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In the Name of God

Dear Readers,

I, on behalf of the editorial board, am proud to present this issue of the *International Journal of Applied Arts Studies (IJAPAS)* under the sponsorship of the Islamic Azad University, Yazd Branch. We were driven to found the *IJAPAS* by a noticeable lack of journals, in the Islamic Republic of Iran in particular, devoted to architecture, urban design, urban planning, architectural conservation and restoration, painting, art history, graphic, digital arts, fashion design, performing art, industrial design, aesthetics and semantics. Although the academic world is increasingly driven by cross-disciplinary visions and models, we seek multi-disciplinary views, an attempt to inform researchers, graduate students, and professionals about the trends, ideas and innovations being put forward in applied arts. To this end, in addition to standard articles, in every volume of the *IJAPAS* we hope to provide a special issue related to a respective field with innovation.

We are also sending out a call for papers related to *Applied Arts* to appear in the next issue of *IJAPAS* in Aug – Sept 2023.

Finally, I should mention that we are committed to a speedy refereeing process for every article submitted to us. We effort to reply to all papers submitted within five weeks' time with a response about acceptance or rejection. We also do not require formatting for submissions in our style until *after* the paper has been accepted by us for publication.

I would like to thank our Editorial Board for their work so far in helping to establish the *IJAPAS*. And, finally, I would like to extend my deepest gratitude to Dr. Ali Boloor, the assistant editor of the *IJAPAS*, for all of his hard work to ensure the timely completion of the issue.

I am delighted to invite you to visit us at www.ijapas.org.

Sincerely,

Dr. Abolfazl Davodi Roknabadi
Editor-in-Chief
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Recognizing and Evaluating the Ruling Dimension in Collective Housing after the Islamic Revolution in Tehran, with a Look at the Discourses that Emerged in each Government

Nahid Poursaeidi Mahani[a], Vahid Ghobadian[b]*, Reza Afhami[c]

[a]*Department of Architecture, Central Tehran Branch, Islamic Azad University, Tehran, Iran*
[b]*Department of Architecture, Central Tehran Branch, Islamic Azad University, Tehran, Iran*
[c]*Department of Art Research, Tarbiat Modares University, Tehran, Iran*

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Research Article

Abstract

After the glorious Islamic revolution, there were unique and diverse discourses to solve existing problems and shortcomings, and each of these discourses have manifested themselves in collective housing in these periods. This research uses a combined method to achieve this How those discourses have appeared in collective housing in each government and to what extent each of them had a contribution in the field of collective housing by using nest by nest method by examining the views of collective housing designers (etic) and by interviewing and extracting indicators and the views of users. The spatial (emic) has been done with a questionnaire. This research has a qualitative and quantitative approach and for the interview and the output of the cascade software from the Atlasti software and the quantitative software used in this research is NCSS, in which factor analysis is done in the Varimax method. The results show that in the physical dimensions of the national housing variable with a value of (0.974), the highest influence is related to the assignment of land in less developed areas with a value of (0.974) and in the spatial dimension, the increase of interactive space with a value of (945.0) 0) and the lowest standard revival is necessary to minimize the construction time (0.561). In the social dimension, studies on failed collective housing (0.814) have the most impact and the standardization of collective housing (414) has the least impact. In the economic dimensions, the highest growth in liquidity and the increase in the ratio of materials (0.811) and the least support for the housing of the former (0.325), in the cultural dimension, the presence of unpleasant odors in the open space (0.223), the least and the most

* Corresponding author. Tel: +98- 09121889277.
E-mail address: v_ghobad@yahoo.com

related to the training of the workforce Maher is (0.691). In service-climate, the use of contextual architecture (0.491) and attention to the basics of sustainability in design and implementation (0.161) are the most and the least.

Keywords: Collective Housing; Post-Revolutionary Government; Indicators of Collective Housing; Mixed Method

1. Introduction

After the victory of the Islamic Revolution under the leadership of Imam (RA) in 1978, concepts such as religious democracy, Islamic human rights, jurisprudence, ijtihad, ummatism versus nationalism, defense of the deprived and oppressed appeared in the discourse of the revolution. (Akhwan Kazemi, 2010: 101) From the negative aspect, the Islamic revolution drew a line of negation on many political-social relationships in the country, and from the positive aspect, it established new relationships and by changing the attitude of Iranians and other people of other societies towards the world, human beings, changed the end of life, government and political system, etc. The result of these events was the generalization of a discourse that has its own coordinates (Hosseinzadeh, 2007: 91). Before the Islamic revolution, the people of Iran were not in control of their own destiny in any way, and Iran was a colonized country in which the Americans interfered in all its affairs. It was for this reason that the return of people's sovereignty was one of the demands of the revolutionary forces; Of course, along with this request, the slogan of Islam was also raised; That is, the people demanded a republic based on Islam, that is, they did not accept the rule of the people without the rule of Islam; Because they wanted a policy that, in addition to the administration of the society being considered one of its basic pillars, the guidance of the people towards excellence is also achieved in it (Akhwan Kazemi, 2010: 74). From the point of view of the Iranian people, guidance towards excellence is definitely achieved in the discourse of the Islamic Revolution; Because it provides a basis for creating moral virtues in society. They saw that before the revolution and during the reign of the Shah, all moral virtues had disappeared; Therefore, they believed that in order to guide and achieve the worship that God has made the purpose of creation, moral virtues must be created and spread in the society and moral vices must be destroyed (Grinceri, 2016: 84). To achieve this and follow the signs of the Islamic Republic, after the imposed war and the existing conditions, governments came to work, each of which was created due to the conditions and was in response to the prevailing situation. Each of the governments that have come to work, in a way, in order to support the central signs of their discourses and according to the support of the existing situation, they are trying to make some kind of policy that will achieve success both inside and outside the country. With the aim of extracting sub-discourses and super-discourses from the theoretical foundations and the emergence of how they appear in collective housing, the research tries to see which aspects of these housings were more effective and had a decisive role in their formation. It seems that according to the objective observations in the space and the types of houses built in different governments, the most effective aspect is the body of the space and its related parts.

2. Theoretical Foundation

2.1. Discourses of Islamic Revolution

The central sign of the Islamic Revolution discourse lies in the slogans that the people raised in Tasua and Ashura referendums in 1978. At that time, the people wanted to return to Islam and the sovereignty of the people; In other words, they raised the issue of independence, freedom and republic, which in their opinion meant returning to the sovereignty of the people and determining

the country's destiny on behalf of the people and their participation in determining their own destiny. They used to mention that "Allah does not allow us to be different, even if we are different from ourselves" (Isenstadt and Rizvi, 2018: 179). Before the Islamic revolution, the people of Iran were not in control of their own destiny in any way, and Iran was a colonized country in which the Americans interfered in all its affairs. It was for this reason that the return of people's sovereignty was one of the demands of the revolutionary forces; Of course, along with this request, the slogan of Islam was also raised; That is, the people demanded a republic based on Islam, that is, they did not accept the rule of the people without the rule of Islam; Because they wanted a policy that, in addition to the administration of the society being considered one of its basic pillars, it would also lead the people to excellence (Hosseinzadeh, 2007: 143). From the point of view of the Iranian people, guidance towards excellence is definitely achieved in the discourse of the Islamic Revolution; Because it provides a basis for creating moral virtues in society. They saw that before the revolution and during the reign of the Shah, all moral virtues had disappeared; Therefore, they believed that in order to guide and achieve the worship that God has made the purpose of creation, moral virtues must be created and spread in the society and moral vices must be destroyed. Iranian people saw that because there are no moral virtues in the society, the moral conscience of the people has not been strengthened and this issue has caused the Iranian society to be caught in political-social problems (Paul, 2005: 711). According to them, the way to strengthen people's moral conscience was to take God and the Hereafter seriously in society; In other words, the people of Iran had become aware of the fact that in order to realize this problem, they must return to themselves so that people can achieve those moral virtues and find the way of guidance. They saw that without divine leaders being at the head of the society, it is not possible to realize this problem. During their history of 2500 years, these people had realized that when kings enter any country, they bring corruption there (An al-Muluk Adha Dakhlawa Quriya Afsduha) (Zarifinia, 1999: 99). For this reason, the rejection of the kingly and royal government was one of the people's wishes to reach God, the Hereafter, guidance and worship, which they knew the way to reach it only if divine leaders came to rule. At that time, the people considered these divine leaders who should be at the head of the government, with the discourse that Imam Khomeini (R.A.) carefully put forward, as jurisprudents of all the conditions. From their point of view, it was in this way that guidance, worship and moral virtue were created in the society and people progressed their evolution towards the perfect human being.

2.2. Effective Discourses in Collective Housing During the Construction Period

After the first decade of the revolution and the problems caused by it as well as the imposed war, the movement towards the growth and development of the country was followed by the programs. Although a plan for 1983-87 was formulated, it was not implemented due to the economic and political pressures caused by the war. From now on, housing programs continued in the form of development programs. During the construction period, the first and second development plans were compiled and implemented. As mentioned earlier, the first development program is associated with the establishment of the construction government headed by Hashemi Rafsanjani and adjustment policies in the economy. The program is compiled and implemented in a situation where the damages resulting from the imposed war, economic liberalization policies and reduction of government intervention in various economic sectors and privatization are discussed. This view, i.e. reduction of government intervention and economic liberalization, has influence in the housing program. The government is trying to stay away from populist policies in the economy and housing sectors as much as possible (Ehtashami, 2018: 73). Economic liberalization is placed on the agenda

of housing programs and economic adjustment and privatization policies are applied in the housing market. The government withdrew from the housing market and subsidized loans with preferential rates eight percent cheaper than the market are available to housing builders. It was placed in the private sector. The building materials that were sold in the black market at high prices were given to the private sector at the government price, and the most land and housing subsidies were given to the applicants in this period. The second plan is actually a continuation of the first plan with more emphasis on economic liberalization, single rate of currency, freedom of import and reduction of government intervention and attention to market-based policies. In this program, the intensity and intervention of the government in the housing market was reduced. This program was compiled and implemented while the activities of the construction and housing sector during the second program faced relatively severe fluctuations, so that the prosperity of the said sector began in 1994 and its price jump continued until the second half of 1996. After that, due to the stagnation of transactions and the decrease in effective demand, investment in this sector decreased, which ultimately led to a decrease in housing production (Grigor, 2013: 119).

The policies related to the housing sector in the second program are mainly based on the three axes of "savings, accumulation and downsizing" in the form of free, supportive and social housing production. Although the development of social housing was proposed in the second program, what was realized in the form of social housing and the rental plan in Iran was to support the provision of real estate housing for low-income groups, which is experienced the history of social housing in Western countries and other countries, i.e. "cheap rental system", is differ The history of social housing in Western countries and other countries, i.e. "cheap rental system", is different, although it has similarities with it. Housing for low-income groups tends to provide private housing and not rental housing, and the concept of rental in the phrase "renting under the condition of ownership" actually refers to the period of paying installments for the purchase of social housing (Rahmani, 1996: 142). In fact, what is proposed as social housing in Iran is different from the interpretation of this policy in Europe and Canada or Singapore and Hong Kong. In those countries, social housing is equivalent to the "cheap rental" system, that is, rental housing owned by the public or non-profit sector that is used by low and middle income groups (Ministry of Economy and Financial Affairs, 2014:104). although it has similarities with it. Housing for low-income groups tends to provide private housing and not rental housing, and the concept of rental in the phrase "renting under the condition of ownership" actually refers to the period of paying installments for the purchase of social housing (Rahmani, 1996: 142). In fact, what is proposed as social housing in Iran is different from the interpretation of this policy in Europe and Canada or Singapore and Hong Kong. In those countries, social housing is equivalent to the "cheap rental" system, that is, rental housing owned by the public or non-profit sector that is used by low and middle income groups (Ministry of Economy and Financial Affairs, 2014: 104).

2.3. Summary of Effective Performance and Discourses in Collective Housing During the Reform Period

In the Khatami government, the housing program was formulated and implemented in the form of the third development program. This program was developed when housing was stagnant. In the law of the third program, chapter 19 is specific to housing. Article 55 states that 3 percent of the legal deposits of banks with the Central Bank of the Islamic Republic of Iran based on the percentage of 2017 will be given to agricultural, housing, industrial and mining banks (1 percent for each bank) to provide facilities to projects Agriculture and animal husbandry, construction of buildings and housing, completion of industrial and mining projects of the non-governmental

sector, whose main feature is job creation (Vezi, 2008: 39). Article 138 states: In order to increase the share of mass production of housing from the total construction of the country and also to increase the production of small residential units, builders (private and cooperative) of residential complexes with three residential units and more in rural areas, five residential units and more In cities with a population of less than 250 thousand people and ten residential units and more in other cities, they are supported as follows:

A. Builders subject to this law are exempted from paying the tax on the first definitive transfer of real estate, and the taxable income of these units will be determined by the Ministry of Economic Affairs and Finance in accordance with the infrastructure levels of each and regardless of their number.

B. The Ministries of Energy, Petroleum, as well as municipalities and other competent authorities are required to regulate the method of collecting fees for the supply, transmission and branching of water, electricity, gas and construction permit fees within the framework of the approved density according to the master plan in such a way that The per capita costs received for each residential unit built subject to this law should be at most equal to the costs received from individual builders.

Article 139 of the third plan law indicates that in order to support housing applicants and in order to strengthen their financial capacity and simplify the use of bank facilities for buying or building housing (Kamrava, 2016: 218).

A. The monthly installments of housing credit facilities from banks are deducted from the taxable income of the recipients of the facilities and the balance of the earned income is included in the tax calculations. The use of this tax exemption is allowed only once for each family or married persons and it will include units with a maximum useful area of 120 square meters.

B. Insurance policies issued by insurance institutions will be valid as collateral for receiving bank facilities.

C. Regarding the families of martyrs and veterans, twenty-five percent and above and freedmen will be granted bank facilities to buy or build housing with minimal fees and long-term installments (Habibi, 2006: 174).

In this program, as in the previous programs, the solution of low-income housing and the liberalization of the housing market are emphasized. Support for miniaturization and massification is also emphasized. Attention has been paid to monetary policies and the facilitation of mortgage lending conditions. Staggering repayment installments of bank facilities for loan recipients and gradual payment of facilities for the phased construction of housing for low-income groups are among the most important policies proposed in the third development plan. For the purpose of financial liberalization, the central bank has been obliged to formulate the necessary regulations to grant more freedom of action to commercial banks in determining the mortgage interest rate (Jalaipour, 2000: 11). Encouraging housing savings cooperatives was put on the agenda. In

order to support mass builders, these people in the program were exempted from paying taxes and the cost of water, electricity and gas supply and construction permit issuance fees up to a maximum equivalent of the fees received from individual builders.

The lack of rental housing units on the one hand and the special characteristics of the applicants for these units on the other hand, made the government, by strengthening the law to encourage and build rental housing units, only model the construction of these units and not directly interfere in the construction. During the third plan, 85,000 rental housing units were built in the country, which constitutes only 4% of the urban housing production during this period (Rafipour, 1998: 63). This is despite the fact that at the beginning of the program, the government was obliged to construct 10%

of the produced housing in the cities on a rental basis. In general, the main goal of the government in the field of building rental housing, which was to set a model for the private sector, was not realized, and its implementation moved more towards the construction of rental units, instead of moving towards renting with the condition of ownership, and even the government itself, like the private sector, has a tendency to rent. He did not show himself. During the third plan, the activity trend of the construction and housing sector has faced relatively severe fluctuations, so that the boom of the said sector began in 2000 and this trend continued until the end of 2002, and after that due to construction restrictions, especially in the city of Tehran, the increase in the cost of construction and the significant growth of transaction prices of housing, the activity of this sector entered a recession cycle (Soltani, 2004: 89). During the third development program, the added value of the building and housing sector grew by 2-4% annually, which shows a low performance compared to the 9.9% target set in the program. The share of the added value of this sector in the GDP was 4.8%, and there was not much success in providing housing for low-income people and solving their housing problem, and the housing situation of these people was degraded and informal housing was added.

2.4. Effective Discourses in Collective Housing During the Justice-Oriented Government Period

The 9th government, with the establishment of the 4th plan, started the central justice in housing policies and programs. Distribution of cheap land among the people through housing cooperatives, as well as providing cheap loans for land preparation and housing construction, are among the strategies in this period. The dominant policy of this period in the field of housing goes back to the Mehr Housing Plan, which was implemented by the 9th and 10th governments. The Ministry of Housing and Urban Development, in order to provide suitable housing for the people and especially the needy, in 2004, prepared a comprehensive housing plan using the views and opinions of researchers and researchers of the housing sector, and its executive strategic document in 2005, consisting of 55 programs. And it was summarized in 9 axes. One of the main axes of the comprehensive housing plan is to pay attention to the provision of housing for low-income groups. Mehr Housing Plan" has been prepared and developed based on the comprehensive housing plan and the same axis (providing housing for the needy).

Mehr housing project in the form of construction of 1.5 million residential units in Note 6 of the 1386 budget law and the "Bill to organize and support housing production and supply" in 2008 became legal and was recognized. With the finalization of the executive strategic document of the comprehensive housing plan and the presentation of its 55 programs in 9 axes, it has been presented for the society to deal with it in a balanced way (Leach, 2013: 314).

Increasing the capacity of housing production and investment through the establishment of support, facilities and provision of other required institutions, establishment and support of housing provision programs for low-income groups and vulnerable groups, and paying attention to the quality issues of housing construction in the country Clause "D" under Note 6 of the 2006 budget law of the whole country has put serious emphasis on providing suitable housing for the people, especially the low-income groups, and proposed several solutions to achieve the set goals. In this regard, the Mehr housing project has been designed and implemented as the most important and central program of the housing sector since 2006. In this plan, the provision of housing for low-income groups with the approach of reducing the cost of housing through the elimination of land prices, paying direct subsidies, granting subsidized facilities, covering part of the construction costs, including density fees and building permits, branches, High supervision and... for the subject

tithes, as well as strengthening the government's sovereign right in the housing sector and achieving social justice and empowering low-income groups, is desired (Mirsalim, 2007: 154).

In paragraph 2-1 of note 6 of the budget law of 2016, it is stated that the Ministry of Housing and Urban Development is obliged to transfer suitable land to qualified persons in the form of a long-term lease of up to 99 years in order to reduce the price of residential units. became In Article 11, paragraph "B" of the second chapter of the implementation instructions of the Housing Supply Program in 2006 regarding Mehr housing, it is stated that the housing and urban development organizations are obliged to allocate the city quota for housing construction in the form of assigning the right to exploit the land according to the indicators The need for housing, the available facilities of the land, should be determined and approved by the housing headquarters of the province (Moslinejad, 2008: 48).

Mehr housing projects were first proposed in the form of development plans on marginal lands under the authority of the government and the Ministry of Housing and Urban Development, but due to the lack of any facilities and the high costs of these lands, other projects including Mehr housing, in worn-out urban contexts and Mehr housing in new cities were taken into consideration (Azizi, 2004: 109), and quick exploitation of projects helps (Naji, 2015: 153).

In general, the goal of Mehr's housing project should be the realization of social justice. Realization of justice through providing suitable housing for low-income and poor groups and making them own houses is the main slogan of Mehr Housing. However, about 10 years have passed since the beginning of this plan, the conditions have become such that this plan has not reached its goals. What has been built under the name of Mehr housing in cities like Parand and Pardis lacks the minimums of a suitable housing. The implementation costs do not read at all with what was originally promised to the applicants. Brokers and intermediaries have diverted the plan. All this has led to the fact that not only this official housing welfare policy does not help to improve the lives of the poor, but it turns into a mechanism that is more based on the stock market, and as a result, most of its benefits go to the pockets of capitalists and power institutions, and it cannot meet the needs of the urban population.

2.5. Effective Discourses in Collective Housing During Moderation Period

The first year of Hassan Rouhani's administration coincides with the final year of the fifth development plan (2018-2019). In the fifth plan, the most important official policies in the field of housing can be listed as follows;

1. Implementation of Mehr housing program, 2. Implementation of rural housing renovation plan, 3. Documentation of rural residential units, 4. Compilation of resettlement program of official settlements and 5. Providing a package of renovation loans (Deputy Planning and Supervision, 2019: 406).

In the comprehensive housing plan (revision), it has been said that the benefits of these policies include: meeting the housing needs of a part of the households and speeding up renovation in worn-out structures. But the negative consequences of these policies have been more than their benefits: lack of cross-sector coordination to provide infrastructure, inappropriate location of Mehr housing, injection of inappropriate financial resources in the form of a central bank credit line, abandonment of the land management system and increase in land prices, capital drift. the private sector and the replacement of banking and government resources instead, the reduction of land supply and the lack of coordination between urban and land development programs. The policies of the housing sector of the 11th government by revising the comprehensive housing plan, planning financial development in this sector and implementing the program of social housing and supportive housing

has been followed by the approval of the government board. To be more precise, the macro policy of the Ministry of Roads and Urban Development in the housing sector, revision and updating of the comprehensive housing plan as a road map of the housing sector until the horizon of 1404, planning for the financial development of the housing sector and finally developing a joint program (social housing) between The Ministry of Roads and Urban Development is with the Ministry of Cooperation, Labor and Social Welfare (Aghaei, 2016: 56).

In the review and update section of the housing master plan as a road map for the housing sector until the horizon of 1404, the proposed programs in the form of the seven axes of the master plan are mainly divided into two parts, institution building programs and operational plans, in order to develop a road map for the housing sector. Launching a land and building investment fund, launching escrow accounts to strengthen the housing pre-sale market, launching a guarantee plan for housing installment sales transactions, drafting instructions on how to issue mortgage bonds in the secondary mortgage market, issuing the first phase of housing mortgage bonds amounting to 3 thousand billion Rials, regional housing savings fund in order to help revitalize the inefficient fabric of Tehran, develop new cities and implement programs in the area of Makran coast housing, develop the regulations of Article 14 of the law on organizing and supporting the production and supply of housing, use Leasing companies in the housing sector, developing an optimal tax package for the housing sector and finally launching real estate funds are among other activities that are considered in the planning of the financial development of the housing sector, and a major part of them is also It has been implemented (Arjomand, 2019: 214). In the section of the joint program for the implementation of the social housing plan between the Ministry of Roads and Urban Development and the Ministry of Cooperation, Labor and Social Welfare, with the approval of the social housing and supportive housing plan, the implementation of this program was put on the agenda. The government, the plan of social housing and supportive housing that was created by the plan and budget and with the cooperation of relevant institutions while studying and analyzing the policies applied in the country in the field of providing housing for low-income groups, which often focus on providing government housing and not using the capacities of non-governmental organizations and relying only on the construction of private housing has been and by using successful global experiences, he has prepared a plan for a new movement in this field and approved it (Ehteshami, 2016: 32). Also, in this regard, the Minister of Roads and Urban Development explained the different dimensions of social housing approved by the Cabinet and emphasized: low-income households are the priority of the social housing plan.

The social housing plan, which was approved by the cabinet at the end of 2015, consists of several parts, one of which is paying low-cost loans and providing land to housing developers. Part of the credits of the social housing project is provided from the government budget, and another part is obtained through obtaining facilities from banks, where the government pays the bank interest subsidy (Najafi, 2015: 81). With the continuation of Mr. Rouhani's government, the current trend based on responding to consumer needs in the housing sector will continue.

3. Research Method

This research is theoretical-developmental in terms of type, and in terms of the nesting method, it was qualitative and quantitative. The nested research design is a design of mixed methods in which a data set provides a supporting and secondary role based on the primary data of another type (Clarck, 2008: 210). Existing documents of ruling discourses and its components are extracted. Then, semi-structured interviews are used for the type of influence and areas of influence as well as indicators of collective housing. At this stage, the questions are extracted from theoretical bases and

the interviewees are university professors who are proficient in this subject and have at least two scientific research articles and are selected as a snowball. Then, in the interview results, interpretive, descriptive and live coding are used for analysis and labeling as well as data reduction. The results are displayed with the help of waterfall charts. And for this, ATLASTI software is used. In this step, looking from the outside (etic) is the answer.

In the next step, after extracting and categorizing the indicators, a questionnaire with a Likert scale is compiled and provided to the space users. Their number is selected based on the upper limit of Morgan's table, which is 384 people. And the results are extracted in the form of factor analysis with NCSS software, the sampling was random and experts were used for validity in the qualitative stage and the CVR formula was used in the quantitative stage, and its value was 0.75. And reliability was obtained with Cronbach's alpha. It was found that its value was 0.72. The diagram of the research process is as follows;

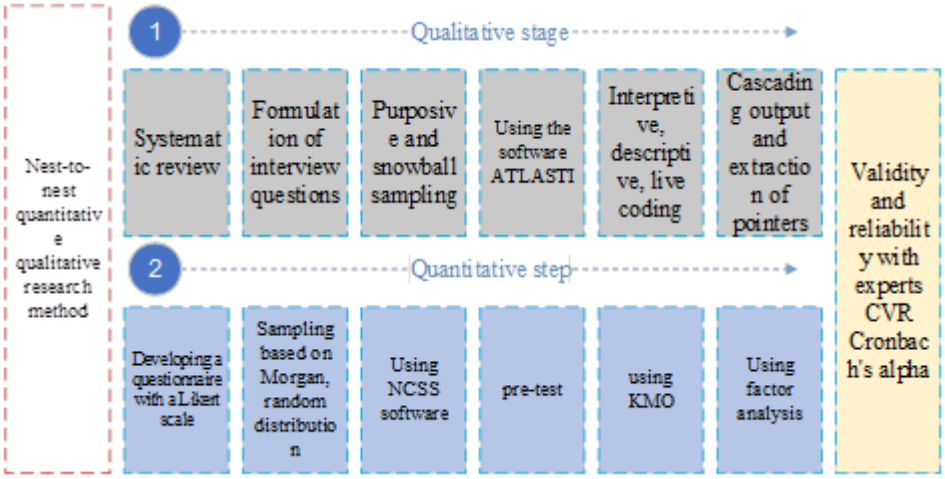


Fig 1 Research process

4. Characteristics and Features of the Studied Area

In this research, among all the collective housing introduced in Tehran, the following are selected, to examine the samples in each period of the government, the geographical area of Tehran is chosen because Tehran is the capital of Iran and has the highest amount of budget for construction in Iran, and sub-discourses and hyper-discourses are better there. The most successful and the most unsuccessful among the introduced collective housing were selected by experts according to the above table in this research.

Table 1 Introduced collective housing selected by experts

	Name of the collective housing	Government period	Kendall coefficient	Construction number	Justice oriented number	Number of corrections	Number of moderation	Favorites
Upto 6 floors	Nasim Danesh	Building	0.415					most unsuccessful
	Saman region 2	Justice oriented	0.528					

	Prophecy	Building	0.625					most successful
	flowers	Justice oriented	0.611					
	Shahrak-e Vali Asr	Building	0.117	7	4	4	4	
	spring	Justice oriented	0.483					
	City arrow	Building	0.501					
	Gulnar	Building	0.517					
	Mountain	Moderation	0.312					
	Apadana	Moderation	0.321					
	City culture	Constructive	0.374					
	Lotus	Justice oriented	0.765					
	College students	Moderation	0.625					
	Kush	Building	0.544					
	Ferdows town	Reforms	0.109					
	Breeze	Construction - Reforms	0.577					
	Zahtabi	Moderation	0.854					
	Tulip	Reforms	0.548					
7-12 floors	Shell	Building	0.625					
	Ferdows	Justice oriented	0.601					
	Sinai	Construction - Reforms	0.522					
	Flowers	Reforms	0.475					
	Purple	Moderation	0.415					
	Behjatabad	Building	0.385					
	Mehr Hashtgerd housing	Moderation	0.155	6	3	5	6	
	Akbatan	Moderation	0.329					
	Writers	Reforms	0.298					
	Mission	Reforms	0.299					
	Star	Building	0.322					
	Tisophon	Justice oriented	0.388					
	Arian	Moderation	0.398					
	Academics	Moderation	0.496					
	Campus	Justice	0.140					

	housing	oriented						
	Ashrafi	Constructive	0.422					
	Mahani	Construction -Reforms- Moderation	0.415					
Above 12 floors	Sweet	Reforms	0.582					
	Hope	Justice oriented	0.352					
	Pasargad	Justice oriented	0.425					
	Ibn Sina	Reforms	0.412					
	Golestan	Justice oriented	0.455					
	Pars	Justice oriented	0.421	6	9	6	3	
	Sattarkhan	Building	0.411					
	Venk Pars	Building	0.325					
	Twenty	Reforms	0.369					
	Glory be to you	Justice-oriented reforms	0.349					
	Prince Park	Building	0.325					
	All the time	Justice-oriented reforms	0.477					
	Mehstan	Justice-oriented reforms	0.488					
	Cute cedar	Building	0.842					
	Hope	Building	0.485					
	Iran land	Justice-centered moderation	0.577					
	Sarvistan	Moderation-justice oriented	0.258					
	Mehstan	Building	0.358					
	Hafez	Reforms - Moderation	0.453					

5. Findings

5.1. Qualitative Findings

At this stage, based on the type of building selected from the most successful and unsuccessful ones, as well as the principles derived from the systematic review of experts, an interview is conducted, some of which are shown below for each dose.

An example of an interview during construction;

During the period of construction, the use of the slogan caused more attention to be paid to the speed of construction, which could eliminate the existing consequences of the war, which was excessive destruction, and this caused Mr. Rafsanjani's government to use this sign all over. This sign affected all the different dimensions in collective housing, it was necessary for the young population to become home owners on a large scale (coding: speed of construction...).

During this period, two groups of collective housing emerged, the collective housing that appeared in the form of satellites around the city, which were supposed to be built and their infrastructures at the same time, but over time, some of the infrastructures were not completed, and actually some of these settlements. They encountered many problems for service delivery, from asphalt roads to sewage system, there are various things that are included in this field (code: Shahrek Aqmari).

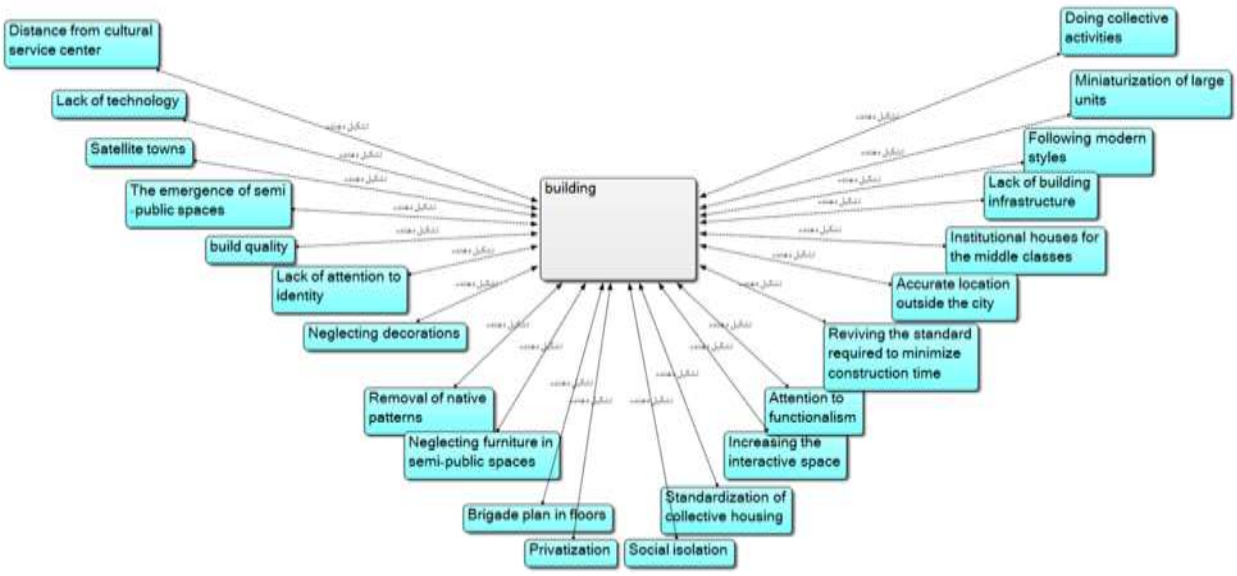


Fig 2 Coding of the factors that emerged from the central sign in the field of housing in the state of construction

5.2. An Example of an Interview During the Reform

During this period, the housing policies of the previous period are supported and mass housing is developed. Emphasis on accumulation in housing becomes mass housing itself. With its construction, a large number of people can own houses (open code: following the policies of the construction period, etc.).

A large number of people in the society are considering becoming home owners, but due to the economic pressures and the increase in inflation and devaluation of the currency, this becomes a risk and causes rental housing to be suggested. that you can own a house with much less money than buying a house (open code: decrease in oil revenues, etc.)

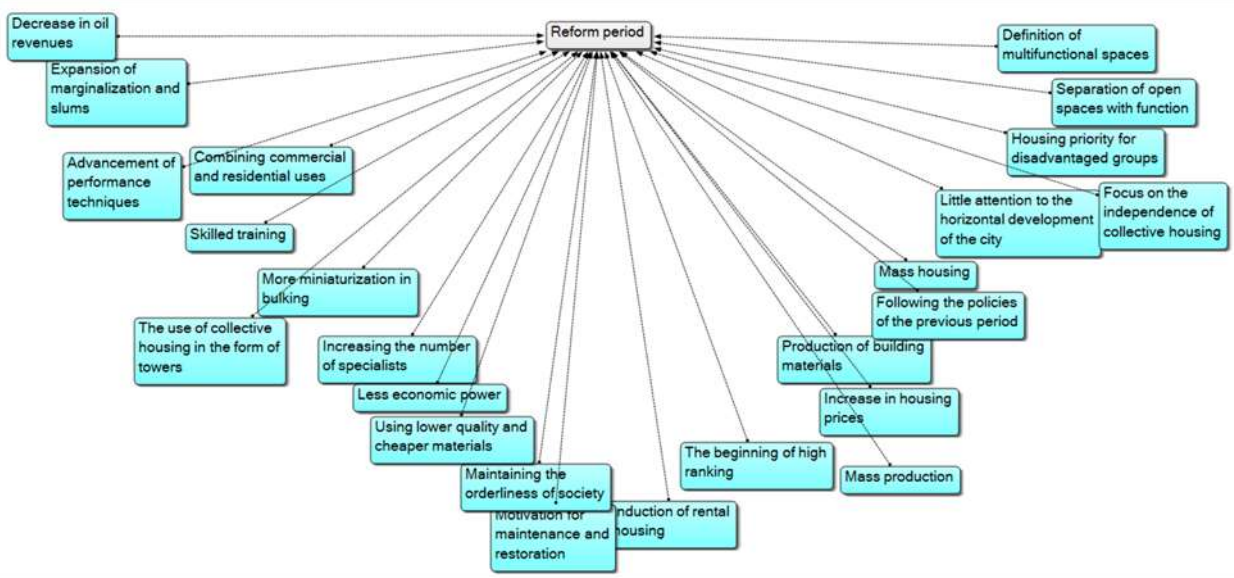


Fig 3 Coding of the factors that emerged from the central sign in the housing sector of the reform government

5.3. An Example of an Interview in the Era of Justice

Ahmadinejad's era has emphasized on low-income housing and Mehr housing. During this period, the expansion of the city continued to different parts and the development of the city continued horizontally in various directions. Also, in some parts, due to the acquisition of cheap agricultural land near the city, it caused their removal and destruction (open coding: indiscriminate horizontal development in the city,...).

Due to the use of facades without identity and without decorations and with minimal shapes, urban facades in sated collections had a huge difference from their neighbors, and western patterns and modern architecture were used in the construction of these buildings. Many functions are due to small construction of spaces and non-compliance with some standards were removed (open code: chaos in the city...).

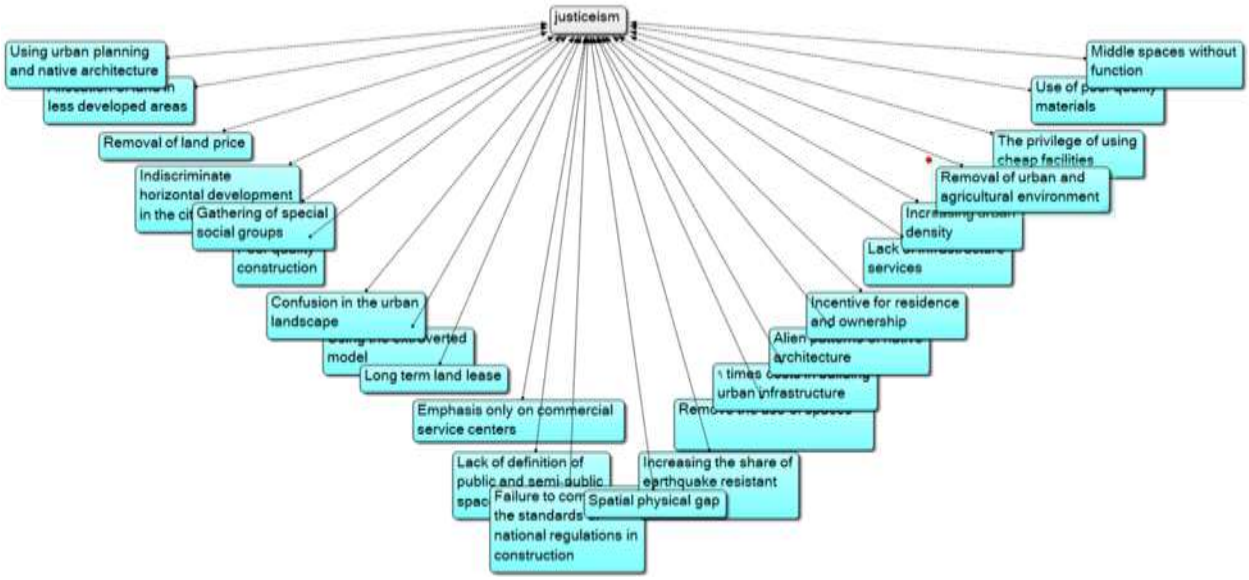


Fig 4 Coding of the factors that emerged from the central sign in the area of justice government housing

5.4. An Example of an Interview During Moderation

During the Rouhani period, the way of looking at housing changed a bit, on the other hand, the economy decreased due to sanctions and the added value of goods and land increased. For this reason, the issue of smaller sized houses of around 25 or 30 meters that only meet physical needs was raised (Open code: National housing...).

In the failed Mehr housing projects, extensive studies were conducted and an attempt was made to eliminate these problems in the future collective housing projects, the marginalized people in the cities were invited in, and in the location of national housing, attention was paid to the fact that People were called in and by this means a heterogeneous population composition was created to put all the strata together (open source: studies in failed collective housing...).

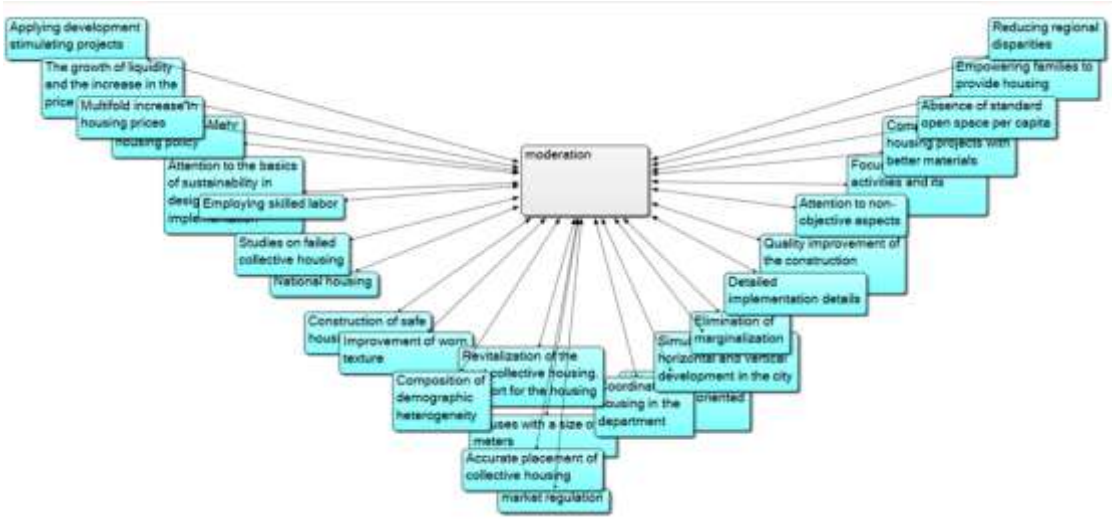


Fig 5 Coding of the factors that emerged from the central sign in the area of moderation

6. Factor Analysis

In order to measure the indicators that emerged from the discourses after the Islamic revolution and to determine the amount of factor contribution and factor analysis are used. The first step in the factor analysis method, after extracting the desired criteria and indicators from the relevant authoritative texts, is to form the initial matrix of information. In this treatise, a matrix with 8 collective dwellings as matrix rows and 101 pis was found, and indicators were formed as matrix columns in the initial information matrix.

7. Checking the Common Values of Each Variable with other related Variables

One of the first outputs of the factor analysis method is the table of commonalities for each variable, which shows how much common variance a variable has with other variables used in the analysis. The higher its value in each index, it shows that that index has a greater relationship with other indicators used in the subject. At this stage, in order to identify the indicators that are most related to the subject, the indicators whose numerical values are less than 0.4 are removed from the calculation process to increase the value of KMO and increase the explanatory power of the model. In this study, the first factor analysis method was carried out with 101 indicators and privatization, floor plan, lack of technology, the emergence of collective modern spaces, from the construction and decrease of oil revenues, increase in housing prices, mass housing, less economic power, increase in expert staff, Focusing on the independence of collective housing from the period of reforms, the goal of using open spaces, confusion in the urban landscape, emphasis on commercial service centers, lack of definition of public and semi-public space in residential complexes from the period of justice and market regulation, support for primary housing. completion of Mehr housing projects with better materials, heterogeneous composition of the population, attention to non-objective aspects, coordination of housing in the target sector, reduction of regional disparities, employment of skilled labor was excluded from moderation due to the low value of KMO So that the number of shares increases and the amount of KMO reaches the optimal level. The 20 indicators removed from among the 101 indicators were the indicators that had the least commonality with other indicators based on the mathematical logic of factor analysis. The table below shows the amount of shared variance between a variable and other variable used in the analysis after removing three relevant indicators and is called the table of commonality.

Table 2 Commonalities of output variables of discourses in collective housing by each state

	Variables	Initial	Extraction	Variables	Initial	Extraction	
Building	Neglecting decorations	1.000	0.800	Physical-spatial gap	1.000	0.617	Justicism
	Increasing the interactive space	1.000	0.606	Alien pattern with native architecture	1.000	0.589	
	Lack of attention to identity	1.000	0.853	Poor quality materials	1.000	0.716	
	Accurate location outside the city	1.000	0.745	Using urban planning and native architecture	1.000	0.573	
	Reviving the standard	1.000	0.816	Middle spaces without	1.000	0.618	

	required to minimize construction time			function			
	Distance to medical service centers	1.000	0.907	Failure to comply with the standards of national regulations in construction	1.000	0.642	
	Institutional houses for the middle classes	1.000	0.832	Lack of infrastructure services	1.000	0.517	
	Doing collective activities	1.000	0.809	Poor quality construction	1.000	0.728	
	Standardization of collective housing	1.000	0.880	Using a progressive model	1.000	0.713	
	Miniaturization of large units	1.000	0.766	Gathering of special social groups	1.000	0.718	
	Neglecting furniture in semi-public spaces	1.000	0.653	Incentive for residence and ownership	1.000	0.846	
	build quality	1.000	0.746	Removal of land price	1.000	0.719	
	Removal of indigenous and cultural patterns	1.000	0.732	Long term land lease	1.000	0.697	
	Satellite towns	1.000	0.573	Allocation of land in less developed areas	1.000	0.951	
	Social isolation	1.000	0.629	Using poor quality materials	1.000	0.871	
	Attention to functionalism	1.000	0.525	Increasing urban density	1.000	0.781	
	Following modern styles	1.000	0.580	Focusing on collective activities and its definition	1.000	0.764	
Reforms	Follow the policies of the construction period	1.000	0.695	Using native architecture and context-oriented architecture	1.000	0.873	
	Use of high-rise collective housing	1.000	0.750	National housing	1.000	0.769	
	Using lower quality and cheaper	1.000	0.694	Studies on failed collective	1.000	0.745	

	materials			housing			
	Advancement of performance techniques	1.000	0.681	Simultaneous horizontal and vertical development in the city	1.000	0.768	Moderation
	Definition of multifunctional spaces	1.000	0.712	Detailed implementation details	1.000	0.872	
	Combining commercial and residential uses	1.000	0.846	Applying development stimulating projects	1.000	0.689	
	Separation of open spaces with function	1.000	0.837	Attention to the basics of sustainability in design and implementation	1.000	0.847	
	Maintaining the orderliness of society	1.000	0.692	Completion of Mehr housing projects with better materials	1.000	0.823	
	The beginning of high ranking	1.000	0.827	Supporting the housing of the first	1.000	0.874	
	Expansion of marginalization and slums	1.000	0.849	Revival of the past collective housing	1.000	0.863	
	More miniaturization in bulking	1.000	0.711	Improvement of worn texture	1.000	0.745	
	Little attention to the horizontal development of the city	1.000	0.674	Empowering the family to provide housing	1.000	0.724	
	Motivation for maintenance and restoration	1.000	0.643	Absence of standard open space per capita	1.000	0.823	
	Housing priority for disadvantaged groups	1.000	0.684	Quality improvement of the construction industry	1.000	0.566	
	Induction of rental housing	1.000	0.547	Houses with a size of 25 meters	1.000	0.914	
	Production of building materials	1.000	0.782	Continuation of Mehr housing policy	1.000	0.735	
	Skilled training	1.000	0.633	market regulation	1.000	0.744	
	Mass production	1.000	0.772	Construction of safe housing	1.000	0.655	
	Indiscriminate	1.000	0.846	Liquidity	1.000	0.718	

	horizontal development in the city			growth and increase in the ratio of materials			
	Increasing the share of earthquake-resistant units	1.000	0.719	Multifold increase in housing prices	1.000	0.855	
	The privilege of using cheap facilities	1.000	0.697	Accurate placement of collective housing	1.000	0.625	
	9 times costs in the construction of urban infrastructure	1.000	0.784	Employing a skilled workforce, having favorable views in the open space	1.000	0.743	
	Removal of urban and agricultural environment	1.000	0.917				
	Extraction Method: Principal Component Analysis.						

8. Checking the Values of Kaiser-Meier-Olkin, Bartlett's Test of Sphericity and Correlation Matrix

The value of KMO is always between 0 and 1. If the desired value is less than 0.5, the data will not be suitable for factor analysis, and if the value is between 0.5 and 0.69, factor analysis should be done with more caution; But if this value is more than 0.7, the existing correlation between the data will be suitable for data analysis. On the other hand, Bartlett's test should be used to ensure the suitability of the data for factor analysis. Bartlett's test tests the hypothesis that the observed correlation matrix belongs to a population with discrete variables. For a factorial model to be useful and meaningful, variables must be correlated.

Table 3 Kaiser-Meier-Olkin and Bartlett values in the measurement of collective housing indicators

Kaiser Meyer Olkin and Bartlett values		
Kaiser-Meier-Olkin Sampling Adequacy Values		0.513
Bartlett's sphericity test	Chi-square	74.196
	Degrees of freedom	36
	Significance level	0.000

Bartlett's test is significant when the dependent probability is less than 0.05. If Bartlett's test is significant, there is a risk that the correlation matrix is a single matrix (with diagonal elements of 1 and non-diagonal elements of zero) and it is inappropriate for further analysis. In factor analysis method, factors are constructed in several ways, one of which is Decomposing into main components is the same method used in this research. Table 3 presents Bartlett's sphericity test and KMO coefficient for the analysis in this thesis. The above table shows that the corresponding KMO value is higher than 0.5 and they are suitable for the factor analysis of the relevant data.

9. Investigating the Explained Variance of the Subject and Determining the Number of Selected Factors

In connection with the final determination of the number of factors (dimensions) explaining the indicators of the phenomenon from each state, three conditions must be observed statistically, the first condition is to pay attention to the point that the special values related to all the indicators of each discourse in collective housing must be higher than 1. The second condition is to comply with the value of the cumulative variance, that the sum of the cumulative variance of the final extracted factors must be higher than 60, and the third condition is that the explained variance of each factor alone must be higher than 10, so that the relevant factor is recognized as the representative factor of each discourse in the collective housing (Zarifinia, 1999).

Examining the above conditions in Table 4 shows that six factors are known as influential factors of the discourse in the studied collective housing. The reason for this is that the eigenvalues of each of the above factors were higher than 1, and this value was 4.665 in the first factor, 3.463 in the second factor, 1.634 in the third factor, 1.527 in the fourth factor, 1.317 in the fifth factor, and 1.107 in the sixth factor. be Examining the second condition shows that the cumulative variance explained by the relevant factors in the studied range is 94.472, which shows that the relevant factors express 94.472% of the markers that emerged from the discourses after the Islamic Revolution. Examining the third condition also shows that each factor independently explains more than 10% of the variance until the value of this issue is 24.946% in the first factor and shows that the most important factor lies in it.

Table 4 Determining the number of factors

Variance percentage and specific values of different factors									
Components	Initial eigenvalues			Explained variance of factors whose eigenvalues are greater than one.			Set of extracted factor values after rotation		
	Total	Percentage of variance	The cumulative percentage	Total	Percentage of variance	The cumulative percentage	Total	Percentage of variance	The cumulative percentage
1	3.927	24.946	24.946	3.927	24.946	24.946	3.326	22.583	22.583
2	2.746	20.697	45.643	2.746	20.697	45.643	2.713	20.567	43.15
3	1.950	14.487	60.13	1.950	14.487	60.13	1.897	14.590	57.74
4	1.442	12.296	72.426	1.442	12.296	72.426	1.439	12.278	70.018
5	1.376	11.029	83.455	1.376	11.029	83.455	1.357	10.964	80.982
6	1.289	11.017	94.472	1.289	11.017	94.472	1.238	10.276	91.258
Extraction Method: Principal Component Analysis.									

The developed factor matrix and the determination of the relationship values of the indicators with the selected factors for naming and interpretation;

After determining the variance of each of the factors, the factor matrix is rotated so that each of the relevant indicators have the highest correlation with the relevant factors and facilitate the conditions for naming and identifying the relevant factors with the help of the score of each index of the factor. In fact, this matrix is the factor matrix whose factors were extracted by decomposition into principal components and rotated by varimax rotation.

The first factor: this factor explains 24.946 percent of the total variance and based on the final filtered matrix with the variables of neglecting decorations, locating outside the city, construction quality, satellite settlements, following modern styles, using lower quality materials. and cheap price, the improvement of implementation techniques, the start of high-rise construction, little

attention to the horizontal development of the city, production of building materials, massification, excessive horizontal development in the city, increasing the share of earthquake-resistant units, eliminating the urban and agricultural environment , physical-spatial gap, foreign model with native architecture, poor quality materials, using extroverted model, giving land in less developed areas, using poor quality materials, national housing, simultaneity of horizontal and vertical development in the city, completion of Mehr housing project with He named better materials, construction of safe housing, construction of poor quality building, detailed implementation details under the title of physical characteristics.

The second factor: This factor explains 20.697% of the total variance and based on the final filtered matrix with the variables of increasing the interactive space, restoring the standard necessary to minimize the construction time, the distance to the medical service centers, neglecting the furniture in semi-public spaces, paying attention to functionality, defining multi-functional spaces, combining commercial and residential use, separating open spaces with functionality, expanding marginalization and slums, middle spaces without functionality, non-compliance with national regulations standards in construction, increasing urban density , improvement of dilapidated fabric, 25-meter houses, accurate placement of collective housing, miniaturization of large units are related. Based on this, the second factor can be named as spatial characteristics.

The third factor: This factor explains 14.487% of the total variance and based on the final filtered matrix with the variables of institutional houses for the middle classes, performing collective activities, standardization of collective housing, social isolation, use of tower collective housing, Aggregation of specific social groups, focus on collective activities and its definition, studies on failed collective housing, revitalization of past collective housing are related. Based on this, the third factor can be named under the title of social characteristics.

The fourth factor: This factor explains 12.296% of the total variance and based on the final filtered matrix with the variables of land price removal, long-term land lease, further reduction in massification, induction of rental housing, credit of using cheap facilities. , 9-fold costs in building urban infrastructures, removing land prices, long-term land leases, supporting housing for the first-born, empowering families in providing housing, liquidity growth and increasing the ratio of materials, multiple-fold increase in housing prices are related. Based on this, the fourth factor can be named under the title of economic characteristics.

The fifth factor: This factor explains 11.029% of the total variance and based on the final filtered matrix with the variables of not paying attention to the nature, removing local and cultural patterns, following the policies of the construction period, maintaining the beauty of the society, motivation for maintenance and restoration. , the training of skilled manpower, the use of urban planning and native architecture, the motivation of residence and ownership, the continuation of Mehr's housing policy, the use of skilled manpower, the presence of pleasant smells in the open space are related. Based on this, the fifth factor can be named under the title of cultural characteristics.

The Sixth factor: This factor explains 11.017% of the total variance and based on the final filtered matrix with the variables of using local architecture, the use of development stimulating projects, paying attention to the basics of sustainability in design and implementation, the absence of standard per capita. Open space, market regulation, building quality improvement are related. Based on this, the sixth factor can be named as service-climatic characteristics.

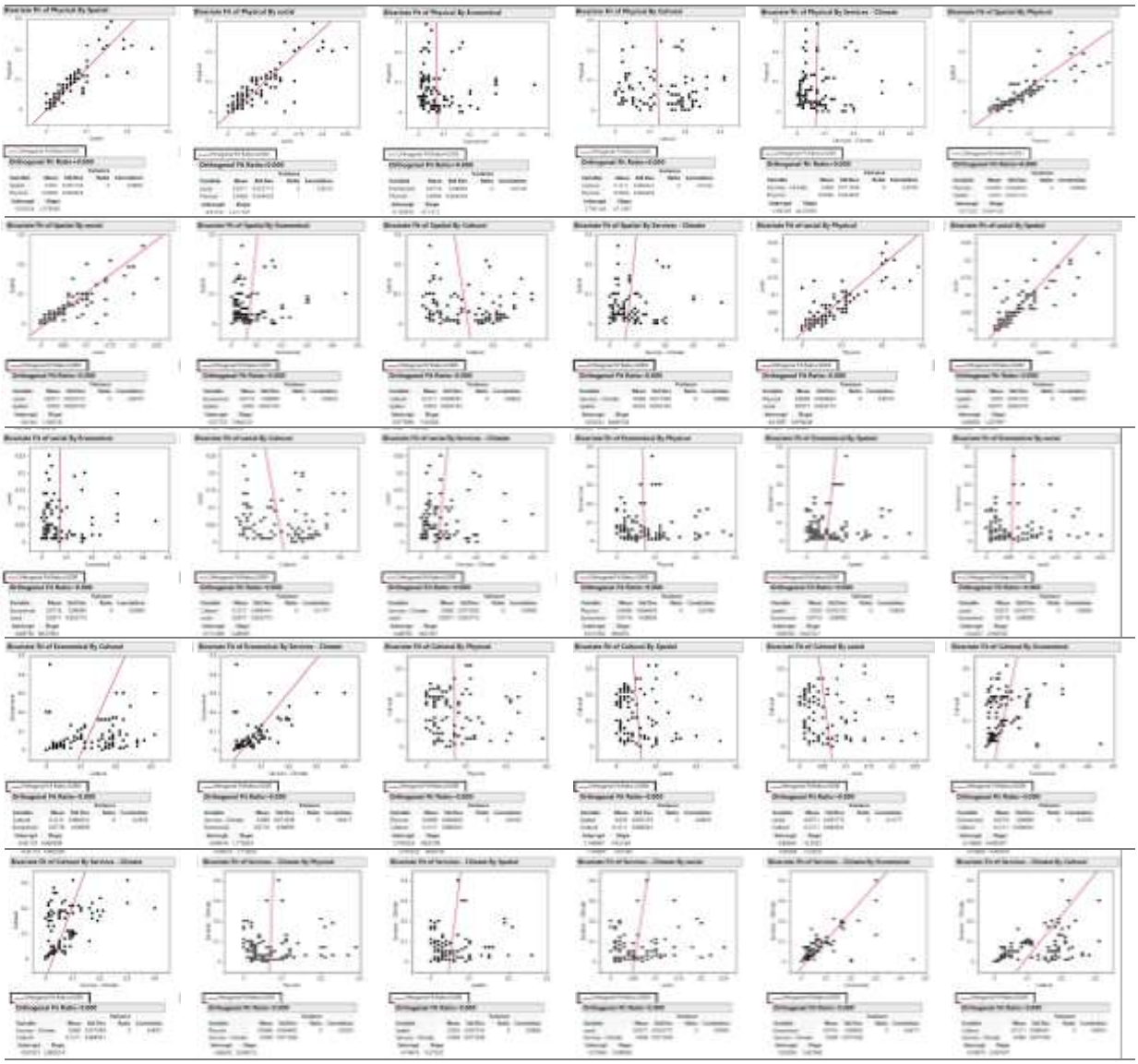
Table 5 The correlation of six factors

Indicators	Factor load	Percentage of changes	Agent name
Ignoring decorations	0.918		
Location outside the city quality construction	0.890		
Satellite towns	0.700		
Following modern styles	0.753		
Using lower quality and cheaper materials	0.772		
Advancement of performance techniques	0.912		
The beginning of high ranking	0.934		
Little attention to the horizontal development of the city	0.917		
Production of building materials	0.872		
Mass production	0.973		
Indiscriminate horizontal development in the city	0.837		
Increasing the share of earthquake resistant units	0.939		
Removal of urban and agricultural environment	0.816	**24.946**	**Physical**
Physical-spatial gap	0864		
Alien pattern with native architecture	0.679		
Poor quality materials	0.716		
Using the extroverted model	0.837		
Allocation of land in less developed areas	0.971		
Using poor quality materials	0.876		
National housing	0.974		
Simultaneous horizontal and vertical development in the city	0.764		
Completion of Mehr housing project with better materials	0.867		
Construction of safe housing	0.842		
Poor quality construction	0942		
Detailed implementation details	0.863		
Increasing the interactive space	0.945		
Reviving the standard required to minimize construction time	0.561		
Distance to medical service centers	0.697		
Neglecting furniture in semi-public spaces	0.834		
Attention to functionalism	0.814		
Definition of multifunctional spaces	0.575		
Combination of commercial and residential use	0.869		
Separation of open spaces with function	0.834	**20.697**	**Spatial**
Expansion of marginalization and slums	0.937		
Middle spaces without function	0.871		
Failure to comply with the standards of national regulations in construction	0.715		
Increasing urban density	0.843		
Improvement of worn texture	0.752		
Houses with a size of 25 meters	0.812		
Accurate placement of collective housing	0.788		
Miniaturization of large units	0.892		
Institutional houses for the middle classes	0.575		
Doing collective activities	0.414		
Standardization of collective housing	0.396	**14.487**	**Social**
Social isolation	0.541		
Use of high-rise collective housing	0.749		
Gathering of special social groups	0.661		

Focusing on collective activities and its definition	0.715		
Studies on failed collective housing	0.814		
Revival of past collective housing	0.802		
Removal of land price	0.485	**12.296**	**Economical**
Long term land lease	0.668		
More miniaturization in bulking	0.489		
Induction of rental housing	0.743		
The validity of using cheap facilities	0.361		
9 times costs in the construction of urban infrastructure	0.497		
Removal of land price	0.554		
Long term land lease	0.616		
Supporting the housing of the first	0.335		
Empowering the family in providing housing	0723		
Liquidity growth and increase in the ratio of materials	0.811		
Multifold increase in housing prices	0.619		
Failure to pay attention to the nature	0.347	**11.029**	**Cultural**
Removal of indigenous and cultural patterns	0.387		
Follow construction period policies	0.542		
Maintaining the orderliness of society	0.634		
Motivation for maintenance and restoration	0.579		
Skilled training	0.691		
Using urban planning and native architecture	0.346		
Incentive for residence and ownership	0.235		
Continuation of Mehr housing policy	0.432		
Employing skilled labor	0.532		
The presence of pleasant smells in the open air	0.223		
Taking advantage of the native architecture of contextualism	0.498	**11.017**	**Service - climate**
Applying development stimulating projects	0.368		
Attention to the basics of sustainability in design and implementation	0.161		
Absence of standard open space per capita	0.543		
market regulation	0.452		
Quality improvement of the building	0.812		

Then a correlation is taken between all the dimensions according to the results obtained from the above table of the physical dimensions of the national housing variable with a value of (0.974) the most effective and the least related to the transfer of land in less developed areas with a value of (0.974) In the spatial dimension, the increase of the interactive space with the value (0.945) and the least revival of the standard necessary to minimize the construction time is (0.561). Collective (414) have the least impact. In the economic dimensions, the highest growth in liquidity and the increase in the ratio of materials (0.811) and the least support for the housing of the former (0.325), in the cultural dimension, the presence of unpleasant odors in the open space (0.223), the least and the most related to the training of the workforce Maher is (0.691). In service-climate, the use of contextual architecture (0.491) and attention to the basics of sustainability in design and implementation (0.161) are the most and the least. In the next step, to check which dimensions can better predict other dimensions from linear regression and curve fitting drawing in NCSS software, the results show that physical-spatial and economic-service climate dimensions with a coefficient above 0.8 can Explain each other's behavior. And the lowest is related to the negative correlation between the variables of physical and cultural dimensions with the value (-0.04).

Table 6 The existing correlation between the governing variables in each dimension and the drawing of the fitting diagram in it



10. Conclusion

In various governments after the Islamic revolution, dealing with housing and improving its conditions has always been an election slogan, but after the coming of governments and severe economic conflicts as well as foreign policies, many of the mentioned issues have not been realized. Or due to not being fully realized, it has caused problems that have reduced the quality of these residential and living places. Based on this research, it was determined that the influential areas in this research included physical, spatial, social, economic, cultural and service-climate. And the improvement of the situation or the decrease in quality has occurred in these dimensions. Based on the studies, it was found that the economy has affected all dimensions of the indicators obtained from the government's discourses. It was also found that most of these collective housings are for the target community of the middle social classes and Downside is made from an economic aspect.

The following strategies can be suggested to solve the problem of the phenomenon in collective housing.

Table 7 Suggested strategies to solve collective housing problems

Design of conceptual urban elements	Providing visibility as elements of the identity of the urban sector	Use of durable and resistant materials
Applying regulations for proper separation of land	Using visual elements such as water and vegetation to enhance visual corridors created towards memorable elements	Highlighting memorable elements by creating a contrast with similar elements in terms of physicality and performance
Using government financial aid to improve collective housing	Creating identity elements to increase readability	The use of light in different houses in order to indicate them and the element of identity
Using local patterns in decorations and building walls	Reproduction of horizontal and vertical rhythms in the main bodies of the neighborhood	Creating a harmonious and integrated skyline
Creating parks and green spaces	The use of physical elements inducing a sense of place, attachment to a place and...	Using materials suitable for the climate and with a useful life
Creating a connection between the spaces of pause and movement	Creating the required housing according to the number of households	Creating required educational applications
Improvement of roads at intersections	Using the difference in height in order to prevent interference between riders and pedestrians	Creating spatial openness in the place of population-absorbing uses
Using the participation of people to improve the level of environmental health	Creating collective spaces for social interactions	Moving or removing incompatible uses in the neighborhood
Creating spatial vitality	Determining a clear legal border in order to reduce the entry of people into the place	Using the element of light in private spaces in order to induce a sense of security
Increasing the economic power of the household	Private sector investment in order to attract active young people to work	Creating jobs suitable for the existing classes in collective housing to strengthen the sense of foot territory

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

Sheida Korjani[a], Shabnam Akbari Namdar[b]*, Maryam Singery[c], Hassan Sattari Sarbangholi[d]

[a]*Ph.D. Student, Department of Architecture, Tabriz Branch, Islamic Azad University, Tabriz, Iran*
[b]*Assistant Professor, Department of Architecture, Tabriz Branch, Islamic Azad University, Tabriz, Iran*
[c]*Assistant Professor, Department of Architecture, Tabriz Branch, Islamic Azad University, Tabriz, Iran*
[d]*Associate Professor, Department of Architecture and Urban Planning, Tabriz Branch, Islamic Azad University, Tabriz, Iran*

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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

* Corresponding author. Tel: +98-9144149453.
E-mail address: shabnamnamdar@yahoo.com

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).

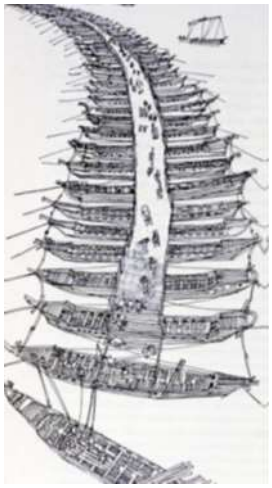

Fig 2 Design of a boat bridge (source: p30world.com)

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.

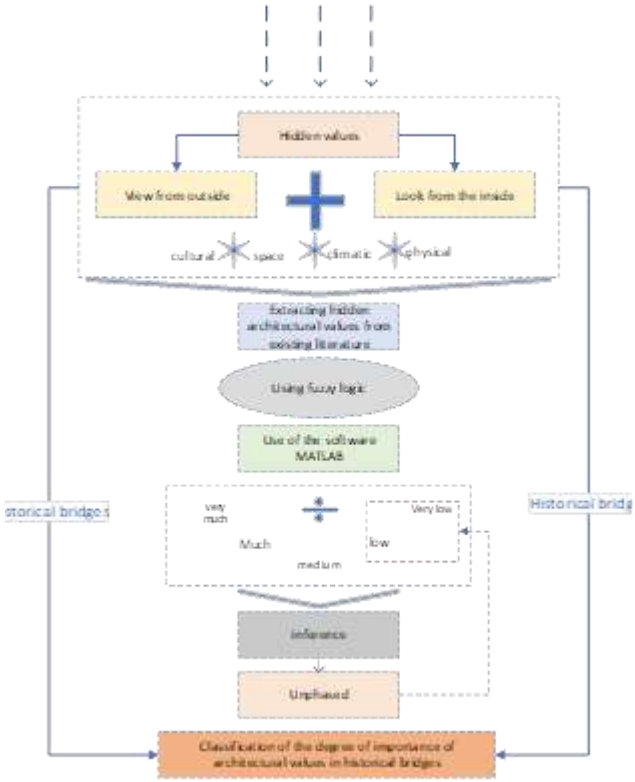

Fig 5 The steps of performing the fuzzy Delphi research method

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

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

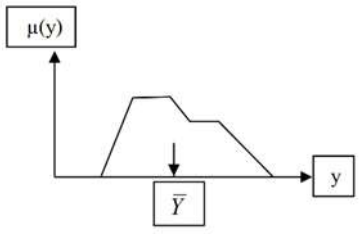

Fig 6 Center of gravity defuzzification method (Source: Monem, Khorrami, and Heydarian, 2007: 34)

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.

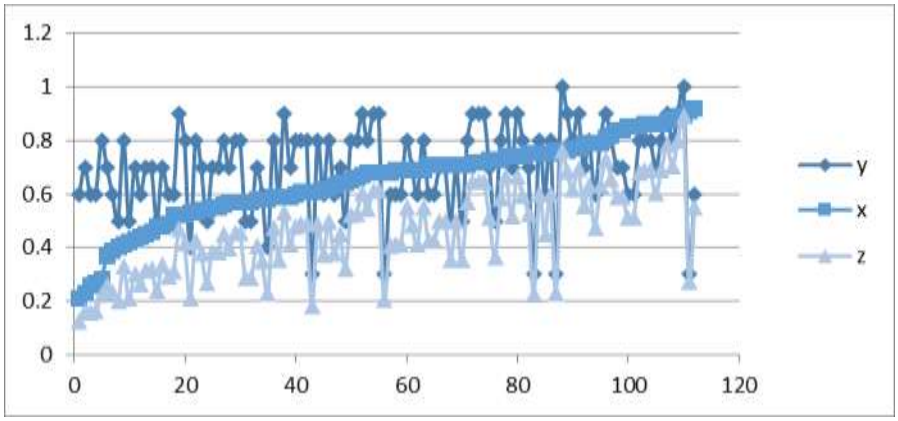

Fig 7 Classification of the importance of each linguistic variable

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.

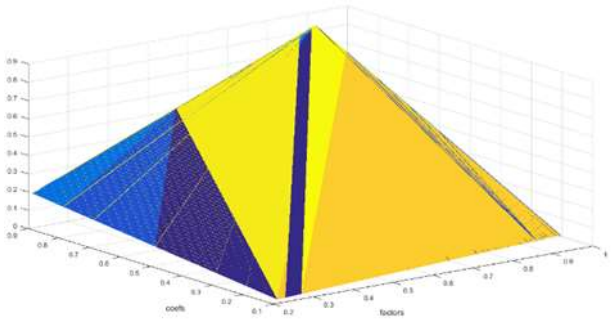

Fig 8 Variables in the physical, spatial, etc. domains with MATLAB software

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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Comparison of the Components of the Physical Structure of the Residential Building of the Qajar Period in the Degree of Influence from the Western Architecture

Alireza Taherian[a], Ahmadreza Keshtkar Ghalati[b]*, Mahmoud Nikkhah Shahmirzadi[c], Gholamhosein Naseri[d]

[a]*Department of Architecture, Semnan Branch, Islamic Azad University, Semnan, Iran*
[b]*Assistant Professor, Department of Architecture, Faculty of Art and Architecture, Kharazmi University, Tehran, Iran*
[c]*Department of Civil Engineering, Semnan Branch, Islamic Azad University, Semnan, Iran*
[d]*Department of Architecture Engineering, Damghan Branch, Islamic Azad University, Semnan, Iran*

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Research Article

Abstract

Residential houses are one of the most important types of Iranian architecture. The history of Iran's architecture shows that traditional houses in various periods almost kept their structural system in the field of their body and mainly stylistic developments were specific to the hidden concepts in their structural field. Looking at the contemporary architecture, it can be seen that the buildings of the Qajar period, while following the past practices, influenced by the western architecture, are subject to changes in the physical structure that have led to the construction of buildings with an eclectic identity. In this regard, the present research, with the aim of extracting the components of the physical structure, tries to investigate the influence of the residential buildings of that period on the principles and concepts of Western architecture. In this article, a mixed qualitative and quantitative research method has been used. First, the components of the physical structure are extracted from the theoretical foundations, and then interviews are conducted to verify the selected samples. After that, quantitative areas will be used to check the effectiveness. It is worth mentioning that interviews are used to collect information in the qualitative stage and questionnaires are used in the quantitative stage. The software used in the quantitative part is JMP and in the qualitative part ATLASTI. The results show that there is a positive and significant correlation between the components of western architecture and the physical structure of Qajar period houses at the level of 0.01. In this regard, first the break from the past and confinement with

* Corresponding author. Tel: +98-9123188201.
E-mail address: ahmadrk60@yahoo.com.

the value of correlation (0.952), then the break from the past and fit with the value (0.932) in the second place and the confinement and the use of rotating and diagonal statue forms with the value (0.925). In the third place, they have the highest correlation between physical structures and western architectural components. The lowest correlation is between severe criticism of objects and imitative and structural schools with a value of (0.112).

Keywords: Physical Structure; Residential Building; Qajar Era; Western Architecture; Mixed Method

1. Introduction

Paying attention to various components in the periods of architecture is sometimes accompanied by extremes and pursued with different goals, which are sometimes used as a tool to seek superiority and stabilize fanatical ideas and extreme nationalism, and sometimes in order to moderate the negative consequences of the modern period in recent years in order to face the phenomenon of globalization. followed Contemporary architecture has seen various influences based on time, place and social, cultural and educational trends, each of which has reflected the specific political, social and cultural conditions of its era. At the same time, it is impossible to ignore the many and distinctive structural changes of this era on Iranian architecture (Shayan and Dezfuli, 2013: 9). A review of the history of Iranian architecture shows that architecture has had a clear and consistent process, in a way that has a logical relationship with its previous and subsequent periods; But during the Qajar era, we see a break in the architecture of this land. In fact, the domination of the new western civilization on the ancient Iranian culture can be seen (Bani Masoud, 2013: 73). What has caused this transformation and rupture in architecture is the intellectual and cultural transformation of Iranian society that began in the Safavid era and reached its peak in the Qajar era and especially the first Pahlavi period. Safavid era was born, but since these changes have not yet been very influential in architecture, the beginning of the transitional period in Iranian architecture should be considered the Qajar period (Safari, 2008: 14). From the perspective of spatial creativity, the architecture of this period is considered a valuable period and is placed in a superior and more evolved position than its previous periods, because spatial creativity increases in this period (Mirmiran, 2000: 54-56). The variety of spaces increases and new spaces are created. Spaces become more open and light, and traditional architectural patterns evolve in line with expanding the space. But when we look from other angles such as sizes, proportions, shapes and decorations, the architecture of this period shows a lower status than its previous period (Farhad and Kashani, 2018). Therefore, Qajar architecture rightly promoted the principles, foundations and old patterns of Iranian architecture and created innovation in terms of space. But it seems that it did not have the necessary strength to create a new architecture (Bani Masoud, 2013, 75). In the traditional architecture of Iran, building a house and residence is a cultural thing that is directly related to the tradition, climate and social cultural attitude of the people, in such a way that the house is considered to be a manifestation of the human being and the manifestation of the cultural traditions of that society (Pourmand and Jedgaran, 2005: 46). In the early Qajar era, the traditional style and style formed the majority of residential buildings (Safari, 2008: 13), but with the rise of the influence of western culture and civilization from the middle of the Qajar period, the use of western architectural art in the design of houses increased and gradually the field of houses appeared in it provided a fusion style and polarization of popular styles. The trend towards western architecture did not end here and in the last three decades of the Qajar era, houses in a completely

western style were created by wealthy and influential Qajar men (Qabadian, 2003: 245). According to Rapaport's opinion, the environment is defined as a set of relationships between objects and also between objects and humans, and he considers its organization based on a systematic pattern (Najumian, 2008: 115). A pattern in architecture is a combination of design principles that are known to form a larger group or set of design solutions. In fact, it can be said that it is a flexible framework that shapes the body (Shahbazmir, Omidari, and Begzadeh, 2014: 26). Architectural patterns are the result of human experience and are a tool to produce form, and in a holistic view, they are considered to be the effect of architectural space (Soltani, Mansouri, and Farzin, 2011: 4). Since the research in the field of fundamental concepts of architecture in order to identify patterns and components, it is necessary to examine the physical and spatial characteristics of buildings, by studying and examining case examples of historical houses as part of the golden pages of the identity of the people of this land, the principles and concepts of Iranian architecture can be extracted from them (Zandieh and Karimi, 2014); Therefore, considering the changes in the physical area of buildings of the Qajar era following the developments originating from Western architecture, despite the growth of traditional architectural patterns from a spatial perspective, this research with a case study in the area of traditional houses of the Qajar era, with the aim of extracting the components of the physical structure and their adaptation to architecture Contemporary West tries to answer the question, which components were more influenced by Western architecture?

2. Research Background

Regarding the history of contemporary architecture in Iran during the Qajar era, except for the writings that express most of the theoretical base and taste of the authors about essays about the influence of the architecture of that era on the architecture of the West in physical and spatial aspects, it seems that there is no documented research that relies on innovation in There are few areas that have investigated the effectiveness of the structural components of this era of Western architecture. Most of the researches are in the form of qualitative approaches and in the form of descriptive analysis, which this research uses both approaches to achieve more substantiated results. In order to be brevity and to avoid prolonging the writing as well as summarizing the results, the background of the research is given in the form of Table 1, separated by books, articles and thesis;

Table 1 Background of the research (source: authors)

Topic	Researcher	Year	Description
Books			
Contemporary architecture of Iran	Bani Massoud	2013	Examining the way, we face the new world and its influence on Iranian architecture, from the Qajar period to three decades after the Islamic revolution, along with the classification of architects of these periods and some of their works.
A look at the emergence of new architecture in Iran	Cyrus Baur	2009	It specifically discusses architectural events, architects and their works from the constitutional revolution to the present day.
Architecture in Naseri Palace (Tradition and Modernity in Contemporary Architecture of Tehran)	Vahid Qabadian	2014	It refers to the description and development of the architecture of the period of Naser al-Din Shah Qajar, especially in Tehran.

Articles			
A look at architectural trends in Tehran	Behrouz Pakdaman	1994	Investigating developments in Iranian society since the middle of the Qajar era and at the same time as creating wider connections with European societies.
Comparative study of architecture and contemporary urban planning of Iran with Europe	Iraj Etisam	2004	It examines and compares four periods of Iran's contemporary history from that time until now. He considers the industrial revolution to be the main cause of changes in Western architecture and urban development, which coincides with the rule of the Qajar dynasty.
Survey of architecture and urban planning of the Qajar period	Farhad and Kashani	2009	First, the architectural features of the Qajar period and the different currents of this period have been briefly discussed. Then, the backgrounds and characteristics of Qajar architecture are determined and categorized, and then each group is analyzed.
Adapting the role of the model and concepts based on experience in the space architecture	Mehrdad Soltani	2012	Examining the concept of pattern with some other concepts and interpretations in the architectural space
Comparative study of contemporary architectural approaches in Iran (recognition of theory in the works of three generations of architects)	Shayan and Dezfuli	2014	Analyzing the signs and currents of thought in the text of the works and recognizing the tendencies of the generations of contemporary architecture
The relationship between today and the past in works of contemporary residential architecture in Tehran	Khaqanpur-Khoei	2016	Understanding the approach of designers in the path of connecting with the past, recording joint efforts and answering the question of how far these designers have come close to the principles of Iranian architecture, considering the architecture of the past.
Thesis			
Comparative study of the architecture of traditional and contemporary Iranian houses from the perspective of physical-spatial organization (study course: Pahlavi and Qajar houses)	Sacrifice-merciful	2021	In order to investigate the impact of the physical-spatial organization of Qajar and Pahlavi historical houses on European architecture, this research aims to investigate and read the structural system of the houses of these two periods. In this way, he has used the library method to collect qualitative information and the historical-interpretive approach based on the comparative strategy in order to analyze the content of the obtained documents.

2.1. Theoretical

The evolutionary course of Iranian architecture has taken place in a continuous and gradual movement, from within previous traditions and experiences; This is the reason why, despite all the sudden changes and transformations caused by military invasions and cultural shocks, the traditional architecture of Iran has achieved a distinguished individuality from the architecture of

other Muslim countries (Kamali, 2008). The developments of the Qajar era were endogenous at first. It had a slow rhythm and maybe similar to other artistic and social phenomena and it had artistic and social factors and phenomena and was influenced by the internal factors and phenomena of the society (Ikhaka, 2003). The peaceful ideas and material manifestations of the West had ended, in the middle of this period it turned into a serious battle and confrontation between tradition and modernity (Pakbaz, 2000). In this way, the architecture of Iranian buildings, which was formed in the early Qajar period in connection with the principles of traditional architecture and in the form of the structures of a traditional city, gradually lost its ancient forms in the middle of the Nasrid period and took on a western appearance (Hashempour and Kaynejad, 2011). In this regard and according to the researchers, due to the fact that they shaped the architectural structure and decorations of many buildings of the Qajar period in a different way from the previous traditional ways, therefore, they can be cited in the study of the influence of Qajar architecture from Western architecture. Therefore, in the following, we will examine the characteristics of the residential architecture of the Qajar period in order to extract and understand it better than the physical structure component. Then, in order to understand the principles and concepts of Western architecture and to examine the effectiveness of them, we take a brief look at their styles and characteristics in the periods at the same time as the Qajar period.

2.2. Physical Structure of the Residential Buildings of the Qajar Period

According to Cooper, the house has two different components; The interior space consists of the enclosed and private space and the exterior which includes the open and public space (Aminpour et al., 2014). Building a house is a cultural phenomenon and its shape, organization and spatial order are influenced by the cultural environment to which the house belongs. Factors such as climate, art and technology are also in the next layers of shaping the body of the building (Rapaport, 2012), so that Hillier described the socio-cultural logic of the space as follows; The social and cultural dimensions in the spatial configuration, like the grammar rules in the shaping of literary texts, in fact, the social and cultural characteristics of the residents of each region are among the important factors in the formation of the spatial structure of the settlement (Hillier, 2007: 77). This theory in the buildings history that was built in a native way was more intense and the building elements and geometric coordination in the construction were more carefully controlled and implemented, which itself caused the socio-cultural stability of the space (Ronn, 2011: 114). In fact, the house is an institution that was created in line with a series of complex purposes and is not a simple structure, but the space is a systematic structure, a structure that has order and hierarchy in such a way that the organization and combination of spaces and elements are formed based on some physical principles. One of these principles is axes and symmetry. In houses, confrontation with the outside has always followed the organization of the inside, and it has had a significant impact on the geometric structure of the house (Wigley, 1994). The role of the house is to create a social unit. The house cannot be studied separately from the society or its context and must be studied as a part of the social and spatial system of the city, including the house and lifestyle, biological complex and landscape. In the traditional architecture of Iran, the house is the most important architectural space, which in combination with the culture, climate, native art in each geographical region and had special spatial elements. In general, the evolution of Iranian houses has a special structural order that has not had significant changes throughout history; But from the Qajar period, due to the fundamental changes in the political and social structure of Iran, fundamental changes took place in houses (Ronn, 2011: 115).

2.3. Architecture of the Qajar Period can be Divided into Two Part

A) Buildings of the first period 1207-1266 AH. 1800-1850 AD, which is the same time as the reign of Agha Mohammad Khan Qajar, Fath Ali Shah, Mohammad Shah and the beginning of the reign of Naser al-Din Shah.

Among their features, the following can be mentioned:

1. Mainly introverted buildings 2. Breaking of internal facades with the retreat of the second floor 3. load-bearing walls, convex arches, cruciform arches, traditional structures such as arch and toise, arch of music, arch of Colombo and four sections 4. Using building materials and wooden beams to build the body of buildings 5. The use of brick, straw, plaster, stone and tile in the facades of buildings (Meshbaki Esfahani and Meshbaki Esfahani, 2018).

The architecture of this period was the continuation of the traditional architecture of the periods of the past kings of Iran and continued until the middle period of the Qajar rule (Soltanzadeh et al., 2018: 18-19). The residential buildings of this period include the entrance, vestibule, central room, porch with two columns in front of it and smaller rooms located around the central room, all of which were in the style of authentic Iranian architecture in the past periods, but in this period, with newer initiatives and the influence of architect elements. The west has been completed in details and construction (Sarikhani, 2004). Among the elements of western architecture, it is possible to create an entrance hall, i.e., stairs that start from the middle of the hall and continue to the fork in the opposite direction up to the top (Nasiri Ansari, 1971), creating a window facing the street with decorative railings and a sloping roof. Instead of flat and domed roofs and the decorations of columns and capitals, he pointed to the Ro-Coco style (Itsam, 1995).

B) Buildings of the second period, 1266-1344 AH. 1850-1925 AD, at the same time as the rule of Naser al-Din Shah, Muzaffar al-Din Shah, Muhammad Shah and Ahmad Shah.

The beginning of the period of eclectic architecture begins with the Naseri period. The first changes were small and insignificant, and in the beginning, the legality of Iranian architectural patterns dominated the building, but over time, the flow of changes in the form of a wide wave affected important cities (Soltanzadeh et al., 2018: 7). In this period, architecture and urban planning, like other manifestations of Iranian life, were influenced by Western modernism, and the form and manner of building design and construction tended towards the Western world (Meshbaki Esfahani, 2018). The influx of new elements started in the fork: 1. Decorative elements and factors 2. Spatial patterns. Simultaneously with the rule of Muzaffaruddin Shah, Muhammad Ali Shah, Ahmad Shah until the end of the Qajar dynasty, the most important historical event, i.e., the collision of tradition and modernity and the occurrence of the constitutional revolution, had taken place. Changes in urbanization and urban planning regulations have started with the departure of traditional architects and the arrival of Iranian educated architects abroad, under the influence of the new western thinking of "modernism" characterized by individualism in the creation of architectural spaces (Soltanzadeh et al., 2018: 6). The following are the features of this course: 1. Buildings with a neoclassical symbol 2. Symmetry in the main view and plan 3. The use of sloping roofs, sometimes with the Centauri symbol 4. Semi-circular arches instead of traditional architectural cross arches 5. Classical columns and decorations and realistic images 6. The balcony above the entrance 7. Creating volumetric compositions in the walls and corners of buildings (Meshbaki Esfahani, 2018).

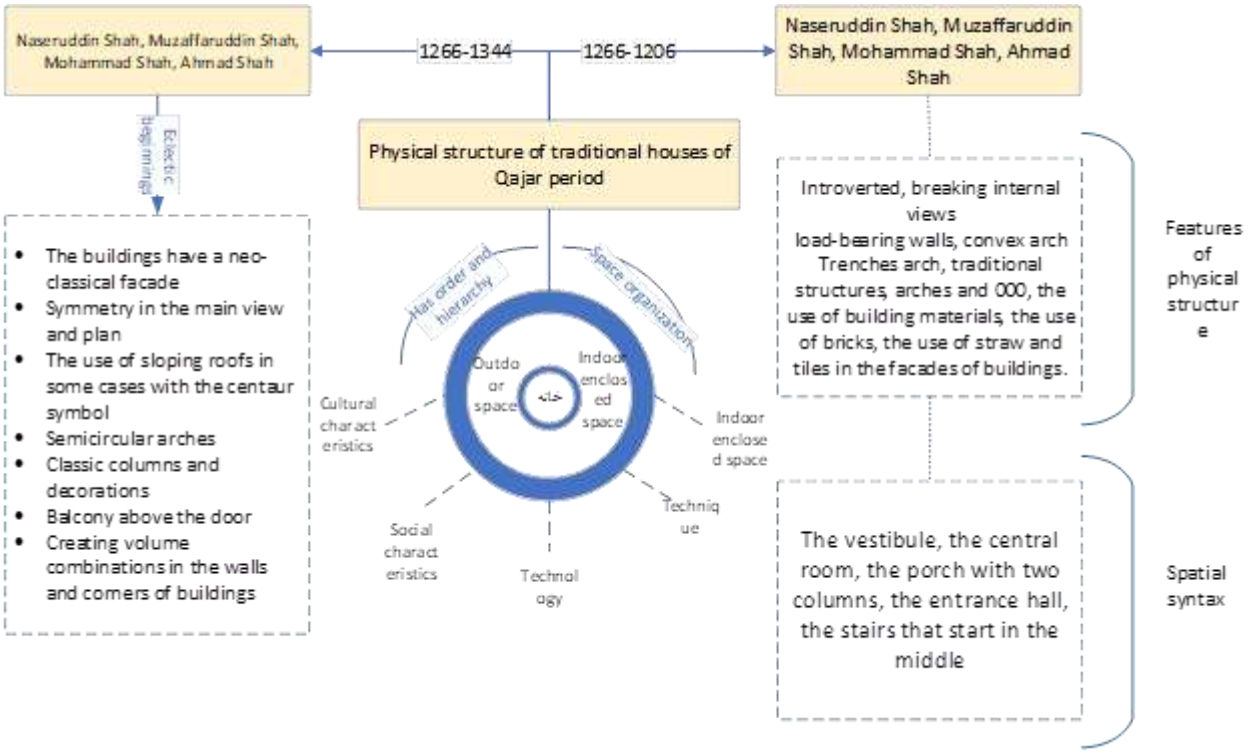


Fig 1 The physical structure of the traditional houses of the Qajar period (source: authors)

2.4. Western Architecture at the same time as the Qajar Period

Late Qajar architecture can be considered as early modern architectural style (Bamanian, 2006: 5). European neoclassical architecture with the combination of Iranian motifs, the first architectural trend in this period can be considered as the late Qajar architecture with the combination of imported elements; which is explained on a case-by-case basis as follows:

Table 2 Characteristics of western architecture coinciding with the Qajar period (source: authors)

Style name	Principle
Chicago School	Designing the building based on the requirements and needs of the new era, looking to the future and using modern materials and artifacts, using a steel frame for the entire structure of the building, showing the structure of the building on the facade of the building, not imitating the styles of the past, very little use of decorations, using windows wide that cover the entire opening between the columns (Curtis, 2009, 431).
New art movement	Strong criticism of imitation objects and schools, separation from the past, inventing new forms, art suitable for the time, using modern products (metal) for the building skeleton and decorations, using decorations inspired by natural, romantic or geometric forms (Shahbazi, Yeganeh, and Bamanian, 2018: 161)
Expressionism	The design expresses the imagination and inner feelings of the designer, the use of rotating and diagonal sculptural forms, the display of spiral movement, no return to the past, the use of modern materials and technology (Roth, 2001, 39).
Futurism movement	Paying attention to the science and technology of future worlds, the impact of high-speed transportation on modern life, breaking with the past, removing decorations, building high-rises, revealing functional components and building technology (Hersey, 1985, 63).

3. Research Method

This research is of applied type from the objective point of view. The research method is a combination of mixed qualitative and quantitative type, which consists of two parts in its data analysis. In the qualitative stage, an attempt is made to reduce the data by using grand theory techniques (open coding, axial coding). The collection tool at this stage is a semi-open interview with short questions that ask experts about the physical structure of the Qajar period building in Tehran, as well as the extent of its influence on the different structure of the selected building from the western architecture. The coding approach uses interpretation, description and live coding; At this stage, ATLASTI software is used. Credibility of the questions and its verification by means of Delphi prospective research with phase (brainstorming, limiting, selection) after selecting the components of the body structure and extracting them according to the selected samples, a quantitative stage is done. In the quantitative stage, first, a questionnaire with a Likert scale is compiled, each question represents a component on the degree of influence of a modern architectural movement, then it is distributed to each of the space users, the sample size is selected by Morgan's table, the upper limit of which is 384 people. This stage is done by using causal-comparative method and by using inferential and predictive statistics to present the physical indicators and factor contribution of each of the influential principles of modern architecture and verify the extracted ones. The validity of the instrument was obtained with the formula CVR=0.75 and reliability was obtained by Cronbach's alpha, which is 0.74.

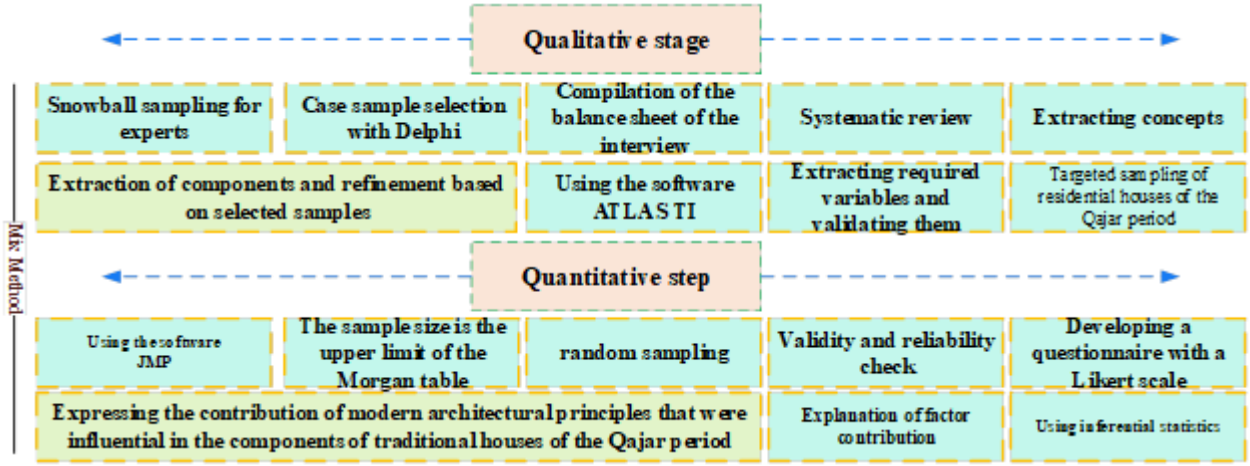


Fig 2 Research process (source: authors)

3.1. Sampling

The introduced examples of traditional houses of the Qajar period have been introduced to the research based on the entry and exit criteria, and the expert panel is selected as follows:

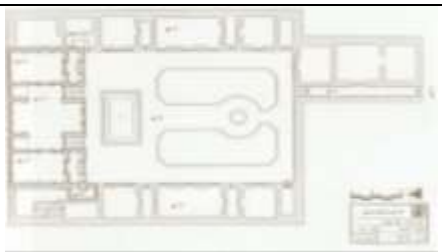
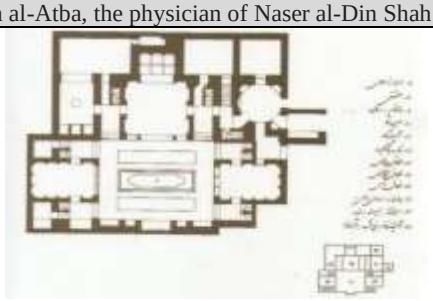
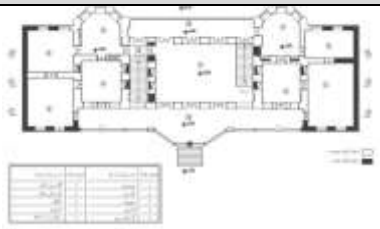
Table 3 Entry and exit criteria in qualitative research

Selection criteria for interview	Criteria for leaving the building research	Entry criteria for building research
Be a faculty member	Not located in the city	There should be a theoretical consensus in choosing it
Be familiar with the topics of body	Its residents do not have	The house is a villa

structure	enough information about it	
Have an article about one of the title variables	have certain limitations in design	Its information is available
Have a residential building design	Part of it is designed by someone else	Score 5 or more in the preference system
The sub-field of architecture or urban planning or civil engineering	be restored	Various materials are used in it

Also, their selection is based on purposeful sampling and on the researcher's observations. The snowball sampling system is used in the interview and selection stage of the expert panel in future research Delphi. The result of the selection for the correctness of the action and the formal validity of the questions from university professors. In the quantitative stage, questionnaires were randomly distributed. The characteristics of the selected buildings are as follows;

Table 4 Characteristics of selected buildings

		Trusted House of Doctors
Manzil Motman al-Atba is a historical mansion in Tehran and related to the Qajar period, which belongs to "Mirza Zainul Abdin Khan Danbali Zarrabi" nicknamed Motman al-Atba, the physician of Naser al-Din Shah.		
		Kazemi's house
Kazemi Mansion or Kazemi Mansion, whose new name is "Old Tehran Museum House" is one of Tehran's old houses, located in Chaleh Maidan neighborhood, in the neighborhood of Imamzadeh Yahya. The current location of the Kazemi building is one of Tehran's old houses, on Khordad Street 15, in Imamzadeh Yahya neighborhood, Abolqasem Shirazi alley.		
		The mansion of the lord of Hormuz
Arbab Hormoz Mansion is one of the monuments of the Qajar period and the sights of Tehran. In this two-story building, you can see a combination of traditional architecture with western architecture. This mansion was renovated in the 90s and finished in 2014.		

4. Research Findings

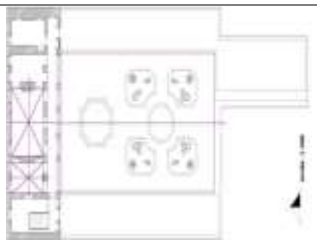
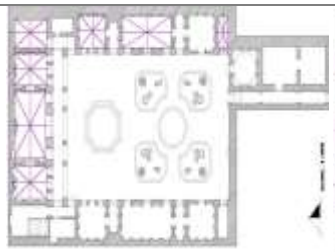
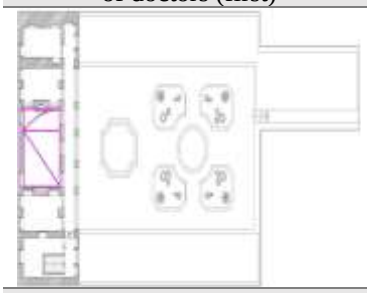
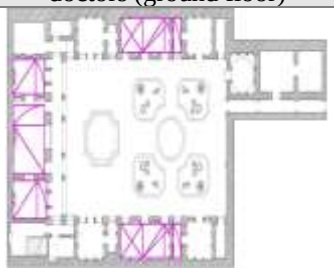
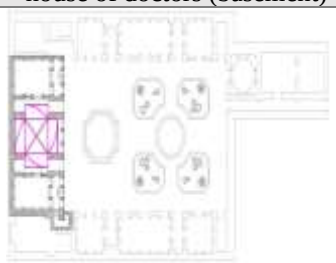
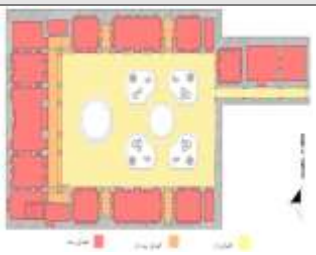
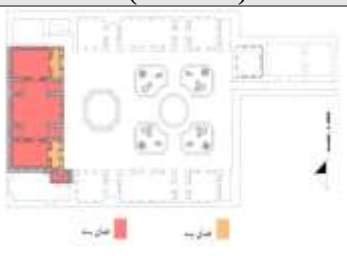
A summary of the interviews conducted regarding the Mutman al-Atabah House

The total volume of the reliable house consists of rectangular spaces. The circular form of one of the ponds and the octagonal form of the gardens and the other pond are built in a complementary

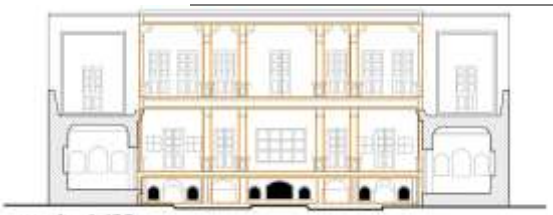
way. Mesh windows in the basement of Motaman al-Atabah house are for attracting light and air flow and seeing the scenery outside. Mesh windows create a balance between outside and inside light. This balance makes the person who looks from inside to outside not tired of the sunlight. The designs used in making mesh windows are often designed to regulate the light inside the room. The windows in this house include doors that have windows due to the bottom being closed and the light passing through them. Symmetry, repetition and rhythm are observed in the north, east and west facades. The large halls and entrances along with the central stairs in the house of Motman al-Atba have created an elongated plan along the facade. The spatial confinement in the house of reliable doctors is such that about a quarter of the building is a closed and semi-closed space and about three quarters of the building is an open space.

There are turquoise-colored tiles in the form of Fakhrumedin mesh in the basement windows. Plaster decorations can be seen on the capitals and fronts in the north facade of the Weber on the fireplaces inside the building and are seen in the form of slime motifs. Brick decorations are used in the basement ceiling. There are wooden decorations on the basement doors as well as inscriptions on the top of the cupboards.

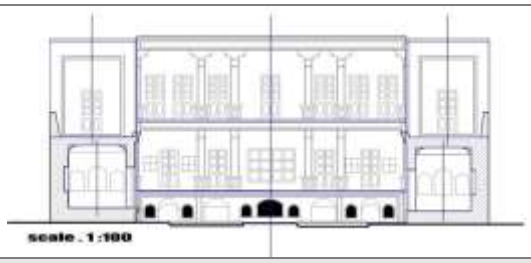
Table 4 Examining the characteristics of the trusted house of doctors

			**symmetry**
Symmetry in the reliable house of doctors (first)	Symmetry in the reliable house of doctors (ground floor)	Symmetry in the reliable house of doctors (basement)	
			**Proportions**
Proportions in the reliable house of doctors (first)	Proportions in the reliable house of doctors (ground floor)	Proportions in the house of the reliable doctors (basement)	
			**confinement**
Confinement in the house of trusted doctors (first)	Confinement in the house of reliable doctors (ground floor)	Confinement in the house of trusted doctors (basement)	

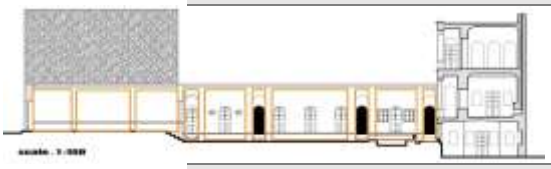
Symmetry, repetition and rhythm in elevation



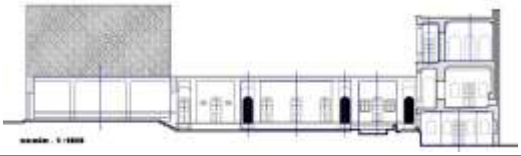
Repetition and rhythm in the north view



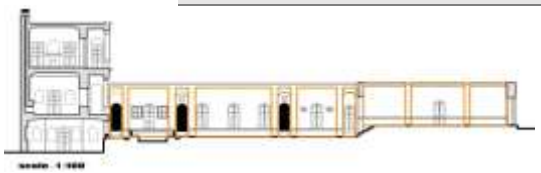
Symmetry in the north view



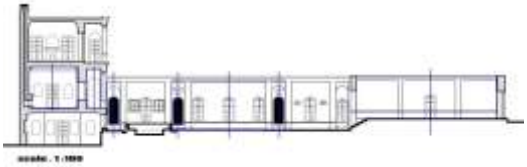
Repetition and rhythm in the view and the western section



Symmetry in the facade and western section



Repetition and rhythm in the facade and eastern section



Symmetry in the facade and eastern section

visual elements

The inscriptions above the closet in the king's room

Plaster on the head

Decorations of Fakhro Madin with tiles

A summary of the interviews conducted regarding the mansion of Arbab Hormoz:

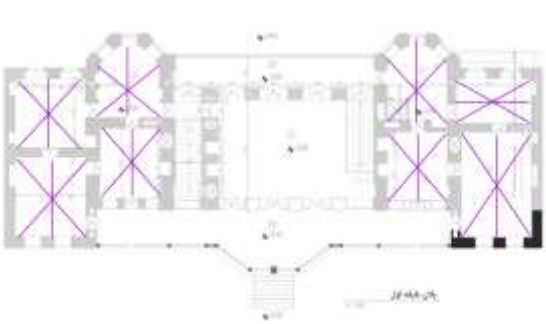
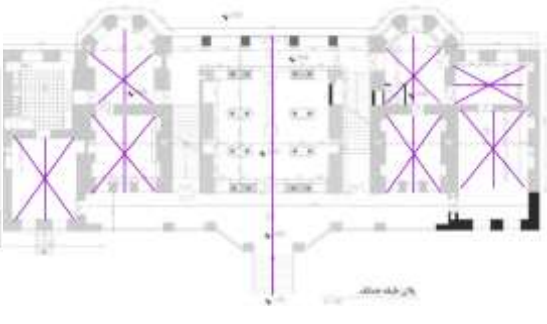
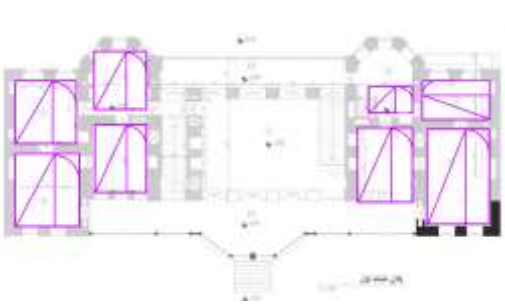
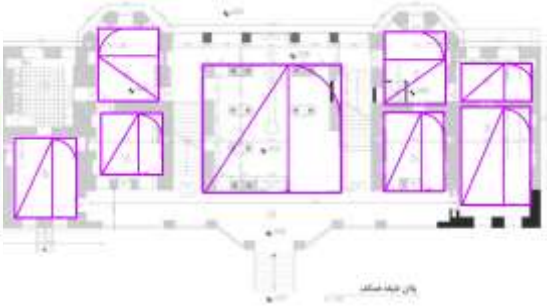
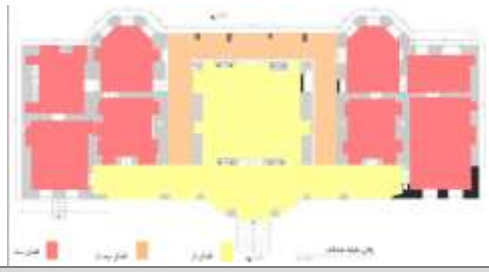
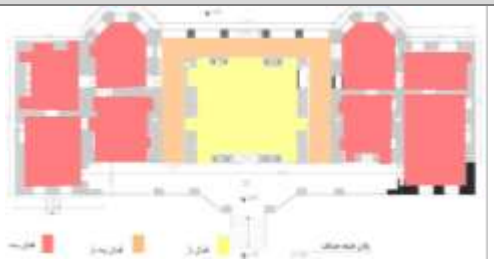
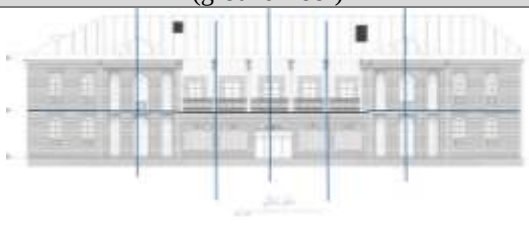
In the entrance area, there is a large shallow rectangular pond (it was deeper in the past). A two-story building, both of which have a large long porch. Full symmetry is seen. The lower porch has eight rectangular columns and the upper porch has two rectangular columns and six elongated and long plaster hexagonal columns with Corinthian leaf capitals. On the left side of the building there is a small door with five steps leading to the basement and two windows can be seen on the sides of the door. The entrance stairs are located right after the pond and in the middle of the building (this part is outside of the facade of the building).

There are two entrances for two rooms on the sides of the main door, and each of the rooms leads to another room, which is made of eight small rooms, i.e. in human dimensions. But from the main door that has been explained, we enter the main middle room or Hozkhaneh. A square room with a brickwork basin in the center with pathways that show water entering and exiting it.

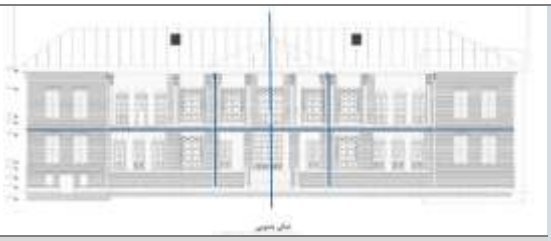
When we go up the stairs, we enter a small corridor, from the left side we reach four rooms that are located on the lower four rooms, and from the right side we enter a king's house, which is a room with three doors that sits on the pond and opens to two porches from the north and south. and the eastern corner is another staircase. There are three niches on the west wall. Shahneshin's roof is also wooden and framed (in the form of a mesh) in pea color and brown, which is worked in the

middle of each flower frame and in the center is decorated with an octagon with a rich and prominent wooden slime.

Table 5 Examining the characteristics of Arbab Hormoz mansion

symmetry		
	Symmetry on the first floor of Arrab Hormoz mansion	Symmetry on the ground floor of Arbab Hormoz mansion
Proportions		
	Suitability on the first floor of Arbab Hormoz mansion	Suitability on the ground floor of Arbab Hormoz mansion
confinement		
	Confinement in the mansion of Arbab Hormuz (first)	Enclosed in the mansion of Arbab Hormoz (ground floor)
Symmetry, repetition		
	Repetition and rhythm in the northern facade of Arbab Hormoz mansion	Symmetry in the northern facade of Arbab Hormoz mansion

Repetition and rhythm in the southern facade of Arbab Hormoz mansion



Symmetry in the southern facade of Arbab Hormoz mansion

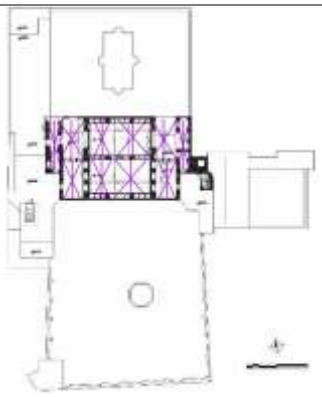
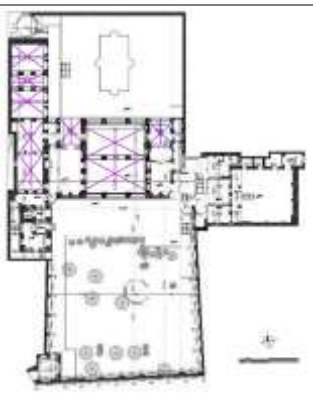
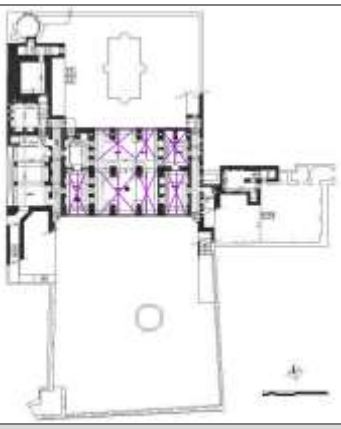
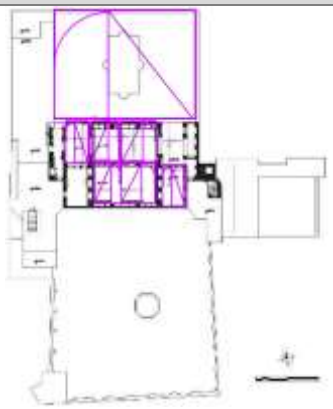
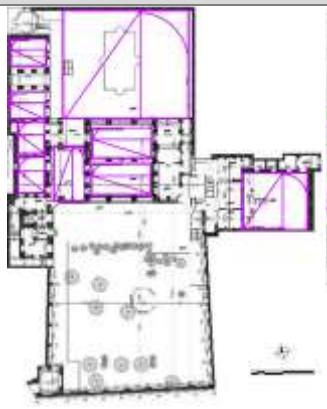
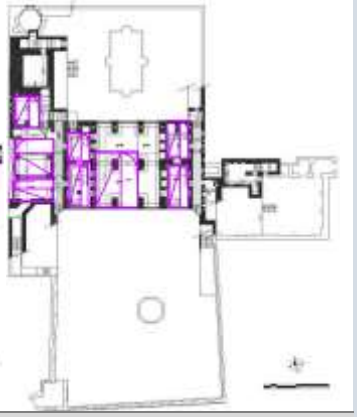
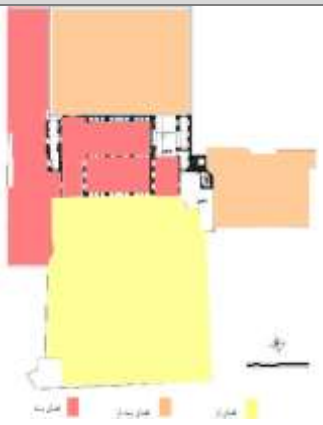
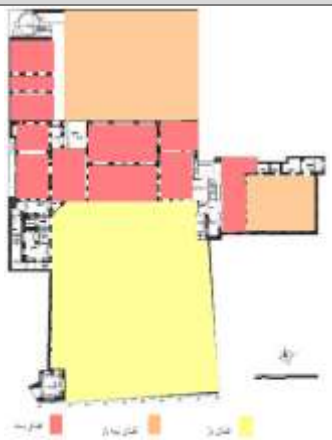
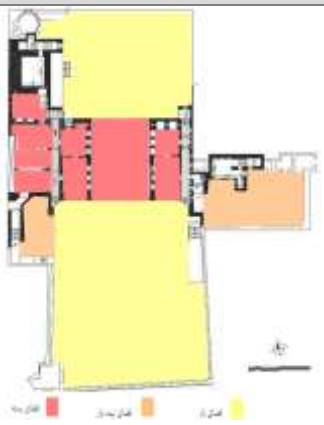
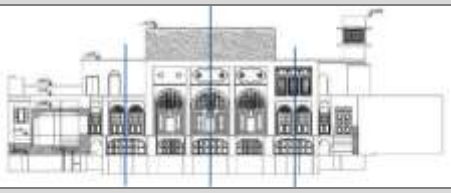
In the windows on the north and south exteriors with colored glass
and sash windows and lattice windows for rooms

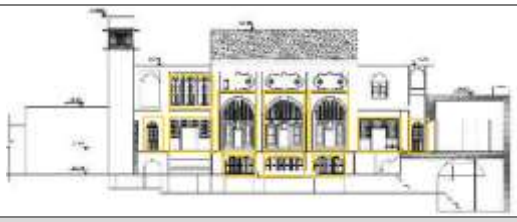
Two internal wooden staircases, which were made of plaster and clay before, and in two earrings

A summary of the interviews conducted regarding Kazemi's house

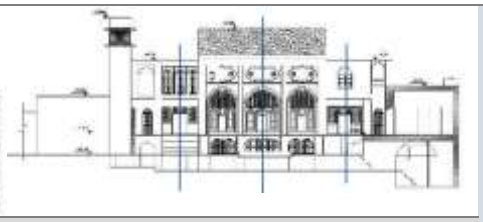
Hierarchy discussion is a conversation between inside and outside, because the sense of outside space cannot be found in the song of inside mood, and in other words, inside lacks these properties and outside conditions cannot be allowed inside. This evolution plays a role in the hierarchy, because the entrance threshold is the condition of entry and transformation, which was placed after the door and in a space such as the vestibule (the main entrance space that is usually placed after the front door), the outer courtyard, the vestibule and the rope; But during the Pahlavi period, this structure collapsed as the inner and outer spaces became more extroverted. Kazemi's house has 3 entrances: the entrance of the crew, the entrance of the north yard and the entrance of the south yard. Designed for all three vestibule entrances. The story of full-fledged color can be seen in the color of the glasses of Iranian sashes, which present an image of heaven to every viewer. This celebration of color, in which no two moments are alike, actually brings joy and happiness to the residents of the house in the colors of red, green, yellow and blue. Kazemi's colored glass is a good example of using color in an Iranian house.

A porch is a roofed semi-open space that is limited on three sides and open on one side. In the houses of the Qajar period, the south porches reveal the view of the house behind its curtain, a view in which usually tanbi (large and main room of the house, which is often located in the heart of the house and has a sash window), kelei (a room located in two On the upper floor, which is formed as a result of the high height of the rope and often overlooks it), there are hozkhanehs (a covered and elevated space that has a pool in the middle and is usually connected with other spaces) and other elements of the house. Of course, in the late Qajar period and the early Pahlavi period, the huge verandas of this decade turn into small verandas that are only for one room and one space, and naturally, the transparency of the space also undergoes changes in terms of area during this period. Kazemi's house has small verandas for the rooms next to Tanbi on the north side and a veranda for the crew.

			**Symmetry**
Symmetry in the upper mezzanine of Kazemi's house	Symmetry on the ground floor of Kazemi's house	Symmetry in the basement of Kazemi's house	
			**Proportions**
Proportions in the upper half of the Kazemi house	Proportions on the ground floor of Kazemi's house	Proportions in the basement of Kazemi's house	
			**confinement**
Confinement in the upper half of Kazemi's house	Confinement on the ground floor of Kazemi's house	Confinement in the basement of Kazemi's house	
		**Symmetry, repetition and rhythm in**	
Repetition and rhythm in the north facade of Kazemi's house	Symmetry in the northern facade of Kazemi's house		



Repetition and rhythm in the south facade of Kazemi's house



Symmetry in the southern facade of Kazemi's house

In the summary of all the codes extracted from the interviews conducted in connection with the components of the physical structure of the residential buildings of the Qajar period, it is presented as follows in Fig 3.

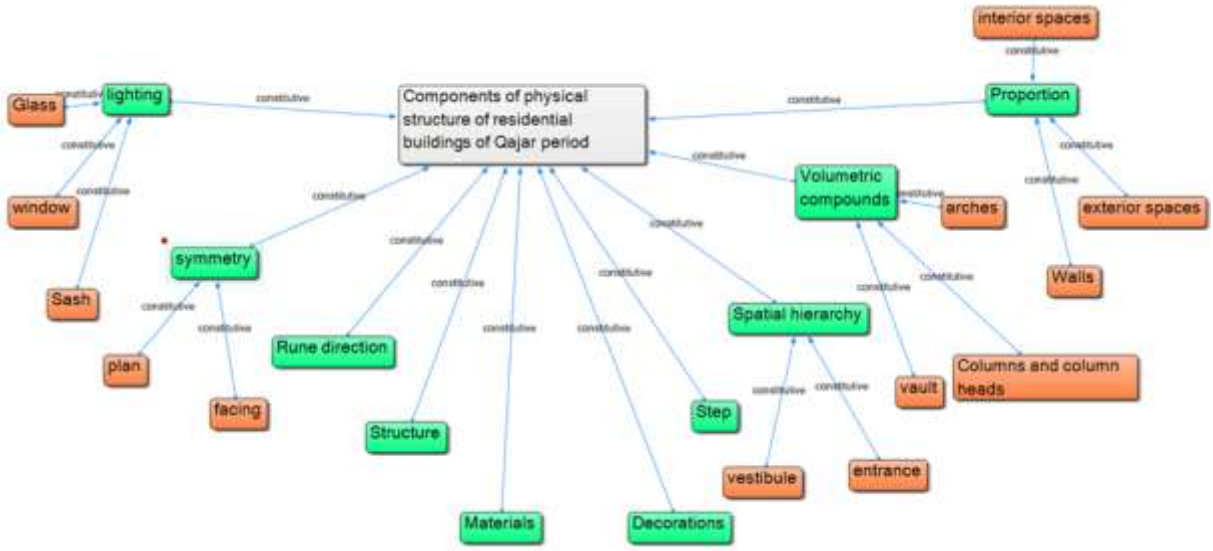


Fig 3 Extracting the components of the physical structure of the residential buildings of the Qajar period with the open and axial coding method

5. Inferential Statistics

5.1. Correlation

The results of the questionnaire are entered into the Spss25 software after numbering. Predictive relationships (regression) and correlation relationships are used for analysis. Two-Sample Kolmogorov-Smirnov Test is used to check the parametric and non-parametric type of data.

Table 7 Kolmogorov-Smirnov test to check the normality of the physical structure variable of Qajar period residential buildings from western architecture

p	Z Kolmogorov Smirnov	Standard deviation	Average	Variable
0.814	0.393	3.23	27.77	The influence of the components of the physical structure of the residential buildings of the Qajar period on the western architecture

As can be seen in Table 7, the Kolmogorov Smirnov test for the variable score of the influence of the components of the physical structure of the residential buildings of the Qajar period of Western architecture is significant (p = 0.814) and (p = 0.733), so it has a normal distribution and Parametric analysis should be used for it.

5.2. Pearson Correlation

Table 8 shows the correlation between the variables. As can be seen, it shows a positive and significant correlation between the components of western architecture and the physical structure of Qajar period houses at the level of 0.01. There is a correlation between breaking from the past and confinement with a value of (0.952). After that, between the component of break from the past and proportion (walls, interior spaces and exterior spaces) with a value of (0.932) in the second place and in the third place, enclosure and the use of rotating and diagonal statue forms with a value of (0.925) are the highest There is a correlation and the lowest correlation is between severe criticism of objects and imitative and structural schools with a value of (0.112).

Table 8 Correlation of Western architectural components and selected components in the physical structure of residential buildings of the Qajar period

Decorations	Ron (direction)	Lighting (window, sash, glass)	volumetric compounds (columns and capitals, arches, vaults)	the stairs	Spatial hierarchy (entrance, vestibule, etc.)	Structure	Materials	confinement	Proportion (walls, interior and exterior spaces)	symmetry (plan)	
0.518	0.963	0.912	0.576	*0.617	0.684	0.579	0.552	*0.685	0.789	0.617	Building design based on the requirements and needs of the new era
0.457	0.811	*0.745	0.485	0.846	0.711	0.585	0.544	0.551	*0.625	0.425	Looking to the future and using modern materials and artifacts
0.548	0.912	0.653	0.688	0.851	0.825	0.921	0.741	0.537	0.621	0.883	Using a steel frame for the entire building structure
0.579	0.587	*0.587	0.544	0.847	0.558	0.817	0.489	0.747	0.577	0.875	Show the structure of the building in the facade of the building
0.748	0.878	0474	0.672	0.781	0.569	0.524	0781	0828	0.632	0.711	Using wide windows that cover the entire opening between the columns
0.618	0.528	0.582	0.356	0.485	0.872	0.112	0.418	0.772	0.552**	0.756	Strong criticism of imitation objects and schools
*0.748	0.736	0.586	0.455	0.598	*0.540	0.741	0.556	0.826	0.306	0.694	Inventing new forms
0.748	0.627	0.747	*0.778	*0.435	0.743	0.586	0.745	0.587	0.307	0.744	The art of the times
*0.910	0.714	0.805	0.734	0.711	0.745	0.788	0.468	0.885	0.805	*0.742	Using modern products (metal) for building skeleton and decorations
0.645	0.742	0.856	0.541	0.580	0.655	0.665	0.764	0.625	0.605	*0.560	Using

											decorations inspired by natural, romantic or geometric forms
0.778	0.730**	0.788	0.856	0.853**	0.713	0.847	0.725	0.730	0.730	0.582**	The design expresses the imagination and inner feelings of the designer
0.854	0.866	*0.664	0.544	0.454	0.589	0.551	*0.718	0.494	0.119	*0.844	The use of rotating and diagonal cheek statue forms
0.738	0.765	0.349	0.685	0.785	0.834	0.581	0.844	0.925	0.225**	0.742	Show spiral movement
0.548	0.655	0.548	0.518	0.529	0.781	0.487	0.849	0.854	0.841	0.782	Attention to science and technology and the future world
0.574	0.677	*0.711	0.784	0.586	0.566	0.714	0.544	0.952	0.932	0.698	A break from the past
0.625	0.785	0.471	0.882**	0.369	0.748	0.841	0.841	0.883	0.639	0.745	Elevation
0.621	0.621	0.558	0.785	0.582	0.874	0.725	0.476	0.587	0.668	0.851**	Showing functional components and building technology

*P<0.05 و **P<0.01

5.3. Multivariate Regression

To use the type of linear or multivariate regression, the internal correlation matrix diagram of the variables is used. After drawing the correlation matrix diagram, it was found that the factors have no linear relationship, so it is correct to use multivariate regression.

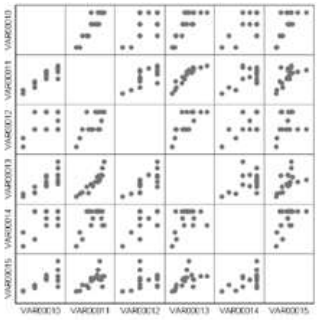


Fig 4 Correlation matrix of factors

According to the results obtained from the regression table, it was determined that the most influential belongs to; Symmetry (plan and view) on break from the past with value (1.000), proportionality (walls, interior and exterior spaces) on the use of modern products (metal) for building skeleton and decorations with value (1.000), confinement on The use of modern products (metal) for the structure of the building and decorations with a value of (0.982), materials for inventing new forms with a value of (1.000), the structure and use of steel frame for the entire structure of the building with a value of (0.964), Spatial hierarchy (entrance, vestibule, etc.) and the use of decorations inspired by natural, romantic, or geometric forms, as well as spatial hierarchy (entrance, vestibule, etc.) with a design expressing the designer's imagination and inner feelings with the value of (000) 1.000), stairs show spiral movement with value (1.000), volumetric

compositions (columns and capitals, arches, arches) strongly criticize objects and schools of imitation with value (0.963) , lighting (windows, sashes, glass) and high-rise building with the amount (1.000), rune (direction) and the use of rotating and diagonal statuary forms with the amount (1.000) and decorations and the use of decorations inspired by Natural, romantic or geometric forms with value (1.000).

But the least amount of effect of the criteria on the pillars of western architecture on the physical structure of the houses of the Qajar period including symmetry (plan and view with a design expressing the imagination and inner feelings of the designer (0.388), proportion (walls, interior spaces and exterior spaces) with severe criticism From objects and schools of imitation with a value of (0.514), focus on science and technology and the future world with a value of (0.246) and materials with a design expressing the imagination and inner feelings of the designer, fire on form with a value of (0.356) , the structure using modern products (metal) for the building skeleton and decorations with a value of (0.401), spatial hierarchy (entrance, vestibule, etc.) on the use of wide windows that cover the entire opening between the columns with a value of (0.213), stairs and design expressing the designer's imagination and inner feelings with a value of (0.388), volumetric compositions (columns and capitals, arches, vaults) showing the structure of the building in the facade with a value of (0.255) and lighting (windows, sashes, glass) on inventing new forms with a value of (0.262). Rune (direction) with a break from the past with a value of (0.417) and decorations on high-rise construction with a value of (0.331).

Table 9 Factor contribution of physical structure variables of Qajar period residential buildings and western architecture

Decorations	Ron (direction)	Lighting (window, sash, glass)	volumetric compounds (columns and capitals, arches, vaults)	stairs	Spatial hierarchy (entrance, vestibule, etc.)	Structure	Materials	confinement	Proportion (walls, interior and exterior spaces)	symmetry (plan)	
coefficient of determination (r2)											
0.872	0.755	0.425	0.265	0.855	0.421	0.665	0.756	0.662	0.974	0.855	Building design based on the requirements and needs of the new era
0.932	0.955	0.823	0.727	0.796	0.421	0.483	0.723	0.406	0.711	0.796	Looking to the future and using modern materials and artifacts
0.836	0.714	0.662	0.331	0.511	0.615	0.964	0.745	0.355	0.569	0.511	Using a steel frame for the entire building structure
0.942	0.844	0.406	0.255	0.804	0.424	0.452	0.795	0.646	0.724	0.804	Show the structure of the building in the facade of the building
0.711	0.744	0.355	0.275	0.684	0.213	0.463	0.355	0.262	0.882	0.684	Using wide windows that cover the entire opening between the columns
0.855	0.511	0.646	0.963	0.711	0.425	0.472	0.913	0.735	0.514	0.711	Strong criticism of imitation objects and schools
0.746	0.920	0.262	0.588	0.811	0.414	0.661	1/000	0.881	0.823	0.811	Inventing new forms
0.875	0.529	0.693	0.624	0.784	0.421	0.452	0.522	0.843	0.676	0.784	The art of the

											times
0.863	0.855	0.522	0.646	0.684	0.581	0.401	0.685	0.982	1/000	0.684	Using modern products (metal) for building skeleton and decorations
1/000	0.873	0.365	0.266	0.688	1/000	0.414	0.695	0.274	0.883	0.688	Using decorations inspired by natural, romantic or geometric forms
0.715	0.755	0.652	0.735	0.388	1/000	0.421	0.356	0.374	0.823	0.388	The design expresses the imagination and inner feelings of the designer
0.706	1/000	0.625	0.881	0.711	0.511	0.421	0.425	0.921	0.607	0.711	The use of rotating and diagonal cheek statue forms
0.881	0.866	0.516	0.865	1/000	0.581	0.615	0.706	0.421	0.518	0.789	Show spiral movement
0.865	0.972	0.352	0.727	0.614	0.421	0.424	0.723	0.246	0.685	0.614	Attention to science and technology and the future world
0.727	0.417	0.745	0.331	0.789	0.615	0.423	0.689	0.821	0.575	1/000	A break from the past
0.331	0.533	1/000	0.265	0.455	0.424	0.454	0.951	0.285	0.874	0.455	high-rise building
0.425	0.695	0.913	0.727	0.653	0.423	0.521	0.869	0.675	0.756	0.653	Showing functional components and building technology

6. Discussion

Until the beginning of the period of Naser al-Din Shah, the use of traditional patterns in the geometric planning of buildings can be seen. These plans include;

a) square or rectangular with a central courtyard

b) Rectangular with a porch or a central hall

c) They can be recognized as rectangular without a porch in one or two floors.

Before Naser al-Din Shah's trip to Farang, new geometric patterns were created, including tall rectangular or square towers, which can be identified in Masoudiyeh mansions.

Specifically, after Naseri's first trip to Farang, the use of elongated rectangular geometry design with one-sided and two-sided linear terraces on the ground floor and floors can be seen in the buildings, and semi-open spaces were created around the building (Masoudieh Building and Motman Ataba House).

At the end of the period of Naser al-Din Shah and the beginning of the period of Muzaffar al-Din Shah, the use of volumetric, polygonal and curved compositions is seen in a limited way in the Masoudiye mansion and the Kazemi house.

Until the beginning of the reign of Naser al-Din Shah, the continuation of the traditional way of spatial division (room to room, vestibule, internal corridors, porch around the central courtyard, etc.) is dominantly seen, although this type of spatial division continued until the end of the Qajar period.

After Naseri's first trip to Farang, due to the change in the geometry, the way of spatial division was changed in the form of linear corridors on both sides of the building along with room-to-room

access, and witnessed the appearance of the spatial division arrangement including wide four-sided terraces along with the use of foyers and lobbies to divide We are space.

Although the studied samples indicate the use of extroverted geometrical combinations from the beginning of the Qajar period, it seems that after Naser al-Din Shah's first trip to Farang (1874), most of the buildings built were designed in an extroverted manner. The use of traditional planning forms in the design of terraces and porches including (central porch with two columns, middle porch with four columns, linear porches around the central courtyard, etc.) are present in palaces and buildings until the late 1870s.

In the architecture of the West, the roof of the portal and the doors of the buildings are crescent-shaped, and all the roofs of the portals are smooth and flat, except for some large arches and porches in front of the bazaars, which are covered with a crescent roof. As a result, in the Qajar period, crescent-shaped doors and windows were used in buildings.

In the Qajar period, influenced by western architecture, we see the formation of a new interior space with ceremonial halls (opening and increasing the scale of the interior spaces, including the height, width and number of halls). Also, in this period, the proportions changed and attention was paid to the wide and high interior spaces.

7. Conclusion

By looking at the developments in Iranian architecture and the opinions of experts in this field, we realize that the most important developments in the field of architecture and urban planning influenced by the West began in the middle of the Qajar period, although the cultural and artistic exchanges of Iranians with the West began in the periods before the Qajar and especially in the Safavid period. However, the extent of its impact on the developments in the field of architecture and construction is not as great as that of the Qajar period. Most of the experts evaluate the role of external factors in the formation of Qajar developments several times than endogenous developments. The simultaneity of Qajar architecture with the western industrial and capitalist revolution and the great French revolution followed by the physical changes of European cities opened a new chapter of changing ideals and new thinking for Iranians. Confrontation with the European modernity of that time has gradually had undeniable effects on the various fields of life in this country, followed by its architecture and urban planning. In the picture below, you can see the changes in the physical structure of Qajar houses and their influence from western architecture.

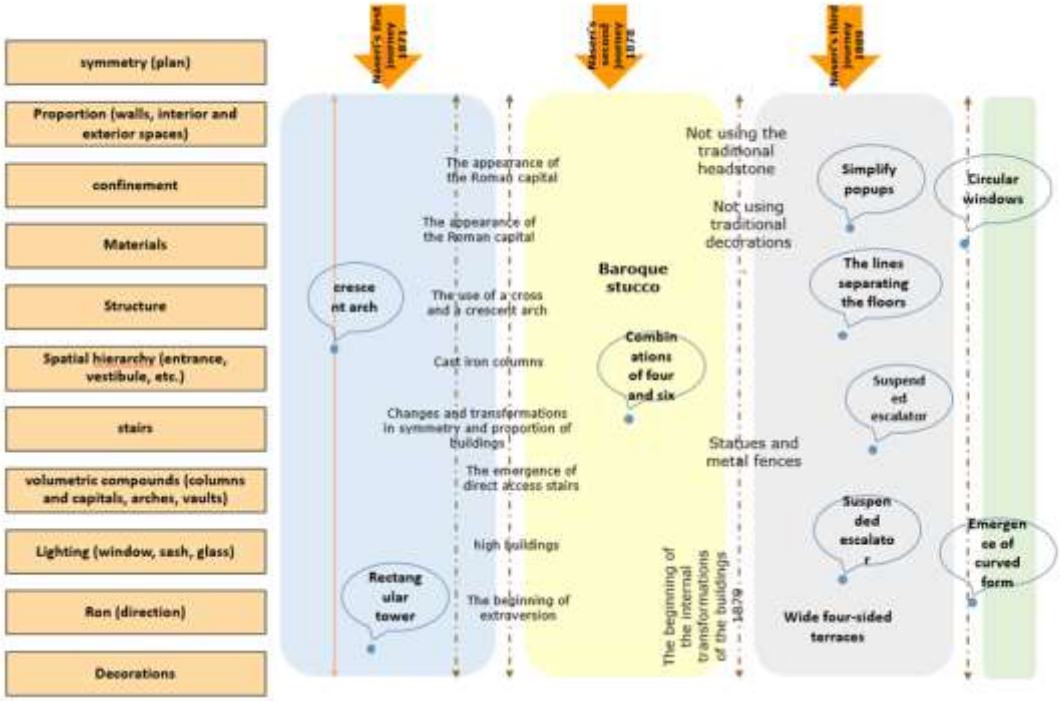


Fig 5 Changes in the physical structure of Qajar houses with influence of Western architecture (source: authors)

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Assessment of Criteria of Social Sustainability and Livability in Valiasr Ave. by Events to Create Good Placemaking

Arezoo Izadyari Aghmiuni[a], Cyrus Bavar[b]*, Parisa Alimohammadi[c]

[a]*Ph.D. Student, Faculty of Technical Engineering, Department of Architecture, Saveh Branch, Islamic Azad University, Saveh, Iran*
[b]*Associate Professor, Faculty of Technical Engineering, Department of Architecture, Saveh Branch, Islamic Azad University, Saveh, Iran*
[c]*Assistant Professor, Faculty of Art and Architecture, Department of Architecture, Central Tehran Branch, Islamic Azad University, Tehran, Iran*

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Research Article

Abstract

Nowadays, paying attention to various dimensions of sustainable development and quality of life has led to efforts to achieve social sustainability in urban spaces for increasing livability and social interactions. In this field, the event space is known as an effective tool to create a lively, experiential, creative, livable, and sustainable urban space. This research aimed to evaluate the sustainability and livability of Valiasr Ave. To this end, the potential spaces were initially identified to create event space by three techniques of the questionnaire, field observation, and space syntax. Afterward, the alternatives were suggested for these spaces, by the platform technique. Based on the results obtained from the questionnaire, a large percentage of people tend to stroll and walk ($p< 0.05$) on Valiasr Ave.; while the results of field observation indicated that this street possesses a commercial-service nature. The results of the space syntax technique also demonstrated that this street has the ability to gather people. The superposition of these 3 techniques led to the determination of forgotten places and the potential spaces to design the places with events of life-giving and consequently increase the sustainability and livability of this street.

Keywords: Social Sustainability; Livability; Event Space; Social Interactions; Space Syntax

* Corresponding author. Tel: +98-9367186028.
E-mail address: cyrus.bavar@gmail.com

1. Introduction

The main goal of a sustainable society is to promote the quality of life of citizens by providing the fields of growth and achievement of sustainable goals in cities. In this field, social sustainability is known as the one of most important dimensions. Indeed, social sustainability tries to meet the social needs of the present and future by emphasizing the concepts of quality of life, vitality, health, social justice, and the ability to live well. Indeed, the social sustainability dimension in addition to trying to improve the level of the quality of life, seeks to promote vitality, livability, preserve values, as well as social and cultural identity of the city. In this regard, one of the most important contexts to create social sustainability in the city is public urban spaces. Studies have shown that public urban spaces as the main part of the urban structure reflect values and social-cultural relationships, such that, according to them, spaces can well facilitate or influence the ability to live in the city and establish social interactions. Therefore, to move towards social sustainability and urban livability, the creation of lively and active public spaces that provide the active presence of the human in the environment, seems essential in the cities.

Nowadays, due to the arrival of new patterns of modern life in urban space, less attention is paid to human needs as a social being. Such that urban spaces have become a transit path, instead of being a context for the pause and presence of citizens, the place for creating various events and social interactions as well as experiencing face-to-face interaction.

Hence, the creation of the event space and the new experiences for space users can be led to livability and space sustainability. In this field, many countries applied livability as the main idea in their urban planning. However, in some countries, urban development programs with modernist thinking have been led to the loss of urban vitality and livability and consequently deep rupture with its identity. Tehran's Valiasr Ave. (Iran) is one of these paths that have lost its livability and sustainability due to the loss of genius loci and lack of formation of lively collective spaces.

Therefore, this research aims to assess the effective factors in the social sustainability and livability in Tehran's Valiasr Ave. (the distance between Beheshti St. and Vanak Sq.) by emphasizing the creation of event space, by three techniques of the questionnaire, field observation, and space syntax. Notably, this Avenue was selected due to its key role in the urban performance-physical structure (in terms of historical, tourism, and cultural-social) and national registration in Iran's Ministry of Cultural Heritage, Tourism and Handicraft. Moreover, given that the objective approach introduces quality of life as a set of real and external conditions related to living standards, it depends on secondary data obtained from official statistics. Likewise, the subjective approach relates to people's perception of life (Chen et al., 2016). Hence, these two approaches are known as important criteria for the assessment of livability, so, here, we selected the evaluation of the indicators of the mentioned approaches as a method of our study. In this regard, subjective and objective approaches have been respectively considered in the form of a questionnaire and GIS (geographic information system) maps. In the following, we assessed the indicators of behavioral approach for a more complete analysis of livability because objective and subjective indicators possess low efficiency and reliability respectively, for assessing individual welfare (Telesca et al., 2018). According to what was said, the mentioned approaches were applied in from three techniques:

1. Objective approach via assessing field observation techniques including accessibility, transportation, existing events, occupancies, and how to occupy space by them.

2. Objective approach via assessing questionnaire techniques including the of identity, social interactions, culture and sustainability, social participation, economic, and environment.

3. Behavioral approach via assessing the criteria space syntax and Gait techniques.

In the following, all studied criteria are assessed by the superposition method, due to the multiplicity of parameters, to determine livability in Valiasr Ave. Afterward, the alternatives were suggested for increasing the sustainability and livability of this Ave., by the platform technique.

2. Literature Review

Sustainable development is an evolving concept which its most prevalent definition according to the Brundtland Commission, is known as the development that can meet the needs of the present generation without compromising the ability of future generations to meet their own need (Jischa, 1998).

The study indicated that sustainable development possesses three dimensions: environmental, economic, and social so that tries to reduce environmental pollution, adjust unstable economic situations, and establish social balance in society (Niamir-fuller, 2012). However, based on reports, the social dimension of sustainable development is the most important factor in this field, because it means strengthening the vitality of society and increasing social and cultural values (Johnston, 1993). In this regard, sustainable architecture is a kind of attitude in architecture which pays attention to the environment and ecological matters in the design of urban space. This kind of architecture also possesses 3 dimensions of sustainable development. Although, far less attention has been paid to the aspect of social sustainability (Kumar and Anbanandam, 2019; Leal Filho et al., 2022). While sustainable architecture and urban planning/ urbanization in the social dimension seek to create opportunities through which urban spaces and places can transfer experiences, promote social interactions, and increase the sense of responsibility and belongingness. Thus, social sustainability in the city is related to social connectedness, social interactions, social stability, social participation, and a sense of responsibility and belongingness (Long & Hutchins, 2003). Hence, paying attention to components of social sustainability including aesthetics, comfort, security, social identity, etc., which have been listed in Table 1 can provide dynamism and vitality in the urban space. The components of social sustainability from theoreticians' point of view have been listed in Table 1.

Table 1 The components of social sustainability according to theoreticians

The components of the study	Socially sustainable development principles	Theoretician	Ref.
Social interactions, identity, sense of belongingness	The neighborhood unit theory (derived from the social attitude of the 1900s): this concept is a residential design model with a neighborhood population that pedestrians can move freely along the interior street. Accordingly, this model can encourage social interaction, neighborhood and collective identity, collective activity, social solidarity, and cohesion among residents in the neighborhood.	Clarence A. Perry	(Lawhon, 2014; Ostrowski, 1968)

	The concept of a hierarchy of needs "Theory of Human Motivation" includes five different levels: to achieve the ultimate levels, basic needs must be met. These needs involve physiological needs, safety needs, and love/belonging as social needs that are known as background for esteem and self-actualization as advanced needs.	Abraham Harold Maslow	(Maslow, 1977)
Social interactions, security	Focus on social interaction, security, vitality, social justice, protection of strangers as well as networks growth of small-scale and everyday public life (attention to humans).	Jane Jacobs	(Jacobs, 1961)
	Focus on security, crowding (dynamics of space), social interaction, privacy, territory, and personal space.	Irwin Altman	(Altman, 1975)
Social interactions	Focus on social interaction, crowding (dynamics of space), vitality, and human scale.	Jan Gehl	(Gehl, 2011)
Social interactions, security, identity	Focus on social interaction, tradition and culture, space intelligibility, security, proper density, social homogeneity, location memory, and the meaning of space.	Amos Rapoport	(Rapoport, 1981, 1984, 1990, 2006)
Social interactions, identity	Focus on social interaction, identity, human scale, access, activity/dynamics, and social justice.	Christopher Alexander,	(Alexander, 1979)
Security	Theory of Defensible Space (about crime prevention and neighborhood safety): a higher crime rate existed in high-rise complexes compared to in low-rise.	Oscar Newman	(Newman, 1996)
	Focus on four principles of social sustainability: Equity, Inclusion, Adaptability, and Security.	Oxford Institute for Sustainable Development (OISD)	(Colantonio & Lane, 2008; Dixon, 2011)

Social interactions, security, participation/ contribution	The development of neighbourhood theory and contribution: focus on social interaction, participation, sense of belongingness, the relationship between neighbourhood (social participation), collective activity, security, and ease of access	Charles Choguill	(Choguill, 2008)
	Focus on social interaction, participation, collective sustainability, sense of place, social equity, and security.	Nikolai Dempsey	(Dempsey et al., 2011)

The studies also illustrate that the concept of sustainability, in addition to the meaning of permanence and stability over time, socially means the permanence of space between people over time (both present and future). Accordingly, space should be such that maintains its applications over time and provides the constant presence of people, the contexts of the formation of activities for different ages and genders, their presence and pause, as well as social interactions via responding to their needs. This is the definition of the dynamism and vitality of space (Mahmoudi, Ahmad, and Abbasi, 2015). Therefore, a space that is vitality and active in terms of people's presence possesses socially sustainable and can provide livability of the space (Mahmoudi, Ahmad, and Abbasi, 2015; Wheeler, 2001), because of livability refers to the subset of sustainability effects which directly affects people in a community, like economic development, public health, affordability, social equity and pollution exposure (Litman, 2011). Hence, Godschalk states that livability emphasizes the optimal quality of life as well as the present time and place (Godschalk, 2004; Larice, 2005). Our studies and analyses focused on the definitions of livability also indicate that this concept overlaps with some concepts and approaches such as sustainability. Therefore, here, we first found common components between livability and sustainability by reviewing and analyzing 24 important studies in this field (from 1975 to 2021) and then used these common components to continue the study. The studied parameters, in some of the most important studies, on livability have been listed in Table 2.

Table 2 The studied parameters of livability

Studies	Parameters*	Ref.
The Project of Public Spaces (1975)	1- 19- 23	(Kent, 2019)
International Conference of Making Cities Livable (1985)	7- 8- 9- 14- 19- 20	(‘International conference of Making Cities Livable’, 1985)
Quality of urban life and the Perception of Livability (1988)	3- 4- 7- 22	OF LIVABILITY: A CASE STUDY OF NEIGHBOURHOODS IN BENIN CITY, NIGERIA’, 1988)
Principles for the livable city (1997)	5- 9- 19- 20- 21- 22- 23	(Lennard, 1997)
Urban Vitality (2000)	5- 7- 11- 12- 22- 24	(Landry, 2000)
Livable Communities (2001)	1- 3- 5- 7- 8- 10- 13- 14- 15- 20- 21- 22	(Wheeler, 2001)
Department of Transportation (U.S., 2003)	1- 2- 4- 5- 8- 10- 12- 13- 14- 15- 16- 19- 21- 22- 23- 24	(Rice et al., 2003)

Measuring the livable city (2003)	3- 5- 7- 8- 9- 10- 11- 13- 14- 20- 21	(Southworth, 2003)
Measuring the Livability of an Urban Center (2004)	4- 5- 6- 8- 10- 13- 15- 21- 23- 24	(Balsas, 2004)
Ottawa County Urban Smart Growth (2004)	4- 8- 10- 11- 15- 16- 17- 21- 22- 23	(Commission, 2004)
New Zealand Urban Design Protocol (2005)	6- 16- 17- 22- 23	(Pirrit et al., 2005)
Livability: What makes a Community Livable (2005)	9- 12- 13- 19- 20-21-22-23	(AIA, 2005)
Livable Communities (AARP- 2005)	2- 3- 5- 7- 8- 14- 17- 18- 22	(Kihl et al, 2005)
Tackling social exclusion (NEHOM project- 2006)	2- 21- 22- 23	(Kährik, 2006)
An Inquiry into Enhancing Victoria's Livability (2008)	2- 5- 6- 12- 15- 16- 17- 21- 22- 24	(Competition & Commission, 2008)
Achieving livability and vibrancy (World Cities- 2009)	3- 9- 11- 14- 19- 20	(Ooi & Yuen, 2009)
Sustainability versus livability (2009)	3- 4- 5- 15- 17-	(Howley, Scott, & Redmond, 2009)
Importance of livability dimensions and attributes (2010)	1- 2- 3- 5- 6- 7- 8- 13- 15- 18- 22	(Leby & Hashim, 2010)
A livable city study in China (2011)	6- 8- 13	(Song, 2011)
Community development (New Zealand, 2011)	3- 4- 6- 10- 12- 16- 17- 22- 23- 24	(New Zealand, 2011)
Sustainable use of biological diversity (2015)	2- 4- 5- 8- 13- 23	(Gu & Subramanian, 2015)
The economic value of walkability (2017)	2- 4- 5- 6- 8- 10- 11- 14- 15- 16- 17- 21- 22- 23- 24	(Litman, 2017)
Creating Livable Cities (U.S, 2019)	1- 4- 5- 8- 13- 23	(Oumarou, 2019)
The Global Livability Index (2021)	1- 2- 6- 10- 13- 15- 16-	(The Economist Intelligence Unit, 2021)

*1.Training and its quality, 2.Sanitation and health, 3.Suitable housing and its diversity, 4. Economy and Employment, 5.Security, 6.Urban infrastructure, 7.Access to daily needs, 8.Variety of transportation, 9. Mixed land use, 10.Cultural and historical factors, 11.Population and building density, 12.Creativity, 13.Green Space and Park, 14.Pedestrian-oriented, 15.Cleanliness, 16.Pollution air and its quality, 17- Fun and leisure, 18.Access to police, 19.Designing in-scale human, 20.Public spaces, 21.Beautiful landscapes, 22.Social interaction and dignity, 23.Local communities and participation, 24.Identity and sense of place

Based on this Table 2 (livability parameters), the most frequentation is related to social interaction and human dignity; security also ranks second. Moreover, local communities and participation, transportation, and its quality ranked third in this assessment. Notably, various dimensions of livability such as urban management, quality of life, vitality, and protection of the city center have been not considered in most studies. However, the assessment of the studies indicated that various dimensions of livability such as functional, physical, and social environments, which reflect the people's common understanding of the quality of their living environment, have been considered in all studies. Therefore, it seems that livability can increase by creating and improving these parameters in the city. This carries out by three main groups of objective indicators, subjective indicators, and behavioral indicators are known as the important criteria in the field of livability (Tiran, 2016).

Given that street, as one of the components of the built environment and a public realm, provides the possibility of access and communication with various destinations of the city, as well as a set of activities, it possesses a significant place in the life of the city (Martinelli, 2019); Hence, this study focused on the street scale.

On this matter, one of the most important Avenues of Tehran is Valiasr Ave. which is known as the largest street in Iran and one of the longest Chenarestan in the world. This Avenue due to having 200-year-old landmarks of contemporary Iranian history possesses historical and identity memory of Tehran. However, today, it is used only for forced activities (no social interactions), due to the increasing physical growth and lack of proper planning, as well as the application of some unprincipled policies and methods in the face of the street; such that, its role in pause and social interactions and consequently livability has been largely lost. Hence, this study aims to assess the effective factors on the sustainability and livability of this Avenue by emphasizing the event space; because the events can give meaning to space and turn urban spaces into lively, experiential, and creative places to create good placemaking (Richards and Duif, 2018). In this case, the social impacts of events such as better access to cultural programs (Richards and Palmer, 2012), new facilities, cleaning of urban space, transformability of unit/land according to the needs, social identity, social participation (Minnaert, 2012; Rich et al., 2011), quality of life, social belonging (Rich et al., 2011; Wood, 2006), genius loci (McCartney et al., 2010; Ramchandani, Coleman, and Christy, 2019), safety and social interaction (Fredline, Jago, and Deery, 2003) can be led to the sustainability and livability of cities. This can make the city attractive to domestic and international users.

3. Methodology

In this study, three techniques of the questionnaire, field observation, and space syntax were used to evaluate social sustainability and urban livability in Tehran's Valiasr Ave. (the distance between Beheshti St. and Vanak Sq.).

3.1. Questionnaire: A Technique for Assessment of Livability Criteria from the Citizen's point of view

In this method, to assess the sustainability, vitality, and eventful of the studied area, a questionnaire was designed according to the criteria of identity, social interactions, culture, and sustainability, as well as, social participation, the economic, environment, security, health, and transportation. The participants in this study included permanent residents, strangers, and employees/shopkeepers. Notably, the Cochran formula was used to determine the sample size due to the uncertainty of the statistical community (Eq. 1).

$$\begin{cases} n=\dfrac{Z^2 pq}{d^2} \\ Z=1.96 \\ p=q=0.5 \\ d=0.0794 \end{cases} \qquad \text{Eq. (1)}$$

Given the Cochran formula, the sample size included 152 participants (residents/employees/shopkeepers: 94 and strangers: 58).

3.2. Field Observation: A Technique for Assessment of Behavioral Dimension

In this method, primary paths around the studied area along with its primary nodes, landmarks, and secondary path were first identified by the methodology of Kevin Andrew Lynch's main factors/elements (Lynch, 1960; Yun et al., 2019) and then the field observation made (the

preparation of cognitive map). Notably, in this method, the data possess a qualitative nature. The spatial information required along with Tehran's occupancy maps were also obtained from the maps of Iran's national cartographic center and Iran's ministry of roads and urban development, respectively. Afterward, the GIS maps of the different information layers (residential, commercial, educational, historical, traffic, office, etc.) which were prepared from Tehran's municipality site were superposed by ArcGIS software. Finally, given the different information layers and their analysis, the potential areas were identified to create event space and more interactions of people and consequently increase the sustainability and livability of the studied area.

3.3. Space Syntax Technique: A Technique for Assessing the Configuration of Space

Given that the axial map is a major topic in the space analyses and space syntax criteria, a space-mass map of the studied area (from the center of Valiasr Ave. within a radius of 1 Km, on either side) was drawn by AutoCAD software and then loaded into the DepthMapX software to achieve axial map (Fig 1). Finally, 6 analyses were carried out according to the parameters of integration (local and global), connectivity, choice, total depth, intensity, and entropy. The Gait technique was also applied to confirm the research's validity. Based on this method, the analyzed paths by using DepthMap (in terms of the evaluation of social sustainability and livability factors) were visually analyzed.

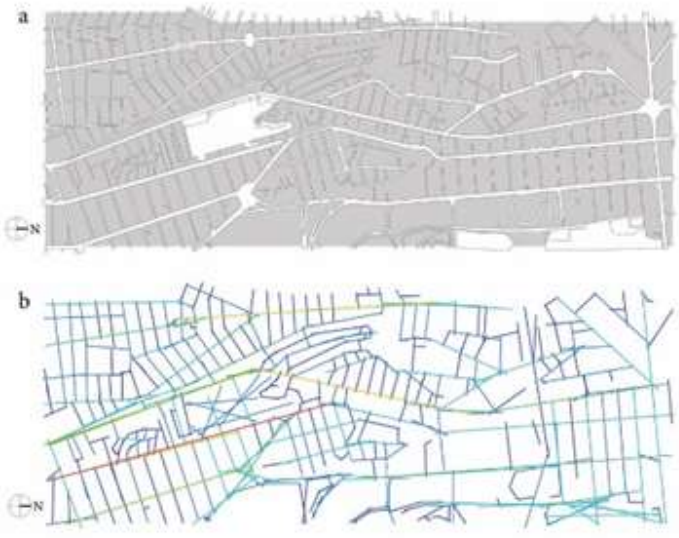


Fig 1 (a) The space-mass map (by AutoCAD software), (b) axial map (by DepthMap software)

4. Results and Discussion

The general approach in this section is to evaluate and promote livability and sustainability in Tehran's Valiasr Ave. (the distance between Beheshti St. and Vanak Sq.). In this regard, all important and potential points were identified for creating the event and providing the spaces to increase social interactions and vitality of urban space. Notably, to spatially identify the studied area, the methods of questionnaire and Field observation were used. The spatial configuration of the area was also evaluated by space syntax techniques.

4.1. Questionnaire

The questionnaires analysis derived from the public's understanding of the studied criteria indicated that the area in terms of security, health, and transportation is favorable so that the mean of the questions for every three criteria was equal to or higher than the medium limit of their criteria (medium limit for security: 76, health: 76, and transportation: 50.44). Notably, the standard deviation = 0 and p> 0.05 for questions related to these three criteria demonstrate that there are no significant differences between citizens' answers.

Moreover, based on the opinion of the participants, the studied area is not at the desired level in terms of the criteria of identity, social interactions, culture and sustainability, social participation, the economic, and environment. Such that the results of statistical analysis (one-sample test with a confidence level of 95%) indicated that from the 24 questions asked to assess the mentioned criteria, 16 questions possessed a mean lower than the medium limit of its criteria. This means that ~67% of the participants believe that the area is weak in terms of these 6 criteria and needs urban regeneration and space sustainability. However, the ranking of these criteria based on their medium limit has been shown in Table 3.

Table 3 The ranking of criteria of livability

Criteria	Identity	Social interactions	Culture and sustainability	Social participation	Economic	Environment
Medium limit	53.77	52.53	53.33	54.08	57	57
Ranking	Third	First	Second	Fourth	Fifth	

4.2. Field Observation

In the first step of this method, space identification was carried out by evaluating Kevin Andrew Lynch's important factors (including three environmental factors: the path, node, and landmark (Fig 2a).

The results of observations showed that Valiasr Ave. (in the studied area) is considered as a first-class street in the area and the streets of Gandhi, Khaled Slamboli, Akbari, Abbas Pour, Ebne Sina, Asad Abadi, and Nelson Mandela are known as the second-class streets. The traffic nodes of the area also include the junction of Valiasr Ave. with Beheshti St. and Vanak Sq. Moreover, Hajar Hospital, Saei Petrol Station, Saei Park, Book City, Mehregan Hospital, School of Traditional Medicine, Dey Hospital, Niloufar Park, Hemmat Bridge, administrative and commercial centers, Embassy of the Republic of Bulgaria, and 9 staircase entrances at the west of the studied area were identified as the important landmarks in this area.

The existence of more than 11000 sycamore trees along the entire path of Valiasr Ave., that a significant number of these trees are in the studied area, is another landmark of this area. Afterward, how to occupy space by the occupancies of the street edge was drawn through the evaluation of the different information layers of GIS maps (Fig 2b and c).

The results showed that most blocks of this area are related to occupancies of the office, therapeutic, residential, and small commercial, so that, most of the paths in this area have been turned into crossing due to the density of the mentioned occupancies and the existence of the

limited number of active urban spaces. Indeed, the area is merely used to get to work or use the public transportation network which contradicts the nature and history of Valiasr Ave.

Notably, Dey Hospital (junction of Valiasr Ave. and Abbas Pour St.), Hajar Hospital (junction of Valiasr Ave. and Beheshti St.), and Mehregan Hospital are known as the most important occupancies in this area. Moreover, Saei Park with a surface area of ~12 hectares is the most important leisure center in the area. The observations also indicated that Simorgh and Raamtin Hotels and commercial shops (such as cafes and restaurants, confectioneries, supermarkets), Nayeb restaurant, Tavazo's Nuts, Petrol Station, Saipa Corporate, book city, Saei Park Library, and Embassy of the Republic of Bulgaria are other occupancies and activities which exist in this area. Furthermore, several bleak blocks (no occupants) were observed in this area (the building at 16th St., garden land (lower of Vanak Sq.), student dormitory building at the corner of Delbasteh Alley).

The evaluation of current plans in this area also demonstrates, although, the cultural-social, historical, and tourism tissue of Valiasr Ave. is important based on the reports of the urban planning and strategic planning, however, there are no special regulations to preserve the cultural-social, historical, and tourism characteristics of this avenue.

The results obtained from the study of the spatial distribution of global occupations in Valiasr Are., also indicated that the link between art, tourism, and global occupancies like Saei Park, cultural center, cinema, etc. have not been considered. Such that, this area of Valiasr Ave. due to the existence of therapeutic, offices, and company centers, is the only space for city trips, and activities that occur in living space and everyday life have not been considered in urban and strategic planning.

Followed by, the maps of different layers of the performance of space, how local residents, strangers, and employees move, as well as daily and nightly activity on the site were evaluated and drawn by the Gait technique (Fig 3a-f).

Based on the results, employees of companies, offices, and shops, as well as strangers as pedestrians, are present in the main body and the first layer of the Avenue, which increases in the middle of the day. The local residents are also in the second layer of Valiasr Ave. which can access the first layer of the mentioned Avenue through staircase paths and east and west accesses.

The results of field observation illustrated that Valiasr Ave. (in the studied area) possesses 12 communication staircases with 2 different forms of the staircase to connect two parts of the city (i.e. staircase that rises completely and provides the possibility of an urban view for the user, and stairs with a platform that can change the direction of the stairs and provide a different view from the city). However, the absence of events in these paths provides no opportunity for the user to pause and stay in the space; so that, these paths are the only paths for city trips and are considered the urban abandoned and lost urban spaces in terms of identity and social interactions.

Given the number of therapeutic and administrative occupancies along the area and the existence of BRT stations (bus rapid transit) around important landmarks and occupancies, the movement of users in this area is often to reach the destination, so that, most of the spaces in this area have been turned into dead space, in most hours. Although, a large number of strangers observe in the junction of Valiasr Ave. and Beheshti St. (in both parts of Valiasr Ave.) which can be due to the existence of therapeutic occupancies such as Hajar Hospital. However, their presence on this path is temporary due to the lack of attractive events, a concentrated population, and suitable space for the user to pause, understand, recognize, and influence the space.

Fig 2 The maps obtained from the Field observation and GIS: (a) paths, nodes, and landmarks of the studied area, (b) occupancies and activities of the site, (c) how to occupy space

Moreover, most administrative and commercial occupancies exist at the junction of Akbari St. and Valiasr Ave. to Saei Park (in both parts of Valiasr Ave.). Hence, after the end of office hours and the closure of the mentioned centers, the area suffers from the phenomenon of nightlife in-activeness. The area of Saei Park also attracts a large number of people, especially local residents, due to the existence of the park, Children and Adolescents Intellectual Development Centre, book

city, and library. However, the main body of the Avenue, especially its western edge, has remained uneventful and forgotten. Further, from Saei Park to Vanak Sq., most of the occupancies are medical and administrative, so that, there are no spaces for social interactions and vitality in the area; the traffic of local residents also is more dependent on the location and who access to the neighborhood (a linear and scattered pattern, except for middle-aged people who are in the park for a long time).

Generally, the results show that many spaces in this area are dead and forgotten spaces that need to design the event for increasing social interactions and urban vitality and consequently promotion of the livability and sustainability of space. The superposition of the obtained maps largely reflects the livability map of the studied area (Fig 3g).

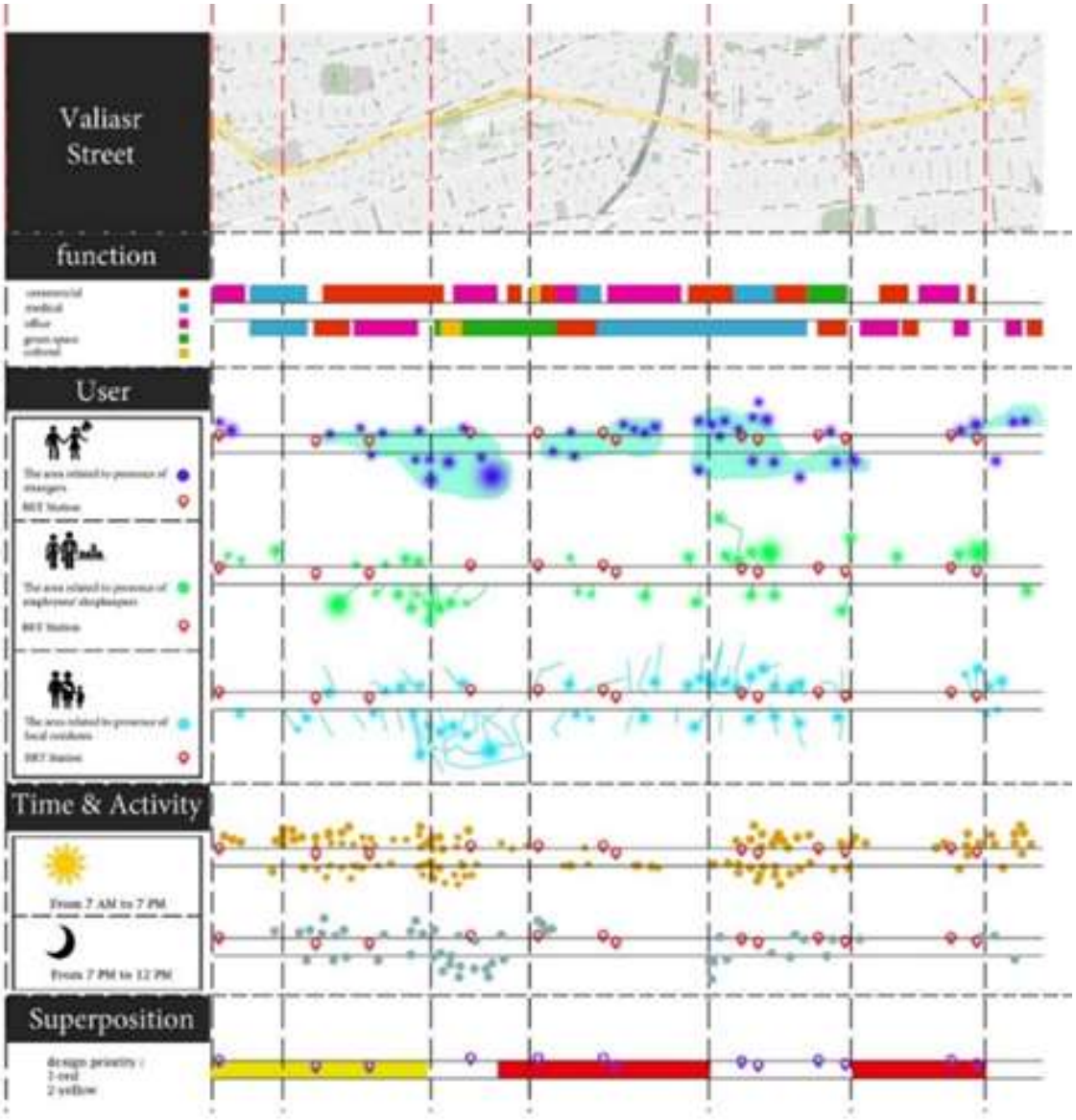


Fig 3 The assessment of the user's movement paths by the Gait technique: function, user, time, and activity, as well as the layers superposition for spaces, need to design

Finally, the analysis of the maps (Fig 2 and 3) led to the creation of the map related to the distribution of event spaces in the studied area. This map includes important events and sensory points, as well as potential spaces for the creation of event space and more interactions of people (Fig 4a). Notably, staircases, graffiti art, oversailing of the façade, and windows, as well as street decoration and artwork (as visual events), street music (as audio events), the smell of coffee and sweets (as olfactory events), etc. are events on the site which attract the attention of users.

Our results indicated that the potential spaces for creating event space that can increase the quality of life and space include the following items:

A. The regions with the government and public ownership to join to the sidewalk (Fig 4b).

(1) vacant land (Northwest side of the Vanak Sq.), (2) Office building parking related to the Institute of Standards & Industrial Research of Iran, (3) garden lands (no use), (4) land without occupancy (the side of Sayed Al-Shuhada Alley), (5) the area of under the Hemmat Bridge, (6) vacant land at the side of the Hamasi staircase of Yousef Abad Neighborhood (west side of the Valiasr St., between Sirvan St. and Hamsayegan St.), (7) vacant land (the side of the Panah staircase), (8) Grassland (no use)(East side of the Valiasr St., between Alleys of Yas and Mehregn), (9) vacant land (the side of Zandeye Alley).

B. Forgotten names, places, and edges (Fig 4c)

Translucent and hard-edge related to Telecommunication Company, [first of hospital Alley, near Hajar Hospital] (1), hard-edge related to Ayadi Alley (2), forgotten place related to Hajar Hospital (3), solid and hard-edge related to Hajar Hospital [in front of Beheshti St. (Abbasabad)] (4), solid and hard-edge related to Shapour Bakhtiar's former garden house [distance between Nader Alley and Delafrooz Alley] (5), bleak building (former student dormitory building) [next to the Delbasteh Alley] (6), Solid and hard-edge related to land's National Iranian Copper Industries Co. [distance between 18th Alley and 20th Alley] (7), translucent and hard-edge related to Saei Park [the southern part of the edge, next to the Asaadi Alley] (8), hard-edge near the 4th staircase (9), forgotten place related to the closed two restaurants (10), bleak shops (11, 12), brick hard-edge related to University of Applied Science and Technology (13), translucent and hard-edge related to Mehregan Hospital (14), translucent and hard-edge related to Grassland near the Mehregan Hospital (15), forgotten place next to Shirvan Alley (16), land of no use next to Ehtesham Alley (17), land of no use near Hamasi staircase (18), several bleak shops (19), translucent and hard-edge related to parking [between 2sd Alley and Shams Alley] (20), translucent-edge related to Dey Hospital (21), forgotten place [Dead end Alley (4th Alley)] (22), solid-edge related to parking (23), forgotten place's Shafagh Alley (24), forgotten place's Falagh Alley (25), forgotten place's 8th Alley (26), Sol Café Gallery [near the Hemmat Bridge] (27), forgotten place [under the Hemmat Bridge] (28), forgotten edge related to the land of no use (29), solid-edge between 10th St. and 12th St. (30), bleak shops (31), forgotten place related to public parking (32), solid and hard-edge related to garden land (33), solid and hard-edge related to around the Vanak Square (34), solid and hard-edge related to west side of the Vanak Sq. (35), land of no use [Northwest side of the Vanak Sq.] (36).

Hence, the superposition of the three maps in Figure 4 indicated spaces that need to design events for the livability of the area (Fig 4d).

Finally, the evaluation and conformity of Fig 4d and the results obtained from the questionnaire with the definition of theorists and researchers about events and the presence of people in the space, as well as urban sustainability and livability indicated that the four dimensions of the people's

participation, social interactions and culture, landscape, and environment, as well as, security are more important than the other dimensions, for sustainability and livability of the studied area. Accordingly, components, criteria, and activities that can lead to sustainability and livability in Valiasr St. space (the studied area) have been listed in Table 4.

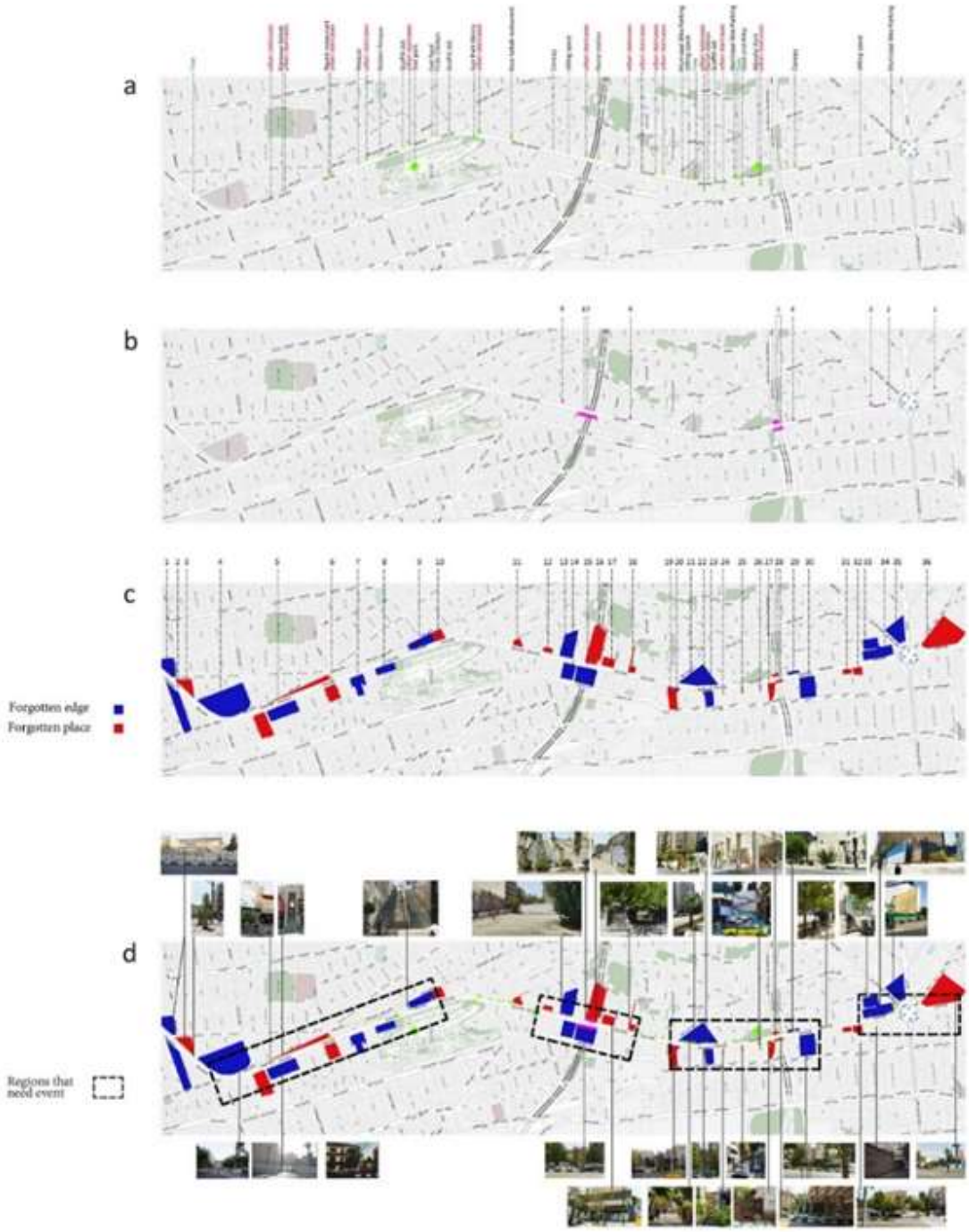


Fig 4 The evaluation of existing events and potential spaces for the creation of event space: (a) the existing events in the studied area, (b) the regions with government and public ownership, (c) Forgotten names, places, and edges, (d) superposition of layers to design event space

Table 4 Assessed dimensions, components, and criteria based on the event and vitality space in Valiasr St.

Dimensions	Components	criteria	Effective activities in the vitality of Valiasr St.
Social	Social interactions	Random social interactions	Everyday social interactions
			Sudden social interactions
		Organized social interactions	Organized social interactions
			Public ceremonies and celebrations to promote the role of space
			Self-Organized social interactions
	Accessibility	Social access	Accessibility of space for all age groups
			Accessibility of space for all genders
			Accessibility of space for a specific group
	Sense of convenience	Peace of mind	Adjacent to nature and natural elements
			Reduction of noise pollution
	Security	Security	Protection against crime
	people's participation	Presence of people	Presence of people in age and gender groups
Cultural and activity	Activity	Selective activities	Walk
			Study
		Social activities	Observe
			Conversation
		Occupancies	Distribution of occupancies based on the spirit of space
			Providing the necessary facilities for the elderly, the disabled, and the children
			Proper separation of incompatible activities
	Aesthetics	Public art	Live music
			Painting in Space
		Side activities	Restaurants and cafes
			Innovation and creativity according to the native culture
			Sale of handicrafts
landscape and environment	Cleanliness	Reduction of pollution and cleanliness of the path	Environmental sanitation

	Climate	suitable vegetation and green space, shading	preservation of sycamore trees and ditch/waterway, suitable creation of green space,
			walking in the shade
	Proper furniture	Fits in urban furniture	Proper furniture for all genders
			Attractive outside finish
	Visual	Natural features	The corridor overlooking the Alborz mountains, the existence of thousands of sycamore trees, wide-ditch/waterway on both sides of the Avenue
Security	Security in urban space	Promotion of social security	Night activities
			Planning for all groups to diversify the Avenue by changing the population, seasons, and hours of day and night
			Quiet movement of people via creating a potentially safe space to stop and stroll
			Adhere to design principles for the disabled
			The attention to lighting and materials

4.3. Space Syntax Technique

In this technique, six analysis groups were performed based on parameters of Integration (global, local), Connectivity, Choose, total Depth, Intensity, and Entropy.

A. Integration

In the first step, the Integration maps of the area (in both global and local scales) were drawn (Fig. 5a-b). As observed in this Figure, warm and cool colors indicate higher and lower Integration, respectively. Based on the results, Valiasr Ave., in the studied area, possesses high Integration.

Given that, in the Space Syntax technique, accessibility and cohesion of space are defined by Integration, areas with more accessibility lead to cohesion and the higher presence of people. Likewise, less accessibility means less pedestrian presence (Chiaradia, Law, and Schwander, 2012).

Hence, the number of people present on the Valiasr Are., in the studied area and global scale, is more than other paths, although, it ranks second on the local scale; so that, people's willingness to use this path has led to more possibility of movement and activity on this Avenue. This is more evident in the area between Saei Park to the junction of Valiasr Ave. and Abbas Pour St. due to the existence of communication staircases with back streets. Thus, the mentioned area can be suitable for cultural-social and commercial occupancies.

The results obtained from the Integration HH map (Fig 5a) also demonstrated that although the streets of Khaled Slamboli St., Gandhi St., and Beheshti St. are considered as second-class streets, in terms of the Asad Abadi. However, Integration HH in more inner-streets possesses cooler colors that show the lower accessibility in these streets.

Moreover, the evaluation of the Integration HH (R3) map (Fig 5b) indicated that Khaled Slamboli St. and Asad Abadi possess a higher flow of pedestrians than Valiasr Ave., so that this Avenue is known as the second-class path. The streets of Akbari, Nelson Mandela, Mughniyeh, and Qasir also possess the highest number of people's movements, after Valiasr St. (in the studied area). Further, the paths that are near important landmarks (such as Saei Park, Children and Adolescents Intellectual Development Centre, book city, Hajar Hospital, Mehregan Hospital, Dey Hospital, Simorgh and Raamtin Hotels, Nayeb restaurant, Tavazo's Nuts, Saipa corporate, and Embassy of the Republic of Bulgaria), possess more accessibility than paths around themselves (in local scale). Data in Table 5 confirm these results.

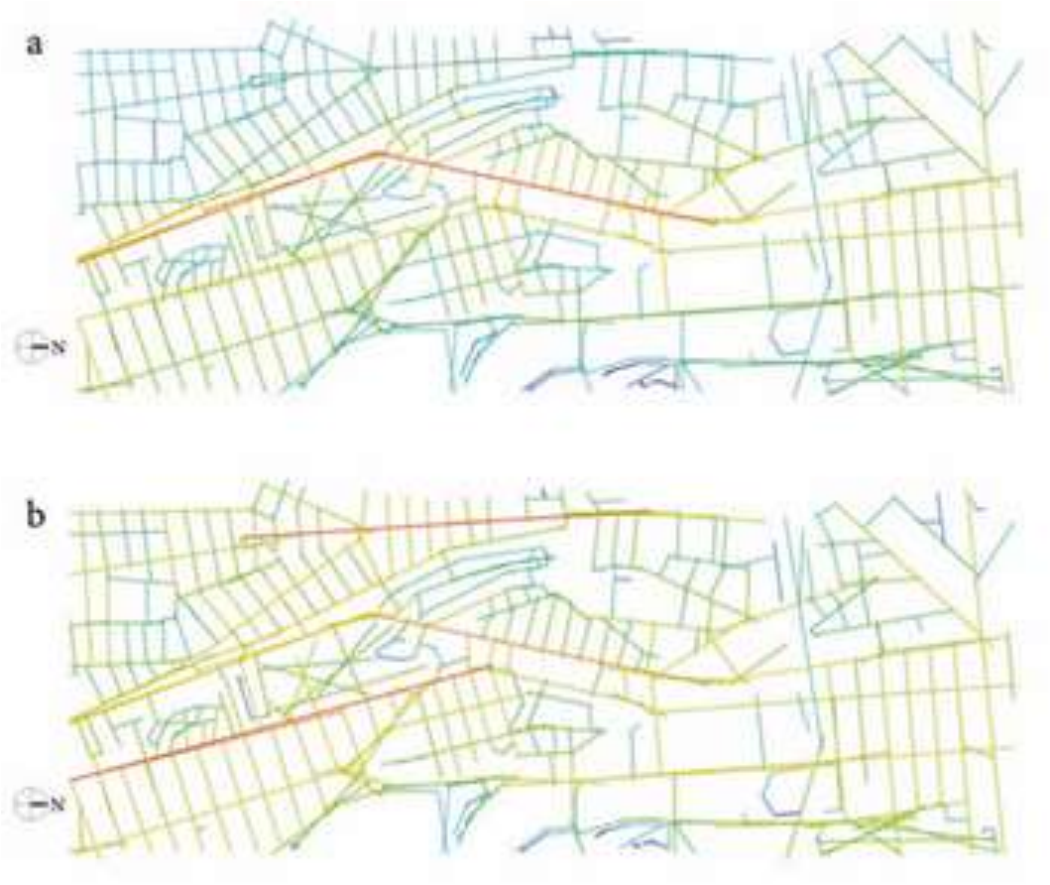


Fig 5 Integration maps: (a) HH (global scale), (b) HH (R3) (local scale)

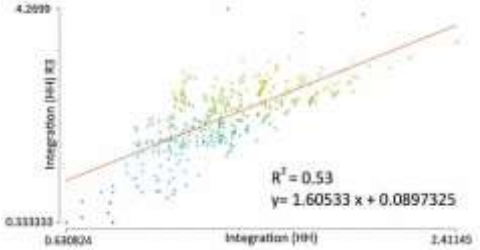
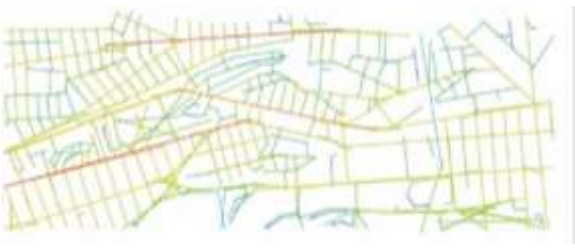
Table 5 The evaluation of paths in the studied area in terms of integration parameter

	Path	Integration HH	Integration HH (R3)
	Minimum	0.63	0.33
	Maximum	2.41	4.26
	Average	1.35	2.27
Valiasr St.	From Beheshti St. to Saei Park	2.19	3.38
	From Saei Park to the junction of	2.41	3.65

	Valiasr Ave. and Abbas Pour St.		
	From the junction of Valiasr Ave. and Abbas Pour St. to Vanak Sq.	2.04	3.36
	Khaled Slamboli St.	1.98	4.15
	Gandhi St.	1.74	2.85
	Abbas Pour St.	1.89	3.10
	Asad Abadi St.	1.36	4.26
	Nelson Mandela St.	2.46	3.28
	Beheshti St	2.65	3.30
	Mughniyeh St.	1.44	3.10
	Qasir St.	1.64	3.37
	Ebne Sina St.	1.43	3.31
	Akbari St.	1.56	2.97

The correlation analysis for Integration HH and Integration HH (R3) indicates the amount of integrity and presence of people in the studied area (Table 6). Based on the results, this area possesses no integrity (R2= 0.53) and needs to form centers for the interaction of people and communication nodes and consequently increase the spatial attractiveness, for sustainability and livability of the area. Notably, the presence of the people in this area is due to administrative and commercial activities, and not merely for using space and meetings.

Table 6 The Evaluation of Integration

Parameter	Correlation curve for path integrity (Integration HH - Integration HH (R3)	Integration of urban tissue, in a radius of 3 Km
Integration HH (R3)		

B. Connectivity

In the next step, Connectivity as a local criterion studies the relationship between space and immediate neighbors (Table 7). Indeed, the connectivity degree indicates the permeability of street spaces, so that, the warmer colors indicate better permeability and consequently higher connectivity (Li, Yan, and Yu, 2016).

Here, the results showed that Khaled Slamboli St. and Valiasr Ave. have high Connectivity, respectively, and are consequently more accessible. In this field, Asad Abadi St. indicated the second rank, while other streets possess less number of accesses (generally, the studied area has low Connectivity). The correlation coefficient analysis between Integration and Connectivity also

indicated that this area possesses low intelligibility and imageability, so that, people cannot understand the basic structure of the area (R2= 0.21).

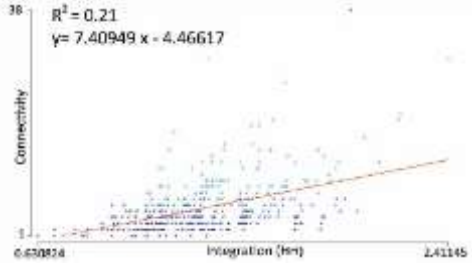
As shown in the correlation curve, Khaled Slamboli St. and Valiasr Ave. (in the studied area); especially the distance between Saei Park and Dey Hospital (due to the existence of urban-staircase) as well as Asad Abadi St. have the highest intelligibility, respectively, and stays better in people's minds. Notably, the density of points at the correlation curve also indicates the existence of paths with low intelligibility. Likewise, the dispersion of points means the existence of paths with higher intelligibility so that in these paths, people can understand the configuration of space with more peace of mind.

These paths include paths that lead up to the entrance of the main paths and paths that are around the main landmarks such as the entrances of Abbas Pour St., Akbari St., and Qasir St. (Fig 6). Based on the results, in this area, the paths with high intelligibility have the following 3 characteristics:

1. The existence of landmarks with suitable scale
2. The existence of changes in the length and width of spaces
3. The existence of a more continuous network of paths

Hence, to increase intelligibility in the whole area, space must be imageability to properly create a sense of familiarity with space and interaction in the environment. Likewise, the creation of event space can provide social interactions, imageability, and security, and consequently sustainability and livability in the area.

Table 7 The evaluation of intelligibility

Parameter	Correlation curve for the intelligibility of movement space (Connectivity - Integration)	Connectivity of urban tissue, in a radius of 3 Km
Connectivity		

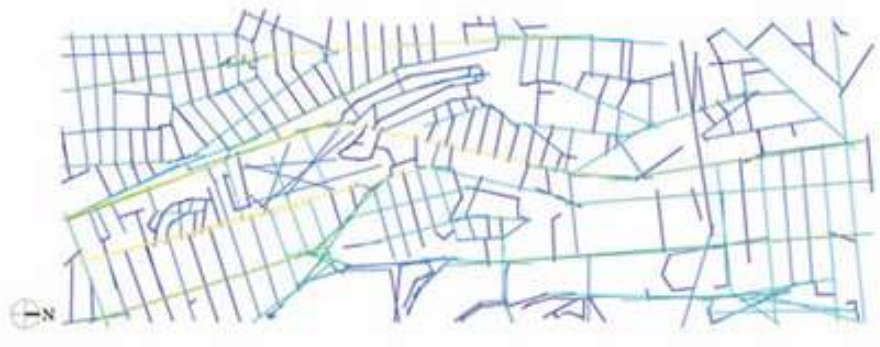


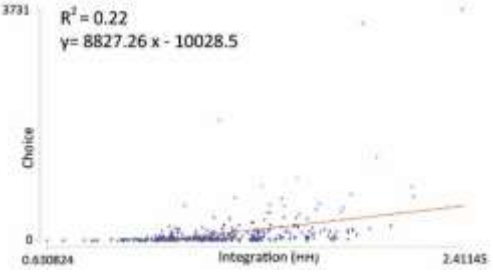
Fig 6 Intelligibility map of the studied area

C. Choice

The choice is a dynamic global criterion for the "passing flow" through space and can measure the potential of possible movement through the space in passing between origin and destination (Chou, 2022). A higher choice value of a street part means busier traffic or more movement of pedestrians in that part (Berhie and Haq, 2017).

Based on the parameter of Choice, the blue spectrum of color on the map of the studied area means fewer choices of these paths by pedestrians. Following the map in Table 8, Valiasr St. (in the studied area) and Khaled Slamboli St. are the first and second priorities of people, respectively. Although, the whole studied area does not possess high selectivity that is related to the urban network structure and people movement pattern. The reports show that there is a significant relationship between Integration and Choice parameters (Bafna, 2003; Li et al., 2017). Here, the correlation analysis of the mentioned parameters indicated that the streets of the studied area possess less value for collecting people and play less role in the pedestrian's movement path (R^2= 0.22). Thus, the techniques of collecting people can be effective in their presence and interaction in the area.

Table 8 The Evaluation of Choice

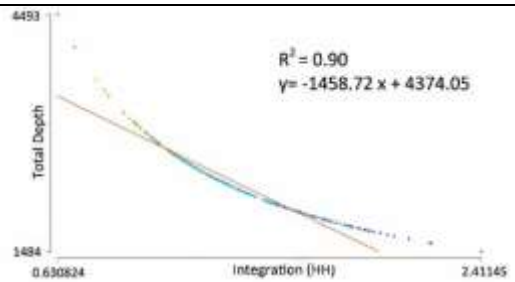
Parameter	Correlation curve for the choice and presence of people in the urban tissue (Choice - Integration)	Choice of urban tissue, in a radius of 3 Km
Choice		

D. Total Depth

The total depth degree demonstrates the openness (lack of restriction) of street spaces (Li et al., 2016). The analysis of the Depth parameter demonstrated this area includes fewer paths that are not easily accessible to the users (Table 9). Generally, there are no differences in privacy between the paths of the studied area which indicates the ease of urban access to this area. Therefore, Valiasr St. (as the longest street in this area) has been able to provide access to this area, such that further presence of citizens on this Avenue can be led to the lack of stagnation in space. The correlation coefficient (R2) of 0.9 derived from the correlation curve of total Depth and Integration illustrates the ease of access to the studied area.

Based on the studies of Matijošaitienė et al. all kinds of crimes are related to the parameters of Integration HH and total Depth so that lower correlation coefficient results in a higher crimes rate in the area (Matijošaitienė, Zaleckis, and Stankevičė, 2013). Therefore, given the R2 value, the area is less vulnerable to crime, due to ease of access.

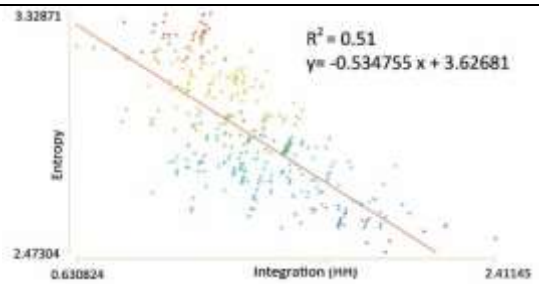
Table 9 The Evaluation of total Depth

Parameter	Correlation curve for map depth in the movement space (total Depth -Integration)	Depth of urban tissue, in a radius of 3 Km
Total Depth		

E. Entropy

According to Hillier's definition (1996), the entropy related to the notions of order and chaos into a single concept is " how easy it is to traverse to a certain depth within the system, so that low and high disorders are known as easy and hard, respectively (Coelho and Krüger, 2015). Therefore, it seems that entropy is a parameter to evaluate the sustainable distribution of people in the environment and their random activities in the urban system. Here, the results of the Entropy analysis indicated that Valiasr St. (in the studied area) has less Entropy which can be due to the excessive similarity of spaces in this Avenue and the common value of most of its spaces. Hence, the sustainability of this Avenue can increase through the creation of events, due to the high accessibility of the area. More Entropy was also observed in the west of the area i.e. Asad Abadi St. (Yousef Abad neighborhood), and the parts of the east of the area, Nelson Mandela St., Ab-o-Atash Park. It can be due to the existence of more options to distribute stranger users and reach the urban space with higher Integration (Table 10). Hence, even if a path is randomly selected, it more likely can lead users to crowded paths. The evaluation of the correlation curve of Entropy and Integration also exhibited that this area has no suitable performance in terms of user distribution, social interaction, and the use of public space (R^2= 0.51), hence, it needs to apply methods such as the creation of event space for an increase in social interactions, the livability of the area, and space sustainability.

Table 10 The Evaluation of Entropy

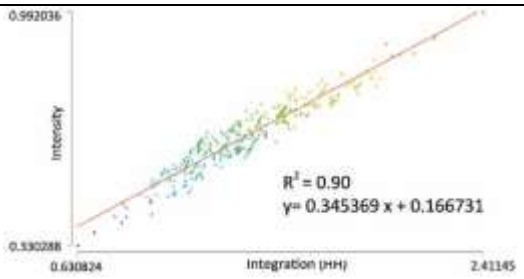
Parameter	Correlation curve for distribution of people in the movement space (Entropy -Integration)	The entropy of urban tissue, in a radius of 3 Km
Entropy		

F. Intensity

Intensity possesses a subjectively emotional dimension and speaks of feelings, responses, and stimuli. People's responses to whether the intensity of space is good or not are related to happening around them in the public realm. Hence, intensity possesses static and kinetic dimensions of stationary people in space. The population that is participating clearly and every day in the public realm of an area. Accordingly, intensity is meaning co-present and interaction in space (Stonor, 2019). Hence, it seems that two techniques of space syntax and field observation should be simultaneously considered for studying intensity (both co-present and human interactions).

In this regard, the analysis of Intensity revealed that the highest Intensity is related to Valiasr Ave. and the streets Khaled Slamboli St., Gandhi St., Nelson Mandela St., Ebne Sina St., and Akbari St. are in the next degree (Table 11). However, the study of the correlation curve of Intensity and Integration indicated a high Intensity for the whole studied area (R^2= 0.9), that is meaning high co-present in the street. Hence, creating places with enlivening events can promote the livability of the street.

Table 11 The evaluation of Intensity in physical and social dimensions

Parameter	Correlation curve for activity/dynamics of the movement space (Intensity -Integration)	The intensity of urban tissue, in a radius of 3 Km
Intensity		

G. Superposition of Results of the Questionnaire, Field Observation, and Space Syntax Technique

Here, the superposition technique was used for integrated analysis of the studied area and locating points that need to design the event for the creation of livability and sustainability.

The results obtained from this technique revealed interesting information. Such that, the overlap of the parameters obtained from the three techniques of the questionnaire, field observation, and Space Syntax indicated that although, the presence of people on Valiasr St. (in the studied area) due to various occupancies is more than other streets of this area.

However, there are no characteristics of Imageability, Intelligibility, activity, security, accessibility, and presence of people in this space. The area of Saei Park to Dey Hospital is an example of this space that lost its perceptual and social pattern and is not considered the place for the formation of social interactions due to the existence of therapeutic centers and office buildings. Moreover, this area considers as a dead urban space, at most hours, due to the existence of lots of buildings, forgotten edges, and lands of no occupants, as well as urban-staircase that are the path only for people's traffic. The area of Saei Park (west side of Valiasr St.), despite several famous restaurants, possesses poor social interactions. The east side also has no livability due to the existence of forgotten edges of Saei Park. The area of Dey Hospital to Vanak Sq. also possesses forgotten edges and poor social interactions, and the presence of people in this area is merely

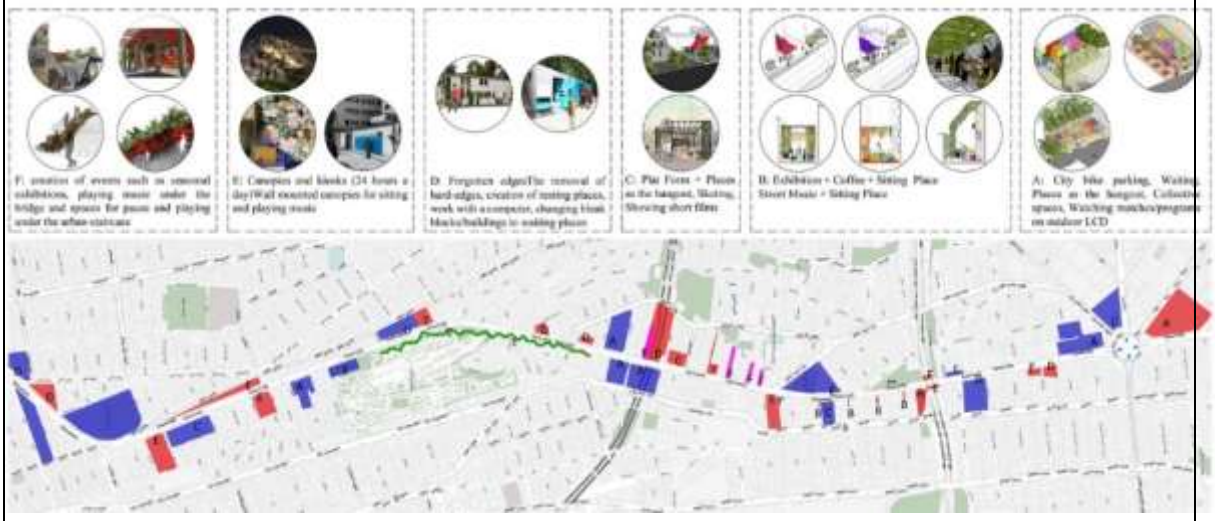
related to the existence of office centers. Hence, there is no opportunity to see, hear, meet, perform human activities, and do routine daily events, so that, this has led to the phenomenon of nightlife inactiveness in the mentioned area.

Generally, our results indicate that Valiasr St. (in the studied area, both edges of the street) has no perceptual-social pattern and its memories have been forgotten; so, it needs meaning for evoking urban memories. In this case, the presence of people and their interactions can be led to an increase in the livability and sustainability of Valiasr St. Based on the superposition technique; the paths that need to design have been listed in Table 12.

Table 12 The paths that need to design, based on the superposition of the field observation method and Space Syntax technique

Assessed criteria	Space Syntax	Field observation	Questionnaire
Integration and accessibility	Valiasr St. (in the whole studied area)	Valiasr St. (in the whole studied area), possesses high access due to the BRT access network (round-the-clock) and subway; although, the presence of people is due to the existence of the office and medical centers.	Valiasr St. (in the whole studied area)
Integrity	Generally, the area is poor	The crowd is on this path only for forced activities (no social interaction)	The whole studied area needs to create space for pausing, conversation, and entertainment (for the voluntary presence of people)
Intelligibility	The area of Saei Park to Dey Hospital	- Saei Park - Urban staircase	- Saei Park - Hamasi staircase to 8th staircase
Social interactions	Valiasr St. (in the whole studied area) possesses high Choosability and cumulatively properties	Saei Park	Saei Park
Total depth and security	Valiasr St. (in the whole studied area)	Valiasr St. (from 7 Am to 9 PM), from Saei Park to Dey Hospital	Valiasr St. (from 7 Am to 9 PM)
Entropy	Valiasr St. (distance between Akbari St. to Dey Hospital)	Valiasr St. due to the natural view existence of sycamore trees and waterway	The whole studied area
Intensity	Valiasr St. (in the whole studied area)	Saei Park	Saei Park, as well as spaces to sit

Combining criteria of 3 techniques (space that needs to design)



Designs to increase livability:
Design of small commercial spaces and places as the hangout such as street kiosks for coffee and ice cream- Design of place to socialize, such as designing space near the staircase and under the bridge, as well as creating the urban gallery- Design of the small events near-forgotten places and creation of landmarks to increase intelligibility and sustainability of the area- Design of urban staircase and creation of space for conversation- Design of night space on the path, such as fast food kiosks- Design of Dead End and forgotten places to remove abandoned spaces and increase the presence of women and children- Design of under the Hemmat Bridge- Design of places for daily events such as conversation.

5. Conclusion

This study aimed to assess the livability and sustainability of Tehran's Valiasr Ave. (the distance between Beheshti St. and Vanak Sq.). To this end, given that the events are known as life-giving factors to space, the potential spaces were initially identified to create event space by three techniques of the questionnaire, field observation, and space syntax. Afterward, the alternatives were suggested for eventful of these spaces that the main technique for their design was the platform. In this regard, the results of field observation indicated that there is no special rule for preserving the context of this street as a historical-tourism and cultural-social area, and currently, this street possesses a commercial-service nature. Therefore, livability can increase by regenerating identity and creating physical attraction. According to the questionnaire, a large percentage of people also stated that the area in terms of security, health, and transportation (as the important parameters in livability) is favorable (medium limit for security: 76, health: 76, and transportation: 50.44) so that they were interested in the stroll and walking on Valiasr Ave. While they stated this area is not at the desired level in terms of the criteria of identity, social interactions, culture and sustainability, social participation, the economic, and environment (from the 24 questions asked to assess the mentioned criteria, 16 questions possessed a mean lower than the medium limit of its criteria). Suth that ~67% of the participants believed that the area is weak in terms of these 6 criteria and needs urban regeneration and space sustainability, via creating a space to hangout, gather, talk, leisure hours, and visit the artwork.

The results of the space syntax technique also demonstrated that Valiasr Ave. can gather people due to its high accessibility. However, the organized plans in this path are further related to flooring and beautifying the street floor, which in practice cannot create activity, vitality, and sustainability

in urban space. The superposition of these 3 techniques confirmed these results. Generally, our study indicates that the development of event-based programs can become this area to an eventful path via the regeneration of event-free paths. In addition to space syntax, these programs can be included the response to needs such as privacy and aesthetic elements of the environment. Hence, here, to assess the levels of sustainability and livability of the area, all analyses were performed based on the events. Based on the results, the creation of the events of life-giving, by the platform technique, the design of dead ends and the creation of the space for pause and hangout, the design of forgotten places, design of coffee and ice-cream kiosks (24-hour a day), design of the places to sit, talk, and audio events (street music/live music), as well as the places for children to play and presence of elderlies can turn the forgotten places or the potential spaces into live places and lead to the increase in the livability and return of the identity of the area.

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Identifying and Ranking the Barriers to Buildings Designed with BIM from the point of view of the Construction Industry Experts Using Fuzzy Delphi Technique

Atefeh Hemmati[a], HasanAli Mosalman Yazdi[b]*, Abolfazl Sadeghian[c], Abolfazl Sherafat[d]

[a]*Ph.D. Student, Department of Civil Engineering, Taft Branch, Islamic Azad University, Taft, Iran*
[b]*Associate Professor, Department of Civil Engineering, Meybod Branch, Islamic Azad University, Meybod, Iran*
[c]*Assistant Professor, Department of Management, Yazd Branch, Islamic Azad University, Yazd, Iran*
[d]*Assistant Professor, Department of Management, Imam Javad Higher Education Institute, Yazd, Iran*

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Research Article

Abstract

Construction industry is one of the wide, decentralized and highly aboriginal industries in any country, therefore this industry considered as an indicator for growth and development or economic recession in many countries. This industry is currently suffering from many inefficiencies. One of the main reasons for this problem is the lack of growth in the technical field. The use of traditional methods is known as one of the main factors inhibiting productivity in the construction industry in Iran, because most of the traditional methods and their nature led to time delay and waste of resources. In addition, on account of increasing complexity of projects, there is a fundamental need to use more integrated, compatible and cost-effective approaches and technologies for the entire project life cycle. Today, one of the most thriving and flourishing technologies in AEC industry is Building Information Modeling (BIM). Despite the many advantages mentioned about the new BIM system, there are also some challenges and problems associated with it, which in some cases they can be very serious and bring great risks. In this research, with the intension of emphasizing and recognizing the barriers to BIM implementation, some challenges and obstacles of using this technique have been investigated. In order to identifying the barriers, questionnaires and interviews were used, and then the barriers were identified and ranked using the fuzzy Delphi technique. Among the sub-criteria, the lack of instructions for the use of BIM in related organizations, which is a sub-criterion of managerial and procedural barriers, ranked first.

* Corresponding author. Tel: +989131516522.
E-mail address: hmosalman@gmail.com

Keywords: Building Information Modeling (BIM); Barriers of BIM; Fuzzy Delphi Technique

1. Introduction

Due to the strategic and infrastructural importance of the construction industry in the economy of a country and the significant increase in construction in this era, the use of traditional and non-scientific methods can no longer handle the existing problems; therefore, the use of new technologies in construction, implementation of scientific models, improvement and reduction of construction costs, … have been important goals of most building constructors. Among the problems of modern constructions, the lack of coordination of plans, mistakes and duplication of efforts, employer request changes during implementation, etc. will not only increase the cost of construction, but also lead to a decrease in the quality of the work.

Another problem is the numerous changes for various reasons at each stage of the project, which may have significant negative impacts on some cases like costs and schedule delays; and in the same way, the interference that may happen between the architecture of the structure and the facilities during the implementation, wastes time and money; and if the collision or interference is critical, it will lead to duplication in efforts and critical changes. Critical changes result in successive delays in the project schedule, re-estimation of the statement of work and additional demands for equipment, materials, manpower and overtime (Reinertsen, 1997). The issue of duplicate efforts also has negative effects on the functional aspects of the project such as time, cost and satisfaction of stakeholders. Direct impacts duplicate efforts on project management includes: a: additional time to redo the work, b: additional cost to cover events of rework, c: Additional materials for rework and carrying contraction waste, c: additional labor force for rework and additions related to monitoring force. Three elements related to duplicate effort including loss of capital, time and demoralization of employees have significant detrimental effects on project coordination and productivity. Therefore, as projects become progressively complex and owners demand faster delivery and greater productivity, contractors have to adopt new methods of project management.

In Iran, the low productivity of the construction industry and the huge volume of unfinished and failed construction projects have caused many problems over the years. Among the important reasons for the low productivity of the construction industry, traditional methods, poor communication and incomplete cooperation between executive agents in information exchange can be mentioned. Considering the multidisciplinary approach of construction projects, clear communication and effective cooperation between project team members is essential. Therefore, information technology performs an important role in facilitating this. All over the world, researchers have thought about fundamental changes in existing traditional processes and expanding the use of information technology in this industry (Chuck Eastman et al., 2011).

Given to the numerous issues in the construction industry, it is crucial to use scientific and modern construction methods and utilize new technologies. One of these technologies is the building information modeling, which is called multidimensional modeling or virtual simulation technology too. It is a revolutionary development that has accelerated the changes.

In fact, BIM is a combination of technology and process which allows practitioners to simulate and examine all required parameters in design, construction, implementation and operation in the 3D environment. This superiority, that is, the ability to control components and simulate them before the start of the project, which is available to experts, practitioners and employers, makes it possible to improve the quality of work, ensure the performance of the components, shorten the

duration of design, control and updating the projects, and consequently reduce costs at each stage of work (Zou, Kiviniemi, and Jones, 2016; Salazar and Almedia, 2004).

BIM presents a way to overcome low productivity in construction and other barriers to innovation in the industry. This technology provides a wide range of direct and indirect benefits and has made the design and manufacturing processes simpler and more clarity in various aspects (Lee, Bae, & Cho, 2012).

But despite having many advantages, this technique faces a series of challenges and obstacles. According to how BIM is implemented and barriers to it, many articles and books have been written in industrialized countries such as North America, Southeast Asian countries, Europe and Australia. But it should be remembered that the construction industry is an indigenous industry due to the impossibility of exporting or importing the final product from one country to another; therefore, each region and country has its own characteristics, methods and tools based on various conditions such as climate, economy and culture. etc. As a consequence, building information modeling process, implementation, utilization and obstacles are different depending on the substrate in each region.

Due to the necessity of integrated information management in the design of buildings and the increasing need to use of BIM, in this investigation, that is applied research, it is try to follow the barriers to implementation of this technique in a targeted and comprehensive way to improve the removal these barriers. For identifying the obstacles, in addition to library studies and reading related articles, interviews were conducted with experts and BIM specialists. Finally, by setting up a questionnaire about implementation of the Delphi Fuzzy technique, the obstacles were determined and ranked. Among the identified sub-criteria, the lack of attention of related organizations to the use of this technology was prioritized.

2. Literature Review

Due to the political, economic, technological and social challenges in the construction industry, it is essential to develop BIM technologies. BIM is useful in all stages and processes of projects, from the design phase to implementation, and is of special importance (Fig 1).

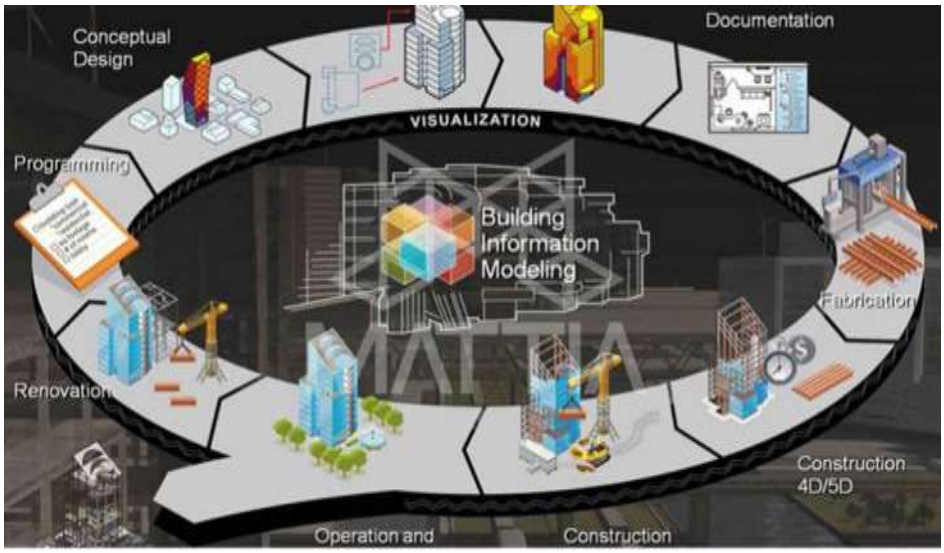

Fig 1 BIM technology applications in the building life cycle

The implementation of the execution plan in line with the BIM national development document of the country in the perspective of 2025 requires the participation of all relevant and interested groups in the country's construction industry. Therefore, considering prevalence of building information modeling in different countries, studies have been conducted on the benefits and obstacles of BIM implementation, which are as follows:

In 2010, Bureuakinci and Fernand carried out a study on a large installation project with an area of 210000 square meters, during which there were many mechanical and electrical installations. They identified a variety of interferences in two parts. The first part was detected using overlaying 2D maps on the light table, and the second part was recognized using BIM in Navis works. Many interferences and conflicts which were unrecognizable in the first part, such as clash between cable tray and mechanical equipment structures, could be fully visible and automatically detected in the 3D models in BIM related software, especially in Navis works. Therefore, manual detection errors were significantly reduced and it caused all interferences and conflicts to be identified in the design phase before implementation, and saved at least 25% of the time and money on such a project. Here, the importance of using BIM could be recognized more than ever and provided a valid reason for employers to use the system.

Knight, Roth, and Rosen (2010) believe that the detection of conflicts in the construction industry is to check possible conflicts which are due to poor design in the design phase, and mainly these conflicts are between mechanical, electrical equipment and building elements. According to the investigations, the cost of interference sometimes reaches 25% of the contract amount, which is remarkable in large projects. Both the contractor and the employer will lose because of this cost increase (Knight, Roth, and Rosen, 2010).

Reinertsen states that mistakes and interferences occur in the implementation phase following the design phase because if an integrated system is not used in the design phase, it will cause interference, duplicate effort and waste of time and money. As a result, time, money and capital will be lost and the investment income will be reduced (Reinertsen,1997).

Paravan, (2012) examined 30 construction project, some of which used BIM and some of which did not. They found that those projects which used BIM had a 30% reduction in time in the design process, a 10% reduction in time in the construction process, and a 16% reduction in interferences and duplication of efforts throughout the project. While the projects that did not use BIM had the most interference, duplication of efforts and changes, which automatically increase cost and time.

In a research, Chelson (2010) concluded that using BIM and creating stronger synergy between project team members will significantly reduce interferences, duplication of efforts and delays in the construction process in civil projects. Additionally, the use of BIM can play an important role in planning and improving the control system. They came to the important conclusion that projects which used BIM in design process had a 90% reduction in interference, as well as 35% time and 20% cost savings.

Kymmel (2008) realized that detection of interferences is an integral and vital part of the process of developing a 3D BIM model. BIM makes it possible to find overlaps and interferences before the implementation phase by forming a complete model of the project. According to Kymmel's research, the most interferences occur between structures and mechanical, electrical equipment, which can be reduced by using BIM, since this technology is able to identify interferences before the implementation phase in the design process.

In a study, Eadie et al. (2014) investigated barriers to BIM implementation in Kingdom state. These barriers included: the cost of purchasing software and hardware, failure to adopt BIM by the senior project manager, the cost of staff training, failure to adopt BIM by employees, lack of

technical expertise, legal problems, lack of perspective, lack of culture of flexibility and change in methods, etc.

Kekana, Aigbavboa, and Thwala (2014) identified barriers to BIM by reviewing existing projects which used BIM, as well as articles and research conducted in South Africa. The main obstacles were the lack of a standard for the use of BIM, the lack of a design team familiar with this technology, and issues related to the intellectual property of data entry.

In research on the Malaysian construction industry, Zakari et al. (2014) determined the barriers to BIM implementation by distributing questionnaires and asking for experts' views. These questionnaires consisted of three parts. The first part was about respondents' personal information, the second part included the identification of barriers to BIM implementation and the last part was related to the prioritization of the barriers. The identified barriers in order of importance were: lack of knowledge about BIM, expensiveness of BIM, increased planning time, reluctance of employers, clients and contractors to use BIM, etc. Eventually, they stated that for the success of the BIM development plan in Malaysia, government's pressure alone is not enough and believed that all the teams involved in the construction industry are responsible for promoting this method.

Santos, Costa, and Grilo (2017) reviewed the research conducted on BIM during the years 2005 to 2015 and divided them into 9 general categories, which were as follows in the order of frequency of articles: 1) collaborative and interoperability environments 2) sustainable construction 3) adoption and standardization of BIM 4) BIM programming 5) image processing, laser scanning 6) facility management and safety analysis 7) construction management 8) review articles 9) BIM and spatial information.

Additionally, Jin, Tang, and Fang used BIM for building information modeling. BIM technology has been supported in many countries including China. For example, in China in 2016, it was approved that all construction projects with an area of more than 20000 square meters and green buildings must use BIM technology in the design and construction phases. Furthermore, in China, construction projects are required to use BIM technology from the end of 2016.

Cao et al. (2017) conducted a study on the impact of requirements of government and related agencies on the use of BIM technology. In this research, in order to experimentally test the theoretical model and research hypotheses, they used the survey research to collect data from organizations participating in BIM-based construction projects. Therefore, questionnaires were prepared and the target community including construction industry activists in China answered them. Before this survey, the validity of the answer letters was checked by selecting 21 contractors. Revised questionnaire had two parts. The first part composed of project information, including project size, project type, type of ownership of the organization participating in the project; and the second part covered motives for construction companies to use BIM technology which were determined by studying past articles and surveying experts as follows: apparent motives, reactive motives, economic motives. In the next step, criteria were prioritized by using analytic hierarchy and pairwise comparisons.

In a study conducted in the form of an experts' survey and a review of performed activities, Hanna, Yeutter, and Aoun (2014) pointed out the benefits of using BIM, especially in electrical equipment.

Research entitled BIM applications and global strategies, Smith (2014) by reviewing published paper, discussed the innovations and access that countries achieved in this field. This researcher investigated the implementation strategy of this technology in countries such as North America, Scandinavia, England, Singapore, China, Hong Kong, Australia, Brazil and South Korea, and stated that the use of BIM technology is rapidly expanding all over the world thanks to the support of

governments; and clients and contractors have realized the advantages of using BIM in the long and short term.

McGraw Hill (2014) carried out a study on the world's ten largest markets, including China and India. The research results showed that the use of BIM is increasing rapidly. Based on BIM's capabilities, this technology reduces 56% of variations during the construction phase and 59% of variations during the implementation phase (29).

Giel and Issa (2013) investigated and calculated payback period in the use of BIM. Studies showed that many companies do not tend to use BIM, due to the high initial cost of using this technology. Therefore, three construction projects, some of which used BIM and some of which did not used this technology, were selected and analyzed. The amount of potential savings of an owner in using BIM was estimated by calculating the profit and costs of using this technique. They evaluated the amount of potential savings of an owner in using BIM by calculating the profit and cost of using this technique. The use of BIM reduced deviations from plans, changes in plans and requests for information (RFI). ROI (return on investment) was estimated from 16 to 1.654% according to the size of the project.

Arzaghi and Sadat Far (2013) studied the functions of BIM technology, the prospects of this technology and the benefits of BIM in Iran and some domestic projects. BIM technology is a technique with parametric modeling that when one component of the model is changed, other components of the model are changed too for maintaining previous relationships and compatibility with other components. In the continuation of the research, they compared BIM technology with traditional 3D CAD technology and pointed out the superiority of BIM technology. In addition, they mentioned the software used in this technology. One of them is Revit software, which is used in the field of architecture, structure and facilities. They determined the applications of this technology in the building life cycle. Among the applications of BIM were the use of this technology in the planning and design phase of the project, the pre- construction, construction and post- construction stages. Finally, they mentioned the benefits of BIM.

Khosrowshahi and Araiisi (2012) investigated the challenges and benefits of using building modeling information system. They examined the BIM technique by preparing a questionnaire, surveying contractors in Finland, reviewing published paper and conducting qualitative and quantitative studies. The results were presented in forms as a guide for the correct use of BIM at operational levels. These findings offered three structural models for systematically dealing with issues related to technology, process and people in BIM implementation. The structural models included organizational culture, training and information management. Eventually, the results were presented as a roadmap for better use of this technology in England. The result of the research was the more extensive use of BIM in the UK and the creation of a sound strategy for the use of BIM.

Morlhon, Pellerin, and Bourgault (2014) studied the benefits of using BIM by reviewing the literature in several stages. At first, in order to examine the subject in general, the research was focused on projects related to BIM implementation. With the case study, critical success factors (CFS) for the use of BIM technique and BIM capability maturity model (CMM) were prepared and presented in tabular form. Therefore, for the optimal implementation of such a system, different levels of maturity should be considered to be able to provide key performance indicators.

3. Methodology

To determine the obstacles, not only library studies and reading related articles, but also conducting in-depth interviews and expressing the results are necessary. Therefore, interviews were conducted with experts and activists in the field of construction who were familiar with BIM

technology and had implemented projects in a practical way. After the initial interviews with the mentioned people, the criteria were identified. Then the analysis performed on the results raised questions about the main phenomenon of the research. Therefore, the next round of interviews was conducted in order to ensure the theoretical saturation of the criteria (categories). In the following, taking into account the main phenomenon and its related sub- criterion, more interviews were put on the agenda. In these interviews, the researchers focused on the questions which helped to perceive the nature of the main research phenomenon and its relationship with the relevant categories.

After understanding the categories and ensuring their theoretical saturation, the third round of interviews was performed. At this step, other interviews were conducted to find theoretical examples of the identified categories and relationship between them in order to provide a basis for modifying the researchers' theory. The main research experts included a number of university lecturers and active specialists who designed construction projects in a practical way using BIM software.

3.1. Open Coding

At this stage, considering the sub- questions of the research including the following, open coding was done:

Legal barriers to BIM implementation

Technical barriers to using BIM

Cultural and educational barriers to BIM

Managerial and procedural barriers to using BIM

Political and legal risks of using BIM

After reviewing the interview text, a code was assigned to each subject. To assign the codes to the text, either the specific word expressed in the sentences or according to the researcher's perception of the sentences was used; or that stated sentences were confirmations of the matter that had already been mentioned in the previous studies, in which case, by using those studies, the appropriate code was given to that part. In open coding, the data was divided into different categories. After identifying barriers, Delphi Fuzzy technique was used for final confirmation of them. The barriers were set up in the questionnaire, and its validity and reliability were checked before sending it to the experts. Additionally, content validity index (CVI) was used to assess validity of the questionnaire. CVI was presented by Waltz and Bausell. In order to calculate the CVI, experts were asked to rate the degree of relevance of each item to the following four- part scale:

Irrelevant

It needs to be thoroughly reviewed

Relevant but it needs to be reviewed

Entirely relevant

The number of experts who chose options 3 and 4 was divided by the total number of experts. If the resulting value was less than 0.7, the item was rejected; if it was between 0.7 and 0.79, it was reviewed; and if it was higher than 0.79, it was acceptable.

For determining the reliability, 8 experts were surveyed and the reliability index was obtained. Some items that their CVI index was below 0.7 were rejected, and the items which their CVI index was from 0.7 to 0.79 were reviewed. One of the prevalent methods of measuring reliability is the use of Cronbach's alpha coefficient. This method is used to calculate the internal consistency of measurement tools, including questionnaires or tests that measure different characteristics. If the

Cronbach's alpha coefficient of the variables is more than 0.7, it confirms the reliability of the questionnaire.

To calculate reliability, Cronbach's alpha coefficient was used. Eventually, by implementing the Fuzzy Delphi technique, barriers were identified, finalized and ranked.

4. Results

The identified barriers and challenges of BIM were presented in the following table, after library studies and reviewing the conducted research.

Table 1 The identified barriers and challenges of BIM

Row	Barriers	Definition
1	The complexity of BIM and its learning curve	It is hard and time consuming to learn
2	The difficulty of the initial setup of BIM	Initial setup of BIM requires powerful hardware, A lot of software and many experts in this field
3	BIM is not suitable for all kinds of projects	It is suitable for large- scale projects
4	I is difficult to measure the effects of BIM	It is practically difficult to measure the use of BIM and its effect on reducing rework, project delay and construction wastes
5	Implementation of work details based on traditional perspectives, not based on executive plans	The implementation of BIM details may be based on traditional perspectives
6	The need for high- performance hardware to manage the large amount of data	Due to large volume of data, powerful hardware is required for data management
7	Lack of global use of BIM in the local construction industry	BIM is not usually used in small- scale local construction
8	Cultural issues and constant social resistance to change	Usually society resists change
9	Lack of demand from employers and contractors (They consider it as an additional cost)	Employers and contractors usually consider it as an additional cost due to lack of knowledge of the capabilities of this technique
10	Poor training services	Limited training courses are held and training services are not enough in this field
11	High cost of buying software, hardware and BIM tools	The cost of buying software and hardware is high
12	The cost of using BIM technology	The cost of using BIM technology is high compared to traditional methods
13	New activities, new organizational chart and lack of information about new salaries	BIM's organizational chart is different from the organizational chart of traditional methods
14	Procedural issues, change in organizational structure and rules, and non- stabilization the BIM process	Being different of process and change in the organizational structure of this technology has caused its instability
15	Lack of full support from senior officials and decision makers	Usually, since this technology is unknown, senior officials do not support it
16	Responsibility and control of data entry	Responsibility for maintaining and controlling input data is not clear
17	Rate of return (ror) is not clear	The economic feasibility is unclear and the cost

		of using BIM is unpredictable
18	Lack of access to BIM tools	BIM implementation requires powerful hardware
19	Shortage of research in this field	There is not sufficient research on all aspects of BIM technology in Iran
20	Legal and contractual issues (absence of a specific contract template)	absence of a specific contract template
21	In BIM, the line of responsibility of each person is unclear	BIM's organizational chart is different from traditional methods, and the line of responsibility of each person in the new chart is unclear
22	Traditional methods of contracting	The methods of contracting in BIM must be different, but it is still done in the traditional way
23	Low computer skills among people working in the construction industry	People working in construction industry do not have enough computer skills
24	Lack of demand and neglect of clients to use BIM technology in design and construction	Clients are reluctant to use this technology in the design of construction projects
25	Lack of awareness of BIM and its benefits by the stakeholders	Usually, the stakeholders are not fully aware of the capabilities of this technology
26	Lack of access to BIM risk insurance policies	Lack of insurance coverage to support the BIM process
27	Lack of scientific manpower aware of the evolution of the model and having a proper understanding of BIM and organizational BIM	There is very little scientific manpower who is fully aware of the evolution of BIM
28	BIM authorization issues	Being different BIM process and related authorization and the problems of obtaining authorization

The Table 2, shows the barriers identified based on interviews with experts. In addition, open coding was done on the interview results (The data that was not seen in the review of the articles but was mentioned in the interviews).

Table 2 Barriers of BIM identified based on interviews with experts

Code	Barriers	Definition
B29	Incompatibilities and functional limitations between software	Some of these software have limitations in input and output data that may cause problems in implementation
B30	Lack of software with integrated functionality	A lot of software is needed to design different parts of the energy discussion and check costs
B31	The country's software embargo for using Auodesk's online capabilities to share files online among consultants and other stakeholders	Due to sanctions against Iran, many Autodesk's online capabilities cannot be used
B32	Spending a lot of time to convert CAD drawings into BIM model	It is difficult to convert AutoCAD drawings into a suitable format for BIM software
B33	It is time-consuming to create some new objects with different applications	Defining new objects which do not exist in existing archives is difficult and time-consuming
B34	Lack of architects/ skilled engineers at using BIM programs	Architects and engineers usually use traditional methods and do not aware of BIM programs
B35	Negative attitude towards information sharing	Since the plan details are provided to a person familiar with BIM to be implemented in the environment of BIM software, there is a

		possibility of copying
B36	Lack of professional interaction and extensive use of BIM	The implementation of information in the BIM environment takes place in several stages and in different fields, including structure, architecture, facilities and costs. Therefore, it is necessary for active people in different fields to interact well with each other.
B37	A lot of time and money is required to train and hire human force	Hiring an expert familiar with this technology or training experts is both time-consuming and expensive
B38	The cost of purchasing licenses for the software used	To use the original software, it is need to purchase a license
B39	Challenges of cooperation between team members and different stakeholders, and negative attitude towards teamwork	In BIM implementation, a team needs to work together, but this usually causes challenges due to poor teamwork skills
B40	The uncertainty of the responsibility of managing the entire model and the instability and lack of integrity of the model	Because of the many different fields of design, it is difficult to manage the whole project and integrate it
B41	Lack of support from industry policymakers in setting standards and lack of evaluation process and lack of awareness of international standards	No measures have been taken by the policy makers of this industry to formulate the necessary international standards and determine the evaluation process
B42	How to prevent copying of information and legal ownership of the model	It is difficult and uncontrollable to prevent copying of information
B43	Lack of government regulations to fully support BIM implementation	There are no coherent laws and government regulations to support the implementation of BIM process

After identifying the barriers, a questionnaire was prepared and vested in the experts to estimate its validity. Following determining validity, less important barriers were removed and the barriers reduced to 39 items. The reliability of the questionnaire was determined by Cronbach's alpha method.

Reliability Statistics

Cronbach's Alpha	N of Items
.738	39

Following reliability and validity assessment, the questionnaire was made available to exports. Fuzzy Delphi technique was implemented in three stages and after reaching a consensus, the barriers to the use of BIM were determined and ranked.

Table 3 The barriers of BIM were determined and ranked

Row	Criteria	Identified sub criteria	Consensus percentage	Weight	Rank
1	Technical and technological risks	The complexity of the software and the difficulty of learning and implementing BIM stages	73.33	0.026	11
2		Lack of software with integrated functionality	80	0.026	10
3		BIM is not suitable for all kinds of projects	73.33	0.023	20

4		Lack of access to BIM tools (software and hardware)	73.33	0.028	4
5		The country's software embargo for using Auodesk's online capabilities to share files online among consultants and other stakeholders	73.33	0.024	16
6		It is time-consuming to create some new objects with different applications	73.33	0.026	11
7		Implementation of work details based on traditional perspectives, not based on executive plans	80	0.026	6
8		The need for high-performance hardware to manage the large amount of data	73.33	0.026	11
9	Educational and cultural risks	Cultural issues and social and constant resistance of people in various positions including owner, contractor, employer… to change	73.33	0.028	4
10		Lack of demand from employers and contractors to use BIM in the design and construction of the project (They consider it as an additional cost)	73.33	0.028	4
11		Lack of awareness of BIM and its benefits by the stakeholders	73.33	0.023	20
12		Lack of demand and neglect of clients to use BIM technology in the design and construction of the project	80	0.026	10
13		Low computer skills among people working in the construction industry	73.33	0.024	18
14		Lack of skilled exports familiar with using BIM	73.33	0.026	7
15		Poor educational and research services in Iran	73.33	0.028	2
16		Negative attitude towards information sharing	73.33	0.026	5
17		Lack of professional interaction and extensive use of BIM between architectural, civil, utility	73.33	0.024	14

		and electrical professionals			
18	Financial risk	The high cost of purchasing software, hardware and BIM tools	73.33	0.022	23
19		The high cost of using BIM technology compared to traditional methods of BIM implementation	80	0.022	22
20		A lot of time and money is required to train and hire human force (waste of resources)	73.33	0.024	14
21		A lot of time and money is required to design a highly detailed model and integrate complex models	80	0.024	17
22		New activities, new organizational chart and lack of information about new salaries	73.33	0.028	2
23		The cost of purchasing license of the used software	80	0.024	17
24	Managerial and procedural risks	Lack of scientific manpower aware of the evolution of the model and having a proper understanding of BIM and organizational BIM	73.33	0.024	14
25		Procedural issues, changes in organizational structure and rules and non- stabilization of the BIM process	80	0.024	19
26		Challenges of cooperation between team members and different stakeholders, and negative attitude towards teamwork	73.33	0.024	18
27		The uncertainty of the responsibility of managing the entire model and the instability and lack of integrity of the model	80	0.024	13
28		Lack of full support from senior officials and decision makers	73.33	0.024	15
29		No obligation to use BIM	73.33	0.026	5
30		Neglect of the departments and interest organizations to the use of BIM	86.66	0.028	3
31		Lack of instructions for using BIM in related	73.33	0.029	1

		organizations			
32	Legal and policy risk	It is unclear who is responsible for controlling and entering data into the relevant software	73.33	0.021	24
33		Legal and contractual issues (Lack of a specific contractual template)	73.33	0.026	8
34		Information security and legal and intellectual ownership of the model	66.66	0.025	12
35		Lack of government regulations to fully support BIM implementation	73.33	0.026	8
36		In BIM, the line of responsibility of each person is unclear	73.33	0.024	14
37		The existence of many legal obstacles, including protocols, standards, the use of BIM in lawsuits and issues related to cyber problems	73.33	0.023	21
38		Traditional methods of contracting	73.33	0.026	5
39		Lack of insurance policies which support accidents and possible problems using the BIM process	73.33	0.026	9

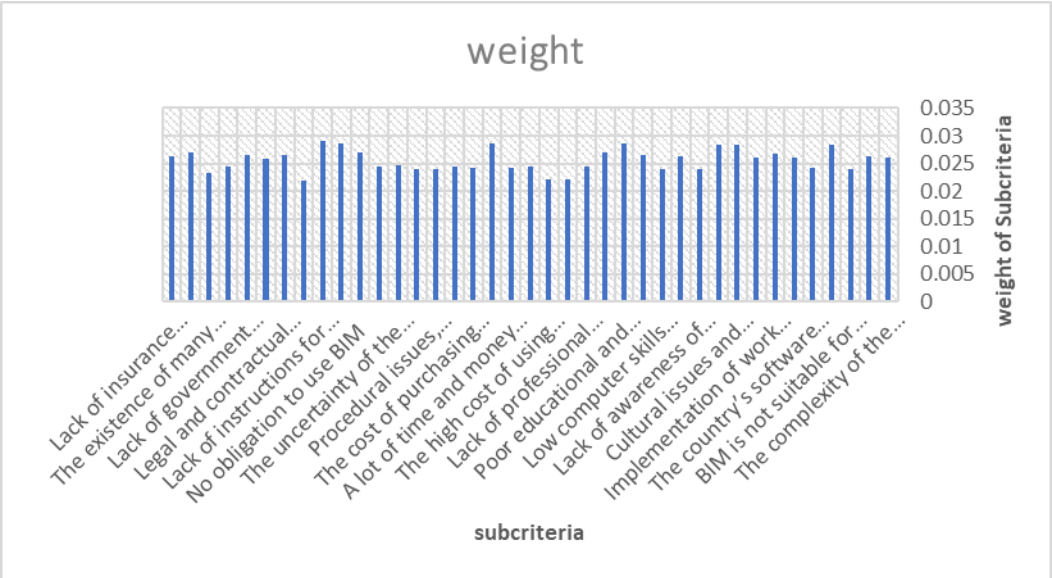

Fig 2 Rank of barriers (sub- criteria)

5. Conclusion and Suggestions

The priority level of each barrier, based on the level of consensus of the respondents is shown in figure 2 as a bar chart. In the figure, barriers (sub- criteria) are placed in the technical and technological, educational and cultural, financial, managerial, procedural, legal and political categories. Among the barriers, the lack of guidelines for the use of BIM in related organizations, located in the managerial and procedural category, ranked first. Poor educational and research services in Iran, new activities, new organizational chart and lack of information about new salaries jointly ranked second. The results showed that Iran's construction industry is still in the stage of BIM adoption and has not fully entered the stage of its implementation in organizations. Therefore, the government should take appropriate measures to support and implement BIM in the subsidiary organizations. BIM adoption in the construction industry requires the creation of legal infrastructures including determination of the model ownership, the responsibility for model defects and errors, and provision of BIM standard contracts by the legislative authority. Additionally, barriers and challenges which are social- organizational type, should be resolved by determining the standard organizational chart. Furthermore, it is necessary to carry out educational and research activities competently by starting up incubators and forming research teams in this field.

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Exploration and Verification of Effective Ecological Architectural Components in Multi-Functional Building in Mashhad (Case Example: Shandiz Padidehe)

Hamid HamedSardar[a], Saeid Tizghalam Zonouzi[b]*, Shooka Khoshbakht Bahramani[c]

[a]*Ph.D. Student, Department of Architecture, Central Tehran Branch, Islamic Azad University, Tehran, Iran*
[b]*Assistant Professor, Department of Architecture, Faculty of Art aand Architecture, Central Tehran Branch, Islamic Azad University, Tehran, Iran*
[c]*Assistant Professor, Department of Architecture, Faculty of Art aand Architecture, Central Tehran Branch, Islamic Azad University, Tehran, Iran*

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Research Article

Abstract

Today's buildings are not built with special plans and rules, but based on limited criteria that can be implemented in almost all regions. In these buildings, the idea of ecological design has been neglected, which will gradually create complex problems in the environment. Considering that multi-purpose buildings as a functional development stimulus project affects all aspects of a neighborhood or district, this research, taking into account the basic concepts in ecological architecture, tries to extract and verify the components of ecological design in the functional buildings of the city. Mashhad especially has the Shandiz collection. It is of a nested application and hybrid type that the data collection tool is designed in a qualitative approach and verified and measured in a quantitative approach. Descriptive statistics are used in the qualitative part and inferential statistics are used in the quantitative part. In the qualitative part, ATLASTI software was used to extract the components from interviews with experts, and in the quantitative part, to examine and analyze the components of ecosystem architecture from the perspective of space users (visitors) from inferential statistics. And JMP software was used. In the next step, correlation is taken between the results obtained from two perspectives. The results of inferential statistics and descriptive statistics were different from each other, and in order to apply the results, inferential statistics should be used. In general, the average correlation coefficient between experts' responses has a higher correlation than that of space users, which points to the lack of knowledge of users regarding ecological design components. Also, the results of the research show from the point of view of designers and experts, the components with the greatest contribution are Functional

* Corresponding author. Tel: +98-9123871031.
E-mail address: arch.szonouzi@yahoo.com

independence of the plan and design from details to patterns with a value of (1.000) and the least related to paying attention to the values of the site in design is with a value of (0.211). From the point of view of Space users, the components with the greatest contribution Equality of human rights and nature and attention to the context of the site with a value of (1.000) and the least related Functional independence of the plan is with a value of (0.331).

Keywords: Ecological Design Component; Ecosystem Architecture; Multifunctional Building; Shandiz Phenomenon

1. Introduction

Paying attention to the ecosystem is primarily seen in the native architecture of every climate, and even this type of view in architecture has been followed and considered in the construction of architecture in the best possible way until about a century ago; But at the same time with the growth of modern architecture in the world, attention to the environment, both culturally and climatically, was forgotten. In fact, "after the energy was supplied at a cheap and reasonable price, what happened in the heating equipment and refrigeration ventilation of the buildings?" It is easy to say that all buildings became dependent on heating, air conditioning and refrigeration systems, making it possible for buildings in the form of unacceptable glass boxes to appear in any climate and located at any latitude without worry. This type of architecture is not even compatible with the climate and was not created according to it" (Nicoletti, 2012: 10).

This is while the ancients used natural energies well to create comfort in their settlements, but with the acquisition of fossil fuels and the emergence of modernity and the trend of conquering nature, a kind of disregard for natural energies took place. Even today, with the occurrence of the energy crisis in the 1970s onwards, it coincided with the support of energy saving management from the point of view of the environment, especially solar energy, which played a special role in the works of professional designers. Also, in addition to the impact of this issue on architectural forms, new systems were also invented to cover buildings (such as semi-transparent coatings that cause shadows and refraction of light) in order to balance energy efficiency (Pourmohammadi, 2012: 117). Paying attention to ecology and ecosystem, which includes a wide range of biological phenomena, opens a new passage for creating responsive architecture. This branch, which has many functions in all fields of architecture, including landscape architecture, urban design, building architecture and technology, can open new and useful ways in responsive architecture. Ecosystem actually includes all biological, geographical, climatic, contextual, and cultural and even human social relations (Sharifi and Azarpira, 2014).

So, if a phenomenon can be accomplished according to these characteristics, the best result will certainly be achieved; whether this phenomenon is architecture or any other human phenomenon. Considering that some of these features are neglected in sustainable architecture, it is necessary to go to a richer branch which is ecosystem and ecological architecture (Torani, 2007). There are various local factors that can be considered in the formation of architecture that fits the human ecosystem and ecosystem. In the review of sustainable architecture and models of lead rating systems, etc., the quality of the environment has been looked at in terms of sustainability (Zanjani, 1992).

But paying attention to mental needs and mental and physical peace was less mentioned, measures should be taken to create a design for better environmental comfort for human life. In addition to paying attention to the relationship between humans and nature, ecological or ecosystem

architecture also pays attention to the human ecosystem and takes into account all human patterns, including poverty, income, happiness, human relationships, etc (Blonder et al., 2020: 1796-1810). As Shaker writes in the article "Urban Ecology and Sustainable Development and Review of Iran and the World's Experiences", the word ecology cannot be understood only in its environmental aspect, ecology shows the social, climatic, cultural conditions and customs of different societies. So that the natives of any place; It carries its own material and spiritual cultural heritage and identity (Shamai and Pourahmad, 2014). This research aims to extract the components of ecological design in ecosystem architecture and tries to answer the question of what are the components of ecological design in ecosystem architecture and which ones have a greater contribution in the multi-functional buildings of Mashhad.

2. Literature Review

In 2019, in an article entitled "Evaluation of ecological architecture affected by the interaction of man-made environment with nature in cold regions, a case example: a historical tavern in Ardabil", Javadi Nodeh et al. Ecological also shows compatibility with the environment, in fact, by using natural resources, they have overcome the effects of cold climate in such a way that the rooms with seasonal function, such as Shahneshin and Sardab, perform optimally against temperature fluctuations.

Mahzoun in 2018 in his thesis entitled "Designing a four-story residential apartment system with an ecological architecture approach in the 11th district of Tehran" examines the knowledge of living beings and their environment and their relationships, and in contrast to sustainable architecture, he looks for solutions in It is against the traditional patterns that can prevent the occurrence of issues such as the destruction of natural resources and the destruction of ecosystems, pollution and global warming. The findings of the thesis indicate that although several factors such as cultural, environmental, economic and social characteristics are influential in the design of a four-story residential apartment system with an ecological architecture approach, compliance with the principles and criteria resulting from fundamental and applied research in the field of architectural design And the design of the site as well as the appropriate structure can consider the use of residential apartments as a desirable, appropriate and realistic solution for housing people and providing other needs related to social and environmental activities, especially in big cities.

In 2017, in his thesis entitled "Designing a commercial-entertainment complex of Qeshm Island with a naturalistic and climate-compatible architectural approach", Zarb Estjabi deals with the design of a commercial-entertainment complex of Qeshm Island with a naturalistic and climate-compatible architectural approach. The current research has been carried out using a descriptive-interpretive method and using qualitative analysis, in which both library and field methods have been used to collect information. The results of the research show that benefiting from the principles and methods of sustainable architecture that emphasizes naturalism and adaptation to the environment's climate in the selection of the site, ideation, design of the interior spaces and the building shell, and the selection of the materials used, in addition to improving the quality of the urban space, leads to Investment attraction and social prosperity will be limited.

In 2016, Arin and Farajpour investigated the characteristics of green roofs, green facades and their environmental functions in Tehran in a theoretical research entitled "The effect of green roofs and green facades on increasing environmental quality and reducing energy consumption in Tehran". The result of this research showed a significant reduction of dust particles suspended in the air (about 20,000 tons) by creating 20% (equivalent to 100 square kilometers) of green space on the roofs and facades of residential buildings in this metropolis, which in turn converted 37,000

tons of carbon dioxide into Oxygen becomes during the day. Also, this research clearly shows that there are very favorable environmental effects, such as: reducing energy consumption, reducing the effect of the city's heat island by cooling the ambient air vapor, reducing the risk of flooding, improving the energy efficiency of buildings, etc. As a result, the use of green roofs and facades in this are a metropolis.

In 2015, in the article "Analysis of Ecological City Indicators in High-Rise Buildings of Mashhad" by comparing the criteria of ecological design in a studied area, Rahnama and Razakian try to clarify the perspective of ecological thinking to some extent in the current situation; Therefore, he evaluated 14 micro-objectives in the form of four groups: "ecological construction", "ecological management", "comfort" and "health", and the final score indicates the ecological status of the building. The findings of the research showed that the principles of ecological design have not been paid attention in almost any of the towers, and few of the HQE standards have been implemented in these towers, not because of the existence of ecological thinking in construction, but because of creating a distinction with other buildings and making each square meter more expensive for the building to be sold.

Ali Haji Qanbari and his colleagues in 2015 in an article entitled "Combination of ecological architecture and new technologies in reducing energy consumption in mountainous areas, a case example: Tabriz metropolis", with the aim of modeling the typical architectural elements of the cold and mountainous climate of Tabriz and combining them with new technologies. As a result, it suggests the use of double-glazed walls instead of thick walls, the use of double-glazed windows instead of regular windows, and other elements included in the article so that energy consumption can be controlled by styling the building.

Kolivand and his colleagues (2014) conducted a research entitled "Investigation of the thermal performance of vegetation in urban open spaces, a case study: Imam Khomeini Port" in an urban area in a hot and humid climate in Imam Khomeini Port. They simulated the area using Envi-met software and examined 12 different influencing factors including: height change, building density, vegetation type, etc. Finally, the results of this research were that as the density and height of buildings increase, the air temperature also increases, which causes an increase in thermal complaints. They also stated that as the area of vegetation increases, the impact also increases because trees create a cooling effect by shading the environment and facilitate the process of thermal comfort compared to grass surfaces.

Syed and Fernandez in 2018 in an article titled "A Reference Architecture for Ecosystem Application with the Purpose of Container Modeling" in UML software to control the ecosystem in heterogeneity and complexities. It was found that the use of Container in the building is abundant.

3. Theoretical Foundation

3.1. Ecological Architecture

Ecological architecture is a trend in the sustainable development of the current world. Architecture based on the principles of ecology is one of the aspects of sustainable architecture. In the 1960s, the Italian-American architect Paolo Soler coined the word "Archeology" from the combination of architecture and ecology (Kenworth, 2006). The first term was known as "ecological architecture". Ecological architecture works on the environment of natural ecology, values natural resources and has a fundamental impact on urban and global ecology (Su et al., 2018: 783-789). In fact, that type of architecture that communicates with nature's ecosystem cycle and

makes maximum use of clean energy by using today's technologies is called ecological architecture (Table 1) (Shamai and Pourahmad, 2014).

Table 1 The term ecology, ecological or biological design and ecological architecture (Source: Madirorusta and Rostami, 2013).

Terms	Topic
Ecology	The combination of the two words house + knowledge Science and knowledge of relationships between organisms with
Ecological or biological design	Integrating artificial biological systems with natural systems Designing a harmless and peaceful artificial environment with the
Ecological architecture	least destructive impact on the environment Working on the natural environment and relating to the ecosystem cycle of nature Valuing natural resources and maximum use of clean energy

Ecological architecture must be formed in accordance with design rules. The idea of ecological architecture is based on the relationship between humans and the environment and nature (Zhong et al., 2018: 562-572). Architecture is created based on the characteristics and patterns of the shape of the land, and paying attention to the native aspects of the place is one of the important issues in ecological design (Sharifi and Azarpira, 2014: 15). Considering the building as part of a larger environment and also as a habitat for organisms is a vital issue in ecological design (Yushanjiang et al., 2021). Another important issue is how to find a solution for the maximum use of renewable energy (Shamai and Pourahmad, 2014). According to Yang, the first step in design is to check the weather conditions of the place to take advantage of the existing potential and use it in passive systems. These factors will have an important impact on the design of plan, section and architectural form (Mohammadpour and Fenderski, 2013). In general, extensive studies have been conducted in the field of rules and points that should be considered in ecological design.

According to Hanover, in ecological architecture, there is coexistence between man and nature (while maintaining health, diversity, sustainability, and support) and in that, attention is paid to mutual relationships (interaction between man and the environment at different scales) (Yushanjiang et al. al., 2021). Respect for the relationship between material and spiritual elements; The consequences of the design are acceptable. Safe elements are left for future generations. The concept of waste and waste materials (through recycling and modification of life cycles, etc.) is removed (Huang et al., 2019: 89-94). Ecological architecture relies on natural energies (Su et al., 2018: 783-789). Understanding the limitations of design (no design lasts forever and no design will solve all problems. Humility to nature as a guide and not a nuisance to be dismissed or controlled) and seeking continuous improvement through sharing is knowledge (McDonough and Braungart, 1992). According to van der Ryn and Kwan, in ecological architecture, solutions are derived from the place and return to the cultural and physical factors of the place. The ecological effects related to the design on the environment are considered; design is done with nature (paying attention to biological processes); each person in turn is a designer (Vander Ryn and Cowan, 1996).

According to Todd et al., in ecological architecture, the living world can be the origin of all designs; Design should follow and obey biological laws and not against them; Equal biological rights should determine the limits of design; The design should reflect bioregional aspects (concurrent attention to the geographical, ecological and cultural dimensions of the place); The use of renewable energy sources must be done; Biological systems must be integrated; Design must complement and evolve with nature; Designs should heal the earth; Design should follow ecological values (Todd et al., 2003: 421-425).

According to McLennan, in ecological architecture, there is respect for the wisdom found in natural systems; Paying attention to people (principle of vitality); to place (principles of ecosystem); to the life cycle (paying attention to future generations); to energy and natural resources (principles of protection of natural resources); and it is done to processes (principle of holistic thinking) (McLennan, 2004). According to Shu-Yang-Friedman-Cat, in ecological architecture, there is a response to the inherent needs of humans. The movement towards sustainability of resources (progress towards a sustainable economy through reliance on renewable resources, recycling and reuse) takes place (Zhong et al., 2018: 562-572). Protection of ecological integrity (preserving the integrity of the structure and function of ecosystems) is established. Following and imitating the existing ecosystems in nature; the debt to the natural environment (ecological economy to reduce environmental damage) is eliminated. The natural habitat is protected. Environmental literacy increases to attract social support, protect resources and protect the natural world (Shu-Yang, Freedman, and Cote, 2004: 98-99).

Holmgren developed design principles for human habitats. His view is mostly used in agricultural systems (Holmgren, 2002). Bergen, Bolton and Fredly identified the first principles of ecological engineering design, which are mentioned in Table 2 (Bergen, Bolton, and Fridley, 2001: 201-204).

Table 2 The views of different people and the studies conducted in the field of ecological design (Source: Madirorusta and Rostami, 2013)

Shu-Yang-Friedman-Cat	McLennan	Todd	Sanborn
•Attention to the inherent needs of humans •Paying attention to the sustainability of resources •Environmental integrity •Imitation of the natural ecosystem •Protection of natural habitats	•Respect for the natural environment •Respect for people •Respect for the ecosystem •Respect for energy and natural resources •Respect for holistic thinking	•Matrix world for all designs •Design aligned with natural laws •Reflecting the surrounding biology • Plan •Use of renewable resources •Design in line with reduction •Poor condition of the planet	•Responsible for the environment •Healthy and reasonable building •Attention to society and culture • Beauty •Economically reasonable •Evolutionary
Bergen	**Holmgren**	**Hanover**	**Van der Rien and Kwan**
Site-specific design Functional independence of the plan Design in line with the maximum use of energy Attention to site values in design	Receiving and storing energy Take advantage of automatic adjustment Use of renewable energy No waste generation Design from details to patterns Composition over segregation Creative design and appropriate responses to the environment	Emphasis on human rights and nature for their coexistence Accepting responsibility for the design result Creating volumes, long term value Eliminating the concept of waste Relying on natural energies Attention to design limitations, attention to the possibility of development	•Solutions come from the ground and the site •Ecological data shapes design •Design goes in harmony with nature •Nature is exposed

According to the viewpoints of different people and the studies conducted in the field of ecological design, it can be concluded that ecological design is based on the integration of perspectives in the field of energy, environment and nature, and what is important in this process is the coexistence of buildings with the environment. Ecological design offers a solution that can be used to design livable spaces in harmony with nature (Jafari Khodavardi, and Yousefi, 2016). There are significant differences between environmental design and ecological design, which are stated in the Table 3.

Considering the differences mentioned between the concepts and principles of environmental design and ecological design, ecological design deals with the issue of environment for the present and the future. This design always believes that the artificial environment should be placed in the context of the surrounding ecosystem (Zhong et al., 2018: 562-572). The principles of ecological design allow architects to design buildings with the least amount of destruction to the environment by considering its principles. Also, the superiority of this type of design over environmental design is considering users' and people's opinions in the design process.

Table 3 Comparison of concepts in environmental design and comprehensive ecological design (source: Jafari Khodavardi and Yousefi, 2016).

Comprehensive ecological design	Environmental design	Concepts in design
•Holism •Environmentalism, altruism, adaptability •People and places •The building interacts with the design. • Interdisciplinary •Egalitarianism, circular communication •Unlimited •Designer and specialist •Open system perspective • Maximum •Design according to the evolutionary process •Shaping the process •The designer as a collaborator and coordinator •Working hypothesis •It is judged by users and the public as well as professional designers. •Popular •The designer helps the users to make decisions.	•Determinism •The only beauty •Form, function, structure, space and materials •Building design is the end point. • Multi String •Hierarchical, linear relationship •Limited •General designer •Closed system perspective • At least •Design according to the problem solving process •Shaping the form •Design as senior and critic •Biased •Judged by professional designers. • Individual •The designer makes decisions for the users.	•Philosophical base •Value orientation •Main design variables •The relationship between the building and the design •Type of design •System and communication •Contribution of other fields •The role of specialties •Design perspective • Creativity •Design problems • Design process •The role of the designer •The role of theory in design •Judgment and arbitration •Designers' point of view •Communication between the designer and the users

What is certain from the theoretical literature of the research is that building construction, like any other construction project, will harm the environment. Ecosystem architecture tries to reduce the harmful biological effects during the life cycle of the building and the importance of the efficiency of heating and cooling systems, the use of alternative sources of energy, choosing the right place for construction sites, the use of local and recyclable materials and materials, energy production on site, collecting surface water and reusing it for gardening and washing purposes, on-site waste management is emphasized. These buildings with ecosystem architecture will have the

minimum amount of interference and destruction on the environment and are a suitable solution for the environmental and energy crises that are leading human environments in the present and future. As a result, it is better to create a culture in this field and use it based on our environmental and cultural dimensions and existing experiences, which not only leads to preservation of the life cycle through native design, but also adds color to the body of cities and comfort in all it created contexts. Let's not forget that designing buildings with ecosystem architecture individually and one by one is good, but it doesn't work. To complete a green process, we need a green city; because nature does not consist of isolated green spots, but rather a wide green cover that should cover the city.

3.2. Multi-Functional Buildings

Single-function buildings and their covered areas are occupied only during part of the day or week and remain empty and unused during other times; but multi-functional or multipurpose buildings gather people at different times, which is a much more useful use of an urban space. The construction of high-rise buildings is justified by following the pattern of intensive growth in cities with mixed use of residential, commercial, office, entertainment, etc. in its different floors (Radhi et al., 2013: 179).

Contemporary cities are dispersed in a very dynamic manner, and the development of modern urban structures has been shaped by efficient space management policies that have emerged in the form of multi-functional buildings. In this way, the use of dense spaces has become a feature of new urban spaces. New buildings are built larger and with more diverse functions in order to meet the needs of numerous users in one volume. Multi-functional buildings welcome people with different services (Pourmohammadi, 2012).

These buildings have reduced the horizontal expansion in the environment and this has made these buildings become one of the dominant buildings in today's urban planning.

A multi-functional building is usually defined as a design that at least combines the characteristics of 3 types of use; That is, retail, residential and commercial sales have been created; But the definition that is used today for a multi-functional building is a combination of various components and variables that all work together in an effort made by various international institutions, the following definition is published in Multi-functional building is the development of different uses in the same land by integrating a mix of retail, office, residential, hotel, entertainment and other uses (Radhi et al., 2013: 181). The basic principle in this pedestrian planning is to pay attention to the elements related to the environment, life, work and play. In this plan, the maximum use of space and facilities is made. There are two different words in relation to the word user, one is "basic use" which is the most lasting and profitable use in multi-functional buildings, and the other is dominant use, which is the user who occupies the most space in the design. It is the basic use that drives the concept of development, as well as the decisions related to the appropriateness and compatibility of uses in this plan (Gerigk, 2017).

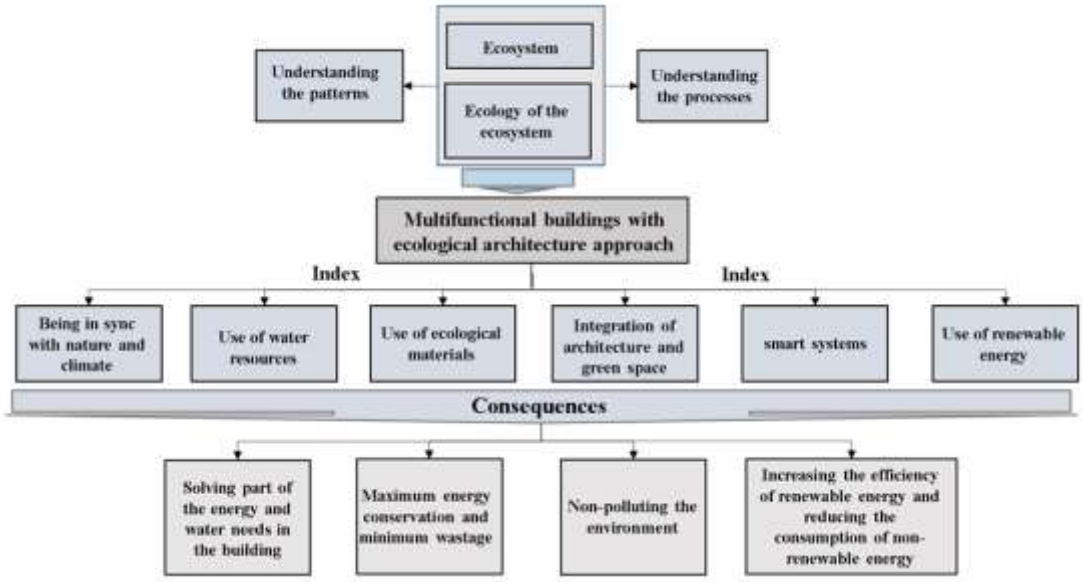

Fig 1 Conceptual model of research

4. Research Method

It is of a nested application and hybrid type that the data collection tool is designed in a qualitative approach and verified and measured in a quantitative approach. Descriptive statistics are used in the qualitative part and inferential statistics are used in the quantitative part.

Descriptive statistics focuses on summarizing the main characteristics of a data set. On the other hand, inferential statistics focuses on making generalizations about a larger population based on a smaller sample of that population. The accuracy of inferential statistics largely depends on the accuracy and precision of large population samples. Doing so involves obtaining a random sample.

In the qualitative part, first, concepts and definitions of ecosystem architecture are extracted and categorized through theoretical foundations. Then, the semi-structured questions of the research interview are designed in accordance with the concepts and definitions taken from the theoretical foundations in the number of seven questions for the interview with the experts. Then, the results of the interview are entered into the Atlasti software and are reduced and extracted the variables of the main theme using descriptive statistics and with the approach of description and interpretation. In the descriptive coding stage, the text of the interview was studied in detail and word for word in search of themes related to the research questions, and at every point of the interview where a theme was found, that part of the interview was selected and a descriptive theme was attributed to it. In the same way, the continuation of the interview was carefully studied and the descriptive themes were attributed to its section. Next, the subsequent interviews were coded descriptively. Then, an attempt was made to go beyond the "description" of the interviewee's statements and focus on the interpretation of their meanings, as a result, interpretive coding was used. This was done mainly by combining descriptive codes that seem to have a single meaning. In the current research, in the interpretation coding stage, the descriptive codes produced in the previous stage were integrated or placed under each other through the interpretation of the meanings of the descriptive codes and during their continuous comparison several times, and finally, axial coding was done.

Table 4 An example of coding from the text of interviews with experts

Axial coding	Open coding		(interview text)
	Interpretive coding	Descriptive coding	Propositions
Ecological management	Energy Management	Use of thermal insulation shells Use of renewable energy	Our buildings should use renewable energy to heat their spaces. For example, put solar panels on their roofs. We have to provide the infrastructure for this. Now in other countries they use insulation and smart materials.
	Management Wastes of Activities	Separation of waste	The main concern of architects and even builders should be to consider the environment. It means to pay attention to both the internal environment and the external environment. Chemical waste, for example, should not be mixed with blood waste. As much as the waste in the environment is reduced and local materials are used, the costs will be reduced and the use of resources will be saved.

In the next step, the author visits the multi-functional complex of Mashhad city with a long thinking system according to the main theme of the article. Data reduction is done in both cases. Based on the results of open and axial coding, a questionnaire with a Likert scale is designed and provided to the group of space users (visitors). The results are compared in two groups using Originpro software. The validity of the questionnaire is controlled by the formula CVR=0.74 and the reliability is controlled by Cronbach's alpha at the rate of 0.78. Inferential statistics are used for data analysis. The statistical population is divided into two groups of space users and people with expertise in this field, and the sample size for both is considered to be the upper limit of Morgan's table and 384 people. The criteria for entry and selection of experts for interviews are as follows:

Table 5 Criteria for selecting experts for interview

Snowball selection	Have at least a master's degree
Be a university faculty member.	Architecture, urban planning, planning.
Have an article related to ecological architecture and its affiliates.	Familiarity with the field of research methodology
Architecture, urban planning, planning.	To be able to visit selected multifunctional buildings
Have design experience in multi-functional buildings.	Have sufficient knowledge of ecosystem architecture and ecological design.
Have enough familiarity with ecosystem architecture.	Have at least one article

In this research, after selecting the participants in the research, the steps of doing the work are displayed in the Fig 2.

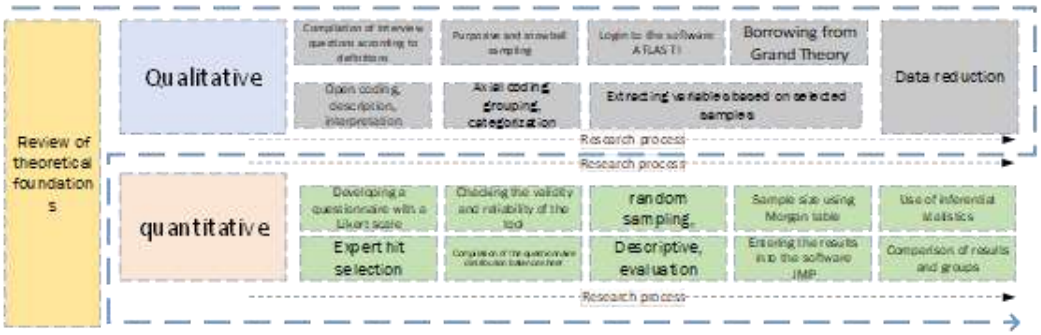

Fig 2 Research process

5. Study Area

Padideh Shandiz multi-purpose tourism complex in Mashhad is considered the largest complex of its kind in the country. This complex includes a shopping center with an area of about 500,000 square meters, a water park, two office towers, a conference hall, residential units under the title of mid-range serviced apartments and a twin tower that includes a 5-star luxury hotel and serviced apartments, the towers with a height of more than 160 meters above the ground, it is the tallest residential building in Iran. Conceptual designs and the first stage of the project have been prepared by ATKINS UK Company, and a significant part of the project's executive plans have been prepared by Atek consulting engineers. Preparation of landscaping plan and interior architecture of the project has been part of Atek's services since the beginning of the first phase.

Padideh Shandiz multi-purpose tourism complex has been designed and implemented on a 50-hectare land with an infrastructure of 1,110,000 square meters in the center of Shandiz city. This complex is projected as the largest shopping, entertainment and leisure center and can be extended to the millions of visitors of Mashhad al-Reza, with a population of over 820,000 citizens, as well as pilgrims to the Holy Shrine of the 8th Imam, whose population will reach 40 million people in the next 15 years. Provide its important, high-quality and memorable services and has the following pillars.

Table 6 Various elements of the city of Padideh

A large cultural complex	Office complex	Flower garden and permanent exhibition of flowers and plants	Indoor playground
Five star hotel	Apartment service complex	Large shopping center	Amusement complex and water park

Due to having various functions and supporting various activities, this complex has many visitors and space users, if ecological elements can be introduced into it, through development stimulating projects, it will play a significant role in preserving the environment and also increasing the mental schema in the audience of these buildings will have.

6. Analysis of Findings

6.1. Descriptive Statistics

In the qualitative part, as mentioned in the research method, semi-structured questions were designed based on the concepts and definitions of ecosystem architecture, and seven questions were designed to interview experts with the aim of extracting components of ecosystem architecture from their point of view. Therefore, first, the experts were asked to start interviewing and answering the questions of semi-open interviews based on observing the documents of Shandiz's multi-functional collection. Then, the texts of the interviews are entered into the ATLASTI software, and according to the categories and themes of ecosystem architecture and ecological design and the interview codebook (balance sheet), the interviews are started to be reduced and live coding, description and interpretation are done in the first stage and open coding of the extracted categories including is below:

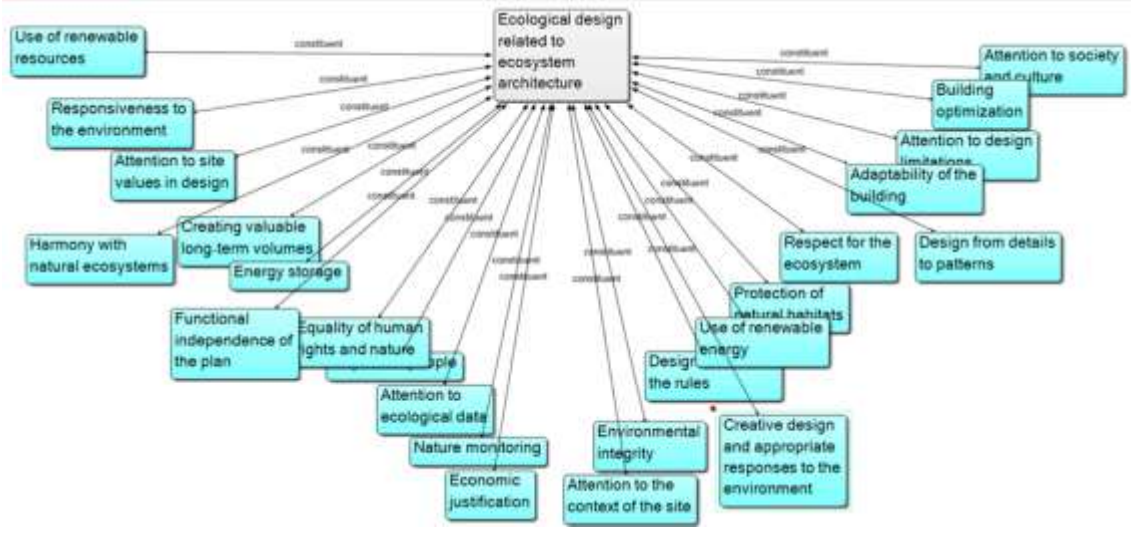

Fig 3 Components extracted from interviews with experts

6.2. Inferential Statistics

According to the descriptive statistics, 253 people (70.7%) of the sample population were men and 131 people (29.3%) were women, and 74.4% were in the age group of 20-30 years. The working method is such that according to the number of components that were extracted from the interviews with experts, the questions of the questionnaire were formulated to be distributed among space users; and each question has an answer between 1 and 5. The sum of the scores of indicators of a component means the score given by each person to the desired quality. Therefore, the score that can be obtained for each quality varies between 5 and 25. Based on this, we create a category in such a way that the people who have given a total score of 5 to 11 to a factor, estimate it poorly, have a score of 12 to 18 as an average opinion and 19 to 25 as a good opinion. The number of experts is 20, which is multiplied by 19.2 to equalize the results. The results of descriptive statistics showed that the most frequency of data obtained from ecosystem architecture design components in the group of space users is most related to nature monitoring and the least is dedicated to economic justification.

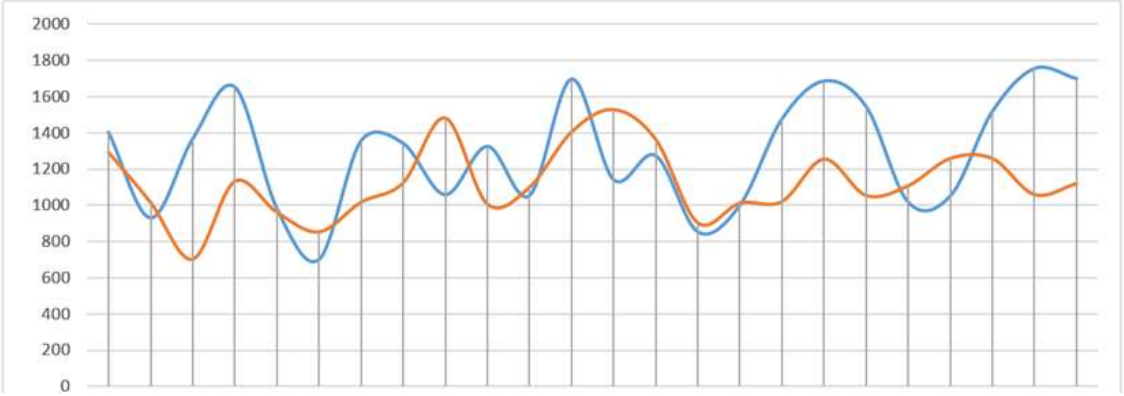

Fig 4 Abundance of ecological design data

6.3. Spearman Correlation

The results of the questionnaire are entered into the Spss25 software after numbering. Predictive relationships (regression) and correlation relationships are used for analysis. Two-Sample Kolmogorov-Smirnov Test is used to check the parametric and non-parametric type of data.

The Kolmogorov-Smirnov test is significant for the score of ecological design components (p=0.032) and therefore they do not have a normal distribution and non-parametric analysis should be used for it.

The Table 7 shows the correlation between the variables. As it can be seen, there is a significant positive correlation between ecological design and its components at the level of 0.01. In ecological architecture, from the point of view of spatial users, the highest correlation is functional independence of the plan with a value of (0.991) and the lowest is related to paying attention to site values in design with a value of (0.202). From the point of view of spatial users, the highest correlation is between Protection of natural habitats (0.895) and the lowest correlation is functional independence of the plan (0.409).

Table 7 Correlation between ecological design variables

Variable	Dimensions	Designers and experts		Space users	
		Significance level (sig)	Correlation coefficient	Significance level (sig)	Correlation coefficient
Ecological design	Responsiveness to the environment	0.000	0.743	0.000	0.464
	Attention to society and culture	0.000	0.574	0.000	0.781
	Economic justification	0.000	0.744	0.000	0.645
	Design in line with the rules	0.000	0.739	0.000	0.653
	Building optimization	0.000	0.675	0.000	0.746
	Use of renewable resources	0.000	0.569	0.000	0.473
	Respect for the ecosystem	0.000	0.746	0.000	0.631
	respect for people	0.000	0.807	0.000	0.683
	Environmental integrity	0.000	0.542	0.000	0.473
	Harmony with natural ecosystems	0.000	0.654	0.000	0.623
	Protection of natural habitats	0.000	0.895	0.000	0.895
	Attention to ecological data	0.000	0.889	0.000	0.720
	Nature monitoring	0.000	0.733	0.000	0.425
	Equality of human rights and nature	0.000	0.743	0.000	0.480
	Attention to design limitations	0.000	0.574	0.000	0.415
	Adaptability of the building	0.000	0.744	0.000	0.411
	Creating valuable long-term volumes	0.000	0.739	0.000	0.443
	Energy storage	0.000	0.529	0.000	0.711
	Use of renewable energy	0.000	0.679	0.000	0.562
	Design from details to patterns	0.000	0.628	0.000	0.745
	Creative design and appropriate responses to the environment	0.000	0.542	0.000	0.615
	Attention to the context of the site	0.000	0.574	0.000	0.465
	Functional independence of the plan	0.000	0.991	0.000	0.409
	Attention to site values in design	0.000	0.202	0.000	0.605

6.4. Regression

According to the results obtained from the regression table, it was determined that from the point of view of designers and experts, the components with the greatest contribution are Functional independence of the plan and design from details to patterns with a value of (1.000) and the least related to paying attention to the values of the site in design is with a value of (0.211). From the point of view of Space users, the components with the greatest contribution Equality of human rights and nature and attention to the context of the site with a value of (1.000) and the least related Functional independence of the plan is with a value of (0.331).

Table 8 Multivariate stepwise regression

Scale		Designers and experts				Space users			
		β	B	F	Coefficient of determination	β	B	F	Coefficient of determination
Ecological design	Responsiveness to the environment	0.781	1/000	222/527	0.615	0.741	1/000	314.217	0.867
	Attention to society and culture	0.732	1/000	122/405	0.451	0.429	1/000	523.147	0.895
	Economic justification	0.662	1/000	343/217	0.846	0.587	1/000	578.218	0.769
	Design as per the rules	0.648	1/000	943/199	0.746	0.685	1/000	298.921	0.825
	Building optimization	0.664	1/000	612/201	0.762	0.621	1/000	247.257	0.712
	Use of renewable resources	0.662	1/000	623/643	0.383	0.381	1/000	644.321	0.786
	Respect for the ecosystem	0.652	1/000	683/849	0.753	0.484	1/000	845.523	0.945
	Respect for people	0.681	1/000	654.218	0.735	0.464	1/000	754.254	0.585
	Environmental integrity	0.483	1/000	945/184	0.571	0.421	1/000	124.541	0.965
	Harmony with natural ecosystems	0.464	1/000	748/276	0.770	0.631	1/000	232.241	0.744
	Protect natural habitats	0.452	1/000	943/199	0.795	0.124	1/000	201.321	0.885
	Attention to ecological data	0.463	1/000	034/499	0.893	0.311	1/000	443.124	0.723
	Nature monitoring	0.662	1/000	643/673	0.467	0.325	1/000	229.265	0.358
	Equality to human rights and nature	0.720	1/000	782/489	0.750	0.623	1/000	852.381	1.000
	Attention to design limitations	0.543	1/000	782/489	0.674	0.223	1/000	441.211	0.721
	Building adaptability	0.420	1/000	782/489	0.567	0.529	1/000	321.541	0.946
	Creating valuable long-term volumes	0.663	1/000	412/382	0.752	0.679	1/000	621.991	0.821
	Energy storage	0.410	1/000	782/656	0.732	0.628	1/000	581.920	0.885
	Use renewable energy	0.662	1/000	643/673	0.467	0.542	1/000	218.654	0.675
	Design from details to patterns	0.720	1/000	715/645	1/000	0.574	1/000	752.382	0.756
	Creative design and responses to the environment	0.541	1/000	712/546	0.674	0.456	1/000	514.321	0.561
	Attention to the context of the site	0.394	1/000	732/318	0.567	0.517	1/000	428.167	1.000
	Functional independence of the plan	0.720	1/000	715/645	1/000	0.425	1/000	323.412	0.331
	Attention to site values in design	0.921	1/000	382/752	0.211	0.518	1/000	154.425	0.727

According to the results obtained in the findings section, it was found that the results of inferential statistics and descriptive statistics were different from each other, and to apply the results, inferential statistics should be used. In general, the average correlation coefficient between the answers has a higher correlation than that of spatial users, which affects the knowledge of users compared to Ecological design components mentioned. In the components with the lowest correlation coefficient, its value is close to 0.5, which shows the high correlation between the components and their responses. This is not the case in the factor share and regression, and in general the averages obtained for the two groups are close to each other, considering the physical aspects and paying attention to the people and the needs of different groups in the space as a flexible element over time with more value in ecological design related to architecture. It has been an ecosystem.

7. Conclusion

The principles of ecological design and attention to ecosystem architecture with the use of various components have been considered for many years in the process of designing and implementing various types of buildings with educational, residential, commercial, cultural, etc. uses in developed countries. Multi-functional buildings as a contemporary product have been less investigated in this country. Ecological design can improve the quality of these buildings by preserving various ecosystems. In the Shandiz multi-functional complex, if the ecological design components are verified and implemented and the impact of each component on the ecosystem architecture is taken into account in this research, it can make this complex in line with peaceful coexistence. As a result, to increase the accuracy and accuracy of the data in this research, two perspectives of experts and space users were used.

The results show that the physical and ecological spatial components have been designed more in the multi-functional complex of Shandiz, but less attention has been paid to other aspects such as the environment.

According to the findings of the research, from the point of view of space users, the variables of equality of human rights and nature and attention to the valuable site context had the greatest impact on the ecological architecture of multifunctional buildings in the city of Mashhad. While, according to the experts, the functional independence of the plan and design from details to patterns had the most impact. But the fact is that the use of details increases the waste of materials and consequently reduces attention to ecosystem and ecological architecture.

Some experts mistakenly consider the environment to consist of separate areas of the environment that do not interact with each other. They claim that ecosystems can be sustained by replacing man-made systems. These people hope that technology will allow humans to deal with nature. In fact, experts consider humans to be completely independent of nature.

According to the views of different people and the studies done in the field of ecological design, it can be concluded that ecological design is based on the integration of the views in the field of energy, environment, and engineering, and what is important in this process is the coexistence of buildings with the environment. Ecological design offers a solution that can be used to design livable spaces in harmony with nature.

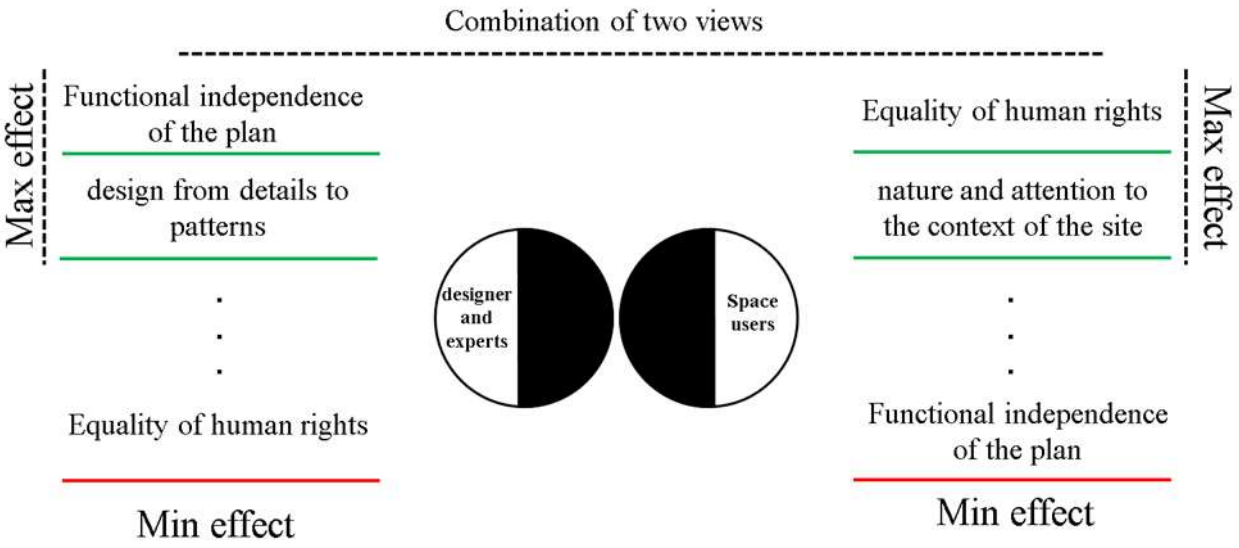

Fig 5 Effect of components from the point of view of space users and specialists and designers

Therefore, the buildings do not have climate function and their shells are the same regardless of their location. In fact, many ecological aspects have not been considered in them. In other words, in this collection, by following the local topography, geographical location, climatic features, the formation of the building form based on cultural, economic and social characteristics, paying attention to the spatial organization based on culture and identity, one of the most optimal responses of the man-made environment in interaction with the natural environment in the complex Shandiz is functional in Mashhad city. The following strategies are suggested to improve the designs of multi-functional complexes as well as complying with ecological design criteria in accordance with ecosystem architecture:

- Paying attention to the ecological data corresponding to each climate in order to recognize and prioritize the ecosystem of each region
- Designing multifunctional spaces for all age groups and dimensional distribution
- Utilizing existing standards such as Bream, Leeds, etc., in order to localize climate and expand environmental sustainability
- Paying attention to the context as the main axis in the internal and external spaces and the connection between them with physical elements
- Utilizing the standards of zero energy buildings in order to store renewable energy and eliminate fossil.

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