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Screening of Architectural Values Effective on Shaping Historical Bridges from Sarcheshme to Zayandeh River

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Research Article

Abstract

Bridges were built in historical periods to cross floods and rivers and created value after construction. They often had remarkable beauty in terms of proportion and design. They displayed power and kindness, they also kept the functions of tourism and spending time as part of the urban space that accommodated urban life. This study was conducted to extract and categorize the architectural values effective on the shaping of historical bridges and screening them based on fuzzy Delphi, the research method is survey type and based on component screening. The research method is applied in terms of purpose and survey method. For this purpose, through document analysis and library studies of articles and books, the hidden architectural values effective in shaping the historical bridges of Zayandeh River were extracted, and then a questionnaire was compiled to examine the contribution of each component from the point of view of spatial users and screening among the spatial users of historical Zayandeh river bridges. Questionnaires with a Likert scale are designed and provided to the group of space users. The fuzzy Delphi technique and MATLAB software were used. The Delphi method consists of three steps: Fuzzification, Inference, and De-fuzzification. The results indicate that the color component from the physical dimension has a membership rate of 0.37 and the final class L has the lowest value and meaningful shapes with a value of 0.81 and the VH class has the highest membership degree in the cultural dimension of the component of avoiding futility with a value of 0.87 and the L class related to substance and meaning and the component containing traditions with values of 0.46 and 0.51 and class H related to self-sufficiency with a value of 0.7 and class VH related to flexibility dimension, the sense of

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place component with a membership value of 0.89 and M class and the medium membership degree is related to spatial elements with a value of 0.56. In the inferential analysis of correlation, it is determined that the spatial dimension can have the greatest impact on other dimensions and also the lowest component is related to this dimension. Paying attention to multiple functions in selected bridges leads to supporting various activities.

Keywords: Screening; Hitorical Bridge from Source to Wetland; Hidden Values

1. Introduction

The bridge is one of the most important buildings and infrastructures of urban and regional development. Considering its shape, the bridge can be considered a symbol and even a sign, and attention to both aspects of the structure and architecture of the bridge can be considered a work. Bridges have long been a means of crossing rivers and a means of connecting different parts of human habitats, and when people thought of building a bridge to cross the water, crossing streams and rivers was done in shallow river crossings. The first step in building a bridge to cross the river was placing a tree trunk on the water in the narrow place of the river and crossing it. The design and structural capabilities of bridges provide living space and the historical investigation shows the historical evidence of the integration of the bridge. The current research relies on the hidden values of bridges and pays attention to the complexity of spatial experiences, structures, and forms of bridges of different periods from the Achaemenid period to the Safavid period, which indicates the culmination of a deep background in the design tradition and the experiences of architects in the field of bridge design in Iran and the inner-city and outer-city bridges design have mostly depended on the function and topography of the place. Because of the openings and the general shape of the bridge, it was a function of the execution conditions, the conditions of passing water, and the ability of water to pass through the large openings in the middle (Partovi, 2004: 96).

Its value and understanding in society are directly related to its actions, behaviors, and cultural and social beliefs. As a result, the value in each society is equivalent to the accepted norms of that society. These norms are obtained through tradition, religion, social relations, etc. Any community that can accurately and comprehensively identify and evaluate its values can represent and even reproduce its cultural elements and identity signs. The existence of value in historical works is accepted today (Chapman, 2004: 216). Thus, one of the research issues for the recognition of historical monuments is the discussion of the recognition of values and phenomena related to their evaluation of historical monuments.

One of the most important issues related to bridges in urban spaces is ignoring the aesthetic qualities and considering them only as a functional structure independent of the environment in which they are placed. To create functional and beautiful bridges, designers should consider both engineering and architectural approaches together. On the other hand, based on the definitions and studies conducted in the field of hidden values of bridges, one of the most important effective factors is creating harmony between the bridge and its surrounding environment, and the harmony between the bridge and the environment in which it is located, and the necessity and importance of research in the field The aesthetics of bridges is the visual fit between bridges in different periods and the investigation of hidden values in the historical bridges of Iran and the evaluation of people's perception of the visual qualities of historical bridges. Spatial designers and users have two different views on historical values, which requires the investigation of people's views regarding historical monuments and the role of each of the values in shaping historical monuments.

This research is aimed at extracting hidden values and screening them concerning residential complexes, which tries to answer the question of how many of the hidden values of architecture can be effective in shaping historical bridges and how many can be removed.

2. Theoretical Foundations

2.1. Historical Bridges

Probably, the oldest and most primitive form of the bridge goes back to the time when mankind was able to use the trunks of trees and large stones to make it possible to cross streams, valleys, and canals. Therefore, the construction of the bridge and its use in mountainous areas with natural complications has been more common than in flat and desert areas. In general, bridges can be divided into four groups in terms of engineering (Ataei, Miri, and Tajalli, 2017: 1834 -1842):

1. Suspension bridges

In these bridges, the passage of the bridge is suspended by a rope that is connected to the two banks of the river. To build these bridges, they usually tied six strands of bamboo (bamboo) at a short distance from each other on both sides of the river, then placed thick boards on them in the width direction, and pulled ropes on both sides of the bridge to prevent pedestrians from falling. These bridges were neither horizontal nor straight like wooden bridges, nor like arched bridges that sometimes curved upwards. On the contrary, they naturally curved downwards when the passerby passed. Therefore, these bridges can be called chain arch bridges (Belmin and Siedel, 2005: 391-408).

Fig 1 Abroud salt suspension bridge made of wood and rope (source: wisgoon.com)

2. Boat or floating bridges

The construction of this type of bridge in stagnant water is easy, but in case of water flow, skilled boatmen must be employed to be able to keep the boats in place at appropriate distances so that it is possible to put beams and planks on them. In times of strong water flow, to keep the floating bridge in place, they pull a strong chain or rope across the river and tie its two ends to strong support on both sides of the river. Although the history of using boat bridges goes back to the 9th century BC, such structures must have a much earlier history (Belmin and Siedel, 2005: 391-408).

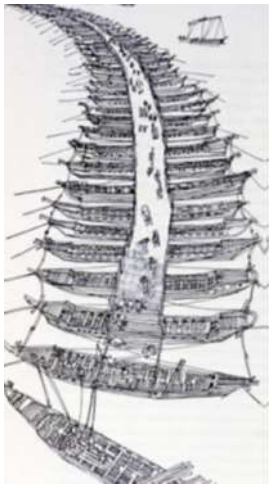

Fig 2 Design of a boat bridge (source: p30world.com)

3. Wooden bridges

The passage in Tiri bridges is in the form of a wooden beam that rests on the two banks of the river at both ends. In their most primitive form, these bridges consisted of one or more wooden beams over a waterway or a narrow valley. However, the necessity of crossing very wide rivers, where a log was shorter than the width of a bridge, caused that for the construction of wooden bridges, their prepared foundations were raised so that the distance between the two sides of the river was reduced and wooden beams could be placed on them. Because of this, the researchers called these bridges trestle bridges, and in fact, the real and evolved form of wooden bridges starts from here (Ellis, 2000).

Fig 3 An example of advanced wooden bridges in Australia (bibbulmuntrack.org.au)

4. Arch bridges

In terms of engineering, these bridges can be placed at a higher level than girder bridges. The construction of this type of bridge started in the Mianrodan region of Iran. Boat bridges, despite their advantages, because they hindered shipping, were replaced by arched bridges in many large rivers. The construction of single-span arch bridges is not so difficult, especially when the weight of the bridge is imposed only on the river bank. But the creation of multi-span arched bridges is associated with important problems, the most important of which is ensuring the strength and

stability of the bridge foundations in the river bed. Especially when the water flow is strong (Rahimzadeh and Najafi, 2010: 71).

Fig 4 Dezful Bridge in 1885 (source: shooshan.ir)

3. Types of Historical Bridges

1. The period of Urartos

The oldest bridge in Iran, the remains of which remain, is the bridge that the Urartos built over the Aras River in the 8th century BC.

2. Achaemenid period

There are also bridges from the Achaemenid period. British archaeologists have identified one of these bridges, which was built in Pasargad in the 4th and 5th centuries AD, and brought them out from under the soil. In this period, it was customary to build dual-purpose bridges known as pul-band for irrigation of the surrounding areas, which can be called Dokhtar Band with two gabled arches (Koch, 1994: 72).

3. Sasanian period

Walerin Bridge or Qaisar Bridge in Shushtar is an example of a Sassanid bridge. This bridge was built by Roman soldiers and engineers who were captured by Shapur I along with the Roman emperor Valerianus in 260 AD. Another bridge that was built during the time of Shapur II is the Dezful bridge. Among the other arched bridges of the Sassanid era, the ruins of which have seven sources, Shapuri Bridge is two kilometers from Khorram Abad. In Kermanshah, on the old road from Biston to Takht Shirin and Sarmaj, the foundations of a huge bridge are left, which is known as Khosrow or Khosravi Bridge, and it is attributed to Khosrow Sassanid (Gruther, 2009: 76).

4. Islamic period

In addition to the many beautiful arched bridges that were built by the Romans or Iranians before Islam, many bridges were also built in the Islamic era. Between the third and fifth centuries, there were several famous bridges in Khorasan. During the Safavid era, especially due to the adoption of the policy of expanding the caravan routes and increasing the caravansary, many bridges were built in different regions of Iran, the most important of which are the Khaje Khajo Bridge, the Thirty-Three Bridges, the Marnan Bridge, and the Joy Bridge. Another interesting bridge is the Khan Bridge, which was built in the early 11th century on the way from Isfahan to Shiraz on the Kurd River. The base of this bridge, which is based on raised rocks, is made of stone and arches, and its body is made of bricks (Badkobeh, 1995: 157).

The bridges were built in the last two years; following the new puzzle, they are created with iron or reinforced concrete and their surface is decorated with natural stones. Two bridges are more important in Iran's railway route: the Veresk Bridge, on the way from Tehran to Gorgan, which is a

metal bridge, and a steel bridge in Kotor Valley, which was built in the 1960s by Austrian engineers (Fielden Bernard and Yukilhto, 2016: 51).

4. Hidden Values of Historical Bridges

4.1. Definition of Value

The word "value" is the infinitive noun of "Arizidan" and in the Persian language, it means price, price, value, rank, merit, merit, worthiness, beauty, and beauty (Moin, 1992: 99). In the Oxford dictionary, value is defined as an important belief in life, about what is right or wrong. This term is one of the concepts that has attracted the attention of many researchers in various fields, and this itself has caused ambiguity in its use in each specialized field (Rahimzadeh and Najafi, 2010: 71). Rukich has divided values into two main groups: instrumental values (which are related to behavior) and ultimate values (a desirable goal that is worth striving to achieve). Values are significant in both objective and subjective dimensions. Objective values exist outside and in our world and can be discovered, and from this point of view, there is a difference between the psychological experience of judgment and the situations related to what is formed in judgment. On the other hand, subjective values depend on the individual's desire and feelings, and on this basis, values in different areas (goodness, beauty, truth, etc.) vary from one person to another, from one group to another, and from one group to another. It is different from one era to another (Badkobeh, 1995: 157).

Table 1 Definitions of value in the opinion of thinkers and researchers

Row	Thinkers and researchers	Definition
1	Rokic	Relatively stable opinion or belief / the factor of preference for a certain behavior or state (Adesnik and Ben Taleblu, 2019: 347)
2	Schwartz	Guiding choice or evaluation of behavior and events (Schwartz, 1992).
3	Rafipour	A relatively stable opinion or belief is the reason for preferring a certain behavior or an ultimate state (Rafipour, 1999: 11).
4	Williams	Criteria and rules of moral judgment about affairs (Sadra and Ghanbari, 2008: 151).
5	Khorasani Mullah	Gentleness and opposition to the power of reason (Sahizadeh, and Izadi, 2004).
6	Allameh Tabatabai	The distinction between the real/born value and the sentimental parasite according to human needs (Hasani, quoted by Tabatabai, 2013).
7	Marx	Theoretical concepts created and propagated by Faradastan in order to validate and legitimize their special privileges (Johnson, 2013: 31-34)
8	Sartre	The meaning chosen for life (Sartre, 2005: 77).
9	Inglehart	Material values: satisfaction of basic needs for life/extra-material needs, satisfaction of inner and pleasurable needs and collective participation (Roche, 1999:6-175).
10	Allameh Jafari	The utility that is abstracted from the usefulness of a truth (Jafari, 1999: 276).
11	Maslow	Equivalency of the concept of need/biological basic/transformation of values with individual growth into social values (Roche, 2018: 78).
12	Koen	Rooted and deep feelings that the members of the society share/determine the actions and behavior of the society (Coen, 2012: 61).
13	method	Ideal/desirability of people or behaviors (Roche, 1999: 76-77).
14	Young	A range of essential ideals and attitudes that give priority to motives and actions to achieve goals (Yung, 1949: 110).
15	Murray	The motivational factors of personality/esteem and value or power that everyone sees in affairs (Schultz, 2009: 31-44).

16	Parsons	An element of institutional systems, including criteria for choosing open and broad orientations (Mills, 1990: 2-41).
17	Horton Cooley	Beliefs about the importance or unimportant of experiences or the correctness or incorrectness of customs, thoughts and actions (Roche, 1999: 50).
18	Mesbah Yazdi	Both completely absolute and unchangeable nor subject to temporal and spatial conditions/ its principles are fixed and its examples are variable (Mesbah, 2000: 165).

Its value and understanding in society are directly related to its actions, behaviors, and cultural and social beliefs. As a result, the value in each society is equivalent to the accepted norms of that society. These norms are obtained through tradition, religion, social relations, etc. Any society that can accurately and comprehensively identify and evaluate its values, can represent and even reproduce its cultural elements and identity signs. To be known, the value in society must have a dynamic identification and evaluation process, and one cannot expect accurate and comprehensive identification of values from a static and static process (Bentley, 2010: 81).

4.2. Historical Values

Historical values can be the result of the process of creating a historical urban context, which is referred to as a result of measuring the qualities of "idea", "design", "connection with nature" and "unity and harmony between works" in the context. Many historical works have the quality of ideas based on the relationship between the wants and needs of those who created them with genuine human needs (Rahimzadeh and Najafi, 2010: 253). Also, in terms of design, many works have special features in terms of geometry and structure and have been able to turn the idea into a design in a suitable way. The two qualities of "connection with nature" and "unity and harmony between works" also result from proper design, which, if followed, add to its value. The existence of value in historical works is accepted today. Thus, one of the issues under research for the recognition of historical monuments is the discussion of the recognition of values and phenomena related to their evaluation in historical monuments (Azkia and Ghafari, 2013: 96).

4.3. Concept and Aspects of Quality

The concept of quality has two objective and subjective dimensions. The objective dimension of quality is related to the look and appearance of the work (forms, colors, and materials) which can be measured by physical indicators, and its subjective dimension is related to good features, values, and the degree of proportionality with a specific purpose.

The subjective dimension of quality focuses on defining and determining its layers and indicators. Also, they specify that the subjective dimension of quality, unlike its objective dimension, has a value load and implies being good, positive, desirable and desirable, suitable, and promoted. As a result of the quality, based on who evaluates it, this evaluation will be different based on the appropriateness of what goals and expectations are done and what is considered standard, priority, and value for the evaluator.

4.4. Common Concept of Quality in Architecture

In architectural literature, three levels of interpretations can be identified and presented:

A) Structural and functional quality

It is a level of quality in architecture that is indicative of its structural or physical aspect. Some have considered this aspect very important; because, in his opinion, when a building does not reach the desired structure, or the users' requirements in the form of performance are not met correctly or at all, how can we talk about architectural quality? The clarity of such quality in architecture was

related to the criterion of "practicality". In his opinion, paying attention to the structure of a building according to the functional requirements makes the architectural effect attain the characteristic of quality (Fielden Bernard and Yukilhto, 2016: 51).

Functional and structural quality primarily refers to the form and efficiency of the building, practical use, and usability, as well as the quality of its implementation. This type of quality requires the building to be accessible to everyone, provide enough spaces, have a specific layout and be flexible enough, and also provide a place that is safe, healthy, and pleasant.

Since the contemporary construction industry also emphasizes structural desirability and functional efficiency in the process and product, this has caused designers to evaluate their works by this aspect of quality, prefabricated systems, and environmental standards. New materials and methods are used, which is why architects have found this pervasive belief in conflict with architectural culture. Of course, this issue is a self-made problem of architects, and Adam Schar in his book "Quality out of Control" shows that it was influenced by a scientific model of architecture that was very influential at least in the British professional community in the late 1960s and early 1970s (Koch, 1994: 72).

B) Environmental and spatial quality

Another common interpretation of the quality of architecture is the observer of its environmental and spatial quality. This aspect of quality refers to the physical space or man-made environment in that it is a set of phenomena or objective facts that are perceived through mental experience. Concerning this interpretation, the foundation of architecture is determined based on two components: "the objective nature of the environment and space" and "the mental relationship of people with them". Based on this, in the conceptual framework of quality-oriented theories in architecture, mainly three approaches: objective (evidence), subjective (evidence) and subjective objective (interactive) determine levels and quality (Gardner, 2010: 76). Perhaps it can be said that the objective approach to the nature and object of the architectural work, the subjective approach to human perception and knowledge of the architectural space, and the overall objective-subjective interactive approach to the environmental quality of architecture.

The images that arise from the environment in the observer's mind are considered to be the result of a two-way flow between the observer and his environment (Gruther, 2009: 76). Therefore, interaction is considered to mean mutual influence between the users and the physical environment, and the quality of the environment is interpreted as the degree of connection and correlation between the mentalities of the audience of the environment and its basic characteristics. In this interactive relationship, the relationship between the environment and its users is not just a simple relationship, but a relationship consisting of a set of relationships between the two, which is proportional, meaning the correlation and appropriateness of two things with each other. Each other is interpreted.

C) Nameless quality

It is a subtle type of freedom from internal and external contradictions that is not the same anywhere. Every structure has internal unity as long as it has this quality, which means that it is compatible with its internal forces. The ultimate goal of using quality patterns has been to achieve such quality. In this regard, patterns must reach that degree of quality to bring life to the environment (Gardner, 2010: 76).

5. Research Method

The research method is applied in terms of purpose and survey method. First, to compile the questionnaire, experts were interviewed. Choosing the circle of experts is a very important part of

the Delphi method. The awareness of this group is a good guarantee for the high quality of Delphi results; therefore, the members of the Delphi circle in a study are selected based on specialization, not based on a random selection process. As a result, the researchers first selected a list of 14 university professors who have extensive knowledge and vision in the field of architectural values and historical bridges and have scientific-research articles and ISI. In the first step, a semi-structured interview was arranged. In these interviews, the researcher tried to explore the approach and its relationship with the field of urban planning and architecture and to identify the experts' view on the subject of the hidden values of architecture effective in shaping historical bridges from their point of view. Also, due to the wideness and abundance of the existing bridges, the selected bridges were selected from the prioritization system by prioritizing the Kendall coefficient.

The second survey was used to collect the opinion of each specialist about each K variable. If a variable is suggested, it is added to the list and additional variables are deleted. Finally, the desired questionnaire was compiled. The structure of the questionnaire includes questions related to the main question of the research; That is, the investigation of the effect of each of the hidden values of architecture in the shaping of historical bridges and in the direction of responding to it. According to experts, architectural codes and values were classified into 4 subject categories. These categories were: physical, climatic, spatial, and cultural, then the extracted factors were examined by a circle of fourteen experts in the form of a closed questionnaire with five-point Likert answers. According to the hidden values of the historical bridges, the questions related to each factor include scores, from their sum, we arrive at the score related to the value of the sense of place in that bridge, which has been examined separately for each element, according to this analysis, we reach this conclusion. Whether any of the hidden values of the historical bridges are effective in shaping the historical bridges or not and also the extent of their influence is determined qualitatively. To do the calculations, a score of 5 for "very high impact" and a score of 1 for "very low impact" was considered by each expert. To minimize the cost and time, the questionnaire was distributed among a random sample of the statistical community (residents of the mentioned complexes). The sample size was selected using Morgan's table, which includes 376 people who were randomly distributed in nine selected communities according to the population. To measure the reliability and validity of the measurement tool, the pre-test method was also used.

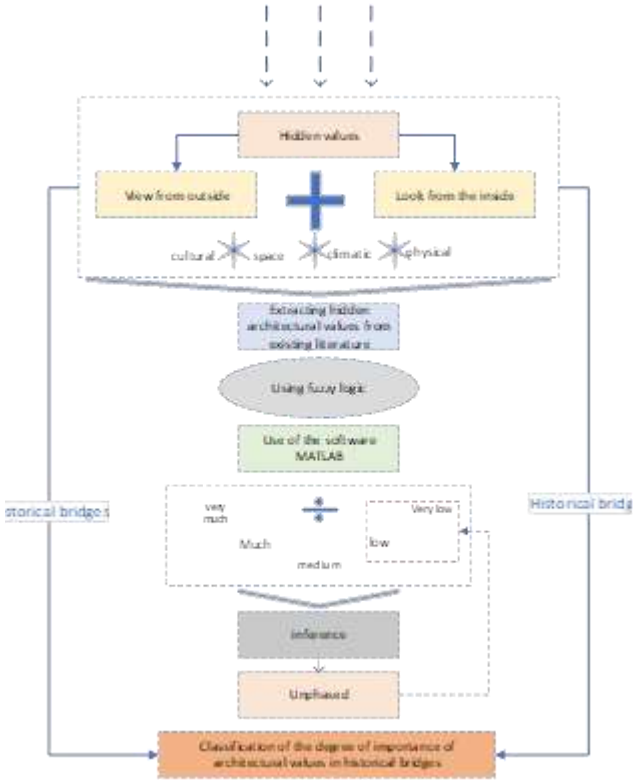

Fig 5 The steps of performing the fuzzy Delphi research method

5.1. Fuzzy Delphi Method

Fuzzy logic is a mathematical theory used to express the complexity of unstructured problems. A fuzzy set is a function that can show the possible value of a set number between zero and one as a degree of membership. In general, the evaluation process of fuzzy inference includes three stages: 1. Fuzzification, 2. Inference, and 3. De-fuzzification.

The purpose of this research is to reach the most reliable agreement of a group of experts on a specific topic, which is done by using a questionnaire and asking experts' opinions, repeatedly, according to their feedback. This method is a complete examination of the opinions of experts, with three main features, unbiased answers to questions and receiving their feedback and their statistical analysis, answering questions in the Delphi method, the subjective data of experts is transformed into almost objective data using statistical analysis. This method leads to consensus in decision making. The Delphi method has been used in many fields of prediction, decision-making, and screening (Stone Fish and Busby, 2005: 241).

Some of its applications are technological foresight, service analysis, factor screening, etc. In the world around us, issues cannot be divided into two or more white or black categories, but each issue fits into a spectrum (Linstone and Turoff, 2002: 76). Using definite numbers in solving problems such as prediction and classification will lead to results that are out of reality. The use of this method to make decisions and reach consensus on issues where the goals and parameters are not clearly defined. It leads to very valuable results (Cheng and Lin, 2002: 77). In this method, thinkers present their ideas in the form of minimum possible, most probable value, and maximum (triangular fuzzification).

5.2. Fuzzification

The main necessity in designing a fuzzy system is the selection of membership functions for linguistic variables. The importance of the obtained effect was defined by linguistic values (very low VL, low L, medium M, high H, and very high VH). For the screening of architectural values in historical bridges, the values that are placed in low and very low classes will be removed from the list of effective factors in the formation of historical bridges.

Table 2 Membership functions related to the profile and the importance of the effect to obtain the degree of membership

Function type	Membership function
Very low	$\mu_{VL} = \begin{bmatrix} 1 & 0 \le x \le 0.2 \\ -6.25x+2.25 & 0.2 \le x \le 0.36 \end{bmatrix}$
low	$\mu_{L} = \begin{bmatrix} 6.25x-1.25 & 0.2 \le x \le 0.36 \\ -6.25x+2.25 & 0.36 \le x \le 0.52 \end{bmatrix}$
average	$\mu_{M} = \begin{bmatrix} 6.25x-2.25 & 0.36 \le x \le 0.52 \\ -6.25x+4.25 & 0.52 \le x \le 0.68 \end{bmatrix}$
high	$\mu_{H} = \begin{bmatrix} 6.25x-3.25 & 0.52 \le x \le 0.68 \\ -6.25x+5.25 & 0.68 \le x \le 0.84 \end{bmatrix}$
Very high	$\mu_{VH} = \begin{bmatrix} 6.25x-4.25 & 0.68 \le x \le 0.84 \\ 1 & 0.84 \le x \le 1 \end{bmatrix}$

5.3. Inference

The most important part of the fuzzy inference method is to build the law base. The purpose of writing these rules is to define diverse propositions that are obtained by combining different states defined for each profile (base and complement) (Shakibaie, 2009: 151).

5.4. Defuzzification

De-fuzzification is a unit that has functioned from a fuzzy set to a definite value. In this study, the final deterministic value, in fact, the center under the surface of the curve in the final fuzzy sets, was obtained (Amini Fashkhudi, 2005: 39-45). The final value of the output is calculated from the following equation, where y is the output value, μ(y) is the degree of membership of the output y, and $\bar{Y}$ is the true value of the output.

$$\bar{Y} = \frac{\int y\mu(y)dy}{\mu(y)dy}$$

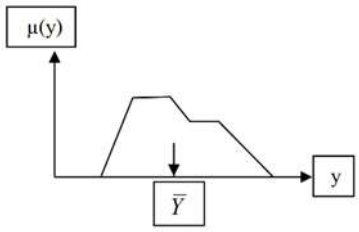

Fig 6 Center of gravity defuzzification method (Source: Monem, Khorrami, and Heydarian, 2007: 34)

5.5. Statistical Population of Participants

The statistical population is the thinkers and experts in the field of architecture and urban planning, who are experts in the field of architecture and urban planning, and 33 of them are selected as the sample size. The first person is selected in a targeted manner and the next ones are selected in a snowball manner.

Table 3 The sample size of selected experts and elites

Number	field of activity	position
5	Urban planning	University professor
8	architecture	University professor
7	Urban	University professor
6	Complex and town design	Professional designers
4	Urban sociologist	University professor
3	Behavioral psychologist	University professor

5.6. Scope of the Study

There are 12 bridges built on the Zayandeh river from Sarcheshme to the lagoon, all of which are not qualified to examine the sense of place, which is one of the non-objective values in the historically built bridges. The choice is asked to select several bridges, the first 4 of which are extracted for the comparative component analysis.

Table 4 Introduced and selected historical bridges

Row	Bridge name	Year of construction	historical period	Picture of the bridge	Kendall coefficient
1	Oregon Bridge	1929	Achaemenid and Sasanian		**0.431**
2	Zamankhan bridge	Not specified	The Sassanians		**0.482**
3	Kale bridge	Not specified	Safavid		**0.211**
4	Baba Mahmoud Bridge	704 Hijri	The period of the Mongol patriarchs		**0.396**
5	Flowerjan bridge	999 AH	Safavieh		**0.941**
6	Marnan bridge	Not specified	Sassanid and Safavid		**0.477**

7	thirty three bridge	1005 AH	Safavid		**0.845**
8	looking for a bridge	1065 AH	Safavid		**0.769**
9	Khajo bridge	1060 AH	Safavid		**0.711**
10	The city bridge	Not specified	Sassanid		**0.411**
11	Chum Bridge	Not specified	Safavid		**0.481**

6. Research Findings

In this study, the importance of the values of historical bridges was calculated using Matlab software and they were classified based on the degree of membership. The findings of the aforementioned method are shown in the following figure.

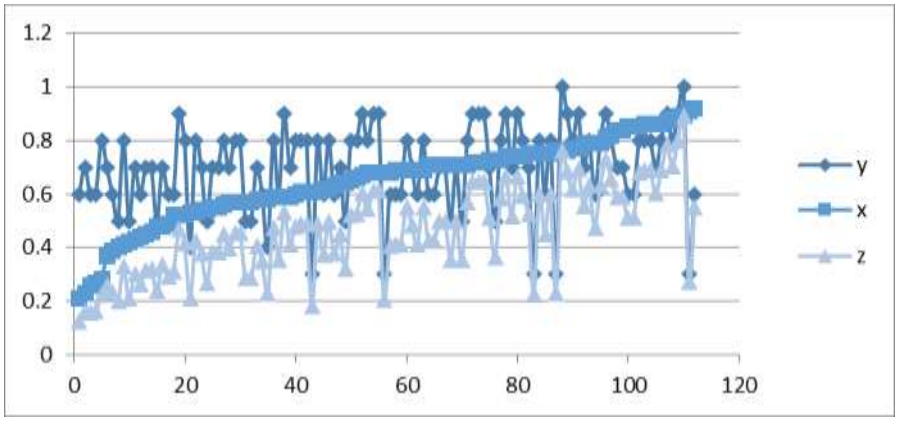

Fig 7 Classification of the importance of each linguistic variable

According to the figure 7, the importance of the effect of each language variable is shown in the table below. To evaluate the fuzzy model, the hidden architectural values of historical bridges and the characteristics whose quality was determined by experts according to the desired quality index were calculated using the software and used as the output of the fuzzy model. In fuzzy logic, a work belongs to two membership functions with different degrees of membership. Finally, the highest

degree of membership determines the importance of the effect of the type of linguistic variable. When the variable x is increasing, the amount of the effect value is changing and increasing from a very low attribute (very low linguistic variable) to a very high attribute, which is shown in the table below. That is, as we move towards increasing the variable x, the value of the language variable increases in each class, which can be seen in the output of the matrix as a class, for example, if the variable is x=0.53, it belongs to the middle class and if the variable is x=0.67, even though it has increased numerically, it still belongs to the middle class. The fuzzy Delphi method of this fuzzy logic solves this problem, and its output is meaningful based on the degree of membership, and for example, if the output of the fuzzy logic is Yˆ= 0.67, then the fuzzy logic determines the degree of membership for two membership functions. It improves slowness and uncertainty.

Based on the results obtained from the following table, it was determined that the color component from the physical dimension has a membership rate of 0.37 and the final class L has the lowest value and meaningful shapes with a value of 0.81 and the VH class has the highest membership degree in the cultural dimension of the component of avoiding futility with a value of 0.87 and class H has the highest value and the lowest value is related to matter and meaning and the component containing traditions with a value of 0.46 and 0.51 and class L. In the climate dimension, the highest membership degree is related to self-sufficiency with a value of 0.70 and the floor H, and in the flexibility dimension, the sense of place component with a membership value of 0.89 and the floor VH and the lowest degree of membership is related to spatial elements with a value of 0.56 and the class M.

Table 5 Degree of membership and final class of agents

	Fuzzy Logic						
	Factor	Degree of membership	The final floor	Factor	Degree of membership	The final floor	
climatic	The presence of nature	0.53	M	Color	0.37	L	physical
	self-sufficiency	0.71	H	Geometric order	0.55	M	
	Vari people	0.56	M	The form and covering of Iranian roofs	0.53	M	
	Strong relationship with context	0.77	H	Geometric patterns	0.71	H	
	Natural ventilation	0.61	H	Niarash	0.69	H	
	introversion	0.69	H	Structural integrity and architecture	0.59	M	
space	flexibility	0.54	M	Meaningful forms	0.81	VH	
	Sense of Place	0.89	VH	Avoiding futility	0.87	VH	cultural
	compatibility	0.74	H	Harmony with culture	0.59	M	
	Space elements	0.56	M	Material and meaning	0.79	H	
	Creating privacy and proper articulation	0.69	H	In the bearer of traditions	0.46	L	
	Attention to multiple functions	0.58	M	Love of sacred numbers	0.51	L	
	Integrity and unity	0.68	H	manifestation of light	0.60	M	

In the figure below, an example of the surface observer of the fuzzy model is presented considering the influence of 26 variables in different dimensions as input variables. In this figure, you can see how different input values affect an output value (architectural formation of historical bridges). In the sense that you can see the reaction in one view. According to the figure below, the hidden values of the architecture are associated with an almost irregular trend of the qualitative degree recorded in the surface observer.

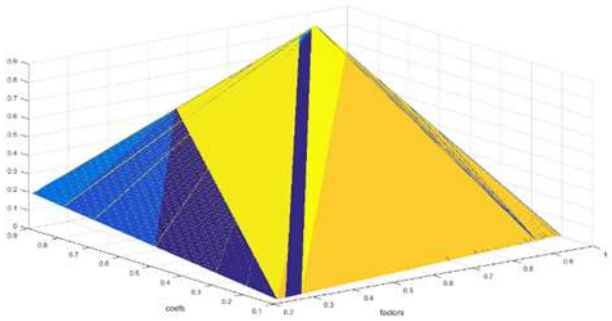

Fig 8 Variables in the physical, spatial, etc. domains with MATLAB software

7. Conclusion

Roads, as an element of communication between societies, should be as old as the life of humanity, and it will not be an easy task to answer the question of whether the bridge was ahead of the road or vice versa. The continuity and evolution of the structure of the formation of historical bridges owing to the progress of humans and architects to understand the behavior of rivers, geography, and climate, and to understand engineering techniques and traditional structures. Without bridges, it is not possible to cross the barriers of rivers and valleys, and these buildings are an integral part of human communication.

The background of the formation of bridges and the evolution of the architecture of these buildings until today, along with the various functions that these buildings had beyond a communication element, makes them highly important in terms of architecture and structure. And this issue also applies to the historical bridge under study, and this building, as the main element of crossing the river and the main access route to the caravanserai, has a higher function in the cultural-historical perspective of the historical bridges under study, and in fact, it is considered to be the link of the historical elements of this place. And for this reason, it has a special place in this historical place.

The purpose of building bridges was more than a means of crossing the river: they often had remarkable beauty in terms of proportion and design, and they displayed strength and grace together, and the bridges of the later periods were also very busy and sometimes with mosques and caravanserais. The bridge is a part of the urban space where the life of the city flows. Apart from that, this linear flow is connected to the flow of water (another linear shape) that goes along its path, and thus the linear shape becomes a point in continuous repetition to establish this connection. The reading of various factors shaping the life of historical bridges, of which the latent values of architecture are also part of it, and can be derived from the presence and influence of any government period. The hidden values of the mentioned historical bridges have components that are connected in a chain and provided the basis for their survival. One of the reasons that can be

imagined for the construction of these bridges is to support multiple activities. This research showed that there are non-objective aspects hidden in the historical works that are built only for functional ease or for a specific purpose, which by extracting them can be used in the redesign of historical buildings or the construction of new buildings for their survival and sustainability. He used them when the following things can be mentioned:

- Designing flexible spaces to accept and change the functional shape of spaces in purely functional buildings and support several activities in the space.
- Efficiency of the physical scenario in the design of the body of multi-functional buildings to support the cultural components and value stability of the building.
- Combining functional spaces with lively urban spaces and using furniture in the spaces of urban bridges to induce stillness and invite more people into the space.
- Definition of activities in line with historical tourism for all age groups in historical and contemporary bridges to invite more people
- Defining different activities for all hours of the day and night and creating security for the presence of different people and increasing the vibrancy of the surroundings of historical bridges.

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