PalArch's Journal of Archaeology of Egypt / Egyptology

THE IMPORTANCE OF DOCUMENTATION OF THE HISTORICAL HERITAGE AT RISK OF THE EARTHQUAKE WITH AN INSIGHT TO CASE STUDIES FROM ALL OVER THE WORLD

Shahrokh Pourbeyranvand
Assistant Professor, Seismological Research Center-Seismology dept., International Institute of Earthquake Engineering and Seismology. Tehran, Iran.

E-mail: beyranvand @ iiees.ac.ir

Shahrokh Pourbeyranvand: The importance of documentation of the historical heritage at risk of the earthquake with an insight to case studies from all over the world -- Palarch's Journal Of Archaeology Of Egypt/Egyptology 18(4), ISSN 1567-214x

Keywords: documentation, historic buildings, earthquake hazard, risk, satellite image, tourism

ABSTRACT

Today, the importance of preserving historical monuments from a historical and cultural perspective, as well as from the growth and development of the tourism industry point of view, as one of the most important strategies for job creation and sustainable development is obvious. As one of the oldest civilizations globally, before and after Islam, Iran has witnessed the emergence of architectural and engineering masterpieces, part of which is still standing despite the seismicity of the Iranian plateau and the devastating earthquakes. Therefore, in addition to the need to conduct studies and necessary measures to strengthen historical monuments, accurate documentation of these buildings at risk of earthquakes is essential to ensure the possibility of reconstruction and restoration of these monuments in case of earthquake damage. In this study, while reviewing the related technical literature, examples of historical monuments destroyed by earthquakes worldwide, with some explanation about the responsible earthquakes, are investigated using online resources and satellite imagery that are freely available. Finally, groups of earthquake-prone historical monuments have been proposed for documentation.

INTRODUCTION

We know that due to its location in the Alpide belt and Arabia and Eurasia's convergence, Iran is one of the most earthquake-prone areas. Numerous examples of historical earthquakes have occurred in Iran's historical, geographical territory, the report of which is available in the relevant scientific references (Ambraseys and Melville, 2005; Berberian, 2014). Experts use these references to extract the required information to analyze the earthquake hazard

Surprisingly, in the book written about the endangered heritages (Meier, 2008), no mention is made of Iran and its vast historical heritage. This may be rooted in political conflicts and regional and global power equations, which increases concerns about the historical heritage at risk of earthquakes in Iran. In industrial countries, extensive studies have been

conducted on historical monuments' documentation (e.g., Bongiovanni et al., 2017). Recently, some research has been conducted in Iran to analyze historical monuments' vulnerability and the need to document cultural heritage (e.g., Kavian et al., 2018)).

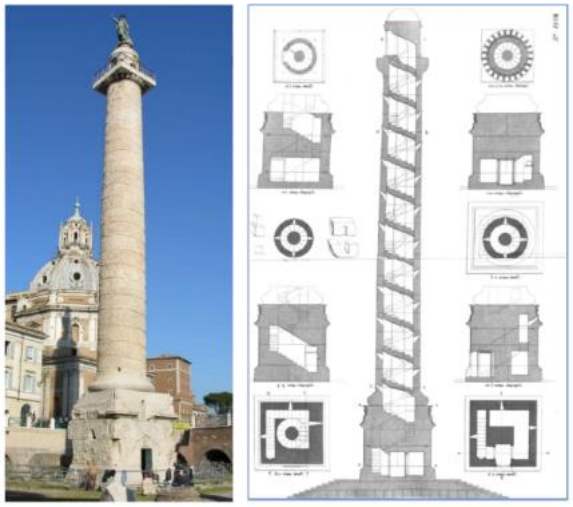

Fig. 1: Left) Trajan's column in Rome. Right) Views of different sections of the building (Bongiovanni, et al., 2017) (with changes)

In this study, in order to show the importance of documenting historical and cultural monuments, while pointing to the recent devastating earthquakes in other parts of the world and examining their destructive effects on cultural heritage, cases of destruction of valuable historical monuments in Iran due to earthquakes will be pointed out.

USING SATELLITE IMAGERY FOR HISTORIC MONUMENT MONITORING

In this study, using free resources that are available online, first, the large earthquakes of recent years were studied and the important information of the mentioned earthquakes was collected and presented in the form of a figure. The impact of these earthquakes on the historical heritage of different countries was then found. Three earthquakes in Haiti, New Zealand and Nepal in 2010, 2011 and 2015, respectively, were found to have devastating effects on the monuments of each of these countries.

With the same approach, the existing photos on the Internet and Google satellite imagery, which are available to the public for free, were examined in the above cases. Through this, the amount of damage to the mentioned buildings was assessed. In the case of earthquakes in Iran, there was no access to free Google satellite images due to unknown reasons. Previous studies using the same method were employed to show the earthquake's effect concerning the Bam earthquake. Regarding the Sarpol-e-Zahab earthquake, the historical monuments in the earthquake area were introduced for future studies by the method discussed. These measures were taken in order to highlight the possible damage to historical monuments and emphasize the need to document this valuable heritage.

RESULTS AND DISCUSSION

Examples of monuments destroyed by earthquakes in the world

In this section, examples of buildings destroyed by major earthquakes in recent years are discussed. These earthquakes, which their characteristics are listed in Table 1, in addition to the losses and damages they have caused, have contributed to the damage to the cultural heritage of countries.

Tab. 1: Specifications of earthquakes used in this study

.No	Country	Date	time UTC	Longitude	latitude	depth (km)	Magnitude	intensity
1	Nepal	4/25/2015	6:11:25	84.731°E	28.231°N	8.2	7.8	IX
2	Haiti	1/12/2010	21:53:10	72.571°W	18.443°N	13	7	IX
3	New Zealand	2/21/2011	23:51:42	172.680°E	43.583°S	5.9	6.1	IX
4	Iran	12/26/2003	1:56:52	58.311°E	28.995°N	10	6.6	IX
5	Iran	11/12/2017	18:18:17	45.959°E	34.911°N	19	7.3	IX

Nepal Earthquake 2015

On April 25, 2015, at 11:56 local time, a magnitude 7.9 earthquake shook Nepal. The epicenter was reported 29 kilometers southeast of Lamjong, Nepal, at a depth of 15 kilometers. It is the strongest earthquake in the region since the 1924 Bihar earthquake. The quake also caused an avalanche on Everest, killing at least 18 people and injuring 61 others. One week before the earthquake, about 50 seismologists from around the world held a conference in Kathmandu to prepare for the quake and improve construction conditions in the city.

Groups from more than 20 different countries, including Japan, France and Norway, worked to rescue the victimNepal earthquake victims. The earthquake in Nepal destroyed dozens of archeological sites, temples and historical shrines in the country, the most significant example of which will be mentioned below. Figure 1 shows the seismic characteristics in question. It is observed that the historical monuments in question are located in contours with the highest seismic intensity.

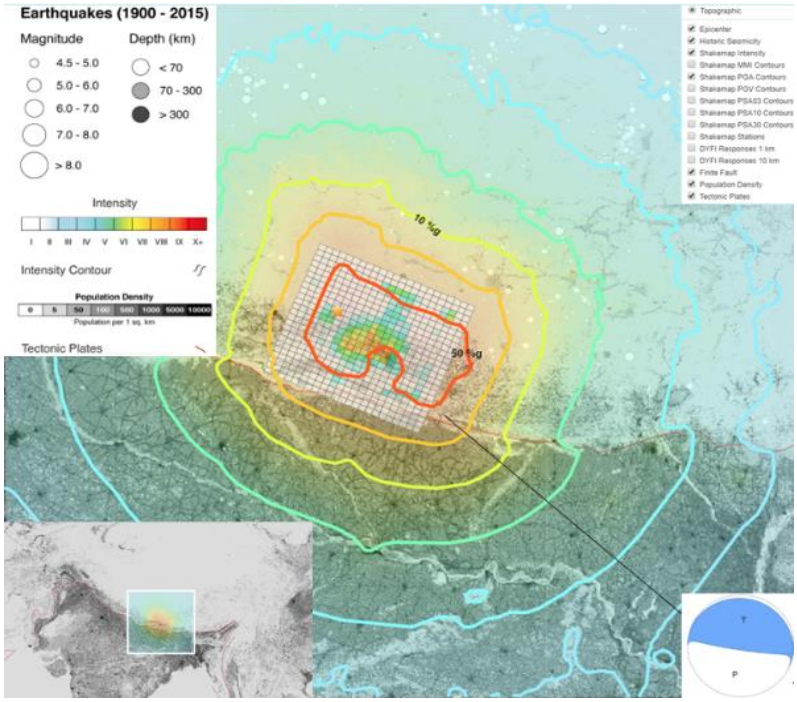

Fig. 2: Nepal Earthquake 2015 with magnitude 7.8 along with Earthquake Center (Yellow Star), Historical seismicity, Shakemap intensity, PGA counturs (Peak Ground Acceleration), Finite Fault (slip distribution on the fault plane), Population density (Background image), border of tectonic plates (red line), general guide map, map legend and seismic focal mechanism (USGS) (with changes).

Swayambhunath

Swiambonath is a fifth-century temple called the Temple of the Monkey (Wikipedia) because of the population of sacred monkeys that live in it. Figure 3 shows this ancient religious complex before and after the April 25 earthquake. Also, satellite images taken by Google before and after the earthquake are shown in Figure 4.

Fig. 3: Swamp Temple before (left) and after (right) of the 2015 Nepal earthquake (internet photo)

Fig. 4: Satellite image of the National Palace before (above) and after (below) of the 2015 Nepal earthquake

Dharahara

Dharahara (Bhimsen Tower), a 9-story, 61.88 meters high tower, was located in the center of Sonhara in Kathmandu. The tower was built in 1832 by Mukhtiyar (similar to Prime Minister) Bhimsen Thapa and was part of the Kathmandu architecture recognized by UNESCO.

The tower had a spiral staircase containing 213 steps. The eighth floor provided a circular balcony for observers, which provides a panoramic view of the Kathmandu Valley. The building also had a bronze sign measuring 2.5 meters on the roof (Wikipedia).

Most of the tower collapsed in Nepal's February 25, 2015 earthquake, but the base is still standing. Sixty bodies were found in the rubble. Reconstruction of the tower began in June 2018. Figure 5 shows the building and Figure 6 shows satellite images using Google Earth before and after the earthquake.

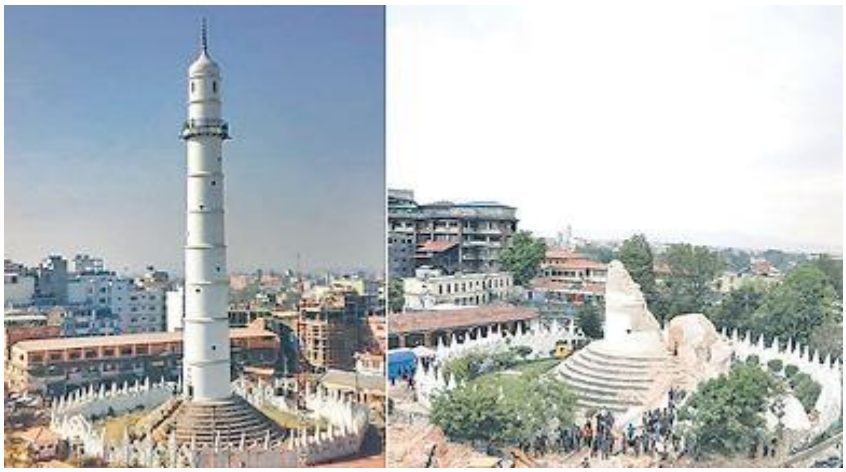

Fig. 5: Deharahara Tower before (left) and after (right) from the 2015 Nepal earthquake (internet photo)

Fig. 6: satellite image of the Deharahara Tower before (above) and after (below) of the 2015 Nepal earthquake (Google Earth)

Haiti Earthquake 2010

An earthquake measuring seven on the Richter scale struck Haiti on January 12, 2010, at 16:53:09 local time, 15 kilometers south of Porto Prince, causing severe damage. The quake that shook Haiti and was also

felt in the Dominican Republic was Haiti's worst earthquake in two centuries.

The death toll has risen to 300,000, making the Haiti earthquake the deadliest disaster in modern human history. Relief groups arrived in Haiti from many different countries. Still, the lack of proper infrastructure and the destruction of existing facilities in the country, especially the damage to management structures, made it very difficult to help victims (Wikipedia).

Figure 7 shows the seismic characteristics in question. It is observed again that the monument in question is located in contours with the highest seismic intensity.

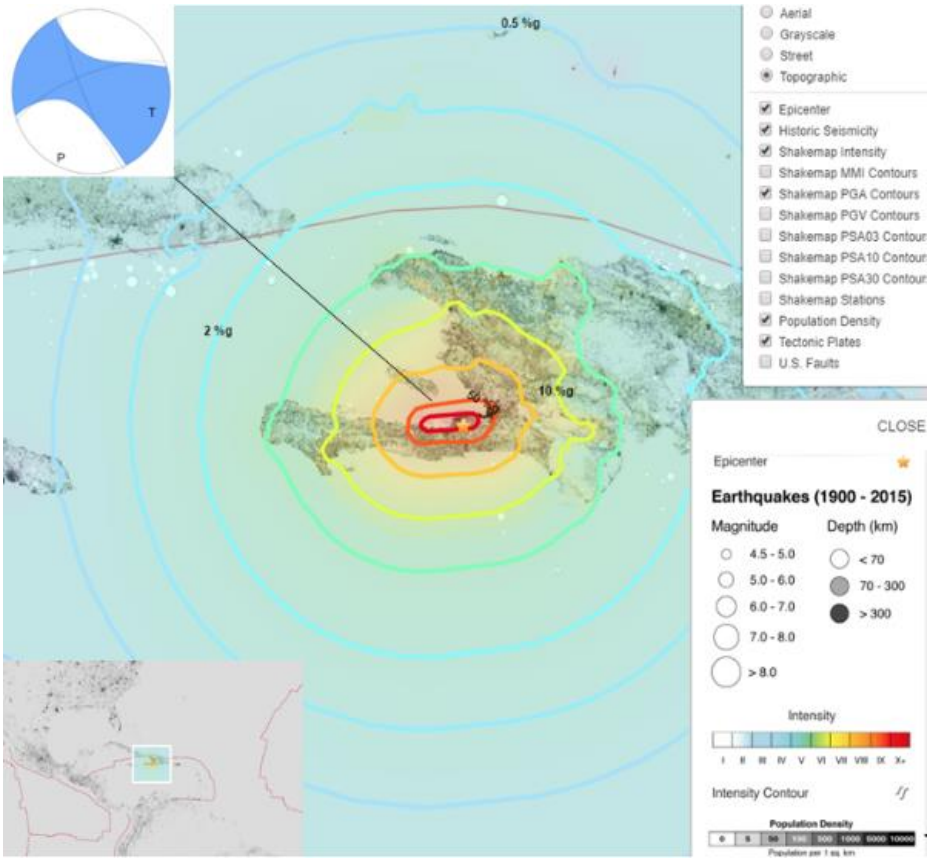

Fig. 7: Haiti Earthquake 2010 with magnitude 7.0 along with Earthquake Center (Yellow Star), Historical seismicity, Shakemap intensity, PGA contours (Peak Ground Acceleration), Population density (Background image), border of tectonic plates (red line), general guide map, map legend and seismic focal mechanism (USGS) (with changes).

National Palace

The National Palace was the official residence of the President of Haiti, located in Puerto Prince. The building was severely damaged in an earthquake in 2010. The building's ruins were demolished in 2012 and a plan has been drawn up to renovate the palace in 2017 (Wikipedia). Figure 8 shows the pre-earthquake and post-earthquake photographs of the building and satellite images using Google Earth (Figure 9).

Fig. 8: Haiti National Palace before (above) and after (below) of the 2010 earthquake (photo from the Internet)

Fig. 9: Satellite image of the National Palace before (above) and after (below) of the 2010 Haiti earthquake (Google Earth)

Cathedral of Our Lady of the Assumption

Our Lady Cathedral, often referred to as the Port-au-Prince Cathedral, was the cathedral in this Haitian capital. The church was built between 1884 and 1914 and, on December 13, 1928, became the Catholic Bishop of Porto Prince. The cathedral was destroyed in the earthquake of January 12, 2010 (Wikipedia). Figure 10 shows photos of the building as

well as satellite images using Google Earth before and after the earthquake (Figure 11).

Fig. 10: Our Lady of Porto-Cathedral Cathedral (left) and after (right) of the 2010 Haiti earthquake (photo from the Internet)

Fig. 11: Satellite Photo of Our Lady of the Cathedral, Before (Up) and After (Down) from the 2010 Haiti Earthquake (Google Earth)

The image of this monument after reconstruction with the snapshot taken before the 2010 earthquake is shown in Figure 12. As shown in the picture, despite trying to keep the building's specifications, there are significant differences in terms of architecture between these two buildings, which could have been minimized if documented correctly and accurately.

Fig. 12: Our Lady's Cathedral before the 2010 Haiti Earthquake (left) and after the Reconstruction (right) (Internet photo)

New Zealand Earthquake 2011

At 6:12 pm on February 22, 2011, a magnitude 6.2 earthquake shook the town of Chris Church in the Canterbury area of South Zealand, 2 km west of Littleton Harbor and 10 km southeast of Christchurch. (Local hours are set to UTC). At the time, it was the second-most populous city in New Zealand. The quake caused extensive damage across Christchurch, killing 185 people and making it the country's fifth deadliest disaster (Wikipedia). As a result of this earthquake, historical monuments were destroyed. Figure 13 shows the seismic characteristics in question. It is observed again that the monument in question is located in contours with the highest seismic intensity.

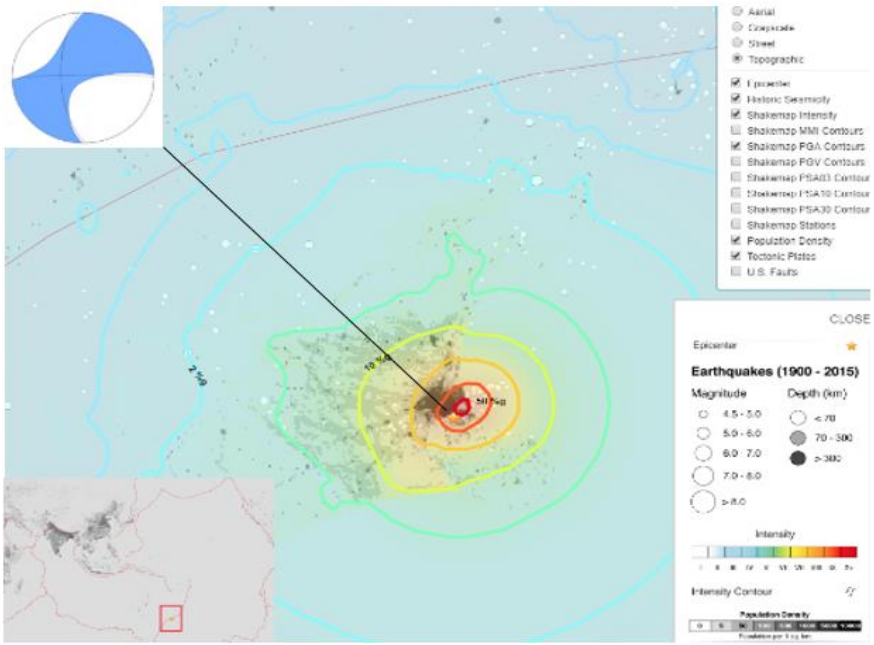

Fig. 13: New Zeland Earthquake 2011 with magnitude 6.1 along with Earthquake Center (Yellow Star), Historical seismicity, Shakemap intensity, PGA contours (Peak Ground Acceleration), Population density (Background image), border of tectonic plates (red line), general guide map, map legend and seismic focal mechanism (USGS) (with changes).

Christchurch Cathedral

Chris Church Church, rarely called the Cathedral of Christ, is a Catholic church in Christchurch, New Zealand. The church was built in the city center between 1864 and 1904 and is surrounded by the cathedral square. It was the Catholic Church of Bishop Chris Church, affiliated with the Church of England in New Zealand and Polynesia.

Figure 14 shows photos of the building and Figure 15 demonstrates satellite.mages using Google Earth before and after the earthquake.

Fig. 14: Christchurch before (left) and after (right) the 2011 earthquake in New Zealand (photo from the Internet)

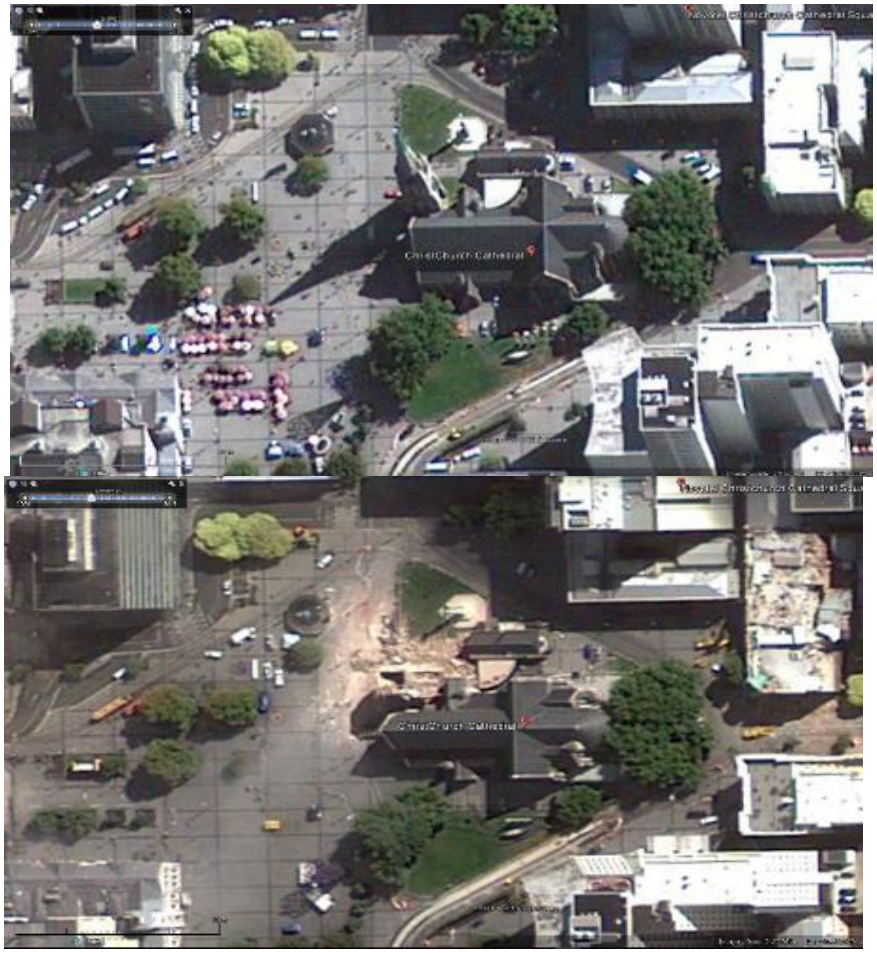

Fig. 15: Satellite image of Christchurch, before (above) and after (below) of the 2011 earthquake in Zealand

Examples of historical monuments destroyed by an earthquake in Iran

With a history of several thousand years and the extent of its historical geography due to its seismicity, Iran is one of the most critical areas that have the highest priority for the study of historical heritage at risk of earthquakes.

Every year, devastating earthquakes occur in the country, each of which threatens numerous historical monuments. Although a significant part of these monuments, which are several thousand years old, have withstood the devastating earthquakes of the past, but the erosion of these buildings due to environmental factors can be an important factor in reducing the seismic resistance of these monuments.

Also, those historical monuments that have not yet experienced a large earthquake in their surroundings need to be studied regarding their risk. The nearby seismic sources and seismic scenarios in case of activation of small and large faults should be identified. This is beyond the scope of the present study; therefore, here, we review the damage to these monuments and buildings due to recent earthquakes to clarify the importance of accurate and scientific Documentation of these historical and cultural monuments, in order to study the potential of retrofitting to prevent damage due to earthquakes and reconstruction after devastating earthquakes and other natural and human-made events is then emphasized,

Bam earthquake 2003

A magnitude 6.6 earthquake at 5:26 AM on Friday, December 26, 2003, for 12 seconds shook the city of Bam and the surrounding areas in the east of Kerman province. Before the quake, Bam had a population of about 90,000, but only a third survived the earthquake. According to official statistics, the disaster killed 26,271 people, injured 30,000 and left more than 100,000 homeless. As a result of this earthquake, many historical monuments, including the citadel of Bam, the most important historical monument in the region, was severely damaged, and information about this will be provided later. Figure 16 shows the seismic characteristics in question. It is observed again that the monument in question is located in contours with the highest seismic intensity.

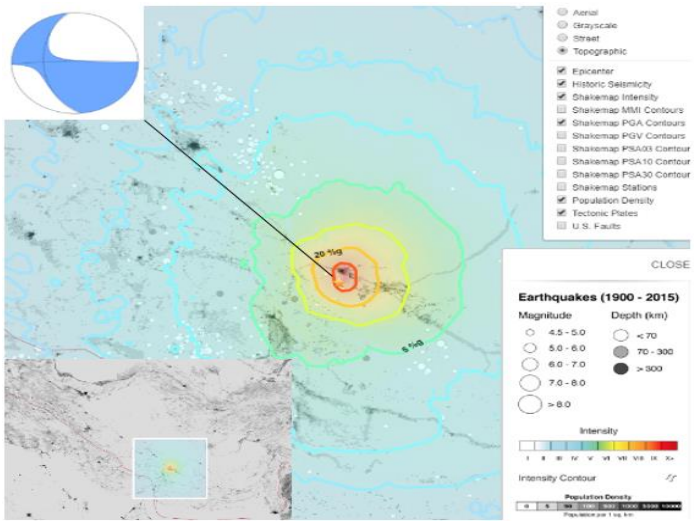

Fig. 16: Bam Earthquake 2003 with magnitude 6.6 along with Earthquake Center (Yellow Star), Historical seismicity, Shakemap

intensity, PGA contours (Peak Ground Acceleration), Population density (Background image), border of tectonic plates (red line), general guide map, map legend and seismic focal mechanism (USGS) (with changes).

Citadel of Bam

Bam Citadel is the largest brick structure in the world near the city of Bam in Kerman province in southeastern Iran. Due to the earthquake of December 26, 2003, which severely affected Bam and its suburbs, the citadel of Bam was almost completely destroyed. A few days after the quake, the government's plans to rebuild Bam Citadel were announced. The following are the images of Bam Citadel (Figures 18-17) as well as the satellite image of the area before and after the earthquake and also after the relative reconstruction (Figure 19).

As shown in this figure, after the earthquake, Bam citadel has suffered extensive destruction, which has been somewhat improved by implementing restoration projects. However, there is still a long way to go to reach the original shape. This can only be done if there is accurate information obtained by scientifically documenting the buildings in this collection.

Fig. 17: Bam citadel before (left) and after (right) the 2003 Bam earthquake (Langenbach, 2005)

The impacts of reconstruction on the architectural landscape of Bam

The newly renovated city of Bam, Iran, retains few features of its former architecture. The overall landscape of the old city's architectural fabric, which existed before the 2003 earthquake, has changed significantly during the city's reconstruction. What is especially remarkable for this city's inhabitants is the loss of harmony between the beautiful and climatically suitable brick houses and other cases of the severely damaged physical structures and citadel of the city (Bam Citadel). This harmony lasted for centuries. These changes were primarily due to pressure to accelerate reconstruction using prefabricated steel frame structures and conventional building materials.

Other factors that have contributed to the changes include (1) fear of the safety of brick construction techniques, (2) lack of skills to use older brick construction methods that guarantee risk reduction, and (3) lack of a code or the approved national building instruction to upgrade brick constructions (Iran Building Code 2800 and national building regulations do not encourage the prevention of brick and mud constructions) and (4)

the slow speed of the brick-and-mud construction technique compared to standard construction techniques involve higher costs.

In fact, if government subsidies for the production and transportation of conventional building materials, such as cement, steel, and brick, are eliminated, the traditional method becomes a more cost-effective choice. Since the earthquake, CRATerre-EAG (French Construction Research Center collaborating on the Bam Reconstruction Project by the Housing Foundation of the Islamic Revolution in collaboration with the United Nations) has mobilized European Union resources to assist the Building and Housing Research Center of the Iranian Ministry of Roads & Urban Development of Iran to reintroduce brick construction techniques into Iranian building codes (Jha et al., 2010).

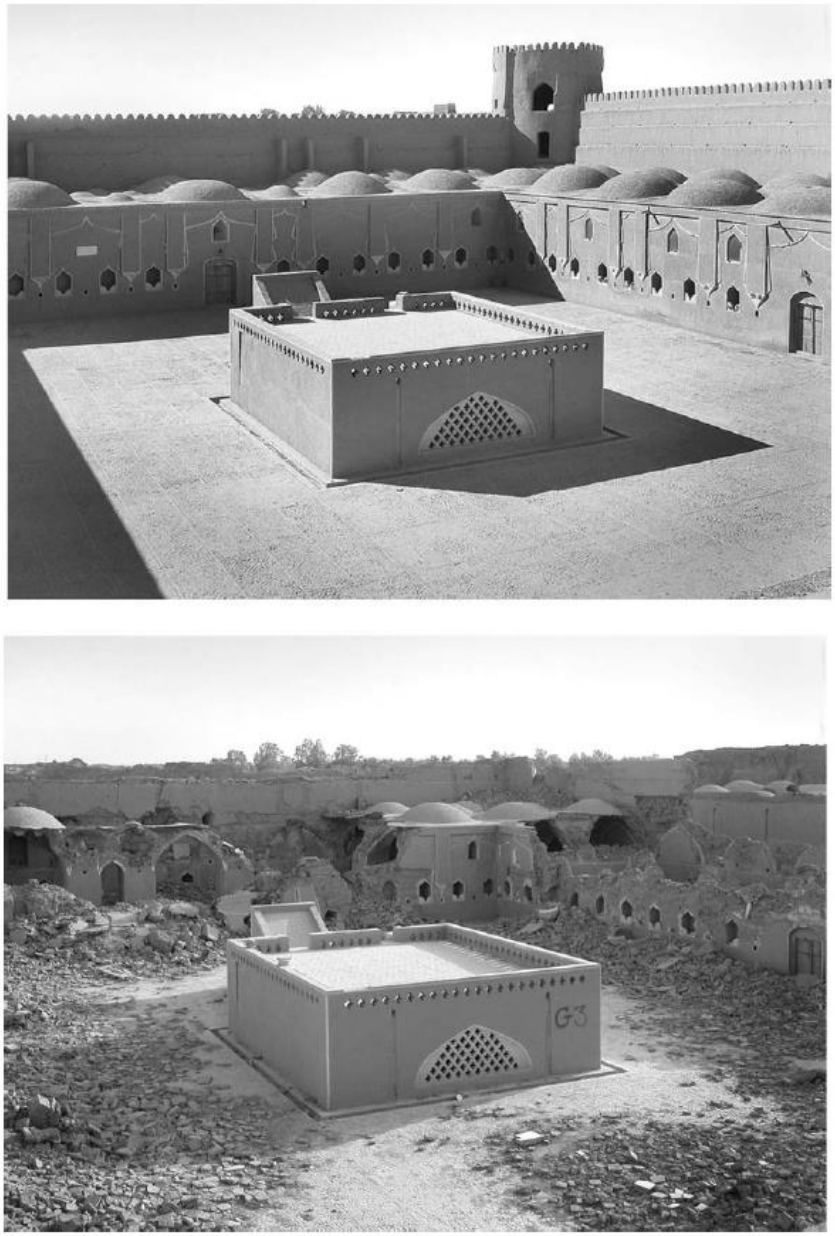

Fig. 18: An example of damage to the buildings of the Bam Citadel complex before (above) and after (below) the 2003 Bam earthquake (Langenbach, 2005)

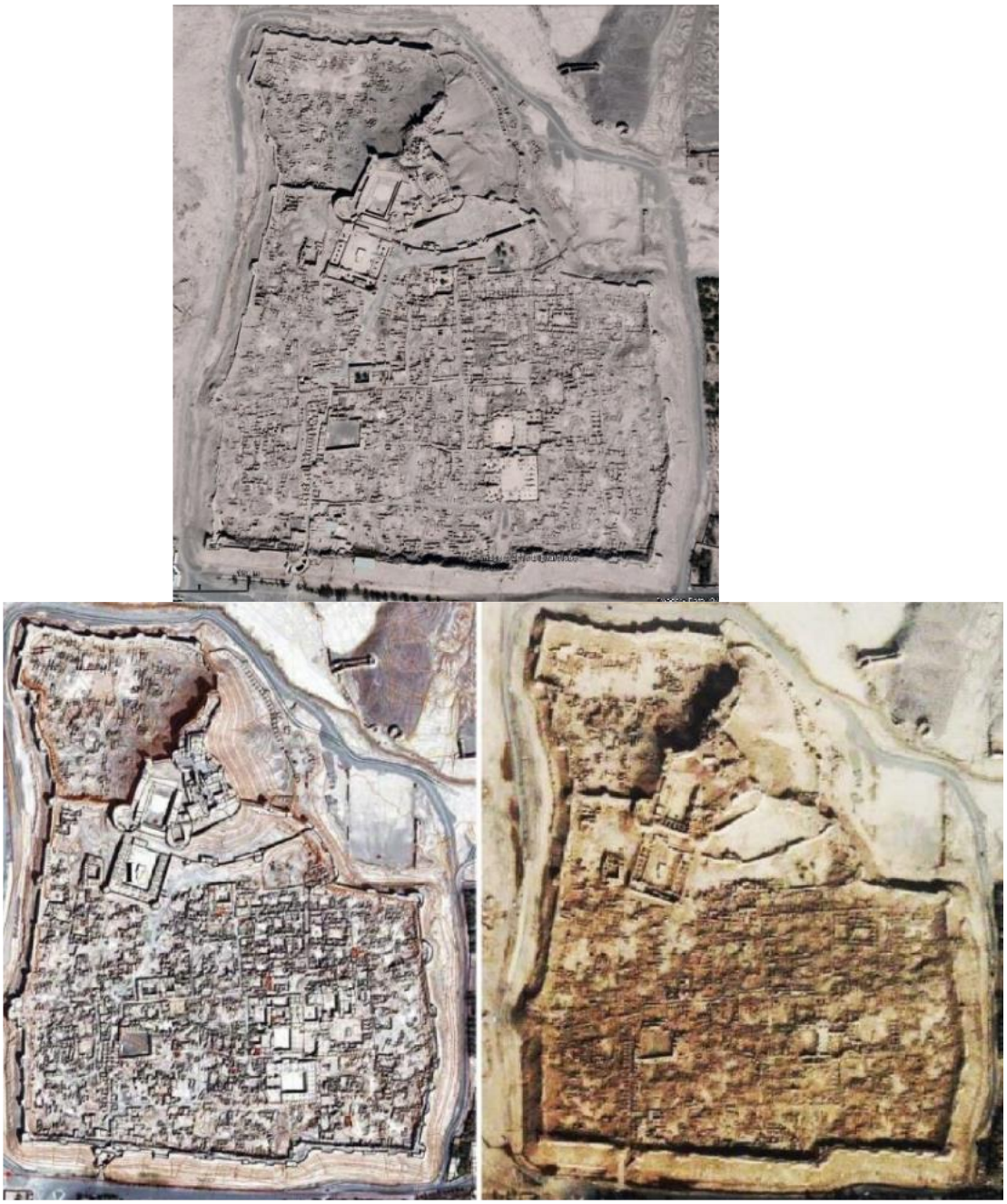

Fig. 19: Satellite image of Bam citadel, before (upper) and after the 2003 Bam earthquake (lower left) (Langenbach, 2005) and now (lower right) (Google Erath)

Sarpol-e-Zahab Earthquake 2017

An earthquake measuring 7.3 on the Richter scale occurred on the evening of Sunday, November 13, 2017, near Sarpol-e Zahab, Kermanshah province, near the Iran-Iraq border, 32 km southwest of the Iraqi city of Halabja. The epicenter was reported 5 kilometers south of Kermanshah. The death toll from the quake in Iran has risen to 620 and the number of injured to 9,388, leaving about 70,000 homeless. The depth of the earthquake was 11 km. Due to this shallow depth and long duration of the earthquake, this earthquake was felt in the country's northwestern region, in the southeast of Turkey, Kuwait and northern Saudi Arabia.

According to the officials of the Cultural Heritage Organization of Qasr Shirin Shah Abbasi Caravanserai, Khosrow Mansion, Chahar Qapi in Qasr Shirin, Zij Manijeh building at Sar-e Pol-e Zahab, and Yazdgerd Castle in Dalahou were damaged (ILNA News Agency). Figure 20 shows the seismic characteristics in question.

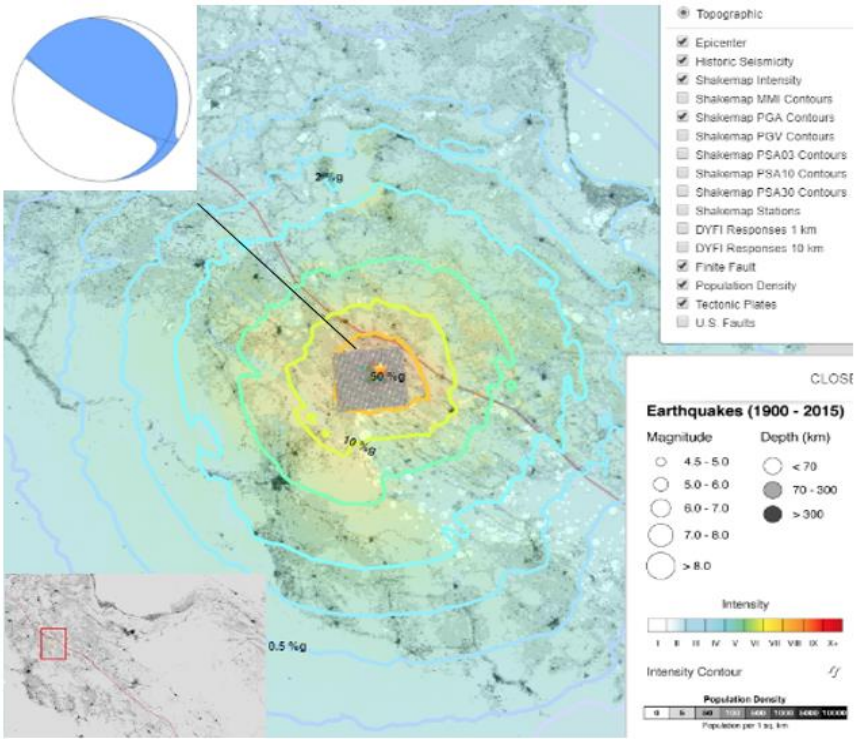

Fig. 20: Sarpol-e-Zahab Earthquake 2017 with magnitude 7.3 along with Earthquake Center (Yellow Star), Historical seismicity, Shakemap intensity, PGA contours (Peak Ground Acceleration), Finite Fault (slip distribution on the fault plane), Population density (Background image), border of tectonic plates (red line), general guide map, map legend and seismic focal mechanism (USGS) (with changes).

In this study, we tried to compare the pre-earthquake and post-earthquake situation of the mentioned buildings similar to the previous ones using Google satellite images. Still, unfortunately, the desired satellite images have become unavailable. In fact, in some areas, no satellite image is available after the earthquake. In other areas, on the contrary, the only available satellite image is related to the aftermath of the 2017 earthquake. In the case of Bam Citadel, there is a similar situation with pre-earthquake and post-earthquake satellite imagery, with no pre-2003 satellite imagery available in the Google Satellite Imagery History section.

These cases, while emphasizing the importance of studies on historical monuments using remote sensing and satellite images and its widespread use in the management of historical monuments and reducing the cost of sending research teams and field studies, the need for experts to access high-quality satellite images at appropriate intervals, especially immediately after major earthquakes to estimate potential damage to buildings, favorably historic buildings is noted.

Figure 21 shows Zij Manijeh or Manijeh Castle's satellite image, a historical building located in Kermanshah province, Sarpol-e Zahab city,

Patagh village, about 15 km from this city. This historical monument was registered in 2005 by the Cultural Heritage Organization with the number 13410 in the list of Iran's national monuments (Wikipedia). The damage was caused to this historical monument due to the Sarpol-e-Zahab earthquake in 1396. Unfortunately, due to the lack of access to satellite images after the quake, it is impossible to assess the amount of damage caused by this method.

Fig. 21: Satellite image of Zij-e Manijeh from the damaged historical monuments in the earthquake of 2017 Sarpol-e Zahab (Google Erath)

Yazdgerd Castle refers to a collection of buildings related to the Sassanid period in the village of Zardeh in the city of Dalahou in Kermanshah province. Yazdgerd Castle complex is located 18 km from Rijab to Sarpol-e Zahab intersection in Kermanshah province. A Canadian Archaeological Board carried out the first archaeological excavations in the area before the Revolution. At first, the construction of this complex was attributed to the Sassanid period. Still, later excavations showed that many buildings in this area belong to the late Parthian period (Wikipedia). Figure 22 shows a satellite image in the Google Earth software before the 1396 Sarpol-e-Zahab earthquake. Unfortunately, post-earthquake satellite imagery is not available on this platform.

Fig. 22: Satellite image of Yazdgerd Castle from the damaged historical monuments in the earthquake of 2017 Sarpol-e Zahab (Google Erath)

MONUMENTS AT RISK OF EARTHQUAKES IN IRAN

To investigate the importance of historical monuments at risk of earthquakes in Iran, it is enough to pay attention to two lists of these monuments. One is the UNESCO World Heritage List in Iran and the other is the National Heritage List of Iran. Each of these works alone has a priceless value in the historical heritage of this land and their preservation is the responsibility of both relevant organs and organizations, as well as individual individuals, especially researchers and those involved in study and research. The following is an overview of these two lists.

UNESCO World Heritage List in Iran

24 sites in Iran are registered in the UNESCO World Heritage List. Among them, there are 22 cultural heritage works and one natural heritage work. Iran acceded to the UNESCO World Heritage Convention three years after the ratification of UNESCO's General Conference on February 26, 1975. In 1979, Choghaznabil, Persepolis and Naghsh Jahan Square were added to the UNESCO World Heritage List as the first historical monuments in Iran. Bam Citadel and its cultural space were included in the list of endangered sites after the Bam earthquake but were removed from the list at the 2013 summit due to restoration work (Wikipedia).

Most of the items on the UNESCO World Heritage List in Iran are in the cultural sector, and most of them are vulnerable to earthquakes and other natural disasters. Thus, there is an urgent need to document these monuments as soon as possible.

Comparison of the number of Iranian monuments registered in the UNESCO World Heritage List with other countries

In this section, in order to clarify Iran's position among the countries of the world in terms of historical heritage, compare the registered works of Iran in the UNESCO World Heritage List or Turkey, Greece, Italy and Egypt as countries that are considered equal to the ancient land of Iran in terms of historical monuments. Can be paid. Table 2 shows the number of works registered in the UNESCO list, the number of works nominated for registration in this list, as well as the first and last years of registration in this list:

Table 2: Number of registered and candidate works in the UNESCO World Heritage List

	World heritage site	List of candidates	from	to
Iran	24	56	1979	2018
Turkey	18	72	1985	2018
Greek	18	12	1986	2016
Italy	54	40	1979	2018
Egypt	7	33	1979	2009

As shown in Table 2, Iran has very soon, along with Italy and Egypt, registered its first works in the UNESCO list, and this process has continued until now. However, considering that each country has been able to introduce only one monument for inclusion in this list every year (excluding the early years), it can be seen that only Italy has been able to register its works in the list. UNESCO made the most of it. Although the situation in Iran is relatively better than in Greece and Egypt, which have ancient civilizations as well, the list of registered candidates shows that Turkey has made a much greater effort in recent years than our country in introducing its historical and cultural monuments.

As the effects of these countries' political, economic, and social situation in the process of introducing and registering monuments in the UNESCO list should not be overlooked, it should be noted that these factors can also play a significant role in the preservation and restoration of these historical monuments. Considering the income of the mentioned countries from the tourism industry and the prominent role of this industry in the economy of these countries and considering the necessity of transitioning from a single product economy dependent on oil exports in the current sensitive situation, to better preserve the endangered historical heritage Earthquake in Iran, documenting these works has the highest degree of priority.

Iran National Heritage List

A collection of historical monuments of Iran have been officially registered in the list of national Heritage of Iran according to the Law on Preservation of National Monuments approved by the National Assembly in 1309. According to this law, "All industrial monuments, buildings and places that have been constructed in Iran until the end of the Zandi dynasty, including movable and immovable, following Article 3 of this law can be considered part of Iran's national monuments and under government protection and supervision." is." (Wikipedia). From 24 September 1310 to 20 Bahman 1318, more than 370 monuments were registered in the collection of national monuments of Iran in fourteen stages. These are summarized in Table 3.

Tab. 3: Number of registered works in 14 series of historical monuments in the list of national monuments

registratio serie	date of registartion	Number of registrations
1	16-Sep-31	64
2	6-Jan-32	148
3	9-Jul-32	11
4	1-Aug-31	12
5	4-Apr-34	2
6	22-Jul-34	12
7	13-Dec-34	12
8	6-Jun-35	20
9	18-Jun-36	3
10	20-Jun-36	12
11	3-Mar-37	24
12	20-Dec-37	23
13	12-Nov-38	12
14	10-Feb-40	18

After that, 24 monuments that were not registered in the first round were registered after ten years. It is worth mentioning that several important historical monuments (such as Aali Qapavi, Tabriz, Nahavand Castle, Shams Al-Amara, Bandar Anzali, etc.) were destroyed before being registered in national monuments for various reasons, including fire and destruction by various people.

A number of works registered in the list of national monuments (such as Bam Citadel, Khosrow Agha Bath in Isfahan, Kerman Church, etc.) were destroyed after registration by natural disasters such as earthquakes or other causes. To view the complete list of national monuments registered in Iran, you can refer to the relevant sources (Encyclopedia of the History of Architecture and Urban Planning of Iranshahr). This database shows that 26666 historical monuments have been registered in the list of Iran's national heritage so far, indicating the huge workload ahead for documenting and subsequent studies related to earthquake risk analysis and strengthening this valuable heritage at the risk of earthquakes and other natural disasters.

CONCLUSION

In this study, using free satellite images of Google, several historical monuments in different parts of the world before and after the devastating earthquakes that occurred in different years in these areas were examined. The Temple of Swamabonath and Daharahara in Nepal, which was destroyed by an earthquake in 2015, the Haitian National Palace and the Cathedral of Our Lady in Port-au-Prince, which was damaged in the 2010 earthquake, Christchurch Church in an earthquake of the same name Damaged in New Zealand in 2011 Examples of seismic hazard for historic buildings abroad

And Bam Citadel was presented as a historical-cultural landmark that was damaged by the 2003 earthquake. Some of these cases have been reconstructed in an incomplete or inappropriate manner, highlighting the

need to document monuments at risk of earthquakes. Also, by examining the satellite images related to the Sarpol-e-Zahab (Azgeleh) earthquake in 1396, the importance of access to and use of remote sensing data, including satellite imagery, in the management, preservation and restoration of historical monuments was clarified.

REFERENCES

Ambraseys, N. N. and Melville, C. P. (2005) A history of Persian earthquakes. New York: Cambridge University Press.

Berberian, M. (2014) Earthquakes and Coseismic Surface Faulting on the Iranian Plateau. Elsevier.

Bongiovanni, G, Buffarini G, Clemente P, Rinaldis D, Saitta F. (2017) Experimental vibration analyses of a historic tower, structure. J Civil Struct Health Monit 7:601–613. https://doi.org/10.1007/s13349-017-0245-4.

Google Earth Pro 7.1.5.1557, DigitalGlobe (2019). https://www.google.com/earth

ILNA News Agency, News ID: 557898

Iranshahr Encyclopedia of History of Architecture and Urban Planning: http://iranshahrpedia.com

Jha, A. K., Duyne, J. E. (2010) Safer Homes, Stronger Communities A Handbook for Reconstructing After Natural Disasters. Herndon: World Bank Publications.

Kavian, W., Malian, A. And Malik, m. (1397) Vulnerability Analysis of Historical Monuments for Cultural Heritage Documentation. journal of Sustainable Architecture and Urban Design(JSAUD), Year 6, Issue 2.

Langenbach, R. (2005) Performance of the Earthen Arg-e-Bam (Bam Citadel) during the 2003 Bam, Iran, Earthquake. Earthquake Spectra, 21(S1), 345-374.

Meier H. (2008) Cultural heritage and natural disasters: Risk preparedness and the limits of prevention: Kulturerbe und Naturkatastrophen. Dresden: TUDpress.

United States Geological Survey: https://earthquake.usgs.gov

Wikipedia: https://fa.wikipedia.org.