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EARTHQUAKE VULNERABILITY ASSESSMENT OF YAZD MOSQUE

Mohammad Ghasem VETR
Assistant Professor, IIEES, Tehran, Iran
vetr@iiees.ac.ir
Mahdi ESMAILI KHALIL ABAD
M.Sc. Student of Civil Engineering Earthquake Orientation, IIEES, Tehran, Iran
mahdi.esmaili@stu.iiees.ac.ir

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Antiquities, including historical monuments, are the cultural heritage of any country. These monuments are the most important features of cultural history of each country and they represent the history and the cultural identity of the past. Therefore, protection and preservation of these historical monuments can be very important to the foundation of national culture. Monuments of Iran are of great importance in terms of culture, art and aesthetics. Moreover, they are a considerable factor in attracting tourists and expanding the country tourism industry. According to documented evidence and historical contexts, many of Iran's exquisite archaeological monuments had been destroyed or damaged by earthquakes. In order to prevent the destruction of these monuments, it is necessary to provide efficient and effective solutions. As a precious monument of Iran, the majestic structure of a central mosque in Yazd province can be mentioned which is analyzed by seismic analysis in this study.

The central mosque of Yazd that is decorated in tile work, domes, minarets etc. is considered as one of the most brilliant buildings and the entrance to the mosque is crowned by a pair of minarets, the highest in Iran and measuring 48 m. Cooked brick and traditional materials are used in the construction and it dates back to the 8th century Hijri. Considering the location of Iran on the seismically active belt, the existence of numerous faults in the region and the importance of this monument due to tourism, historical and cultural significance probable earthquakes are of the important and significant issues.

Figure 1 .Views of the eastern side of the Yazd mosque.

For this purpose, 3D geometric model of the structure in an appropriate software was developed and analyzed by finite element software ANSYS with a recurrence interval of 475 and 2475 years. After gravity, modal and spectral analysis, the results have been investigated and the vulnerable and susceptible points of the monument are identified and finally the proposed retrofitting and strengthening methods for this historical monument are mentioned.

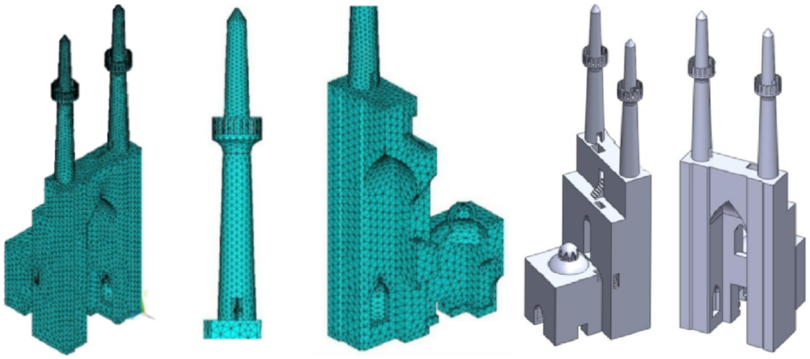

Figure 2. Different model of central mosque of Yazd.

In this research, the endurance and stability of Yazd Jameh Mosque, one of the most brilliant and ancient monuments in Iran, was investigated in order to resist potential earthquakes with emphasis on preserving its historical value and authenticity.

Analyzes were gravimetric, modal and spectral in two return periods of 475 and 2475 years. The gravity analysis showed that the deformation distribution at the height of the structure was non-uniform and that the compressive stresses at the toe of the octagonal stem arches and the interface columns of the dome and porch were higher than other parts. The results of spectral analysis for the earthquake with a return period of 475 years showed that most of the structure remains intact and only breaks down where stress concentration is exists. In this case it can be expressed that the dome and the porch of the mosque remain stable. Based on the results, for the earthquake with return period of 2475 years, it can be said that the earthquake at this level causes extensive and irreversible damage at the dome and porch.

Therefore, according to the studies, it is estimated that for such structures that have historical nature and cultural heritage, due to the large size of the bearing members, there is no problem in terms of compressive strength and tensile strength determines most of the vulnerable and critical points of the building. New technologies can be used to improve the seismic behavior of such valuable structures, which are briefly described below.

Reduce the base shear force by using isolators - reinforcing materials (injection of concrete or cement, using new sticky materials) - use of FRP sheets in the walls and side wall between the two dome shells - local modification or form some of opening and corners.

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