ON HYDRO-GEOLOGICAL AND GEOMORPHOLOGICAL FACTORS AFFECTING THE LEVEL OF SEISMIC HAZARD IN SEISMICALLY ACTIVE AREAS

L.T.Fattakhova[1], L.A.Ibraghimova[1], A.B.Guliyeva[1], F.Z. Mehtizade[1], A.G. Babazadeh[1].

Introduction.

The effect of earthquake manifestation on the earth's surface depends on many factors - their magnitude (M), epicentral distance (Δ) and depth (H) [5]. In addition to these factors, the effect of seismic hazard is also influenced by local engineering-geological, hydro-geological, geomorphological conditions.

The general (background) level of seismic hazard of the regions is estimated on the basis of the general seismic zoning (GSZ) map. The level of seismic hazard in local territories (construction sites) is also strongly influenced by the parameters of the formations that make up the part of the geological section close to the earth's surface - structure, lithological composition, physical-mechanical and hydrogeological properties, thickness of the layers, relief of the earth's surface, etc.

In this regard, it is necessary to take into account the influence of engineering-geological and hydro-geological factors on the level of seismic impact during construction work in seismically active areas, especially at strategically important facilities, high-rise buildings.

Over the past 20-25 years, major construction work has been carried out in Azerbaijan, especially in Baku. Engineering-geological, hydro-geological and engineering-seismological studies carried out at these construction sites have made it possible to create a large database of the parameters of structures.

Based on the analysis of this database in the Sabail, Khatai, Nasimi, Nizami districts of the Absheron Peninsula, a number of construction sites have been identified that differ in variable lithological composition, structure, physical properties of soils, and hydro-geological conditions.

In these areas, construction site soils (bulk soil, silt, sand) have very poor bearing properties, and the water level regime directly depends on sea level.

Also on the sea terrace a few meters above sea level, located in the Primorsky park zone, areas located on flat terrain, the lithological composition consists of bulk soil, oil-saturated, dusty, water-saturated, free-flowing sand, soft plastic clay, plastic clay soils predominate. Although the slope at the construction sites in these areas is low (0.5-1°), the water flow is from the bottom up and the pressurized water mixes with the water in the upper layer. The supply of groundwater with pressure water, depending on their depth, increases soil moisture, which leads to a decrease in wave velocities in the soil.

Taking into account the fact that the construction sites are close to the Caspian Sea in the "White City" area of Sabail, Nasimi, Khatai districts of Baku city, the soils, which are intersections in these areas, are porous, which can be seen during visual inspection. At most construction sites located in the Khatai region, water is at 2 levels:

The water level in horizon I is 0.5-9.0 m;

The water level in horizon II varies between 10.0-22.0 m.

Water in the I horizon is formed due to the passage of water through the nearby territory, water in thermal, sewer networks, atmospheric sediments and condensation. These waters are classified as domestic waters and are usually removed from the territory by drainage.

The waters of the II horizon are classified as underground groundwater.

At some construction sites in the White City area of this region, the soil is contaminated with oil products. This is due to the fact that the study area is an old oil industrial zone and many local oil pipelines pass through it. The continuous seepage from these pipes was absorbed directly by the sandy soils.

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

Table 1.

Calculation of points due to pressure and groundwater (examples).

№	Groundwater	Areas with pressurized water. Water level (m)	Soils (in which water is fixed)	$\Delta I_{q.s.s.}$ m	I_i (points)
1.	5,20-6,50 м	12,0-30,0м; 38,0-50,0м; 52,0-59,0м	Limestone, plastic sandstone	+1,0	9 points
2.	5,0-6,0 м	55,0-60,0м	Limestone	0,0	8 points
3.	5,50-7,0 м	29,0-54,0м; 56,0-63,0м; 79,0-92,0м	Limestone, fine sand	+1,0	9 points
4.	1,80-3,80 м	15,0-25,0м	Watery sand	+(0,9÷1,0)	9 points
5.	4,0 м	-	Limestone	+(0,53÷1,0)	9 points
6.	15,0-25,0 м	-	Sandy soil, watery	+0,60	9 points
7.	I horizon -3,30-4,0 м; II horizon -10,0-15,0 м	-	Sandy soil, watery	+(0,59÷1,0)	9 points
8.	I horizon -3,50-7,0 м; II horizon -12,0-13,30 м	-	Clay soil, semi-solid consistency	+(0,07÷0,10)	8 points
9.	I horizon -3,30-4,0 м; II horizon -11,30 -16,40 м	-	Semi-solid loam, Limestone	+(0,50)	9 points
10.	I horizon 2,8-7,0 м II horizon 9,0-18,0 м	-	Limestone, watery sand	+(0,30)	9 points
11.	1,50-2,50 м	Pressure water (artesian)	Bulk soil	+(0,78÷0,94)	10 points
12.	1,50-2,50 м	-	Bulk soil	+(0,78÷0,91)	9,0 points
13.	3,0-4,0 м	-	Bulk soil Watery sand	+(0,29÷0,44)	9 points
14.	1,30-1,40 м	-	Bulk soil	+(0,48÷0,81)	9 points
15.	5,90-7,60 м	-	Hard plastic loaml, limestone	+(0,21÷0,49)	8 points
16.	1,0- 4,20 м	-	Dusty sand, bulk soil	+0,50	9 points
17.	2,50 - 4,70 м	-	Semi-hard clay	+(0,05÷0,22)	8 points
18.	1,0 - 4,0 м		Bulk soil	+0,50	9 points

Based on visual observations, it was noted that in some areas the contamination had reached saturation levels. Hard plastic clays and watery sands predominate in these areas. Underground waters, which are close to the surface of the earth, made these soils moist, watery and plastic, fluid.

If during the operation of buildings and structures a rise in the level of groundwater or flooding of the soil is predicted, then the class of the soil changes depending on its characteristics in the watered state.

To determine the effect of hydro-geological conditions on the soil, when considering well sections in some construction sites designed in the Nasimi and Nizami districts, the water pressure in these areas is mainly 12.0-30.0 m; 38.0-50.0; occurs in the depth interval of 52.0-59.0 m and there is a rise of these waters to the surface of the earth.

On geological and lithological sections of construction sites with difficult hydro-geological conditions and in the presence of pressurized water, sections of several wells are shown as examples (Fig. 1÷4), as well as the proximity of such construction sites to the sea and the presence of pressurized water in the area are factors that seriously affect to the level of seismicity (Table 1).

The study of well sections, determination of the depth of groundwater, assessment of the conditions of immersion of rocks reflect the main features of the geological environment.

The soils of these construction sites, which represent an area near the sea, belong to the III category of seismicity, and the presence of pressure water in the area causes an increase in the level of seismicity [1].

If pressure water is located at a shallow depth in the study area, then it does not affect the soils located in the upper layer (Fig. 4).

The presence of artesian water at construction sites can lead to building collapse, affecting the seismic properties of soils found in the area. Groundwater changes the engineering-geological quality of the rock in most cases, either due to its composition or due to the characteristics of the chemical composition.

Several examples of geological and lithological sections of construction sites in the Nasimi and Nizami regions.

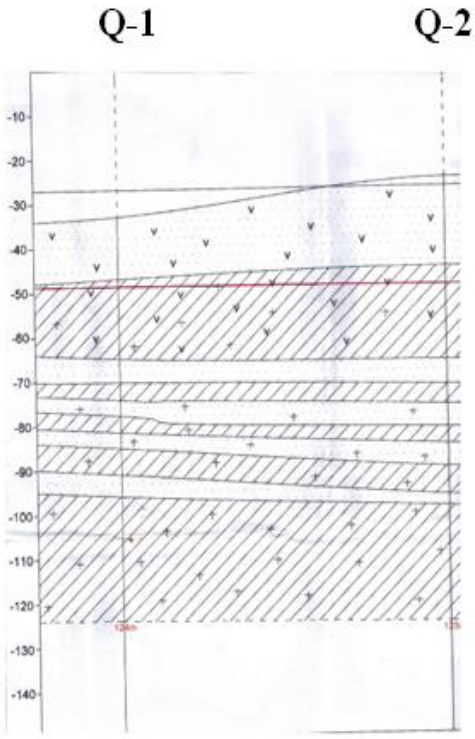


Figure 1. Nasimi district

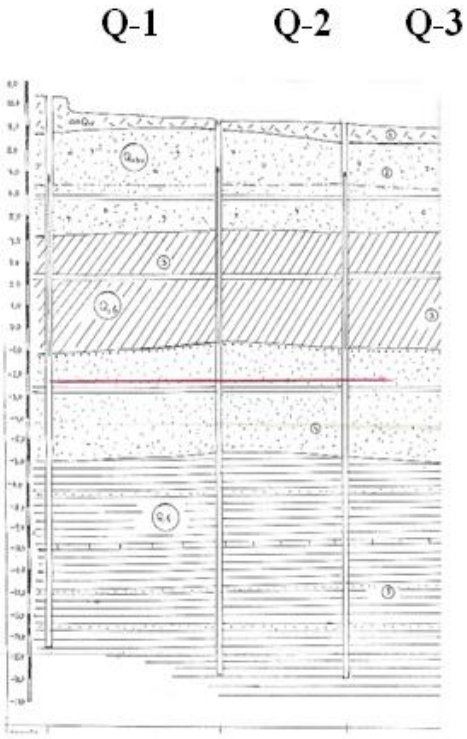


Figure 2. Nasimi district

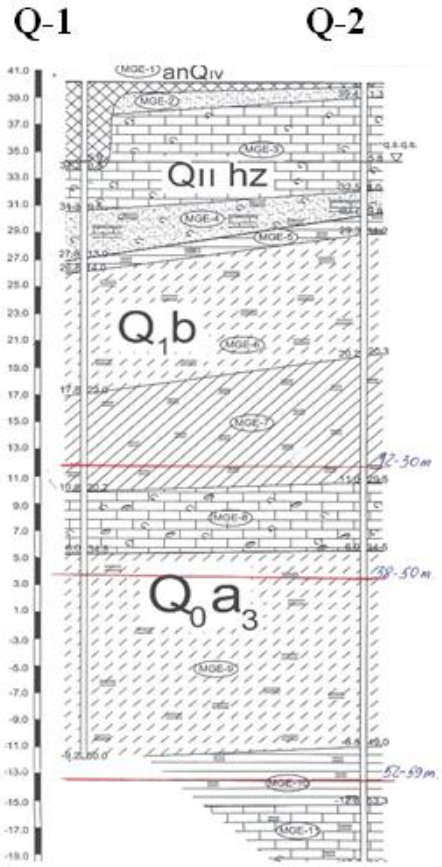


Figure 3. Nizami district

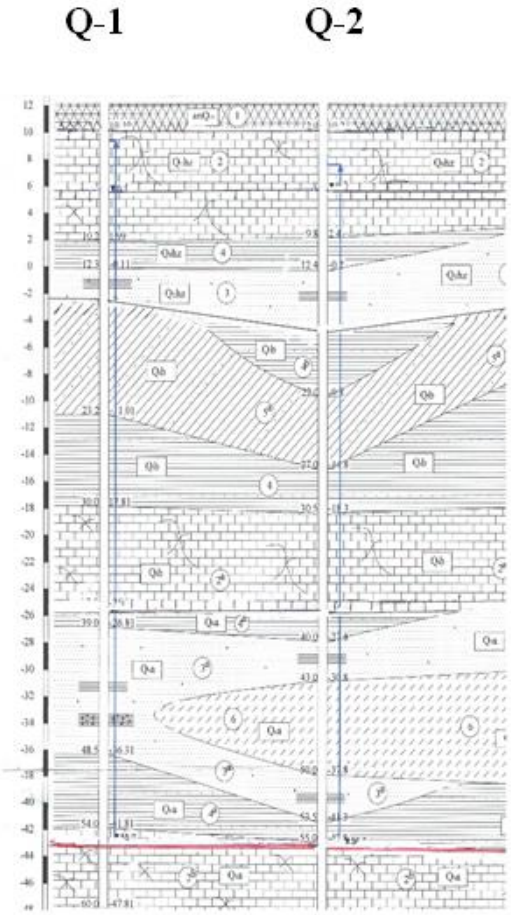
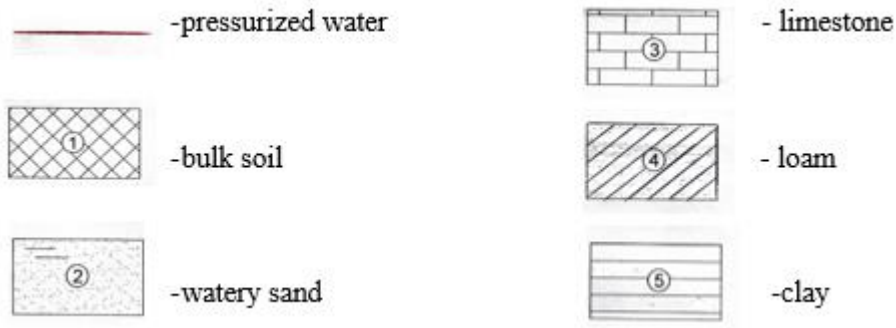


Figure 4. Nizami district

Symbols:

Pressurized water areas:



During its movement, water carries away with it small fractions present in the pores of the rocks, forming cavities of different sizes in the rocks, which leads to a decrease in water resistance. Under the influence of gravity, groundwater destroys rocks and causes a change in their physical and mechanical properties in a negative direction.

So, depending on the degree of hydration, the soils of construction sites, the mechanical parameters of which fluctuate over a wide range, are mainly represented by soft plastic clays, soft plastic loams and wet sands. With intense seismic vibrations, these soils are subjected to compaction, which, in turn, adversely affects the seismic resistance of buildings and structures erected on them.

Soils are unsuitable for construction, the strength of which has weakened, softened when interacting with water, the solidity of which is broken due to excessive cracking and corrosion processes.

It is known that the moisture of soft rocks and the slope of the terrain are the main conditions for the occurrence of landslides. Landslides are formed due to intense moisture of rocks. Groundwater wets the rocks of atmospheric sediments to fluidity, and the mass moves relatively quickly. The depth of coverage of the sliding mass does not exceed 10-15 m, and the length of the sliding is several times greater than its width.

The increase in slope creates favorable conditions for the collapse of fractured rocks and buildings due to the weight of water in areas with water, and the definition of landslides, groundwater, pressure water, slope and stability of the building base is an important factor that determines the geological conditions of the area.

When carrying out measures against the landslide process in areas prone to landslides, during construction work, one should take into account the study of the geological and hydrogeological conditions of the area and the prevention of water runoff in these areas, protecting the landslide massif from natural destruction, increasing the stability of the inclined surface, terracing slopes.

The study of geological and hydrogeological conditions in the construction sites of territories prone to landslides, prevention of groundwater, increasing the stability of an inclined surface by mechanical means is one of the important issues.

Features that can enhance the seismic impact on the earth's surface are soil compaction, landslides, subsidence, formation of cracks in the soil, etc. Since compacted soil is fluid, it subsides under buildings and structures and causes destruction [3] (Fig. 5).

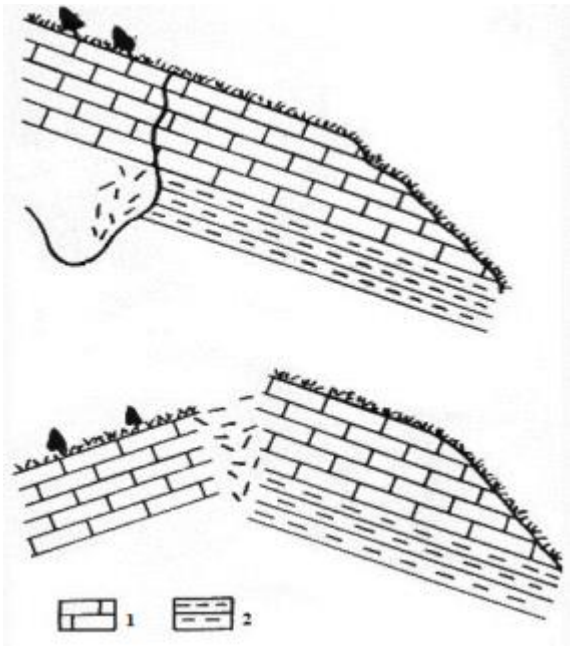
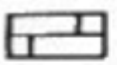


Figure 5. Influence of hydro-geological conditions on rocks

Symbols:


- limestone


- loam

The riskiness and danger of geological processes should be assessed according to the patterns of their development, the nature and mechanism of the process, depending on the stage of research, the degree of knowledge and features of the area where the process develops [4].

Thus, another factor that changes the basic physical and mechanical properties of rocks during construction is hydrogeological and geomorphological conditions. The problem of assessing threats and risks arising from the development of geological processes is very relevant. Any engineering activity

affects the geological environment, creates appropriate changes in this environment, ensures the durability of the ongoing construction with the geological environment and changes depending on the engineering-geological activity as the main issue of engineering geology.

Results:

1. The presence of underground and pressure (artesian) waters in construction sites changes the physical and mechanical properties of soils in a given area, strength indicators in a negative direction, violates the solidity of rocks and causes an increase in the level of seismic hazard.

2. Geomorphological conditions are the main indicator during construction. In areas with water, an increase in slope, due to the gravity of the building, creates favorable conditions for the collapse of construction sites, and wetting of soft rocks leads to landslides.

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