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Investigating the Quality Improvement of Architecture in term of the Use of Structure and Function in Traditional Architecture with the Approach of Investigation in the Religious Buildings of Mashhad

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ABSTRACT

Throughout the history of architecture, the structure has always played an effective role on architecture. Paying attention to the fact that the structure is a necessary and unavoidable part of the building can play a significant role in improving the quality of architecture. The traditional Iranian architect, by using the principles of Islamic architecture and geometry in the implementation of the building, has been able to be effective in improving the quality of the architecture of the implemented buildings. As a museum of traditional and Islamic architecture, Khorasan Architecture presents numerous and diverse works in this field. In this research, 41 historical monuments were selected by examining the religious buildings of Mashhad. The condition of the studied buildings was investigated in terms of the qualitative improvement of the Plate structure, the spatial structure and the illustrative structure in different historical periods from the Sassanid era to the Pahlavi period. With field surveys, it was found that 26 buildings have 65% improvement in the quality of plate structures, 15 buildings have 37.5% improvement in the quality of spatial structures, and 2 buildings have illustrative quality improvement in their records. Through the analysis, it was observed that most of the buildings were executed during the Safavid period and the quality improvement of the internal surfaces due to the plate structure was the most used with 22.5%.

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Introduction

Balance, which is the most important event in stability, means the state of non-movement and stillness in the whole and parts of the building. If the forces acting on the object are in balance with each other, the object will not move in that direction and this situation is called equilibrium. In fact, equal and opposite forces cause balance in the desired direction. In this condition, the incoming external forces and the internal and external reactions of the building are in balance. Resistance in a structural element means flawlessness of the structural components and the ability to withstand the loads applied to these components. This concept, which is directly related to the type of structural materials, means the amount of tolerance of a structural element under the applied forces.

Stability means the resistance of the building against overturning (against external forces), without its components being separated, which is called geometric stability. Geometric stability is related to the number and types of connections and how they are used (simple or roller connections and complex connections such as joints). On the other hand, there is resistance stability (internal stability) which is the concept of bearing load of material particles of the building under the influence of forces.

Structural form is the creation of beauty through cutting and appropriate size, in order to facilitate the flow of power in a structural system, which is of particular importance. Such forms are visually beautiful and effective.

Examples of this form can be seen abundantly in nature, and for this reason, designers take examples from nature; Therefore, in order to achieve a suitable and beautiful combination in the form, the designers should also consider the force cutting (Alami, 2015). In many cases, the structure is not visible and the architecture covers it (Brigati, 1997).

The important and significant point is that there is a grammar to understand and recognize the structure which depends on the force. Power is the basic pillar of the structure and its most important part. In fact, the structure is a geometric order for the transfer and flow of forces.

These are the forces that give different shapes, dimensions and characteristics to different materials; Therefore, in order to understand the structure, it is necessary to study and understand the forces and how they spread and distribute and withstand them in different materials.

Conscious regulation of the safe and smooth flow of forces in a component as well as in a set of components (the whole building) is one of the fundamental factors of the formation and emergence of the building form, Therefore, knowing the force and its components is essential (Alami, 2015).

Therefore, the position of the structure and its importance in the design and the role it has in shaping the form is a subject that must be studied due to its importance. On the other hand, the knowledge of how the knowledge of the structure was created, clarifies the relationship between this knowledge and architecture throughout history. Although the form is considered as a manifestation of architecture, the formation of the form depends on the structure; Therefore, the structure and its concepts and method of operation have the main role in creating the form (Iranmanesh, 2018).

The combination of architecture and structure is a combination of art, aesthetic values, technology, materials and their behavior, function and execution. The main goal of architectural design is to create forms that both meet the practical needs of the space and are successful in terms of aesthetics. Also, the purpose of the structure design should be to create forms that, while meeting the practical needs, also bear the applied loads in the best way and in an economical way. Therefore, the harmony between structure and architecture should be the creation of places and spaces that lead people to understand the meaning and identity of the environment. Also, the coordination of structure and architecture with the new knowledge of space against the material and spiritual needs of man provides a new solution in order to improve the quality of the environment and make it suitable for the desirable life of man (Jahan Tigh, 2015). It is important to acknowledge that the various elements of Islamic architecture have the capability to instill a sense of order, harmony, spirituality, identity, and vitality within the environment. This not only creates an aesthetically and emotionally pleasing experience for observers but also emphasizes the importance of understanding the identifying elements of Islamic architecture (Mirjalili, 2023).

in the process of creating an architectural work, the simultaneous design of the structure and architecture has always had a great result in the design of an architectural work; Architectural and structural designers have achieved different methods and ideas in an effort to integrate architectural and structural considerations, and nature has been a special source for providing efficient ideas in this field. The structure of nature has obtained unique patterns in response to each of the architectural and structural design categories, their use can be effective in creating optimal results (Hoseledar, 2013).

In ancient Iran, it is not everyone's job to create a traditional building that, in addition to a decent appearance, also pays attention to the interior and a valuable meaning. In ancient Iran, creating a traditional building that, in addition to a decent appearance, also pays attention to the interior and a valuable meaning, is not everyone's job and needs a special architect (traditional architecture).

Regarding the characteristics of this person and her training method, Qayoumi Bidhandi has given very good explanations:

The traditional architect considered his profession sacred, because he saw his place in a sacred chain through which he was connected to (the architect of the world). Architects considered God as the architect who raised the blue and huge dome of the world and created the whole world so beautiful and efficient that no weakness can be seen in it.

Therefore, we should look for similarities in architecture as well and in order, efficiency, beauty and inviolability, he imitated the divine mansion. The building should be built in such a way that it is in harmony with the architecture of the universe and it does not stand against the system of nature, but is considered a part of it (Qayyumi Bidhandi, 2015). Residential houses, as the main center of human life, should have the highest level of peace. Historical and traditional houses have a hidden peace inside them, which has diminished with the passage of time (Ghaemi, 2023).

A traditional architect was a builder who was an architect, engineer, contractor, designer and builder at the same time and he was the one who supervised the construction of buildings such as churches, palaces and other traditional and epic structures (Dorsey, 2013).

It is written in the dictionary of Dehkhoda (Dehkhoda, 2010), Designing means the action and job of a designer, planning, drawing a construction plan on paper or on the ground, monitoring means taking care and being under the supervision of having a job (official work and stewardship) and building, edifice. It is making and preparing, which has been addressed in the field of architecture under the title of construction and protection or repair (Rahim Nia, 2016). Architecture education has long been related to many topics. The assortment of these topics and their correct arrangement in the learning process has been one of the key subjects in forming educational systems and the description of courses in this university major. Simultaneously, the effectiveness of an educational system in educating people in the work environment is another concern that is considered as a measure of the quality of the same educational system in public judgment (Asgari, 2022).

In the Razi method, facade brickwork was done along with stiffening, and the building became more stable and its facade more durable. But in the Azeri way, first the building was made with clay or brick and rubble stone or pickaxe, with haste and in a rough way (without facade).

Then facade construction was added to it, which was either with a skin of bricks, brick knotting and plaster, or it was coated with plaster and painted on it. Little by little, the use of brick was reduced and it was replaced by tiles (glazed pottery) and potters with embossed designs (Mehri) (Pirnia, 2010).

Safavid kings who had relations with European countries and countries that were neighboring and close to Iran, such as India and Turkey today, which is called the Ottoman state. They used

luxury, beauty, glory and splendor in Iranian buildings, especially from the Ottomans Without having a tradition of Indians and Ottomans. For this reason, they added to the decorations of the buildings in every way (Pirnia, 2010).

During the Qajar dynasty, unfortunate events happened in Iran, which led to the weakness of the country and the loss of its various parts, the influence of foreigners and the weakening of the foundation and independence of Iran.in this period, we have the decline of Isfahani style.

At this time, when Iran's relations with the West increase, unfortunately, Iranians become self-absorbed and are influenced by the culture and civilization of the West. So that everything comes from the West and they consider themselves to be lacking in everything. Anyway, after the Isfahani style, there is no other style to replace it and no matter how much they tried to fix this discrete art field, they did not succeed.

In this period, they paid a lot of attention to decorations and found their place in palaces and residential houses. Mirroring and plastering quickly became common, large halls were decorated with various geometric shapes of mirrors (mirror hall of Golestan Palace) And the wooden roofs of the houses were painted (Pirnia, 2010).

Research Objectives

Main objective:

Improving the quality of architecture by using the structure in the group of plate structure, spatial structure and illustrative structure and its function in traditional architecture

Sub objective

1. How to model traditional architecture for quality improvement
2. How structure and architecture interact in the group of plate, spatial and illustrative structures
3. Investigating the religious and historical works of Mashhad city in terms of quality improvement in different historical period

Statistical Society, Sampling Method and Sampling Size

According to the available statistics of the national heritage registered in Khorasan Razavi province as in (Table 1), which is equal to 1372 until the time of preparing this text. By identifying the national heritage registered in the city of Mashhad as the city studied in this research, it was discussed and the number of registered inheritances was 218. By examining this heritage and separating the registered national religious heritage in Mashhad city, its number was equal to 50 heritages. These heritages have been placed in different historical eras in terms of number and variety and it makes it possible to examine the buildings from the point of view of

the integration of architecture and construction in different historical periods from the 4th century onwards.

Table 1. The number of registered heritages examined

Registered religious national heritage in city of Mashhad	Registered national heritage in city of Mashhad	Registered national heritage in Razavi Khorasan province
50	218	1372

The sampling method is also mentioned according to the reporting forms, in-person review and collection from the national heritage (Figure 1). Also, the studies conducted on each heritage and matching each of them based on the construction method, form, geometry and performance will be from the point of view of structural and architectural integration.

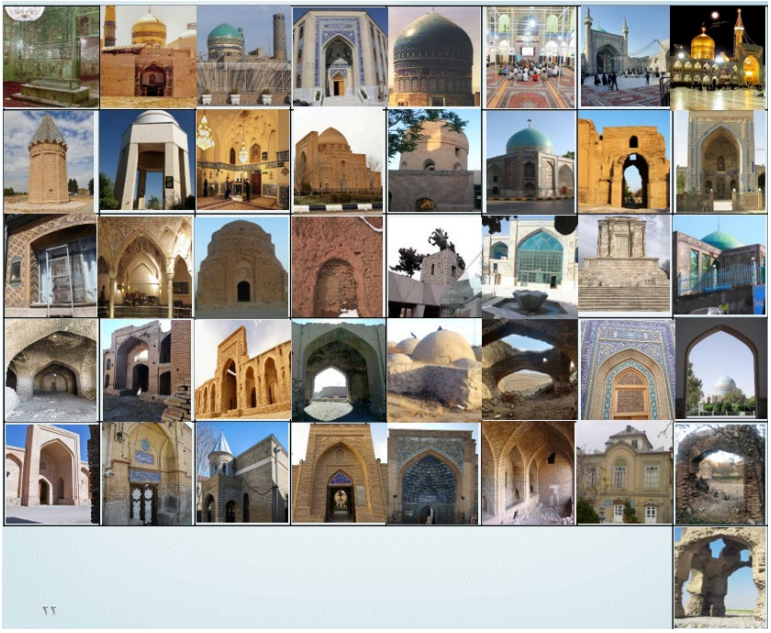

Figure 1. Image of the studied buildings

Research Method

Based on the purpose of the research and since in this research the relationships between the data have been dealt with using rational and analogical reasoning method, the research method is fundamental. From the point of view of the data collection method, according to the description of the conditions and buildings under investigation, the research method is based on the descriptive-analytical method.

In this research, first by examining the library of historical works in Khorasan province and then selecting the religious works in Mashhad city, it reached the number of 41 works that can be

checked in this city and then, we analyzed and analyzed these works with in-person collection and field study.

The condition of the studied buildings was investigated in terms of the qualitative improvement of the planar structure, the spatial structure and the expressive structure in different historical periods from the Sassanid era to the Pahlavi period. The results were analyzed and checked with SPSS software, and the results are presented in separate sections.

How to Enter and Process Data

By knowing the types of relationship between the structure and the physical or functional aspects of the building in architecture, we investigate the religious buildings in the city of Mashhad in different periods of history.

For this purpose, we will first collect the required items according to the field investigation of the desired works and then we will record the information by documenting the obtained information.

In order to record the information, the information collected for each building has been documented according to the prepared tables and analyze the requested items, we enter the collected information in SPSS software to obtain the required analysis.

Entering Multiple Response Data into SPSS

In some cases, each observation (subject) in a variable may have more than one response for example, a historical monument may be present in different historical periods during its lifetime. Therefore, it is necessary to record the historical periods in the form of multiple answers for such buildings.

In the upcoming project, the data was of multi-response type, which will be explained below on how to enter and exit from them. For example, the presence of 14 investigated buildings in 9 historical periods is recorded as numbers 0 and 1, where 1 means the presence of the building in that period and zero means the absence of the building in that period.

Improving the Quality of Internal Surface due to the Structure

The quality improvement of internal surfaces due to the structure can be checked based on the following:

Surface structure: The structure can help architecture by means of piling and creating texture on the surfaces.
- Spatial structure: spatial structure, like a self-standing column, has a tangible effect on the space around it (Ching, 1996).

Van Mis expresses his concern: "Some spaces have a lot of trouble becoming places. Consider an example of "neutral" spaces (Van Mis,1990).

- Expressive structure: which focuses on the meaningful role of the structure (Golabchi, 2019). The structure does not need to be clear and understandable. There is no firm or binding belief that a structure should be understood as a functional skeleton of a building or a machine built with advanced technology. Of course, it can be vague or obvious; it will be a precious experience in my mind, if some kind of puzzle or a layer of ambiguity, casts a curtain on my perception of "structure" (Balmond, 2002). According to the mentioned cases, it can be said that the structure is a geometric order for the transmission and flow of forces.

In addition to a decent appearance, traditional buildings have also paid attention to the inside and a valuable meaning. In addition to being an architect, the traditional architect was also a structural engineer.

By using the specifications mentioned above, it is possible to categorize the factors and specifications that express the integration of architecture and structure Therefore, a building from the perspective of form, qualitative improvement of the internal surface due to the structure will be placed in the group of Surface structure, spatial structure or expressive structure.

Quality Improvement Review

In the (Table 2 and Figure 2), the condition of the studied buildings has been checked in terms of quality improvement.

Table 2. Examination of buildings in terms of quality improvement

Percentage of all buildings	**Answers**		**Quality improvement**
	Percentage	**Number of responses**	
65%	60.5%	26	**Surface structure**
37.5%	34.9%	15	**Spatial structure**
5%	4.6%	2	**Illustrative structure**
107.5%	100%	43	**Total**

- Based on the obtained results, it can be seen that 26 buildings have the quality improvement of the Surface structure in their record. In other words, 65% of the studied buildings have been identified in this quality improvement.
- Based on the obtained results, it can be seen that 15 buildings have quality improvement of spatial structure in their portfolio, in other words, 37.5% of the studied buildings have been determined in this quality improvement.

- According to the conducted study, it can be seen that 2 buildings have the qualitative improvement of the Goya structure in their records. In other words, 5 percent of the studied buildings have been determined in this quality improvement.
- Quality improvement according to the last column of the (Table 2) is also depicted in the (Figure 2):

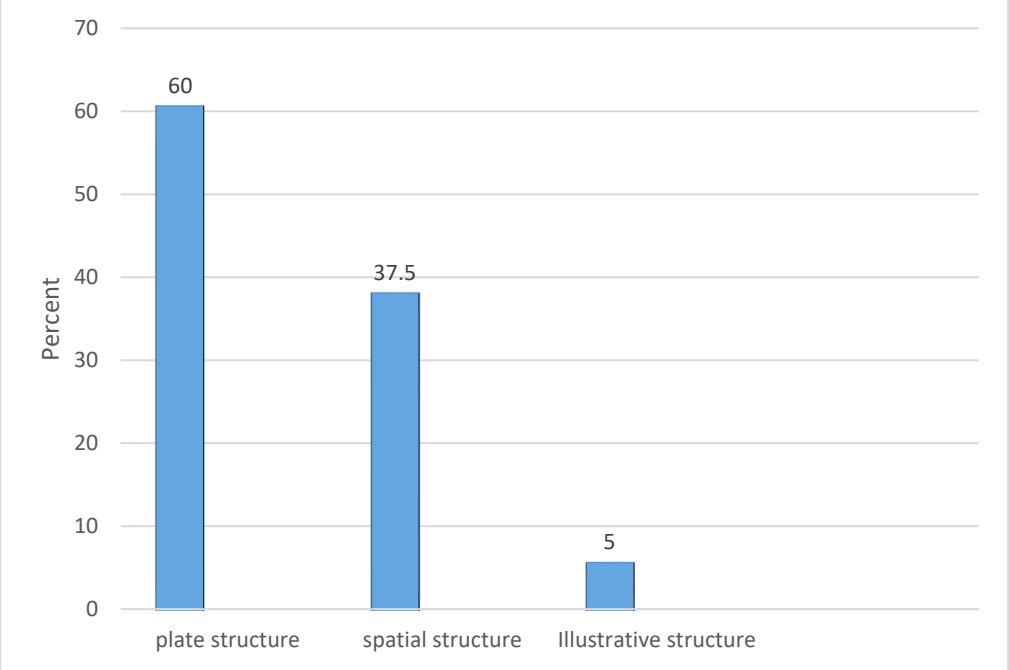

Figure 2. The percentage of quality improvement in the studied buildings

Simultaneous Examination of the Historical Period and Other Variables in the Studied Buildings

Investigating the Historical Period and Improving the Quality of Buildings

In order to simultaneously examine the historical period and improve the quality of the studied buildings, the (Table 3) was prepared.

Table 3. Examination of buildings in terms of historical period and quality improvement

		Total	Quality improvement	Indicator	Historical period
	Illustrative structure	**Spatial structure**	**Surface structure**		
1	1	1	1	Abundance	Samanian
	100%	100%	100%	Percentage	
1	1	1	1	Abundance	Ghaznavi
	100%	100%	100%	Percentage	
6	1	3	4	Abundance	Seljuks
	16.7%	50%	66.7%	Percentage	
12	2	6	7	Abundance	Timurian
	16.7%	50%	58.3%	Percentage	
14	1	6	9	Abundance	Safavian
	7.1%	42.9%	64.3%	Percentage	
2	1	1	2	Abundance	Afsharian
	50%	50%	100%	Percentage	
10	1	2	9	Abundance	Qajar
	10%	20%	90%	Percentage	
4	1	2	3	Abundance	Pahlavi
	25%	50%	75%	Percentage	
40	2	15	26	Abundance	**Total**

In 41 studied buildings, quality improvement is observed in 40 buildings and the following results were obtained and shown in (Figure 3):

- In the Samanian historical period, a building has a qualitative improvement of the type of Surface structure, spatial structure and expressive structure.
- The historical period of Ghaznavid is a building with a qualitative improvement of the type of Surface structure, spatial structure and expressive structure.
- In the historical period of the Seljuqs, out of 6 buildings with qualitative improvement, in 66.7% of the buildings, the improvement is of the Surface structure type. In 50% of the buildings, the improvement of the spatial structure has been used. In 16.7 percent of the buildings, the improvement of the Goya structure has been used.
- In the historical period of the Timurids, out of 12 buildings with quality improvement, 58.3% of the buildings are of the type of surface structure. In 50% of the buildings, the upgrade of the spatial structure has been used. In 16.7 percent of the buildings, the improvement of the Goya structure has been used.

- In the historical period of the Safavids, out of 14 buildings with quality improvement, in 64.3% of the buildings, the improvement is of the Surface structure type. In 42.9% of buildings, spatial structure improvement was used. In 1.7% of the buildings, the improvement of the Goya structure has been used.
- In the Afsharian historical period, out of 2 buildings with quality improvement, in 100 percent of the buildings, the improvement is of the Surface structure type. In 50% of the buildings, the upgrade of the spatial structure has been used. In 50% of the buildings, the improvement of the Goya structure has been used.
- In the historical period of Qajar, out of 10 buildings with quality improvement, in 90% of the buildings, the improvement is of the plate structure type. In 20 percent of the buildings, the improvement of the spatial structure has been used. In 10 percent of the buildings, the improvement of the Goya structure can be seen.
- In the Pahlavi historical period, out of 4 buildings with quality improvement, in 75% of the buildings, the improvement is of the Surface structure type. In 50% of the buildings, the improvement of the spatial structure has been used. In 25% of the buildings, the improvement of the Goya structure has been used.

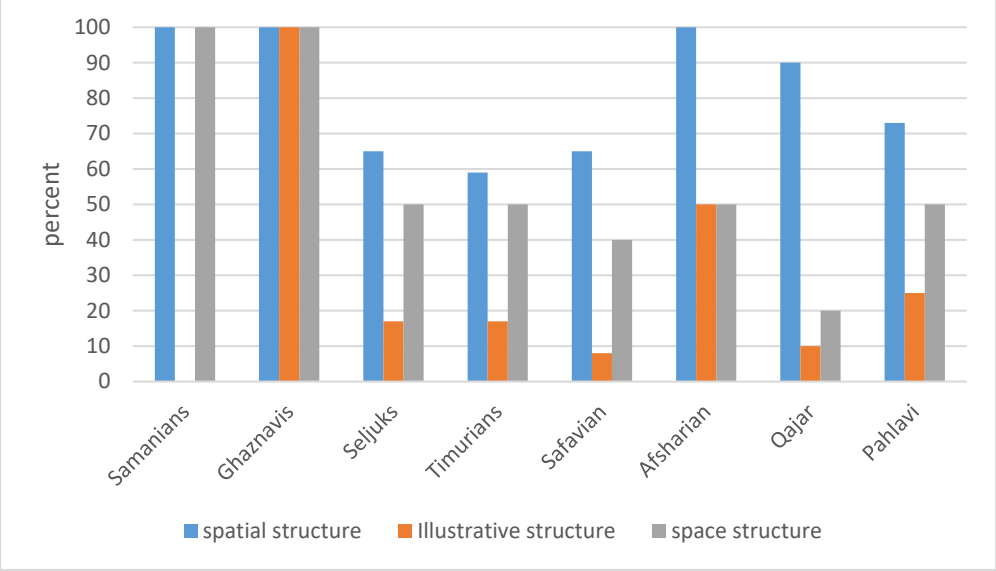

Figure 3. Review of quality improvement by historical periods

Investigating the Type of Building Quality Improvement in Different Historical Periods

In order to simultaneously examine the historical period and improve the quality of the studied buildings, the (Table 4) was prepared.

Table 4. Examination of the buildings in terms of the quality improvement of the building in different periods

All	Quality improvement			Indicator	Historical period
	Illustrative structure	**Spatial structure**	**Surface structure**		
1	1	1	1	Abundance	Samanian
	50%	6.7%	3.8%	Percentage	
1	1	1	1	Abundance	Ghaznavi
	50%	6.7%	3.8%	Percentage	
6	1	3	4	Abundance	Seljuk
	50%	20%	15.4%	Percentage	
12	2	6	7	Abundance	Timurian
	100%	40%	26.9%	Percentage	
14	1	6	9	Abundance	Safavian
	50%	40%	34.6%	Percentage	
2	1	1	2	Abundance	Afsharian
	50%	67%	77%	Percentage	
10	1	2	9	Abundance	Qajar
	50%	13.3%	34.6%	Percentage	
4	1	2	3	Abundance	Pahlavi
	50%	13.3%	11.5%	Percentage	
40	2	15	26	Abundance	**Total**

Out of all the studied Surface structures, most of the buildings (equivalent to 34.6%) belong to the Safavid and Qajar period. Of all the buildings of spatial structure studied, most of the buildings (equivalent to 40%) are equally located in the Timurid and Safavid periods. Also, most of the buildings with Illustrative structures (equivalent to 100%) were located in the Timurid period.

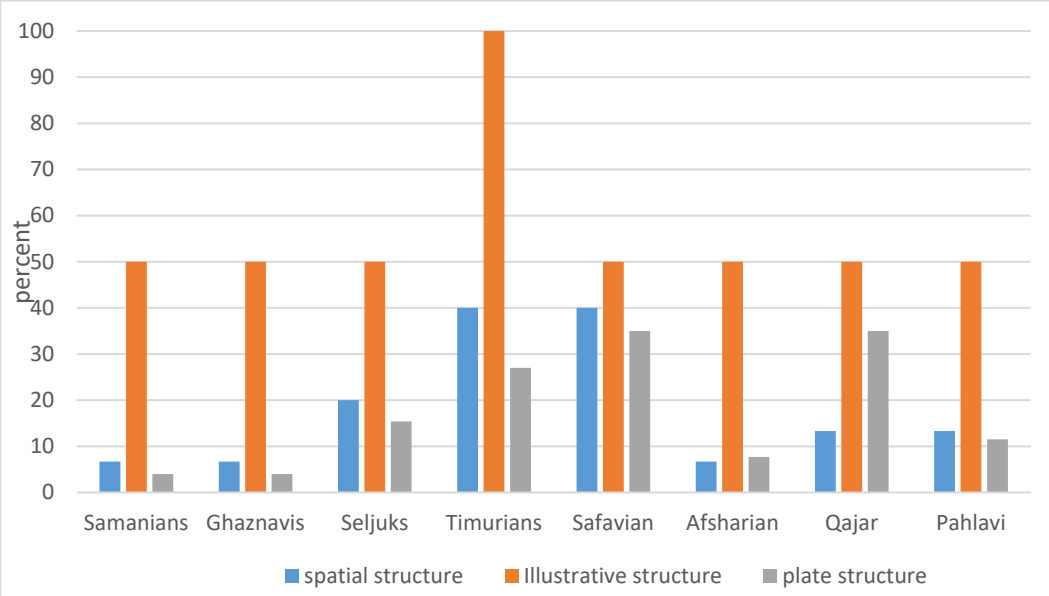

Figure 4. Examining the percentage of quality improvement of different buildings in different historical periods

In (Table 5 and Figure 5), the percentage of the total has been considered, in such a way, 40 buildings that have been upgraded in quality and the type of their historical period is known, are considered 100% ,and the percentages are calculated.

Table 5. Examination of the buildings in terms of the quality improvement of the building in different periods

All	Quality improvement			Indicator	Historical period
	Illustrative structure	**Spatial structure**	**Surface structure**		
1	1	1	1	Abundance	Samanians
2.5%	2.5%	2.5%	2.5%	Percentage	
1	1	1	1	Abundance	Ghaznavis
2.5%	2.5%	2.5%	2.5%	Percentage	
6	1	3	4	Abundance	Seljuks
15%	2.5%	7.5%	10%	Percentage	
12	2	6	7	Abundance	Timurians
30%	5%	15%	17.5%	Percentage	
14	1	6	9	Abundance	Safavian
35%	2.5%	15%	22.5%	Percentage	
2	1	1	2	Abundance	Afsharian

5%	2.5%	2.5%	5%	Percentage	
10	1	2	9	Abundance	Qajar
25%	2.5%	5%	22.5%	Percentage	
4	1	2	3	Abundance	Pahlavi
10%	2.5%	5%	7.5%	Percentage	
40	2	15	26	Abundance	**Total**

- Out of all the considered buildings, only one building has had a qualitative improvement during the Samanid and Ghaznavid periods, which is equivalent to 2.5% of all buildings, and it is a Surface structure, a spatial structure, and an illustrative structure.
- In the Seljuq period, a total of 6 buildings were upgraded, most of them were Surface structures, and they constitute 15% of all buildings under investigation.
- The Timurid period, the number of buildings reaches 12, which constitutes 30% of the total buildings, and 17.5% of the buildings are plate structures.
- In the Safavid era, when we have the largest number and percentage of buildings under investigation (14 buildings and 35% of all buildings), the highest percentage of quality improvement of the Surface structure has also happened.
- Only two buildings have been upgraded in the Afshariya period and they comprise 5% of all buildings under investigation.
- In the Qajar period, 10 buildings and 25% of all buildings had building upgrades, the majority of which is equal to 22.5%, belongs to the quality improvement of the Surface structure.
- During the Pahlavi period, 4 buildings and 10% of all the buildings under investigation have been improved in quality.

Of all the studied buildings, most of the buildings had a qualitative upgrade of the planar structure and were located in the Safavid and Qajar period.

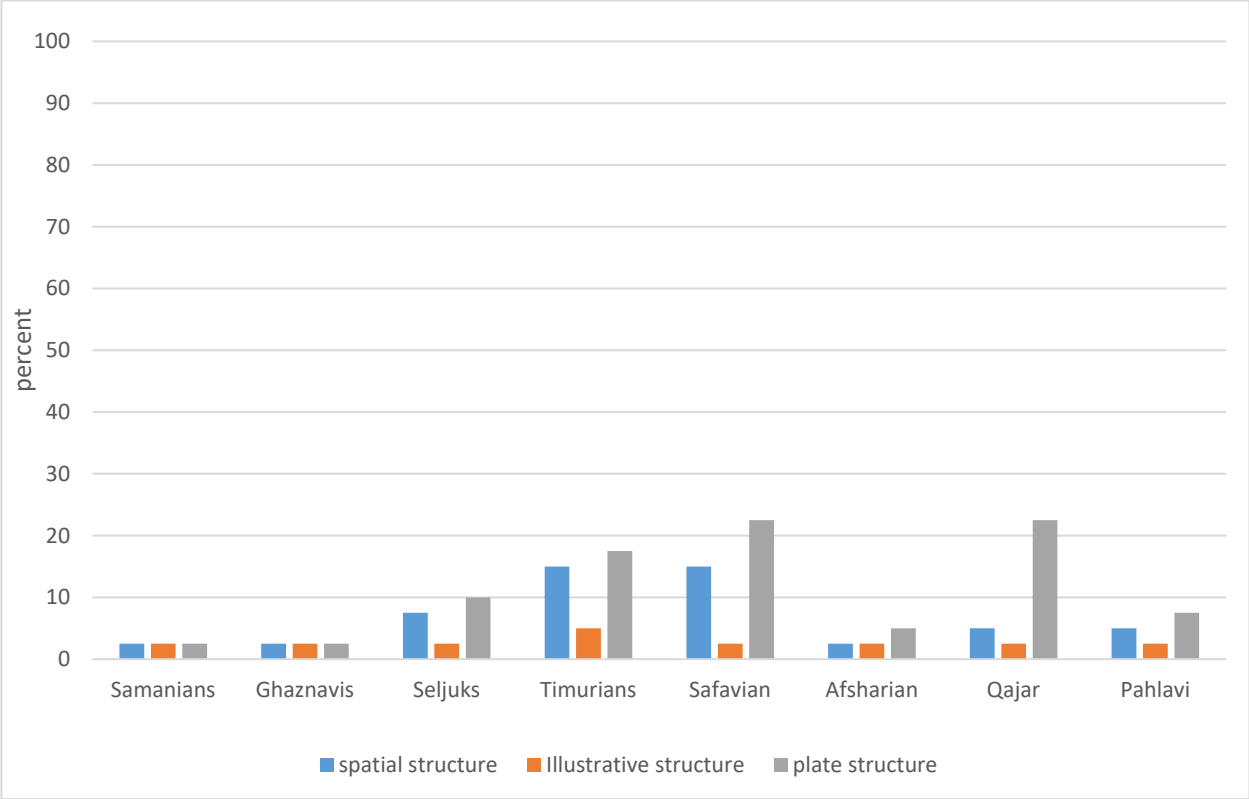

Figure 5. Examination of buildings in terms of quality improvement of different buildings in historical periods (percentage of the total)

Conclusion

According to the survey of 41 historical monuments, the following results were obtained, the results that are mainly mentioned are related to the features that at least 50% of the buildings had that feature and its type may be different.

- By examining the historical periods of the buildings, it was determined that 15 buildings have the Safavid historical period in their records. In other words, 36.6% of the studied buildings were determined in this historical period. Also, 29.3% of the buildings were in the Timurid period and 24.4% of the studied buildings were in the Qajar period.
- The inspection of the buildings in terms of quality improvement showed that 65% of the buildings have quality improvement of the plate structure type. Also, 37.5 percent of the buildings have quality improvement of the spatial structure type and the rest of the quality improvement of the illustrative structure type.

The results of the simultaneous examination of the historical period and variables show the following:

- Examining the quality improvement of the buildings shows that the plate structure has been used the most and was used in all the Samanid, Ghaznavid, and Afsharian

buildings and in the Safavid and Qajar historical periods, it includes more than 22% of all the investigated buildings

- By examining the religious buildings of the city, it was determined that the traditional architect was able to improve the quality of the building by using the surface structure as an influencing element on the architecture, and in this way, he benefited from the integration and combination of architecture and structure and create a sustainable building in the history of architecture.

Author Contributions

All authors contributed equally to the conceptualization of the article and writing of the original and subsequent drafts.

Data Availability Statement

Not applicable

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Ethical considerations

The study was approved by the Ethics Committee of the Islamic Azad University, Mashhad Branch. The authors avoided data fabrication, falsification, plagiarism, and misconduct.

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Conflict of interest

The authors declare no conflict of interest.

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