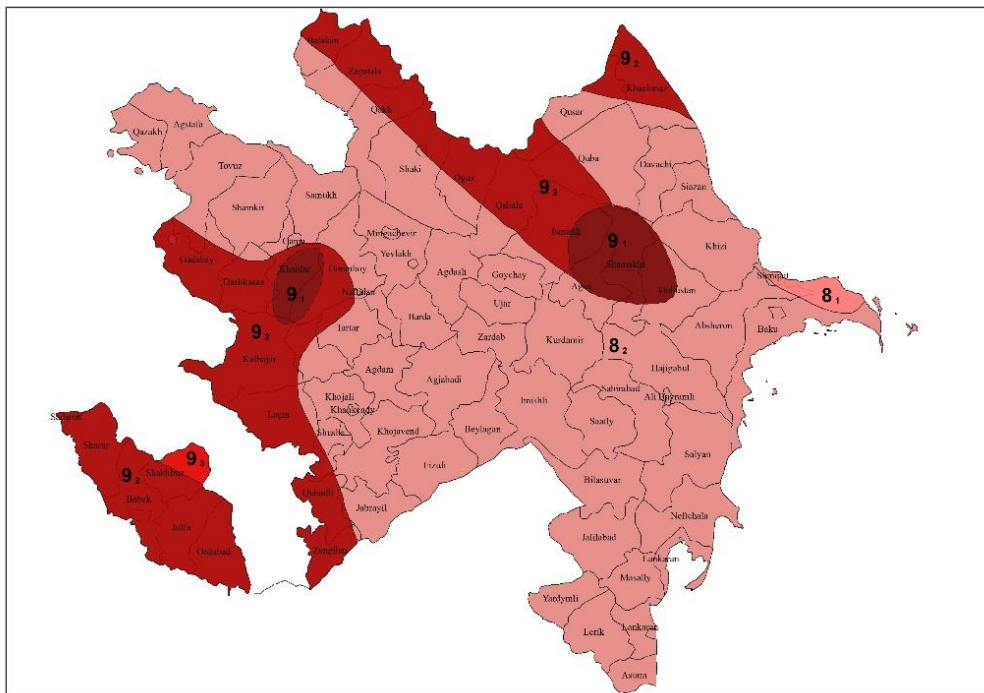


Figure 1. Temporary seismic zoning map of the Azerbaijan territory (1991).

	- intensity 8 ₁ point		- intensity 9 ₂ point
	- intensity 8 ₂ point		- intensity 9 ₃ point
	- intensity 9 ₁ point	(Intensity by MSK-64 scale)	

Research conducted in the field of seismic zoning mainly covers the issues of complex and detailed study of seismicity, seismotectonics. As a result of solving these problems, the maximum level (point) of possible seismic impact of the studied area in a certain time interval is estimated [T.Y. Mammadli, 2010].

The structure of the East Caucasus and especially the territory of Azerbaijan consists of the folded-blocks formation with different sizes and configurations, bounded by longitudinal (Caucasus) and transverse

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(anti-Caucasian) faults and flexure zones of the earth's crust [Shikhalibeyli, 1996]. These deep faults with great length have had a significant impact on the tectonic development of individual zones of the region.

In Azerbaijan territory predominate faults with the Caucasian direction: south-eastern and north-western. These faults have been identified on the basis of structural-tectonic observations, analysis of thicknesses, sedimentary facies and geophysical studies [Shikhalibeyli, 1970]. These faults or their various segments have been studied by many researchers [Khain, Shardanov, 1952; Shikhalibeyli, 1956, 1966, 1970, 1996; Kirillova, Sorsky, 1960; Borisov, 1967; Rogozhin et al., 1988, 1993, 2014; Shikhalibeyli, Hasanov, 1979].

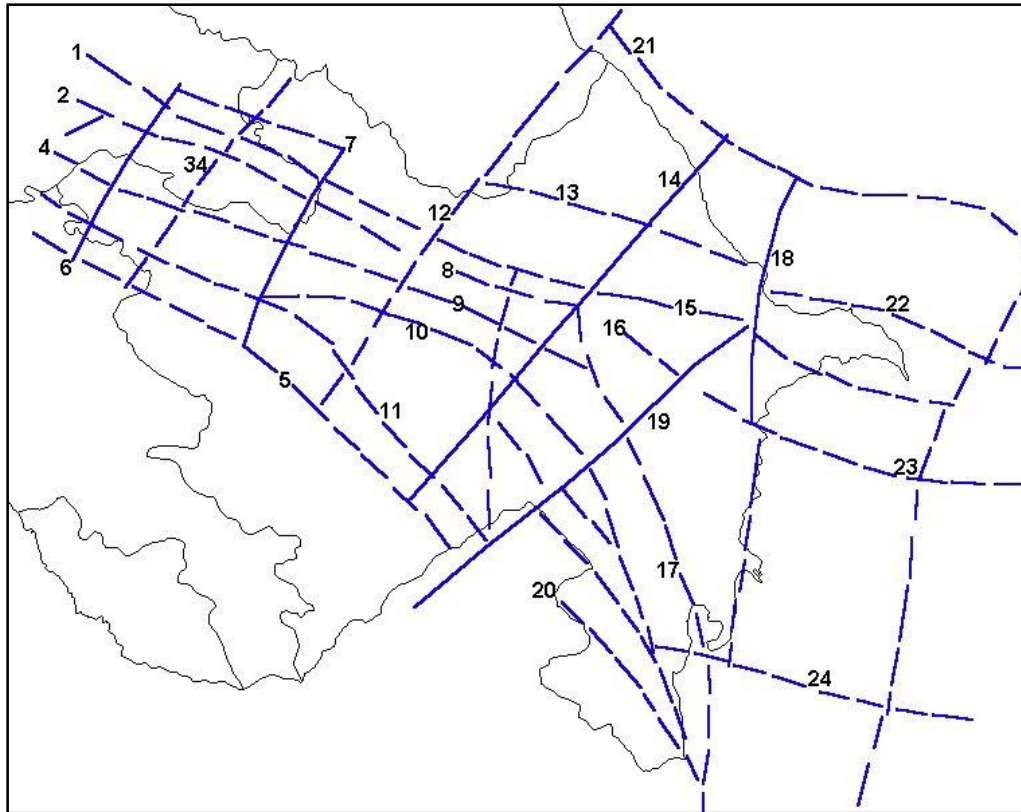


Figure 2. A part of the depth structure map of the Black Sea-South Caspian regional sedimentation zone [Map ..., 1992] (used source numbers are preserved).

Whole lines indicate the transverse faults and broken lines indicate the longitudinal faults of the Greater Caucasus.

1. Vandam; 5. Front Lesser Caucasus; 6. Qazakh-Signakh; 7. Gandja-Alazan; 8. North-Adjinour; 9. Goychay; 10. Mingachevir-Saatli; 11. Kura; 12. Arpa-Samur; 13. Siyazan; 14. Gizilboghaz-Davachi (Shabran); 15. Germian; 16. Adjichay-Alyat; 17. West-Caspian; 18. Yashma; 19. Lower-Araz (Palmir-Absheron); 20. Talish; 21. Central-Caspian; 22. Absheron-Balkhan; 23. Sangachal-Ogurchu; 24. Mil; 34. Tovuz - Aliabad; 35. Imishli - Gabala.

Studies show that the greatest seismic hazard to the area of Absheron Peninsula is expected from potential source zones located in high-activity Adjichay-Alyat, Palmir-Absheron, Goychay, Vandam, Siyazan and Makhachkala-Turkmenbashi depth faults. The strong earthquakes in these fault zones can be felt in the Absheron Peninsula, as well as in Baku with a magnitude of 8 on the CEC-64 scale.

However, there are other factors that affect the level of seismic hazard. These factors include geological, lithological, hydrogeological conditions of the fields, physical and mechanical properties of grounds (porosity (e), consistency (I_L), ground density (ρ_d), hydrogeology, etc.). For this reason, the study of engineering-geological and engineering-seismic conditions in the construction areas of large buildings and facilities is important.

Grounds serve as foundations (base hole) for construction sites. Therefore, during the engineering-geological study, first of all, the regularities of spatial differences in the composition and physical and mechanical properties of grounds should be determined.

If weak grounds (technogenic grounds, cast soil) with all physical and mechanical properties and seismic resistance (according to the load-bearing capacity) are excavated from construction sites and their place is filled with compacted grounds and at the same time, if the flow of groundwater to the foundations of buildings

(fed by atmospheric sediments, domestic and sewage) , which can affect the foundations of buildings, is prevented by certain measures (eg drainage, piles), the seismicity of construction sites can be 8 points.

The engineering-geological and engineering-seismological conditions of the territories of Absheron region and Sumgayit city are almost similar. In order to study the impact of this condition on the level of seismic hazard, the lithological composition, physical and mechanical parameters of grounds under the foundations of high-rise buildings, as well as aggressive effects, resistance, seismic properties, hydrogeological conditions, transverse wave propagation velocities on the foundation have been studied, well data drilled at construction sites has been analyzed and the seismicity of these areas has been clarified.

Absheron region is one of the largest regions of the Azerbaijan Republic. The territory of Absheron region is 1966.1 km². This region consists of Khirdalan city, Saray, Mehdiabad, Djeyranbatan, Gobu, Guzdek, Hokmali, Digah settlements, Mammadli, Novkhani, Masazir, Fatmayi, Goredil, Pirakashkul, Gobustan villages.

1700 wells data have been analyzed in the reports of about 100 construction sites of the territory of Absheron region. Construction sites in the Absheron region are mostly in the city of Khirdalan and Masazir settlement.

The most common ground in the Absheron region is semi-hard clay ground. Physical and mechanical characteristics of semi-hard clay soil is:

Porosity coefficient	$e=0.500\div 0.800$
Consistency	$I_L=<0\div 0.20$
Density, in the dry state	$\rho_d=1.50\div 1.70 \text{ g/cm}^3$
The velocity of propagation of transverse seismic waves in the layer	$V_s=350\div 600 \text{ m/sec}$
Water level in Absheron region location level	- between 4.40-25.0 m; - between 3.20-20.0 m;

Water is formed mainly on semi-solid clay grounds.

Construction sites in the Absheron region mainly belong to the eastern part of the area.

The specified seismicity of 10 construction sites in Absheron region is estimated at 9 points, which belong to Khirdalan and Masazir settlements.

In general, Absheron region is assessed as an 8-point area.

The special place of Sumgayit in the country life is not limited to its important role in the territory of the republic. Sumgayit is the second largest city in Azerbaijan in terms of population and the third largest in terms of area after Baku and Gandja. It is located 35 km northwest of Baku, on the western shore of the Caspian Sea, on a plain. Its area is 0.094 thousand km².

Both engineering-geological and hydrogeological conditions have a great influence on the level of intensity in Sumgayit. 670 wells data have been analyzed at about 45 construction sites in the city.

The most common grounds in Sumgayit city are hard and semi-hard clay grounds.

1. Clay ground, with solid consistency (thickness-4.0-25.0 m)

$$e = 0,562\div 0,717$$

$$I_L = <0\div 0,25$$

$$\rho_d = 1,45\div 1,65 \text{ q/sm}^3$$

$$V_s = 420\div 580 \text{ m/sec}$$

1. Clay ground, with semi-solid consistency (thickness-4.0-21.0 m)

$$e = 0,587\div 0,849$$

$$I_L = <0\div 0,24$$

$$\rho_d = 1,45\div 1,65 \text{ q/sm}^3$$

$$V_s = 420\div 580 \text{ m/san}$$

Water level in construction sites of Sumgayit city is - between 0.10 ÷ 8.90 m; settlement level - between 0.10 ÷ 7.0 m.

The water is formed mainly on ground and semi-solid clay sandy ground.

The impact of existing waters on coastal construction sites is significant. That is why the 9-point construction sites in Sumgayit city are mainly close to the sea.

In general, the city of Sumgayit is rated as an 8-point area.

According to the research conducted in Absheron region and Sumgayit city, water horizons were found in almost all drilled wells.

Detailed seismicity for high-rise buildings in Absheron district and Sumgayit city is shown in Figure 3.

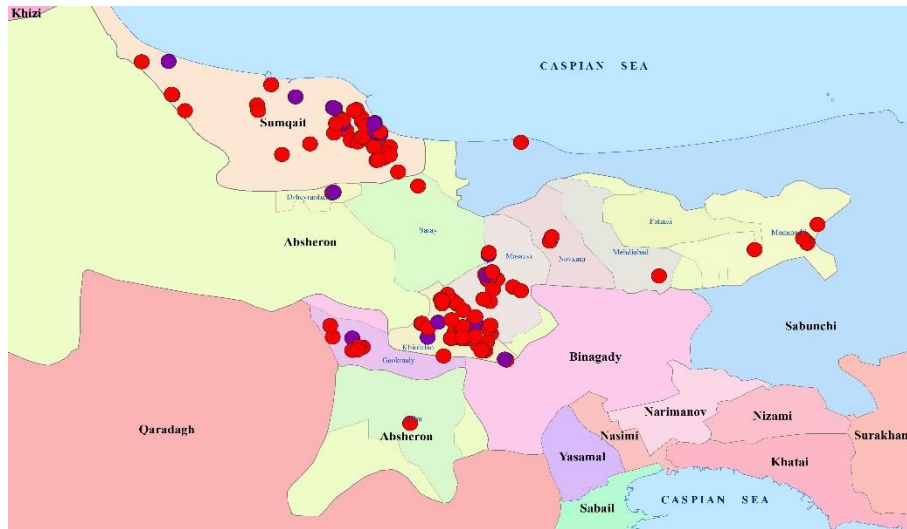


Figure 3. The map-scheme of construction sites with specified seismicity in territory of Absheron region and Sumgayit city (1998-2019 years).

- - Zones with 8 (eight) points;
- - Zones with 9 (nine) points.

The propagation velocity of transverse seismic waves (V_s) in the ground involved in geological sections at the construction sites of Absheron region and Sumgayit city and their class have been determined.

To accomplish these issues, initially, fund materials related to the research area and the surrounding area have been collected, studied and results have been obtained by summarizing.

According to the results of seismic studies, no grounds has been identified in the wells drilled to a depth of 25.0-30.0 m in the construction sites of Absheron region and Sumgayit city, and these grounds fully comply with the recommendations for seismic microzoning at construction sites.

Conclusion

1. A standard (widespread) ground has been assigned for the territory of Absheron district and Sumgayit city. The standard for Absheron region is semi-solid clay, and for Sumgayit - solid and semi-solid clay ground. Both grounds are appropriate with AzDTN2.3-1 "Construction in seismic areas" normative document.
2. Seismic hazard in both Absheron region and Sumgayit city is estimated at 8 (eight) points.
3. The level of seismic hazard in the coastal areas of Sumgayit is higher - 9 (nine) points.

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