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EARTHQUAKE RISK ANALYSIS AND REVIEW OF THE GEOLOGY OF THE DAM SITE AREA OF DASHT PALANG

Sayed Yaghub Zolfagharifar [1,2] , Chamran Deljoo [2]
[1]Department of Geotechnics & Transportation, Faculty of Civil Engineering, Universiti Teknologi Malaysia, MALAYSIA
[2]Department of Civil Engineering, Yasooj Branch, Islamic Azad University, Yasooj, IRAN

ABSTRACT

Iran is considered one of the most earthquake-prone countries in the world, so that, each year, many small and medium earthquakes, and every ten years, a large earthquake happens in it. Because of tectonic earthquakes, and geographical and climatic situation, Iran, has the potential of creating several strong earthquakes. Therefore, seismic studies, geological and seismic tectonic seismic areas of the country are essential. In this paper, geological studies and seismic assessment can be eliminated from the fault and the intensity of the earthquake from their area of Dasht Palang dam site is investigated using empirical relationships.
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KEY WORDS

geological, seismic, stratigraphic, magnitude, intensity.

***Corresponding author:Email:**yzfsayyed2@live.utm.my;**Tel:** +989013617474; **Fax:**+987433313212

INTRODUCTION

The tectonic earthquake in Iran shows that the position of the seismic, geological and tectonic quite consistent with its status. Tectonic point of view, Iran is located on seismic Alpide belt. This belt starts from the Portuguese and extending through southern Europe and Iran in the East and South-East Asia and the Pacific and more than 95 percent of the world's earthquakes formed in the linear region. Iran is an area with high seismic potential, due to the pressure that comes to Iran, the plane of the kingdom and the great earthquake, and the amount of human and financial damages from them.

Area of Dasht Palang dam is located in Bushehr Province, located in the various faults that cause earthquakes and heavy with their movements. Therefore, the surrounding area of Dasht Palang Dam Site is a high-risk earthquake-prone area of the country. The dam site is located in the vicinity of major faults such as Borazjan fault, Pishani Koohestan fault, Pish jarfay Zagros fault and fault Kenarbandak, the movement of each, will create a destructive earthquake. More than 105 earthquakes, with a magnitude of 4.5 on the Richter scale, and 50 earthquakes, with a magnitude of 4.9 on the Richter scale, happened in the area of Dasht Palang Dam. Geological evidence and earthquake events and studies show seismic activity of the region. Therefore, the calculated risk of earthquakes in the site is inevitable; in order to reduce injuries and damages caused by earthquakes to a minimum consider the economic issues.

MATERIALS AND METHODS

General geology of the project area

In [**Figure- 1**]Study area, the construction division of Iran, is part of the Zagros Folded Zagros (external), southwest of Iran, and sediment, chemical and clastic sediments are often among relatively young Cenozoic Miojiosinklain Zagros, with a thickness of approximately 12,000 meters which was composed mainly of limestone, marl and shale.

An overview of the geological features of the area is:
- The general trend in the region is northwest-southeast.
- Most of the alluvial plains, formed in the central part of the syncline (Dasht Palang syncline), and faults the process chains, too, have had a decisive effect on the formation of some of them.

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- More than 10 kilometers of sedimentary deposits, Kambrin- Pliocene age were formed in the Zagros sedimentary basin, they have created, a row of precipitation, with a lack of stratigraphy, and the most important tectonic event type orogeny at the end of the Tertiary and Quaternary beginning, made them rigid, folded and fault.
- Faults have been very few away from the High Zagros and their function is limited. Most concurrent with the Zagros fault are compressive but faults in the other direction is almost parallel slide.
- Hormoz series is the oldest formations in the area, which is composed mainly of gypsum and salt, they were viewed as salt domes, the Amir anticline, Khormoj, Koohnamak and Koohsormeh.
- Most of the stones of this row is made of carbonates (mostly limestone), but in the Tertiary period, especially during the Neogene clastic continental sediments, limited due to interference of the marine environment, led to the formation of the Gulf, where it started In most places, with evaporite deposits.
- Formation of Fars (Gachsaran, Mishan and Aghajari), tab are linked to each other, and sometimes replaced with each other completely, and because the thickness is very variable.
- As a result, in the late Neogene orogenic conglomerate Bakhtiari Formation unconformity is located on the older formations.

In [Figure- 1], the geological structure of schematic classification is presented.
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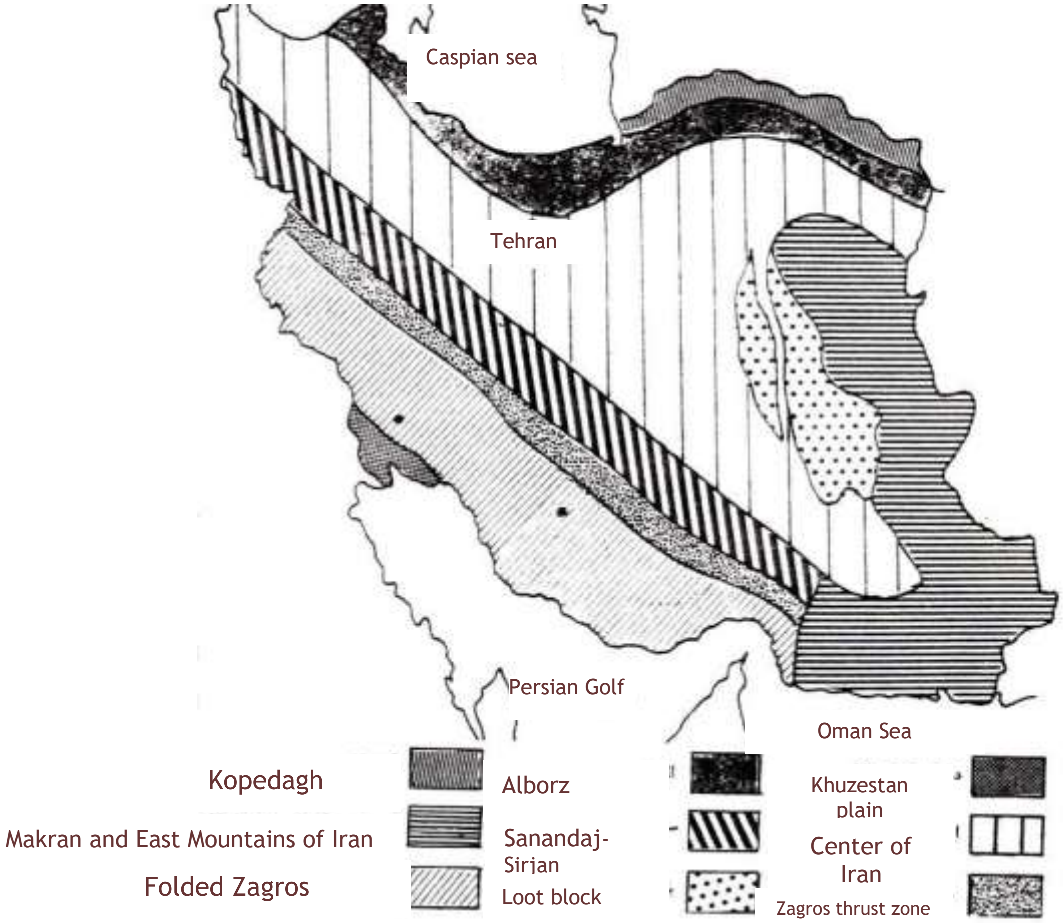

Fig: 1.The geological structure of schematic classification is presented
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Schematic drawings of the division of Iran geological structure, from Ashtoklin and Ruthner, Obteind from Alavi Naeini, 1972

Stratigraphy

The project geology is based on stratigraphic data [1]. Stratigraphy can look directly in many cases, layers, on the surface, but, on the rocks are not on the surface, but about core, small stones, leaving the drill exploratory wells, and the wells forms march are used. The next step is the introduction of stratigraphic units, or groups of such formations. With the introduction of these units, we can not classify the layers of the Earth's surface, in terms of features. The stratigraphy, the scope of the project includes Hormoz

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series, Khami Group, Bangestan Group, Pabdeh-Gorpi make, Asmari formation, Gachsaran make, Goori sector, Mishan formation, Aghajari formation (sandstone and conglomerate) and deposits and deposits the present period.

RESULTS

In geological formations in the area

Tuesday salt dome, are seen in the area close to it and is that it contains salt domes, in Gachoo anticline, Koohenamak and Khormoj. Khormoj salt dome, including Maran, black shales and igneous rocks gypsum, dolomite, limestone and marl black and anhydrite, dome can be seen in the cast of the masses, the great fault Qatar-Kazeroon is the main cause of the rise of the salt domes at ground level, in the areas. Salt dome in salt anticline in 30 km South-West of Dasht Palang Dam is shown in [**Figure- 2**].

Fig: 2. Dome in Namak salt anticline, 30 km from the South West of Dasht Palang Dam

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Aghajari formation is the most important and most extensive stratigraphic rock units, ranging from Dasht Palang Dam which is especially important. Its constituent rocks, generally include marl and sandstone, which is red in general, but also in its light gray color. The status of the dam, spillway, reservoir and river water diversion tunnel are made in full and more than 8% for the valley - the river is formed in the unit (they had Aghajari Aj signs on the map diagram) . Specifications and availability are within the proposed project area, listed, in [**Table- 1]** and **[Figure-3]** shows.

Table 1: Area of the formations in the study area

Symbol	Name geological formations	Area (Hectare)
Aj	Aghajari formation	64692.6
Q	Deposits and deposits of the present age	52796.19
Mn	Mishan Formation	51334.58
Ajc	Aghajari Formation - sandstone and conglomerate	24346.07
Gr	Gori area	17742.95
Gs	Gachsaran make	14491.28
As	Asmari formation	11687.79
Bgp	Bangestan Group	11016.79
Pd-Gu	Pabdeh-Gurpi make	4898.68

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Jk	Khami group Bangestan Group	2644.36
Hs	Hormoz series	1858.52
Lands lide	Landslide	378.09
Bk	Bakhtiari Formation	146.78
Total		258034.65

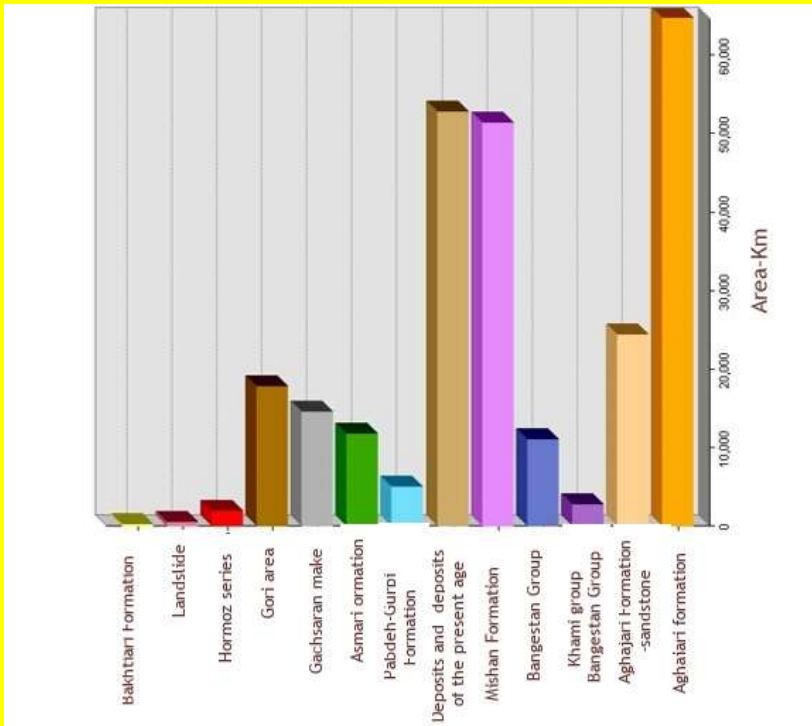

Fig:3. The area of each of the formations in the study area

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TFaults in the area

There are a lot of faults in the range of Dasht Palang Dam that some of these faults were active during the Quaternary and so they are more important. The main fault zone are as follows.
Borazjan fault (B)

Borazjan fault, with a length of about 180 kilometers, is located in the south of the fault Kazeroon. As a result, moving right along this fault in the northwest - southeast of anticlines Khormoj and Giskan and folding it has moved to a North - South and Ghaledokhtar anticline in the center, there is an axis with the north - South direction. Distance from the fault to the dam site is 54 km.

Pishani Koohestan fault (MFF)

This fault is one of the main thrust faults which consists of several separate pieces, and its construction, topographic, land and seismic tectonic important morphological characteristics. This fault is composed of discrete parts of the complex and thrust faults, which varies between 15 and 115 km long, and it includes Chynkhvrdgyha and Byrvnzdgyha of ASMARI Formation limestone. This fault is 15 km from the dam site.

Pishjarfaye Zagros Fault (ZFF)

Pishjarfaye Zagros fault separates Pishjarfaye Zagros belt (in the north and north east), the coastal plain of the Zagros (south and west). This fault is determined, bordering northeastern coastal plain alluvium Persian Gulf, and is a component of reverse fault slip. Pishjarfaye Zagros Fault shows that the 150 km of dextral displacement along active fault Kazeroon-Borazjan. Distance from the fault to the dam, 65 km.

Kenarbandak fault

This fault is a fault close to the dam, which is in plain syncline Leopard, and to the WSW-ENE, and is followed by about 7 kilometers. It seems it is a left-lateral strike-slip (horizontal displacement of about 300 meters). It's nearest terminal to the site about 6 km. The fault, in the valley Knarbndk, there is no sign of movement in the quarter.

Other major faults in a radius of 150 km, are as follows: Sarvestan fault (SF), Kazeroon fault (KZF), Panj shir fault (PSE), Boshgan fault (BF), Keilagh fault (KF), Jegardan fault (JF), Kooh heidar fault (KHF), Tang heidar fault (THF), Kore bas fault, Dasht arjan faults (DAF), Bachon Moordshahrak fault (BMF), Bahim-Koohgarm fault (BGF), JonoobKoohsorkhan fault (SSP), Bando bast fault (BBF), Koodian-Bahim fault (KBF).

Seismicity

Area of the construction division, part of the Zagros simple folded zone, is in the southwest of Iran and sediment and it is often among the chemical and clastic sediments are relatively young, Cenozoic Miojosinklain Zagros, with a thickness of approximately 12,000 meters which was formed mainly of limestone marl and shale. The simple structure of folded Zagros zone is the successive characteristic stalactites and stalagmites which are the northeast - southwest. The folding, near Bandar Abbas and Minab starts, and passes of Hormozgan, Bushehr, Fars, Khuzestan, Chaharmahal Bakhtiari, Kohkiloye va Boyer Ahmad, Kermanshah and Kurdistan and then to Iraq and Turkey and then joins to The Alpine mountain range.

In this context, Barbarian believes that driven by the Folded Zagros, the Seismotectonic has complex features [2]. In his opinion, in this area, shortening the solid crust of the Earth, occurs due to faults in longitudinal movement, in the basement of Precambrian, in all Zagros zone, and seismic faults absorbed, at a depth of 10 km by ductile layers of sedimentary cover Fanerozoik as Hormoz series, Gachsaran formations, etc., and as a result, there is no earthquake fault on the ground

DISCUSSION

Preliminary earthquake hazard zoning map

According to studies conducted by the Ministry of Housing and Urban Development, preliminary zoning map relative risk of earthquake in Iran, have been prepared. Accordingly, Iran has been divided into four zones, with high, high, medium and low risk. This map is presented in an earthquake (2800), in-laws, building design and acceleration on the design proposed for each area. Since the scope of the map is in the category of high risk areas, the acceleration on the project is considered, according to the law of 2800, equal to g 0.30. In this context, the required structures in the project should be resistant to such acceleration. Relative risk by city and zoning earthquake studies in the area of the proposed project are respectively in **Table- 2**and **Figure- 4**.

Table 2: Relative risk of earthquake, according to the city of project site

Description	Amount of relative risk	
Dashtestan City	High relative risk	*4*
Dashti city	High relative risk	*4*
Farashband City	High risk	*5*

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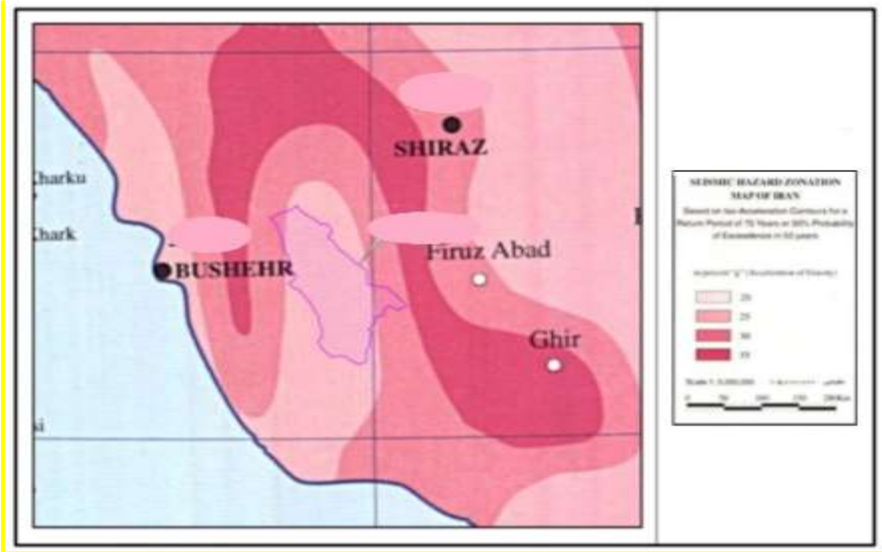

Fig: 4. Zoning of earthquakes

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Calculating the power of seismic faults job

In order to evaluate seismic risks for the region all possible sources of seismic activity should be recognized and their ability to produce a strong movement of the earth in the future, the assessment [3]. In this study, geological maps have been used to determine the major faults in the Dasht Palang Dam. The faults are raised to 150 km radius of the site according to the distance from the site, as well as the faults, 4 faults, which can have more impact on the site have been selected the fault included are, Borazjan fault, Pishani Koohestan fault, Pishjarfaye Zagros fault and the fault Kenarbandak [4]. The analytical method to estimate the parameters of the Earth has been done, based on the possible movement of the entire length of the known faults on the ground in 150 km radius area of Dasht Palang Dam; they are introduced as the earthquake in MCE. Maximizing the potential of each seismic faults based on an average of 4 respect using the empirical relationship between the length of the fault and a great earthquake, earthquake potential of the fault, using the relationship Ambrasise and Melville (1982) for the Middle East , Mohajer Ashjaei & Noroozi (1978), Thatcher (1958) and Press (1967) was calculated in**Table- 3**. Below, we've noted the relationship between the length and severity of a possible earthquake fault that they have been presented by the researchers:

Equation (1) Ambrasise and Melville (1982) for the Middle East

$$\text{Log } Lr = 0.7\, M - 3.24$$

Equation (2) Mohajer Ashjaei & Noroozi (1978)

$$M = 5.4 + \text{Log } L$$

Equation (3) Thatcher (1958)

$$\text{Log } Lr = 1.02\, M - 5.77$$

Equation (4) Press (1967)

$$Ms = 1.061 \text{ Log } Lr + 5.75$$

In the above equations, L is equal to half the length of the fault in meters, Lr is equal to half the length of the fault in kilometers and M is a large earthquake on the Richter scale. Empirical formula is to calculate the job of seismic faults usually in relation to the fault of the fault.

Set the maximum magnitude earthquake fault which is estimated in the study area, thus indicating very good for the seismicity of the region and among the largest earthquake of the series, manifests, and the maximum potential earthquake zone by comparing the average magnitude of the fault. It is clear that the maximum expected earthquake (MCE), is having a huge 8.1 for Borazjan fault. Therefore, one can conclude that the maximum potential earthquake fault zone appears by Borazjan .

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Table 3: Estimate the creation of a major earthquake faults in the area

Name of fault	maximum magnitude earthquake with the creation earthquake faults				Total length of the fault km
	P	T	M & N	A & M	
Borazjan	8.1	7.9	7.7	7.9	180
Pishani Koohestan	7.9	7.7	7.5	7.6	115
Pish Jarfaye Zagros	8.1	7.8	7.6	7.7	150
Kenar Bandak	6.6	6.5	6.2	5.8	7

Calculate job seismic intensity of faults

The following experimental instructions have been used to calculate the relationship between the maximum earthquake intensity in the macro seismic epicenter (Merkali scale), and magnitude [5]:

Equation (5), Ambrasise and Melville (1982), experimental command

$$I_0 = 1.3M_s + 0.09$$

Equation (6) to experimental Mohajer Ashjaei & Noroozi (1978)

$$I_0 = 1.7M_s - 2.8$$

In relation to the above is the intensity of the earthquake at the center, and is the maximum magnitude earthquake. The maximum intensity of earthquakes, macro seismic a focus on the faults within the Dasht Palang Dam is calculated in the **Table-4**. By comparing the magnitude and intensity of earthquakes for the faults, it is clear that the maximum expected earthquake (MCE), Ms=7.9 severity of Borazjan fault, I_0=10.8. Therefore, it can be concluded that the maximum potential earthquake zone appears by Borazjan fault.

Table 4: maximum intensity earthquake macroseismic center

Name of fault	Maximum macro seismic intensity of center		maximum magnitude of earthquake
	M & N	A & M	
Borazjan	11	10.6	8.1
Pishani Koohestan	10.3	10.1	7.7
Pish Jarfaye Zagros	10.5	10.2	7.8
Kenar Bandak	7.9	8.3	6.3

Calculation of seismic intensity ranging from site

The maximum intensity of earthquakes are caused by the fault, the site of the dam is calculated in the **Table-5**, according to equation (7)

Equation (7) Corner (1974) Is = Io +3.72 - 2.99Log h

In the above equation, I_s is the maximum acceleration at the site, Io is the maximum acceleration in the macroseismic center and h is the minimum distance to the fault location.

By comparing the average of the intensity of earthquakes in the area, it is clear that most of the resulting severity of the dam to the maximum expected earthquake, respectively resulting from Kenarbandak fault, Borazjan, Pishjarfaye Zagros and Pishani Koohestan which Borazjan fault brings the most intense earthquake in Dasht Palang Dam area.

Table 5: maximum intensity earthquake site

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Name of fault	Maximum intensity at the site in Dasht Palang Dam	minimum distance between faults, the site of Dasht Palang Dam
Borazjan	9.3	54
Pishani Koohestan	10.4	15
Pish Jarfaye Zagros	8.7	65
Kenar Bandak	9.5	6

CONCLUSION

Based on the available data and analysis of seismic faults can be eliminated, it is clear that in the context of the devastating earthquake event Dasht Palang Dam is not unexpected and examined the range, has a history of seismicity. In this study most of faults around the site which likely seismicity are presented. Because, length of the straight section of faults is the only criterion of judgment in this review, faults the distance to the region is low and they can get the highest seismic risk in the study area calculated using the attenuation relationship between the magnitude and duration of the fault, the severity and magnitude of the relationship, the relationship between the intensity and the minimum distance to the fault area, the job seismic, macroseismic intensity of focus and intensity of earthquakes in the area. Of these Borazjan fault, the shear magnitude and intensity of center, respectively 7.9 and 10.8, and Kenar Bandak faults create maximum seismic intensity of 9.5 and Borazjan fault, intensity of 9.3 in the area. In this study, the maximum potential earthquake in the region caused by the fault Borazjan with a length of 180 km which is located at a distance of 54 kilometers from the area and it is considered as the causative fault and most feature earthquake in the region caused by a fault Borazjan with 7.9 magnitudes on the Richter scale.According to the studies performed in the area of citizenship social rights in the Pahlavi era it can be found out that among the items investigated and evaluated regarding the topic of the citizens' social rights, based on the documents, evidences and records it can be concluded that the city of Tehran's citizens' social rights which included as well enjoying the welfare and comfort service facilities were not observed at all by the municipality and the city was generally in a very bad situation and the only places which enjoyed a higher quality and a greater extent of such welfare-service facilities were the regions in which the Shah and the court members and people were residing and it was only them who could enjoy the maximum possible facilities related to their social rights. Also, in the occasions that the municipality undertook measures to develop some of the neighborhoods the results would be nothing more than interference and usurp of the people's holdings and personal estates and this in itself led to discontent in the people of the municipality's undertakings.

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