International Journal of Applied Arts Studies

Volume 9, Issue 3

August – September 2024

Islamic Azad University, Yazd Branch, Iran

Acknowledgement

IJAPAS would like to thank the following people for their contributions in this volume.

Section Editor

Ali Boloor

Masoud Latifi

Salar Zohoori

Reviewers

Akramolsadat Kheyrossadat

Loghman Karimi

Proof-Reading

Amin Naeimi

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 Nov – Dec 2024.

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
International Journal of Applied Arts Studies (IJAPAS)
www.ijapas.ir

INDEX

Available online at www.ijapas.ir

International Journal of Applied Arts Studies

IJAPAS 9(3) (2024) 07–34

The Role of Age in Understanding the Components of Tradition and Modernism in University Buildings in Tehran

Mohammad Reza Sharafiyan[a], Hossein Soltanzadeh[b]*, Shervin Mirshahzadeh[c], Mohammad Mohammadzadeh Doghaheh[d]

[a]*Doctoral Researcher, Department of Architecture, Central Tehran Branch, Islamic Azad University, Tehran, Iran*
[b]*Professor, Department of Architecture, Central Tehran Branch, Islamic Azad University, Tehran, Iran*
[c]*Assistant Professor, Department of Architecture, Central Tehran Branch, Islamic Azad University, Tehran, Iran*
[d]*Assistant Professor, Department of Architecture, Rudbar Branch, Islamic Azad University, Rudbar, Iran*

Received 02 March 2024; revised 29 April 2024; accepted 18 July 2024

Research Article

Abstract

Tradition and modernism as a concept also follow the same thing, but there may be differences in the effect of each indicator due to the difference of groups in the type of view of the past and the future. This research was conducted with the aim of investigating the components of the modernism tradition in the age groups (20-30), (30-40), (40-50) and (50-60). For this purpose, first, the components in the tradition of modernism are extracted from the review literature. Then to verify them, Kendall's w coefficient is used. In the next step, a questionnaire based on the Likert scale is distributed among space users. The research method in this research is a qualitative and quantitative combination. The results show that among the age groups of 20-30 and 30-40, the correlation drops to an incredible extent, which can almost be said that they do not fully explain each other's behavior. In the age groups of 20-30 and 50-60, the correlation value is low. In the age group of 30-40 and 40-50, the correlation value is low. In the age group of 30-40 and 50-60, the value of correlations has increased slightly. But the correlation between the indices of tradition and modernism obtained in the age groups of 40-50 and 60-50 is high. According to the fit obtained

* Corresponding author. Hossein Soltanzadeh.
E-mail address: hos.soltanzadeh@iauctb.ac.ir

The present article is extracted from the doctoral dissertation of the first author entitled "Comparative Study of Contemporary Architecture of University Spaces in Iran and India", which was done under the guidance of the second author and the advice of the third and fourth authors at the Faculty of Architecture and Urban Planning of Islamic Azad University, Central Tehran Branch.

Publisher: Islamic Azad University, Yazd Branch.

from the step-by-step regression model of age groups, due to the increase in data, only age groups (50-60 and 50-40) and (20-30 and 40-30) can predict each other.

Keywords: Tradition; Modernim; Age Group; University Buildings.

1. Introduction

During the formation of modern Iran during the first Pahlavi period and the beginning of reforms in various administrative, economic and social fields, as well as higher education in the country, the development of educational centers and institutions was placed as one of the important agenda. The main pillars of this transformation in Iran's university system were established in 1934 with the establishment of Tehran University as an important neighborhood in the contemporary history of Iran and a starting point for the development of new sciences and the process of modernization of Iranian society and society (Shahbazi et al., 2017: 43). Economic and cultural necessity in the second Pahlavi period, planning policies for the growth of universities, colleges and higher education centers were followed with considerable intensity and speed (Behnam, 2013: 102).

Many factors that caused fundamental changes in Iran's architecture in different political, cultural, social, economic, etc. fields in the contemporary era, left their effects in the form of physical and sometimes structural changes in public buildings. that the architecture of universities was not exempted from this; The prevailing cultural conditions and the spirit of the times, the dominant architectural trends of the day, the attitudes, working methods and experiences of architects, motivations and goals, etc., are among the factors influencing the formation of universities with different architectural patterns and orientations. Emerging modernity in Pahlavi, Iran had significant achievements in various fields including science and education. But following its transformation, it created a kind of break that emerges from traditional architecture to modern architecture and caused the emergence of a new body that is not compatible with Iranian architecture in the bed of emerging buildings, the faculties were in the universities. Also, paying attention to modernity and preserving the values of traditional architecture created buildings that used the indicators of tradition and modernism in different ways in the body of its spaces. These indicators seem to have different effects in associating this concept in different age groups. Tradition and Modernism It seems that the concept of the passage of time and the speed of development of communication has made architecture as a global process and this can have a significant impact on the understanding of body spaces as a phenomenon of tradition or modernism. This research aims to examine the components of Tradition and modernism in 4 age groups and presenting the correlation between them tries to answer the question that which of the age groups has a high correlation between the understanding of the components of tradition and modernism and at what age this understanding of space decreases.

2. Research Background

In 2000, Naghizadeh came to this conclusion in an article entitled the relationship between the identity of "Iranian architectural tradition" and "modernism" and "modernism" in order to provide an insight into determining the boundaries and limits of how different views and ideas influence the past and contemporary architecture of Iran. that the architectural tradition of Iran is based on the values of Iranian culture, which itself is inspired by the Islamic worldview (Naghizadeh, 2000: 81).

In 2007, Şerefhanoğlu Sözen and Gedik, in an article entitled "Evaluation of traditional architecture in terms of the body of the building: the old house of Diyar Bakr" emphasized the importance of the characteristics of traditional buildings in terms of energy efficient design, providing suitable buildings for the environment. Common examples of vernacular architecture are to represent local climate conditions, materials, techniques, building systems and lifestyles, traditions and economy, and people's living conditions. The best and most examples are residential. Usually, contemporary buildings are the same regardless of the weather and the region in which they are built, and favorable conditions are created by technology and high energy consumption. It is to create favorable conditions for the residents with the lowest energy consumption.

In 2013, in an article entitled Tradition, Art, Architecture, with the aim of revitalizing architecture through tradition, Akrami came to the conclusion that the neglect of the main concept of tradition in the collective mind of society, especially in the eyes of academics and art owners, has caused the decline of traditional society and distortion of the concept of tradition. Is. In this sense, reviving the true concept of tradition in the current crisis-stricken world, and especially in the disjointed world of the East, seems necessary and vital (Akrami, 2004: 144).

Pourmand and Khazaei in 2014, in an article entitled Manifestation of Tradition in Today's Architecture, while briefly examining the common features of the content and form expression of traditional Iranian architecture and how to use them in today's Iranian architecture, came to the conclusion that there are glimmers of hope in a fundamental transformation in The field of architecture has emerged and the preservation of traditional principles can be seen in the modern works of Iran today (Pourmand and Khazaei, 2014: 51).

Hamid Majdi, Jamal al-Din Sohaili in an article titled "Emergence of Modernism in Turkish Architecture and Confrontation with National Architectural Sectors" first studied the fields of national identity crisis and confrontation with Western modernism in Turkey's social and political conditions and by examining the areas of influence of western modernism ideas in The Ottoman Empire has come to the conclusion that the contemporary architecture of Turkey has always been affected by the struggle between the influence of modernity and national trends (Majdi, Soheili, 2011: 57, 51).

Pourahmad et al. in 2011, an article entitled "The Effect of Modernism on the Spatial-Physical Development of Iranian-Islamic Cities (The Example of Tehran)" investigated and analyzed the process of formation and physical-spatial changes of the Iranian-Islamic city with an emphasis on the city of Tehran and how They discussed the organization and influence of urban elements from various factors, especially modernism. In addition to the physical shape and physical characteristics, the old textures along with the inner-city elements and spaces have hidden special cultural, social, and historical values. Following the content and physical changes of the cities, a huge population poured into the cities without any plan, it created the physical and spatial development of Iranian cities, especially the city of Tehran, and in fact, modernism as a new model of urban development first led to the change of the shape of the city and then to the change in the people interested.

Mahmoud Abedi and Hossein Sultanzadeh in an article entitled Interaction between tradition and modernity in the contemporary architecture of the Persian Gulf countries: a case study of the United Arab Emirates with the aim of analyzing the interaction of tradition and modernity in contemporary architecture and the relationship between native and cultural aspects, with a comparative analysis of 8 examples for this result It has been found that in the United Arab Emirates, most of the forms do not represent the culture of the Emirates and lack designs with symbolic form in relation to the

place, which weakens the relationship between tradition and modernism (Abedi, Soltanzadeh, 2014).

In 2015, Parsaee et al., in the article "Research on the Former British Consulate as the first example of modern architecture in Iran", first introduced and explored the British Consulate Hall (Sabze Abad building). The results indicate that there were changes in the situation of Bushehr, especially during the Qajar period, when this city faced changes and reforms, these changes were manifested in various political, economic, and architectural fields, and the building of Sabz Abad was the result of these changes. By analyzing the architectural mechanism, this issue has shown that the Sabzabad building did not follow the traditions of Bushehr and had a modern approach, which has very few similarities with the local features of the region, and this building can be one of the first modern buildings in Iran.

In 2014, Agboola and Zango in the article "Development of Traditional Architecture in Nigeria: A Case Study of the Structure of USA Houses" identified the moderating and determining factors as the main issues affecting the development of traditional architecture, including knowledge of local materials, construction methods, existing new methods, social factors. , cultural and environmental factors have helped and architects have been asked to put their efforts into traditional design and use modern construction techniques; This is through the use of low-cost building materials such as wood, stone, and soil and the design principles of privacy, space, and comfort in traditional Nigerian architecture.

In 2015, Rezaei and Hanachi, in an article entitled "Oudjalan Neighborhood, Urban Heritage in the Confrontation between Tradition and Modernity", identified the obstacles to the revitalization of the Oudjalan neighborhood. They concluded that the obstacles in the way of revitalizing Odlajan neighborhood are cultural and social rather than economic, technical, and political, which consists of citizens' and residents' apathy towards old textures and buildings, in other words, the process Modernization, which started in Iran at the end of the Qajar period, was accompanied by the rejection of tradition and history, one of the results of which is the community's disinterest in heritage and a permanent desire for various members. Regarding the historical values of tradition and heritage, it is necessary to carry out extensive studies.

In 2016, in an article titled "Comparative Study of Architecture and Content of Iranian Schools from the Traditional to Modern Period", Sepideh al-Muhammiq et al. compared the changes in the architecture and content of schools and the relationship between the two in the traditional, transitional, and modern eras of Iran (Alaghemand, 2016: 5).

In 2017, in an article titled "Native and Contemporary Architecture, Aswan's Construction Developments in Egypt", Bayoumi researched and analyzed the construction of the Nouvian environment. The results of the research show that native architecture is the result of many aspects of the social and cultural environment and economic values, which is unique and dependent on tradition, and despite the new words of architecture in architecture, new technologies such as materials were developed, and in rural architecture, everything existed stably, not instability. There was an economy and not a lack of water and the lack of it, the cycle should have been used to create a new city and new buildings, which has also been ignored.

Baseti in 2017, in an article entitled "The relationship between tradition and modernism in the formation of the fabric of cities with emphasis on cultural dimensions" investigated the relationship between tradition and modernity in the formation of the architecture of the Qajar era in the years 1918-1965 AH. The results indicated that society has faced many problems in understanding and accepting the principles of modernity, especially in the field of culture, and has been caught in many challenges that it has not succeeded in getting rid of, and this fact can be seen at the

community level. Obviously, with the lack of such a plan, society unconsciously takes advantage of the culture of modernity and uses it without knowing its exact nature and function.

Yousef and Al Haroun in an article titled; The perception of the yard in Kuwait between tradition and modernity was discussed. The yard is a multi-purpose open space where families gather, and in the 1950s, it was subjected to rapid and unprecedented urbanization. In this study, the yard is used as a means to investigate a number of socio-cultural, economic, political aspects and move towards the modernity of the domestic environment, which is far from the type and culture in the society and how people deal with the concepts. Traditionalism and modernity come to the conclusion that there is a connection between past realities and current perceptions about the yard (Yousef, 2019: 2).

Xiaoxim. Zhao et al. in an article entitled: From indigenous to semi-native; A case study of the display of vernacular architecture and adaptability in Chinese village revitalization deals with the fact that vernacular architecture is considered as a heritage that should be protected because it is changing day by day due to the trend of villagers towards modern architecture. The purpose of this study is to present the term new vernacular (buildings with vernacular appearance and contemporary execution methods and materials) and semi vernacular (reuse or renovation of vernacular buildings in combination with new traditional and traditional building techniques) in order to differentiate between two types of vernacular villages. Is. As a result, a new definition of new terms arises (Xiaooxim, 2019: 1121).

Mannan et al. in an article titled: I.M.Pei Islamic Museums of Qatar and Tradition and Modern Development in Islamic Architecture aims to improve methods of evaluating efforts in the development of traditional architecture in the context of modern architecture. With the expansion and connection with various nations in the Middle East, modernization makes differences compared to the ruling traditions, the buildings in the vicinity of the museum have differences with the museum itself. But on the surface, it has commonalities, but after analysis, it is concluded that it has many differences with the original topic of tradition (Mannan, 2019: 271).

Alcinador and Coq-Huelva in an article titled; Restoration, native architecture and invented traditions with the aim of analyzing the role of rehabilitation of native architecture and mainly social groups with a high level of territorial dynamics in Catolinia. This issue is of particular importance because the introduced place of Empor Dant near Catalonia has a social and political position very similar to the center of Catalonia. This article discusses various methods in reclaiming and restoring different traditions in the new world with It has the benefit of contemporary techniques and it comes to the conclusion that social sciences can be the most important factor in rehabilitation to promote existing traditions and adapt them to modern architecture (Alcindor and Coq-Huelva, 2019: 2).

In 2020, Ataei Hamedani, in an article entitled Leaping of tradition through modernity in contemporary Chinese and Indian architecture, looked for the quality of the relationship between the concepts of tradition and modernism in Chinese and Indian architecture and concluded that the goal of an architect in designing is to create prosperity and Comfort is for people of every region and it doesn't matter which one can be used (Ataei Hamedani, 2020: 125).

3. Theoretical Foundations

3.1. Tradition and Modernism in the Context of Contemporary Iranian Architecture

The Naseri period is one of the most important cultural milestones in Iran (Saremi, 1995: 59). From the middle of the Qajar era, a fundamental change took place in the architecture of Iran, in

such a way that the source of inspiration, the structure of design ideas and architectural form, and subsequently, the materials and the method of building construction, became oriented towards the Western world and Iran's several thousand-year-old architectures was pushed back (Qabadian, 2013: 123). The approach to the West in the course of contemporary architecture is the fruit of a cultural approach, and the course of modern architecture in Iran is the result of the context that was created based on this approach and formed on its foundation. The collapse of the Ottoman Empire, the sending of Iranian students to Europe, the establishment of Dar al-Funun, the change of social customs and benefiting from the industrial achievements of the West and other achievements of the Western civilization was a solution that no one could ignore. Architecture and urban planning were exposed to substantive changes as a result of this cultural trend (Mokhtari-Taleghani, 2010: 235). Although the main point of changes in the contemporary architecture and urban planning of Iran was founded in the Qajar period, but the turning point of these changes and developments comprehensively came to the fore in the first Pahlavi period. In this period, the process of developments gained special momentum, so that the first Pahlavi period can be called as the founding period of modern architecture in Iran (Baman, 2012: 1).

The beginning of modern architecture in Iran (as the style of the school of architectural modernism) began in a relatively active way at the end of the first Pahlavi period. In fact, avoiding history and negating the use of historical and classical architectural signs and forms was an attitude that modern architecture in the West is part of the principles. The same thing that happened later in the contemporary architecture of Iran, and modern architecture tried to completely separate from the past and from the traditions in architecture (Kiani, 2012: 8). In the second Pahlavi period, under the influence of Western modern architecture is the dominant and influential current of modern architecture (Bani Massoud, 2013: 267) and its distinctive features, as in the past, are attention to the outside and adherence to a theory that promotes universality and standardization of the way of life, including architecture (Naghizadeh, 2000: 1987). The establishment of Tehran University is considered to be the beginning of the formation and establishment of the architecture education system in the country, and it has a strong influence on the transfer of Western art - modern art - this faculty is one of the most important institutions that was able to 1970 solar to cultivate the most expert and influential architects.

Parallel to the flow of modern architecture, between the 1960s and 1970s, modern architecture is formed with the trend of localism and historicism. In these decades, architects tried to create a kind of integration between modernism and tradition in architecture, so that the created space has an Iranian identity (Bani Masoud, 2012: 267). At this time, a number of prominent architects such as Hoshang Sihun, Nader Ardalan, Kamran Diba, Hossein Amanat, Koresh Farzami, Ali Sardar Afkhami and Gholamreza Farzanmehr designed important and valuable buildings in which these two completely different architectures were combined in an innovative and beautiful way. accepted. In this way, even before the postmodern architecture spread in the West and finally in other countries, a kind of modern Iranian architecture that paid attention to the civilization, culture and history of Iran grew in our country. In this period, the traditional forms and architecture of Iran's past were not used as ornaments for modern buildings, but the architect from the beginning of the design tried to integrate and display both aspects of the native culture of Iran and the global characteristics of the modern age in the physical body of the building. This article is contrary to the form of new buildings, which are either completely modern or completely traditional, or traditional designs are used as the design of modern buildings (Qabadian, 2007: 42-43).

After the victory of the Islamic revolution in Iran, the Iranian society faced comprehensive changes in all aspects of life, and religious traditions and values were emphasized. In architecture, it

changed under the influence of the ideas and works of the second Pahlavi period and the familiarity of architects with the postmodern movements of the nineties. In this way, the eight tendencies of architecture after the revolution - revival of the traditional architecture of Iran, vernacularism, tendency towards Western architectural styles, continuation of the topics of transcendental modern architecture, integration of concepts and elements of Iranian architecture with technology and modern architecture, tendency towards superior technology, the tendency towards neomodern architecture and computer architecture was formed (Hamze Nejad and Radmehr, 2016: 150), and the trend towards modern architecture and its integration with tradition continues.

3.2. Characteristics of Tradition in Architecture

Sunnah in Dehkhoda culture means way and method - method and law - rite - custom and institution - duty - obligatory - necessary - rules of religion and Sharia, mustahab (against duty) - the religion of the congregation (against Shia - Char Yari) and also against Heresy has come. According to Nazim-ul-Itabaa: "The so-called jurisprudence is what the Prophet and the Imams of Hoda, may God bless them, have acted upon, unless they have abandoned each other once or twice in their lifetime." In the opinion of Dr. Seyed Hossein Nasr: Sunnah emphasizes the aspect of continuity and transmission, and religion emphasizes revelation and receiving a message from a divine origin. On the other hand, both are essentially one reality. Tradition in Webster's culture means the non-written transmission of beliefs and customs from one generation to the next (Hujjat, 2013: 19-20). In terms of its lexical root, the word "Tradition" is related to transmission, and in its scope of meaning, it includes the concept of transmission of knowledge, customs, techniques, laws, templates and many other elements that have a written and written nature (Nasr, 2001: 135).

When the tradition in Iranian architecture is mentioned, it means the forms, combinations, routines and decorations that are accepted as characteristics of Iranian architecture and are always in important, large and designed buildings and especially It has been used in ritual and religious buildings and in addition to climatic, material, environmental or functional reasons, it also has a cultural aspect and has been noted as a feature, sign and in some cases a symbol (Soltanzadeh, 2004: 141).

The most important terms used in the definition of this architecture are: historical architecture, old architecture, authentic architecture, architecture with identity, insider architecture, meaningful architecture, native architecture and local architecture; By examining the common synonyms, it can be said that traditional architecture has four times: time, place, culture and meaning, and the three basic characteristics of this architecture can be: 1- Traditional architecture has patterns that are the crystallization of society's culture, in The length of time has been continued and transferred from hand to hand. 2-Traditional architecture is related to sacred matter and is a valuable and meaningful type of architecture. 3- Traditional architecture is the product of a traditional method in design and construction; Danst (Sadeghi Pi, 2018: 8).

Indicators indicate the most general, most important and main perceptions of an audience from the characteristics of an architecture and reveal the most important traits in the works of an architecture. The indicators are the alphabet of the space design in every architecture and are the basis and standard of cleanliness and separation of different architectures from each other. Although it is possible and perhaps obvious that each of the characteristics of an architecture is used in other architectures, but as a rule, the set of characteristics of each architecture should be able to distinguish it from other architectures. By carefully planning the buildings and its different levels in each architecture, one can get more characteristics of that architecture and in this way provide more precise means to distinguish it from other architectures (Haji Ghasemi, 2011: 8).

Table 1 Opinions of some experts regarding the characteristics of traditional Iranian Architecture (Source: Author)

Characteristics of Iranian architecture	Opinion
People-loving, self-sufficiency, avoiding futility, shyness and introversion (Hashemi, 1995, 3)	**Mohammad Karim Pirnia**
Climatic agreement, direction of establishment, sanctity and privacy, interior and exterior, introversion, spatial hierarchy, priority of Yazdani sense over the sense of beauty and goodness (same)	**Latif Abul Ghasemi**
Symbolic vision, environmental adaptation, exemplary model of Garden of Heaven, positive spatial systems, complementarity, human scale and social participation, innovation (Ibid.)	**Nader Ardalan**
Reflecting the ideas and values of the time with the help of visual size-geometric signs, the connection between the cosmic order and the earthly order, the centrality and having four sides of the earth, respect for light, the reflection of ideas and values in typology and architectural morphology, urban links (ibid.)	**Mohammad Amin Mirfendersky**
Legibility and ambiguity, connection with the system of creation with the help of geometry, introversion, complementary and coordinating role of decorations, obvious coordination of form and function, reflection of design lines on the structure, climatic compatibility, reflection of function in the spirit of the building, acceptance, mobility and Slippery and lightness, storytelling (the same)	**Yaqoob Daneshdoost**
Geometric diversity and richness, spatial and temporal hierarchy, human scale, adaptation to the environment, empathy with nature, unity in multiplicity (same)	**Darab Diba**
Inducing a sense of unity with the help of rhythm, repetition, order and geometry tools, the completeness of the part while playing a role in the whole, introversion and the difference between the interior and exterior space affected by the climate and respect for the nobility, the absence of excess of beauty in the function, the transcendence of the function from meeting normal needs (same)	**Hossein Sheikh Zainuddin**
Simplicity and clarity, balanced and proportionate and mutual and balanced combination of mass and space (same)	**Mahmoud Tavasli**
Application of coatings (same)	**Ali Akbar Sarmi**
Transparency (permanent movement from material quality to spiritual quality and as a result the reduction of matter and increase of space), noble humility through the horizontal stretching of the building, happiness resulting from a positive worldview (the same)	**Hadi dies**
The definition of space, either single or multiple, according to the degree of coverage or degree of enclosure, with how the floor, ceiling and wall are clearly realized, in the form of open, covered and closed spaces; The establishment of closed and covered space groups and walls around the open space through communication, connection, expansion, sequence, interference and continuity of space, fluidity and buoyancy of space, multi-valued spaces, mutual dependence of structure and spatial organization; architectural response to nature and climate; compliance of space with human movements and settlements; Light, perspective and direction. (same)	**Mohammadreza Haeri**
Inventing patterns of space components such as porches and domes; Inventing a four-evan plan as an evolution of the use of porches and domes, inventing and evolving four-sided, four-row, eight-heaven patterns, inventing decorations with brickwork, tiling, plastering, carving, and moqrans. (same)	**Hossein Sultanzadeh**
Centralization, centralization, symmetry in centripetal architecture, spatial classification, organization of movement in space, fluidity of space (Noghrekar, 2017, 604-612)	**Abdul Hamid silversmith**
privacy and seclusion (inward tendency, connection between inside and outside), crystalline order (purity and perfection of forms, central order, emphasis on axis and direction, symmetry, repetition), gem inside (geometry of applications), taropod Hidden (hidden geometry of Islamic buildings), soil and chemistry (materials of traditional Iranian architecture) and Naqsh Ajab (geometric and plant motifs), voice of love (color in Islamic architecture), kalk khayalangiz (presence of line in Islamic	**Kambyz Haji Qasmi and Kambyz Navaei**

architecture), in Golestan Khyal (design of open spaces). (Navaei and Haji Ghasemi, 2011)	
Interior architecture, architecture of courtyards, architecture of connecting open and closed spaces, architecture of semi-open spaces, architecture with full stories, architecture of order and neatness, architecture of dignity and moderation, architecture of openness and serenity, architecture of aimless space, architecture Easy and restrained, architecture of diversity and harmony, architecture of ceilings, architecture of sophistication and elegance, architecture of pattern and color, architecture of similarity of part and whole, architecture that fosters light, architecture of coexistence with water, architecture with lines, poetic architecture, architecture peace of mind (Haji Ghasemi, 2013).	**Cambyz Haji-Qasmi**

3.3. Features of Modernism in Architecture

The modern word Modernus was first coined by the Romans in the 6th century AD from the word Modo meaning "newly" and the word modernity was first used by "Baudelaire" in 1863 in an article about Constantin Guise titled "The Painter of Modern Life" (Jahanbeglu, 1995: 49-50). The term Modernism has been used as a symbol of new ideas and ways that have replaced traditional ideas and ways and has covered all aspects and fields of the individual and social life of Western man, especially the aspects related to religion, religious knowledge, art and beauty (Tavakoli Kazeruni et al., 2022). In its identification of modernism, the comprehensive culture of political science states that modernism or modernism is an attempt to harmonize traditional institutions with the progress of science and civilization, that modernism is the external manifestations of the new western civilization, and modernity is its internal intellectual, philosophical and cultural elements (Malleksabet and Sakenyandehkordi, 2022). And it has a series of basic concepts that are related to each other. Modernity is said to be an age in which man, as the subject of identification and in a way, turns the foundation of the whole world and man into his epistemic model and authority, in this human age, the basis of everything is placed at the service of mankind (Aghajari, 2010: 35). This historical period began after the cultural renaissance in post-medieval Europe (Ahmadian, 2010, 101). But before it is a historical event, it is a philosophical point of view; which was historically formed late in the 18th century and was institutionalized with the Enlightenment thought, modernity acts as self-organizing and transformative actions in different strata and sections of society, (Noor Alizadeh and Jahangard, 2022), and now it has migrated to non-European areas and environments and to Modernity is a process that by elevating science to the status of a myth, it came to benefit greatly from science as the only way to happiness and called for the downgrading of the two principles of "prudence and progress" of the transition from tradition (Behnam, 2013: 25). The intellectual project of modernism, in a general and philosophical sense, that is, the ideal of individual sovereignty over the individual and social life of man, in other words, the main element of the intellectual and philosophical project of modernism is rationalism (Haji Ghasemi, 2013).

4. Evolution of Modern Architecture - in relation to its Drivers and Foundations - can be Traced in Four Periods

4.1. The First Period - Birth of Modern Architectural Components

This era, which begins under the influence of the industrial revolution, the weakening of feudalism and the economic system based on landholding, the emergence of labor societies and the rapid development of cities, as well as the discovery of new construction facilities, is the era of the

dispersion of modern architectural components. Because its structural, economic and cultural aspects are evolving and forming separately (Agboola and Zango Modi, 2014)

In this stage, which began in the 1760s according to Benevolo, although modern architecture has not yet taken a cultural-philosophical form, it is not accompanied by the eclectic thoughts of the day. Thoughts that are the result of the dead end of European traditional architecture - aimless returns to the past and the chaos of architecture and have been approved by some philosophers:

"Hegel tries to solve the hierarchy of different styles through dialectics. He considers these schools as a series of thesis, anti-thesis and synthesis, and as a school of eclecticism, he calls it the result of the clash of different styles. "Knows it, recommends it" (Bani Masoud, 2013).

4.2. The Second Period - Assimilation of Components

This era, which begins about a century after the beginning of the first era, is the era of convergence and alignment of components that were formed due to various causes and factors during a century, and each of them carries a corner and facet of modern architecture. they do "After each of the components are clearly defined, the need to organize them with each other emerges. When this need is implemented in the form of a work program, modern architecture as a means to Making thought into action is born" (Bemanian, 2015).

The second era of modern architecture is the era of convergence of industrial architecture and socialist architecture and the era of rejection of retrogressive and aristocratic architectures.

It was during this period that the French Academy announced in a statement in 1846 that the imitation of old styles was false and artificial.

4.3. The Third Period - Emergence of the Modern School

This era, which begins shortly after the beginning of the 20th century, is an era when architects and architecture make up for their backwardness from the socio-philosophical and technological developments of the time, and a perfect harmony between thought and architectural structure emerges. Modern architecture takes an ideological form, and architectural statements range from the simplest - such as: "Decoration is a crime" by Adolf Loos and "the less, the better" by Mies Vander Rohe - to the most complex ones. Because the resolutions of Siam are published (Chakhrekh, 2004).

The architecture of this time understands the rationalist spirit of the 20th century and aligns itself with it. Benevolo considers this era as the stage of creating a bridge between theory and practice, and its date is 1919 AD, which is the year when Gropius opened the Weimar School. According to him: it is only at this time that we can talk about the modern movement in a special sense.

The establishment of the architecture school in Weimar meant that modern architecture found itself and became a modern school and has clear, definite and enforceable principles and rules that can - and should - be taught (Şerefhanoğlu Sözen and Gedik, 2007).

The great need for construction, after two world wars, gave modern architecture, which now claimed to be international, an opportunity to leave the motherland behind and spread throughout the world.

4.4. The Fourth Period - Collapse of the Modern School

When modern architecture named itself as a school and started compiling the dos and don'ts and demanded globalization; And when the goodness and badness of every work was measured by the standard of modern architecture and it was taught and imposed in architecture schools all over the

world - including Iran - as a definite and undisputed verdict, a new tradition was being formed. It was a tradition that had to be broken by the express decree of modernity, even though it has given itself the modern name.

At 3:32 p.m. on July 15, 1972, the Perth Ego residential complex in St. Louis, which was built based on Le Corbusier's idea (Machine for Life), was exploded with dynamite. A European tradition that was broken in America and then an American heresy (post-modern architecture), in pursuit of an illusory and brilliant identity and past, which of course did not last long (Tavakoli Kazeruni et al., 2022).

Just as the pre-modern era of eclecticism is given a philosophical face by philosophers such as Hegel and Moliere, the post-modern era, which first started with the rejection of modern dogma, is gradually put into a philosophical form; A format that considers the hard-earned unity and coherence of the modern school as narrow-minded, monopolistic and unipolar and demands a wide range of views and multi-polar thinking. We pay attention to the recommendations of this thinking from the language of "Michel Foucault": "Perform actions, thoughts and ideals by multiplying, combining and separating" and "collect what is positive, numerous and diverse". Prefer a form and what flows over stability and mobility arrangements to systems. Believe that what is productive does not remain stagnant and is always in motion" (Sadeghipi, 2018).

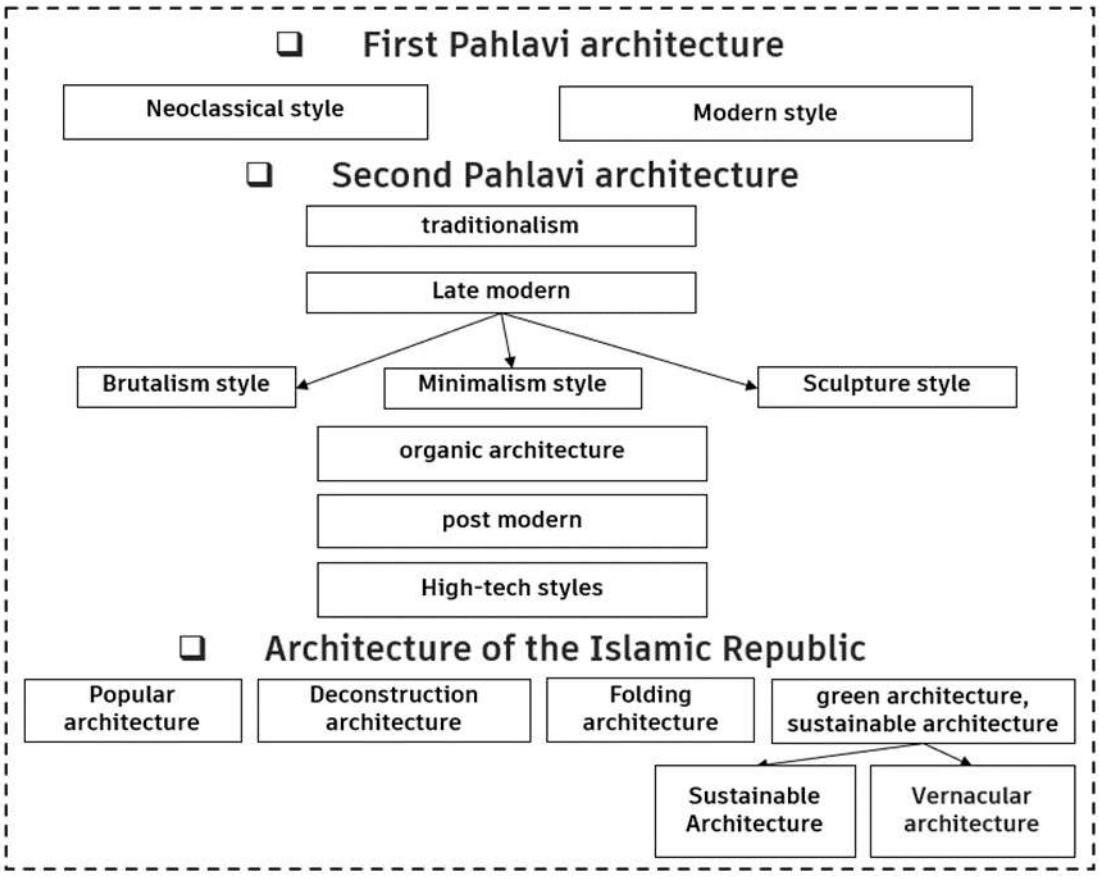


Fig 1 Architectural styles in contemporary Iranian architecture (Source: Author, 2024 adopted from Naghizadeh, 2019; Hojjat, 2013)

In this way, we are witnessing an eclecticism that is much wider, more equipped, more technical and more philosophical than the pre-modern eclecticism, and this time modern architecture is also playing alongside ancient architecture, classical architecture, Gothic architecture, oriental architecture, etc. Gird: Architecture of Modernity (Hojjat, 2013: 125-123).

The features of modern architecture that separate it from the ancient and traditional architecture are as follows:

Table 2 Characteristics of modern architecture from the perspective of foreign and Iranian thinkers

Characteristics of modern architecture		Theorist
Modern architecture was born with a change in the definition of architectural beauty. According to Peter Collins: ... all that is added to the Vitruvian Trinity - stability, efficiency and beauty - is that space is a positive architectural quality and this is the life word of modern architecture... (Jahanbeglu, 1995).		Peter Collins
Modern architecture is the architecture of breaking previous molds and frameworks. Refusal of the past as a source of inspiration for works of art and the use of technology in a pure way are among the topics of concern for modern architects.		Ernst Borden
Applying the industry with an aesthetic approach and expanding its facilities	Early modern	
Functionalism, paying attention to car aesthetics, urban issues, production and construction, etc.	Superior modern	
Getting rid of purely functional restrictions, expanding form-oriented features, dealing with symbolic analogies (Kamelnia, 2013: 82 and 83) and (Burden, 2002).	Late modern	
The language of modern architecture includes: the list of functions, non-perspective, anti-perspective, breaking the box, architectural structures; Membrane, sheath, space in time, building in the city (Kamelnia, 2013: 83).		Bruno Zoey
Removing decorations, completely abandoning history and historical elements, a plan free from the constraints of classical geometry, paying special attention to the function and function of the building, combining simple and pure geometric volumes such as cubes, cylinders and cones, etc., and finally building a building that can answer all Humans should be of different cultures and races (Saremi, 1995: 64).		Ali Akbar Sarmi
Renewing construction and design processes, rejecting traditional environments and following the principle of universality, following the same principles in construction, having a wise and practical order, using new materials of glass, concrete and steel, avoiding unnecessary decorations (Bani Masoud, 2012: 277).		Amir Bani Massoud
An end to historicist architecture and looking to the past, inventing new and emerging forms and emphasizing performance and compliance with new science and technology and observing geometric and mathematical proportions and optimism towards logical and scientific solutions (Qabadian, 2007: 178).		Vahid Qabadian
Modern architecture is based on innovation, depends on time and breaks the pattern. Philosophically, it is subject to modern thought and philosophy (modernity), benefits from advanced techniques and materials, and is constantly changing and evolving. Relying on new technologies, this architecture does not consider itself obliged to adapt to the conditions and use environmental resources and can be established in various environmental conditions. Modern architecture appears in the West as an original phenomenon and in other lands as an imported and alternative phenomenon (Hojjat, 2013: 104, 105, 108).		Isa Hojjat
Avoiding history, reduction based on the simplest elements, concentrating the spatial existence to the main core, uniformity of all components by reaching a simpler form, avoiding decorations and the use of even one unnecessary form, reaching forms to show the main function of the building, brevity, functionalism and extremes. in simplicity (Kiani, 2013: 160 and 161).		Mustafa Kayani

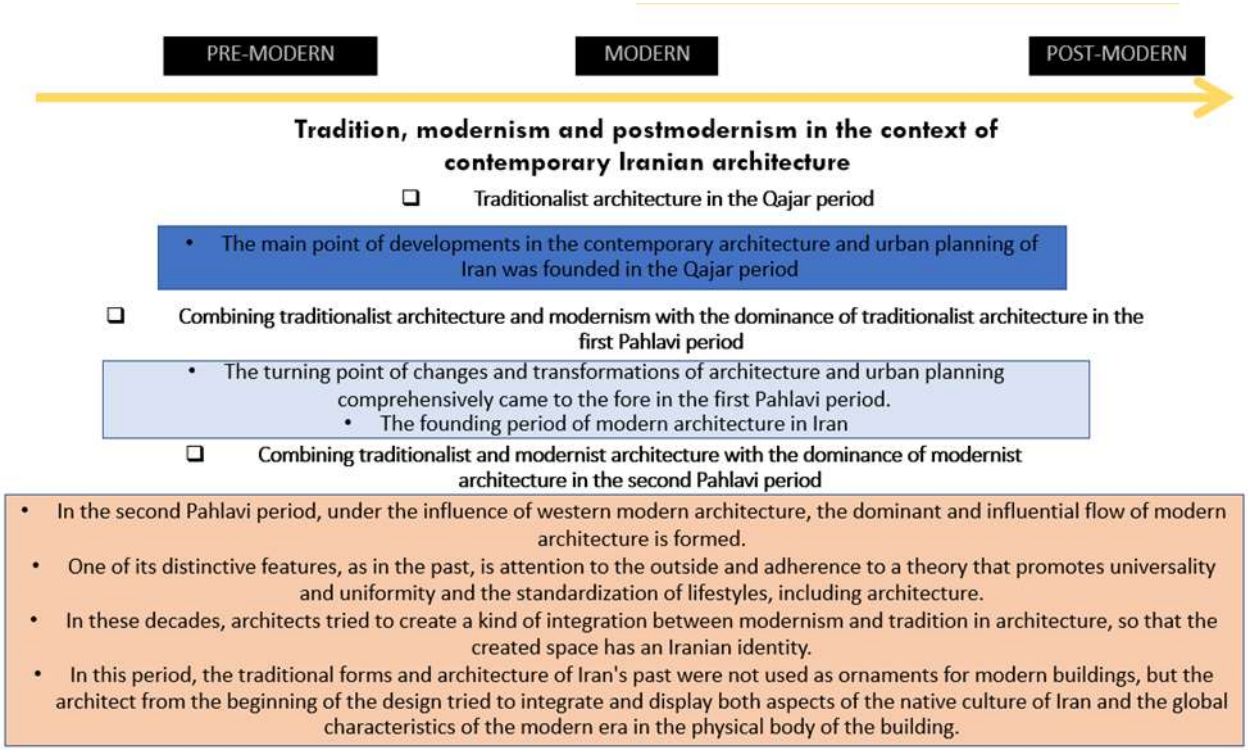


Fig 2 Contemporary architectural developments in Iran (Source: Author, 2024 adopted from Mozamiq, 2016)

5. Research Methodology

The present research method is fundamental-applied in terms of type, and in terms of the type of method, it has a nest-to-nest combination method. To answer the research questions, nest-to-nest research method of qualitative and quantitative type is used. After studying the theoretical foundations and research background, research variables are extracted. After extracting the variables and creating a conceptual framework, it is tried to refine the variables according to the studied samples. The first qualitative sampling of 30 experts who are completely familiar with the topic of tradition and modernism and their indicators in architecture as well as university buildings. Therefore, experts are first asked to confirm and then score the variables of tradition and modernism, and according to the obtained scores, the Kendall coefficient of each variable is calculated, and those whose values were less than 0.5 are eliminated due to non-compliance with the case samples. Then, in the quantitative stage, the variables of tradition and modernism obtained in the previous stage are compiled in the form of a questionnaire with a Likert scale and given to space users randomly. In quantitative sampling, based on the opinion of experts and the extracted variables, a closed questionnaire with five-point Likert answers was developed. The structure of the questionnaire includes questions related to the main question of the research; that is, to investigate the effect of each of the factors of tradition or modernism in university buildings of Tehran and in line with responding to it. In order to perform the calculations, a score of 5 for "very high impact" and a score of 1 for "very low impact" were considered by each expert. The sample size is considered as four clusters (20-30), (30-40), (40-50), (50-60). For more validation of the sample size, the upper limit of the Morgan table, which is 384 people, is used. To facilitate the analysis with inferential statistics, JMP software is used. Finally, based on the results, the correlation

between the variables was taken. The validity of the questionnaire using the CVI formula is 0.76 and the reliability using Cronbach's alpha is 0.75.

Conditions for entering the research	Number	Expert board
1- Aristocracy to tradition and modernism	10	Professors of architecture
2- Designing university buildings	8	Professors of landscape architecture
3- Academic faculty or with a doctorate degree	7	Urban design professors
4- aristocracy characterized by tradition and modernism	5	Urban planning professors
5- Aristocrats for future research Delphi	30	Total

6. Study Area

The range to be measured was selected by the board of experts in Tehran and the existing faculties in each national university. These universities have different campuses and faculties.

Table 3 Character of faculties of universities in Tehran

Number of faculties	Year of construction	city name	University name
10	1964	Tehran	Al-Zahra University
9	1978	Tehran	Tarbiat University of Shahid Rajaei
17	1981	Tehran	Tarbiat Modares University
24	1934	Tehran	University of Tehran
14	1918	Tehran	kharazmi University
5	1990	Tehran	Shahed University
19	1959	Tehran	Shahid Beheshti University
13	1984	Tehran	Allameh Tabatabaei University
15	1962	Tehran	Iran University of Science and Technology

7. Findings

7.1. Qualitative Findings

At this stage, the expert panel is asked to first study the variables extracted in theoretical bases and confirm if they are representative of tradition or modernism, then introduce the case examples of universities in Tehran and they are asked to the variables Give a score of 1 to 10 according to the presence or absence of the study area. In the next stage, the experts were dealt with as a separate panel and they were asked to rank the indicators selected by each panel. 50% of the experts were selected. Experts are asked to rate the agents on their board's edit lists; Average rank is calculated for each item. In each list, evaluation is done using W. Kendall and this continues until they reach a consensus and some of the variables of the first round are removed. The table below shows the calculated Kendall coefficient for each variable, as well as the excluded variables of the first round.

Table 4 Kendall coefficient of indicators of tradition and modernism

Characteristics of tradition							
W Kendall	Index	W Kendall	index	W Kendall	index	W Kendall	index
0.745	Introversion	0.431	Climate agreement	0.635	Avoiding futility	0.725	public relations
0.388	being complementary	0.769	Human Scale	0.521	Space systems	0.483	An exemplary model of the garden of paradise
0.456	Internal and external	0.582	Niaresh and introversion	0.573	self-sufficiency	0.611	Respect and privacy
0.631	Respect for the light	0.781	Link between components	0.477	Reflection of ideas	0.584	social participation
0.684	Environmental compliance	0.530	Symbolic insight	0.822	Spatial hierarchy	0.744	settlement
0.711	Coordination of form and function	0.873	Decoration coordinator	0.695	Link with the creation system	0.693	Readability and clarity
0.517	Geometric diversity and richness	0.506	storytelling	0.423	Slippery and lightness	0.599	Climatic adaptation
0.839	unity in diversity	0.617	Empathy with nature	0.582	adaptation to the environment	0.811	Spatial hierarchy
0.478	Application of coatings	0.726	Balanced composition	0.624	Simplicity and clarity	0.722	Repetition and order and geometry
0.298	Space buoyancy	0.492	Manifest realization of components	0.578	Horizontal elongation of the building	0.818	transparency
0.623	Create patterns	0.856	Conformity of structure and spatial organization	0.396	Fluidity and buoyancy of space	0.713	Interference and continuity of space
0.481	Spatial classification	0.901	Symmetry in architecture	0.730	pivoting	0.905	centralism
0.208	soil and chemistry	0.569	hidden geometry	0.296	Geometry of applications	0.623	privacy
0.542	Color in Islamic architecture	0.544	Design of open spaces	0.886	Geometric and plant motifs	0.655	Traditional architectural materials
0.619	Architecture with line	0.496	Living together with water	0.593	Diversity and harmony architecture	0.486	Connecting open spaces
Characteristics of modernism							
W Kendall	Index	W Kendall	index	W Kendall	index	W Kendall	index
0.120	Breaking the mold	0.308	Beauty	0.507	Performance	0.436	stationary
0.588	Development of form-oriented features	0.772	functionalism	0.688	Use of technology	0.749	Rejection of the past
0.673	Break the box	0.408	Anti-perspective	0.568	Inconvenience	0.326	Symbolic analogies
0.769	Formalism	0.314	Space in time	0.576	membrane	0.699	Tower structures
0.595	Simple volume combination	0.844	free plan	0.907	Remove decorations	0.592	"Honest" expression of materials and structures
0.671	Compliance with geometric proportions	0.543	Invent novel shapes	0.862	Use of new materials	0.516	Construction compliance
0.307	Focus on spatial entity	0.496	Uniformity of all components	0.617	Aversion to history	0.658	Beneficiary of techniques and materials
0.765	No decorations	0.713	transparency	0.326	Connection with nature	0.552	extroversion
0.564	Brutalism	0.788	Dumb element of building components	0.514	style	0.811	Statue-like building
0.539	Development of form-oriented features	0.218	time dependent	0.659	Simplicity	0.688	Honesty

According to the table a number of indicators were removed after talking with the expert panel, climate agreement, obvious realization of components, cohabitation with water, complementarity, internal and external, use of coatings and space buoyancy, spatial classification, soil and chemistry, were eliminated due to the low Kendall coefficient. From the modern indicators, static, symbolic analogies, connection with nature, beauty, anti-perspective, space in time, uniformity, all components, dependent on time, breaking molds, concentration in spatial existence are removed, the reason for removal is repeated by the expert panel. By other indicators in other concepts, the lack of existence in university buildings, the lack of understanding by spatial users have been mentioned.

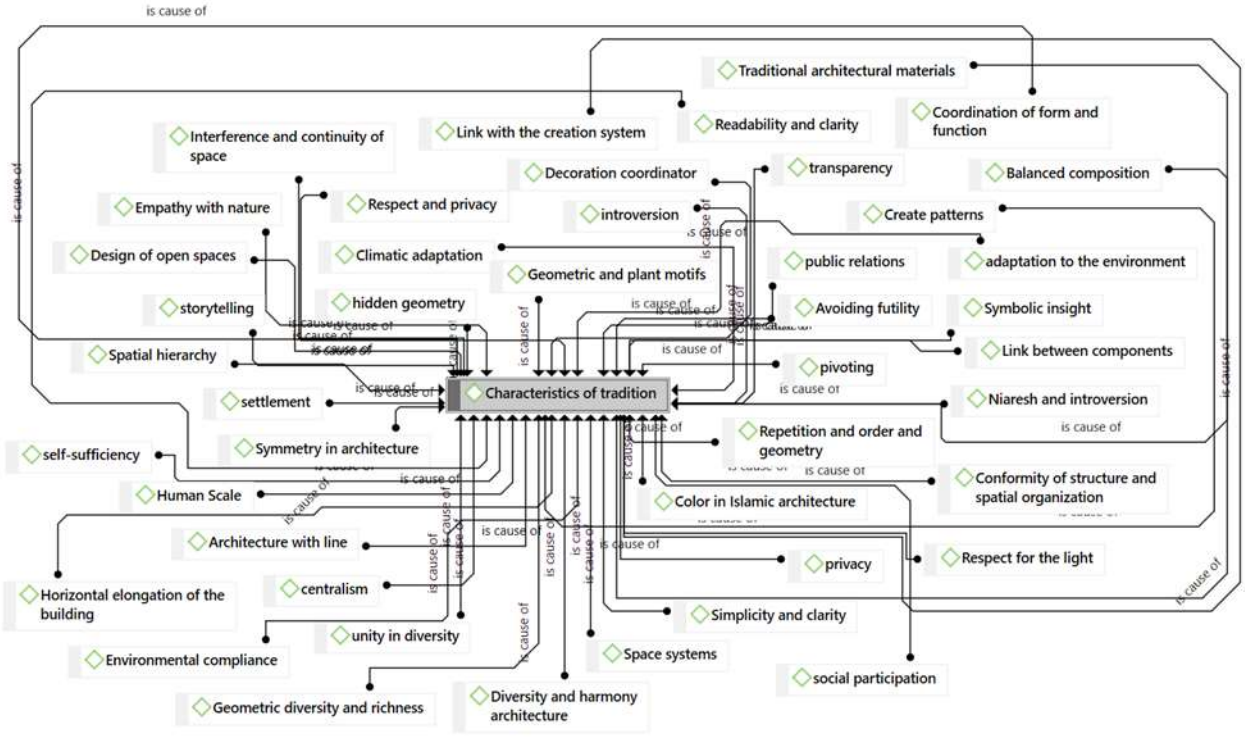


Fig 3 Finalized characteristics of tradition according to experts

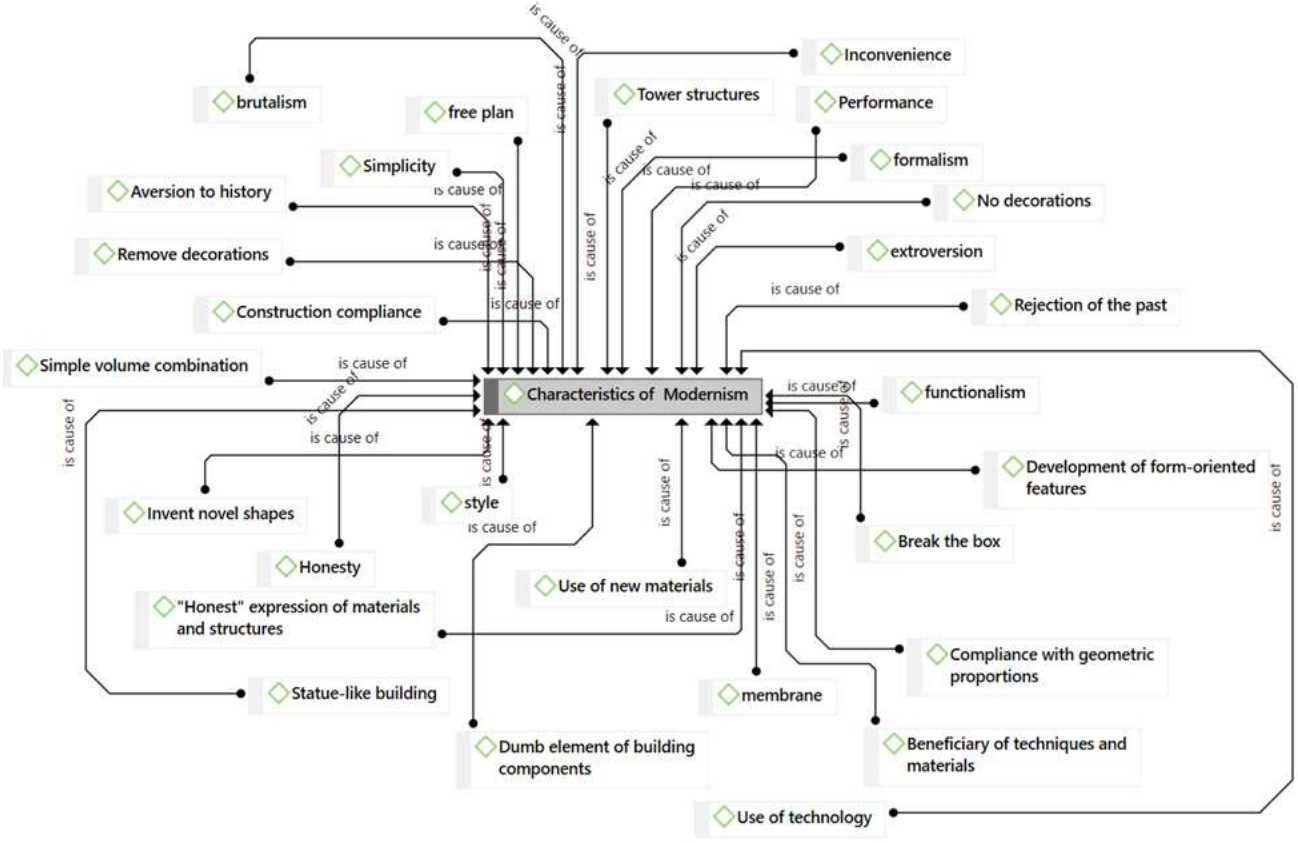


Fig 4 Finalized characteristics of modernism according to experts

7.2. Quantitative Findings

Descriptive statistics

In this section, one question has been formulated for each variable. The questions are closed with a Likert scale that has answers from very high to very low. To convert them in the JMP software, they are given a range of 1 to 5 points. It was found that in tradition, the most common feature of architecture for all age groups is variety and harmony, the least is related to the interference and continuity of space, in modernism, the use of new materials is the most and the innovation of novel forms is the least.

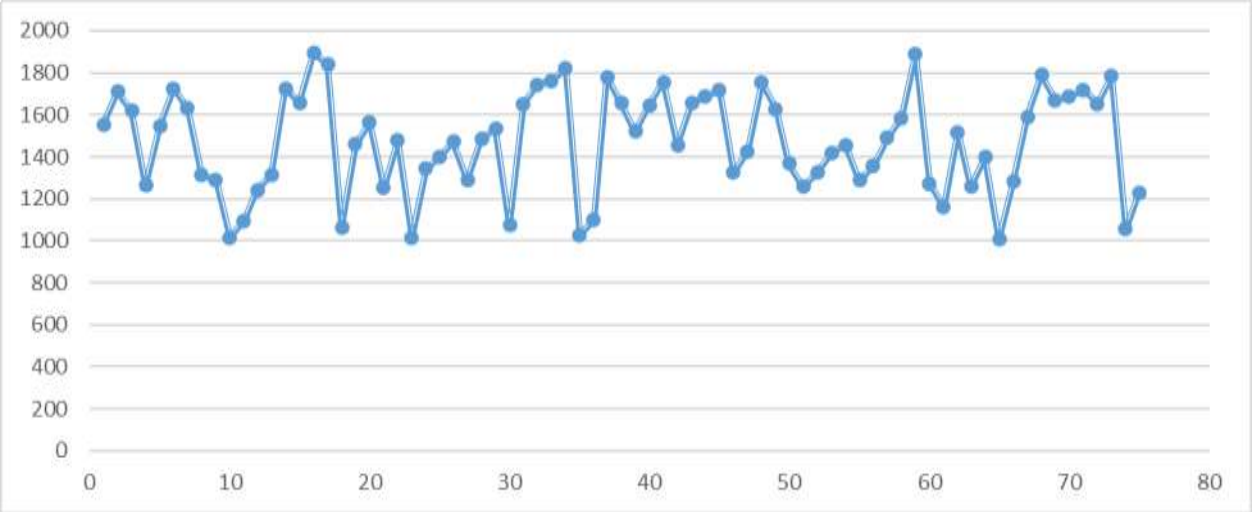


Fig 5 Frequency chart of tradition and modernism indicators for all age groups

Inferential statistics

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.

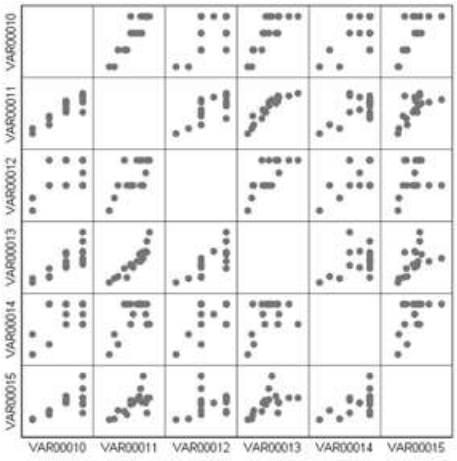


Fig 6 Correlation matrix diagram

According to the Table 5, obtained from the coefficients the indicators of tradition in all age groups, the following items were determined for the indicators of tradition:

20–30-year group:

In this group, social participation, symbolic vision, natural empathy, architecture with line has the highest coefficient of determination with a value of (1.000) and spatial hierarchy with a value of (0.246).

30–40-year group:

The highest coefficient of determination is related to the indicators of spatial hierarchy, symbolic insight, empathy with nature, inventing patterns, architecture with a line with a value of (1.000) and the lowest coefficient is related to adapting to the environment with a value of (0.254).

40–50-year group:

The highest factor contribution is derived from the coefficient of determination related to the symbolic insight component of empathy, empathy with nature, respect and privacy, balanced composition, inventing patterns and architecture along with the line with the value (1.000) and the lowest is related to the adaptation of the environment with the value (0.244).

50–60-year group:

The lowest coefficient of determination is related to the factor contribution of shyness and introversion with a value of (0.246) and the highest is related to the introversion of form and function coordination with a value of (1.000).

Table 5 Step-by-step regression of tradition indicators for different age groups

50-60 years				40-50 years				30-40 years				20-30 years				
t	β	F	The coefficient of determination	t	β	F	The coefficient of determination	t	β	F	The coefficient of determination	t	β	F	The coefficient of determination	Scale
571/44	0.741	342/411	0.645	571/44	0.741	342/411	0.710	522/46	0.781	222/527	0.752	451/39	0.762	217/314	0.867	people
365/31	0.429	446/444	0.788	365/31	0.429	446/444	1/000	152/42	0.732	122/405	0.920	328/44	0.372	147/523	0.895	Respect and privacy
255/31	0.623	752/985	0.913	255/31	0.623	752/985	0.714	223/40	0.662	343/217	0.803	823/36	0.872	381/852	1/000	social participation
479/58	0.685	223/211	0.514	479/58	0.685	223/211	0.883	239/38	0.648	943/199	0.746	362/39	0.685	921/298	0.625	To establish
982/21	0.621	773/225	0.749	982/21	0.621	773/225	0.619	958/8	0.664	612/201	0.681	958/18	0.597	257/247	0.612	Readability and clarity
134/11	0.652	681/653	0.656	134/11	0.652	681/653	0.836	134/11	0.662	623/643	0.816	644/16	0.436	321/644	0.656	Climatic adaptation
425/24	0.612	654/724	0.813	425/24	0.612	654/724	0.920	441/18	0.652	683/849	1/000	422/21	0.852	523/845	0.645	Spatial hierarchy
132/23	0.381	621/741	0.625	132/23	0.381	621/741	0.654	144/19	0.665	603/349	0.846	144/19	0.665	254/754	0.645	Repetition and order and geometry
121/48	0.484	325/512	0.715	121/48	0.484	325/512	0.625	173/49	0.483	945/184	0.814	231/39	0.213	541/124	0.715	Interference and continuity of space
963/47	0.464	748/276	0.806	963/47	0.464	748/276	0.546	963/47	0.464	748/276	0.546	914/29	0.425	241/232	0.514	centralism
348/33	0.372	752/985	0.315	564/43	0.421	125/302	0.881	226/46	0.452	943/199	0.795	221/24	0.414	321/201	0.795	privacy

735/402	741/77	321/12	256/11	219/18	398/91	218/54	452/47	425/24	134/11	982/21	479/58	255/31	365/31	571/44	342/13	421/22	325/29	524/44	
0.411	0.545	0.542	0.521	0.454	0.423	0.424	0.615	0.421	0.421	0.414	0.425	0.213	0.665	0.852	0.436	0.597	0.685	0.872	
159/411	420/865	425/154	175/431	256/369	219/511	667/216	309/215	214/475	222/461	421/131	425/154	175/431	325/512	621/741	654/724	681/653	773/225	223/211	
0.756	0.754	0.675	0.285	0.821	0.246	0.421	0.921	0.958	0.584	0.752	0.919	0.583	0.345	0.518	0.842	0.755	0.792	0.756	
811/26	725/28	310/39	542/20	458/36	458/13	807/16	214/32	698/29	566/48	581/48	839/28	324/23	341/32	354/18	552/22	216/22	214/15	448/49	
0.919	0.361	0.518	0.603	0.517	0.301	0.202	0.456	0.574	0.542	0.628	0.679	0.529	0.223	0.425	0.325	0.311	0.124	0.631	
104/204	415/245	211/305	219/523	415/161	405/121	125/423	235/456	317/645	382/752	312/520	210/521	937/621	695/325	371/458	214/315	258/149	125/521	034/519	
1/000	0.635	0.365	1/000	0.311	0.701	0.325	0.418	0.745	0.756	0.654	0.452	0.244	0.882	0.275	0.368	0.540	0.745	0.265	
852/21	728/25	325/29	564/24	458/36	458/36	897/16	231/12	658/23	566/48	587/44	879/24	694/19	321/58	356/21	552/41	256/45	288/25	229/47	
0.823	0.562	0.619	0.607	0.517	0.517	0.309	0.411	0.545	0.542	0.521	0.589	0.421	0.411	0.401	0.452	0.661	0.472	0.463	
112/114	475/245	214/475	211/568	415/161	415/161	325/411	115/421	301/699	382/752	362/214	960/542	987/650	658/471	371/492	564/321	258/147	034/523	034/499	
0.984	0.825	0.285	1/000	0.311	0.811	0.315	0.831	0.645	0.756	0.781	0.455	0.254	0.745	0.331	0.462	0.978	0.895	0.243	
342/13	421/22	325/29	524/44	348/33	418/43	861/287	131/22	618/25	566/48	586/31	825/21	324/29	351/58	326/25	517/49	254/65	288/25	248/48	
0.902	0.162	0.619	0.524	0.522	0.521	0.221	0.654	0.541	0.542	0.514	0.578	0.341	0.454	0.423	0.424	0.615	0.421	0.421	
667/216	309/215	214/475	222/461	421/131	425/154	175/431	167/428	321/514	382/752	654/218	920/581	991/621	541/321	211/441	412/323	265/229	134/522	124/443	
1/000	0.963	0.275	1/000	0.331	0.727	0.265	0.874	0.661	0.756	0.754	0.675	0.285	0.821	0.246	0.421	0.921	0.958	0.323	
Empathy with nature	storytelling	Decoration coordinator	Symbolic insight	Link between components	Niarash and introversion	Human Scale	Diversity and harmony architecture	Geometric and plant motifs	pivoting	Horizontal elongation of the building	Simplicity and clarity	adaptation to the environment	Link with the creation system	Spatial hierarchy	self-sufficiency	Space systems	Avoiding futility	Traditional architectural materials	

458/36	0.309	633/572	0.661	231/23	0.765	221/324	1/000	555/35	0.451	243/582	1/000	525/45	0.532	219/511	0.624	Balanced composition
542/20	0.517	485/152	0.874	128/21	0.338	213/520	0.658	126/28	0.628	284/714	0.590	163/28	0.852	256/369	0.646	Conformity of structure and spatial organization
310/39	0.517	117/525	0.265	821/65	0.716	272/122	0.266	878/34	0.745	542/215	0.369	811/30	0.725	544/219	0.262	Symmetry in architecture
725/28	0.607	252/731	0.727	316/55	0.985	420/839	0.726	211/81	0.923	411/825	0.662	011/31	0.911	420/865	0.735	hidden geometry
811/26	0.619	781/37	0.331	411/43	0.326	121/241	0.852	452/47	0.147	159/411	0.860	452/47	0.147	159/411	0.881	Design of open spaces
231/23	0.562	312/652	1/000	321/44	0.218	612/542	0.681	111/24	0.235	653/414	0.793	218/54	0.436	633/572	0.843	introversion
128/21	0.823	234/746	0.275	331/69	0.224	421/215	0.921	326/63	0.211	444/185	0.781	398/91	0.274	485/152	0.982	Respect for the light
458/36	0.451	252/731	0.963	181/32	0.812	234/746	0.425	881/26	0.744	136/981	0.309	219/18	0.688	117/525	0.274	Environmental compliance
542/20	0.628	342/124	1/000	256/11	0.821	252/731	0.374	256/11	0.821	252/731	0.374	256/11	0.821	252/731	0.374	Coordination of form and function
310/39	0.793	841/372	0.624	214/32	0.807	342/124	0.316	856/42	0.947	781/882	0.621	321/12	0.835	781/37	0.842	Geometric diversity and richness
458/36	0.781	309/564	0.646	345/24	0.213	841/372	0.983	381/82	0.851	848/682	0.831	741/77	0.625	312/652	0.745	unity in diversity
564/24	0.309	602/175	0.262	821/769	0.521	309/564	1/000	894/174	0.409	188/660	1/000	735/402	0.308	218/935	0.819	Creating patterns
325/29	0.624	222/461	0.735	574/31	0.857	602/175	0.256	879/28	0.789	660/544	0.435	852/36	0.856	720/524	0.435	Color in Islamic architecture
728/25	0.646	214/475	0.881	717/65	0.842	801/520	1/000	517/40	0.842	662/224	1/000	508/37	0.932	622/856	1/000	Architecture with line

According to Table, in which the coefficient of determination for the indicators of modernism is mentioned, the following items were identified in different age groups:

20–30-year group:

The lowest coefficient of determination is related to tower structures with a value of (0.354). And the highest coefficient of determination is related to the index of compliance of hardware and construction, removal of decorations, observance of geometric proportions and development of form-oriented features (1.000).

30–40-year group:

The highest coefficient of determination is related to extroversion, removal of decorations, compliance with geometric proportions and lack of decorations with a value of (1.000) and the lowest is related to the membrane index with a value of (0.355).

40–50-year group:

The coefficient of determination is related to rarity (0.388) and the largest factor contribution is derived from the coefficient of determination related to the removal of decorations and compliance with geometric proportions with the value of (1.000).

50–60-year group:

The highest coefficient of determination is related to the removal of decorations and the absence of decorations with a value of (1.000) and the lowest factor contribution is derived from the coefficient of determination related to date avoidance with a value of (0.417).

Table 6 Step by step regression of modernism indicators for different age groups

50-60 years				40-50 years				30-40 years				20-30 years				
t	β	F	The coefficient of determination	t	β	F	The coefficient of determination	t	β	F	The coefficient of determination	t	β	F	The coefficient of determination	Scale
571/44	0.845	366/520	0.755	581/54	0.265	175/431	0.855	231/12	0.665	245/627	0.672	852/58	0.662	501/318	0.757	Rejection of the past
365/31	0.653	639/621	0.955	855/33	0.727	425/154	0.796	897/16	0.483	255/428	0.820	686/69	0.406	801/544	0.354	Tower structures
255/31	0.211	981/919	0.714	255/31	0.331	421/131	0.511	458/36	0.464	383/527	0.789	886/52	0.355	857/369	0.659	"Honest" expression of materials and structures
479/58	0.395	183/532	0.844	479/58	0.255	222/461	0.804	458/36	0.452	911/259	0.658	586/55	0.646	506/710	1/000	Construction compliance
982/21	0.211	425/186	0.744	944/61	0.275	214/475	0.684	564/24	0.463	564/243	0.815	321/83	0.262	289/658	0.974	Beneficiary of techniques and materials
134/11	0.251	441/139	0.511	956/15	0.963	309/215	0.711	325/29	0.472	611/621	1/000	681/16	0.735	526/689	0.711	extroversion
425/24	0.511	288/458	0.920	712/65	0.588	667/216	0.811	728/25	0.661	619/872	0.895	411/59	0.881	314/278	0.569	Statue-like building
132/23	0.284	239/488	0.529	632/84	0.624	219/511	0.784	852/21	0.452	652/349	0.756	106/12	0.843	586/784	0.724	Honesty
121/48	0.326	369/225	0.855	141/89	0.646	175/431	0.684	555/35	0.401	941/285	0.723	296/42	0.982	695/174	0.882	Performance
963/47	0.745	614/255	0.873	923/63	0.266	425/154	0.688	126/28	0.414	763/786	0.745	854/53	0.274	261/824	0.514	Use of technology
0.421	0.699	349/214	0.755	544/14	0.735	125/302	0.388	878/34	0.421	943/153	0.795	581/74	0.374	316/512	0.823	Inconvenience
0.246	0.452	698/215	0.866	488/21	0.881	125/423	0.711	288/92	0.421	624/485	0.355	228/55	0.921	255/984	0.676	membrane
0.821	0.523	214/365	1/000	232/45	0.865	405/121	1/000	538/55	0.615	034/574	1/000	518/39	0.421	250/518	1/000	Remove decorations

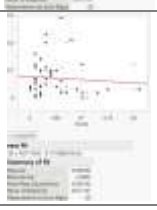
0.285	0.842	789/522	0.972	286/52	0.727	415/161	0.614	276/86	0.424	838/569	0.913	364/41	0.246	211/159	0.883	Use of new materials
0.675	0.623	632/741	0.417	522/22	0.331	219/523	0.789	554/44	0.423	864/921	0.522	526/58	0.821	588/453	0.823	Aversion to history
0.754	0.714	965/745	0.533	323/16	0.425	211/305	0.455	346/22	0.454	351/582	0.685	258/62	0.285	255/439	0.607	style
0.756	0.849	856/254	0.695	312/38	0.823	415/245	0.653	321/86	0.521	658/447	0.695	322/37	0.675	565/325	0.518	Simplicity
0.661	0.652	751/359	0.981	388/63	0.662	104/204	0.735	564/18	0.414	958/683	0.356	324/29	0.754	551/825	0.685	functionalism
0.874	0.912	526/852	0.872	839/25	0.406	221/324	0.658	823/18	0.421	620/875	0.425	825/21	0.921	133/746	0.575	free plan
0.421	0.853	126/752	0.932	581/21	0.355	381/584	0.589	562/14	0.421	362/325	0.706	586/31	0.421	655/145	0.874	Invent novel shapes
0.246	0.358	635/157	0.836	456/69	0.646	388/858	0.754	566/48	0.615	382/742	0.723	566/48	0.246	325/659	0.756	transparency
0.821	0.751	365/415	0.942	652/31	0.262	388/644	0.684	858/23	0.424	325/675	0.689	618/25	0.524	333/544	0.581	Dumb element of elements
0.511	0.695	654/892	0.711	256/14	0.693	244/486	0.722	231/39	0.213	185/481	0.951	131/22	0.688	154/448	0.914	Development of form-oriented features
0.804	0.215	214/611	0.855	854/41	0.522	175/424	0.736	877/57	0.425	365/251	0.869	522/27	0.295	183/532	0.573	Break the box
0.684	0.623	358/851	0.746	413/23	0.365	424/210	0.758	458/63	0.414	469/815	0.661	652/85	0.855	425/186	0.747	formalism
0.711	0.214	248/621	0.875	459/76	0.652	422/178	1/000	458/41	0.421	742/251	0.581	901/56	0.742	441/139	0.581	Simple volume combination
0.312	0.975	511/321	0.863	545/24	0.625	226/544	0.792	985/52	0.421	223/541	1/000	501/88	0.922	288/458	1/000	Compliance with geometric proportions
0.214	0.325	741/259	1/000	314/79	0.516	269/375	0.698	325/84	0.615	219/852	1/000	312/20	0.629	239/488	0.814	No decorations
0.742	0.145	654/987	0.715	728/18	0.352	495/248	0.857	722/25	0.424	575/249	0.511	421/62	0.252	369/225	0.403	bruthalcium
0.752	0.147	328/146	0.706	812/25	0.745	106/225	0.399	882/45	0.423	154/254	0.542	042/13	0.982	614/255	1/000	Development of form-oriented features

After explaining the factor contribution of each of the indicators, it was found that there was a correlation between the space users of the age groups of 20-30 years and 30-40 years with a value of r2=0.78 and the target community of one can explain the other to a large extent. So, to check one age group, it can cover another age group. Among the age groups of 20-30 and 30-40, the correlation drops to an incredible extent and its value reaches r2=0.0004, which can almost be said that they do not fully explain each other's behavior and behave differently than have each other In

the age groups of 20-30 and 50-60, the correlation value is low and is around r2=0.008. In the age group of 30-40 and 40-50, the correlation value is low and is r2=0.003. In the age group of 30-40 and 50-60, the value of correlations has also increased slightly and reached r2=0.02. But the correlation between the indices of tradition and modernism obtained in the age groups of 40-50 and 60-50 is high and r2=0.73. According to the fit obtained from the step-by-step regression model of age groups, due to the increase in data, only age groups (50-60 and 50-40) and (20-30 and 40-30) can predict each other. In general, in relation to responding to the perception of the characteristics of tradition and modernism in different age groups, the following correlations are in order;

(20-30 and 30-40)> (50-60 and 40-50) > (40-30 and 60-50)> (50-40 and 40-30) > (30-20 and 40-50)

Table 7 Fit between the components of tradition and modernism in different age groups

40-50	30-40	20-30	
			**30-40**
			**40-50**
			**50-60**

8. Discussion

The important point in these results is that considering that in the age groups of 30-40 years and 40-50 years, the maximum and minimum indices correspond to each other, but there seems to be a very low correlation in the mentioned age groups. So, in the study and designs related to tradition and modernism, the target population should be divided into age groups of 20-40 years, 40-60 years, and 60 years and above. Due to the higher average coefficients obtained from the indicators of modernism, it can be concluded that users The space of their perception is more than the indicators of modernism and they have been able to communicate with these indicators in a more concrete way, which does not change with age and increases a bit more. Also, the index of removing decorations in all age groups has the same coefficient. But in the age groups of 20 to 30 years, the most attention is related to various spaces that have the presence of people and many details along with traditional signs and modernism in simple forms that are combined with each other and lacks decorations. It is known that the same thing exists in the age groups of 30 to 40 years, but most of the patterns that arise from balanced combinations in volumes without decorations play a greater role in the association of modernism and tradition at the same time. In the age group of 40 to 50 years, most of the characteristics of tradition and modernism overlap with

most of the previous age groups, but there is a significant difference in other components, which designers need to consider in their development and design planning projects. Taking the age groups of 50 to 60 years, a balance can be observed between the maximum indicators in the number of components of tradition and modernism. But in general, this age group can be predicted due to its less availability in the society with the previous age group, and it is suggested that the following age groups be evaluated as well.

It is suggested that the following age groups are also evaluated.

9. Conclusion

Iran's architecture and urban planning, with its several thousand years of history, suddenly suffered an interruption during the Qajar era. The emergence of western academic education, the existence of various advisors for the training of different departments, new materials and new manufacturing technologies were the things that were very influential in the formation of this matter. University buildings in the city of Tehran can coincide with these developments from time to time and buildings derived from the presence of modernism and its beginnings, which were designed for specific cultural groups. In the current era, despite the phenomenon of time and the high speed of developments in the age of communication, it seemed that the way people look changes with the passage of time in relation to the perceptual indicators of tradition and modernism. This research showed that the age groups of 20 to 40 years and 40 to 60 years think in the same way, and changes in the perceptual norm for the indicators of tradition and modernism happen every 20 years. According to the results of the research, many of the indicators that induce tradition in the past do not have these meanings and change. Physical characteristics are more important at younger ages and gradually decrease at older ages and spatial characteristics take their place. In general, it is suggested to use the following strategies to design collections that all age groups benefit from and that require the simultaneity of tradition and modernism;

- Research and investigation on local patterns showing the simultaneity of tradition and modernism for all age groups
- Conducting unstructured interviews of different age groups to find commonalities and differences regarding the way of looking at the body and... space
- Using national elements in the form of branding patterns for the design of components of different places to familiarize and assimilate all age groups
- Paying attention to the visual elements of tradition and using them in the body of the building and associating them with modern technology and materials
- Applying all indicators with high factor load as a result of this research in the designs depicting tradition and modernism.

References

Aghajari, H. (2010). Dialogue of Tradition and Modernity. *Reflection of Thought, 17*, 35-44.

Agboola, O., & Zango Modi, S. (2014). Development of Traditional Architecture in Nigeria: A Case Study of the Structure of Hausa house form. *International Journal of African Society Cultures and Traditions, 1*(1), 61-74.

Ahmadian, Q., & Nouri, M. (2010). Modernity is the place of conflicting opinions. *Political Studies, 9*, 127-99.

Akrami, G. (2004). Tradition, Art, Architecture. *Soffeh* Journal, 14(1-2).

Alaghemand, S., Salehi, S., & Farhang M. (2016). Comparative study of architecture and content of Iranian schools from traditional to modern period. *Bagh Nazar* Journal, 49, 5-18.

Alcindor, M., & Coq-Huelva, D. (2019). Refurbishment, vernacular architecture and invented traditions: the case of the Empordanet (Catalonia). *International Journal of Heritage Studies*, 1-16.

Ataei Hamedani, M. (2020). The manifestation of Chinese traditions in contemporary architecture. *Armanshahr Journal, 11*(25), 1-11.

Bayoumi, M. (2017). Nubian Vernacular architecture & contemporary Aswan buildings' enhancement. *Alexandria Engineering Journal, 57*(2), 875-883.

Baman, Z. (2012). *Modernity and Modernism: A Collection of Essays on Politics, Culture and Social Theory*. Hossein Ali Nozari, 3rd edition, Tehran: Naqshjahan.

Bani Masoud, A. (2013). *Iran's Contemporary Architecture in Struggle between Tradition and Modernity*. 5th edition, Tehran: Century Architecture Publishing House.

Bani Masoud, A. (2012). *Western architecture, its roots and concepts*. Fifth edition, Tehran: Century Architecture Publishing House.

Bani Masoud, A. (2013). *Postmodernity and Architecture*. 3rd edition, Isfahan: Khak Publishing.

Baseti, S. (2017). The relation between tradition and modernism in formation of urban fabric with emphasis on cultural dimensions; case study: Birjand city. *Urban Management Journal, 17*(51), 55-73.

Behnam, J. (2013). A look at sixty years of education system in Iran. *Cultural and Social Quarterly of Dialogue*, No. 5.

Bemanian, M. (2015). Factors Affecting the Formation of Architecture and Urban Planning in the First Pahlavi Period. *Modares Honar Quarterly*, No. 1.

Burden, E. (2002). *Burden Illustrated Dictionary of Architecture*.

Chakhrekh, S. (2004). *Transition from Modernity (Nietzsche, Foucault, Lyotard, Derrida)*. Tehran: Age.

Haji Ghasemi, K. (2013). Indicators of Islamic Architecture of Iran. *Soffeh Journal*, (58).

Hamzenejad, M., & Radmehr, M. (2016). Analysis of spatial principles and optimal model selection in contemporary model-oriented architecture of Iran, case study: the country's cultural heritage organization, Hossein Amanat. *Two scientific-research quarterly journals of Iranian architectural* studies, 6(11).

Hashemi, S. R. (1995). Architecture and Culture. *Abadi Journal, 5*(19).

Hojjat, I. (2013). *Tradition and heresy in architectural education*. Tehran: Tehran University Press. Second edition.

Jahanbeglu, R. (1995). Modernity: From Concept to Reality. *Conversation, 10*, 49-55.

Kamelnia, H., & Mahdovinejad, M. J. (2013). *Familiarity with contemporary architecture from east to west, examining its foundations, concepts and roots*. Tehran: Alam Memar Institute.

Kiani, M. (2003). Iran's contemporary architecture and the modern school. *Architecture and Culture*, (15 and 16).

Majdi, H., & Soheili, J. (2010). Emergence of modernism in Turkish architecture and confrontation with national architectural movements. *Hoviyat Shahr Journal, 9*, 49-58.

Malleksabet, F., & Sakenyandehkordi, M. (2022). Design of Iranian-Islamic Postmodernism Mantle Using Nanomaterials, *International Journal of Applied Arts Studies, 7*(2), 65-72.

Mannan, R. (2019). *Museum of Islamic Art in Qatar by IM Pei: Tradition and Modern Development in Islamic Architecture*. 2019 NCUR.

Mokhtari Taleghani, E. (2010). *The Heritage of Modern Iranian Architecture*. Tehran: Cultural Research Office.

Mozamiq, S., Salehi, S., & Farhang M. (2016). Comparative study of the architecture and content of Iranian schools from the traditional to the modern period. *Bagh Nazar Journal, 49*, 5-18.

Naghizadeh, M. (2000). The relationship between the identity of "Iranian architectural tradition" and "modernism" and "modernity". *Scientific-Research Quarterly of Fine Arts Journal, 7*.

Nasr, S. H., & Aram, A. (1980). *Science and Civilization in Islam*. Tehran, Khawrazmi.

Navaei, K., & Haji Ghasemi, K. (2011). *Clay and imagination, a description of Islamic architecture in Iran*, Soroush Publications.

Noghrekar, A. H. (2017). *An Introduction to Islamic Identity in Architecture and Urban Planning*. Tehran: Payam Sima Design and Publishing Company: Ministry of Housing and Urban Development, Bureau of Architecture and Urban Design.

Noor Alizadeh, H., & Jahangard, A. (2022). Analysis of Published Critiques in Sukhan Monthly Magazine on the Subject of Paintings and their Effect on Iran's Modern Painting Flow from 1943 to 1959. *International Journal of Applied Arts Studies, 7*(1), 65-82.

Parsaee, M., Motealleh, P., & Parva, M. (2017). Research on the Former British Consulate as the first example of modern architecture in Iran. *HBRC Journal, 13*(1), 61-71.

Pourahmad, A., Azimi, A., Molaei Amin, F., & Ayyub, M. (2011). The Effect of Modernism on the Spatial-Physical Development of Iranian-Islamic Cities (The Example of Tehran). *Studies of the Islamic Iranian city Journal, 2*(6), 47-61.

Pourmand, H. A., & Khazaei, M. (2014). The Manifestation of Tradition in Today's Architecture. *Two Quarterly Journals of Islamic Art Studies, 2*.

Qobadian, V. (2013). Modern Iranian Architecture. *Architecture and Culture Journal*, (18 and 19).

Qobadian, V. (2007). *Basics and Concepts in Contemporary Western Architecture*. 7th edition, Tehran: Cultural Research Office.

Rezaei, N., & Hanachi, P. (2015). Oudlajan Neighborhood, An Urban Heritage between Tradition and Modernity. *Journal of Iranian Architectural Studies*, (7), 19-34.

Sadeghipi, N. (2018). A reflection on traditional architecture. *Soffeh scientific-research quarterly Journal, 48*.

Saremi, A. A. (1995). Modernity and its implications in Iran's architecture and urban planning. *Conversation Quarterly Journal, 10*.

Shahbazi, M., Yeganeh, M., & Bemanian, M. R. (2019). Meta-analysis of environmental vitality factors in open spaces. *Quarterly Journal of Urban Studies, 9*(34), 61-76. doi: 10.34785/J011.2021.812

Şerefhanoğlu Sözen, M., & Gedik, G. Z. (2007). Evaluation of traditional architecture in terms of building physics: Old Diyarbakír houses. *Building and Environment Journal, 42*(4), 1810-1816.

Soltanzadeh, H. (2004). Reflection of tradition in the architecture of contemporary mosques (Tehran). *Architecture and Culture Journal, 20*, 141-146.

Tavakoli Kazeruni, M., Noshadi, B., Daneshvar, F., & Fatemi, S. A. (2022). Sustainable Architecture in Traditional Houses of Kashan. *International Journal of Applied Arts Studies*, *8*(2), 71-86.

Xiaoxin, Z., & Kelly, G. (2019). From ‘neo-vernacular’ to ‘semi-vernacular’: a case study of vernacular architecture representation and adaptation in rural Chinese village revitalization. *International Journal of Heritage Studies, 25*(11), 1128-1147.

Yousef, A., & Al Haroun, M. (2019). Perceptions of the Courtyard in Kuwait: Between Tradition and Modernity. *Journal of Arabian Studies, 9*(2), 182 208.

Available online at www.ijapas.ir

IJAPAS International Journal of Applied Arts Studies

International Journal of Applied Arts Studies

IJAPAS 9(3) (2024) 35–56

The Effect of the Shape of Curved Ceilings on Sound Quality, Sunlight, and Heat Absorption in Lecture Halls

Fereshteh Kamrani[a], Mansour Yeganeh[b]*, Mohammad Reza Bemanian[c]

[a]*Department of Architecture, Shahrekord Branch, Islamic Azad University, Shahrekord, Iran*
[b]*Associate Professor, Department of Architecture, Faculty of Art and Architecture, Tarbiat Modares University, Tehran, Iran*
[c]*Professor, Department of Architectural Engineering, Faculty of Art and Architecture, Tarbiat Modares University, Tehran, Iran*

Received 22 February 2024; revised 29 June 2024; accepted 02 September 2024

Research Article

Abstract

Architects' most essential design concern from the past to the present is the geometry of the ceiling form. By analyzing the geometry of various curved ceiling forms, one can find a suitable form in terms of heat absorption, sunlight, and sound quality. The geometry of the form is directly affected by the amount of volume, surface area (ratio of span ratio to height), and the equation of fit of its curve. This study examines the types of curved ceilings based on form geometry in terms of sound quality and sunlight. The main question is what effect does the geometry of the curved ceiling types have on sound quality, amount of sunlight, and heat absorption? The present study investigates Reverberation time, speech transfer index, speech clarity, amount of sunlight, and shading of the speech space in different arcs based on the equations of curve fitting and body shape. Each selected sample is drawn algorithmically in Grasshopper and using Odeon for acoustic simulation and Grasshopper to simulate the absorption of radiant energy of sunlight and the amount of shading and using the Energy Plus, Ladybug plugin. Descriptive analysis of forms with scatter matrix diagram and correlation coefficient analysis between architectural, acoustic, and sunlight variables were performed by Pearson method with SPSS22. The analysis shows that by increasing the amount of area, volume and slope of the curve, it reduces the quality of reverberation time and the speech transmission index, and increases the amount of shade performance, sunlight and shade absorption.

* Corresponding author. Tele: +98-2182883732.
E-mail address: yeganeh@modares.ac.ir

Publisher: Islamic Azad University, Yazd Branch.

Keywords: Acoustic Quality; Solar Absorption; Curve Fitting; Form Geometry.

1. Introduction

The difference between architecture and other arts in simultaneous production is aesthetics regarding its structure, stability, and application (Song et al., 2016). Determining the shape of a building is the most critical task in the architectural design process (Pena et al., 2021). The initial shape of the building affects performance and construction cost, daylight usage, energy consumption, shadow performance, acoustics, functional accessibility, and solar utilization, and other features (Agirbas, 2019). Shape search becomes a crucial step in the conceptual design phase because its results are inputs for later stages of the design process, the construction phase, and throughout the life cycle of the building (Pena et al., 2021). One of the main parts of the building is the structure of the ceiling geometry and architectural form (Hamed Sardar et al., 2023), which has significant effects on energy consumption and thermal comfort of the sound quality of the building (Vasegh et al., 2020). The geometry of the building ceiling has significant criteria for determining the thermal performance of the building in terms of form (Fooladi et al., 2016). One of the strategies used in architecture is to control the sun's radiation and the resulting heat through shade (Zare and Ghanbari, 2022). Shape and form affect the reception of sunlight on the surfaces of domed buildings, and each affects the sound quality of the interior space so that the surface more exposed to sunlight increases heat absorption (Shiri et al., 2020). Recently, acoustics have been considered in non-professional music venues such as libraries, offices, multipurpose spaces, lecture halls, etc. (Cairoli, 2018; Kaarlela-Tuomaala et al., 2009; Xiao and Aletta, 2016). To create acoustic quality through architectural form, the geometry of the ceiling form is one of the most critical factors. When a speech signal is broadcast in space, the speech transmission index, bending time, and speech resolution of this frequency in the transmission path are affected by the architectural form and change and affect the sound quality of the environment (Munteanu et al., 2018; Gramez and Boubenider, 2017; Robinson et al., 2014; Tervo and Tossavainen, 2012). Due to the stability of curved or domed ceiling s in Iranian architecture, one of the best examples for simultaneous study in acoustic quality is the amount of sunlight absorption and shading. Applying these patterns in contemporary architecture in terms of acoustic and thermal efficiency requires understanding the relationship between the components of the architectural body and the acoustic and thermal components simultaneously with each other. This can be applied by recognizing the effect of the geometry of the forms in different dimensions of the current architecture. The present study investigates the components of sunlight absorption, shading, and acoustic components of the dome space in dome form in different arches based on curve fitting equations. Architectural parameters (surface, volume, height, and rise (ratio of height to orifice)) and the curvature of different arches significantly affect the components of time and velocity, speech transfer index, speech clarity, heat absorption, and solar radiation put. This research tries to analyze and answer this central question:

Influence of architectural parameters and equation of curvature of different types of arches on the components of sound quality, heat absorption, and radiation

What is the Sun? To answer the above questions, the research process is defined as follows

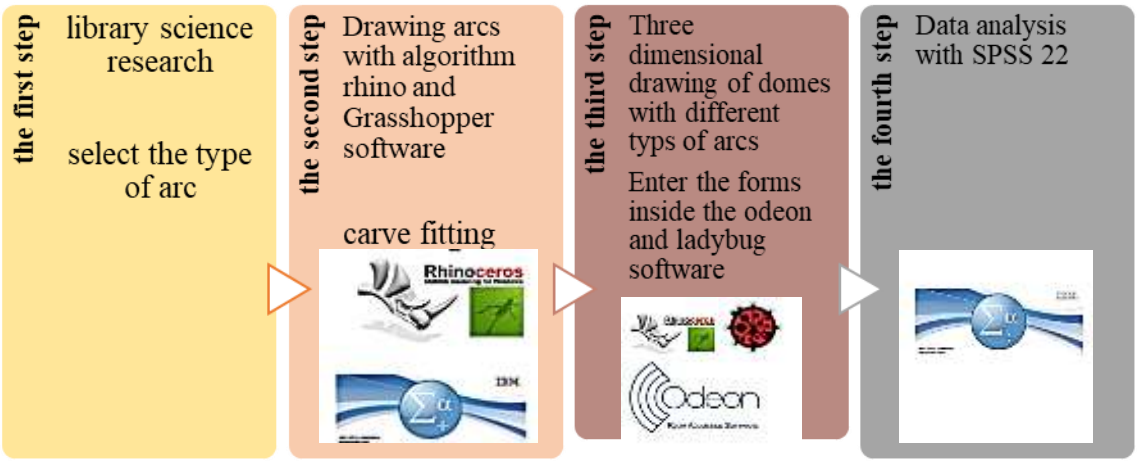


Fig 1 Research Process

1.1. Research Background

Less research has been done on the geometry and proportions of domed and arched ceiling s, taking into account all aspects of architecture or environmental comfort. A group of researchers focused on geometric properties (Farshad, 1977; Huerta, 2007); mathematics (Capilla Tamborero et al., 2021; Izadpanah, 2018), and proportions (Capilla Tamborero et al., 2021; Feizolahbeigi et al., 2021). Other researchers have examined the proportions, type, and shape of arcs due to sunlight (Fooladi et al., 2016; Fathy, 2010; Biwole et al., 2008). Some other studies have presented geometry and proportions, emphasizing acoustic analysis (Ismail and Eldaly, 2018; Inoue et al., 2009). Previous researchers who have worked on the geometry of dome arches have paid less attention to the acoustic aspects, the effect of sunlight, and the absorption of sunlight in different types of arches at the same time.

1.2. Ceiling Form Geometry

Since the birth of architecture, geometry has been, is and will be (Omranifar et al, 2023). Geometry has long been the basis for architects to create architectural works, especially in Iran (Beigi et al., 2019). The field of geometry knowledge is two concepts related to each other, number and shape, which are entirely dependent on mathematical knowledge, and sometimes one is considered (Noghrekar, 2013). Architecture, geometry, and proportions are two inseparable components because making motion within a regular geometric system is essential (Beigi et al., 2019). Past Iranian architecture is a relative geometric system in which the dimensions are obtained with specified coefficients from each other and by dividing and drawing geometric shapes. The set of specific ratios between the components as well as the component and the whole is called the system of proportions (Mojtaba et al., 2011). There is a close relationship between geometry and its arrangement in all stages of architectural work development (Beigi et al., 2019). In shaping the building, pre-thinking is the most influential factor in covering the building (Memarian and Safaeipour, 2018). Ceiling covering in Iranian architecture has a high priority and importance over other organs. Compared to the world's architecture in different eras, this architecture is dazzling in terms of the variety and richness of coatings, as if it has no other concerns (Safaeipour and

Pourmand, 2012). Various arches have been used to make Iranian arch and dome coverings from the past to the present. A mixture of several arcs is part of a specific geometric shape, such as a part of a circle, hyperbole, or any known geometric curve (Pirnia, 1994). Researchers have categorized arches from different perspectives, such as sharpness, rise, and morphology (Nima Vali Bey, 2012).

Application of ceiling geometry compatible with sunlight

Sunlight is one of the most significant natural factors in the constant change of climatic conditions of a point on the earth's surface. Sunlight, which causes light and illumination, eventually turns into heat and affects the region's climate. The shape and form of the building should be to the favorable or unfavorable thermal effects of the environment (Shiri et al., 2020). Accordingly, some forms and forms are superior to others in different regions. Heat loss of the building has a significant impact on the shape of the building (Shiri et al., 2020). Dome ceilings in hot and dry climates and ceilings reduce room temperature in summer and reflect more radiation than flat ceilings (Runsheng et al., 2003). Dry between winter and summer, they absorb more radiation in summer and less in winter than vertical surfaces (Shiri et al., 2020).

Application of ceiling geometry in harmony with acoustics

Indoor quality, IEQ (Indoor Environmental Quality) is considered an indicator of comfort level that is not limited to thermal conditions but includes thermal comfort, sound comfort, indoor air quality, and visual comfort (Mihai and Iordache, 2016). Many researchers have studied the quality of sound in the room. Also, the objective parameters of sound to express the quality of sound in the room, analysis of factors affecting the quality of sound, and possible solutions for sound quality in the room (Zhao et al., 2015). Large halls, in many ways, represent the pinnacle of acoustic design (Everest and Pohlmann, 2015). In general, the acoustic design of large halls is twofold: first, the space that is typically for lectures and the spaces that are usually for music. The former emphasizes speech comprehension, while the latter emphasizes sound for music. Even the largest hall is not so different from the smaller room in some acoustic aspects. In general, the essential and basic criteria of acoustics are equal. Large halls should have the least ambient noise with internal and external sources. The amount of time should be by the values in Figure 2.

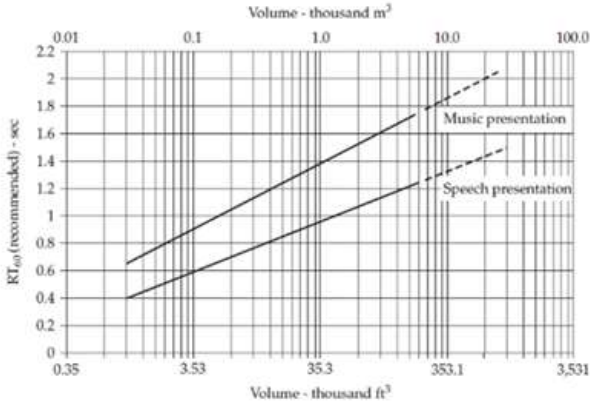


Fig 2 Vaccination time diagram in large-scale halls (Everest and Pohlmann, 2015)

It should be noted that all acoustic needs must be compatible with the needs of aesthetic and functional architecture (Everest and Pohlmann, 2015). Calculation of many components is required for modern acoustic design, one of the leading acoustic parameters for designer's time and time again (Elkhateeb et al., 2016). Vaccination means that the sound remains in a closed environment until the sound output stops. Over time, a series of reflections or echoes reduces its strength by limiting absorption and air loss. Vakhansh has been described by Mulan (1983) as a continuous presence of sound and audible after cutting off the sound source. Technically, the time required to reduce 60 decibels of sound is called the "wear time." A fraction from seconds to five seconds and more in small rooms. It varies up to vast areas, such as prayer halls in mosques. Different rooms and activities require different opening times for acceptable sound quality. The best time to speak is less than 1 second for speech and more than 1 second for music. Short speaking times are essential for clear speech. Otherwise, the constant presence of resonant noise obscures the underlying sound and causes speech to become blurred. Larger rooms seem to require longer opening times, as with lower sound frequencies. According to Berg and Stork (1995), the best reading time for a speech should be less than 1 second in 500 Hz and less. The opening time of a room should be proportional to the function and volume of the room (Othman and Mohamed, 2012).

Comprehension is the highest design priority for any hall intended for spoken words. That is true in many places of worship, halls, and theaters. Audio systems are often used to overcome acoustic limitations and for greater clarity in vast spaces (Everest and Pohlmann, 2015). Speech comprehension is the percentage of a word or words that listeners properly hear. That is a vital element of human communication. Without a significant understanding of speech, communication becomes difficult. Good comprehension is affected by RT time, background noise, and the listener's distance from the speaker. The three elements, timing (RT) and background sound, are influenced by the room's architecture. Therefore, more attention should be paid to them in the design phase (Othman and Mohamed, 2012). Nexon (2002) emphasized that in the draft version of the ISO 9921 standard in "Assessing Speech Communication," speech comprehension is defined as "measuring the effectiveness of speech comprehension." Measurement is usually expressed as a percentage of a properly understood message. Speech comprehension does not mean the quality of speech. Speech comprehension is related to the number of things that are correctly detected. In contrast, speech quality is related to the quality of speech signal reproduction according to the amount of audible distortion. Thus, a message that lacks quality may still be understandable (Othman and Mohamed, 2012). The speech Transmission Index (STI) is an objective criterion for determining speech transmission (Hossam Eldien, 2013). Loss of speech signal transmission is caused by reflection, interference, and background noise (GOŁAŚ and SUDER-DĘBSKA, 2009). Helps to contribute to speech quality" (Kuttruff and Mommertz, 2013). According to Barnett (1999), the STI reference value varies from 0 = bad to 1 = excellent. At this scale, an STI of at least 0.5 is desirable for most applications (Barnett and Acoustics, 1999) (Figure 3).

Fig 3 Speech Transmission Index Scale (Source: Barnett and Acoustics, 1999)

Figure 4 Graph of the amount of physical quantities of sound quality based on the ISO3382 standard used in the design and evaluation of lecture halls.

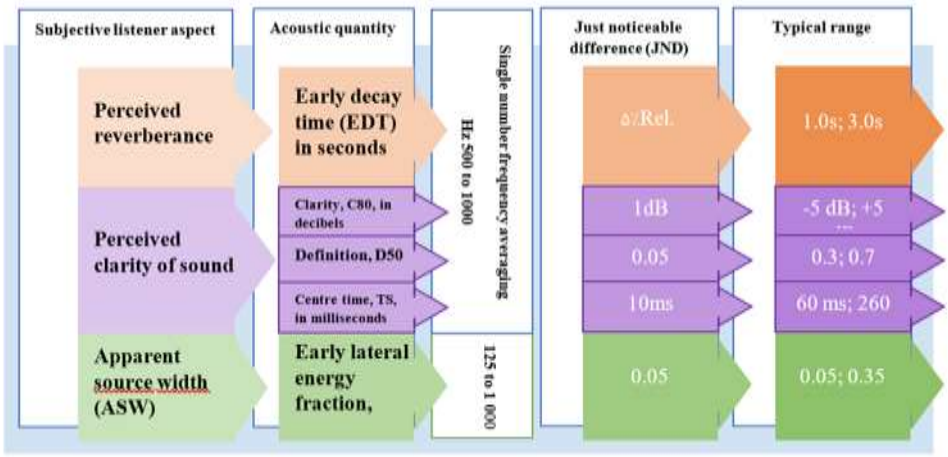


Fig 4 Diagram of several assumed physical quantities that determine the sound quality (Source: iso 3382, Skålevik, 2008)

2. Research Method

The present study investigates the analysis of the amount of sunlight received and heat absorption in the range of shadows and acoustic components in the form of a curved ceiling to explain the optimal shape of the lecture space. For the first time, this study investigates the sound quality component, the amount of sunlight received, and heat absorption in the shadow range based on the body and the curve fitting equation. The method of data collection is library and simulation. Library data collection tools (articles, books), software simulation (Odeon, Grasshopper, Energyplus), and data analysis tools are SPSS software. Using a combined method (simulation, descriptive analysis), this research comprises applied articles. The research method is that GrassHopper software was drawn algorithmically after selecting the types of arcs by the experts of each sample in the traditional method of masters not to change the line mode. Karl Friedrich, with SPSS software, performed the least-squares method. Then the 3D forms were simulated in Odeon software, and on the other hand, the 3D forms were simulated in Grasshopper software with the Ladybug plugin. In the following, the scalar matrix diagram performed a descriptive analysis of each acoustic indicator, the amount of sunlight received, and heat absorption in the shadow range. Finally, the amount of sunlight and heat absorption in the shadow range was analyzed by the Spearman method in SPSS software to analyze the architectural and acoustic components. Table 1 below presents the variables and metrics examined.

Table 1 Variables and metrics studied in this study.

		Architectural form	**Acoustic**	**Energy**
Components	**Conceptual construction**	The geometry Form ceiling	Acoustic comfort	Thermal behavior buildings
	Variable	Computational geometry, Form	Acoustic quality	Solar energy absorption
	Measures	**Computing:** slop of curve, **physical:** Volume, Area, Ratio Height to span	(reverberation time)RT, (the clarity) C80, (speech transmission index) STI	Solar radiation received and shade

In this research, the arc type of the samples was selected purposefully with the opinion of experts according to the purpose of the research. Table 2 describes the selected samples based on the physical characteristics of each sample. Also, from the point of view of experts, selected examples of arches of selected domes have historical value and are used in buildings today.

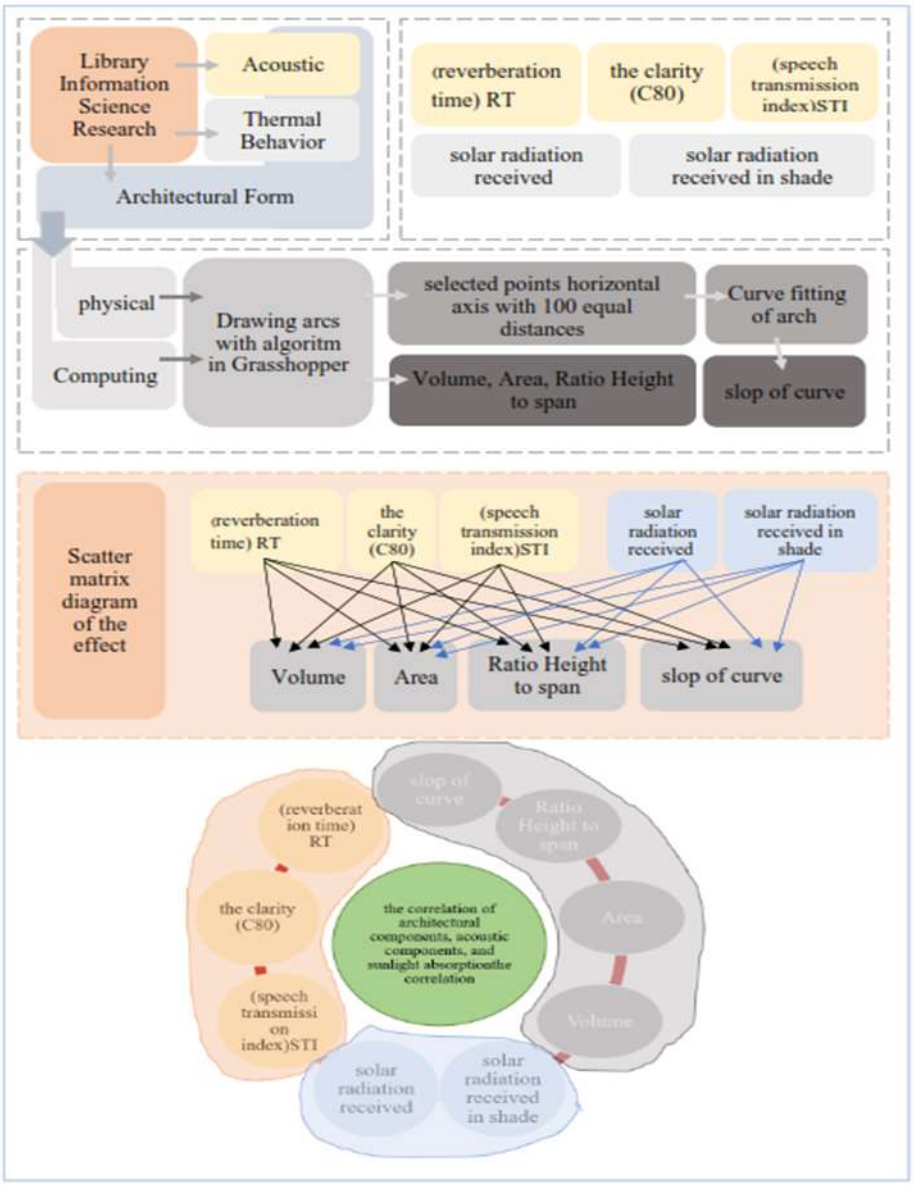


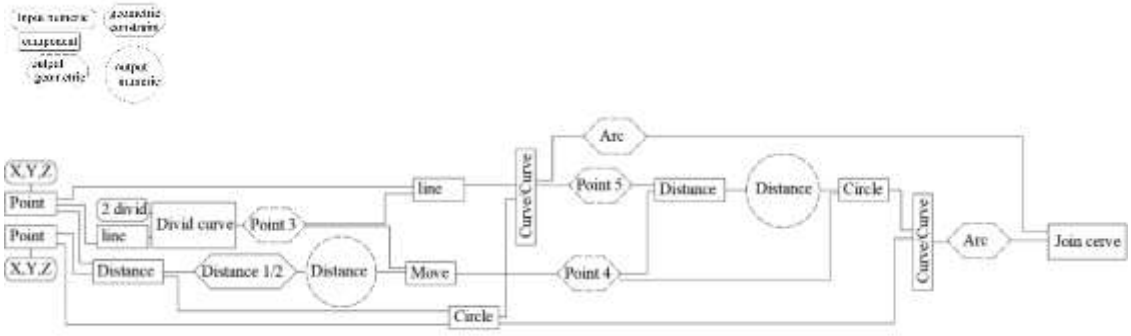
Fig 5 Research method

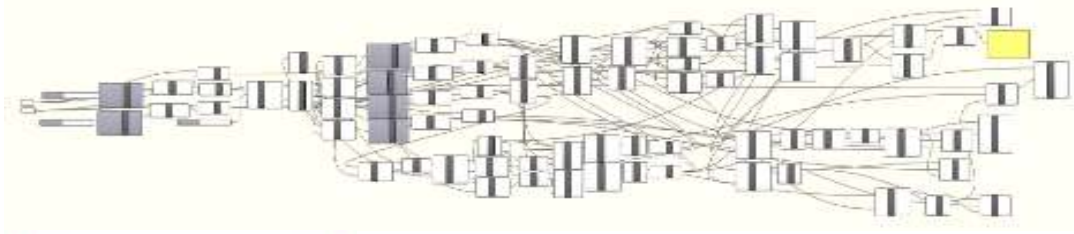
Table 2 Description of room model with different types

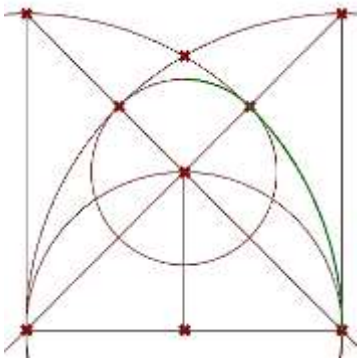
Physical characteristics	Volume m3	Area m2	Span m	Height m
1	1328.23	478.57	15	11.89
2	550.31	267.02	15	5.74
3	698.09	304.84	15	7.28

4	629.67	287.94	15	5.62
5	696.54	304.11	15	6.53
6	473.76	249.39	15	4.81
7	910.54	360.39	15	8.98
8	889.08	354.02	15	8.22
9	965.58	377.31	15	9.98
10	905.8	358.62	15	8.73
11	958.64	374.61	15	9.77
12	887.83	353.37	15	8.03

In most research done for drawing arches, drawing curves on arches and visually comparing them with a known arc with bending has been used (Izadpanah, 2018). Many bends can be used to approximate an arc. The closest bend to the arch has been carefully selected according to the difference between several bends and the drawing arc (Izadpanah, 2018). However, from Horatha's point of view, every person sees the curve he likes in the arc (Huerta, 2007). To prevent this error, the curve fitting and expression of the type of arches were performed by the matrix method, and to check the fitting error by the Least squares method, Carl Friedrich Gauss was performed. First, to fit the curve in GrassHopper software, each of the selected arcs with the same aperture was drawn by the master method in this software. Figure 6 is an example of the drawn algorithm of one of the arcs in Grasshopper software.







For each of the twelve arcs, it is drawn specifically based on that method in the software, which is drawn above the algorithm of arc number 1.

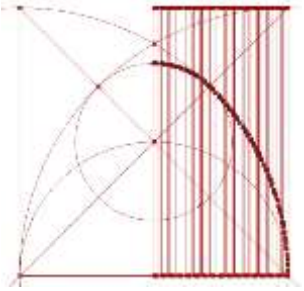


Fig 6 Example of an algorithm plotted in the Grasshopper software (Source: Authors)

It is necessary to select the appropriate points on the curve connections for analysis. These points should be selected homogeneously based on what experts say in all arcs (Izadpanah, 2018). The base points of the arc were selected as starting points, and their horizontal axis (openings) with 100 equal distances. Based on the values obtained in SPSS software. The least-squares method is used to check the amount of error. Table 3 describes the selected samples based on the mathematical properties and the image of the arc arcs of each sample.

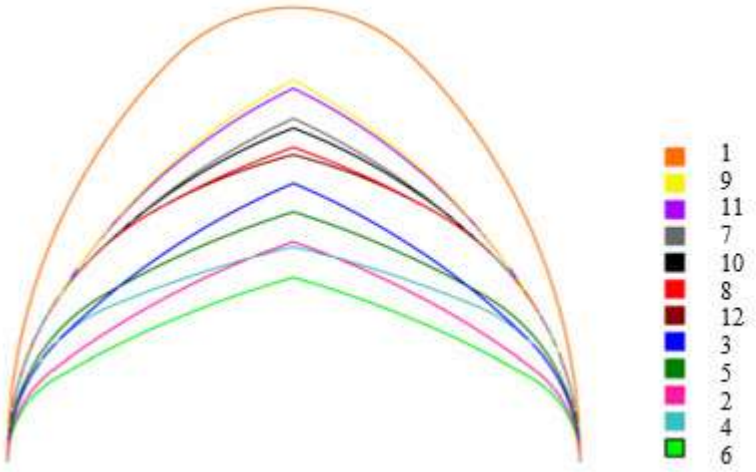


Fig 7 Drawing arc arches selected by experts

Table 3 Description of curve fitting arches

Arc	Curve Fitting				
	X3	X2	X1	b	r
12	0.027	-0.4322	2.6451	1.3201	0.987223
11	0.0191	-0.333	2.5679	1.3156	0.98929
10	0.0235	-0.3784	2.5249	1.3664	0.990892
9	0.0187	-0.3246	2.5601	1.316	0.972347

8	0.0282	-0.4392	2.6547	1.3178	0.981526
7	0.0235	-0.3714	2.5055	1.3749	0.986656
6	0.01	-0.1557	1.1465	0.8516	0.988843
5	0.0222	-0.3335	1.9946	1.1412	0.982735
4	0.0229	-0.3384	1.8803	1.0652	0.993252
3	0.0134	-0.2221	1.7583	1.0709	0.988294
2	0.0103	-0.1682	1.3386	0.9073	0.993111
1	0.0246	-0.4945	3.684	1.8955	0.981494

Architecturally and acoustically, it is essential to anticipate the sound characteristics of a prefabricated lecture hall. During the twentieth century, simulations were performed with the physical model of the hall. From the early 1960s, computer simulations of the development room led to the prediction and analysis of architectural designs. There are two geometric methods, one for the direct sound to the receiver and the other for the sound propagated to the corresponding surrounding surfaces before reaching the receiver. There are two geometric methods in Odeon.

In this research, to simulate Odeon software, it is considered that this software is a basis for researchers and a valuable tool for consulting companies in the objective and subjective field of acoustic room (Naylor, 1993). The Odeon program uses a combined primary wave tracking method to determine possible reflectance sequences (Naylor, 1993). Sound waves are sent from a source inside the room, followed by a reflection in the room, and the output data is stored for later use in determining the reflections received at one point (Naylor, 1993). The presentation of the 3D model in the Odeon allows the acoustics to be produced, described, and heard. This study created all room models using Grasshopper 3D software and then imported them into Odeon Room Acoustic 9.0 software. According to the sample dimensions of similar spaces in Iranian architecture expressed in the research background (Hossam Eldien, 2013; Rezazadeh Ardabili et al., 2018) and a cube with dimensions of 15 meters under the curved ceiling is the same for all models. That is to prevent the effect of volume change on acoustic parameters and to ensure analysis based on the characteristics of the dome (Kassim et al., 2014). Verification included a water tightness test in determining that the room model was examined to ensure the simulation accuracy and that all forms were completely closed, as shown in Figure 8 as an example of two models. The first parameter to be set is the amount of background noise in lecture halls. In lecture halls, the recommended noise standard for the HVAC system is NC 35 (Crocker, 2007). This simulation aims to identify the effectiveness of the form, the type of arc, and the fit of the curve, which is why the functional materials assigned to each similar model have been used in other models. The sound source informs it is the point type that emits natural sounds in the environment. The sound source in each figure is 1 meter from the edge of the wall and is 1.8 meters high from the floor. Table 4 shows the values entered in the Odeon software setting and the absorption coefficient (α) for the surface of the rooms and their floor, and at the bottom of the speaker volume table used by each model in Table 4. In the dome model, the materials, the opening of the dome, and the space under the dome were considered equally so that only the main variable, the shape of the dome, could be examined. Figure 8 Examining some examples of closed forms in Odeon software source.

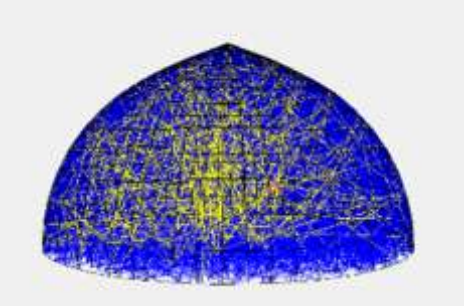


Fig 8 Examining some examples of closed forms in Odeon software (Source: Authors)

Table 4 First part of the statistical data entered in the software and the second part is the absorption coefficients (α) for the room level, and the third part is the speaker power (Source: Authors)

Statistical Data							
Environmental Conditions RH%	Environmental Conditions Temp. C^0		Number of rays use		Axis Point source		Point receiver
50.00	20		900000		1.8, 7.5, 1.7		27
The absorption Coefficients (α) for rooms' surfaces							
Material	Octave band centre frequency (Hz)						
	125H	250H	500H	1000H	2000H	4000H	NRCC
Floor							
Carpet, heavy, on concrete	0.02	0.06	0.14	0.37	0.60	0.65	0.29
Ceilings							
Brick, unglazed	0.03	0.03	0.03	0.04	0.05	0.07	0.005
Sound power of omni-directional speaker used in both experiments (Omni. SO8).							
Frequency (Hz)				250	500	1000	2000
Sound power (dB)				69.6	74.8	71.8	63.8

In all models, the location of the receiver and speaker is fixed. For example, the Form 6 model is located in Figure 9.

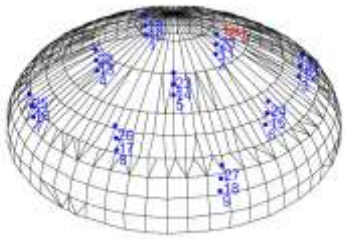


Fig 9 Location of transmitter and receiver Model 6 For examples of forms (Source: Authors)

To check the amount of sunlight received on the outside of the building, a method is needed that can simulate sunlight on the surface of the models with great accuracy. To simulate sunlight on surfaces, they need to show the components of location, time, weather conditions, and the effect of shadows on external surfaces in the analysis. Therefore, for analysis, it is necessary to use a suitable

tool to receive and evaluate sunlight on the exterior of the building. Radiance, Daysim, and ArcGIS Ecotect software are for evaluating sunlight on building surfaces (Brito et al., 2012; Freitas et al., 2015; Andersson et al., 1985). To analyze solar radiation, radiance software can be used that analyzes small scales with high accuracy using the Perez Diffuse Radiation Model (Perez et al., 1990; Perez et al., 1987). The basis of this software is based on algorithms that write with a visual algorithm in the GrassHopper environment. Radiance software is proposed for analyzing sunlight in a three-dimensional model with high-precision complex curve geometry. The simulated samples in Rhino 7 software are set at zero degrees. In this study, using the EPW file of Yazd city, which is one of the hottest cities in Iran, was included in the software. Receiving sunlight on the hottest day of the year at 16:00 and the whole year is considered. Figure 10 shows Form 6 of the simulation with the ladybug plugin.

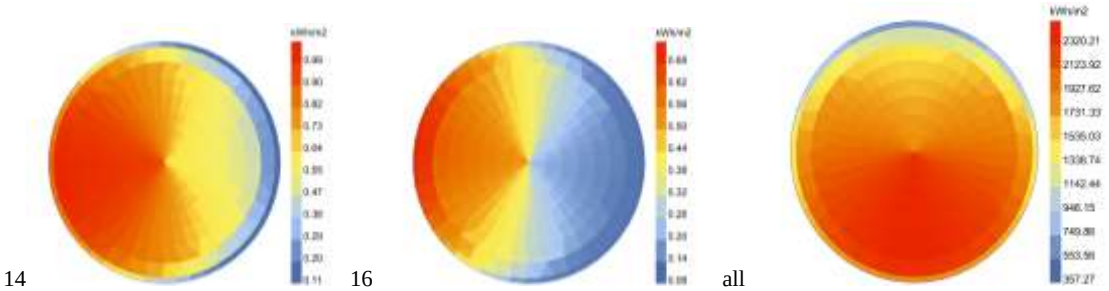


Fig 10 Simulated image in Grasshopper software Ladybug plugin

3. Findings

In this section, each of the research objectives is a descriptive analysis of the components of sound quality and the amount of solar radiation and heat absorption in the shadow range based on the architectural body parameter and the coefficient of variables of the arc fitting equation. In the following, the components of sound quality and the amount of sunlight received, and heat absorption in the shadow range is expressed, respectively.

3.1. Analysis and Adaptation of Acoustic Data of Dome Form

The simulated forms in GrassHopper software were entered into Odeon 9 software. The amount of time-lapse components, sound clarity, and speech transmission index of each dome form were obtained. Table 5 is the data obtained from the simulation.

Table 5 Ratio time, speech resolution, and speech transfer index obtained from model simulations (Source: Authors)

Number of forms	Reverberation Time	Clarity (C50)	Index Transmission Sound
12	3.64	-3.40	0.53
11	3.74	-3.48	0.52
10	3.62	-2.11	0.55
9	3.75	-3.45	0.52

8	3.62	-3.35	0.53
7	3.61	-2.10	0.55
6	2.29	-0.76	0.62
5	3.09	-2.56	0.56
4	2.93	-1.93	0.57
3	3.10	-2.17	0.57
2	2.29	-0.55	0.61
1	3.63	-3.36	0.53

The most critical component of acoustic quality is its time in the speech space. Other components of the speech transmission index are used as an objective and physical criterion to determine the quality of speech. The speech transfer index is the interval between zero and one, the best case 1, and the worst-case 0. Another component of speech clarity is that the ratio of initial sound energy to late sound energy should be between the numbers 5- and +5. According to Table 5, Form No. 6 with a height of 4.81, area of 249.39, a volume of 473.71 and a slope of 0.06 with a time of 2.29, transmission index of 0.62 and speech resolution of -0.76, form No. 2 with a height of 5.74, area 267.02, volume 562.37 and a slope of 0.06 With a vowel time of 2.29 and a speech transfer index of 0.61 and a speech resolution of -0.55, followed by form No. 4 with a height of 5.62, an area of 287.94, a volume of 629.67 and a slope of 0.13 with a vowel time of 2.93 and a speech transfer index of 0.61 and a speech resolution of 1. 93-, respectively, have the lowest amount of speech time, speech clarity and the highest amount of speech transmission index. As shown in table 5, form No. 1 with a height of 11.89, area of 478.57, a volume of 1306.08 and a slope of 0.14 with a time of 3.62, a transfer index of 0.52 and a speech resolution of -36.36, Form No. 11 with a height of 9.77, area 374.61, volume 938.19 and Slope 0.11 with a rotation time of 3.74 and a speech transfer index of 0.52 and a speech resolution of -3.48, followed by Form No. 9 with a height of 9.98, area 377.31, volume 944.89 and a slope of 0.14 with a rotation time of 3.75 and a speech transfer index of 0.52 and resolution. Speech 3.45 and at the end of Form No. 12 with a height of 8.06, area 353.37, volume 880.80 and a slope of 0.16 with a rolling time of 3.75 and a speech transfer index of 0.53 and a speech resolution of 3.40, respectively, the highest rolling time, speech clarity and minimum They have a speech transmission index. The simulation data are analyzed using the Scatter matrix diagram in Figure 11.

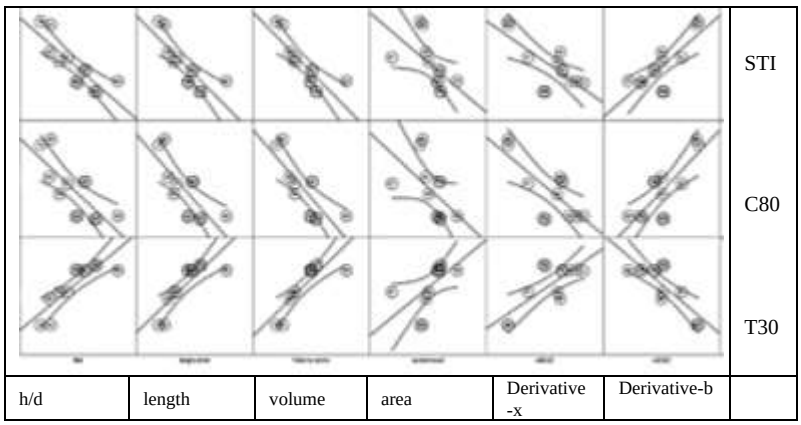


Fig 11 Scatter matrix diagram effect of volume, area, height-to-dome ratio, arc length, and arc curve slope on acoustic components (Source: Authors)

According to Figure 10 of the Scatter Matrix diagram, the effect of architectural components on sound quality with increasing volume, area, height to dome ratio, arc length, and slope of the arc curve increases the amount of time. It decreases the speech transmission index and speech clarity. This diagram shows that the sound quality decreases with increasing the amount of volume, area, height to dome ratio, arc length, and slope of the arc curve. Form 2 in Figure 11, has less bending time, higher speech clarity, and a higher transfer index than form 4, both of which have approximately equal area, volume, and height-to-mouth ratio, but Form 2 has a lower curve slope than form 4. That indicates that the type of curve shape and reducing the slope of the arc curve increase the amount of sound quality components of the dome.

3.2. Analysis and adaptation of data on the amount of solar radiation and heat absorption in the shadow range of the dome form

The amount of shading on the form and receiving sunlight was obtained using Rhino software (GrassHopper). An algorithm with Ladybug plug-in, Honeybee with Plus Energy Radiance rendering engine, was written to study sunlight on the surface of various domes. The type of arch, volume, area, and height of the opening of the domes, which is a component of the body of the dome form, affect the amount of sunlight received. In modeling the shape of the domes, the materials, the opening of the dome, and the space under the dome were considered equally to examine only the main variable, the shape of the dome. Table 6 is the data obtained from the simulation with Ladybug software.

Table 6 Area of shadow and sunlight, and at the bottom of the table, the amount of shadow and sunlight is expressed

Number of form	**Area Shade**						**Area Radiation Sunlight**					
	Area Shade 14 m^2		Area Shade 16 m^2		Area Shade all year m^2		Area Radiation Sunlight 14 m^2		Area Radiation Sunlight 16 m^2		Area Radiation Sunlight all year m^2	
	The ratio of area 14 to all	Area 14	The ratio of area 16 to all	Area 16	The ratio of area all year to all	Area all	The ratio of area 14 to all	Area 14	The ratio of area 16 to all	Area 16	The ratio of area all year to all	Area all
1	0.48	231.56	0.53	255.67	0.23	110.04	0.59	247.02	0.47	222.9	0.77	368.53
2	0.24	64.55	0.48	127.25	0.08	20.36	0.88	202.47	0.52	139.76	0.92	246.66
3	0.34	105.01	0.5	151.64	0.11	33.6	0.74	199.83	0.5	153.2	0.89	271.24
4	0.29	83.4	0.47	135.19	0.13	37.04	0.83	204.54	0.53	152.74	0.87	250.9
5	0.3	92.24	0.49	148.08	0.13	39.51	0.75	211.87	0.51	156.03	0.87	264.6
6	0.2	48.91	0.45	112.12	0.07	17.84	0.88	200.48	0.55	137.27	0.93	231.56
7	0.4	145.81	0.52	186.13	0.16	58.27	0.6	214.58	0.48	174.27	0.84	302.13
8	0.38	135.11	0.51	180.56	0.16	56.82	0.66	218.91	0.49	173.46	0.84	297.2
9	0.43	163.02	0.52	196.84	0.17	64.4	0.64	214.29	0.48	180.47	0.83	312.92
10	0.4	143.53	0.51	184.37	0.16	58.27	0.61	215.09	0.49	174.25	0.84	300.36
11	0.42	157.58	0.52	194.75	0.17	65.49	0.6	217.03	0.48	179.86	0.83	309.12
12	0.38	135.11	0.51	180.03	0.16	56.82	0.67	218.25	0.49	173.33	0.84	296.54

Solar radiation received

Number of form	**Shade**			**Solar radiation received**		
	Shade 14 Kwh/m2	Shade 16 Kwh/m2	Shade all year Kwh/m2	solar radiation received 14 Kwh/m2	solar radiation received 16 Kwh/m2	solar radiation received year Kwh/m2

	The ratio of received 14 to all	received 14	The ratio of received 16 to all	received 16	The ratio of received all year to all	received all	The ratio of received 14 to all	received 14	The received of area 16 to all	received 16	The ratio of received all year to all	received all
1	0.16	55.49	0.21	43.99	0.08	83289.41	0.84	281.10	0.79	169.03	0.92	950605.25
2	0.07	17.59	0.22	29.57	0.01	10627.87	0.93	235.04	0.78	101.93	0.99	714021.42
3	0.10	24.95	0.21	29.11	0.03	22780.04	0.90	225.78	0.79	110.52	0.97	691274.41
4	0.06	16.33	0.22	30.50	0.04	27633.98	0.94	240.39	0.78	106.30	0.96	696725.88
5	0.08	19.28	0.22	29.87	0.04	28552.90	0.92	228.90	0.78	106.53	0.96	680059.28
6	0.04	9.51	0.21	24.24	0.02	9961.25	0.96	220.22	0.79	92.60	0.98	624010.12
7	0.14	36.15	0.23	33.80	0.05	38037.20	0.86	217.15	0.77	115.99	0.95	730000.62
8	0.11	30.41	0.23	35.50	0.05	38461.56	0.89	235.27	0.77	115.75	0.95	753578.13
9	0.13	37.08	0.21	35.12	0.05	43769.90	0.87	243.10	0.79	132.95	0.95	773524.08
10	0.15	38.23	0.23	35.03	0.05	38037.20	0.85	220.05	0.77	116.02	0.95	751785.61
11	0.12	31.91	0.21	32.08	0.06	43898.91	0.88	226.24	0.79	122.84	0.94	709091.21
12	0.11	30.41	0.24	35.62	0.05	38461.55	0.89	236.43	0.76	115.91	0.95	755811.80

The amount of energy received by sunlight on the surface of the form of domes is affected by the shape of the curve, the slope of the curve, the ratio of height to the opening, area, and volume. Table 6 examines the amount of area and absorption of radiant energy in the form of domes at 14, 16, and all hours of the year and the ratio of shadow and sunlight to total shadow and sunlight. According to Table 6, the highest absorption of sunlight on the hottest day of the year in Yazd at 14:00, Form 1 with 281.09 KWh / m2, respectively, Form 9 with KWh / m2242.09 KWh / m2, followed by Form 1 with 16, respectively. The rate is 169.01 KWh / m2, Form 9 with a rate of 132.83 KWh / m2, which is the lowest amount of solar energy received at 14 hours, respectively, Form 8 with a rate of 217.15 KWh / m2, Form 10 with a rate of 220.4 KWh / m2, and at 16 hours, respectively. Form 6 is 92.5 KWh / m2, Form 11 is 101.93 KWh / m2. Table 6: The ratio of the area of absorption of sunlight to the total area of shadow and sunlight at 14 hours is the hottest hour, and the day of Form 1 with 0.59 is the lowest, and the highest is Form 6 with 0.88. The highest ratio of absorption rate was received by Form 6 with 0.96 and the lowest by Form 1 with 0.84. Figure 11 data analysis chart shows the amount of sunlight received and heat absorption in the shadow range from the Ladybug simulation using the Scatter matrix method.

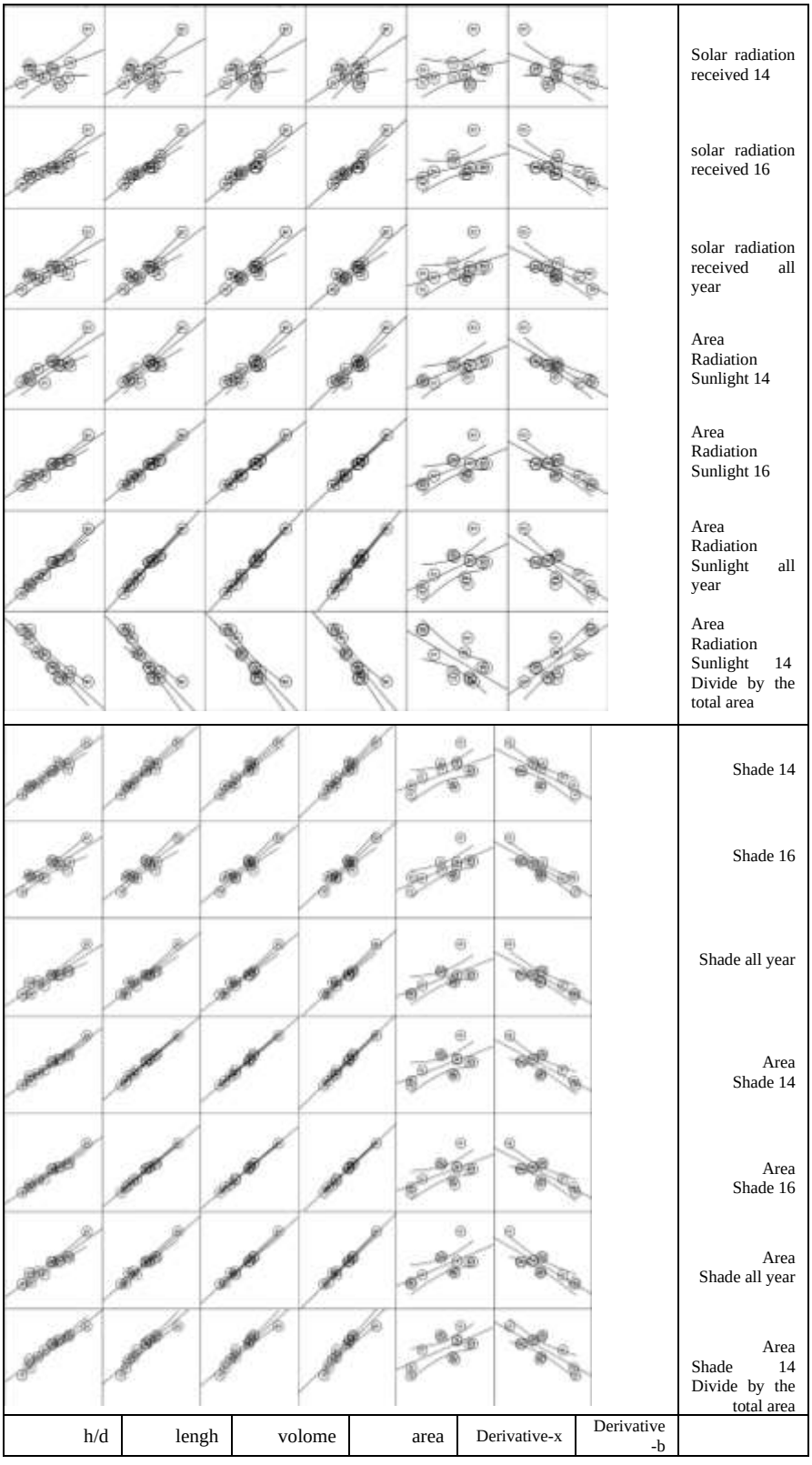


Fig 12 Scatter matrix diagram of the effect of volume, area, height-to-dome ratio, arc length, and arc curve slope on components receiving sunlight and heat absorption in the shadow range (Source: Authors)

The scatter matrix diagram in Figure 12 shows the effect of height to orifice ratio, volume, dome surface, length, and slope of the arc curve on the components of receiving sunlight and heat absorption in the shadow range. By increasing the ratio of height to opening, volume, the dome's surface, length, and slope of the arc curve, the area and amount of solar energy received directly increases—the area and amount of energy received by direct sunlight in the shade increases. In Figure 11, the area receiving solar radiation energy at 14 o'clock decreases as the ratio of height to aperture, volume, dome surface, length, and slope of the arc curve decreases. Form 4 in Figure 12 has the ratio of solar energy to the total dome less area and the amount of solar energy and area and the amount of solar energy received in the shadow more than form 2, both of which have approximately the same area, volume, and height to the crater. However, form 2 has a lower curve slope than form 4. It indicates that the type of curve shape and decreasing the slope of the arc curve increases the amount of area components and the amount of solar energy and the area and amount of solar energy received in the shade and reduces the ratio of solar energy to the entire dome.

3.3. Correlation between Acoustic Components, Amount of Sunlight, and Heat Absorption with Architectural Components

Pearson correlation coefficient was used to test the relationship between acoustic variables, the amount of sunlight received, and heat absorption in the range of shade and architecture. Figure 13 Correlation diagram of sound quality for the components of time of onset, speech resolution with frequency 500 and speech transmission index and the amount of solar radiation and heat absorption in the shadow range at 16 hours and the whole year and the ratio of solar energy to total energy reception the dome with architectural components is shown by Spearman correlation test (Fig 13).

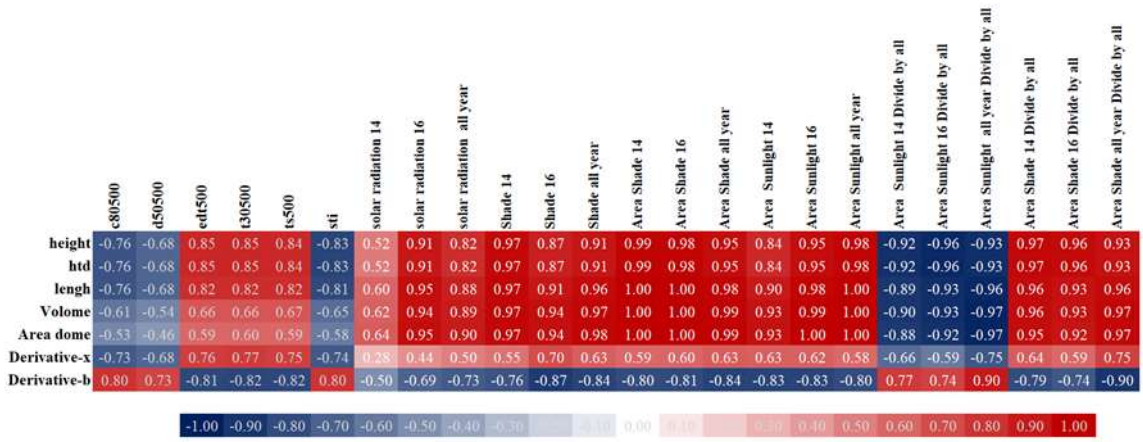


Fig 13 Correlation between acoustic components, amount of sunlight, and heat absorption with architectural components

The thermal diagram of the correlation of architectural components, acoustic components, and sunlight absorption is located in which the components of height to the opening, height, volume, dome area, curve slope, and arc length with a value above 0.53 are directly related to the amount of time and that they are inversely related to the components of speech clarity and speech transmission index or correlation rate greater than 0.5. In other words, increasing the amount of architectural components increases the amount of reading time. It decreases the amount of speech transfer index,

which decreases the sound quality of the speech environment. Components of height to the aperture, height, volume, dome area, curve slope, and arc length with a rate above 0.53 are directly related to the amount of sunlight absorption, the amount of sunlight absorption in the shade, and the area of each of them and an inverse relationship with a rate above 0.5 with the ratio of the area of sunlight to the total area and the area of the shadow to the total area. Increasing the components of volume, area, height-to-dome ratio, arc length, and arc curve slope increases the amount of energy absorption. However, dome performance increases with increasing span ratio, dome curve slope, and more shading.

4. Conclusion

The ceiling is one of the factors affecting the thermal and acoustic quality of the building. Dome ceilings have superior structural stability due to their application. Due to its high structural performance, it is necessary to improve its efficiency in other aspects, including thermal and acoustic performance. Vacation time (T30), speech resolution (C80), and speech transfer index (STI) are the main factors of sound quality from the perspective of architects in large-scale lecture halls. Sunlight and heat absorption in the shade range is the leading causes of heat loss through the shell. This study used the amount of sunlight, heat absorption, and acoustic components simultaneously in widely used arcs.

Increasing the volume, area, height-to-dome ratio, arc length, and slope of the dome arc curve increases the amount of time to bend, decreases the speech transmission index, and reduces speech clarity. It indicates that sound quality decreases with increasing the volume components, area, height to dome ratio, arch length, and slope of the dome arch curve. Increasing the ratio of height to span, volume, dome surface, length and slope of the arc curve, area and amount of solar energy received and the area and amount of solar energy received in the shade increase directly, but the shading performance on the form increases. These results are from the research done in acoustics such as Kazem, Yalmaz and Aref, Din and Anvar. In terms of heat absorption with Sarposhan and Yaghoubi, Gofz et al., And Shiri et al., Dome forms have almost equal volume, area, height to dome ratio, and arc length. Domes with lower arc curves have higher quality in acoustic components such as bending time, speech transfer index, and speech clarity. Dome forms have approximately equal volume, area, height-to-dome ratio, and arc length but have a higher curve slope in shading on the form.

References

Agirbas, A. (2019). Façade form-finding with swarm intelligence. *Automation in Construction, 99,* 140-151.

Andersson, B., Place, W., Kammerud, R., & Scofield, M. P. (1985). The impact of building orientation on residential heating and cooling. *Energy and Buildings, 8*(3), 205-224.

Arian, M. (2006). *Another look at the towers*. Country Cultural Heritage Organization.

Barnett, P., & Acoustics, A. (1999). Overview of speech intelligibility. *Proceedings-Institute of Acoustics, 21*(5), 1-16.

Beigi, F. A., Golabchi, & Ardabili, R. (2019). Analysis of theoretical and practical geometry and proportions of the dome of two discrete shells of Isfahan Abbasi Mosque. *Journal of Fine Arts-Architecture and Urbanism, 24*(4), 35-48.

Biwole, P. H., Woloszyn, M., & Pompeo, C. (2008). Heat transfers in a double-skin Ceiling ventilated by natural convection in summer time. *Energy and Buildings, 40*(8), 1487-1497.

Brito, M. C., Gomes, N., Santos, T., & Tenedório, J. A. (2012). Photovoltaic potential in a Lisbon suburb using LiDAR data. *Solar Energy, 86*(1), 283-288.

Cairoli, M. (2018). Architectural customized design for variable acoustics in a multipurpose auditorium. *Applied acoustics, 140*, 167-177.

Capilla Tamborero, E., Calvo Roselló, V., & Gómez-Collado, M. C. (2021). Geometrical Analysis of Oval Domes through Architectural and Mathematical Methods. The Case of the Dome of the Camarín of the Virgin of El Puig (Valencia, Spain*). International Journal of Architectural Heritage*, 1-15.

Crocker, M. J. (2007). *Handbook of noise and vibration control*. John Wiley & Sons.

Elkhateeb, A., Adas, A., Attia, M., & Balila, Y. (2016). Absorption characteristics of masjid carpets. *Applied acoustics, 105*, 143-155.

Everest, F. A., & Pohlmann, K. C. (2015). *Master handbook of acoustics*. McGraw-Hill Education.

Farshad, M. (1977). On the shape of momentless tensionless masonry domes. *Building and Environment, 12*(2), 81-85.

Fathy, H. (2010). *Architecture for the poor: an experiment in rural Egypt*. University of Chicago press.

Feizolahbeigi, A., Lourenço, P. B., Golabchi, M., Ortega, J., & Rezazadeh, M. (2021). Discussion of the role of geometry, proportion and construction techniques in the seismic behavior of 16th to 18th century bulbous discontinuous double shell domes in central Iran. *Journal of Building Engineering, 33*, 101575.

Fooladi, V., Tahbaz ,M., & Majedi, H. (2016). Double-shell dome in terms of thermal behavior in Kashan desert climate [Research]. *Journal of Research in Islamic Architecture, 4*(2), 90-106. http://jria.iust.ac.ir/article-1-488-fa.html

Freitas, S., Catita, C., Redweik, P., & Brito, M. C. (2015). Modelling solar potential in the urban environment: State-of-the-art review. *Renewable and Sustainable Energy Reviews, 41*, 915-931.

GOŁAŚ, A., & SUDER-DĘBSKA, K. (2009). Analysis of Dome Home Hall theatre acoustic field. *Archives of Acoustics, 34*(3), 273–293.

Gramez, A., & Boubenider, F. (2017). Acoustic comfort evaluation for a conference room: A case study. *Applied acoustics, 118*, 39-49.

HamedSardar, H., Tizghalam Zonouzi, S., & Khoshbakht Bahramani, S. (2023). Exploration and Verification of Effective Ecological Architectural Components in Multi-Functional Building in Mashhad (Case Example: Shandiz Padidehe). *International Journal of Applied Arts Studies (IJAPAS), 8*(1), 117-135. Retrieved from http://www.ijapas.ir/index.php/ijapas/article/view/431.

Hossam Eldien, H. F., Yasser (2013). The Effect of Domes Shape on the Acoustics of Mosques.

Huerta, S. (2007). Oval domes: History, geometry and mechanics. *Nexus Network Journal, 9*(2), 211-248.

Inoue, S., Sugino, K., Katou, M., & Imaizumi, H. (2009). Speech transmission performance and the effect of acoustical remedies in a dome. *Applied acoustics, 70*(1), 221-230.

Ismail, M. R., & Eldaly, H. (2018). Acoustic of monolithic dome structures. *Frontiers of Architectural Research, 7*(1), 56-66.

Izad Panah, F. (2018). Application of bending fitting and least squares method to study the geometry of Iranian arches. *Journal of Mathematics and Society, 3*(1), 41-53.

Kaarlela-Tuomaala, A., Helenius, R., Keskinen, E., & Hongisto, V. (2009). Effects of acoustic environment on work in private office rooms and open-plan offices–longitudinal study during relocation. *Ergonomics, 52*(11), 1423-1444.

Kassim, D. H., Putra, A., Nor, M., & Muhammad, N. (2014). Effect of pyramidal dome geometry on the acoustical characteristics in a mosque. *Journal of Mechanical Engineering and Sciences, 7*, 1127-1133.

Kuttruff, H., & Mommertz, E. (2013). Room acoustics. In *Handbook of engineering acoustics* (pp. 239-267). Springer.

Memarian, Gh., & Safaeipour, H. (1397). *Niaresh Iranian architecture*. Goljam.

Mihai, T., & Iordache, V. (2016). Determining the indoor environment quality for an educational building. *Energy Procedia, 85*, 566-574.

Mujtaba, A., Sadat, A. H., & Akbar. (2010). Research on the historical course of proportional adjustment systems in architecture with emphasis on practical and aesthetic considerations. *Book of the Month (Art), 151*, 46-57.

Munteanu, C., Bogdan, D., Mihaela, M. L., Cobîrzan, N., Tămaș-Gavrea, D. R., & Babota, F. (2018). The acoustic properties of the lecture hall of the Faculty of Building Services in Cluj-Napoca. *Procedia Manufacturing, 22*, 331-338.

Naylor, G. M. (1993). ODEON—Another hybrid room acoustical model. *Applied acoustics, 38*(2-4), 131-143.

Nima Wali Beg, F. M. Z. S., & Tehrani, F. (2012). Geometric and mathematical features in the structure of Chafd five and seven sharp in the cover of the Persian song arch. *Iranian Journal of Restoration and Architecture, 1*(3), 39-50.

Othman, A. R., & Mohamed, M. R. (2012. Influence of Proportion towards Speech Intelligibility in mosque's praying hall. *Procedia-Social and Behavioral Sciences, 35*, 321-329.

Omranifar, S., Balilan Asl, L., & Norouzborazjani, V. (2024). Comparison of Geometrical Proportions in the Tomb Monuments of the Contemporary Period with an Emphasis on Various Systems of Global Proportions. *International Journal of Applied Arts Studies (IJAPAS), 8*(4), 45-62. Retrieved from http://www.ijapas.ir/index.php/ijapas/article/view/468.

Pena, M. L. C., Carballal, A., Rodríguez-Fernández, N., Santos, I., & Romero, J. (2021). Artificial intelligence applied to conceptual design. A review of its use in architecture. *Automation in Construction, 124*, 103550.

Perez, R., Ineichen, P., Seals, R., Michalsky, J., & Stewart, R. (1990). Modeling daylight availability and irradiance components from direct and global irradiance. *Solar Energy, 44*(5), 271-289.

Perez, R., Seals, R., Ineichen, P., Stewart, R., & Menicucci, D. (1987). A new simplified version of the Perez diffuse irradiance model for tilted surfaces. *Solar Energy, 39*(3), 221-231.

Pirnia, M. (1994). Arches and Arches-Arches [Research]. *Athar, 15*(24), 5-45. http://journal.richt.ir/athar/article-1-357-fa.pdf

Rezazadeh Ardabili, M., Sidi Saravi, M., & Taheri Amiri, S. (2018). Comparative study of the plan and dome of Ardabil mosque on Friday with similar plans and domes to check the correct drawing of the dome curve. *Architecture and Urbanism (Fine Arts), 23*(3 # a00621). https://www.sid.ir/fa/journal/ViewPaper.aspx?id=483901

Robinson, P. W., Siltanen, S., Lokki, T., & Savioja, L. (2014). Concert hall geometry optimization with parametric modeling tools and wave-based acoustic simulations. *Building Acoustics, 21*(1), 55-63.

Runsheng, T., Meir, I., & Etzion, Y. (2003). An analysis of absorbed radiation by domed and vaulted Ceiling s as compared with flat Ceilings. *Energy and Buildings, 35*(6), 539-548.

Safaeipour, H., & Pourmand, H. (2012). The meaning of cover in Safavid architecture. *Journal of Fine Arts-Architecture and Urbanism, 17*(1), 39-48.

Silverware, AI. (2013). *Wisdom of Islamic Art and Architecture*. University of Science and Industry.

Sina, H .A. (1986). *Expansion of messages in wisdom and nature* (Asemi, H. Trans.). Darghabs.

Shiri, Tawhid, Ban, D., & Taban. (2020). The effect of form on the amount of shading and heat absorption in the dome of Yazd reservoirs. *Journal of Islamic Architectural Research, 7*(4), 75-92.

Song, H., Ghaboussi, J., & Kwon, T. H. (2016). Architectural design of apartment buildings using the implicit redundant representation genetic algorithm. *Automation in Construction, 72*, 166-173.

Tervo, S., & Tossavainen, T. (2012). 3D room geometry estimation from measured impulse responses. 2012 *IEEE International Conference on Acoustics, Speech and Signal Processing* (ICASSP).

Vasigh, shiri, Tohid .Climatic adaptation of the dome body based on the amount of radiation received (study of the domes of mosques: Imam Isfahan, Sheikh Lotfollah, Qazvin Prophet Mosque and Urmia Mosque). *Armanshahr Architecture and Urban Planning, 13*(33), 211-225.

Ward, G. J. (1994). The RADIANCE lighting simulation and rendering system. *Proceedings of the 21st annual conference on Computer graphics and interactive techniques*.

Xiao, J., & Aletta, F. (2016). A soundscape approach to exploring design strategies for acoustic comfort in modern public libraries: A case study of the Library of Birmingham. *Noise Mapping, 3*(1).

Zare, M., & Ghanbari, J. (2022). Comparative Analysis of Vernacular Passive Cooling Techniques in Hot Humid Regions. *International Journal of Applied Arts Studies (IJAPAS), 7*(2), 43-54. Retrieved from http://www.ijapas.ir/index.php/ijapas/article/view/408

Zhao, S., Qiu, X., Cheng, E., Burnett, I., Williams, N., Burry, J., & Burry, M. (2015). Sound quality inside small meeting rooms with different room shape and fine structures. *Applied acoustics, 93*, 65-74.

Available online at www.ijapas.ir

International Journal of Applied Arts Studies

IJAPAS 9(3) (2024) 57–88

The Impact of the Paradigm Shift on the Schools' Architecture Considering Adaptive Studies of Schools of Tabriz and Urmia in the Era of Qajar and Pahlavi I

Zahra Farzaneh[a], Sahar Toofan[b]*, Arash Saghafi Asl[c]

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

Received 28 August 2023; revised 19 June 2024; accepted 20 July 2024

Research Article

Abstract

Schools are the most familiar learning spaces in the mind, which have undergone fundamental changes over time in various sectors, including architecture. The aim is to compare the architecture of Qajar and Pahlavi period schools and the effect of paradigm shift and transformation in Tabriz and Urmia schools. In this research, the evolution and continuity in the architecture of schools in the Qajar period was analyzed with regard to the spatial indicators and the body of learning the open space of Iranian schools. The research is important from two practical and descriptive-analytical aspects, it is practical for exploiting all kinds of schools of the Qajar and Pahlavi periods and fundamental for how to face them in the space of transition from architecture in the city. The method of doing the work is mixed and qualitative-quantitative. First, library information is collected and then the interview technique is used. The components extracted in the questionnaire were compiled with a Likert scale and distributed among the experts. In the qualitative part of the interview method, he collects data, and in the Atlasti software, he extracts the components and changes of schools based on open and axial coding and the results of the questionnaire with the SPSS software, analysis of variance, regression (ANOVA) for data analysis with statistics. During the Qajar period, the arrival of modernity in Iran caused a transformation and a paradigm shift in school architecture. With the establishment of Dar al-Funun by Amir Kabir, a huge change in the model of schools took place, which led to the separation of schools from mosques. As a result, the educational spaces from the school mosque with the pattern of the central courtyard later changed to the schools with the elongated plan pattern, and the educational evolution in the Qajar period

* Corresponding author. Tel: +98-9144112547.
E-mail address: sahar.toofan@iaut.ac.ir

Publisher: Islamic Azad University, Yazd Branch.

followed the concept of physical-shape continuity of the traditional Iranian architecture and items such as the central courtyard, module and frame. The arrangement of views and symmetry, introversion and appropriate geometry, etc. can be seen.

Keywords: Paradigm Shift; School; Qajar; Pahlavi I.

1. Introduction

From the beginning of the 13th century (late of Qajar and early of Pahlavi), Iran experienced fundamental changes in political and social situation and various aspects of peoples' lives, such that dominant attitude and mindset transformed unprecedentedly (Sami Azar, 1997: 149). The architecture of Iran has been displayed in different states on frequent constructions, and it has a special place in which beliefs, rituals, and religions are exhibited in the geographical and regional states. Cultural principles and the worldview of the society create the environment and induce principles and values in humans and somehow play a role in cultural transformations (Masoudi Googani and Hooshmandpoor, 2012: 154-155). Schools are the learning space of Iran in the Islamic era. School can be described as an institution for higher education in which ancient Islamic knowledge, such as tradition, commentary, and religious education, are being taught. The school was designed to be in service of an innovative institution (Hilen Braand, 2010: 173).

As an educational organization, the school is a system of social interaction; An organized whole composed of human people who interact and interact with each other through organic and complex relationships. As a social system, the school is different from other social systems with features such as interdependence of components, defined and defined population, clear distinction to the environment, complex network of internal social relations and unique atmosphere and culture (Habibi et al., 2012: 102; Divandari et al., 2018). Knowledge of the process and way of formation of schools and the physical-functional characteristics of schools and their place in the city and their socio-cultural effects in each of the periods of Iran's history, before each subject, into a written collection including the number Schools, status of the founders, size, physical shape, their place in the city, functional characteristics and other characteristics of their requirement in each era, it is necessary to prepare the ground for a comprehensive analysis about the status of schools in history (Fali and Sultanzadeh, 2015: 18). The theoretical importance of the research on the main problem of changing the paradigm shift since the beginning of the 13th century (late Qajar and early Pahlavi) is that the country of Iran had undergone fundamental changes in the political, social and various aspects of people's lives, such that the attitude and way of thinking. The ruler changed in an unprecedented way (Sami Azar, 1997: 149; Divandari et al., 2018).

The importance and necessity of research on the change of paradigm and cultural changes in the schools of the Qajar and Pahlavi periods, which has an effect on the architecture of educational spaces, and includes the removal of cells in schools and their transformation into classrooms that are divided into four. The direction of the courtyard was the way to the cell, and later in the Qajar period, modern education replaced the traditional education, which became a classroom. In most of the schools, each cell had a porch that gives access to the cells located in the courtyard, which later in the Qajar period, these porches were used as open classroom space. It was inferred about the change of paradigm in the schools of Qajar and Pahlavi periods, which includes: design, pattern, form and basic concepts in architecture.

In this research, the study of cultural changes and physical structure of Qajar and Pahlavi era schools is considered, the reason for choosing these two periods is the transition from tradition to

modernity, which shows the effectiveness of space from such a transformation, which is based on values. For a long time, the structure of the schools was traditional in accordance with the educational values of the previous schools (in the form of schools and religious teaching), while the changes in the physical structure and cultural changes of the schools, which began at the same time as the Qajar era. The Pahlavi era is an institution where the relationship between teacher and student, the relationship between life and study in one space has completely changed in comparison with the schools of the Qajar period.

Research purposes: The objective is to conduct an adaptive investigation on the architecture of schools in the era of Qajar and Pahlavi and the impact of the paradigm shift and transformation in the schools of Tabriz and Urmia.

Research questions: How did the paradigm shift and transformation affect the schools of the Qajar and Pahlavi eras?

What was the historical process of higher education in Iran in the Qajar and Pahlavi eras?

What are the most effective factors in forming and paradigm shift impact in the architecture of schools from Qajar to the Pahlavi era?

Research assumption: Change in educational state and architectural paradigm shift can be prominent factors in the space of the schools of the Qajar and Pahlavi I era.

2. Research Background

Numerous research has been conducted about the era of Qajar and Pahlavi I on school architecture and familiarity with its patterns and transformation in the Qajar era. Among these papers, the following are notable.

Hamid Tarifi Hosseini (2012) investigated educational systems generally and the higher educational system in the book titled "Adaptive and analytic investigation of the historical process of higher education of Iran" by emphasizing effective social, economic, political, and cultural changes in Qajar, Pahlavi, and Islamic revolution. As a crucial structure and subsystem in society, these educational systems need to change and transform over time to fulfill the expected objective.

Javad Divandari, Aida Barkati and Shagaig Dashti Joshghan (2017), in the comparative article on the evolution of the spatial structure of Qajar and Pahlavi schools with an emphasis on the hidden values of education in Mashhad (case study: Suleiman Khan and Yadgar School Dr. Ali Shariati), this research by choosing two consecutive historical periods (Qajar and Pahlavi) as a starting point in the change and transformation of the structure of schools (schools and the spatial structure of schools in the Qajar and Pahlavi eras with regard to the values of the educational system in this era) explains.

Sahreh Mehrabian, Hossein Safari and Jamaluddin Sohaili (2019), in the article titled "Comparative comparison of the morphology of contemporary Iranian schools using the method of space arrangement, with the aim of analyzing the characteristics of spatial configuration and investigating the effect of the type of arrangement and spatial organization" They have worked in a pattern.

Ahmad Babaei Zarch, Soheila Torabi Farsani, and Muhammad Hassan MirHosseini (2019), in a paper titled "Effective factors on growth and establishment of the novel educational system in Yazd since Constitutional era until the end of Pahlavi I. According to the results, Zoroastrians of Yazd should be considered an effective and leading group in the way of development of schools in addition to providing highlighted social background from the Constitutional era, and as a result, the novel method of education in Yazd.

Sepideh Alaghemand and Seyed Bagher Hosseini (2014), in a paper titled "Adaptive Investigation of Architecture and Content of Traditional and contemporary schools of Iran. Case study: Two schools in Mashhad, Chahar Bagh of Isfahan, Agha Bozorg of Kashan, Dar Alfonoun, and Markar of Yazd. This research aimed to conduct an adaptive investigation of the architecture and contents of traditional and contemporary schools and to recognize the transformation and change process.

Seyyed Mohammad Hossein Zakari and Sediqeh Artman (2019), in the article entitled "Measuring students' environmental satisfaction with the environmental components of the school", in this research, some environmental components, such as radiation and light, sound, heat, color, dimensions, And the materials were evaluated and compared.

Seyedeh Boshra Mousavi (2018), in a paper titled "Representation of Qajarian Buildings of Dar Alfounoun School based on visual documents." The Dar Alfounoun School was established with the efforts of Mirza Mohammad Taqi Khan Farahani in the second year of the reign of Nasser Aldin Shah. The building of this school changed significantly over time until the end of the Qajar era.

Mehri Yasnas (2017), in a book titled "The History of novel schools of Iran (Qajar era). Education in Iran was traditional until the beginning of the second half of the 13th Hijri calendar, and there was no organized structure to take care of education in Iran, so the school was governed as an old-fashioned primary school.

Maryam Sadat Razavi Poor and Mohammad Mehdi Zakeri (2016), in a paper titled "the impact of the education system on the architecture identity of Schools in Qajar and Pahlavi eras (1876-1881)," investigated the history and transformations of architecture over time, such as changes in appearance and structural changes in forming different buildings, which had an accurate impact on the architectural identity of buildings.

Mohammad Yusuf Kayani (2013), in the book entitled "Iranian Architecture of the Islamic Period", the architectural space of schools has also entered a new stage at the same time as the changes in the architecture of mosques. Architects, following the architectural features of mosques, built schools with more or less the same features.

Hossein Soltanzadeh (1984), sometimes the process and method of forming schools and skeletal-functional features of schools and their place in the city and their cultural-civil impact on each cycle of Iranian history requires a determined set with the number of schools, path of founders, capacity, skeletal appearance, their position in the city, functional properties, and other crucial properties to provide a background for a comprehensive analysis about the school situations.

Mehdi Nasiri (1387), in the article examining the development of the educational system of schools in the Qajar and Pahlavi period, the purpose of this article is to examine these three educational periods, especially the sociological examination of the educational system in this historical period.

Naseh Mohammad Amin (2007), a comparative look at the history of six historical schools in Iran (with an approach to criticizing the teaching of the alphabet in the traditional educational system), this article seeks to identify and introduce the characteristics of the six historical schools "Dar al-Funun, Elmiyeh and Alborz Tehran, Rushdieh" Tabriz, Saadat Bushehr and Shauktieh Birjand" which are all more than one hundred years old.

Eghbal Ghasemi Pooya (1999), in the book titled "new schools of Qajar era." This paper is about the reasons for establishing and developing new schools in the Qajar era and introducing their founders and pioneers. It defines the educational system transformation and the emergence of new schools in intellectual backgrounds.

Neda Saeidi Kia (2017), in a paper titled "Evolution of the Architecture of Schools of Iran over time," noted patterns for designing schools that should be considered in the architecture of schools; patterns such as the small society of learning, the input of the missionaries, workshop of life skills, technology, and clarity, internal and external green spaces, sofa, flexibility, cozy places, using solar energy, ventilation, and natural light.

Sami Azar (1997), in the history of schools' transformation in Iran, investigated the historical transformations of the schools of Iran and believes that the architecture of current schools is the result of social and historical changes, not the consequence of thinking and finding solutions about body spaces.

Mehran Karahmadi, Mustafa Kiani, and Maryam Ghasem Sichani (2020), in a paper titled "Investigation of new schools of Isfahan in the Late Qajar and Pahlavi I Era, investigated factors of forming factors and body components to recognize historical-political, cultural, and social factors that affect creation of novel schools of Isfahan in the mentioned eras and recognizing the nature of architecture, and skeletal and architectural comparison of these schools.

Samad Sardari Nia (2003), in the book "Dar al-Funun Tabriz", is an institution of higher education during the Qajar era, which during its activity was able to leave a significant impact on the culture of this region by training some talented young people.

Professor Viladimir Minoriski (1953), in the book titled "History of Tabriz." He is considered the greatest researcher in this area and a great teacher, according to professors in the West. This book discussed Tabriz and its geographical position.

Reza Amin Sobhani (1958), in the book titled "History and Etymology of Schools of Tabriz." This book was published in the summer of 1951, but because of the beginning of the school year and increasing the volume of printed matters of the Farhang printery, the remaining could not be published, and another part, which included the history of the established school until 1946, was published and until the early of 1952.

The novelty of this research is that contrary to the previous papers that discussed the architecture of schools in the Qajar era and schools of Tabriz, this paper conducted an adaptive investigation on schools of Tabriz and Urmia in the Qajar and Pahlavi I era in terms of design indices, pattern, form, and basic concepts in the architecture. In this research, cities in the northwest of the country were selected by considering the importance of these two provinces in terms of their location in the path of the silk road, which has been the route of transforming the science and civilization of European countries to Iran, and consequently, emergence of the first ones in these cities, such as the first printery, national newspaper, deaf-mute school, and public library in Tabriz, and the first Medical school, novel school, and the first local journal in Urmia.

3. Selecting Specimens and Distribution of Questionnaires

The statistical specimen volume was 39 persons of experts and elites of architecture, according to the Morgan table, and the questionnaire included 60 questions. The information-gathering technique using the questionnaire depended on the response of researchers, and the collected data were analyzed using SPSS. The results were extracted using statistical analyses, correlation, and testing received indices.

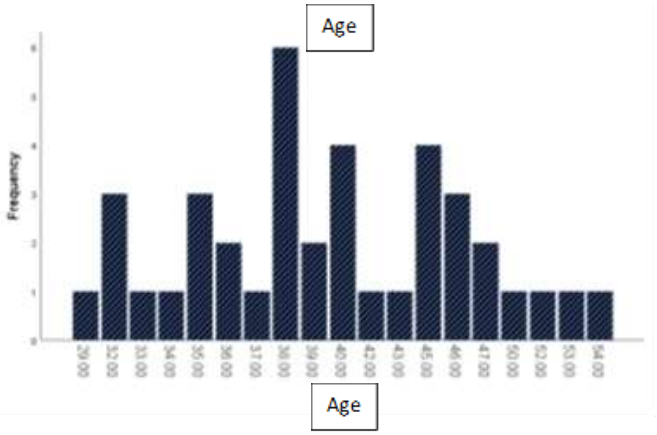


Fig 1 Analyzing the age of people (Source: authors)

4. Theoretical Fundamentals

4.1. Schools' Construction in the Era of Qajar and Pahlavi I

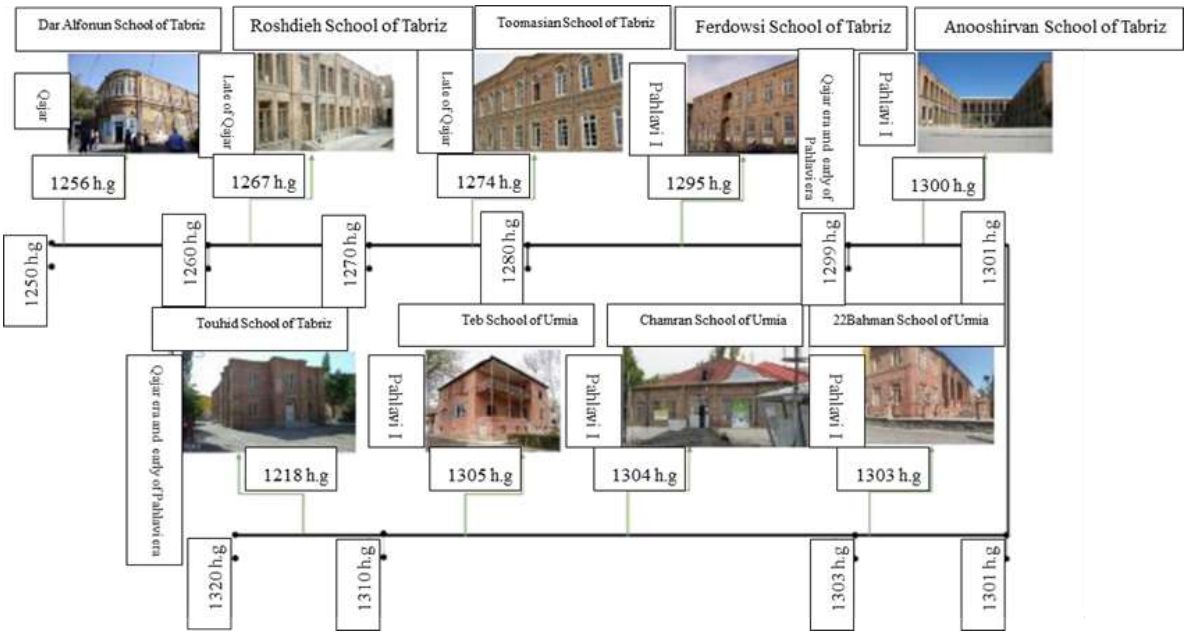


Fig 2 Timetable of Schools' construction in East- and West- Azerbaijan in the era of Qajar and Pahlavi I (Source: authors)

4.2. Adaptive Investigation of Schools' in terms of Architecture

Table 1 Adaptive investigation of schools in terms of architecture (Source: authors)

Name of School	Teb School of Urmia	Chamran School of Urmia	Anooshirvan School of Tabriz	Ferdowsi School of Tabriz	Roshdie School	Dar Alfonun School of Tabriz
Historical era	Pahlavi I	Pahlavi I	Pahlavi I	Late of the Qajar era	Late of the Qajar era	Qajar
Position	West Azerbaijan (Tabriz)	West Azerbaijan (Tabriz)	East Azerbaijan (Tabriz)	East Azerbaijan (Tabriz)	East Azerbaijan (Tabriz)	East Azerbaijan (Tabriz)
Date of Construction	1305 SH	1304 SH	1300 SH	1295 A.H	1267 A.H	1256 A.H
Use	6-classes girls elementary school	Boys high school	Junior high school	Secondary education	Girls' Knowledge and Work High school	Boys secondary high school
School components	Classes, gathering hall, Hussainiyah, janitor, sport	Classes, gathering hall, Hussainiyah, janitor, sport	-	Library, classes	Library, laboratory, industries workshop, handcraft	-
Plan	Symmetry in plan-rhythm in view	Symmetry in plan and view, rhythm in view	Symmetric and rhythm in view	Symmetry in plan and view, rhythm in view	symmetric	asymmetric
Geometry	Rectangular-shape plan	Rectangular-square shape plan	U-shape	H-shape	Z-shape	L-shape
Number of stories	Two stories-floor and the first story	Two stories-floor and basement	Three stories-floor, first, and basement	Three stories-floor, first, and basement	Two-stories	Two stories-floor and the first story
Number of yards	A yard	A large yard	2 yards-inland and outland	Two yards-Internal and external	1	1 Internal yard
Accessibility and links to the classes through the porches	Links through the porch to corridors and classes	Internal circulation and links through the corridor	Links through corridors and internal stairs	From the porch to the inside and connection corridors and stairs to the upstairs	4 separate entrance-through the court	Directly from the yard to the classes
Introvert-extrovert	Internal circulation and links through the corridor	extrovert	Introvert	extrovert	Introvert	Introvert

Spatial sense	extrovert	Sense of peace inside the school building	Sense of movement around the corridor	Sense of peace in the central yard and beautiful nature causes a reduction of stress	Reminder of traditional architecture- simple- historical symbols of survival	Sense of peace and separation of accessibility of each class- sense of attachment
Natural components	Utilizing green spaces and trees all around the school building	Utilizing the green space all around the building of Chamran school	Green space and tree	Old porch and trees in the space, green space, stress reduction	Existence of the green space	Green space and trees in the central yard
Decorations	No particular decoration	Efficient execution of brickwork on the external wall of the building, decorations of the door and windows	Brick decorations with Roman arch and quasi-convex brickwork around the windows	Brick decoration in the body of the building- bevel around the frame of the windows	Simple method to volume elements and sculpture	Bricks- Columns all around the porches

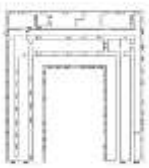
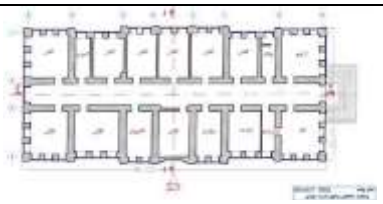
Row	Name of school	Plans and images
1	Dar Alfonun school of Tabriz	  
2	Roshdie School	  
3	Ferdowsi school of Tabriz	 
4	Anooshirvan school of Tabriz	 
5	Chamran school of Urmia	 
6	Teb school of Urmia	 

Table 2 Share funds in terms of architecture (Source: authors)

- All six schools have an architectural space suitable for the educational system.
- All the above schools have a regular geometric shape (rectangular square).
- Usually, a circuit is built near the body of the market with the main lines.
- The use of inner or outer yard and its favorable atmosphere can be seen in all schools.
- All schools have a middle corridor between classes or a corridor in the front of the yard.
- Most of the central courtyards in the traditional architecture of Iran, especially schools, are built with appropriate degree of enclosure, geometrical order in the form of a square, rectangle or complete square with a specific definition and as a complete and flawless space, usually symmetrical.
- The presence of a central courtyard and the creation of a water pond and greenery in the example of schools, the direct relationship of the school's constituent elements such as rooms, teachers, etc. And the spaces of the building on the four sides of the yard, which are placed in the optimal place according to the environmental desirability in terms of geographical directions and the importance of the role of the spaces for different seasons.
Hierarchy: First, we enter the semi-public area from the public area, and then we enter the semi-private entry way, and finally we enter the private area of the school yard.
- Transforming communication and movement paths into learning environments and places to sit and study in order to socialize corridors and stairs.
- The external order in the form of a piece of land in traditional cities with an organic texture (natural order and in accordance with environmental conditions such as the slope of the land, waterways, network of accesses and boundaries of ownership, etc.) is mostly irregular.
- The arrangement of filled and empty spaces according to the urban context and image, so that the school is considered as an important element and at the same time continuous and inseparable in the urban context and image.
- The lack of open spaces and the absence of indoor or semi-open spaces that can be used by students in special climatic conditions such as areas with intense sunlight and high temperature or rainfall in rainy areas can be used by students in many times of the year.
- The spatial quality of the school building or open space, open spaces or courtyards and covered or semi-open spaces and physical order and the relationship between them are considered to be the most important in the design of schools.

Table 3 Differences in terms of architecture (Source: authors).

- In the previous period, Qajar had cells, which were removed later.
- In order to respond to the new education system, schools change from introverted and traditional to extroverted and contemporary.
- It is a combination of introverted and extroverted spaces, in this case, in the building complex, while there are central courtyards or internal open spaces, the entire complex is surrounded by open spaces. Introversion is seen in traditional schools and extroversion is seen in contemporary schools.
- The horizontal communication space takes place through the corridors around the open space and also the semi-open spaces in traditional schools. But in contemporary schools, these horizontal connections are made through communication corridors.
- Creation of desirable visual and perceptual quality such as unity, diversity, hierarchy, sequence, comparison, continuity, continuity is seen in the collection of full and empty spaces in traditional schools.
- The role of the yard from the middle of the Qajar period onwards, from the heart of the complex and the

central space, is reduced to an open space.

- The first transformation happened in Dar al-Funun, which presents a semi-traditional model and a new definition of schools.

- The Safavid period schools evolved compared to the Timurid period, but there was no significant change from the Safavid period to the Qajar period, while from the middle of the Qajar period, a huge change occurred in the pattern and body of the schools to respond to the new way of education. In this way, new schools started to be formed with a new teaching method in the form of rows of benches in the classroom and the creation of corridors in Dar al-Funun.

5. Indices of Schools of Qajar and Pahlavi Era

Considering conducted investigations in the case study schools of the Qajar and Pahlavi eras, design, pattern, form, and basic concepts of architecture are discussed. Indices of each parameter are presented below.

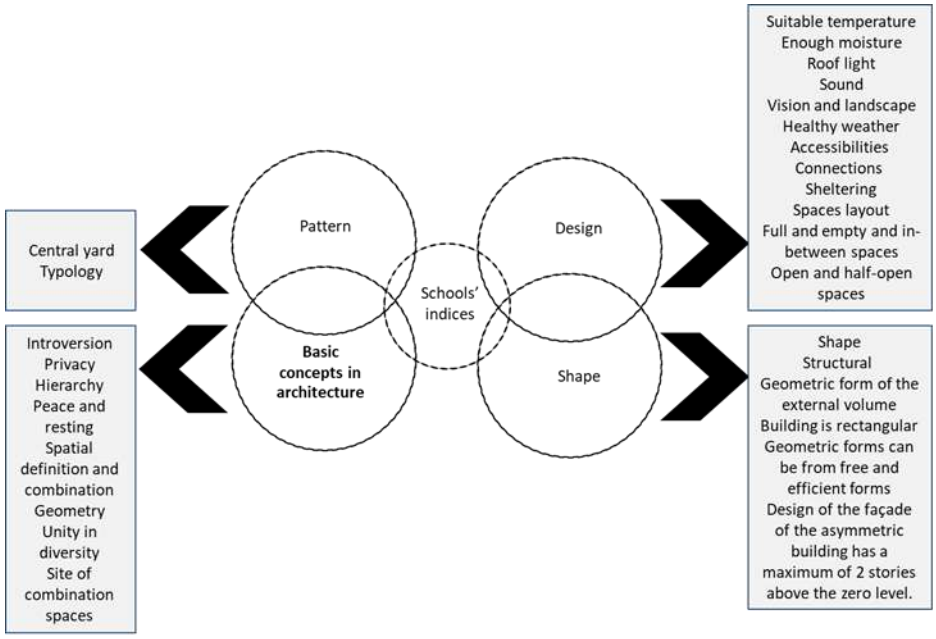


Fig 2 Indices of schools of the Qajar and Pahlavi era (Source: authors)

6. Research Method

In terms of nature, the present research is included in the set of quantitative-qualitative researches. In order to answer the research questions and achieve the main goal of the article, the research is important from two practical and descriptive-analytical aspects, and it is practical for the exploitation of all kinds of schools of the Qajar and Pahlavi periods and fundamental for how to face them in the space of transition from architecture in the city. It has been used in order to achieve the main goal set (architectural quality and paradigm shift in school education). On this basis, after extracting the appropriate theoretical framework, by researching and reviewing the surrounding texts and documents in the field of education in the first Qajar and Pahlavi eras, and developing a basic conceptual model related to the identification of the effective components on the quality of architecture and education in the schools of the period. First, Qajar and Pahlavi collected field data

using tools such as observation, interview and questionnaire. The method of doing the work is mixed and qualitative-quantitative. In the qualitative method, with the help of the contextual theory, the extraction of components is started, and in the quantitative part, the factor contribution of a variable is presented. Coding of semi-structured interviews with experts and professors of Azad University of Tabriz and Urmia has been done. The first qualitative sampling was done from 15 experts in the Azad University of Tabriz and Urmia, who had full knowledge of the subject and knowledge of the studied samples, using various components and the conditions of examining the sample of Qajar and Pahlavi period schools, scores with a spectrum 1 to 10 are given and those whose average is higher than the average of the upper and lower limits are selected and referred to the board of experts to validate the results. The research was done with an applied approach and a descriptive and analytical research method. The method of collecting information is field and library to examine the patterns of schools in these periods. First of all, this article examines the architecture of educational spaces and the impact of the paradigm shift in the Qajar and Pahlavi periods from a qualitative point of view, and then statistical indicators and tests are used to compare and evaluate the research findings. The data collection technique was based on the researchers' answers, and the collected data was analyzed with SPSS and the descriptive statistics method of deviation and regression variance (ANOVA) in Qajar and Pahlavi period schools, using statistical analysis, correlation and the received indicators have been tested and finally the results have been extracted. After evaluating the architecture of the educational spaces of Tabriz and Urmia schools, the validity and reliability of the research has been examined with Cronbach's alpha coefficient in the Qajar and Pahlavi period. According to the ground principles, labeling is done using Atlasti.9 version 9.1.3.0 software. In the analysis of semi-structured interviews, Atlas T software is used for convenience and data reduction, and the tagging approach is open and central coding, which includes the following (source: author).

7. Research Findings

7.1. Design Indices in Schools of Qajar and Pahlavi Era

Appropriate Temperature and Enough Moisture

Temperature and relative moisture are physical factors of the environment, and their increase and reduction affect the convenience of people (Bako-Biro et al., 2007: 18). Documents show that an insufficient ventilation system disturbs learning and increases the absence of students (Sterling, and Arundel, 1985).

Roof Light

Establishing the building in the direction of sun radiation in the cold season; it should be noted that immediate radiation of light in learning spaces causes mutiny of the eye and cause problems for students (Ghermezi and Nasrollahi, 2019: 8). Providing visual comfort is a fundamental principle, which is possible by providing sufficient light for classes and learning spaces. In addition to affecting the performance of the users, it also affects their health and energy efficiency (Ahadi and Khanmohammsdi, 2015).

Sound

If the sounds outside the class overpower the sound of the teacher, learners inevitably give their hearing power to the sounds outside or do not listen to any of the sounds, even the teacher's sound. These situations mostly cause disturbance in learners, and the position importance of the class is highlighted (Zoufan, LotfiPour, 2000).

Healthy Weather

The opening is an important component of the building that affect the current air of the internal space significantly (Shetabivash, 2015).

Accessibilities

In the past, accessibilities of learners existed directly from the yard, but now it is a hierarchy of the yard to the hallway and to the class. Putting functional areas related to each other and beside each other eases the accessibility to similar uses (Azemati, Aminifar, and Pourbagher, 2015).

Space Layouts

The spatial layout of schools defines link method, internal events, and space experience. The spatial discipline is an important factor in providing physical and mental convenience to the users, so trying to obtain principles of effective spatial layout seems to be essential in schools (Azemati, Aminifar, and Poorbagher, 2015). The physical design of classrooms can affect the behavior of both users, including teachers and students (Stewart and Evans, 1997).

Full and Empty Spaces

Spaces without roofs in connection with the sky and profited from natural light are called empty or open spaces, and spaces with roofs enclosed by walls and windows are called closed or filled spaces (Ghaffari et al., 1998: 29). The most significant effective aspect in defining and determining the conceptual type and quality of the architectural space is the skeletal organization of full and empty spaces in the scale of architectural units and urban complexes.

Full and Empty and In-Between Spaces

In addition to the internal design of schools, considering the design of the open space is also important. The schoolyard is the natural extension of the classroom. Connection with nature reduces neural pressures and improves the mental and spiritual health of students and teachers (Daneshmehr, 2007). Schools can benefit from open and half-open spaces as useful educational tools by improving their quality. Stoop and porches facing the yard in Islamic schools, multiple yards of the Chahar Bagh school, and porticos of the Khan School of Shiraz provided a desirable use of nature. Placing cells around the central yard and the large ratio of the yard's area to the closed space indicate the high importance of the open space in the architecture of Islamic schools (Pirnia, 2013) (Tables 4 and 5).

Table 4 Statistical and comparative analysis of design indices in the Qajar and Pahlavi era (Source: authors)

Variable	Suitable temperature		Enough moisture		Light roof		Sound		View and perspective		Healthy weather		Accessibilities		Links		Hierarchy		Layout of spaces		Full and empty spaces		Full and empty and in-between spaces	
	Qajar	Pahlavi	Qajar	Pahlavi	Qajar	Pahlavi	Qajar	Pahlavi	Qajar	Pahlavi	Qajar	Pahlavi	Qajar	Pahlavi	Qajar	Pahlavi	Qajar	Pahlavi	Qajar	Pahlavi	Qajar	Pahlavi	Qajar	Pahlavi
Number	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39
Mean	3.10	3.41	2.97	3.10	4.05	3.95	3.10	3.33	3.64	3.72	3.49	3.44	3.77	3.72	3.54	3.59	3.54	3.33	3.56	3.62	3.13	3.74	3.10	3.74
Median	3	4	3	3	4	4	3	4	4	4	4	4	4	4	4	4	4	3	4	4	3	4	3	4
Deviation	0.821	0.785	0.811	0.718	0.793	0.724	0.641	0.838	1.181	1.169	1.295	1.273	0.706	0.686	0.790	0.637	0.884	0.838	0.754	0.711	0.767	0.938	0.882	1.093
Domain	4	3	3	2	3	2	3	3	4	4	4	4	3	3	4	3	3	3	3	3	3	3	4	3
Minimum	1	2	1	2	2	3	2	2	2	1	1	1	2	2	1	2	2	2	2	2	1	2	1	2
Maximum	5	5	4	4	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	4	5	5	5

The value of each design index has been analyzed in the form of descriptive and comparative statistics between the Qajar and Pahlavi periods. For example, in the question of suitable temperature with the number of 39 people, its variable mean is 3.10 in the Qajar period and 3.41 in the Pahlavi period, the standard deviation is estimated at 0.821 in the Qajar period and 0.785 in the Pahlavi period. The amount of standard deviation in this variable (suitable temperature) is higher in the Qajar period than in the Pahlavi period, and the amount of standard deviation is average in both.

Table 5 Analysis of Variance (ANOVA) (Source: Authors)

		Sum of squares	Mean of squares	Degree of freedom	F	Significance
Suitable temperature	Regression	12.756	18	0.709	1.104	0.0412
	Remaining	12.833	20	0.642		
	Total	25.590	38			
Enough moisture	Regression	14.641	18	0.813	1.574	0.0163
	Remaining	10.333	20	0.517		
	Total	24.974	38			
Light roof	Regression	8.397	18	0.467	0.602	0.058
	Remaining	15.500	20	0.775		
	Total	23.897	38			
Sound	Regression	9.673	18	0.537	1.817	0.009
	Remaining	5.917	20	0.296		

	Total	15.590	38			
Vision and landscape	Regression	34.808	18	1.934	2.129	0.052
	Remaining	18.167	20	0.908		
	Total	52.974	38			
Healthy weather	Regression	40.160	18	2.231	1.892	0.008
	Remaining	23.583	20	1.179		
	Total	63.744	38			
Accessibilities	Regression	6.590	18	0.366	0.594	0.006
	Remaining	12.333	20	0.617		
	Total	18.923	38			
Links	Regression	7.609	18	0.423	0.526	0.008
	Remaining	16.083	20	0.804		
	Total	23.692	38			
Hierarchy	Regression	18.026	18	1.001	1.717	0.012
	Remaining	11.667	20	0.583		
	Total	29.692	38			
Spaces layout	Regression	10.173	18	0.565	0.990	0.050
	Remaining	11.417	20	0.571		
	Total	21.590	38			
Full and empty spaces	Regression	12.942	18	0.719	1.527	0.017
	Remaining	9.417	20	0.471		
	Total	22.359	38			
Open, half-open and in-between spaces	Regression	18.590	18	1.033	1.878	0.008
	Remaining	11.000	20	0.550		
	Total	29.590	38			
At this stage of the research, according to the regression test in Table 3, the coefficient of determination for the appropriate temperature is 0.0412 with significance (F test is equal to 1.104). According to the significance, there is a significant relationship between the variables.						

7.2. Shape Indices in Schools of Qajar and Pahlavi Era

Shape

The shape and appearance of the building must match the favorable or unfavorable thermal effects of the environment. Different shapes and forms have different thermal performance due to many reasons, including the amount of surfaces in different fronts, the ratio of surface to volume, the effect on the amount of radiant energy received at different times, etc. The difference in the light absorbing walls of these buildings, the energy consumption of their lighting is also different (Nasrullahi, 2011).

The Geometry of the External Volume of the Building is Square, Rectangle, Free and Efficient

The manner of placing spatial-functional elements in it is that they are placed in four directions around the central yard. The shape of the central yard is an extended rectangle close to a square (with chamfer corners). The school entrance is on an axial side, which passes through the middle of two edges and the center of the rectangle (Kiani, 2011: 138) (Tables 6 and 7).

Table 6 Statistical and comparative analysis of shape indices in the Qajar and Pahlavi era (Source: authors)

Variable	Shape		Organizational		The geometry of the external volume of the building is square		The geometry of the external volume of the building is rectangular		The geometry can be from the free and effective forms		Design of the building façade is symmetric		With at least two stories above the zero level	
	Qajar	Pahlavi	Qajar	Pahlavi	Qajar	Pahlavi	Qajar	Pahlavi	Qajar	Pahlavi	Qajar	Pahlavi	Qajar	Pahlavi
Number	39	39	39	39	39	39	39	39	39	39	39	39	39	39
Mean	3.54	3.72	3.51	4.28	2.56	2.90	4.00	4.00	2.41	3.33	4.21	3.69	4.28	3.74
Median	4.0	4.0	4.0	4.0	2.0	3.0	4.0	4.0	2.0	3.0	5.0	4.0	4.0	4.0
Deviation	0.822	0.826	0.970	686..0	1.142	0.852	0.918	0.761	1.093	1.493	0.923	0.731	0.560	0.549
Domain	3	3	3	3	4	3	3	4	4	4	3	3	2	3
Minimum	2	2	2	2	1	1	2	1	1	1	2	2	3	2
Maximum	5	5	5	5	5	4	5	5	5	5	5	5	5	5
The variable mean, the geometric form of the external volume of the square building, in the Qajar period is 2.56 and in the Pahlavi period is 2.90 and the standard deviation in the Qajar period is 1.142 and in the Pahlavi period is 0.852, which the standard deviation in the Qajar period is excellent. is. It seems that according to the analyzes that have been done, the use of the central pattern in the school plan can be used as a strategy for designing the basic factors to create spatial coherence, integration and continuity among the school spaces.														

Table 7 Analysis of Variance (ANOVA) (Source: Authors)

Indices		Sum of squares	Mean of squares	Degree of freedom	F	Significance
Shape	Regression	9.647	18	0.536	0.610	0.052
	Remaining	17.583	20	0.879		
	Total	27.231	38			
Organizational	Regression	16.109	18	0.895	1.868	0.008
	Remaining	9.583	20	0.479		
	Total	25.692	38			
Structural	Regression	12.410	18	0.689	0.591	0.867
	Remaining	23.333	20	1.167		
	Total	35.744	38			
The geometry of external volume of the building is square	Regression	33.423	18	1.857	2.297	0.026
	Remaining	16.167	20	0.808		
	Total	49.590	38			
The geometry of external volume of the building is rectangular	Regression	17.667	18	0.981	1.370	0.024
	Remaining	14.333	20	0.717		
	Total	32.000	38			
The geometry can be from the free and effective forms	Regression	33.019	18	1.834	2.955	0.011
	Remaining	12.417	20	0.621		
	Total	45.436	38			
Design of the building façade is symmetric	Regression	23.942	18	1.330	3.161	0.007
	Remaining	8.417	20	0.421		
	Total	32.359	38			
With at least two stories above the zero level	Regression	5.314	18	0.295	0.897	0.05
	Remaining	6.583	20	0.329		
	Total	11.897	38			
At this stage of the research, according to the regression test in Table 5, the coefficient of determination for form indicators is 0.052 with significance (F test equals 0.610). According to the significance, there is a significant relationship between the variables.						

7.3. Pattern Indices of Schools in the Pahlavi and Qajar Era

Central Yard

The most important skeletal transformation in recent decades of the history of school construction in Iran is replacing the central yard with a corridor. This transformation was an end to the pattern of traditional schools and a beginning for designing schools using a novel method. This

change is the decay of introversion concepts to the central yard and traditional hierarchy in organizing spaces of the school (Sami Azar, 2000: 109-110).

Typology

Typology is usually a simple description of the properties of a building. Generally, it is applied to a type of category in which a number of different objects are organized based on one or several common properties, and the science that recognizes and analyzes types is called typology (Memarian, and Dehghani, 2016: 22) (Tables 8 and 9).

Table 8 Statistical and comparative analysis of pattern indices in the Qajar and Pahlavi era (Source: authors)

Variable	Central yard		Typology	
	Qajar	Pahlavi	Qajar	Pahlavi
Numbers	39	39	39	39
Mean	4.31	2.92	3.56	3.23
Middle	4.00	3.00	4.00	3.00
Deviation	0.766	1.08	1.095	0.90
Domain	2	4	4	3
Minimum	3	1	1	2
Maximum	5	5	5	5
The central courtyard with 39 people, its variable mean in the Qajar period is 4.31 and in the Pahlavi period is 2.92, the standard deviation in the Qajar period is 0.766 and in the Pahlavi period is estimated as 1.08.				

Table 9 Analysis of Variance (ANOVA) (Source: Authors)

		Sum of squares	Mean of squares	Degree of freedom	F	Significance
Central yard	Regression	12.724	18	0.707	1.475	0.019
	Remaining	9.583	20	0.479		
	Total	22.308	38			
Typology	Regression	28.923	18	1.607	1.928	0.007
	Remaining	16.667	20	0.833		
	Total	45.590	38			
At this stage of the research, according to the regression test in Table 9, the coefficient of determination for the model index (central yard) is 0.019 with significance (F test is equal to 1.475). Regarding the significance, there is a significant relationship between the central courtyard and typology. Until the middle of the Qajar period, Iran's traditional schools preserved the traditional model and body, which consisted of a central courtyard with a number of cells around it, but from the middle of the Qajar period onwards, with the change of the teaching method and the introduction of the new method, the old model and body of the schools did not respond to the new teaching method.						

7.4. Indices of Basic Concepts of Architecture in Schools of Pahlavi and Qajar Era

Introversion

The introversion principle is one of the fundamentals of Islam architecture, which was highly noted in organizing different elements of the building, especially in traditional houses and schools (Pirnia, 2004: 35). Separating the internal arena as an educational space and the external arena as the general arena is one of the common properties of traditional schools (Ghaffari, 1998: 9).

Privacy

By privacy in architecture and urban planning, we mean giving a skeleton to a space so that it has a boundary in terms of skeleton and meaning. Having a boundary in the area of spatial skeleton mostly focus on principles that form the security of the space and are in the meaning area of properties that give value and privacy to the architectural space, in which a person can rest (Hashemi Zarrajabad et al., 2014: 129).

Hierarchy

The existence of a series of spatial hierarchies is one of the principles that has the greatest impact on the formation of spatial privacy in the traditional architecture and urban planning of Iran (Wathiq et al., 2009: 56). The principle of hierarchy means the organization and combination of spaces and elements based on some of their physical or functional characteristics that lead to the emergence of a hierarchy in the way elements are placed, used or observed (Mahdoinejad, 2010). Hierarchy in architecture is the separation of the importance and meaning of a form or space from other organizational forms or spaces, by the size of the shape or its location (Gruter, 2003: 333).

Geometry

Geometry means kindness and justice (more manifest of kindness, wealth, and shapes, and also the justice of God) and the use of coordinated geometric patterns in components and totality of the building in internal space and self-center geometry (concentrated geometry in the circle) and unifying agent in Islamic buildings (Burkhart, 2013: 87).

Unity of Diversity

In a world of abundance and diversity, there is one real unity. On the contrary, there is an understandable and ideal abundance in a world of absolute unity (Namazi, 2003).

Arena of Different Spaces

The placement of different performances and combinations of open and closed spaces in Islamic schools created a proper arena in these spaces. Considering the performance of Islamic schools and residential chambers, the presence of a mosque beside the school is required.

Table 10 Statistical and comparative analysis of basic concepts in the Qajar and Pahlavi era (Source: authors)

Variable		Number	Mean	Median	Deviation	Domain	Minimum	Maximum
Introversion	Qajar	39	4.28	4.00	0.759	3	2	5
	Pahlavi	39	3.00	3.00	1.00	4	1	5
Privacy	Qajar	39	4.49	5.00	0.683	2	3	5
	Pahlavi	39	2.87	3.00	0.789	3	2	5
Hierarchy	Qajar	39	4.13	4.00	0.801	3	2	5
	Pahlavi	39	3.46	3.00	0.789	3	2	5
Peace and resting	Qajar	39	4.00	4.00	0.795	3	2	5
	Pahlavi	39	3.38	4.00	1.01	3	2	5
Spatial definition and combination	Qajar	39	3.59	4.00	0.751	3	2	5
	Pahlavi	39	3.76	4.00	0.985	3	2	5
Geometry	Qajar	39	3.92	4.00	1.036	4	1	5
	Pahlavi	39	3.74	4.00	1.04	3	2	5
Unity in diversity	Qajar	39	3.49	4.00	0.721	3	2	5
	Pahlavi	39	3.28	3.00	0.998	3	2	5
Arena of different spaces	Qajar	39	3.40	4.00	0.998	3	2	5
	Pahlavi	39	3.58	4.00	1.069	3	2	5

The average value of introversion in the Qajar period is 4.28 and in the Pahlavi period is 3.00, and the deviation in the Qajar period is 0.759 and in the Pahlavi period is 1.00, and the deviation in the Pahlavi period is excellent. From the end of the Qajar era onwards, the role of the yard and introversion was reduced from the communicative heart of the complex to an open space. From the middle of the Qajar era onwards, there was a huge change in the pattern of schools. In the new era, imitation of the architecture of the West and the conquest of the modern educational system can be seen comprehensively in modern schools.

Table 11 Analysis of Variance (ANOVA) (Source: Authors)

Indices		Sum of squares	Mean of squares	Degree of freedom	F	Significance
Introversion	Regression	14.147	18	0.786	2.028	0.006
	Remaining	7.750	20	0.388		
	Total	21.897	38			
Privacy	Regression	9.577	18	0.532	1.303	0.028
	Remaining	8.167	20	0.408		

	Total	17.744	38			
Hierarchy	Regression	13.942	18	0.775	1.487	0.012
	Remaining	10.417	20	0.521		
	Total	24.359	38			
Peace and resting	Regression	12.250	18	0.681	1.158	0.037
	Remaining	11.750	20	0.588		
	Total	24.000	38			
Spatial definition and combination	Regression	13.519	18	0.751	1.897	0.008
	Remaining	7.917	20	0.396		
	Total	21.436	38			
Geometry	Regression	20.519	18	1.140	1.126	0.039
	Remaining	20.250	20	1.013		
	Total	40.769	38			
Unity in diversity	Regression	11.410	18	0.634	1.521	0.018
	Remaining	8.333	20	0.417		
	Total	19.744	38			
Arena of different spaces	Regression	17.827	18	0.990	1.997	0.05
	Remaining	9.917	20	0.496		
	Total	27.744	38			
At this stage of the research, according to the regression test in Table 9, the coefficient of determination for the indicators of basic concepts in architecture is (introversion) with a significance of 0.006 (F test is equal to 2.028).						

8. Adaptive and Comparative Analysis of Case Study Schools

The case study schools and standard deviation was analyzed by considering the conducted analyses and regression analysis in schools of Qajar and Pahlavi I eras.

Table 12 Analysis of schools of the Qajar and Pahlavi era and the deviation value (Source: authors)

Indices	Variables	Deviation		Dar Alfonun school of Tabriz	Roshdie School	Ferdowsi school of Tabriz	Anooshirvan school of Tabriz	Chamran school of Urmia	Teb school of Urmia
		Qajar	Pahlavi						
Design indicators	Suitable temperature	0.821	0.785	Opening and Ventilation inside spaces	Large openings and green space	Wide presence of trees and green space to reduce air pollution	Providing suitable temperature with a desirable orientation of the building	Opening all around the building	Using green space and tree all around the building of the school
	Light roof	0.793	0.724	Organizing chairs of the class by the maximum utilizing of the light	Large yard with very large openings	Entrance of the proper light through windows	Using the daylight by considering the visual comfort	Direct lighting of main spaces from the yard	Lighting from all around the building from the yard

	Sound	0.641	0.838	Separating official-service spaces from educational spaces		Using hallways and internal walls without the opening in the middle of the classes	The presence of closed porches all around the classes that face the yard, prevents sound in the space	-	Far from sport spaces and preventing from the sound
	Vision and landscape	1.181	1.169	Providing a landscape that faces the green space for classrooms, by installing windows with an appropriate height	Green space in the yard	View from the windows to the yard and from porches to the external yard	Providing a desirable view by using large windows and a closed porch	View from the windows of the classrooms to the main yard	The building is in the middle of the yard and has a good view from the classes to the yard
	Healthy weather	1.295	1.273	Healthy weather in the yard and transforming it into the internal space	Large windows on both sides create a healthy weather	Healthy weather in corridors through the draft through porches	Providing a suitable vision and healthy weather in half-opened porches facing the yard	Creating healthy weather in the middle corridor between classes	Healthy weather in classes with many windows
	Accessibilities	0.706	0.686	Accessibility from the yard to the classes	4 separate entrances through the court	Accessibility to the classes from the corridor	Accessibility from the internal yard and all around the yard, corridor, and classes all around the corridor	Accessibility from the main yard to corridors and classes	Accessibility from the main yard to the half-opened porch and by entering the corridor and classes
	Links	0.790	0.637	Directly from the yard to the classes	4 separate entrance-through the court	From the porch to the inside and connection corridors and stairs to the upstairs	Links through corridors and internal stairs	Internal circulation and links through the corridor	Links through the porch to corridors and classes
	Hierarchy	0.884	0.838	Entrance with entrance components of the yard and porch	Entrance from the yard and main porches	Entrance from the yard and from the porch to the corridor	Entrance from the internal yard to porches and the corridor	Corridor exist between classes	Link through the porch to the corridor and classes
	Spaces layout	0.754	0.711	Proper layout of all classes facing the yard	All around the central yard	Classes are organized between the corridor	Organization of the classes is all around the corridor which is in the form of a closed porch	Organization of the classes in between the corridor in the middle of the classes	Regular organization of the classes between the two corridors and connection as the hierarchy
	Full and empty spaces	0.754	0.938	Yard-Porch	Porches are open	Yard and porch-Closed stoop	The closed-porch yard	Main yard	Half-opened yard and porch
	Full and empty spaces	0.882	1.093	Half-opened space	A porch exists between the open and half-opened space	Open and half-open space with a porch and corridor between classes	External and internal yard-Open and half-opened space of porches	A large main yard and, like the new schools, without the porch	The main yard all around the building and half-opened porch
Shape indices	Shape	0.847	0.986	L-shape	Z-shape	H-shape	U-shape	Rectangular-square shape plan	Rectangular-shape plan

	Structural	0.822	0.826	Structure fitting the use (educational)	Structure fitting the school with the yard	Structure of school fitting with the external yard close to the new schools	The structure fits the new school	The structure fits the new school	-
	Square volume	1.142	0.852	-	-	-	-	-	Square-shape
	Rectangular volume	0.918	0.761	Rectangular-square	-	Square and rectangle	3 attached rectangular-square	Rectangular	-
	Free and effective forms	1.093	1.493	-	Clear shape	-	-	-	-
	Façade symmetric	0.923	0.731	asymmetric	symmetric	Symmetry in plan and view, rhythm in view	Symmetric and rhythm in view	Symmetry in plan and view, rhythm in view	Symmetry in plan-rhythm in view
	At least two stories above the zero level	0.560	0.549	Two stories	Two-stories	Three stories-	Three stories-	Two stories-	Two stories
Pattern indices	Central yard	0.766	1.085	inner courtyard	Coherence factor of surrounding spaces	It has two inner and outer courtyards	Outer courtyard and inner courtyard	Outer courtyard	Outer courtyard
Indices of the basic concepts in the architecture	Introversion	0.759	0.902	Introvert	Introvert	Introvert	Introvert	Extrovert	Extrovert
	Hierarchy	0.801	0.789	Entrance with entrance components of the yard and porch	Entrance from the yard and main porches	Entrance from the yard and from the porch to the corridor	Entrance from the internal yard to porches and the corridor	Corridor exist between classes	Link through the porch to the corridor and classes
	Peace and resting	0.795	1.016	Sense of peace inside the school building	Sense of peace and separation of accessibility of each class-sense of attachment	Reminder of traditional architecture-simple- historical symbols of survival	Sense of peace in the central yard and beautiful nature causes reduction of stress	Sense of movement around the corridor	Sense of peace inside the school building
	Spatial combination and definition	0.751	0.985	Combination of square and rectangle	Combination of square and rectangle	Combination of square and rectangle	Combination of square and rectangle	Combination of square and rectangle	Square
									

9. Open Coding for the Transformation of the Historical schools Concept

Interviews conducted

In introverted architecture, three problems of creating a favorable relationship between man and nature, setting environmental conditions for human life and logical connection with the features of the site are considered (Kedbaz: environmental and climatic factors, the presence of nature,...)

The internal order of traditional schools is geometric, symmetrical and with introverted architecture and with a special connection in the form of successive spaces between outside and inside (Kedbaz: geometric order,...)

In the architecture of traditional schools, the module and rhythm of the components play an important role in the quality of the expression of the space (Kedbaz: rhythm,...)

In these schools, it is possible to understand their good quality as the empty spaces dominate the spaces and evoke a feeling of lightness and transparency in people (Kedbaz: transparency,...)

The sequence of diverse spaces, dark and light, changes in the density of space, diversity in the degree of enclosure, size, direction, color, decorations, etc. can be considered as desirable measures for schools (Kodebaz: spatial diversity, decorations, color, ...).

In school architecture, human scale means the relationship between human dimensions, sizes and abilities with space or elements (Kedbaz: human scale,...)

Having the right identity and connection with sustainable values in native and traditional architecture. The school has a desirable personality and identity, which is the adaptation of form and function and concept in the body of the building (Kedbaz: form and function,...)

The school building is an effective element in the quality of image and urban architecture, which has the desired form and visual quality (Kedbaz: Urban image, ...)

Visibility and the importance of its role in the image and view from the distance of the city (Kedbaz: physical form, ...)

In the architecture of historical schools, paying attention to the skyline and the view from the far side of the city and creating the necessary legibility in the school's dimensions (Kedbaz: legibility, ...) (Source: authors).

9.1. Open Coding

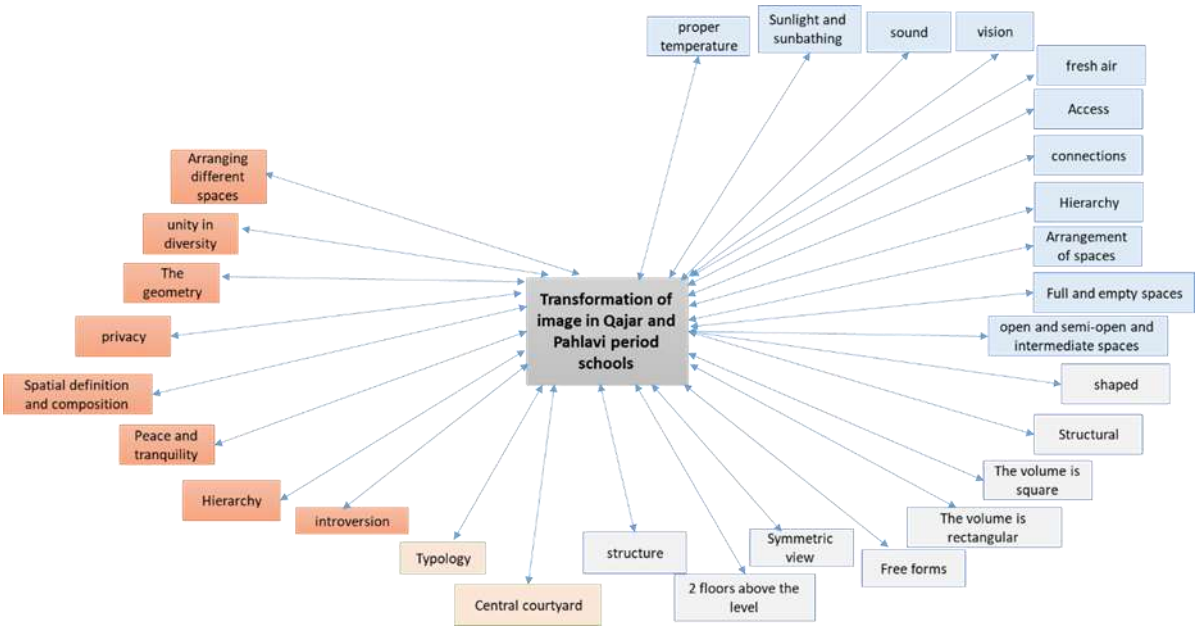


Fig 3 Open coding of semi-structured interviews with experts (Source: author)

9.2. Axial Coding

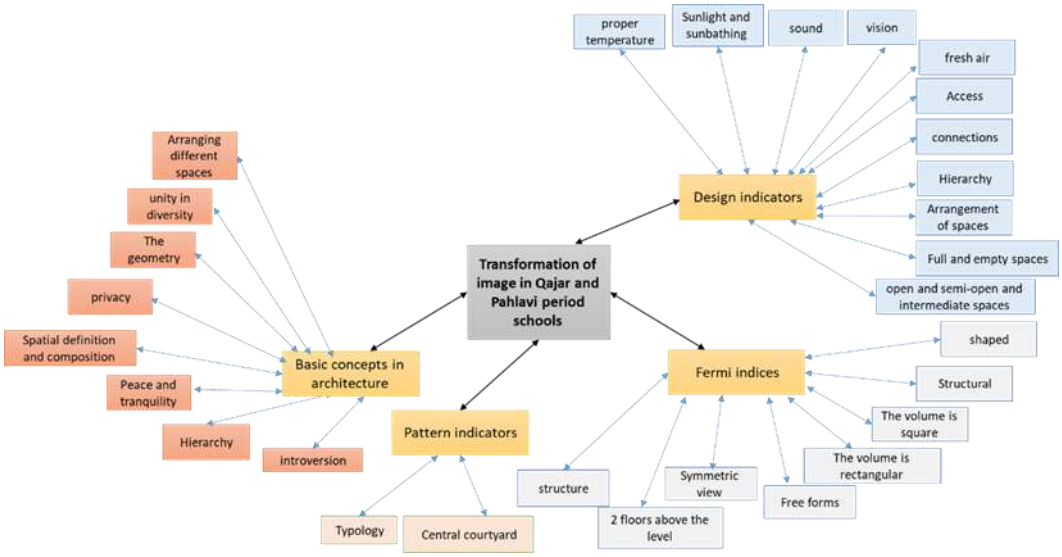


Fig 4 Qualitative model extracted from the process of open coding and interviews with experts (Source: author)

10. Smirnov's Kolmogorov Test

In this stage, after choosing the selected variables from the qualitative stage, a questionnaire is compiled and randomly distributed among space users. The results are entered into SPSS software, 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 (Source: authors).

Table 13 Kolmogorov-Smirnov test to check the normality of the components of the paradigm shift indicators (Source: authors)

Variable	**Average**	**Standard deviation**	**Z Kolmogorov Smirnov**	**Asymp. Sig. (2-tailed)**	**p**
Components of the indicators of conceptual transformation	40/46	6/19	1/10	0/0170	0/177

As can be seen in Table 13, the Kolmogorov-Smirnov test for the score of the components of cultural changes and the indicators of paradigm shift is significant (p=0.177) and therefore the internal and external indicators do not have a normal distribution and non-parametric analyzes should be used for them. used. If the value of Sig is less than 500, it means that the test is significant and non-parametric tests should be used. Here, since it is less than 5 percent, it means that the non-parametric test should be used (Source: authors).

11. Cronbach's Alpha Coefficient of Statistics for Research in the Qajat Period

It can be stated that the best method of calculating internal consistency is to use Cronbach's alpha coefficient to measure the reliability of a questionnaire. This method is based on the coordination and compatibility of questionnaire questions. It is obtained by finding the variance of each question and the variance of the total of questions. Its calculation formula is as follows (Source: authors).

Table 14 Cronbach's alpha coefficient of the Qajar period.

Reliability statistics	
Cronbach's alpha	A number of cases
0/707	30

Table 13 Summary of the statistics of Qajar period research.

	Number	Percent
Items	30	100.0
Excluded	0	0.0
Total	30	100.0

The results obtained in Table 16 are as follows: The numerical value of Cronbach's alpha coefficient, which considers the 30 questions of the questionnaire, is equal to 0.707, which shows that the reliability of the questionnaire is average (Source: authors)

- Cronbach's alpha coefficient of research handling statistics in the Pahlavi period.

Table 16 Cronbach's alpha coefficient of the Pahlavi period.

Reliability statistics	
Cronbach's alpha	A number of cases
0/877	30

Table 15 Summary of the statistics of Pahlavi period.

	Number	Percent
Items	30	100.0
Excluded	0	0.0

		Total	30	100.0

The results obtained in Table 16 are as follows: The numerical value of Cronbach's alpha coefficient, which considers the 30 questions of the questionnaire, is equal to 0.877, which shows that the reliability of the questionnaire is average (Source: authors).

12. Architectural Solutions of Effective Indices in the Architectural design of Schools

Change in the overall structure of the school building, which stepped toward extroversion and increased the students' desire to be present in the school.

Change in the structure of micro spaces, creating new educational spaces in new schools.

Accessibility hierarchy, since new schools are extrovert and have new educational spaces.

Natural elements in the Qajar era used the central yard to provide light and ventilation, and afterward, since the middle of the Qajar era, the central yard was emitted and transformed to the extrovert type, and the green space should be used in yards of the school.

The introversion form should be maintained in the architecture of schools, and connection should be established through corridors.

Central organization in the plan of schools to create a visual connection and high clarity in the school space

Using linear organization in combination with the central organization to create numerous spaces, the more nonlinearity in the corridor and spatial opening, the value of its indices increased.

Using the visual type in an open space is an interaction to create a link between inside and outside using a method that links customers to each other.

Using more reliable and up-to-date heating equipment in renovated schools, the comfort temperature of students according to standards was not considered

Despite considering safety and aesthetic factors, the psychological matters in designing the pattern of windows and openings in renovated schools were not considered

Existence of hierarchy and green space as links between places, green space is the common link between places

Using rhythm, discipline, and connection between components coordinates them and creates the feeling of balance, belonging, being purposeful, clarity, spatial transparency, and comfort

Using Iranian architectural evidence, materials such as brick and using tilework and arches

Changes in the educational environment facilitate the flexible design of classrooms

Improving the quality of environmental factors by providing a proper ventilation system, providing sufficient light, and vicinity to the window to use the natural light and more view

Design of furniture and layout of the educational space to improve the psychological situation by creating a desirable educational atmosphere and improving the relationship between authorities and students (Source: authors).

13. Discussion and Conclusion

Changes in architectural methods occurred over history, and above all, the industrial revolution transformed the learning system of trainer-student into a desirable academic system. The arrival of civilization to Iran in the Qajar era caused a change and paradigm shift in school architecture. A significant transformation appeared in the architecture of schools through the establishment of Dar al-Funun. Before the Qajar era, mosques were the place of teaching and training. By separating schools from mosques and considering changes over time, the construction of schools using the novel method began in the late Qajar era, and most importantly, quick transformations in the Pahlavi I era affected the educational system of Iran significantly. Considering the analyses of

design indices in schools of the Qajar and Pahlavi eras, open spaces with different spatial elements like green space and pools are more observable in the Qajar era, while closed, half-opened, and in-between spaces with appropriate and human relationships are more considered in the Pahlavi era. Providing sufficient natural light is critical in all eras. According to analyses, using the central pattern in the school plan can be used as the design solution of fundamental factors for creating spatial unity, uniformity, and continuity between spaces of the school. Until the middle of the Qajar era, traditional schools of Iran maintained traditional patterns and skeletons; it consisted of a central yard with some chambers around it. But since the middle of the Qajar era and after changing education methods and the entrance of new methods, the old style of schools was not enough. In the late Qajar era, the role of the yard and introversion was reduced from the connection heart of a set to an open space. Since the middle of the Qajar era, a significant change appeared in the patterns of schools. The architecture of traditional buildings of the Qajar era is symmetric around one axis or two perpendicular axes. The main elements of the school building are placed on two sides of the axis and boost the centrality of the yard and general skeleton, which is seen in the case study schools. It seems that the educational evolution in the Qajar period can follow the concept of formal and physical continuity of the traditional Iranian architectural format and items such as the central courtyard and module and the framing of facades and symmetry, introversion and appropriate geometry And... it can be seen. The model of these schools includes a central courtyard with a number of classrooms around the courtyard. In the architecture of these schools, the form of introversion is maintained and communication is possible through the corridors. During the Qajar period, the cell part was removed and turned into a corridor and classroom, and later schools changed from an introverted type to an extroverted type. In a comparative comparison between traditional schools and modern schools, it is possible to point out the difference between centralism in the mosque of traditional schools and centralism and polarity in modern and modern schools in the analysis of plans and sections according to the basic concepts of architecture (order, proportions) , symmetry and axis, hierarchy) we can refer to the macro policy of the country during the time of Reza Shah, which was manifested in the form of the Shah, a symbol of power, centrality and axis, and also to the authority of Reza Shah, along with the import of science from the West, and his unconscious influence on the educational system. The architecture of traditional schools is often symmetrically formed around one axis or two perpendicular axes, the main elements of the school building are located on both sides of the axis and together with the design of the courtyard, they strengthen the centrality of the courtyard and the overall structure. The formation of educational spaces based on geometric form, central courtyard, introvert and extrovert type, privacy, spatial arrangement, communication and open and semi-open spaces have evolved in both periods. In the Pahlavi period, the central courtyard is lost and the linear form is replaced. During the Qajar period, Iran's schools maintained the traditional model, but from this period onwards, with the establishment of the Dar al-Funun, changes were made in school architecture. In the new era, imitating Western architecture and the dominance of the novel educational system are observable. Plan and architecture are not similar to old schools and are in the form of an extended rectangle. In this age, introversion is removed, extroversion is formed, and the linear state is replaced with the corridor in the middle and side flanges replacing the central yard. It creates shape diversity and changes in the architectural skeleton of schools. This point has been created in the building plan, internal performance, transformation, and paradigm shift in the entrance and yard of the school.

References

Alaghmand, S., Salehi, S., & Mozaffar, F. (2017). A Comparative Study of Architecture and Content of Iran's Schools from the Traditional Era to the Modern Era. *Bagh-e Nazar, 14*(49).

Alagehmand, S., & Hosseini, B. (2014). Comparative study of architecture and content of traditional and contemporary schools in Iran, a case study: Do Dar School in Mashhad, Chahar Bagh, Isfahan, Agha Bozur, Kashan, Dar al-Fonun and Markar Yazd. *International Conference on Civil Engineering, Architecture and Urban infrastructures*.

Azemati, H., Aminifar, Z., & Pourbager, S. (2015). The model of spatial arrangement of modern schools based on the principles of Islamic schools in order to improve people's learning. *Naqsh Jahan Scientific and Research Quarterly*, 6-2, 16-23.

Alhaji, M., & Ahmed, A. (2013). Analysis of human heat stress status for academic learning environment in Kano University of Science and Technology, Wudil, Kano State, Nigeria. *Stroke, 3*, 13.

Arundel, A. V., Sterling, E. M., Biggin, J. H., & Sterling, T. D. (1986). Indirect health effects of relative humidity in indoor environments. *Environmental health perspectives, 65*, 351-361.

Ahadi, A. A., & Khanmohamadi, M. A. (2015). Better Performance of Students by Proper Utilization of Daylight in Classrooms Case Study: The Architecture School, Iran University of Science and Technology. *Journal of Architecture and Urban Planning, 8*(15), 25-42.

Bakó-Biró, Z., Kochhar, N., Clements-Croome, D. J., Awbi, H. B., & Williams, M. (2007, June). Ventilation rates in schools and learning performance. In *Proceedings of CLIMA* (pp. 1434-1440).

Babayi, Z. A., Torabi, F. S., & Mirhosaini, M. H. (2020). *Factors Affecting the Development and Establishment of the Modern Educational System in Yazd from the Constitutional Revolution to the End of Pahlavi I*. 1-20.

Babaei, S., & Khakzand, M. (2022). Contextualism in the Works of Non-Iranian Architects during the Pahlavi I Era Case Study: Alborz and Iranshahr Schools. *Journal of Iranian Architecture Studies, 7*(14), 171-189.

Burkhart, T. (2013). *Sacred art* (Sattari, J. Trans.). Tehran: Soroush Publications.

Divandari, J., Barakati, A., & Dashti Joshghan, Sh. (2018). A comparative comparison of the evolution of the spatial structure of Qajar and Pahlavi schools with an emphasis on the hidden values of education in Mashhad (Study example: School of Suleiman Khan and Yadgar Dr. Ali Shariati). *Architectural Quarterly, 1*(1).

Daneshmehr, Z. (2007). School yard fun. *The new School Journal, 41*, 54-57-54.

Ghaffari, A., Takapumanesh, Sh., Shahin, A., & Farooqi, S. M. (1998). Design principles of educational spaces, principles and criteria of school design. *Organization of Modernization, Development and Equipment of Schools, 6*, Tehran.

Ghaffari, A. (1998). The principles and basics of designing educational spaces, determining the principles of construction and explaining sustainable values in traditional schools of Iran, introducing selected samples. *Organization of Modernization, Development and Equipping of Schools, Shahid Beheshti University, 1*, Tehran.

Ghasemi Puya, I. (1999). *New Schools in the Qajar Period: Founders and Pioneers*. Publisher: University Publishing Center, first edition.

Ghermezi, M., & Nasrollahi, F. (2019). The Effect of Building Typology on the Reduction of Energy Consumption in Esfahan Schools. *Iranian Journal of Energy, 22*(2), 5-21.

Habibi, K., Pourahmad, A., & Meshkini, A. (2012). *Improvement and Renovation of Old Urban Textures*. El-Eght Publication, Second Edition, Tehran, pp. 1-350.

Hashemi Zarrajabad, H., Taqvi, A., & Masoudi, Z. (2014). Introversion and reflection of the principle of privacy in Iranian-Islamic architecture, Example of field research: historical houses of Birjand. *Social-cultural studies of Khorasan, 3*.

Helenbrand, R. (2003). *Islamic architecture, form, function and meaning* (Ayatollahzadeh, B. Trans.). 7th edition.

Kiani, M. (2011). Architecture of Iran during the Islamic period. *Tehran: SAMT Publications*.
Kamel Nia, H. (2006). Grammar of Designing Learning Environments, Concepts and Experiences. *Publisher: Sobhan Noor*, First Edition.
Masoudi Gogani, A., & Houshmandpour, Y. (2012). Studying the Contrast of Traditional or Modern Architecture. *Iran Social Science Studies, 9*(35).
Mehrabian, S., Safari, H., & Sohaili, J. (2020). Comparative comparison of the morphology of contemporary Iranian schools using the method of space arrangement. *Educational Innovations Quarterly, 19*(74).
Mousavi, B. (2018). Representation of the Qajar building of Dar al-Funun School based on visual documents. *Scientific Quarterly of Architecture and Urban Development, Safa, 30*(88), 107.
Memarian, Gh. (2004). *A Survey of Theoretical Principles of Architecture*. Tehran, Soroush Danesh.
Memarian, Gh., & Dehghani Tafti, M. (2016). In search of a new meaning for the concept of species and typology in architecture (case study: Taft city hall type house). *Housing and Village Environment Journal, 162*, Tehran.
Mahdavi-Nejad, M. J., & Nagahani, N. (2013). The effect of visual literacy on the perception of beauty in architectural works. *Architecture and urban planning of Armanshehr, 4*(7).
Minorisky, P. (1953). *History of Tabriz* (Karang, A. A. Trans.). Tehran Bookstore Publications.
Namazi, M. (2003). Causality and unity of existence from Mulla Sadra's point of view. *Qom: Publication Center of Imam Khomeini Educational and Research Institute* (Quds Sareh).
Naseh, M. A. (2007). A comparative look at the background of six historical Iranian schools (with an approach to criticizing the teaching of the alphabet in the traditional educational system). *Anjuman Journal, 28*, 107-134.
Nasiri, M. (2008). Studying the evolution of the educational system of schools during the Qajar and Pahlavi period. *Research Institute of Islamic Sciences and Culture, 25*(150), 195-278.
Nasrullahi, F. (2011). National Building Regulations and Reducing Energy Consumption in the Building Sector. *Second Energy Management and Optimization Conference and Exhibition, Niro Research Institute*, Tehran.
Pirnia, M. K. (2004). Iranian Architectural Stylistics. *Soroush Danesh Publications*, Tehran.
Pirnia, M. K. (2013). *The Style of Iranian Architecture*. Edited by G.H. Memariyan, Tehran: G. H. Memariyan.
Shetabivash, H. (2015). Investigation of opening position and shape on the natural cross-ventilation. *Energy and Buildings, 93*, 1–15.
Stewart, S. C., & Evans, W. H. (1997). Setting the stage for success: Assessing the instructional environment. *Preventing School Failure, 41*(2) ,53-56.
Sterling, E. M., & Arundel, A. (1985). Criteria for human exposure to humidity in occupied buildings.
Sadat Razavipour, M., & Zakeri, M. M. (2016). The impact of education system transformation on the architectural identity of Qajar and Pahlavi period schools (1320-1255). *National Studies Quarterly, 18*(4).
Sobhani, R. A. (1958). History and nomenclature of schools in Tabriz. *East Azerbaijan Culture Publications, 1*(22), Tabriz.
Sami Azar, A. (1997). History of school developments in Iran. *Organization of modernization, development and equipping of country schools*, Tehran.
Sami Azar, A. (2000). Shents view and the functional model of open space in Iranian schools. *Safa Magazine, 10*(31), 109-110.
Soltanzadeh, H. (1984). The history of Iranian schools from ancient times to the establishment of Dar al-Funun. *Publisher: Aghah, first edition*.
Sardari Nia, S. (2003). Dar al-Funun Tabriz (Mozaffarih School). *Neday Shams Publications*, first edition, Tabriz.

Tarifi, H. (2012). Comparative and analytical study of the historical course of higher education in Iran with emphasis on the social, economic, political and cultural changes affecting it in the three eras of Qajar, Pahlavi and Islamic Revolution. *Secretariat of the Supreme Council of Cultural Revolution, Education Commission and education.*

Available online at www.ijapas.ir

IJAPAS International Journal of Applied Arts Studies

International Journal of Applied Arts Studies

IJAPAS 9(3) (2024) 89–100

A Thematic Reflection on Gülru Necipoğlu's Theories in the Topkapi Scroll- Geometry and Ornaments in Islamic Architecture

Seyed Ehsan Mirhashemi Routeh[a], Hossein Soltanzadeh[b], Shervin Mirshahzadeh[c]

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

Received 22 February 2024; revised 03 May 2024; accepted 02 July 2024

Research Article

Abstract

The study conducted by Necipoğlu in the book "Geometry and Ornaments in Islamic Architecture" is widely recognized as an influential work. However, some of her assumptions require re-analysis after approximately three decades. This research aims to re-evaluate her three hypotheses from the book, namely the denial of the connection between Sufism and architecture, the position of architecture in the classification of sciences, and the close relationship between mathematicians and artisans. For this purpose, this research, which is methodically organized based on content analysis and interpretive-historical approaches, obtained its data from historical sources and tried to reanalyze the mentioned assumptions by relying on the actor-network theory. The study concludes that although there is a lack of documentation, the connection between architecture and Sufism cannot be disregarded, and one should believe in some form of relationship between them.; Architecture has been an independent knowledge in the classification of sciences since the 8th A.H., and the relationship between mathematicians and craftsmen should be viewed as mutual, and both have played a significant role in promoting the knowledge of practical geometry in architecture.

* Corresponding author. Tel: +98-9122093203.

E-mail address: hos.soltanzadeh@iauctb.ac.ir

This article is derived from a doctoral thesis entitled "The explanation of intellectual and epistemological references effects, on the Islamic architecture" which is carrying out at the Central Tehran branch, Islamic Azad University by the first author with the guidance of the second author and the advisor of the third author.

Keywords: Islamic Architecture; Actor-Network Theory; Sufism and Architecture; Geometry.

1. Introduction

Necipoğlu's seminal work, "Topkapi Scroll- Geometry and Ornaments in Islamic Architecture," made a profound impact on the field of Islamic architecture by providing an explicit framework for theories that had previously been left implicit. Its first edition was published in 1995 and immediately garnered acclaim, earning both the Albert Hourani and Spiro Kostov book awards. This study offers a valuable perspective on the history and art of Islamic architecture, informed by the ideology that underpins it. As nearly three decades have passed since its publication, it is now imperative to revisit, elaborate upon, scrutinize, and reassess the theories put forth in the book to continue pushing the boundaries of Islamic architectural scholarship. The field of Islamic architecture is categorized into seven distinct areas (Blair and Bloom,2003; Mojtahedzadeh, 2022), including historiographical, archaeological, cultural context-based, traditionalist, phenomenological with a hermeneutic tendency, and based on religious teachings. Professor Necipoğlu's study falls under the final category, which is influenced by the current post-colonial studies. The distinguishing feature of Islamic architectural studies influenced by the post-colonial movement is their opposition to the Western scholars' high handedly visions about the art of the East.

According to Necipoğlu's hypothesis, architecture is a distinct field of study that is consistently classified under the mechanics (Ĭlm al ĥiyal), in all classifications of sciences encyclopedias (Necipoğlu, 1995: 139). She posits that during the Islamic epoch, there existed a close association between geometry theorists and architecture practitioners (Ibid, part4). Moreover, it has been proposed that there was a weak correlation between social movements like Sufism and architecture during that period (Ibid, part 2). This study aims to conduct a thorough analysis of these three fundamental principles as outlined in her book. To achieve this objective, the study will employ a qualitative approach utilizing a combination of content analysis and historical interpretation. The research will draw on historical documents and evidence as a means of testing the validity of Necipoğlu's assumptions. This research is inspired by Necipoğlu's later ideas (2017), where she considered the effectiveness of actor-network theory in Islamic architecture. However, she did not elaborate on this perspective. To ensure historical accuracy, this study endeavors to examine the presence of this theory and detect any indications of it in the perspectives of Islamic scholars in the late Ilkhanid and Timurid eras. By doing so, the research seeks to illuminate and enhance comprehension of these three issues.

2. Research Background

It is not unusual for innovative concepts and hypotheses to encounter opposition, and this particular study is not exempt from such scrutiny. In truth, the level of criticism directed towards it has been so severe that it has been labeled as a "not intended to be read" publication (Saliba, 1999: 637). Additionally, this article challenges the inconsistent arguments of the author in Arabic to English translations, which have led to general criticism (Ibid, 638- 639). One of the major problems identified in Necipoğlu's research is the lack of sufficient evidence to prove the relationship between craftsmen and mathematicians (Ibid, 641- 642). However, it should be noted that the nature of this relationship has not been determined in this article and the author has not provided any answers. Despite this, there are documents that suggest the mathematicians were aware that their methods were not very useful for craftsmen. For example, there is a recommended

method for craftsmen to find the direction of Qibla (Al- Biruni, 1973: 249-252). Such documents could have been mentioned in this critical paper.

Further research has brought to light doubts about the authenticity of the records utilized by Necipoğlu, and the birthplace of geometric designs has come under scrutiny (Allen, 2004). The author asserts that the epistles on practical geometry did not prove to be especially efficacious in the realm of architecture and that the development of these patterns commenced in the late antique era, continuing through the Islamic epoch (Ibid, 12-16). However, the article falls short of providing substantiating proof for this claim and is limited to offering critical commentary on the subject.

Necipoğlu's research presents a significant challenge as she posits that architecture and Sufism are not connected. Scholars who follow traditionalist thought disagree with this claim, citing Necipoğlu's lack of understanding regarding the social origins of mysticism and Sufism, as well as trade union affiliations (Bolkhari, 2016: 537- 453). It is worth noting, however, that these critics have yet to produce any concrete evidence supporting the purported relationship between Sufism and architecture. What sets the current study apart from previous reviews is its effort to align themes and assumptions with historical documents and intends to rectify or adjust assumptions based on a theoretical framework that she has endorsed.

3. Research Methodology

In this study, the methodology employed is thematic analysis, which involves interpreting and organizing aspects of phenomena to summarize, interpret, classify, divide, and reconstruct qualitative data and the repetition of themes in the text is used to identify them (Braun & Clarke, 2006: 75-76). To verify the themes proposed by Necipoğlu, the interpretive-historical method is utilized, because of their historical nature (Grout and Wang, 2012: 31-34). Interpretation requires theoretical foundations, premises, and assumptions to support a convincing argument (Collingwood, 1946: 9-10; Behnoud, 2022: 21). In this study, the actor-network theory is employed as a theoretical basis, so the research methodology is a combination of thematic analysis and interpretive-historical methods. One of the recurring themes in Necipoğlu's research is the relationship between mathematicians and artisans. This study presents a fresh interpretation of this relationship, drawing on historical documents and epistles on practical geometry, as well as the theoretical basis. The classification of sciences, specifically about the position of architecture in the scope of science, is another recurring theme. This research proposes modifications to Necipoğlu's theories by referring to the encyclopaedias of science classification during the Islamic period. Finally, the relationship between Sufism and architecture is analysed. The study explains the nature of this relationship based on historical documents and their interpretation.

4. Theoretical Foundation

The purpose of a theory is to provide a comprehensive set of concepts and regulations that can elucidate a particular subject, ultimately enhancing our comprehension of it (Razjoyan, and Masoudi nejad, 2018: 149). This research utilizes the actor-network theory to achieve this purpose. A branch of semiotics (Law, 1999: 2), this theory takes an ontological approach and is influenced by science and technology studies. It proposes that all knowledge is comprised of social, technical, conceptual, and textual processes, formed by both human and non-human factors such as objects and tools (Dilaveroglu et al., 2021: 44). It's important to note that when applying this theory to historical research, the prevalent ideas of the time being studied must be considered. Otherwise, the

research may be led to anachronism. One of the key tenets of this theory is tracking the actions and actors involved in a network to reveal the nature of the network (law, 2008 a) and how material objects and tools appear in time and space (Law, 2008b). According to the actor-network theory, an actor is not limited to a human with a will (Latour, 1996) but can include any entity with the ability to act, including non-human entities (Latour, 2005). The theory suggests that these actors can make other elements dependent on them, creating a network of interdependent entities (Anvari and Karamollahi, 2018: 39). According to Islamic philosophers' ideas, human movements can be classified as "natural" or "artificial" (Nasir al-Din al-Tūsi, 1977: 149). They attributed artificial movement to human will and the assistance of nature (Qūtb al-Din al-Shirazi, 1990: 1/ 159-161). They also believed that such movements were intended to benefit humans (Tabātabāei, 2004: 237). The general division of movement is based on the mover (the subject of movement) and the agent of movement (Tabātabāei, 1993: 4/46-60). In the case of artificial movement, this means a change or transformation in the materials of nature by a subject or agent to meet primary and secondary human needs (Ibid, 11-12). This process is called art and is considered the best science and the medium of the emergence of truth in existence (Ibn al-ʿArabī, 1999: 6/234). Therefore, in the view of Islamic philosophers, materials, and nature also play a role in the artificial movement, in addition to humans.

This theory emphasizes the importance of networks, where networks and actors are two aspects of the same phenomenon (Latour, 1999a: 19). One person cannot build even one house, but two people can build several houses, so the building process is not up to one person and is a collaborative matter (Ibn Khaldūn, 2003: 2/681-683) as it requires the skills of various workers such as architects, engineers, construction workers, artisans and craftsmen (Ibid: 2/807-811). Some scholars separated engineers and Artisans and considered their differences in the potential of inference (Nasir al-Din al-Tūsi, 1977: 288). It means that at least three actors should be involved in construction. A group in the theoretical field (having the potential of inference), they are known as theoretical geometry scholars (Fārābi, 2010: 77) and are probably involved in the supervision of the building or presenting the general plan (Aghayani Chavoshi, in Būzjānī 2010: fifty-six) and some have acquired their knowledge in practice, who are practical geometry experts (Artisans) (Fārābi, ibid.) and acquired their knowledge through continuous practice (Al-Tahanavi, 1996: 2/1097) and are in charge of building construction and are not very knowledgeable about theoretical geometry (Aghayani Chavoshi, ibid.: fifty-seven). This is while achieving perfection in any industry is considered to fill the gap between theory and practice (Fārābi, 1979: 164). Therefore, the intermediary link needs to have a common language with engineers and manufacturers. This intermediary circle is the master artisans (Ghorbani, and Sheikhan, 1992: 32, 47, 85-89; Laleh, 1996: 42, 48; Mojtahedzadeh, 2021: 145) who, as they say, complete the work by following the instructions of the masters of that industry (Nasir al-Din al-Tūsi, Ibid).

But if we imagine that these three groups are activists in the field of architecture, we are wrong. It has happened a lot that, like the Ferdows historical school (in Aleppo), the patrons, the client, and the users have changed the type of execution and even the geometrical principles governing the construction (Tabbaa, 1988: 23-32); So, this group of hidden actors in the field of action. Reflecting on the data of the previous paragraph, we can say: the network is a collection of all actions, actors, methods, documents and images, tools and materials that appear in a certain time and place (Latour, 2014).

Therefore, relying on these opinions, architecture is an artificial movement, that is, it is directed to action; therefore, one dignity of this network is the process of action. Every human action is based on his knowledge and will; as a result, the agent (actor) with any benefit of knowledge in this

industry is considered another dignity of the architectural network. The industrial movement requires the capture and transformation of natural materials; accordingly, the materials, constructions, and tools of the aspect will be considered another form of architecture. Finally, the product of the architectural work is the last aspect that results from the sum of the previous subjects. The interaction of material and non-material forces affects these subjects and forms the theoretical model of the research (Fig.1).

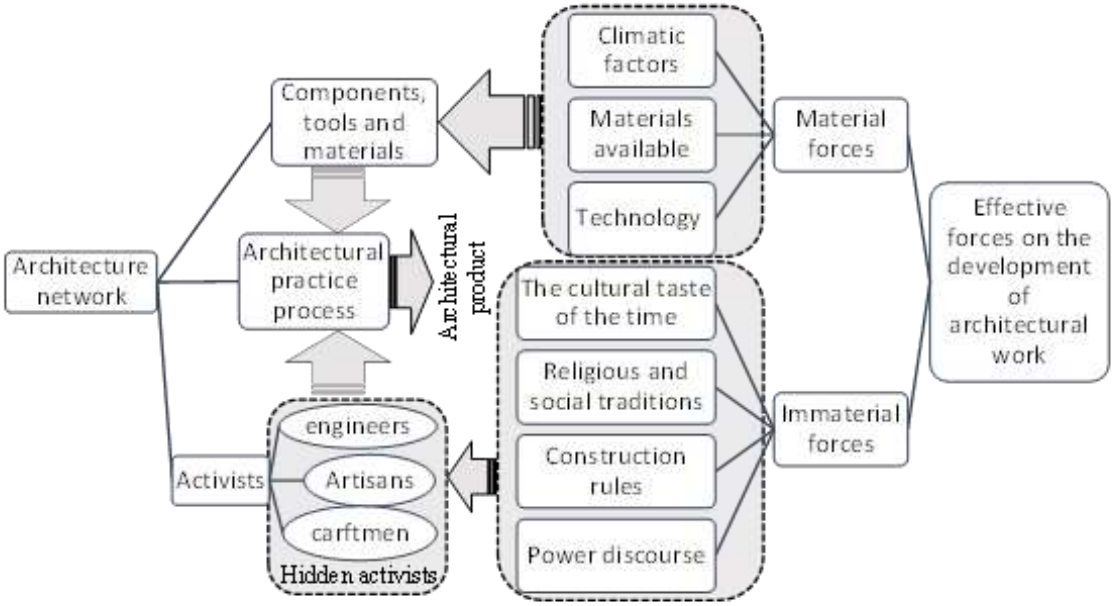


Fig 1 Conceptual model of the material and immaterial forces on actors and architectural works. (Source: Authors)

5. Findings and Discussion

5.1. Analysis of the Relationship between Architecture, Sufism, and Mysticism

In her research, Necipoğlu has rejected the views of traditionalists who assume Islamic architecture is based on mystical and Sufi foundations and consider it to have a timeless nature, due to lack of documentation (Necipoğlu, 1995: 75-83). It seems that her hypothesis needs to be adjusted. It is believed that Sufism was first mentioned in science classification encyclopedias during the 7th A.H (Shams al- Din Amoli, 2002: 2/ 2-128). Some Sufism masters have identified seven stages on the path of the seeker. Each stage has eight conditions, which become increasingly spiritual and difficult as one ascends to higher stages ('Ala' al-Dawla Simnani, 1990: 256-264). Naturally, such difficult conditions can only be achieved by seclusion from the world. This form of mystical behavior can be interpreted as a theoretical mysticism that was established by Ibn al-ʿArabī (1165-1240). Some researchers have believed that it is related to architecture, although there is no evidence to support this claim. As Sufism matured, a popular version of it called " chivalry (Futuwah)" was introduced to penetrate the hearts of the community (Mahjoub, in Va'ez Kashefi, 1971: seventy- seven). Chivalry has been considered a noble science and a branch of Sufism (Va'ez Kashefi, 1971: 5; Shams al- Din Amoli, 2002: 110-128). Its study is not as difficult as the

cases presented earlier. The principles and the ability to acquire chivalry have come in the same form in almost all chivalry edicts (Futuwat nameh) of this age, based on an Imam Ali's hadith (Shams al- Din Amoli, ibid: 115; Va'ez Kashefi, ibid, 27-28; Khan Mohammadi, 1992: 12-13). Such behavior can be considered as a kind of practical mysticism that is not unique to nobility and elites but can also be raised among experts, craftsmen, and guilds. In the east of the Islamic world, the impact of this social culture on guilds is theoretically with chivalry edicts (Futuwat nameh) and public and popular assemblies of some monasteries (Muhammad ibn Monavvar, 2010: 1/67, 270), which is a kind of moral education. From a practical point of view, similarities can be traced in some common ceremonies between guilds and companions of Sufism, such as tying the waist (Shūdd) or promotion to the position of a master (Saeid al- Sheikhli, 1983: 36). Therefore, one should believe in the relationship between a branch of Sufism and a profession such as architecture. Such teachings are effective on religious affairs such as ethics and beliefs and definitely have an effect on the actors the course of architectural action and ultimately the architectural product (Fig. 2).

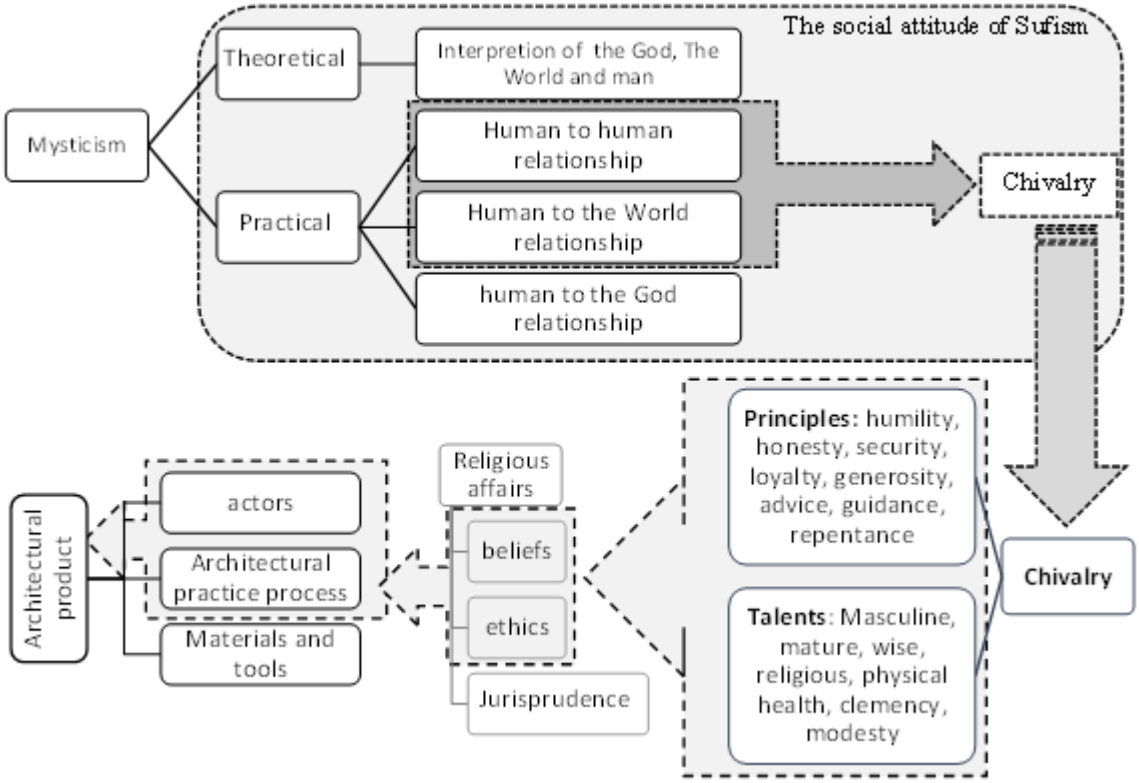


Fig 2 Explanation of the relationship among Sufism, religion and the architectural product. (Source: Authors)

At the same time in the West of the Islamic world, the influence of the Sufism social trend on guilds is different. In the chronicles of the Mamluk period, there are mentions of artisans who attended Sufi meetings and later became scholars and court officials (Ibn Ḥajar al-ʿAsqalānī, 1969: 2/ 321-322, 348, 384). Naturally, the presence of these professionals in the royal system was not without reason and according to luck, but probably the number of study circles in this period, which were mainly managed by Sufis (Al-Maqrīzī, 1997: 4/119; Fernandes, 1997: 110), has been effective in their development, but such an assumption needs a document. One of the authentic texts of this

epoch, it is mentioning a school built by Amir Kafur al-Sarghtamshi, and it is said that at the same time religious students, Sufi seekers, and also artisans are engaged in it, and it is emphasized that its purpose is to eliminate the deficiencies of artisans and craftsmen (Al-Sakhāwī, 1992: 6/226). If Sakhāwī had explained more about this, many of the problems that are present today in the discourse on how to educate architects in the past could have been answered. It is evident that professionals had access to schools managed by Sufis, through which they progressed to high positions in government. As a result, the influence of Sufism on guilds, including architecture, can be seen across the Islamic world, both in the East and West, albeit in different forms. Based on the theoretical foundations of the research, the dignity of architecture is not the only product, as the actors involved, the process of action, the components, and the tools used are also part of it. Therefore, the influence of Sufism on the outcome of architecture during this period is related to the moral and ideological education of the people involved, which plays an important role in the process of architectural action, and ultimately contributes to the architectural products.

5.2. Architectural Knowledge Status in the Scope of Islamic Sciences

In the mentioned research, it is explicitly acknowledged that "Islamic encyclopedias consistently classify architecture and the crafts together with mechanics (Ĭlm al ĥiyal) as subcategories of practical geometry" (Necipoğlu, 1995: 139). Providing such an opinion needs more scrutiny. By examining the science classification encyclopedias in the Islamic era, architecture is classified under mechanical science (Ĭlm al ĥiyal) in only one encyclopedias (Table 1). It seems that Necipoğlu means only Farabi's epistle among all encyclopedias of the Islamic period, because no such comment has been presented in the others (Table 1). According to the book "Ihsa' al- Ulum", geometry is classified into theoretical and practical parts. The theoretical aspect deals with the fundamental principles of the subject, while the practical aspect involves the practical application of altering the shape of materials (Farabi, 2010: 77-79). Farabi (870- 950) designates "Ĭlm al-ĥiyal (mechanic)" as one of the seven divisions of mathematical sciences, which aims to provide a framework for applying theoretical knowledge to practical fields and industries (Ibid: 89). He further divides "Ĭlm al-ĥiyal" into two subcategories, namely numerical and geometrical. Notably, Farabi is the first to explicitly include "architectural engineering" as part of the geometrical Hiyal in the classification of sciences. In his analysis, the importance of “Ĭlm al-ĥiyal" for practical industries like construction and carpentry was emphasized (Ibid: 91-92). Farabi made a distinction between the theoretical and practical aspects of architecture, with the engineering component involving methods and the "executive work" comprising the actual construction. Notably, Farabi did not explicitly include executive tasks in the realm of science but rather considered them a prerequisite for practical industries. As such, it can be inferred that the author only considered the theoretical aspect of architecture to fall under the purview of science. From these premises, Necipoğlu posited her hypothesis on the intimate connection between theoretical and practical geometry scientists.

Table 1 Architectural knowledge status in the science classification encyclopaedias

Encyclopedias	Architecture status	Source
Ihsa' al- Ulum	In this encyclopedia, architecture is included under the mechanical science (Ĭlm al ĥiyal).	Fārābi, 2010: 90-92
Mafātīḥ al-ʿUlūm	With only one example, he has introduced the application of Ĭlm-al-ĥiyal in building construction.	Al-Khwārizmī, 1930: 118-141

al-I'lam bi manaqib al-Islam	He does not consider practical industries as science at all and therefore did not categorize them.	Al-'Amiri,1988: 81-87
Jāmi‘ al-‘ulūm	Architecture has been mentioned in the field of intellectual sciences and its purpose is to meet worldly needs.	Fakhr al-Dīn al-Rāzī, 2004: 464-465
Irshād al-Qāsid	He defines architecture as a subcategory of geometrical knowledge under the name of “Uqūd al– Abniah”, and considers *Ĭlm-al-ĥiyal* to be a separate branch.	Ibn-al-Akfānī, 1904: 108
Miftāḥ al-saʿāda	He defines architecture as a subcategory of geometrical knowledge under the name of “Uqūd al – Abniah”, and considers Ĭlm-al-ĥiyal to be a separate branch.	Taşköprüzade, 1985: v.1: 352

5.3. Close Association between Geometry Theorists and Architecture Practitioners

There has been no consensus on the interaction between the companions of theoretical geometry, artisans and masons who collectively contributed to the development of Islamic architectural decoration before the Mongol conquests (Bier, 2019: 2). Some scholars, such as Chorbachi (1989), Necipoğlu (1995), and Özdural (2002) claim that this relationship has always existed, while others such as George Saliba (1999), Terry Allen (2004), and Yaser Tabbaa (1988) do not believe in its existence. Necipoğlu provides substantiation for her perspective using two forms of evidence. Firstly, she cites the opening remarks alluded to by Farabi which we elaborated in the preceding section. Secondly, she references Abu al-Wafa' al-Būzjani's (940-998) manuscript on practical geometric principles (Kitāb fima yahtaju ilayhi al-sani’ min ‘ilm al-handasa or al- Nijarah) (Necipoğlu, 1995: Part 4), which declares in its introduction that the text was composed to rectify the inadequacies of artisans. While Buzjani mentions at the outset of this epistle that its intended audience is artisans, he underscores in his other works, such as "Arithmetic for the bureaucrats," that these individuals often disregard scientific counsel. Rather, they tend to adhere to the teachings of their former masters, even if these teachings are flawed (Saliba, 1999: 644). On the other hand, one may question why Buzjani focused on this practical geometry treatise instead of spending time on more important theoretical mathematics epistles if this treatise is not utilized. Some historical reports from the century in which Būzjani lived (4th A.H), recount that scientific assemblies, which were sometimes attended by artisans, were held regularly (Arkoun, 2017: 35). Būzjani himself conveyed in a report in this epistle (al- Nijarah) about his presence in a meeting where he solved a problem for tiling together with artisans (Būzjani, 2011: 114-122). On the other hand, some reports prove that there were schools in this period that were established with financial assistance from the government, and the masters of every industry trained students or discussed and exchanged opinions with other scholars (Ibn Miskawayh, 1998: 481-482). With these interpretations and documents, it can be acknowledged that the interaction of artisans and mathematicians cannot be hidden, nor can it be confirmed.

It seems that a logical conclusion can be reached with the theoretical basis presented in this research. According to the theory of "network actor" and the concept of "artificial movement", none of the architectural elements and the forces affecting it alone can provide the final aspect that is the architectural product, and their goal is reached in interaction with other actors (Fig. 1). Before this, it has been stated about the arrangement of actors in the field of architecture that their difference is in the power of inference that one is considered a simple builder and the other is called an engineer, while both are dependent on each other to achieve the goal (Nasir al-Din al-Tūsi, 1977: 288). Bruno Latour believes that the prerequisite of even the theories of scientists is "action". With this assumption, he somehow considers action as preferable (Latour, 1999 b: 66). Such a point of view

is also current in the thought of Muslim scholars, and Ibn Arabi (560-638 A.H) in the "Fusûsu'l-hikem" strongly emphasizes that " Science arises about beings (objective or abstract)" (Ibn al-ʿArabī, 2008: 87). The simple form of this Proposition means that there must be something that about which, science is created and theorizing around it.

From the sum of the mentioned opinions, it can be analysed that firstly, any activist, whether strong or weak, is capable of making changes in the network; Secondly, according to Pierre Bourdieu in the book "Logic of Practice", the actors of each field are "active agents". The concept of an active agents is based on the claim that every actor has the ability to improvise according to the principles of each network and field without coercion or commitment (Webster, 2018: 51). In the narration that was accounted from Būzjani, the artisans did not accept his opinion (Būzjani, Ibid). It is obvious that these artisans were not at the level of Būzjani in terms of science, but because they are active agents, they have the ability to make changes in their network in relation to the construction culture of the epoch. Therefore, Necipoğlu's opinion can be modified in this way, the interaction between artisans and mathematicians was not one-way, but a two-way interaction, artisans raised issues with mathematicians in scientific meetings, and on the other hand, mathematicians formulated some epistles on practical geometry tried to fill the gap between practice and opinion and promote the knowledge of practical geometry. It appears that using fuzzy logic for inference is more suitable than using the formal logic employed by other scholars (Fig. 3).

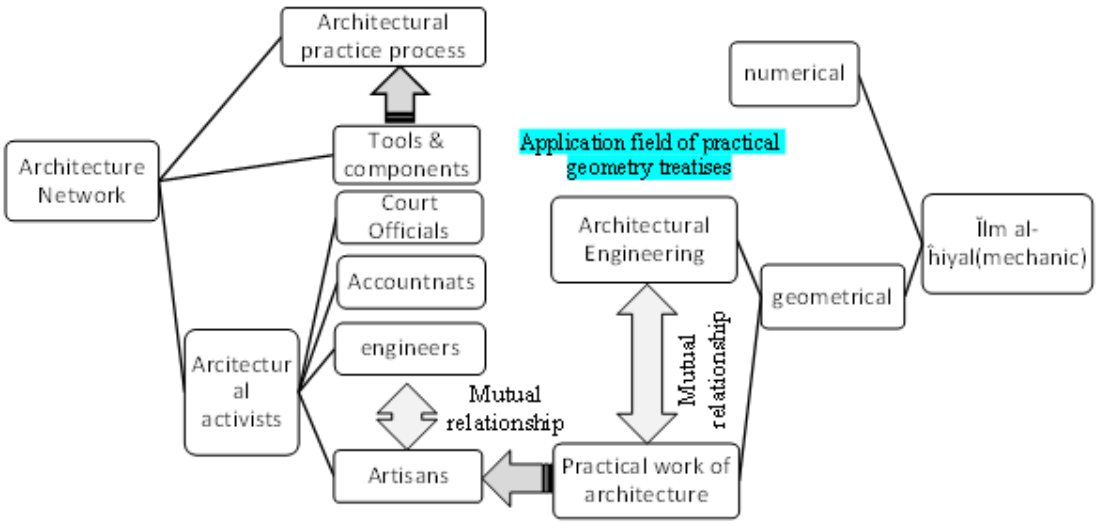


Fig 3 Explaining the relationship between industrialists and other architectural activists and users of practical geometry treatises (Source: Authors)

6. Conclusion

The present study aims to reanalyse three hypotheses put forward by Necipoğlu in her seminal research. The study employs historical sources and a theoretical basis that aligns with the thoughts of Islamic period scholars to scrutinize these assumptions. One of Necipoğlu's hypotheses pertains to the ratio of intellectual currents, such as mysticism and Sufism, which she denied due to

insufficient resources. However, the study demonstrates that Sufism has been influential on guilds, such as architecture, in the East and West of the Islamic world, albeit in different ways. In the West, craftsmen received direct education in schools that were certified by Sufism, while in the East, chivalry edicts (Futuwat nameh), public meetings, and imitation of the ritual were prevalent among guilds. This finding refutes the assumption that there was no affinity between Sufism and guilds. The second assumption made by Necipoğlu concerns the position of architecture in the field of Islamic sciences, which she considered a subset of mechanics (Ĭlm al-ĥiyal). However, an examination of other encyclopaedias reveals that only Farabi believed in this division. From the eighth century onwards, architecture was classified as "ʿUqūd al– Abniah" under mathematics and geometry and became an autonomous subject. Therefore, this hypothesis requires modification. The third assumption made by Necipoğlu pertains to the relationship between artisans and mathematicians. This assumption requires a change in the logic of the conclusion. According to the documents presented in this research, every activist in the field of architecture with any amount of knowledge in the Islamic period could change their network. Therefore, the one-way relationship between mathematicians and craftsmen should be transformed into a two-way relationship, and sufficient credit must be given to all activists. Both artisans and mathematicians have been instrumental in bridging the gap between theoretical science and practical science, and both have contributed to the promotion of practical geometry in architecture. In conclusion, each of the hypotheses presented by Necipoğlu can be an opportunity for other researchers to investigate them more deeply.

References

Al-'Amiri, A. (1988). Al-I'lam bi manaqib al-Islam (An Exposition on the Merits of Islam). A. Abdulhamid Ghorab (E.d.). Riyadh: Dar al- Isalah. (In Arabic).

Allen, T. (2004). Islamic art and the argument from academic geometry. *online publication: http://www. sonic. net/~ tallen/palmtree/academicgeometry. htm (Solipsist Press, Occidental, California, 2004)*.

Al-Khwārizmī, K. (1930). *Mafātīḥ al-ʿUlūm. O. Khali* (Eds.). Egypt: No Publisher. (In Arabic).

Al-Maqrīzī, T. (1997). *Kitāb al-mawāʾiẓ wa' l-Iʿtibār bi dhikr al-khiṭaṭ wa'l-āthār*. 4 vols. Beirut: Dār al- kutub al- Ilmiyah. (In Arabic).

Al-Sakhāwī, M. (1992). *al-Ḍawʾ al-lāmiʿ li-ahl al-qarn al-tāsi*. 12 vols. Beirut: Dār Maktabah al-hayt. (In Arabic).

Al-Tahnavi, M. A. (1996*). KaŞhaf-e-Istilahat al- Fonoun (Scouts of technology terms)*. A. Dahrouj (Eds.). Beirut: Maktabah Nasheroun. (In Arabic).

'Ala' al-Dawla Simnani. (1990). *Persian manuscript* (Mūşannafāt), N.M. Heravi (Eds.). Tehran: Elmi Farhangi. (In Persian).

Anvari, M., & Karamollahi, N. (2018). A critical examination of the epistemic foundation of Actor-Network theory by Bruno Latour. *Márifat-e- Farhangi Ejtemaei, 35*(3), 35-54.

Arkoun, M. (2017). *Humanism in Islamic thought* (Mousavi, A. Trans.). Tehran: Tarh Naghd.

Bier, C. (2019). The arts of ornamental geometry: by Gülru Necipoğlu, Leiden, Netherlands, Brill, 2017, 376 pp, hardcover, ISBN-13: 9789004301962.

Blair, S., & Bloom, J. M. (2003). The mirage of Islamic art: Reflections on the study of an unwieldy field. *The Art Bulletin, 85*(1), 152–184.

Bolkhari, H. (2016). *Mystical foundations of Islamic art and architecture* (3th ed.). Tehran: Soureh Mehr. (In Persian).

Būzjānī, A. (2010). Kitāb al-Nejārah (In applied geometry). J. Aghayani chavoshi (E.d). Tehran: Miras Maktoob. (In Persian).

Chorbachi, W. A. K. (1989). In the Tower of Babel: Beyond Symmetry in Islamic Design. *Computers & Mathematics with Applications, 17*(4-6), 751-789.

Collingwood, R. G. (1946). *The idea of history*. Oxford University Press.

Dilaveroglu, B., Polatoglu, C., & Ciravoglu, A. (2021). A review on actor- network theory as a potential tool for architectural study. *Eurasian Journal of Social Sciences, 1*(9), 44-60.

Fakhr al-Dīn al-Rāzī. (2004). Jāmiʿ al-ʿulūm, S. A. Al-e- Davoud (Eds.). Tehran: Dr. Afshar Endowment Foundation.

Fārābi, A. (1979). *Civil politics* (Sajjadi, J. Trans.). Tehran: Iranian Philosophy Association. (In Persian).

Fārābi, A. (2010). *Ihsâ al-'ulum* (4th ed.). (Khadivjam, H. Trans.). Tehran: Elmi Farhangi. (In Persian).

Fernandes, L. (1997). Mamluk Architecture and the Question of Patronage. *Mamluk Studies Review*, (1), 107-120.

Ghorbani. A., & Sheikhan, M. (1992). *A description of the life and works of Būzjāni*. Tehran: Elmi Farhangi. (In Persian).

Groat, L., & Wang, D. (2013). *Architectural research methods* (7th ed.). (Eynifar, A. Trans.). Tehran: University of Tehran press. (In Persian).

Ibn al-Akfānī, SH. (1904). *Irshād al-Qāsid (A dictionary for scholars)*. M.S. Al- Amedi (Eds.). Beirut: No publisher. (In Arabic).

Ibn al-ʿArabī, M. (1999). *Al-Futuhat al-Makkiyya (The Openings Revealed in Makkah)*, A. Shams al- Din (Eds.). 9 vols. Beirut: Dār al- kutub al- Ilmiyah. (In Arabic).

Ibn al-ʿArabī, M. (2008). *Fusûsu'l-hikem* (Khajavi, M. Trans.). Tehran: Moula. (In Persian).

Ibn Ḥajar al-ʿAsqalānī, A. (1969). Inbā' al-ghumr bi-abnā' al-ʿumr. H. Habashi (Ed.). 4 vols, Mişr, Lajnah Ihyā-e- tūrath al-Islāmiah. (In Arabic).

Ibn Khaldūn, A. (2003). *Muqaddimah* (Gonabadi, M. P. Trans.). Tehran: Elmi- Frahangi. (In Persian).

Ibn Miskawayh, A. (1998). *Tajārib Al-Umam Wa-Ta'āqub Al-Himam* (Monzavi, A. Trans.). Tehran: Tous.

Khan Mohammadi, A. A. (1992). Fotovvat - Nameh, The letter of Generosity. *Soffeh, 2*(1), 10-15.

Laleh, H. (1996). Islamic period Architects: Theoretical knowledge and its practical application. *Waqf Miras Javidan, 4*(3-4) 39-50.

Latour, B. (1996). On Actor-network Theory: A few clarifications. *SozialeWelt, 47*(4), 369-81.

Latour, B. (1999 a). On Recalling A.N.T, In *Actor Network Theory and After*. J. Law, & J. Hassard (ed.). Oxford: Blackwell.

Latour, Bruno (1999 b). *Pandora's Hope, Essays on the Reality of Science Studies*. Harvard University Press.

Latour, B. (2005). *Reassembling the social: An introduction to actor-network-theory*. Oxford University Press.

Latour, B. (2014). What is the style of matters of concern? In *Spinoza Lectures*. Open Library: VanGorcum.

Law, J. (1999). After ANT, Complexity, Naming and Topology, In *Actor Network Theory and After*. J. Law, and J. Hassard (ed.). Oxford: Blackwell.

Law, J. (2008) (a). Actor Network Theory and material semiotics. In: *B.S. Turner* (Ed.). The New Blackwell Companion to Social Theory. Oxford: Blackwell, pp.141–158.

Law, J. (2008) (b). On sociology and STS. *The Sociological Review*, (56), 623-649.

Muhammad ibn, M. (2010). *Asrār al-Tawhid (The Mysteries of Unification)*. M. Shafiei Kadkani (Ed.). Tehran: Agah. (In Persian).

Mojtahedzadeh, R. (2021). *The Relations between architecture and science in Islamic period of Iran*. Tehran: Matn. (In pesian).

Nasir al-Din al-Tūsi. (1977). *Nasirean Ethics*. M. Minavi & A. Heidari (Ed.). Tehran: Kharazmi. (In Persian).

Necipoğlu, G. (1995). *The Topkapi scroll- Geometry and Ornaments in Islamic Architecture*. Getty Publications.

Necipoğlu, G. (2017). Ornamental geometries: A Persian compendium at the Intersection of the Visual Arts and Mathematical Sciences. *The arts of ornamental geometry. Brill*, 11-8.

Özdural, A. (2002). Omar Khayyam and architecture (Kanani, N. Trans.). *Farhang Journal*, 39-40, 189-254.

Qūtb al-Din al-Shirazi, M. (1990). Dūrrat al-tāj (Pearly Crown (3th ed.)). M. Meshkat (Eds.). 5 vols. Tehran: Hekmat. (In Persian).

Razjoyan, M., & Masoudi nejad, S. (2018). *Step by step to theory creation*. Tehran: Ney. (In perian).

Saeid al- Sheikhli, S. I. (1983). *Guilds during the Abbasid era* (Alamzadeh, H. Trans.). Tehran: University Publication Center. (In Persian).

Saliba, G. (1999). Artisans and Mathematicians in Medieval Islam. *Journal of the American Oriental Society, 119*(4), 637-645.

Shams al- Din Amoli, M. (2002). Nafaèïs al- Fonūn fi Árāès al-Uʼyūn. E. Mianji (Eds.). 3vols. Tehran: Ịslamiyah. (In Persian).

Tabātabāei, J. (2004). *The decline of political thought in Iran* (4th ed.). Tehran: kavir. (In Persian).

Tabātabāei, M. H. (1993). *The Principles of Philosophy and the Realism Method* (4th ed.). M. Motahari (E.d). vol 4, Tehran: Shahid Motahari Scientific-Cultural Foundation (In persian).

Tabbaa, Y. (1988). Geometry and memory in the design of the Madresat al Firdows in Aleppo. *Theories and principles of design in the architecture of Islamic societies*, 23-34.

Taşköprüzade, A. (1985). Miftāḥ al-saʿāda wa miṣbāḥ al-siyyāda (bliss key and a guidance to greatness). Beirut: Dār al- kutub al- Ịlmiyah. (In Arabic).

Va'ez Kashefi Sabzevari, H. (1971). The Royal Book of Spiritual Chivalry. M. J. Mahjoub (Ed.). Tehran: Bunyad Farhang Iran. (In Persian).

Webster, H. (2018). *Bourdieu for Architects* (Hanif, E. Trans.). Tehran: Fekr-e- No.

Available online at www.ijapas.ir

International Journal of Applied Arts Studies

IJAPAS 9(3) (2024) 101–116

Modeling the Effects of Enclosure Components in Ekbatan and Ati Saz Residential Complexes

Peyman Akhondi[a], Mohammad Jalili[b]*, Gholamreza Talischi[c], Farzaneh Sasan pour[d]

[a]*Ph.D. Student, Department of Architecture, Borujerd Branch, Islamic Azad University, Borujerd, Iran*
[b]*Assistant Professor, Department of Architecture, Borujerd Branch, Islamic Azad University, Borujerd, Iran*
[c]*Assistant Professor, Department of Architecture, Bu-Ali Sina University, Hamadan, Iran*
[d]*Associate Professor, Faculty of Geography and Urban Planning, Kharazmi University, Tehran, Iran*

Received 18 November 2023; accepted 06 September 2024

Research Article

Abstract

Examining the physical-perceptual structure of architecture creates a context for users to understand the goals and meaning of architecture by being in the space, on the other hand, it creates the precise proportions of the spatial body, in which meanings can be understood. Movement in space, both internal and external, which is created by the presence of the body, deepens the users' understanding of architecture. Functional body structure also refers to the activities that take place inside the space and means a proportional body that creates a suitable space for certain activities. This research is of a nested combination of qualitative and quantitative to extract components and dimensions after a semi-structured interview and then from PN modeling for the degree of factor effect and comparing the component effect system as well as the matrix. Correlation sampling is used for the snowball system interview, and in the quantitative stage, the upper limit of the Morgan table is used. The facilitating software's are ATLASTI8 and JMPSAS17. The results show that access coherence, user coherence and environmental coherence have the highest dimension and a larger factor contribution that has significant relationships, but coherence in creating security despite the influence coefficient of Bal has a significant relationship. does not have Coherence in municipal laws has a larger factor share than the first three cases, but it has a less significant amount. In general, based on the scope of the effect of the components of confinement and also its

* Corresponding author. Tel: +98- 9166621619.
E-mail address: mohammad.jalili@iau.ac.ir

focus, it shows the continuity of the relationship between the components. Based on the relational correlation, it is determined that each dimension has a relationship with the other two dimensions and can be predicted, and the third dimension, which will be added to the blue color, has far less predictability than them. It is important to pay attention to the dimension of cohesion in both sets, which has no predictability based on other dimensions and has acted separately and should be considered in the first stage for planning and design. In general, the dimensions of confinement in the collection of Ati Saz and Ekbatan have a correlation of 0.772 in the way of application.

Keywords: Enclosure Dimensions; Ekbatan Residential Complex; Ati Saz Residential Complex; Combined Method.

1. Introduction

The scientific and philosophical study of the concept of space shows that space is mostly a subjective matter. The empirical understanding of space confirms that space is not the object itself, but the relationship between objects, or the container of objects or the radiation of objects, and the artistic work of architectural space is interpreted with words such as enclosed, sacred, transparent, personal, collective, which have a mental and perceptive aspect (Negin Taji, 2011). Architectural space generally refers to the spaces between building materials, the purpose of which is to create safety for human activities, so that sometimes this space is known to have special qualities (Falahat and Shahidi, 2015). The distance between the physical elements of the building creates a sense of confinement, and confinement has a direct effect on behavior. Enclosed spaces strengthen social relationships, and the lack of enclosure leads to people moving away from each other. Accurate perception of the elements that create enclosure will be of great help in evaluating the desirability of the space in the analysis stage. Any element or phenomenon that is placed in space separates it and gives it a spatial identity. This element or phenomenon can have physical, social or mental properties. Depending on the effect of power in each of the mentioned dimensions, the identity and nature of a space is formed by emphasizing that feature (Seydian and Abafat Yeganeh, 2007). Examining the physical-perceptual structure of architecture creates a context for users to understand the goals and meaning of architecture by being in the space. On the other hand, the precise proportions of the body create a space where meanings can be understood. If the spatial coherence in the movement in the space, both inside and outside, with the presence of the body, it will deepen the knowledge of the users of the architecture (Falahat and Shahidi, 2015).

As one of the enclosed communities in the city of Tehran, Ati-Saz town has special importance due to its special environmental and social distinctions, its location in the second district of Tehran and its proximity to Saadat Abad neighborhood, which today, due to the neglect and inappropriateness of management methods and lack of Paying attention to socio-cultural issues in it has become a ground for the formation of socio-cultural and even economic conflicts in the region.

Ekbatan town is an example of these enclosed communities that have been formed in Panj district of Tehran. The existence of conflict with the immediate layer of this area, both physically and socio-culturally, has caused concerns and wide disturbances in this area. The fact that this site has a suitable geographical location and is located in one of the important areas of Tehran metropolis, on the one hand, and the inappropriate management and lack of extensive supervision of the municipality on this area, emphasizes the need to review the management policies and makes this matter appear vital. As a result, this research aims to answer the following question:

What are the components of spatial confinement on the network of coherent spaces of residential neighborhoods, including Ekbatan and Ati-Saz? And what priority do they have to influence the coherence of the studied area?

2. Theoretical Foundations

2.1. Confinement and Cohesion

In re-reading the concepts and definitions of the urban space, enclosure and dimensions related to it, the most important factor of physical identity is considered according to Zucker, the physical nature of the urban space is related to the shape of the body of the enclosing buildings, uniform and uniform or diverse, the absolute dimensions of the bodies compared to the width and in For the space involved, the angle of the passages or streets that reach the square, the location and location of historical monuments, etc. are dependent (Low, 2004). DK Ching believes that the strongest type of space definition is when four vertical planes completely enclose an area of space. According to him, four levels can define a visual and spatial range that self-organizes the mass in the middle and the surrounding buildings are considered to belong to the internal range and make the enclosed space active and dynamic. Finally, the leading transic defines space or anti-space in terms of mass and volume (Judd, 1995). In fact, the legibility of a space is created in contrast with its context. In this regard, according to the perspective of the urban planner who considers mass or space positively, form and space become important as a relationship between form and context (Levinson and Christensen, 2003). In the past, the open space was designed in a positive way, with clear boundaries and clear enclosures. There was no ambiguity. The initial proper functioning of the space depended on the facilities available in relation to the demand, the characteristics of the surrounding uses, the users (Levinson and Christensen, 2003).

This point, which is one of the main aspects of the difference between modern and traditional urban planning, is directly affected by the confinement or lack of it in urban spaces. In modern urban planning, the mass is considered as a positive factor and because the single object is placed in the space, therefore, formless urban spaces are created that have a distorted identity from the physical dimension (Low, 2004). These spaces, which often have a large and inhuman scale, are devoid of any enclosure, in contrast to traditional urban planning, space is considered a positive factor, in fact, mass is considered a consequence of space, in other words, space is the principle and mass is secondary; Therefore, the urban spaces of this thinking are organized and defined (Sassen, 2018). The main factor in this idea is the shaping of the space by the mass. This physical feature is objectified both on the surface and in space. The confinement in two dimensions' acts as the boundary of the object; Therefore, maximum confinement is achieved in minimum separation (Judd, 1995).

This feature defines spatial boundaries in three dimensions and makes the space perceptible to the citizens in such a way as to induce the feeling of being in the space. In such a space, a strong experience is created in the citizen who is able to understand his relationship with the environment and with the elements and components. It happens in the environment. In this regard, the comparative study of the qualitative and quantitative factors of spatial confinement in the traditional urban planning of Europe and Iran shows the influence of cultural and climatic factors on the degree of spatial confinement. In other words, the historical background of culture and climate is very effective in determining the desired enclosure (Vesselinov and Le Goix, 2012). In order to achieve an attractive urban place, the space must be enclosed in a desirable way, and in fact, it can

be said that the first principle governing the design of urban places is It is confinement (Levinson and Christensen, 2003).

From the small dimension, the feeling of being enclosed in space is based on the relationship between the distance of the observer's eye and the height of the body enclosing the space. Some western sources have calculated this relationship based on the angle between the perpendicular line from the observer's eye to the body and the distance between the observer's eye and the upper edge of the body. Therefore, confinement has been presented as a constant and universal principle with four general rules: (McKenzie, 1994)

1. About 45 degrees (1:1 ratio) full enclosed feeling
2. About 30 degrees (ratio 1:2) the threshold of feeling enclosed
3. About 18 degrees (ratio 1:3) minimum feeling of confinement
4. About 14 degrees (ratio 1:4) lack of feeling of being enclosed in space

Table 1 Integration criteria from the perspective of researchers (Source: Ismaili et al., 2013; Hatami and Ziyai Naji, 2017; Zakavot, 2015; Alikaei and Zamani, 2014; Berkman and Kawachi, 2014; Hamouche, 2009; Yip, Sarma, and Wilk, 2016; Qin, Wang, and Cho, 2021 Murillo, Echeverria, and Vasquez, 2016)

Natural order develops from the unconscious integration of man with the laws of nature. Harmonious order implies multiplicity within unity. Geometrical order is the rule of the oldest system of cities (Esmaili et al., 2014).	Unity through the organization of space/natural-geometric-harmonious order/unity of mass and space	Ardalan and Bakhtiar, 1974
The principle of enclosing space - the principle of scale and proportion - the principle of spatial diversity - the principle of territory - the principle of composition, the continuity of spatial continuity - the continuity of neighborhood centers and urban centers - the combination of buildings with urban elements - the combination of residential units and urban elements (Hatami and Ziaee Naji, 2017).	The principle of enclosing space - the principle of scale and proportion - the principle of spatial diversity - the principle of territory - the principle of composition	Mahmoud Tusli, 2002
Man's way of thinking towards the whole, that is, his worldview, is essential for the overall order of his mind (Zakavat, 2017).	Holistic coherence	Novin Tolai, 2007
Functional organizationalists believe that the combination and compatibility between the components of the city form should play a role in its performance, causing sufficient participation of the components to achieve the goal and responding to the needs of a large number of residents (Zakavat, 2017).	Organizational coherence	
The unity of the shape of the enclosure of the space - the rhythmic continuity of the elements in the city - the balance of mass and space - the visual overlap - the proportion of length, width and height, the combination of various forms that complement the city's appearance, the continuity of the city's elements in order to create continuity in the view and movement of pedestrians - creating continuity through Identifying connecting elements - belief in historical continuity (Zakavat, 2017).	aesthetic coherence	
Structuralists believe that space as a unifying element - emphasizing the design of a large-scale spatial network as a connecting element of the city body - emphasizing the step-by-step expansion of creating a coherent structure through the process of centrality of symmetry and connection between elements is possible (Zakavat, 2017).	Structural coherence	
This approach considers compatibility with the physical, historical, socio-cultural context as the factor of coherence in the form.	contextual coherence	

Physical orientation on: 1. The possibility of mutual relations between the masses and the disjointed space and different areas of the cities is emphasized. 2. It is in finding inclusive patterns that provide the possibilities of these mutual relations. 3. It does this through a blizzard (Zakavt, 2017).			
The principle of spatial hierarchy - The principle of continuity in the composition of space - Unity in composition - Human scale - Oneness - Spatial diversity - Spatial contrast	How to combine space	Physical structure	Mohammad Reza Pourjafar, 2013
Combination of functions-scale of activities	Providing services	Activity structure	
Mental image-sense of place (Alikaei and Zamani, 2014).	Making space meaningful	Identity structure	
In the tree structure, no unit is connected to another unit except through connection to the whole, but in the semi-network structure, the units are connected to each other, according to his belief, since modern city planners have considered the city as a tree. The organization of cities is organized into branches with separate functions and localities and regions (Hatami and Ziaee Naji, 2017).			Christopher Alexander, 1965
A coherent and transparent physical complex that consists of 5 elements: node, edge, sign, road and neighborhood is capable of creating a clear mental image / Lynch emphasized the perceptual coherence of the city landscape and its tangible forms (Esmaili et al., 2013)).			Kevin Lynch, 1972
The result of his work is extracting the principles in which the system of connected but diverse urban space is taken into account by maintaining the human scale in the height of the buildings, balanced facades and creating a meaningful and defined shape that provides the possibility of meeting and social communication (Zakavat, 2017).			Rob Carrier, 1979
The first principle of continuous network connection, the second principle of enclosing sides and continuity. The third principle: coherent bridging. The fourth principle of axis and perspective - the fifth principle: integration of inside and outside (Zakavt, 2017).			Roger Transic, 1986
He considers the creation of a center to be the most important principle for creating unity and believes that a whole should have a center in itself and create a network of centers around it (Esmaeili et al., 2013).			Christopher Alexander, 1987
The whole has a gradual growth and this type of growth is homogenous with the end of the whole. The whole is not predictable. The whole is connected and not fragmented, and its parts are related in a complex and surprising way. The whole has an effect on us and is able to make a person move (Zhakawt, 2017).			
Gradual growth is a necessary condition of totality The growth of wider totalities of the imagination is necessary to create totality in the existing structure. Every building should have a continuous and beautiful public space in its neighborhood. The structure of each building should create smaller wholes in the fabric (Hatami and Ziaei Naji, 2017).			
Uniform facades are commemoration of some elements of the city as a whole, luxury of building materials, balance of components instead of absolute size, use of measures such as cornice and continuous wall surfaces, same height and facade to create continuity of building to show power in a spatial area. (Esmaili et al., 2014).			Neil Carlson, 1989
Coherence is reasonable harmony or unity that skillfully connects all parts within a body in such a way that nothing can be added or removed from it without reducing its beauty (Alikaei and Zamani, 2014).			Reka Albert, 1991
Social cohesion has been the most central issue of sociology in the past and present, and it is considered a type of social capital and implies a collective agreement among the people of a society (Berkman & Kawachi, 2000).			Berkman, Lisa. F. Kawachi, Ichiro, 2000
The continuity and stability of the social, political and cultural life of a society depends on the coherence and solidarity between the constituent elements of the social structure. Coherence means the feeling of mutual responsibility between several people or groups, who have awareness and will (Yip et al., 2016).			Yip, Calvin. Sarma, Sisira. Wilk, Piotr, 2016
Physical cohesion is the process of organizing various interdependent elements in the form of			Ben Hamouche,

the city, in which mutual relationships or necessary and simultaneous participation between the parts subjectively and objectively with the aim of creating a purposeful, integrated, neat, legible, meaningful whole. and it converges with the trends of nature (Hamouche, 2009)	Mustapha, 2009
Improper distance of two adjacent bodies (according to their scale and function), body geometry (in the design of walls and paths), accessibility of two adjacent walls, diversity and arrangement of uses and the relationship between mass and space are among the most important factors that weaken cohesion. are physically in cities (Murillo et al., 2016)	Murillo, Rosenda. Echeverria, Sandra. Vasquez, Elizabeth. 2016
Achieving greater physical cohesion in current cities does not mean removing large-scale elements; Rather, macro-scale elements should be linked to their same-scale elements in the city, such as large urban areas or metropolitan functions (Qin et al., 2021).	Qin, Weidi. Wang, Yi. Cho, Seungjong. 2021

3. Research Methodology

Considering that the current research methodology is a mixed methodology (qualitative and quantitative), it means that first the qualitative method is used to calculate the dimensions and components of the research by coding the concepts extracted from the interview, and then the quantitative method is used to measure the statistics. Inferential and enclosure components are used in the physical structure of residential buildings of contemporary Iran, the research paradigm is also the governing paradigm of combined methods, i.e. pragmatism.

The present research method is developmental-applied in terms of type and has a nested combination method in terms of method type. To answer the research questions, nest-to-nest research method of qualitative and quantitative type is used. First, a systematic literature review is conducted to review previous texts and studies in this field. Then, based on the definitions, questions centered on the main question of the research are developed, which include 5 items as follows;

1. Express your definitions of the words of confinement in residential complexes?
2. What are the components of confinement in Ekbatan and Ati Saz residential complex?
3. What are the components of modernism in the architecture of selected residential buildings of the Pahlavi period?
4. Move in the architectural space of one of the selected buildings by mentioning the name with the system of thinking aloud and speak the components you see?

Scholars are selected based on the snowball system and semi-structured interviews continue until theoretical saturation. For correctness, the questions are checked and scored by experts using the Delphi method. The way to enter the research of thinkers is as described in the table below. Interviews are conducted with 26 people, and theoretical saturation occurs from the 21st person onwards. The results are entered into the ATLASTI software and grand theory techniques are used which include coding for ease of use from a pre-designed coding table. Quantitative stage is done in causal-comparative way. Then, one question is considered for each component and it is compiled in the form of a questionnaire with a Likert scale and provided to the residents. The validity of the questionnaire using the CVI formula is 0.72 and the reliability is 0.72 using Cronbach's alpha. The statistical population includes all the residents in all age groups, and the distribution of the questionnaire was done with a random approach, equally from each of the residential complexes. The sample size of residents of the upper limit of the Morgan table includes 384 people. SIGMAPLOT software is used to analyze inferential statistics. Table 1 shows the characteristics of the interviewees.

Table 2 Characteristics of the interviewed people

Conditions for entering the research	Number	Expert board
1. The aristocracy of confinement in residential complexes 2. Faculty or with a doctorate degree 3. The aristocracy of the residential component 4. Aristocrats of future studies Delphi	7	Professors of architecture
	8	Professors of landscape architecture
	9	Urban design professors
	4	Urban planning professors
	30	Total

4. Open Coding

Open coding is an analytical process through which the concepts identified and the characteristics of those dimensions are discovered in the data (Greene and Caracelli, 2003: 49). At this stage of the foundational data theory, the primary categories of information about the phenomenon under study are divided by information segmentation. gives shape (Shehbazi and others, 2019: 68). The researcher bases the categories on the collected data (Creswell and Plano Clark, 2006: 397).

5. Analysis of Findings

In the summary of all the codes extracted from the interviews conducted in connection with the examination of the degree of confinement in the neighborhood cohesion of the residents of Ekbatan and Ati Saz, it is presented in the Figure 1.

5.1. Open Coding

At this stage, the researcher tries to recognize the hidden concepts by reviewing the collected data set. Finally, the information obtained from the interviews with professors and experts, 46 concepts were extracted through open coding in connection with the examination of the degree of confinement in the neighborhood cohesion of the residents of Ekbatan and Ati Saz. This structure of experience was based on the type of meanings resulting from positive experience and complex connections of different dimensions, which form the main nature of the degree of confinement in the cohesion of the neighborhood of Ekbatan and Ati-Saz residents. The main parts of the resulting space became the basis of the discussion about the influencing dimensions in the degree of confinement in the cohesion of the neighborhood of Ekbatan and Ati-Saz residents and the questions raised in this regard. Then the classes formed in open coding were compared with each other and the relationship with their sub-classes was checked. Similar classes were merged together and grouped in one central class.

5.2. Extraction of Descriptive-Interpretive Codes in Open Coding

At this stage, first, 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. And after the descriptive coding of the interview text, their meanings were interpreted. In Table shows the descriptive and interpretive coding of some interview texts.

Table 3 A selection of conceptual codes extracted from the text of the interviews (Source: taken from the analysis of Atlasti software version 23.1.1.0)

Extracted conceptual code	Propositions taken from the text of the interview and interpretation
The possibility of crime	For residents of gated communities, security is the first concern. The residents think that they and their neighbors have protected their place of residence inside a strong barricade and thus protected themselves from crime.
The variety and type of businesses belonging to the local scale	For residents of gated communities, security is the first concern. Residents think that they and their neighbors have kept their place of residence within a strong wall and thus protected themselves from crime. Gated communities improve the local economy by creating employment (temporary job opportunities related to activities Construction, service jobs such as gardening, repairs and security are new demands for certain services there.
The amount of communication with neighbors	Residents of enclosed neighborhoods have a sense of belonging to the neighborhood more than residents of other neighborhoods, especially in neighborhoods with sports facilities because people share activities together.
Permeability rate	Enclosed communities privatize public spaces through the use of walls and fences that block public access and undermine the concepts of democracy and citizenship.
Number of public transport stations	Travel patterns throughout the urban network can change. Traffic through walls and sidewalks and access to transportation stations may be longer.
Existence of specific regulations for tax determination	In order to integrate the enclosed neighborhoods, specific regulations are used to determine taxes and there is a written mechanism to manage these neighborhoods.
Service satisfaction	In these neighborhoods, especially in large projects, amenities are of high quality, and residents enjoy access to attractive parks, open spaces, innovative facilities, meeting spaces, and public art.
The existence of a formal mechanism for managing closed communities	In the closed neighborhoods, there are elected boards for consolidation. These boards act as neighborhood decision-makers, contracts govern resident behavior, and fund monthly local utility bills.
The degree of people's desire to improve the neighborhood	Civic participation is high within the enclaves to create a cohesive society, and there are fewer responsibilities and problems for the local government. In closed communities, people have a greater desire to improve their living conditions.
The quality and variety of local camps	In enclosures, there are more active behavioral sites that strengthen social bonds.

The spider diagram shows the codes extracted from the interview text.

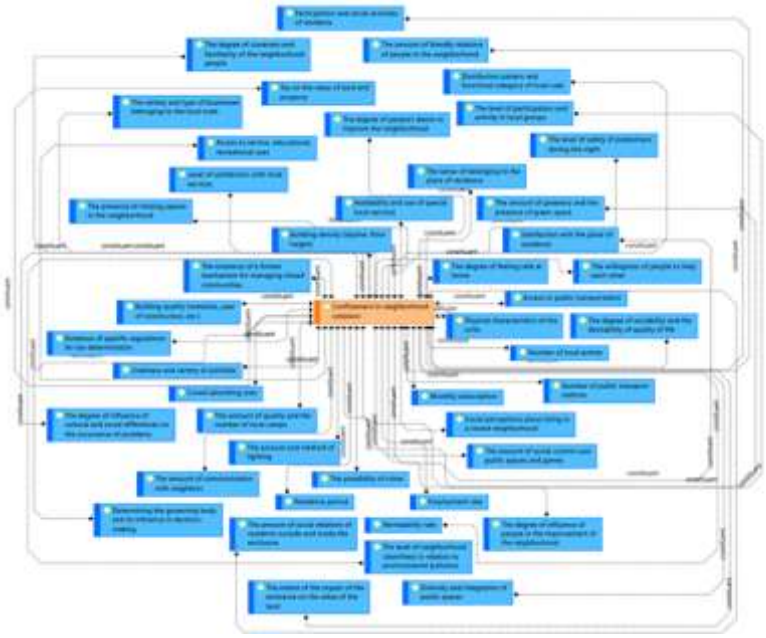


Fig 1 Repetition of each of the codes extracted from the interview text in open coding (source: taken from Atlasti software analysis version 23.1.1.0)

5.3. Descriptive statistics

At this stage, the statistical population for this research is the residents of the future residential complexes of Ati Saz-Ekbatan, which is used to find the sample size from Morgan's table, and due to the lack of an accurate upper limit of the population, which is 384 people, it is selected as the sample size. Questionnaires are randomly distributed. The results show that 39% of the participants are women and 61% are men. The most age group of participants in this research is 54% between 18-22 and 25% between 22-26 and 21% between 26 and 30. The highest frequency is related to the physical characteristics of units with a value of 1914 and the lowest is related to the duration of residence with a value of 984. The support of the moving average of the data distribution shows the correctness of the method of measuring the instrument, also the answers are correlated with each other and can be predicted in Figure 2.

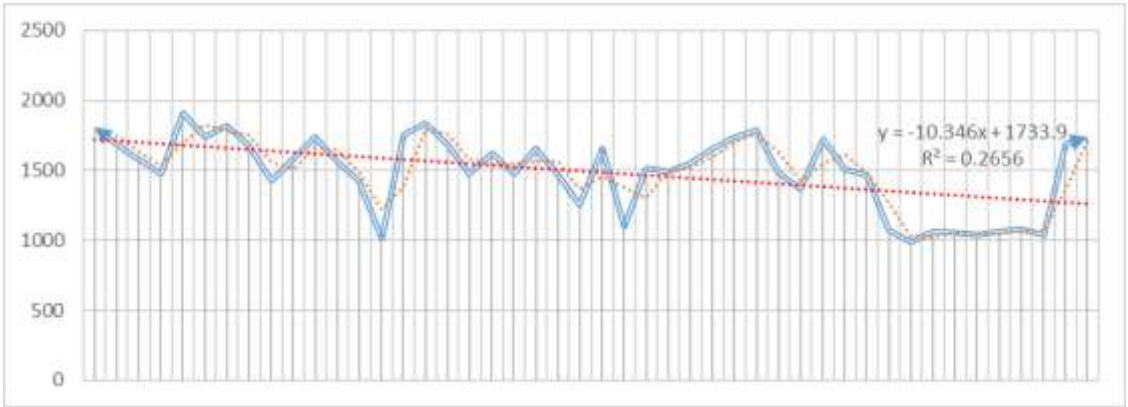


Fig 2 Frequency diagram of enclosure components in residential complexes

5.4. Inferential statistics

Correlation

Two-Sample Kolmogorov-Smirnov Test is used to check the parametric and non-parametric type of data.

Table 4 Kolmogorov-Smirnov test to check the normality of inclusion variables

Variable	Average	Standard Deviation	Z Kolmogorov Smirnov	p
Enclosure components in selected residential complexes	25/41	5.28	0.893	0.585

As can be seen in the above table, the Kolmogorov-Smirnov test is not significant for the score of the physical components of the behavioral setting (p=0.585), and therefore the enclosure variables do not have a normal distribution and non-parametric analyzes can be used for them.

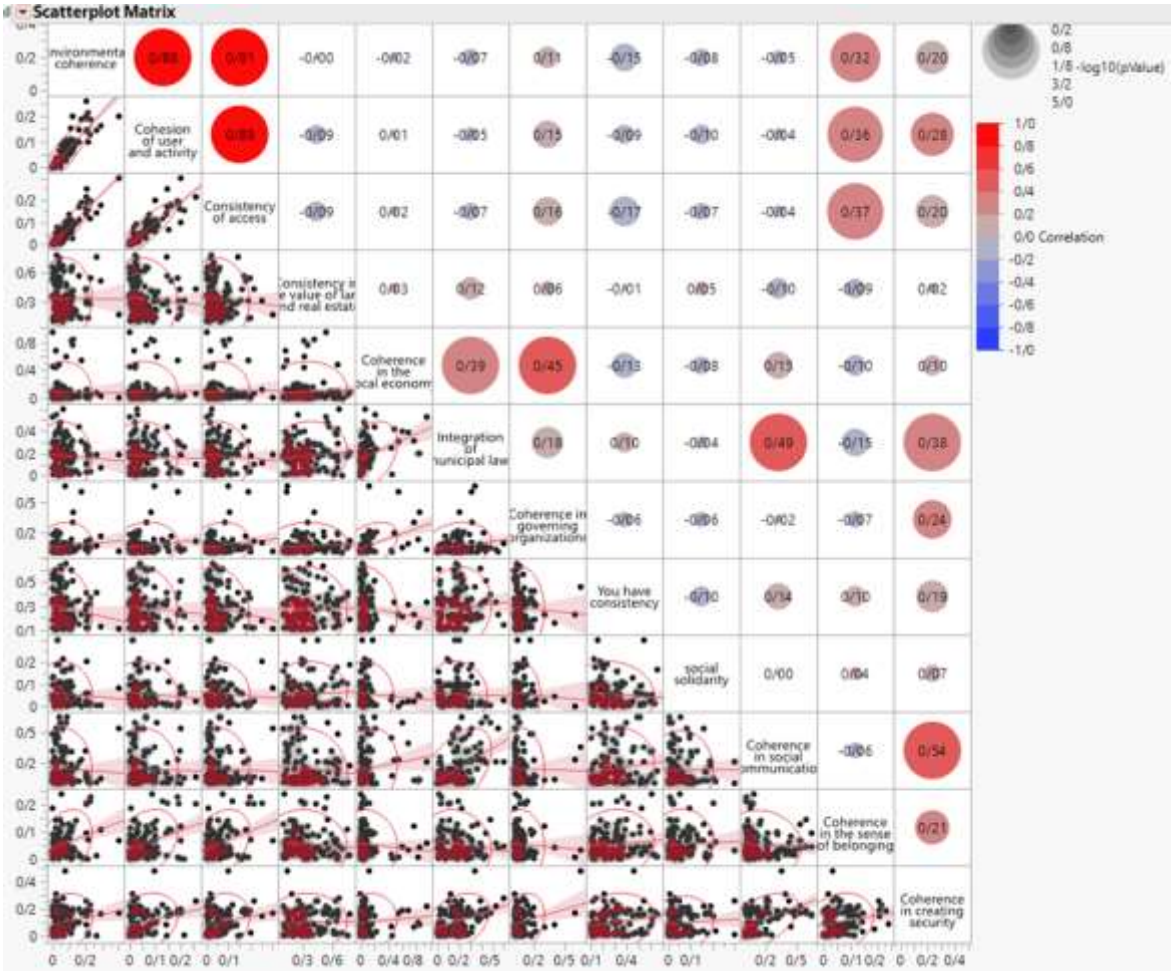


Fig 3 Correlation between the dimensions of enclosure relative to each other

Based on the correlation matrix between the dimensions, it was found that access coherence, user and activity coherence, environmental coherence have the highest correlation relationship with others, but case-by-case coherence in social communication has the highest average correlation coefficient with other components.

PN Modeling

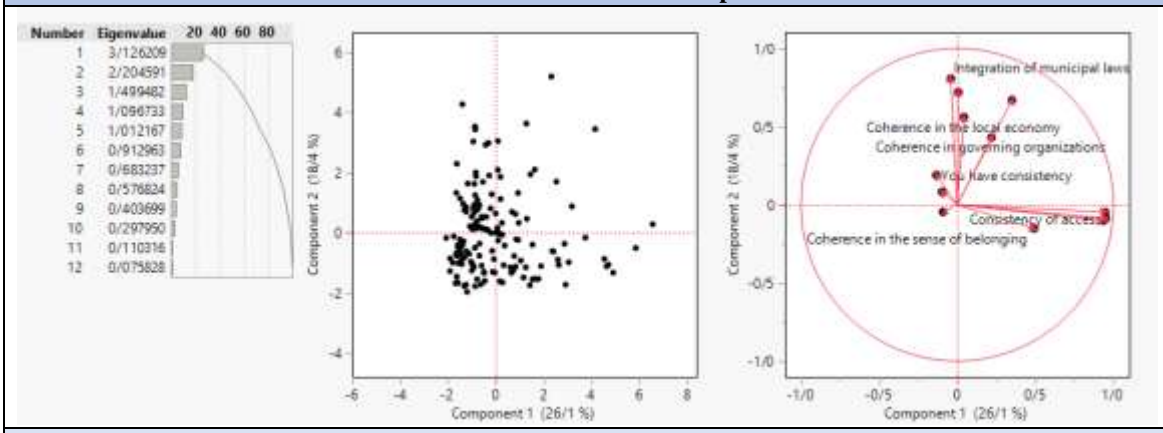
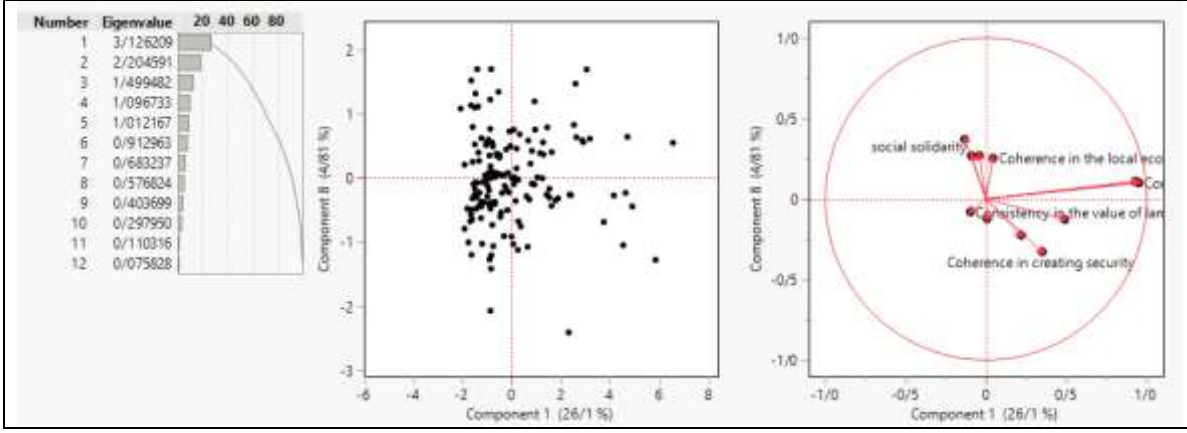
In the next step, PN modeling is used to check the effect of the components in each questionnaire. It was clarified that in Ekbatan residential complex, the coefficients of determination and factor contribution are more effective on a case-by-case basis, and the distance between the maximum and minimum components (highly effective and low effective) is large. On the other hand, the use of the components as described below and with each other will increase the impact in creating enclosure.

1. Consistency of use and activity, coherence in social relations, coherence in the value of land and real estate
2. Coherence in sense of belonging, cohesion in local economy, cohesion in municipal laws
3. Coherence in ownership, cohesion in governing organizations, social cohesion

In the future collection, the effect of the components to create the enclosure was less than that of Ekbatan, and the distance between the maximum and the minimum (highly effective and low effective) is reduced, and the use of some components as described below and with each other has the effect of creating more enclosure. will do;

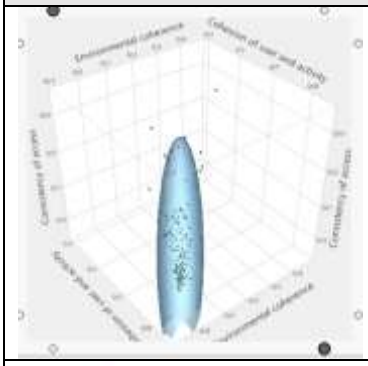
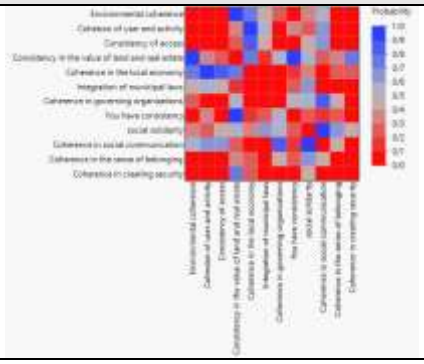
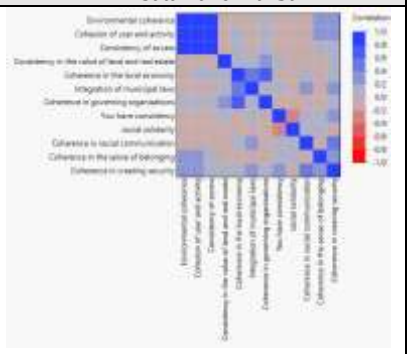
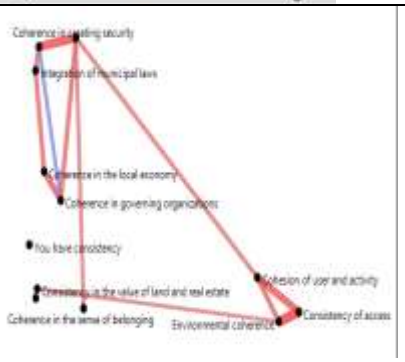
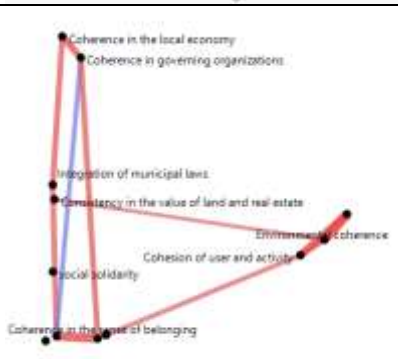
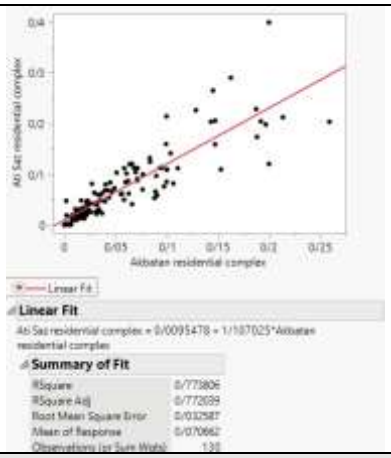
1. Consistency of access, coherence in the sense of belonging, coherence in managing organizations
2. Social cohesion, cohesion in the local economy

Table 5 PN modeling of confinement components in Ekbatan and Ati Saz collection

Ekbatan residential complex

Ati Saz residential complex


Based on the findings obtained in PN modeling for the factor share and the factor growth chart, it was found that most of the obtained relationships have significant coefficients less than 0.05 and tend to 0, which is evident in the graphic chart and the most significant relationships have points. It is red. Also, the coherence of access, coherence of user and coherence of environment has the highest dimension and a larger factor contribution that has significant relationships, but coherence in creating security does not have a significant relationship despite the impact factor. Coherence in municipal laws has a larger factor share than the first three cases, but it has a less significant amount. In general, based on the scope of the effect of the components of confinement and also its focus, it shows the continuity of the relationship between the components. Based on the relational correlation, it is determined that each dimension has a relationship with the other two dimensions and can be predicted, and the third dimension, which will be added to the blue color, has far less predictability than them. It is important to pay attention to the dimension of cohesion in both sets, which has no predictability based on other dimensions and has acted separately and should be considered in the first stage for planning and design. In general, the dimensions of confinement in the collection of Ati Saz and Ekbatan have a correlation of 0.772 in the way of application.

Table 6 Coefficient and scope of the application of enclosure components in Ekbatan and Ati Saz residential complexes

Scope of the effect of dimensions	Significance of relationships	Factorial effect of effective dimensions in Ekbatan and Ati Saz
		
		
Future communication correlation	Correlation of communication	Graphic correlation

6. Conclusion

In the current research, to investigate the degree of confinement in the neighborhood cohesion of the residents of Ekbatan and Ati-Saz, to identify these factors from the point of view of experts and

spatial users, and to extract the dimensions, components of each of the community effects and indicators of each of the components for measurement. The research method used was a combination of qualitative and quantitative type. In the qualitative part, with the help of the grounded theory method, variables were extracted from semi-structured interviews with the coding technique using Atlasti software version 23.1.1.0.

According to the investigations carried out in this research, in both neighborhoods, the factor of social cohesion is considered the most effective factor in the cohesion of the residents of both neighborhoods. The reason for this is that the enclosure and separation of Ekbatan and Ati Saz neighborhoods from the surrounding neighborhoods, both physically and socially, has caused problems such as social-cultural discontinuity in this area, which has consequences such as the fragmentation of the social fabric. The isolation and insularity of these two neighborhoods has caused the administration of this area to face problems and social participation in urban governance is decreasing. One of the most important problems caused by the lack of communication and connection between Ekbatan and Ati-Saz neighborhoods with the surrounding neighborhoods is social disunity and segregation in this area, which, if appropriate decisions are not taken and the need for social cohesion of the area is not taken into account, can cause many problems in the future. be cultural-social. The lack of communication and physical connection has also caused a gap in the physical tissue and its lack of harmony with the surrounding environment. In addition to the mentioned issues, these neighborhoods also struggle with the problem of access and inefficient public transportation, and this has caused major changes in the process of citizens living in these neighborhoods. From a physical point of view, fragmentation and isolation of Ekbatan and Ati-Saz neighborhoods can cause disharmony in the urban structure of Tehran, which may affect the economy of the region and affect the price of land and real estate. From the social point of view, the disruption of the social fabric and the existence of strange gates and walls will cause the loss of the socio-cultural identity of the neighborhood and the cohesion in the sense of belonging will decrease and decline, which is harmful to the quality of the environment and safety and security and the effects It will bring a side. Because in these neighborhoods, the residents have little or very little contact with their neighbors, and this is a sign of the residents' limited social interactions with their other neighbors. The very old residents of the two neighborhoods are relatively high, and the migration and relocation between the residents of the neighborhoods is relatively low. As a result, there is a sense of belonging in these neighborhoods and people are satisfied with their place of residence. According to the surveys, the public spaces of these neighborhoods are relatively safe and suitable for children to play, and they feel safe because of the presence of guards in these two neighborhoods and the lobbies of each block. The fifth most important factor from the residents' point of view is the governing organizations. Ati-Saz, and Ekbatan, are too big for a group of 5, 7 or 9 people to manage them, each phase of settlements has a separate board of directors and things are managed interactively. In Ekbatan and Ati-Saz towns of commercial units, Block 23 Board and Phase 1, 2, and 3 each have a separate board of directors that make decisions related to their area. One of the positive opportunities created in the settlements is the opportunity for participation and management from the bottom up in these residential complexes because, as mentioned in the previous section, all the powers of administration and maintenance of the settlement are the responsibility of the owners. But in these two towns, one of the basic problems is the lack of participation of people in the administration of the town and the indifference of the residents to the issues, and this is one of the important weaknesses in both towns.

References

Einifar, A., & Ghazizadeh, N. (2010). Typology of residential complexes in Tehran with open space criteria. *Armanshahr Journal, 3*(5), 35-46.

Alikaei, S., & Zamani, S. (2014). The principles of coherent urban design with an emphasis on the spatial qualities of the city. *Third International Congress on Civil Engineering, Architecture and Urban Development*, 1-14.

Berkman, L. F., Kawachi, I., & Glymour, M. M. (Eds.). (2014). *Social Epidemiology*. Oxford University Press.

Bruhn, J. G. (2011). *The sociology of community connections*. Springer Science & Business Media.

Caldeira, T. P. (2000). *City of walls: crime, segregation, and citizenship in São Paulo*. University of California Press.

Cséfalvay, Z. (2011). Gated communities for security or prestige? A public choice approach and the case of Budapest. *International journal of urban and regional research, 35*(4), 735-752.

Falahat, M. P., & Shahidi, P. (2015). The Role of the Concept of Mass-Space in Explaining the Place of Architecture. *Bagh-e Nazar Scientific Research Monthly, 12*(35), 27-38.

Hamouche, M. B. (2009). Can chaos theory explain complexity in urban fabric? Applications in traditional Muslim settlements. *Nexus network journal: Architecture, Mathematics and Structure*, 217-242.

Hatami, R., & Ziyai Naji, P. (2017). Explaining the concepts of enclosure in architectural space. The *5th International Conference on Architecture and Sustainable Urbanism in the Middle East and South Asia*, 10-10.

Hatami, R., & Ziyai Naji, P. (2021). Investigating the relationship between the energy consumed in activities and the spatial confinement component in order to improve the quality of the architectural design process. *Armanshahr Architecture and Urbanism, 14*(34), 79-89.

Ismaili, T., Kayani, H., & Janbaz Ghobadi, Gh. (2013). Sustainable development planning of coastal areas using spatial coherence approach, case study of Noor and Mahmoud Abad cities. *Second International Congress on Structure, Architecture and Urban Development*, 11-11.

Judd, D. (1995). *The rise of the new walled cities*. Maxine Goodman Levin College of Urban Affair, Cleveland State University.

Le Goix, R., & Webster, C. J. (2008). Gated communities. *Geography Compass, 2*(4), 1189-1214.

Levinson, D., & Christensen, K. (2003). *Encyclopedia of community: from the village to the virtual world* (Vol. 1). Sage Publication.

Low, S. (2004). *Behind the gates: Life, security, and the pursuit of happiness in fortress America*. Routledge.

McKenzie, E. (1994). *Privatopia: Homeowner associations and the rise of residential private government*. Yale University Press.

Murillo, R., Echeverria, S., & Vasquez, E. (2016). Differences in neighborhood social cohesion and aerobic physical activity by Latino subgroup. *SSM - Population Health, 2*, 536-541.

Mohammadi Zadeh, N., Majdi, H., Zarabadi, Z. S. (2017). Presenting a conceptual model of cohesion and fusion criteria in the context of historical neighborhoods with each other (case example: Kerman historical context neighborhoods, region 1). *Bagh Nazar, 15*(61), 36-52.

Negin Taji, P. (2011). Investigating the Role of Physical Factors in Forming the Concept of Place and Sense of Place. *Landscape Journal, 3*, 29-16.

Pourjafar, M., & Sadeghi, A. (2008). The principles of rulings on the purposeful design of urban landmarks. *Urban Identity, 2*(3), 95-106.

Qin, W., Wang, Y., & Cho, S. (2021). Neighborhood Social Cohesion, Physical Disorder, and Daily Activity Limitations Among Community-Dwelling Older Adults. *Archives of Gerontology and Geriatrics, 93*, 104295.

Roshni, P., Habibi, K., Zarabadi, Z. S. (2016). Presenting a conceptual model for the integration of the urban space network and its application in the 6th district of Tehran. *Bagh Nazar, 14*(48), 31-42.

Salah, N. M., & Ayad, H. (2018). Why people choose gated communities: A case study of Alexandria metropolitan area. *Alexandria engineering journal, 57*(4), 2743-2753.

Sassen, S. (2018). *Cities in a world economy*. Sage Publications.

Seydian, S. A., & Abafat Yeganeh, M. (2007). Review of the Concept of Physical Confinement in Urban Space. *Rah-o-Sakhtman Monthly, 46*, 46-54.

Shulin, S. H. I., Zhonghua, G. O. U., & Leslie, H. C. (2014). How does enclosure influence environmental preferences? A cognitive study on urban public open spaces in Hong Kong. *Sustainable Cities and Society, 13*, 148-156.

Tolai, N. (2002). The form of a coherent city. *Safa, 12*(3), 5-19.

Vesselinov, E., & Le Goix, R. (2012). From picket fences to iron gates: suburbanization and gated communities in Phoenix, Las Vegas and Seattle. *Geo Journal, 77*(2), 203-222.

Wang, R., Lu, Y., Zhang, J., Liu, P., Yao, Y., & Liu, Y. (2019). The relationship between visual enclosure for neighbourhood street walkability and elders' mental health in China: Using Street view images. *Journal of Transport & Health, 13*, 90-102.

Yilmaz, N. G., Lee, P. J., Imran, M., & Jeong, J. H. (2023). Role of sounds in perception of enclosure in urban street canyons. *Sustainable Cities and Society, 90*, 104394.

Yip, C., Sarma, S., & Wilk, P. (2016). The association between social cohesion and physical activity in Canada: A multilevel analysis. *SSM - Population Health, 2*, 718-723.

Zakavat, K. (2011). The position of spatial organization in urban design. *Safa, 54*, 105-118.

Zargarzadeh Dezfouli, M., Babaei Murad, B., & Babai Murad, M. (2013). The lostness of the spatial function of Iranian neighborhoods in the integration of today's urban structure, a case example of Kebabian Shahr neighborhood (Hamadan). The *second national conference on architecture and urban planning over time*, 11-11.

Available online at www.ijapas.ir

International Journal of Applied Arts Studies

IJAPAS 9(3) (2024) 117–131

Challenges of Online Education in Architectural Design from the Perspective of Professors and Students

Mehdi Tavakoli Kazeruni[a]*, Nazanin Sabetan[b]

[a]*Assistant Professor, Department of Architecture, Shiraz Branch, Islamic Azad University, Shiraz, Iran*
[b]*Ph. D. Student, Department of Architecture, Najaf Abad Branch, Islamic Azad University, Isfahan, Iran*

Received 18 August 2024; accepted 05 September 2024

Research Article

Abstract

Architecture education is very important in the education of future architects and is defined by the combination of practical and theoretical coursework. Due to the pandemic conditions, online education is one of the available options for education. which faces many challenges. However, due to the prevalence of virtual education in the world, due to the corona disease in the world and the need for communication between the scientific fields and practical education, it is faced with the adverse effects in the form of numerous challenges and shortcomings. The purpose of this research is to extract concepts and dimensions. And the components of the challenges of online education of architectural design.

Methods: This research is practical in terms of purpose. The research method used is a qualitative method, which was done with content analysis and coding of data collected by 12MAXQDA software. Then, from among the challenges based on the sub-components of online education challenges, the coding process is divided into two sections: general challenges; online education and specific challenges; Architectural design is taught online.

Findings: Based on the review of 732 free codes in 26 code-oriented categories, 7 main concepts were reached, which include the challenges of the educational environment and educational facilities; the challenge of students' psychology; the impossibility of correction and solving students' problems; weakness in the way professors evaluate students' learning. For architectural design, the lack of understanding of the design concept and the students' ability to analyze and be

* Corresponding author. Tel: +98-9177142863.
E-mail address: m_tavakoli1@yahoo.com

creative to implement the design, the weak educational program and the content of intensive courses, and the weakness of the electronic infrastructure.
Conclusion: According to the findings for these 26 code-based online architectural design training courses, which are based on various and different challenges, and improving its quality will increase the quality of virtual courses and requires a serious look for the training of future architect engineers

Keywords: Online Education; Virtual Education; Architectural Design.

1. Introduction

Architecture education is very important in the education of future architects and is defined by the combination of practical and theoretical coursework. Due to the pandemic conditions, online education is one of the available options for education. which faces many challenges. However, due to the prevalence of virtual education in the world, because of the corona disease in the world and the need of communication between the scientific fields and practical education, it is faced with the adverse effects in the form of numerous challenges and shortcomings. The purpose of this research is to extract concepts and dimensions. And the components of the challenges of online education of architectural design (Asadpour, 2021).

Throughout history, education has been one of the pillars of civilized societies. In today's era, its importance has increased to such an extent that the quality of education has been defined as an added value. In this definition, the quality of an educational system is the status of the students of this system in terms of knowledge, attitude and acquired abilities, so that it is possible to attribute the existing level of these acquired capabilities, abilities and attitudes to the educational system (Bazargan, 2010).

Architecture education aims to cultivate inner talents and improve the necessary skills, as well as transfer architectural concepts and values, seeking to educate creative and knowledgeable people in this field. On the other hand, teaching architectural design is a challenging matter that depends on many variables. Since the formation of a designer's personality and the acquisition of design skills are related to this category, it is highly sensitive and it is necessary to pay attention to the process of architectural education in architecture schools due to its importance (Daneshgar Gadham, 2009).

There have been changes in architecture education all over the world, one of which is the introduction of digital education and the use of modern technologies. Online education has had challenges, and there are flaws in the field of architectural education, and there are also many challenges in architectural design education (Benjamin H, Flett, and Zeigler-Hill, 2020).

At first glance, the challenges of virtual education overlap with the concept of disadvantages of virtual education, but it can be said that these challenges are issues that should be addressed seriously, and by addressing the aforementioned issues, the quality of virtual courses will increase. On the other hand, although the challenges are similar, we can consider this concept in a general way, and its difference with the limitations of virtual education is that these challenges will not necessarily be seen in all the cases raised in the discussion of limitations. But the limitations are considered to be one of the limitations of virtual education (Bayat, 2019).

Since the purpose of this article is to investigate the challenges of online architectural design education, this article deals with virtual education, architectural design, architectural design education, online architectural design education. At the end, suggestions and conclusions will be presented.

1.1. Virtual Education

The history of virtual education goes back to the beginning of the 20th century and even before that. In 1858, the University of London was the first of its kind in the sciences to award degrees through the delivery of coursework and course materials by post and through distance learning. From 1900 to the present, distance learning has gone through several developments. (Ebrahimzadeh, Mousavi, and Adam Nohayi, 2013).

1-before from 1900: the first appearance the car half automatic, that one the car Computer in opinion taken will be.

2- 1900 – 1959: the first period Development Technology Computer (the first and the second war global

3- 1960 – 1979 space and Internet primary

4- 1980 – 1989: Computer and evening Internet

5- 1990 – 199: evening technology Information and expansion Internet

2000-6-today society global

Education virtual, an opportunity B alternative for confrontation with Limitation Hi Education face to face realization the ideal Education for everyone and context making for Development stable and balanced in the country is (altar and Salehi, 2015).

This learning is a new approach in providing an equipped, interactive and learner-oriented learning environment that can be used at any time and place by using the resources and characteristics of various digital technologies and aligned with other forms of educational environments to create a free, flexible and distributed system in education. is used (Kermi et al., 2013). In recent years, virtual education has been promoted as one of the important applications of new information and communication technologies in the world, and extensive activities have been started in this direction. Considering the rapid changes that are taking place in the surrounding environment, the implementation of virtual systems in order to provide services and new technologies in the field of teaching and learning has been raised as a basic need (Fatehi et al., 2022).

For speakers, students and universities who are familiar with online lectures, the format of lectures using Internet-based information technology does not pose a problem. On the contrary, those who are not familiar with online lectures experience stuttering. They need to be quick and responsive to give online lectures. Unfortunately, this stuttering makes the speaking method ineffective, even causing problems. Schools and universities close their campuses indefinitely and suddenly have to transfer their online education using free services like Google, leaving their students with heavy course loads, achieving low results (Arif, 2020).

1.2. Architectural Design

There are many ambiguities in defining design, and theorists examine and define this matter from various angles. Also, to define it, it is necessary to know the different situations of design and its exact differences. In addition to this format, different approaches such as Architecture design interior design and. It has different backgrounds for definition. Of course, different theorists have sometimes tried to provide very general definitions, such as: the optimal solution for a set of real needs in a specific situation (Lawson and Park, 2018).

The existence of these definitions emphasizes the comprehensive scope of this issue. Therefore, in the field of architecture, design is considered an analytical process that requires analysis,

evaluation and selection. In fact, design can be seen as an effort to invent solutions before implementing them (Shefaei and Behzadpour, 2015).

In other words, it can be said that design is a multidimensional activity that includes a variety of skills and thought processes, including analytical reasoning, intuition, and creative expression. Learning how to design can be a frustrating and confusing process that is difficult for some students to understand. Teachers use a wide range of strategies when teaching. These strategies are often based on how their professors teach with little or no theoretical basis in student learning. For students, lack of understanding of the design process can challenge their desire to be motivated and actively engaged in the studio project. The result is less than optimal learning and students who do not achieve their potential (Hosseini et al., 2018).

In the architectural design process, there are three main obstacles facing the architect:

- How to deal with and communicate with the subject
- Lack of necessary experience in the design process
- Lack of continuous communication between the hierarchies of the design process (Rahimi, 2009).

Design, especially conceptual design, is a process for formulating and determining the problem, speculation, evaluation and progress in architecture, so designers need a modeling tool that has the speed and flexibility to confirm and strengthen the initial plan. Preliminary sketches are perhaps still considered a superior skill for introducing metaphor into the design conversation. True collaborative design work will undoubtedly be the norm for many design professionals. But to realize it, designers need to use a combined model with the ability to combine the advantages of the preliminary plan with the opportunities obtained from the models (Garner, 2005).

In the course of questioning, the designer tries to find the best process for the best product. He designs the basic data, limitations, guidance and features of the shape, contiguity, and dimensions of performance-related issues. It is the form of theoretical foundations and links with fields and disciplines that are related to architecture in some way (Kahdooi et al., 2016).

Teaching architectural design is a challenging matter that depends on many variables. Since the formation of a designer's personality and the learning of design skills are related to this category, it has great sensitivity and it is necessary to pay attention and study the architectural education process in architecture schools. In this regard, the initial steps of education in learning architectural design are very important in the training of designers (Daneshgar Gadham, 2009).

Teaching architectural design in most universities is done with a workshop system, it is based on doing work by students and then correcting it by professors. In fact, architectural design is something that is formed in collaboration between students and professors. In the meantime, it is possible for students to use the opinions of their other classmates; But these opinions are applied in a tasteful and scattered manner, which ultimately cannot help to improve a project in the right direction, and it is the student who decides to use in the field of architecture, although the methods of designing and producing space and form , is the most central issue, but apparently there is neither a unique method nor a single path in its process for design (Lawson and Park, 2018).

Today, it is considered a new thing that distance education is offered by universities for bachelor's and master's degrees. Although for the wide application of such a system, especially in architecture education, even for its current level, more time is needed due to the need for advanced programs and the special needs of the field of architecture. In architecture education, the course units are divided into theoretical and practical groups. Theory units can easily adapt to online units, as many universities have been offering theory units virtually for many years. The main problem is

related to practical units and workshops, which are difficult to transfer to the Internet, especially architectural design courses and workshops (Ebrahimzadeh et al., 2013).

For the effectiveness of the workshop as the heart of architectural education, the sub-categories of sketching and construction, photo and copy, individual criticism, collective criticism, building together and teaching from others are the category of cooperative education with the sub-categories of brainstorming, cooperation and social skills, solving Weaknesses of each other, dialogue between students and lecturers, students and goal setting and striving for the goal were identified, the media category with the subcategories of authentic site introduction, social interaction, sharing, representation and sketches, and finally the assessment category with self-evaluation subcategories. The professors are a collective assessment that should cover the activities of the architectural design department (Zandi et al., 2019).

The categories of architecture education include the ability to design with sub-categories of identification (understanding the problem, simultaneous evolution of the problem and solution, the context, the request of the client and the real consumer, design regulations), formulation (separation of the problem and multiple functions, concept and ideation), framing (way The primary solution and format of architecture and gathering background and reference), reflection (testing ideas, reflection in the process, expertise, evaluation) is the category of active design thinking of the branches of convergent thinking, creative thinking, critical thinking, combination of elements, analysis and inference. The effectiveness of the workshop as the heart of architectural education is from the sub-categories of sketching and construction, photo and copy, individual criticism, collective criticism, building together and teaching from others. Weaknesses of each other, dialogue between students and lecturers, students and goal setting and striving for the goal were identified, the category of media with the subcategories of introducing a valid site, social interaction, sharing, representation and sketches and finally the category of assessment with the subcategories of self-evaluation, professors It is a collective evaluation that should cover the activities of the architectural design institute (Zandi et al., 2019).

As an example, one is the process of designing education that is formal in education The architectural design is used, including the following steps can be seen in the Table 1:

Table 1 Architectural design teaching methods (Karvan et al., 2018)

Stages/Titles	Teaching and learning methods	Assignments	Prerequisite	presentation method
1- Draft	Presenting the coach Presenting the instructor-comprehensive Comprehensive presentation	- His research -Case study - Project briefing session - Meeting with the employer	- Research and presentation skills Advanced research skills - Research and thinking skills - Management ability	-
2-Schematic plan	brain storm Instructor feedback Comprehensive trainer discussion group discussion Sharing ideas Feedback from colleagues	- Site analysis - Draw a diagram - Zoning - Design idea -Programs - expansion - Division	- Commitment - Critical thinking skills - Management feature - Moral values - Self-confidence - Conversation	-Physical model - draft - 2D drawings - 3D drawings

			skills	
3- Development of the plan	- Coach's response - Comprehensive trainer discussion - Brainstorming - Presentation of successful projects - Group discussion - Feedback from colleagues	- Architectural design - Perspective - structure - technical	- Critical thinking skills - Self-confidence - Commitment	- Design and drafting - His research - Interpretation and design Graphics

Because in education of comprehensive design, they should be familiar with the process of problem solving to design, factors influencing the formation of concepts, critical thinking in design, and the stages and practice of studies in design, Ledar in education mainly relies on the conceptual, analytical, and social process, which Based on that, design learning topics are formed (Thaghafi, 2014).

Design is known as a thinking of identifying the problem and formulating the problem of its basic causes, structural dynamics and operations that lead to the problem solving approach. The design process is the scientific study of existing ideas, thought and thought in obtaining architectural solutions. The combination of the concepts of schema images and the discovery of design ideas, the examination of design issues, local limitations and the inseparability of projects and development had concepts (Karvan, 2018), they have divided the activity of designers into three groups of perception and imagination, and building an organization. In general, design They have organized with a wide range from computer programming to the creation of architectural form and space and imagination and construction. In general, the design process faces a range from computer programming to the creation of architectural form and space and urban design and has different aspects (Zandi et al. 2019).

Architectural design education is dependent on many variables. During the course of design training and design practice by architecture students, it can be seen that a complete and comprehensive understanding of the design problem did not happen immediately after the introduction and confrontation with the design problem, and during the design process, there are still ambiguities in the mind. He is struggling with the student (Sadeghi, 2018).

Online education in architecture had a history even before the recent pandemic. Over the past decade in Australia, Curtin University (2021) has offered the world's first accredited online architecture, innovative interior design and online bachelor and master of architectural science programs through self-directed learning and visual, verbal and written communication techniques. , Cape Peninsula University of Technology (2021) in Cape Town, South Africa, offers a two-year part-time program through block publication in a hybrid format including online education, university blocks and work-based coaching (Asadpour, 2021).

The online design studio is used as a tool and a method to transfer design knowledge virtually to students, visitors and guests in a familiar environment during the Corona virus. Therefore, the online studio was used to develop an online viewer experience for the students' final presentation called a virtual presentation (Ahmed et al., 2020). Many other research efforts are being made to provide new horizons of architectural education. All of them represent new opportunities that should probably be considered as a normal (not abnormal) situation. For future architects to meet these challenges, a review of the architecture curriculum is needed. The emphasis is on the studio as much as the other dimensions. Moreover, it may be time to expand the architecture curriculum, integrate different regulations, and really try to create the future (Adnan and Anwar, 2020).

2. Research Background

Online education is planned learning in which learning and teaching usually take place in separate environments. For this reason, online education needs communication and institutional technologies for designing and planning education. Online learning only focuses on the needs of the learner for the relationship with the instructor, while online education should include both sides of the relationship, i.e. the instructor and the learner. Online education is a new way to design, compile, deliver and evaluate education that uses electronic capabilities and facilities to help learning. E-learning is an educational method that has been created since the emergence of the Internet and the growth of this technological phenomenon and the use of its capabilities, and in fact, it is an evolution of the distance and virtual education method and meets the needs of people who want knowledge and want to learn, especially That the time and place are completely optional in this educational method. Today, electronic education has attracted the attention of many teachers and educational institutions and is one of the most basic and popular topics and uses on the Internet. Strategic planning and attention to online and virtual education has followed at the middle level (creating equal educational opportunity and creating new educational innovation) and the micro level (Salimi and Fardin, 2019).

The characteristics of the professor and educational content and the user's enjoyment of using electronic learning systems are effective in encouraging the use of electronic learning systems (Lim, 2020). The main factors of students' satisfaction are the combined environment of traditional and electronic methods can increase the level of students' satisfaction. The data becomes Universities should also address these issues in online education by developing codes of conduct to ensure transparency and security (Jentsen, 2019). In a research aimed at investigating the traditional education and distance education of health students, they found that the communication time between the student and the teacher in distance education is better than the classroom-oriented communication time (Kendai, 2020), but the virtual space is a native environment that simultaneously With its increasing development, it also spreads the ruling thought and the culture mixed with it. The flow of thought production and civilizational dynamics resulting from the virtual space overcomes the user and can transform, complete or destabilize his identity. But from another point of view, the virtual space reduces the obstacles of the real space in the global communication of the message, and due to its diversity, in different forms of images, animations, avatars and similar cases, it reduces the inability to express verbally and in writing, and it provides a unique opportunity to propagate religion and It has provided the processing of the word of revelation and the perceptual evolution of humans (Kendai, 2020).

Education technology is a partial intermediary for online learning and a complete intermediary for lesson technology in terms of its relationship with students' satisfaction, since all dimensions have a proper alignment and have a meaningful evaluation level. On the other hand, course technology significantly facilitates the learning process of students (Sun, 2016)

Since the majority of articles on the challenges of online education in architectural design have first mentioned the common challenges of online education, in this article we will first examine the researches on the common challenges of online education:

The background of research in the field of general virtual education challenges

Adaptation to conditions of sudden transition to online learning and comparisons of reactions to online conditions compared to more conventional face-to-face learning conditions confirmed that students have pervasive negative reactions to online conditions due to the pandemic. In addition, adaptation to the pandemic was widely associated with more positive responses in several indicators. Also, the indirect communication model was supported that personality traits are

associated with specific reactions to online learning through their relationship with adaptation (Besser, Felt, and Zeigler-Hill, 2020). Complementary analysis showed more positive reactions and learning adaptation of students who have a sense of belonging. and were more important, highlighted the role of adaptation and the significant challenges of university students who have experienced changes in their learning and living conditions, due to the need to rapidly adjust to the changes and uncertainty caused by the covid-19 pandemic, attests .Other relationships identified show that an increase in the level of belonging and importance may be a way to improve the level of attention, motivation, learning and fulfillment of students' expectations, and this is consistent with evidence about the role of matter and belonging in positive orientation. and learn the results. In general, these results indicate the complete and relevant use of positive psychology structures in the adaptation in general and in the adaptation of students' learning. Overall, these results indicate a complete and relevant use of positive psychology constructs in general adjustment and in students' learning adjustment (Besser, Felt, and Zeigler-Hill, 2020).

Higher education providers are increasingly aware of the diversity of their current and potential learners and are striving to provide a range of options for their engagement. The increasingly flexible delivery modes of different pathways and opportunities available to university students for those seeking further education. In changing different modes and in different modes, one size fits all modes is often used. Barriers to participation are especially evident in group work activities. The online environment also creates challenges for many academic staff who increasingly require a higher level of technical and technical ability than their regular academic workload. Adds the toolkit in providing them with direct experience through different methods to prepare a wide variety of people in different contexts and settings that they may interact with in the future in the workplace. and external, it may be a valuable implementation for academics who want to engage with the online space in various ways and plan online educational programs. This can also help to limit some of the interaction of foreign students who prefer to have access to a wide range of interaction with their peers (Gillett-Swan, 2017).

An additional challenge is the infrastructure required to facilitate online courses and thus the high prices associated with accessing the content, whereas, for online learning to do so, students must have access to the correct instrumentation, whether a telephone be smart and what a portable computer. They have jointly received sufficient net information packages. Similar online learning in rural areas simultaneously finds issues. This could be as a result of class sizes and higher lecturer-to-student ratios, reducing students' ability to access online content and even fewer resources to access it outside of smartphones, similar to Internet cafes. Smartphone technology may already exist, however, the power of urban and rural Indonesians to unlock their potential is uneven. The most common strategies used by teachers to solve students' problems are the use of online chat, in which Whatsapp has been the most used. Other strategies employed were the use of video conferencing and the combination of both online chatting and a video conference. On the contrary, there are some problems (Seylan, colleagues, 2020).

- In a research, the obstacles to the development of virtual education in Iran are described as follows: (Kardan and Fahimi Fard, 2013).

-Slowness in the development of required telecommunication infrastructures

-Lack of liquidity for the development of communication networks

-Lack of liquidity of various organizations and industries for the relatively expensive development of electronic education

- Necessity of equipping virtual education systems in local and national languages

- The expensiveness of producing electronic course content and the necessity of pure design and production
- Failure to develop a suitable policy for the implementation and development of e-learning in accordance with the goals and facilities of various organizations and industries
- Giving little importance to education in most of the policies and decisions of senior managers
- The number of private sector practitioners in the field of e-learning and the lack of leadership and convergence among them in the field of e-learning (Kardan and Fahimi Fard, 2013).

Educational problems: how to write a lesson in electronic education, the lack or lack of incentives for teaching through electronic means (Sabbaghian et al., 2019).

In a major research, the factors that cause the failure of electronic training courses have been investigated, which are: weak and inappropriate disappointment in training technology and training personnel, poor execution of the training course, lack of participation and interaction, heavy costs of personnel and training technology, investment Weak and inappropriate in educational technology and educational personnel (Jay Badyen and Agini Suye, 2010)

- In an article, the main factors identified as the failure of e-learning courses are the impossibility of using direct conversations with professors and other learners instead of using chat tools / the boring / stressful content of e-learning courses. existence of e-learning courses / complexity and difficulty of the learning process in e-learning courses / unattractiveness of e-learning / boringness of materials and course contents of e-learning courses / inefficiency of e-learning courses in the category of learning / lack of appropriateness and compliance E-learning courses are based on the individual conditions of the learners / not having enough time for learning (Verzalik et al., 2010).

3. Research Method

The present research method is based on various studies and investigations related to the subject of research in the field of architectural design education and online education in the years 2005 to 2021 and also by using authentic Latin articles in the fields related to online education and architectural design, coding key concepts to summarize The amount of information that is caused by using the software in three stages of open coding, axial coding and finally, the selection of the main categories of MAXQDA12, in the following, we can refer to the tool for collecting information from theoretical studies, the steps of conducting research for validation studies: selection from the professors of architectural design education (targeted sampling and explaining the problem for them) and then preparing questionnaires in 2 sections (professors, students) according to the sub-components of the challenge of online education and sending it to the professors of architectural design. Below is the diagram of the research structure and process.

4. Findings

In this research, after extracting and coding the information related to the general and specific components of online architectural design education, in the open coding stage, coding was done by extracting the opinions of experts that were directly mentioned in books, magazines, and authentic Persian and Latin articles or by The authors were identified, through the representation of concepts, line by line, phrase by phrase, paragraph by paragraph or page by page. , a concept or a code was attached to each line of the sentences, and this code or concept filled the maximum conceptual and semantic space. At this stage, all the information was coded and until the saturation of the data, included 749 open codes, 32 central codes and 6 concepts, and the definitions and principles that were raised about the challenge of online education in the articles related to the research topic in the

theoretical foundations section were found. Many cases have common concepts that are expressed in different expressions. In Table 2, the number of extracted open codes are shown separately for each area. After extracting the open codes, the central coding stage of the common concepts were categorized in the form of major categories.

Table 2 Number of extracted open codes for each area

Theme	**Axial code**	**Number of open source**	**Challenge**
- Technical challenge -Cultural challenge - Economic challenge - Educational challenge	category First Problems technical is that in it weakness in Below made I see and was not communication the face to the face to between teacher and learner and decrease security in Information - Handle Second Problems a skill and Absence match Teachers with Education on line may be that Absence Acquaintance with the environment virtual and Structure it difficulty Evaluation quality learning Students Absence Proportion manner evaluation with presentation harvest down to be Literacy Information and computer E Learners resistance Teachers for login to evening fan bring and change Shame Hi assessment traditional and in finally increase Volume work Teachers - Handle Third Problems that Issues moral expression done are that it particle for direct object from the most important Issues a dream Teachers virtual knowing are (abstinence and Colleagues ,2014) challenge Hi major before Roy Teachers in to work get fan bring Information and Communication are from: ready not being Below made I see Absence Education and skill force human Absence Allocation Credits enough to this domain Expensive and Also illiteracy or low Literacy Teachers in application tools electronic (Olabi and Colleagues, 2013) the result review Obstacles and challenge Hi university virtual badge gave that Ali Although Existence Problems and Issues technical in Zimeneh Infrastructure I see Issues cultural and social and managerial from sentence challenge Hi before Roy this Universities in Iran are (Khadior and Rahmani, 2014) speed down Internet, weakness in	586	**The common challenge of online education**

	Resources hard software and soft software and dissatisfaction from quality Services to title challenge Hi technical technology cost up and capital put inappropriate to title challenge Hi force human Absence Acquaintance with Education electronic support low The officials and Absence desire Students to do works a team to title challenge Hi legal and Absence desire to learning always and attitude traditional to title challenge Hi cultural Centers Education electronic Universities government city Tehran may be (Fakhrzad, 2005) from other challenge I see can to Employing industry learning nimble and face to growth; speed in Learnings electronic; force Human specialist in design and production content and in presentation content(teacher); Methods teaching suitable Environments electronic; the need day In addition to Innovations again educational.reference Also must addition to be that use useful from one period virtual(online and or Offline)in need presence in one environment to away from pollution sound is; If this pollution audio, able consideration be, learning particle for direct object with Disturbance faced will did(Shabani and Mahmoudi, 2018)		
1-Design-process& communication skills 2-learning self-taught 3-Design, modeling and digital presentation 4-Familiarity&experienceWith professors and virtual software 5-Devices and technical facilities 6-Training and evaluation	1-1-Adequate feedback and reviews From Nedris teacher 1-2-ability teacher in conveying feedback virtually 1-3-Teacher skills for teaching virtual design 1-4-Enough time to respond to the teacher's criticism 1-5-Suitable hardware facilities for tutors 1-6-The possibility of explaining the design idea 1-7=Understanding Virtual design problem 1-8-Correct understanding of individual training 1-9-The usefulness of virtual training Compared to face-to-face communication 1-10-The desirability of teacher-	163	The specific challenge of online education in architectural design

	student communication as part of the design process 1-11-Company in Studio Design as an activity-oriented course 1-12-More case study opportunities in e-learning 1-13-possibility bring up Questions in the virtual studio 2-1-Development of student abilities 2-2-Improving creativity in response to the design problem 2-3-Saving student time compared to face-to-face training 2-4-Changing the role from a passive student to a knowledgeable one atmosphere Active and participant 2-5-Learning course objectives virtually 2-6-force to Trust in your abilities exceed the guidance of the instructor 2-7-Improving the quality of the final work 2-8-Necessary academic training on electronic learning methods 3-1-SendingMedia of the final design compared to the printed work 3-2-3D modeling as an alternative to physical model making 3-3-Advantage of 2D drafting software Satisfying the final virtual presentation 4-4-Prior acquaintance with the supervisor and the quality of learning 4-5-More design experience and knowledge atmosphere and efficiency of e-learning 5-5-Internet access quality 5-6-Access to the appropriate device (such as a laptop graphics) 6-1-The role of the professor as a consultant and facilitator instead of a provider and coach 6-2-Change in the evaluation criteria of the supervisor		

5. Result and Discussion

The COVID19 pandemic last fall semester challenged traditional architectural design courses and made everyone make hasty and urgent decisions. This incident not only revealed the shortcomings and weaknesses of the old education systems, but also provided opportunities for revision and reform. Because the challenge has occurred and continues to exist on a global scale,

scattered experiences can be coordinated with effective strategies and effective tactics. In summary, the results of this paper highlighted some important factors. Six specific indicators obtained from the analysis of the articles were identified: 1: Design process and communication. 2: self-taught learning; 3: Digital design, drafting, modeling and presentation; 4: experiences; 5: technical equipment and facilities; and 6: training and evaluation. Among the challenges of professors in teaching architectural design, we can point out lack of familiarity with educational software, lack of ability to produce content, lack of familiarity with class holding services, lack of expression skills, lack of ability to attract the audience's attention, lack of body language (Kiran and colleagues, 2020).

According to the results of previous research, Asadpour, 2021, Morozumi et al., 2001; Niculae, 2011; Schnabel and Ham, 2012; Masdeu and Fuses, 2017; Iannou, 2018; The challenges of online architectural education methods for design education were investigated and this research, in addition to their results, in the challenges of online architectural design education, it was concluded that there is a weakness in the way professors evaluate the students' learning for architectural design and it should be The use of multiple evaluation methods in the class and the use of students in teaching and discussions prevented cheating, and there is a lack of understanding of the design concept and the ability to analyze and create students to implement the plan, which should be used in the selection of students at the entrance of the university and the existence of its interests. Pay special attention to architecture. The necessity of preparing native software for virtual education, the use of visual effects in effective learning, the concentration of an important element in learning through virtual education, the need to have two-way video communication in virtual education, the lack of sufficient supervision in holding high-quality classrooms in education systems. virtual, online tests and the problem of inadequate evaluations, professor-oriented virtual education system, not student-oriented. Infrastructural problems are still ongoing for students and the Internet is the main problem of all students. Accordingly, their structural characteristics and relationships were analyzed with regard to their relationships with the two pillars of architectural design education, i.e., professors and students, considering the important role The general nature of communication skills, both physically and figuratively, there is evidence that these factors result from the traditional roles of education practitioners and curriculum providers. Although students insist on changing the role of the professor as facilitator and consultant, they consciously refuse to accept the role of an active participant in the design studios. An important part of the education system, at least in developing countries, focuses on improving skills Teaching is focused and does not encourage and motivate students. Now that e-learning prioritizes individual skills, there is a great opportunity to move towards sustainable education in architecture. In addition, changes in teaching methods require structural reforms in educational content and upgrading of professors' skills, none of which is possible without support from architecture schools. University professors mentioned online exams and insufficient evaluation, lack of monitoring of online education systems and weaknesses in the online education delivery systems of universities as other problems of students these days, and it is hoped that by recognizing the weaknesses and highlighting the strengths of the day, Let's witness the reduction of challenges and progress in this field.

Based on the review of articles, it was concluded that potentially the most appropriate teaching and learning methods are in the form of a combination of both face-to-face and virtual methods in the design studio. The Corona pandemic in 2020 accelerated the recognition of these approaches and forced professors to take these hybrid methods seriously when teaching architectural design and evaluating what students have learned in their design studio. In the future, studies on different approaches to designing the design workshop and work on the workflow of design courses need to

increase the quality and quantity, so that a better and healthier design studio environment can be produced.

6. Conclusion

Examining the challenges and proposing solutions to improve online architecture education during the outbreak of the Corona disease and the closure of educational centers is very important. Due to the fact that all education is online in the whole world, paying attention to practical courses such as architectural design education is a new opportunity to address Its challenges have been provided. The purpose of this research is to examine the challenges and solutions of general and specific online education of architectural design education. Despite the great emphasis of the lecturers in the field of design on the importance of proper teaching of architectural design, little research has been done on the challenges of teaching architectural design professors and students in online education. In this research, by inferring and analyzing the research content about the challenges of learning and teaching online architectural design, the components of the general and specific challenges of online architectural design education are determined, and after checking in MAXQDA 12 software, the general and specific challenges of online education Architectural design is divided into 2 categories of challenges for professors and students, and training students to understand the design process from understanding to practical applications and implementation of the design, raising the electronic infrastructure and site facilities, and assigning a part of the system to the evaluation of projects and assignments. And solving problems of students are very important. New configurations must be developed to redefine studio content, procedures, and outcomes to ensure student learning efficiency, assessment practices and assessment methods, and objective and meaningful achievements. All these should be based on new communication skills as part of the media.

- Peer, emotional, social and economic solutions should be considered in planning policies and definition of new design studios. Isolation, loneliness, and the disadvantages of using social media should also be considered as part of strategic planning. Both students and academic staff.

Limitations on national resources and university facilities should be considered in any planning and structural reforms. The results of some recent studies have shown that e-learning has led to a greater gap between poor and poor students. Finally, global online communication in transferring experiences between architecture faculties and schools should be further increased. Sharing university facilities can actually fill a little void in other universities and improve the sense of empathy.

References

Adnan, M., & Anwar, K. (2020). Online Learning amid the COVID-19 Pandemic: Students' Perspectives. *Online Submission, 2*(1), 45-51.

Asadpour, A. (2021). Student challenges in online architectural design courses in Iran during the COVID-19 pandemic. *E-Learning* (pages 10-15).

Armaghan, M., & Tharwat Jo, H. (2014). The nature and role of virtual architecture education in the age of information technology. *International conference on architecture, urban planning, civil engineering, art and environment; Future horizons, looking at the past*, Tehran.

Bayat, V. (2019). Advantages and limitations; Opportunities and Challenges. *Psychological Studies and Educational Sciences Quarterly, 7*.

Bazargan, A. (2010). *Evaluation of education*. Second edition, published by Tehran university (pages 18).

Benjamin. H. G., Flett, G. L., & Zeigler-Hill, V. (2020). *Adaptability to a sudden transition to online learning during the COVID-19 pandemic: Understanding the challenges for students*. Scholarship of Teaching and Learning in Psychology.

Besser, A., Flett, GL., & Zeigler-Hill, V. (2020). Adaptability to a sudden transition to online learning during the COVID-19 pandemic: Understanding the challenges for students. *Scholarship of Teaching and Learning in Psychology*.

Daneshgar Gadham, G. (2009). Understanding the design problem in architecture education, examining the factors affecting the adequate understanding of the design problem as a starting point for beginner designers. *Fine Arts*, (37), 59-68.

Ebrahimzadeh, S., Mousavi, M., & Adam Nohsayi, Sh. (2013). Examining the role of virtual education in learning architecture. The *first national conference of new ideas and technologies in architecture*, Tabriz.

Fatehi, A., Javaid, M., Qadri, M. A., & Suman, R. (2022). Understanding the role of digital technologies in education: A review. *Sustainable operations and computers, 3*, 275-285.

Gillett-Swan, J. (2017). The challenges of online learning: Supporting and engaging the isolated learner. *Journal of Learning Design*, *10*(1), 20-30.

Haghir, S., & Shohanizad, Y. (2011). Rethinking the teaching of the course "Acquaintance with contemporary architecture" (undergraduate degree in architecture in Iranian universities). *Architecture and Urban Planning (Fine Arts)*, *17*(3), 71-80.

Harserkhani, H., Sagham, Sh., & Ranjbar, S. E. (2019). Examining the challenges and providing solutions to improve online chemistry education by Moalem Yar designer. *11th National Conference on Chemistry Education of Iran*, Isfahan.

Jaafari, E., Homayoni Bakshaish, N., & Alam El Hadi, J. (2021). *Students' lived experience of justice in virtual education courses*. Education technology.

Lawson, D., & Park, J. (2018). Describing the geometric difference of architectural forms in three primary shapes of circle, triangle and square. *Journal of Asian Architecture and Building Engineering, 21*(1), 1–21.

Lim, I. (2020). Reality for Malaysia's university students: Online learning challenges, stress, workload; possible solutions for fully digital future until Dec. *Malay Mail*, 16.

Salimi, A., & Fardin, R. (2019. Review challenge I see and presentation Solutions improvement Education online(online)Chemistry by execution designer the teacher Dude. the *11th Conference national Education Chemistry Iran*, Isfahan.

Saleh Sadekpour, B., & Mirzaei, Sh. (2008). Attitudinal challenges of faculty members in electronic education. *Education Technology (Technology and Education)*, *3*(1), 77-87.

Sajidi, M. (2019). Investigating the effect of education on the degree of willingness to learn and attitude among those interested in architecture. *Shabak, 6*(4 (55), 21-28.

Sardashti, S., Shafaei, M., & Mozafar, F. (2018). Applying critical education in the architectural education system (case study of a master's architecture design class of Gorgan Azad University). *Education Technology (Technology and Education), 13*(4), 709-725.

Tabatabai Bafghi, S., Hatami, J., & Khazaei, M. (2016). Examining the challenges of teaching poster design in Iranian art universities (a qualitative study). *Journal of Visual and Applied Arts*, *10*(20).

Tolit, M., Taheri Rad, M., & Pirannejad, R. (2019). Examining the challenges of clinical education of students of operating room and intelligence fields of Birjand University of Medical Sciences. *Development strategies in medical education, 7*(1), 52-60.

Thaghafi, M. (2014). A comprehensive composite model for architectural education: integration of face-to-face and virtual learning environments. *Education Technology (Technology and Education)*, *9*(4), 253-263.