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The Seismic Safety Assessment of Historical Houses of Tabriz Based on Italian DPCM Guidelines; Case Study: Ali Monsieur House

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ABSTRACT

Each year, many historical buildings are threatened by the risk of damages due to natural disasters, including earthquakes. The key step before retrofitting and restoring historical buildings is to provide a seismic safety assessment of these structures to identify their weaknesses. Italy is one of the pioneering countries that has released a special guideline under the title of "Italian guidelines for evaluation and mitigation of seismic risk to cultural heritage(DPCM)" in order to assess historical buildings. This guideline includes three levels of assessment and is also used for three classes of various buildings. Manual computation results of this guideline at the first level can demonstrate the general status of the building in the shortest time possible for restorative activities. In Iran, no such a guideline is available for historical buildings. Therefore, this study called for developing a guideline for assessing historical buildings in Iran, while examining the safety status of the historical Ali monsieur House of Tabriz City under the Ultimate Limit State (SLU) and Damage Limit State (SLD) based on manual and numerical computations proposed by the Italian DPCM guideline. Pushover analysis (numerical modeling) was carried out based on equivalent frame model three-dimensional modeling in 3MURI.13 software. Findings of the two levels of assessment were used to compare the obtained results. In sum, data from assessing both levels of Ali monsieur House revealed that this building was not safe under the ultimate limit state, but demonstrated good safety under the damage limit state. Notably, the manual computations offered in the Italian guideline served more conservatively because they provided safety index and shear strength values of the buildings less than those obtained from numerical computations. However, it is considered a useful and applied method prior to carrying out restorative measures.

Keywords: Seismic Safety, Historical House, DPCM, Ali Monsieur House.

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1. INTRODUCTION

Preserving historical legacies in all societies has always been important because they represent the identity of each country (Allahvordy 2020). Preserving and restoring these works of architecture have helped to transfer social history and civilization to future generations and prospered the tourism industry by improving economic and social conditions (Nasseh and Taghavi 2019). Over the past years, natural catastrophes have caused irreparable damages to cities, especially those with historical sites and buildings. Historical textures of cities as places with cultural legacy values are characterized by spatial-physical structures and involve various hallmarks of historical eras. The values attributed to them and determining their degrees of significance may play major roles in protecting them and capitalizing on them in the form of cultural tourism (Abbaszadeh, Mohammad Moradi, and Soltanahmadi 2015). Damages caused by earthquakes could inure damages to the architectural legacy of regions and thus result in the loss of tourism income, especially in areas where tourism is becoming a great industry; meantime, the damages may engender serious consequences for the improved social, economic and development aspects of society. For this, it is essential to preserve and maintain works of architecture (Giuliani, De Falco, and Cutini 2022).

The recording of recent seismic incidents indicates that small-to-medium earthquakes could inflict irreparable damages to structural and non-structural components of historical sites, including churches, palaces, and towers, because the seismic behavior of historical masonry structures is different from those of modern masonry structures, constructed in line with design regulations; as a result, it is increasingly becoming important to provide the seismic assessment of old structures for ensuring their stability, as such assessments have managed to considerably influence designs and planning for theory preservation (Torelli et al. 2020). Many measures have been taken to find a method to provide seismic assessments; the first measures, however, were done in Italy and New Zealand.

In 2003, the confirmation of building seismic safety based on seismic codes of existing buildings was made compulsory in Italy (O.P.C.M.3362 2003). In New Zealand, building assessment and retrofitting regulations are provided under the title of "Assessment and Improvement of the Structural Performance of Buildings in Earthquake" (New Zealand Society for Earthquake Engineering, NZSEE). These rules and regulations apply to all non-reinforced masonry structures with no differentiation for historical sites (Derakhshan, Ingham, and Griffith 2009). The standard European authority for assessing the resistance of existing structures against earthquakes is Euro Codes 9 (Section 3) (CEN 2005). Guidelines by the International Scientific Committee on the Analysis and Restoration of Structures of Architectural Heritage (ISCARSAH), a scientific committee of subsidiary of ICOMOS (International Council on Monuments and Sites), which was founded in 1996, and guidelines provided by ISO13822 are aimed at assessing existing structures. These two sets of regulations somewhat correspond to each other, but the latter makes no reference to historical buildings (Schueremans and Verstrynge 2008).

Since a specific regulation for assessing historical sites is lacking in Iran, the present study aimed to provide a seismic assessment of a historical house pertaining to the Qajar era in the city of Tabriz using two levels of assessment, i.e., the first level (manual computations) and the third level (numerical analysis) based on Italian guidelines for determining and reducing seismic hazards of historical structures (DPCM 2005). The core objective of the study was to examine the reliability and validity of the first level of assessment, which was performed based on a simple mechanical model. This level was compared with the third level of assessment, which was a more complicated model and considered the non-linear behavior of the structure. The first level of assessment was performed based on the relations provided by the Italian guidelines (DPCM 2005). Also, the non-linear assessment of the building was made based on the third level of assessment by 3MURI software using equivalent frame analysis.

2. RESEARCH LITERATURE

Much research has been done on the safety assessment of historical buildings in Iran and the world, including the following:

Pouraminian et al. (Rahimi, Pouraminian, and Sadeghi 2016) assessed Tabriz's Arg-e-Alishah (Alishah Citadel) using the analysis techniques elaborated in O.P.C.M and found that the structure lacked appropriate safety against regional earthquakes. Numerical analysis was also performed using the ANSYS.V10 program for confirming the results Both results were compared and were found to be in line with each other.

In 2019, Akhoundi et al. (Akhoundi, Mohammad pour, and Shahbazi 2020) studied the seismic behavior of a masonry building before and after retrofitting by the FRP technique. They used 3MURI software for evaluating the bundling's behavior.

Betti et al. (2017) used 3MURI software for assessing the seismic hazards of the Italian Casa Vasari Museum. Their findings, which included local and global analyses, were clearly critical and they reaffirmed the necessity of combining all three levels of assessment. The Italian Pelella Palace was first subjected to a seismic assessment by Casapulla et al. (Casapulla, Argiento, and Maione 2018), who used the first level of assessment proposed by the new Italian guideline version. They then compared the results with the previous results of the old guideline. They concluded that the findings were correspondent due to weaker directions and failure modes; however, there were differences over the computation of the base shear capacity and relevant ground acceleration. They did the non-linear static analysis based on the three levels of assessment and demonstrated the results of the processes of degradation, pushover curve and the seismic safety index.

Hejazi and Eshghi (Mana and Sasan 2019) used DIANA software to perform the spectral analysis, time history and non-linear static analysis of the Qabus Tower and concluded that the 2800 Regulation could not be an appropriate standard for historical buildings.

Using the three levels of assessment determined by Italian standards, Torelli et al. (Torelli et al. 2020) studied the seismicity of the Cugini Tower in Gimignano, Italy. Findings indicated that there was a need for providing a general analysis of predicting the seismic performance of such buildings because simplified static and kinematic analyses do not identify general failure modes caused by locally concentrated loads. The Italian Palace of Priors was examined by being subjected to a seismic assessment test by Castori et al. (2019) based on the three levels of assessment, proposed by the Italian guidelines. According to each of the levels, building seismic reactions did not produce similar levels of assessment.

3. THEORETICAL FOUNDATIONS

Seismic safety assessment is performed to predict damages caused by an earthquake. These damages may include loss of life, loss of property or damages to cultural treasures. According to the Euro Code 8 (EC8), a seismic assessment refers to a "quantitative method of investigating whether or not a building, both an intact or a damaged one, meets the limit state intended, based on the seismic measures taken". Vulnerability assessment (possible damage analysis), estimating people's encounter with buildings (referring to public presence or cultural legacy) and seismic hazard analysis are all critical steps in this process.

Over the last 30 years, notable advancements have been made about integrating seismic assessment techniques into seismic codes. Most assessment techniques usually include apparent and functional situations. The study of geometric configurations compares construction details and construction materials with various "rule of thumb" obtained from post-earthquake observations. In the meanwhile, performance-based reviews calculate the possible performance of buildings in an expected earthquake based on special indices of limit states.

The assessment method of each code may take the form of a rapid method or an accurate analysis method. However, some novel guidelines include both methods in a framework (Engineers 2014). While rapid assessment methods may evaluate configurations, accurate analysis approaches usually combine the configuration assessment approach and the performance. Configuration related reviews are fast and convenient and tend to be used for standard buildings, which may not be justified by accurate modeling or experimental methods. However, these reviews specify the existing faults and expected solutions. Although these reviews are less applied for unusual structures, rapid evaluation techniques may be based on score assignment, with each score assigned by their correspondence or non-correspondence with a set of definitions of building vulnerability. For this, simple experimental or configuration methods are used to examine the level of correspondence of the reviews. Thus, the first step may be to facilitate decision-making concerning the most appropriate method of intervention or using the rapid approach to find the most vulnerable buildings. It is thus imperative to employ an accurate approach for designing and proposing retrofitting interventions.

3.1. Italian DPCM Guidelines for Assessing and Reducing the Seismic Hazards of Historical Buildings

To assess historical buildings, Italians use their special guideline aimed at developing a framework for analyzing structures and retrofitting historical buildings in conjunction with their special needs (Torelli et al. 2020). This guideline, entitled "Italian guidelines for evaluation and mitigation of seismic risk to cultural heritage (DPCM)" provides a novel framework for seismic safety assessment through a multi-level method, which seeks to make stages of investigation and assessment dependent on various objectives. This guideline generally includes three levels of assessment, defined as follows: the first level: qualitative analysis assessment using simplified mechanical moduli; the second level: seismic assessment for performing local interventions, and the third level: accurate seismic assessment of the building.

The first level of assessment evaluates the building within the texture and the region and thus classifies the site in terms of seismic safety. This level relies on a simple structural model and adopts a force-based approach, which requires integrating a limited number of geometric and mechanical parameters into qualitative data obtained from visual assessment and construction features. The second level of assessment is aimed at the seismic safety of the building when local interventions are taken in each and every section of the building. It is notable to suggest that the second level is only used when local interventions do not change the structural behavior of the building. In the end, it is the third level of assessment, which is based on the building's general structural response for determining the degree of acceleration that helps the structure to reach various limit states.

In each level, seismic safety is determined by an index, obtained from comparing the expected seismic demands and seismic capacity. It should be mentioned that the first and third levels of assessment are respectively based on general simple and accurate models, both provided by the combined effects of floor diaphragms and the in-plane responses of structural walls. Accordingly, the results of both levels can be compared. On the other hand, the second level of assessment provides the seismic assessment of local failure modes, which are mainly due to out-of-plane response of the walls.

3.2. Historical Building Safety

In general, a historical building is a structure characterized by aesthetic, economic, social and symbolic values; it is a representation of cultural identity. A key point about historical buildings is that no regulations were used when they were built, which makes most of them vulnerable to natural incidents, like earthquakes. While inspection aims at finding causes of damages and failure in sites, safety assessment helps to understand the necessity and a series of reinforcement measures (AyatollahZade Shirazi 2003). Concerning historical buildings, safety situation assessment is to find the most appropriate method from among existing retrofitting approaches and generally to employ measures with the least interventions in buildings. To ensure the appropriateness of assessment approaches, it is necessary to consider special characteristics of historical architecture. However, each of the structures may differ from each other in terms of construction materials and methods because each was built by a constructor and was subjected to repair and restoration changes over time. Furthermore, various construction methods may not be well understood in terms of structures and there is usually little information about their performance (Quinn 2017).

4. INTRODUCING THE HISTORICAL ALI MONSIEUR HOUSE

The historical Ali Monsieur House dates back to the Qajar era, and is located in one of the old and historical neighborhoods of Tabriz City (East Azarbaijan province, Iran). Unlike other noble houses, this house does not cover a large area. The historical Ali Monsieur House is a brick-made building where the interior and exterior corridors are separated at the entrance (Fig. 1 and 2). The notable point at the entrance section is the unusual manner in which the interior and the exterior courtyards are connected to each other, the example of which is not seen in any other houses. The plasterwork on the building's outer façade represents one of the most beautiful aspects of the house. The dulcimer- and congress-shaped brick decorations, combined with the plaster facing, have embellished the windows. The building in a two-story site features an asymmetrical plan. The plan is also represented by the typical plan of the basement and ground floors. The building's walls are constructed by bricks with sand and lime mortars. The basement of this building has a vaulted ceiling and the ceiling of the ground floor is also made of wooden beams (Fig. 3).

Fig. 1. Image of the Historical Ali Monsieur House

(Cultural heritage of East Azarbaijan province)

The walls of this building are constructed based on the traditional technique of construction in the region and have dimensions of 4*20*20 cm, made of lime, sand and mortar. There is unfortunately no information about the way this building was constructed; however, considering typical Qajar-era foundation construction, mainly made of cobblestone, mortar and lime, we decided to model the building foundation features as based on cobblestone and lime mortar.

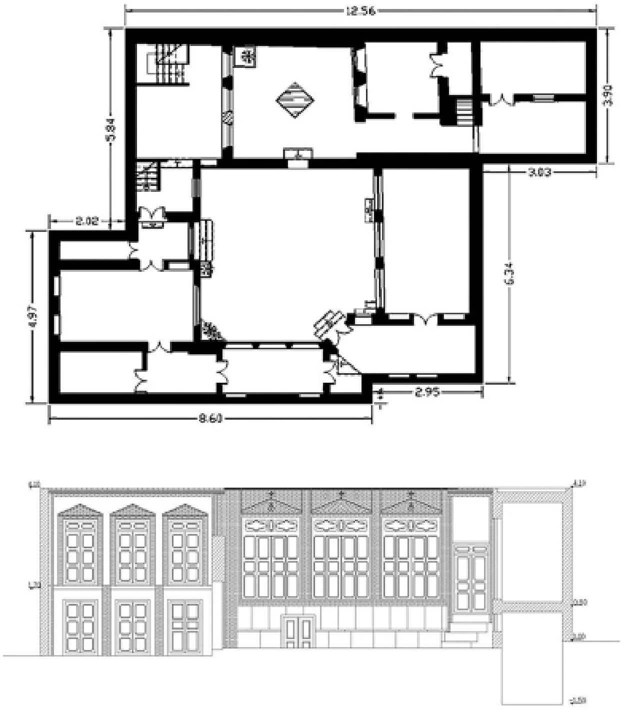

Fig. 2. Plan and Façade of the Historical Ali Monsieur House

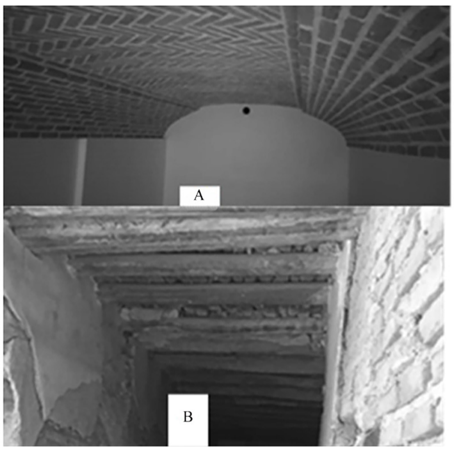

Fig. 3. Basement Floor Ceiling (a) and Ground Floor Ceiling (b)

Since the first level of assessment focuses on individual buildings and does not refer to a set of buildings, the present study aimed to study Ali Monsieur building individually. It is notable to suggest that both levels of assessment are based on the combined effects of both floor diaphragms and in-plane responses of structural walls (box-like behaviors). This study did not examine the out-of-plane behavior of the walls.

To determine the building's mechanical properties, data available in the seismic retrofitting guidelines for existing buildings (Code 360 2013) were used. Table 1 gives modulus of elasticity, shear modulus, and compressive strength values of masonry materials, used in computation and software modeling.

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Table 1. Specifications of Masonry Materials

Modulus of Elasticity of Brick Unit (MPa)	920
Shear Modulus (MPa)	368
Compressive Strength (MPa)	2.3
Shear Stress (MPa)	0.09
Specific Gravity of Working Brick Unit, along with Pressed Brick and Sand-Lime Mortar (kg/m^3)	1800
Wooden Beam's Specific Gravity (kg/m^3)	500
Specific Gravity of Working Brick unit, along with Pressed Bricks and Plaster-Soil Mortar (kg/m^3)	1750
Thatch Specific Gravity (kg/m^3)	1600

(Code360 2013)

According to the historical Ali Monsieur House, the building's factor of safety (FC) (DPCM 2005; Code 360 2013), which is determined based on our understanding of the history and geometry, structure and materials, the mechanical properties, soil and the foundation, is 1.35.

5.METHODOLOGY

This study used a complete process of structural identification aimed at assessing the seismic safety of Ali Monsieur House. To this end, investigations into the changes and development of structures over time are initiated. In addition, the building's structural characteristics, the typology of the ceiling and masonry walls will be studied because these data will help to accurately define the numerical models used for seismic safety assessment. Then, the total seismic response of the selected building will be modelled in 3MURI software, and then analyzed following the qualitative examination of the building using computations related to the first level. The findings will be then studied.

5.1. Introducing Seismic Parameters

Historical building safety against regional seismic hazards is defined by limit states for protecting residents against rare earthquakes of high intensity (Ultimate Limit State (SLU) and Damage Limit State (SLD) are aimed at limiting economic and functional damages to buildings caused by low-intensity earthquakes). In this regard, SLU examines the status of the building in earthquakes with an exceedance probability of 10% in the last 50 years, while SLD examines the status of the building in earthquakes with an exceedance probability of 50% in 50 years. Since Ali Monsieur House is located in Tabriz City, the ag value was 0.35g for an earthquake with an exceedance probability of 10% in 50 years, as per the Earthquake Standard 2800. Also, the value of this parameter for the earthquakes with an exceedance probability of 50% in 50 years was 0.14 g.
The total return period of the building was calculated as a function of its total height as the following Equation (1), provided in 2800 Regulations.

$$T=0/05H^{0/75}=0/105\ S \qquad (1)$$

5.2. Building Safety Index Assessment based on Simplified Mechanical Models

The first level of assessing the safety of Ali Monsieur House was performed based on simplified mechanical models for "Villas and buildings with load-bearing and flat diaphragm walls". At this level, several geometric and mechanical parameters, easily obtained at the stage of understanding, were used to calculate the building safety index (IS); it should be reminded that these computations do not require considering probability interactions of the building with its adjacent buildings. The building's seismic capacity assessment at this level presupposes that the damages or failures to the walls are caused by shear and flexural issues. The first parameter to be calculated was the shear strength of each floor in different directions. According to Equation (2), in order to calculate the building's shear strength (F), it was required to calculate the area of the walls resistant to shear force in x and y directions in the ith floor (A) and the plan's irregularity coefficient (β), which is directly correlated with the distance of the center of mass from the center of stiffness, while being reversely correlated with the distance of the center of stiffness from the farthest wall in the corresponding direction. Also, the homogeneity of the stiffness and resistance of masonry walls (μ), the dominant pier collapse (ξ) and the shear strength of the ith floor (τ_{di}) were calculated.

$$Fi=(\mu i\xi iAi\tau i)/\beta i \qquad (2)$$

Based on values obtained from the parameters A, ξ, μ and β, the shear strengths of x and y direction were calculated, which were respectively 937 and 613 kN in the basement floor and 934 and 525 kN in the ground floor. It should be mentioned that the lowest shear strength obtained was noted as the main shear strength. Concerning the building, the shear strength was found to be 525 kN.
After calculating the shear strength, acceleration was calculated under the SLU and SLD states, as represented by the following Equation (3):

$$a=(qF)/(e^{*}MC_{T}) \quad (3)$$

Where q is the building's behavior factor, which was considered 3 for buildings of regular heights, while it was considered 2.5 for buildings with an over resistance factor of 1.5. In this study, the factor was considered to be 3. M represents the total of the seismic mass, e^{*} is the percentage of the mass involved in failure, and C_T is the normalized spectrum, obtained from the ratio of the elastic response spectrum to the ground acceleration, which includes the site effects. As for the calculation of this parameter, since our domestic regulations have made no reference to it, the values of this parameter, as per NTC18 (NTC 2018) under SLU and SLD, were 2.5 N/kg and 2.49 N/kg, respectively.

In order to calculate the percentage of mass involved in e^{*}, two equations were proposed; the first concerns the failure of a story of the building where it is possible to fail and the second equation concerns the building's uniform failure (the lowest story). This study used the second one $e^{*}=0.89$. According to these values, Equation (3) represents the values of acceleration under SLU and SLD of 3.05 N/kg and 1.861 N/kg, respectively.

According to the Italian guidelines, the building's safety index can be calculated as represented by Equation (4). If the index is larger than 1, the building is safe against seismic activities, and if it is less than 1, it is not safe enough.

$$I_S= a/(\gamma_I \, Sa_g) \quad (4)$$

The denominator of this equation is the seismic demand. γ_I is the building's importance coefficient, which is 1.2, consistent with the 2800 Standard. ag is the acceleration of the intended limit state and the parameter S is actually the coefficient of site effects for base acceleration, which is equivalent to the S0 coefficient at a vibration time of 0 second in the 2800 Standard (IRSt 2800) (S0) and the S coefficient in the NTC (NTC, 2018) Regulation. This coefficient is a function of the type of oil of the site and regional seismicity. The type of the site's soil was determined to fall under the III category, based on the geo-technical studies. Because the building is located in the city of Tabriz with a relatively high risk, the S0 value was considered 1.1, consistent with the 2800 Standard (IRSt 2800), while as for the horizontal component of earthquake, the value of S was 1.17, consistent with the NTC 08 (2018). Because in the present study, 3MURI software uses European regulations, this parameter saw a value of 1.17. In sum, the building's safety indexes under the SLU and SLD were 0.633 and 1.861, respectively.

5.3. Building Vulnerability Assessment Based on the Third Level

The third-level assessment of Ali Monsieur House was performed by the non-linear static analysis of the building in 3MURI software. This software, developed in Italy, is an engineering program for analyzing the seismicity of masonry and composite structures. This software uses a displacement-based analytical approach and determines the total horizontal force required for building displacement until the target displacement. The multi-stage analysis is used to obtain the pushover curve where each step is defined by displacement and corresponding shears as it is a good method for masonry structures. Because the approach is based on displacement, the non-linear behavior of materials of such structures can be compared to force-based methods.

3MURI software used the Frame by Macro-Element (FME) method. This method carries out the meshing only by several macro elements and considers the building walls as frames formed of three various types of macro-elements such as piers, spandrel beams and nodes. Mechanical specifications provided by the software are listed in Table 1.

The software also helps to model the ceilings by forming nodes and defining the covering as the finite element and frame properties. Regarding vaulted ceiling, the equivalent horizontal stiffness is defined based on geometric configurations, thickness, mechanical properties of materials, and the connection system to the walls. Figure 4 below illustrates the three-dimensional model of the building, automatically meshed by the software.

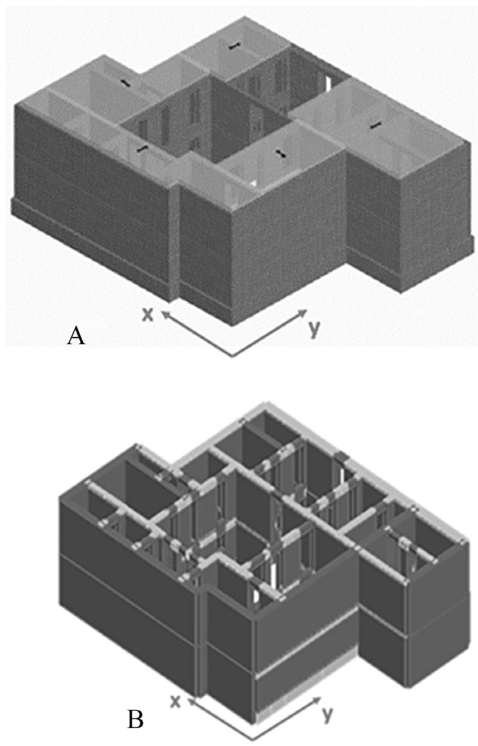

Fig. 4. Building's 3D Model (a); Meshing by the Software (b)

The pushover analysis was performed by considering two systems of horizontal force systems applied to the surface of the floors and to two orthogonal directions corresponding to the main axes of the building, including the uniform lateral load proportionate to the weight and the triangular lateral load proportionate to the first mode form in the analysis. Both models of the applied loads were proportionate to the mass distribution, proposed in line with the Italian Regulation (NC 2018). 3MURI software performs the pushover analysis in two ±x and ±y directions under two various loading states without eccentricity and the random eccentricity of the center of mass. According to pushover results, in order to calculate the seismic safety index, ultimate displacement (seismic response) and target displacement (seismic demand) were used, which corresponded to the ratio between the seismic demand response in terms of maximum acceleration at the first level of assessment. Pushover analysis results of the building in the software are graphically illustrated in Figure 5. The horizontal axis of this graph shows displacement by cm, while the vertical axis shows the shear strength by kN. This graph shows that the building experienced the highest shear strength in the x direction, which is due to the greater thickness of the x-direction walls compared to the y-direction walls. Also, Figure 6 shows the model of various element damages. According to this figure, dominant damage modes are flexural and shear damages.

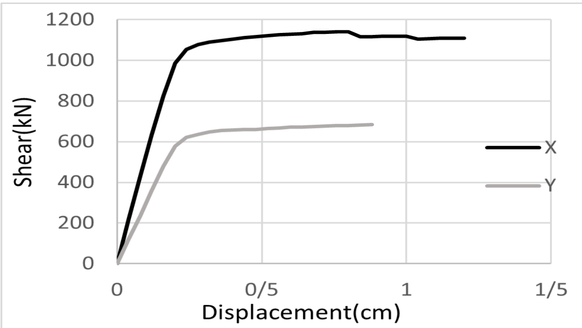

Fig. 5. Pushover Analysis Graph of Ali Monsieur House in 3MURI Software

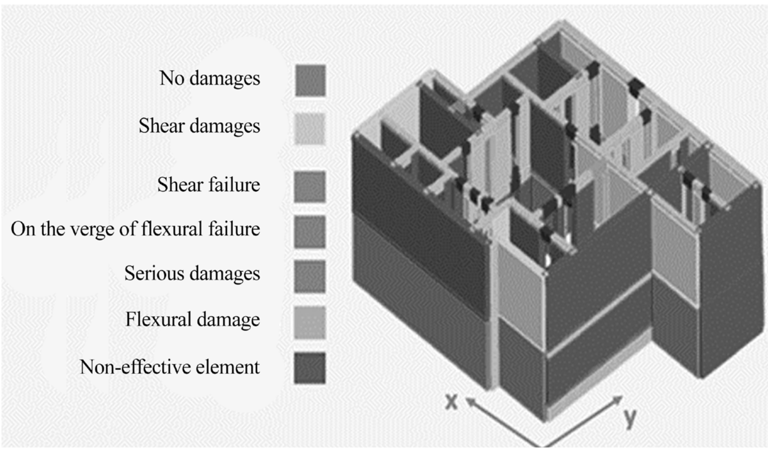

Fig. 6. Pushover Analysis Graph of Ali Monsieur House in 3MURI Software

6. FINDINGS

The safety situation of Ali Monsieur Houses was measured based on the DPCM guidelines. Also, the validity and reliability of the simplified mechanical relations (based on a force-based method (first level of assessment)), proposed by this guideline, were critically studied by matching them with a more complicated model (third level of assessment), which examines the non-linear and ductility of the building. Results from the first and third assessment levels under the ultimate limit state and damage limit state ae listed and compared in Tables 2 and 3. Under the SLU, the seismic safety index (Is), obtained from the first level (66%), was less than the seismic safety index (ά) of the third level. Also, under the SLD, the seismic safety index (Is), obtained from the first level (93%), was less than the seismic safety index (ά) of the third level. Also, the shear strength of the first level (58%) was less than that of the third level. Therefore, it is safe to say that the first-level assessment was more conservative than the third level because it considers fundamental simplification for describing the structural behavior and discards the non-linear behavior of the structure.

Table 2. Comparing Results of two Levels of Assessment for Ali Monsieur House under the SLU

	Is	Ά	Shera Strength (kN)
Level 1	0.633		525
Level 3		0.958	893
(Levels 1)/(Level 3)	0.66		0.58

Table 3. Comparing Results of two Levels of Assessment for Ali Monsieur House under the SLD

	Is	Ά
Level 1	1.861	
Level 3		1.995
(Levels 1)/(Level 3)	93%	

7. CONCLUSION

Iran has a rich ancient civilization and is home to thousands of historical buildings. A large number of these sites can be found in Tabriz City. Tabriz has gone through many destructive earthquakes due to its proximity to the north Tabriz Fault. These catastrophes have always threatened historical sites. For this, it is critical to take retrofitting measures for this building. It should be mentioned that the first step before retrofitting is to provide a seismic safety assessment.

Since no guidelines have been proposed in Iran for historical buildings, this study did a seismic safety assessment for examining the safety status of the historical Ali Monsieur House of Tabriz City under the Ultimate Limit State (SLU) and Damage Limit State (SLD) based on manual and numerical computations, proposed by the Italian DPCM guideline. Results of both levels indicated that the building did not have the necessary safety against regional seismicity conditions under the ultimate limit state; however, the site was found to be safe against the damage limit state, at both levels of assessment. The comparison between the first and third levels revealed that results of manual computations (the first level) were less than those of the third level; accordingly, the first level (manual computations) was concluded to offer more conservative results; however, it was found to be a simple and applied method for determining the safety situation of the building, because it does not need any accurate data on mechanical properties of materials.

It is notable to suggest that the two compared methods are not interchangeable; rather, they are at two different levels of assessment. In addition, the comparison should be considerably extended to a number of buildings to provide experts with more general results.

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CONFLICT OF INTEREST

The authors have no conflicts of interest to declare.

MORAL APPROVAL

The authors commit to observe all the ethical principles of the publication of the scientific work based on the ethical principles of COPE. In case of any violation of the ethical principles, even after the publication of the article, they give the journal the right to delete the article and follow up on the matter.

PARTICIPATION PERCENTAGE

The authors state that they have directly participated in the stages of conducting research and writing the article.

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