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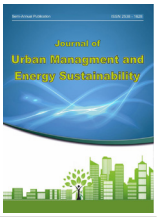

ORIGINAL RESEARCH PAPER

Explaining the indexes affecting the formation of the architectural pattern of Iranian residential buildings based on the philosophy of structuralism in Qajar, Pahlavi and contemporary periods

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ABSTRACT

Iranian architecture in different periods, under the influence of philosophy of structuralism, has had different readings, the most obvious of which in the three periods of Qajar, Pahlavi and after the 1979 Iranian revolution, has led to the production of numerous buildings that, depending on their type, have interacted with Iranian behavioral patterns and culture in residential use. This research is of a descriptive-analytical type, which has a development aim, but its fundamental characteristic can be pointed out, especially in explaining the depth of the theoretical foundations, the proposed model and framework. The method of collecting information is in the form of a library and field from references such as the architecture department of academic institutions and international data and at the field level. First, after examining the theoretical foundations as well as the history of the research in the two dimensions of procedure and content, where there is an emphasis on clarifying the aim, not repeating it, factors are extracted as the result of the research framework and using the Delphi method as the final indicators proposed in the form of a model. The results of the Delphi method indicate that the spatial hierarchy index, climatic adaptability, and spatial connectivity have the most impact with an average score of 4.52, 4.51, and 4.32, respectively, and the main model has the impact of structuralist philosophy on the architecture of residential buildings in three periods.

Running Title: The indexes affecting the formation of the architectural pattern of Iranian residential buildings based on the philosophy of structuralism

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INTRODUCTION

Structuralism, as a theoretical approach, emerged as a result of the scientific and intellectual developments of the 20th century and quickly penetrated various fields of the humanities and social sciences. This approach, by focusing on the infrastructural relationships between elements, rather than analyzing individual elements or independent historical events, attempted to provide a systematic method for understanding phenomena (Adimihardja & Salura, 2004). The main origin of structuralism should be sought in Saussure's linguistics. In the early 20th century, Ferdinand Saussure, by presenting the theory of the language system, emphasized that language is not a set of words that are meaningful individually, but rather a system whose elements only find meaning in terms of their relationships and differences within the system (Anwar et al., 2018). This view created a revolution in the understanding of language and led to the development of branches such as the structural analysis of text, literature, and cultural symbols. In Saussure's theory, language is a set of internal relationships that operate in the form of comprehensive systems. Each element acquires meaning only in terms of its differences and relationships with other elements. This concept paved the way for the structural analysis of symbols, texts, and cultures, and laid the foundations for later theories such as Lévi-Strauss's symbolic analysis (Bebhe et al., 2019). The roots of structuralism in architecture lie in the criticisms formed during the modernist era of architecture and urban planning in the mid-twentieth century. In this way, ideas influenced by structuralism in architecture crystallized. (Salingaros, 2000) A group called 10, as pioneers of protest and criticism for the sake of Athens, founded the idea of structuralism in architecture, which was influenced by the works and ideas of Strauss. Between 1960 and 1970, structuralism was objectified in response to the ideas in functionalism, and Otterlo was the first person to form the Group of 10 in 1959, along with Kahn, Keynes, Tange, and a number of other people. (Peters, 2017) Structuralists criticized the rationalist ideas that led to functionalism in cities because they believed that these ideas led to the formation of lifeless, uniform spaces without identity. Group of 10 tried to put forward views that were more flexible than functionalist views. Therefore, identity and flexibility in form are considered the most important issues for structuralists in architecture. Structuralists believed that in addition to function, the construction of spaces should also be considered. (Lake et al., 2021) Structuralizing spaces were the first step that urban designers with a structuralist approach took. Structuralists in architecture believed that architects and city planners should only design and plan the main parts of the city, and that the rest should be created by the people. (Yatmo et al., 2021) This was while modernism simply stated that a city should be designed completely and implemented its plans for the entire city. Structuralists emphasized the failure of cities such as Brasilia and Chandigarh to design and implement. (Norberg-Schulz, 2000) Functional architecture was criticized for its excessive uniformity of designs, inability to intervene in the tastes of users in the design and division of the city for various activities, and excessive standardization in construction, which is actually the most important criticism of functional architecture. (Salura et al., 2020) Structuralist designs allowed users of space to choose the space for their daily activities themselves, thus allowing for diversification and giving identity to the space through users. Therefore, flexibility and performance were formed in cities (Christophori Lake, 2022).

Structuralism in Iranian residential architecture offers a distinctive lens to examine how space, hierarchy, and meaning are organized within a cultural and historical context. In the Qajar era, late 18th to early 20th centuries, architects and patrons began negotiating traditional domestic forms with emerging modern ideas, often infusing spatial arrangements with sym-

bolic orders that reflected social stratification and ceremonial life. (Gheituri et al., 2008) The period's residential forms frequently displayed a tension between enduring Persian typologies and the influence of European planning concepts introduced through diplomatic and cultural exchanges, while still prioritizing intimate courtyards as organizing cores that mediated public and private realms. The structuralist reading emphasizes how these courtyards function as central nodes around which rooms, corridors, and service spaces are arranged, creating a spatial grammar that encodes social relations and ritual practices within the home. In this sense, the Qajar house can be understood as a material manifestation of a broader syncretism where traditional patrilineal hierarchies and emerging modern citizenship cohabit within the same dwelling. Transitioning to the Pahlavi era, the architectural discourse shifted toward rationalization and modernization, yet structuralist ideas persisted in nuanced forms. (Bolandian & Naseri, 2014) The drive to create legible urban fabrics and standardized plans often mirrored the need to stabilize the rapidly changing social order, while private domestic spaces retained the courtyard-based logic but were increasingly enveloped by larger, more disciplined façades and plans. Structuralist insights illuminate how even when new materials, technologies, and production methods were adopted, the house continued to function as a node within a larger network of domestic obligations and social performances. The formal language became more streamlined, yet the organization of rooms and circulation still followed a logic of hierarchy and sequence, illustrating how architectural structures encode cultural expectations about gender, family life, and social status. (Ghobadian, 2016)

After the seismic cultural and political shifts of the 1979 Revolution, Iranian residential architecture underwent a reevaluation of modernization, tradition, and identity. Structuralism remains relevant as scholars analyze how new housing typologies ranging from mass housing to redesigned courtyards reframe the relationship between public space, domestic privacy, and community life. The revolution prompted a renewed interest in vernacular forms and local materials, while also challenging the universality of Western architectural models, thus reconfiguring the structural grammars of domestic space. In this period, the house often acts as a site where collective memory, religious practice, and contemporary sociopolitical aspirations converge, with spatial hierarchies reinterpreted to reflect changing notions of family, gender roles, and community responsibility. A structuralist reading reveals how such houses organize flows, thresholds, and rooms to support rituals, social gatherings, and everyday life within new political imaginaries. (Caput, 1997) Across these three eras, the structuralist perspective highlights recurring motifs: a central courtyard as a regulatory spine that gathers surrounding rooms; a hierarchy of spaces that communicates status and function; and thresholds that mediate movement and encourage or constrain social interaction. In Qajar housing, these motifs express a negotiation between tradition and modernity, with spatial configurations serving as a stage for ceremonial life and kinship structures. In the Pahlavi period, the consolidation of a modern state coincides with a more formalized, almost bureaucratic spatial organization that still roots itself in the domestic courtyard as an ethical and social anchor. (Ranjbar Kermani, 2009) Post-1979 Iran witnesses a reimagining of domestic space that respects vernacular sensitivities while engaging with contemporary housing demands, resulting in layered architectures where memory, identity, and collective practice are embedded in the built form. Across all periods, structuralist analysis underscores how the organization of space in Iranian houses is not merely functional but deeply meaningful, reflecting and shaping the moral economies of family life, public ritual, and community belonging. (Raies Samiei, 2013)

Scholars who apply structuralism to Iranian domestic architecture often draw attention to patterns of juxtaposition, repetition, and segmentation that reveal latent orders governing everyday life. These patterns are not static; they respond to shifts in political ideology, economic structure, and cultural exchange, illustrating how houses act as repositories of cultural codes. The courtyard, corridors, and annexes repeatedly encode ideas about hospitality, privacy, and reproduction of social roles, while exterior facades communicate status and aspiration within the urban fabric. The continuity of certain organizing principles across dynastic changes demonstrates architecture's capacity to stabilize social experience even amid upheaval. Such a reading foregrounds architecture as a disciplined practice that constructs social realities as much as it reflects them. (Suzanchi, 2010) The persistence of structuralist motifs in Iranian residential design thus offers a vital lens through which to understand continuity and transformation in a society that valorizes layered meanings within everyday life. In addition to spatial organization, structuralist theory invites examination of material choices construction techniques, and climatic adaptations as elements that reinforce symbolic structures. In addition to spatial organization, structuralist theory invites examination of material choices, construction techniques, and climatic adaptations as elements that reinforce symbolic structures. The use of courtyards, mashrabiyas, and verandas can be interpreted as architectural devices that orchestrate light, privacy, and social interaction in ways that encode gendered spaces and ritual practices. Across the three periods, material palettes from traditional brick and plaster in the Qajar era to a growing embrace of modern concrete and steel in the Pahlavi period, and finally to vernacular repertoires that foreground local timber, brick, and earth-aware techniques after 1979 reflect shifting epistemologies about durability, legitimacy, and belonging. Structuralism thus helps explain why certain thresholds, such as entryways and transitional halls, acquire symbolic weight beyond their functional roles, acting as stages for social performance and negotiation of domestic authority. (Kashfi, 2012) By tracing these patterns, scholars can illuminate how Iranian houses function not only as shelters but as microcosms of broader cultural negotiations between tradition and modernity, private life and public realm, and local rootedness and global influence.

MATERIALS AND METHODS

The Philosophy of Structuralism and Architecture of the Qajar Period

The Qajar period (1210-1344 AH) is considered a turning point in the developments in Iranian architecture. During this period, structuralism in architecture is clearly visible. Qajar architects combined traditional and modern elements and tried to preserve their national and cultural identity. This period witnessed the formation of buildings that not only represented royal power but also reflected the social and cultural developments of Iranian society. Qajar architecture insisted on using elements of Iranian architecture, including porches, central courtyards, and Iranian gardens. These spaces served as social and meeting places for people and helped strengthen social relations. In these public spaces, social and cultural interactions took place and people could easily communicate with each other. For example, Golestan Palace and Negarestan Garden are examples of the fusion of art and politics. With their intricate decorations and delicate designs, these buildings represented the Qajars' efforts to create a strong national identity. In fact, the use of traditional elements in the design of these buildings represented the preservation of Iran's cultural and historical values. During this period, the use of new materials such as plaster and stone, alongside traditional techniques, indicated the architects' adaptation to the changes of the times and the new needs of society. These architectural changes reflect the pressure that

cultural and social institutions were exerting towards change and innovation and clearly point to the effects of these pressures on social and cultural structures. This interaction between traditional and modern elements, especially in the design of cultural and social manifestations, actually demonstrates structuralism in Qajar architecture and, in a way, also expresses the social conflicts and tensions of the time. The details and aesthetics in these buildings show how much human emotions and feelings can affect structures.

The Philosophy of Structuralism and Architecture of the Pahlavi Period

The Pahlavi period (1344-1357 AH) witnessed significant developments in architecture and an emphasis on modernity. With the beginning of this period, Iranian architects moved towards creating buildings with new and innovative designs. At this time, the structuralist approach was interpreted in new ways and social and cultural structures were combined with modern architectural styles. The architecture of this period was significantly influenced by the laws and practices of modernization. Large plans and projects that were created with the aim of updating public and urban spaces were indicative of this development. Tall towers, commercial centers, and modern public buildings were designed as symbols of urban development and social progress, indicating a fundamental change in the philosophy of structuralism in architecture. However, during this period, the design of public spaces was also important to increase social interaction. New commercial and recreational spaces, such as parks and shopping malls, were created to encourage social interaction and social interaction. These spaces, which depicted new forms of social life, reflected the structural and socio-cultural influences of the Pahlavi era. Although modernity in architecture during this period led to significant advances, social contradictions and challenges remained. Architects designed buildings that were not only beautiful but also functional and efficient. This approach reflected an effort to align human needs with modern architectural techniques and techniques. The philosophy of structuralism at this time also helped to strengthen national and cultural identity against Western influences. Architects who designed buildings continued to strive to preserve elements of Iranian identity and history in their works and to somehow establish a balance between modernity and tradition. Thus, Pahlavi architecture represented an attempt to create a new social and cultural structure while respecting the heritage of the past.

The Philosophy of Structuralism and Architecture in the Post-Revolutionary Era

After the Islamic Revolution (1357 AH), Iranian architecture underwent fundamental changes. During this period, structuralism in architecture paid special attention to redefining Iranian identity and cultural values. Architects sought to create a space that not only contained religious and national influences, but also responded to the social and economic needs of society. With the revolution, the use of Islamic and indigenous elements in the design of buildings reached its peak. Architects sought to return to national and religious identity and tried to create spaces that were in harmony with the culture and religion of the people. New mosques and cultural centers, such as the Holy Mosque of Jamkaran and the Mahdi Islamic Center, reflect this tendency towards identity and socialization. These spaces not only reflected the religious culture of the society, but were also a place for human interactions and the social life of the people. In addition to paying attention to cultural identity, the preservation and restoration of historical monuments also became a priority. Architects tried to preserve the country's cultural and historical heritage using modern techniques. This trend led to the return of national and historical monuments to the social arena and their transformation into cultural attractions. These efforts are also noteworthy from a structuralist perspective, as architects reconstructed existing

spaces with questions of identity and culture in mind and strengthened social interactions. Structuralism in post-revolutionary architecture also led to a special focus on public spaces. Spaces such as parks and squares, which emphasize socialization and interaction among people, were considered symbols of the new society. These places became arenas for cultural and social exchange where people could communicate with each other and participate in the creation of a new social identity. In addition, architects paid special attention to the design of green and sustainable spaces. This approach was of particular importance due to environmental crises and the need for sustainable development. Buildings are designed in a way that is consistent with environmental principles and helps improve the quality of urban life. Finally, the philosophy of structuralism in the post-revolutionary era has sought to create a balance between modernity and Iranian culture, between preserving national identity and contemporary social and economic needs. Therefore, the architecture of this period is not only an embodiment of aesthetics and pragmatism, but also reflects an effort to understand and preserve identity in changing social and cultural conditions. With these interpretations, architecture at this time is an attempt to establish a dynamic dialogue between the past and the present, as well as between the global identity and the specific needs of society. (Tab. 1)

Table 1: General table of the effects of structuralist philosophy on the architecture of the three periods: Qajar, Pahlavi, and after the Islamic Revolution

Period	Architectural Features	Impacts of Structuralism Philosophy	Notable Examples
Qajar	- Integration of traditional and modern elements	- Strengthening national and cultural identity - public space and social interactions	- Golestan Palace - Negarestan Garden
	- Use of Iranian elements such as iwān and courtyard	- Use of symbolism to express power and wealth	- House of the Constitutional Colonel Vaziri
	- Complex designs and artistic decorations	- Creating social spaces to increase interaction	- Tehran Bazaar
	- Attention to aesthetics and details	- Efforts to preserve and revive Iranian culture	- Tile decorations
	-	- Expressing social and political contrasts	-
Pahlavi	- Emphasis on modernity and innovative designs	- Creating harmony between new and traditional elements - focus on updating public spaces	- Supreme Cultural and Art Council Building
	- Design of tall and modern buildings	- Strengthening national identity against Western influences	- Chess Park
	- New commercial and recreational spaces	- Creating social spaces for interaction and cultural development	- Milad Tower
	- Attention to efficiency and functionality of buildings	- Efforts to preserve cultural heritage in the face of modernization	- Azadi Sports Complex
	-	- Shift in approach to public space and social interactions	-
Post-Revolution	- Emphasis on national and religious identity	- Return to cultural and religious identity - strengthening public and social spaces	- Jamkaran Grand Mosque
	- Designing green and sustainable spaces	- Preservation and restoration of historic buildings as cultural heritage	- Tehran Museum of Contemporary Art
	- Use of Islamic and indigenous elements	- Emphasis on designing public spaces for social interaction	- Parks and public squares
	- Creativity in design to address social needs	- Creating dialogue between past and present	- House of Artists

Investigating the architectural effects of residential houses based on structuralist architecture Residential architecture is known as one of the most basic and essential forms of architecture in any culture and society. In Iran, residential architecture is not only formed based on individual and social needs, but also in connection with the history, culture, and climate of the region. These days, structuralist architecture, as an important approach in designing residential houses, has attracted the attention of many architects and urban planners. To examine the effects of this approach on residential houses, we can pay attention to various aspects of history, culture, and function. Structuralist architecture is designed so that all elements of a building become a coherent and related whole. In this regard, in designing residential houses, the social and cultural structures of the target society are of particular importance. Architects should pay special attention to determining the needs of residents and authenticating the cultural identity of the region. For example, in Iran, given the cultural and historical diversity, each region may display specific characteristics in the design of its houses. Currently, Iranian architects, inspired by traditional architecture, are trying to create residential spaces that not only meet functional needs, but are also aesthetically and culturally attractive. In this way, spaces that are exposed to view connect with natural elements such as light, proper ventilation, and beautiful views. This approach is inherent in the spirit of Iranian architecture and can be seen in buildings such as the historical houses of Yazd and Kashan, which are well adapted to their climate and have a sense of national identity. Attention to public and private spaces in the design of residential houses is also one of the important influences of structuralist architecture. Creating relationships that protect privacy for residents while creating a social space for symbolic human interactions is of interest to architects. The design of spaces such as courtyards and verandas, which in Iranian architecture specifically represent such principles, shows how social structures can be formed in the design of residential houses. This allows residents to benefit from a shared social space in addition to their private space. In addition, the use of natural resources and renewable energy in house design is influenced by the philosophy of structuralism in architecture. This approach allows architects to create designs that adapt to the environment and improve the quality of life of residents by using natural light, proper ventilation, and the use of local plants. This stimulation of innovation in house design, especially in rural and semi-rural areas, can contribute to sustainable development and the creation of an environmental culture. Structuralist architecture also pays attention to the process of interaction between humans and the environment. In this regard, architects should consider theories and concepts related to human interactions in house design. For example, placing living spaces on the sunny side of the house leads to the creation of a comfortable and pleasant space and strengthens the connection of residents with nature and the surrounding environment. This not only helps improve the quality of life of individuals, but also adds to the creation of social solidarity in residential areas. In addition, structuralist architecture emphasizes the creation of flexible spaces that can easily adapt to changing needs and social conditions. This concept in the design of residential houses means creating spaces that can be changed and, if necessary, can respond to the changing desires and needs of residents. For example, the design of multi-purpose rooms that can easily be converted into work or play spaces can be a symbol of this approach. Paying attention to the use of local materials in the design of residential houses is also an important issue influenced by structuralist architecture. The use of local materials, especially in rural and sparsely populated areas, can help reduce construction costs and also increase the sustainability of buildings. This allows houses to naturally adapt to their environment and strengthens the residents'

sense of belonging to their place of residence. Finally, it should be noted that one of the most important effects of structuralist architecture on residential houses is the creation of a positive interaction between architecture and local culture. Architects with a deep understanding of the needs and desires of the local community can present designs that not only create desirable living spaces, but also help improve social and cultural quality. In fact, this type of design can help create a sense of word formation, cultural and social identity, and call on individuals to create a cohesive and sustainable society. In general, the effects of structuralist architecture on residential houses in Iran indicate an effort to create spaces that are not only responsive to individual needs, but also purposeful in interaction with the environment, culture, and society. This approach is the result of a continuous effort to create a balance between tradition and modernity, identity, and the daily needs of residents. As a result, the architecture of residential houses that are designed under the influence of structuralist philosophy are considered to represent the strengths and cultural and social achievements of Iran. This can help connect different communities with their rich history and culture, leading to improvements in their daily lives. (Tab. 2)

Table 1: General table of the effects of structuralist philosophy on the architecture of the three periods: Qajar, Pahlavi, and after the Islamic Revolution

Period	Architectural Features	Impacts of Structuralism Philosophy	Notable Examples
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	- Creativity in design to address social needs	- Creating dialogue between past and present	- House of Artists

xThis table details the various impacts of structuralist architecture on residential homes in Iran and explains how this approach to design and construction helps improve the quality of life and preserve culture and social identity.

Explanation of the theoretical framework

Therefore, the development and explanation of comprehensive and practical models in this field can ultimately be an effective solution to increase the understanding of the pattern of influence of structuralist architecture based on the philosophy of structuralism on the architecture of residential houses in Iran. Accordingly, the theoretical framework of the thematic studies can be presented as follows: (Tab. 3)

Attention to the distance and interaction between public and private spaces shows how the spatial network of communication in buildings reflects social hierarchy. From a structuralist perspective, public spaces are the arena of community presence and private spaces represent the logics of power and influence in the urban context. These patterns are in the form of representations of social order in different periods, but with changes in technology, public spaces may find new functions (such as co-working spaces or semi-private spaces). In a period comparison, the Qajar with its emphasis on the central courtyard and neighborhood governance relations, the Pahlavi with urbanization development and modernist reconstructions, and the contemporary with greater flexibility in the division of spaces, each represents a type of social interaction. Structuralist-spatial theory acts as a framework for analyzing these proportions and shows us how lines across spaces have a symbolic and social role. Light and ventilation, as environmental reflections, in the structuralist view, represent the relationships between urban and architectural context. This index shows how skylights and natural ventilation not only have a technical function, but also indicate the interface between the interior and exterior of the building and, consequently, between different social groups. In different periods, changes in window technology and the reduction or increase in light can reflect changes in social structures. Comparing this index between periods can show to what extent the principles of structuralism in paying attention to environmental reflection and the relationship with social uses have been maintained or have changed. The flexibility of spaces as a response to the changing needs of society and uses indicates a practical dimension of structuralism: the formatting of partitionable spaces and change of use. This issue is abundantly seen in contemporary residential architecture, but it also exists in previous periods, although in a more limited form. From a structuralist perspective, this flexibility is a symbol of the reflection of social and economic changes and shows how the rules of use can be aligned with changes in social structure. Comparing the three periods can shed light on which periods have shown the greatest degree of flexibility and how these changes relate to discourses of dominance or resistance. Local materials, as symbols of cultural identity and the resilience of a region's ownership, reflect the relationship between the building and the local context. In the framework of structuralism, the choice of local materials is not only a technical decision but also an expression of the cognitive rules and semantic symbols of society. In each period, the meaning and function of materials can be redefined in different ways: from representing local identity to demonstrating independence from modernization. Comparing this index can show how local identity in different historical contexts has aligned or become aligned with power mechanisms and structural policies. The connection with nature and biodiversity in residential spaces, from a structuralist perspective, indicates the coexistence of social order and natural creations. Although the concept of green spaces seems more contemporary, it also has a symbolic and functional role in historical contexts. This index can indicate new social centers, such as public spaces with a calming function or a public connection to the surrounding environ-

Table 3: The theoretical framework of research

Design Feature	Key Design Feature Driver	Description of the Driver in the Context	Related Theory	Related Source	Author or Researcher
Attention to public and private spaces	Functional interaction / spatial hierarchy	Spatial network of connectivity between public and private spaces	Structuralist-spatial theory in the urban fabric	Structuralism	Jean Baudrillard
Use of natural light and proper ventilation	Environmental reflection of light / natural ventilation	Axis of reflection and ventilation / appropriate windows and skylights	Environment-reflection theory with a structuralist view	Space Production	Ronald Barres and Henri Lefebvre
Flexibility in space design	Spatial accessibility / functional flexibility / innovation in space production	Partitionable/formable spaces / adaptable-use spaces	Structuralism-operational in dynamic residential spaces	Design for change	Julian Scott or Jacques Derrida
Use of local materials	Local sustainability / cultural identity / parochialism / sense of place / physical resilience	Selection of local materials and how they are implemented	Structuralism-localism theory	Architecture and identity in local contexts	Claude Lévi-Strauss and Amos Rapaport
Creation of green spaces	Connection with nature / biodiversity	Plant cover structure and tree planting, etc.	Ecological sustainability theory in urban spaces	Design with nature	Ian McHarg
Design inspired by traditional architecture	Historical values / climate responsiveness	Strengthening neighborhood identity	Structuralist/ historic and symbolic theory	Production of space, architecture, and identity in local context	Claude Lévi-Strauss
Consideration of climatic features	Climatic adaptability / climate adaptability	Promotion of local culture considering climate	Climate architecture theory / climatic structuralism	Climate-responsive architecture	Jack Nasr (note: likely a transliteration error; verify author)
Design of shared spaces	Social interaction / legibility	Strengthening social cohesion and reducing need for extensive development	Spatial network theory / co-creative spaces	Pattern language	Christopher Alexander
Diversity in design	Alignment with varied needs / spatial compatibility	Adaptability in usage	Pluralism	Diversity and architecture	Neil Leach
Creating connections between buildings	Externalized functionality / spatial connectedness	Creating links between neighboring buildings to strengthen local fabric	Theory of connectivity	How Buildings Learn	Stewart Brand

ment. Periodic differences in the level and design of green spaces tell us how the concepts of sustainability and naturalism are aligned with social structures and architectural changes. Recognizing traditional architecture and responding to climate within the framework of historical/symbolic structuralism shows how tradition and localism function as semantic frameworks. Here, traditional architecture is a symbolic language for expressing neighborhood identity and responding to climate. But from a structuralist perspective, this reproduction or redefinition of tradition can help represent power, hierarchy, or social unity in the form of residential spaces. Comparing this index across periods can show how traditional representations are interpreted

in more modern contexts. Adaptation to climate, as an important factor in design, also serves as a reflection of structuralism in the architectural context. Climate architecture means providing the most adaptive spaces to climate conditions, but it is also a symbolic expression of the relationship with the environment and society. In different periods, changes in building orientation, natural ventilation methods and building cladding can indicate changes in climate regulations and attitudes. This indicator can show in a period comparison whether climate-friendly principles have been maintained or changed as part of social and cultural structures. Shared spaces are seen from a structuralist perspective as a reflection of social networks and coexistence in the residential context to strengthen social solidarity and reduce the need for extensive development. This indicator tells us how the pattern language in the design of spaces is used to create social connections and how harmonious spaces can strengthen neighborhood structures. In a period, comparison, changes in harmonious architecture can show how social contexts have moved towards solidarity or centralization in different periods.

Diversity in design reflects a response to different needs and an emphasis on functional flexibility. This index can serve as one of the structuralist tools for studying how residential spaces vary in different contexts. Examining this index allows us to see how patterns of diversity in each period are coordinated with class, cultural, and economic relations. At the same time, the representation of diversity can indicate a tendency to be open to social differences or, conversely, to strengthen convergence within a single architectural ensemble. Functional extroversion and spatial connectivity between neighboring buildings indicate the formation of local structure. In this index, the harmonization of spaces and the strengthening of connections between buildings can lead to the strengthening of social context and neighborhood markets. From a structuralist perspective, the relationships between buildings are more expressive than a single independent building and can indicate how the spatial network functions in the urban context. Comparing this index in three periods can show how the relationship between buildings functions as an architectural language to express the rules of structuralism in the urban context and whether this language has been interpreted differently in the contemporary period.

Therefore, the main concepts can be explained in the form of an effective factor in the following order:

- Structuralism-spatial and reflection of hierarchy in public-private spaces
- Environmental reflection of light and ventilation and connection with social functions
- Flexibility of spaces and change of use as an expression of social structures
- Local materials as an expression of local identity and resilience
- Green spaces and connection with nature as semantic units in the urban context
- Traditional architecture and climate response as structural symbols
- Climate and climate architecture as an expression of the relationship with the environment
- Shared spaces and strengthening social solidarity
- Diversity in design and response to diverse needs
- Connection between buildings and strengthening the local context

Methodology

This research is of a descriptive-analytical type, which has a development aim, but its fundamental characteristic can be pointed out, especially in explaining the depth of the theoretical foundations, the proposed model and framework. The method of collecting information is in the form of a library and field from references such as the architecture department of academic institutions and international data and at the field level. First, after examining the theoretical foundations as well as the history of the research

in the two dimensions of procedure and content, where there is an emphasis on clarifying the aim, not repeating it, factors are extracted as the result of the research framework and using the Delphi method as the final indicators proposed in the form of a model. In the Delphi method, in successive courses, by forming an elite board consisting of specialists in the field of architecture, university professors, researchers in the field of architecture in the number of 15 people1, in the form of a digital questionnaire using Google Pot tools and sending the answers in the form of a link. is received, the type of answers is also set based on the Likert spectrum as very low, low, medium, high and very high impact. The number of influencing factors on the subject factors influencing structuralist architecture on residential houses in Iran, which after going through stages including the specified average limit and also calculating the Kendall coefficient for the answers, polling is stopped when a certain average is reached and the final indicators are proposed as a research framework. It will be given. In the following, the extracted indicators are explained as the main model of the research as a result using intermediate analysis.

DISCUSSION AND FINDINGS

Description of the Delphi method

The Delphi method is known as a qualitative research method for solving complex problems and reaching consensus in various fields, including sustainable development and policy making. This method has been well implemented especially in the review and evaluation of factors in research related to sustainable and low-carbon buildings in other countries and has obtained acceptable results. The fuzzy Delphi method is a research technique that aids in analyzing and gathering expert opinions across various fields. This method is particularly useful for examining complex and multifaceted issues. In the context of indoor air quality in central courtyard houses in a hot and humid climate, emphasizing the concept of natural ventilation, the fuzzy Delphi method can help identify and prioritize the factors that impact the design and construction of these types of buildings. As defined, this method involves multiple rounds of questionnaires where expert opinions are collected and analyzed. Utilizing the fuzzy Delphi method allows researchers to achieve a consensus on the importance and necessity of specific factors while evaluating diverse opinions. This method accounts for the uncertainties stemming from varied perspectives by employing fuzzy techniques, thus facilitating decision-making under conditions of ambiguity. Research focusing on identifying selected factors affecting indoor air quality in central courtyard houses in a hot and humid climate, emphasizing the concept of natural ventilation can achieve a more precise understanding through the application of the fuzzy Delphi method. These factors may encompass various aspects of design, construction materials, and renewable energy technologies. For instance, studies that investigate challenges in zero carbon construction reveal that expert opinions can significantly influence the development of new and effective solutions. This approach enables researchers to gather diverse viewpoints and reach comprehensive conclusions. Ultimately, the fuzzy Delphi method serves as an effective tool for identifying and prioritizing the factors that influence zero carbon buildings. This method allows researchers to thoroughly consider the insights and experiences of experts and contribute to the development of strategies aimed at achieving indoor air quality in central courtyard houses in a hot and humid climate.

Steps to implement the Delphi method

The Delphi method involves a series of questionnaires or stages that are carried out sequentially with controlled feedback. These stages generally include five steps. In each stage of the research, the Delphi panel members, consisting of experts in the field of low-carbon building design, re-

1. The panel of elites and experts includes 15 faculty members of Tehran University, Tabriz University of Arts, Isfahan University of Arts, as well as researchers of Islamic Azad University.

spond to questions. One notable feature of this method is the anonymity of the panel members, which allows them to express their opinions freely without being influenced by friendly or competitive judgments. In practice, Delphi panel members participate more than once in answering questions. This repetition provides them with an opportunity to reconsider their decisions by reviewing feedback from other experts on each indicator. The exchange of data between panel members is controlled by the researcher. The researcher collects individuals' responses and, after evaluating them, passes the results on to the next round. This process prevents personal discussions among individuals and thus helps facilitate and streamline the work and research process.

Findings of the Delphi Method

In this research, the dimensions of structuralist architecture in the field of housing were used as a premise in the first stage, extracted from the theoretical foundations for the subject, and then the dimensions of the component and the main criteria were presented according to the research hypothesis. These sub-components were expressed in it based on the assumption of the experts' awareness dimension and the process of the impact of the structure of the structuralist philosophy on Iranian residential architecture. These factors were arranged as a package of proposals in the panel of experts and elites so that the Delphi method could be planned and applied to it. The total of 24 factors that were tested in this method to reach the final indicators include: functional interaction, spatial hierarchy, geographic, environmental light reflection, natural ventilation, spatial accessibility, functional flexibility, innovation in space production, local sustainability, cultural identity, localism, sense of belonging to place, physical resilience, connection with nature, biodiversity, historical values, climate responsiveness, climate adaptability, climate adaptability, social interactions, readability, alignment with different needs, spatial adaptability, functional extroversion, and spatial connectivity.

Findings of implementing the Delphi method

First round

In this round, the panel members identified 18 factors out of 24 factors extracted from successful research as having a medium, high, and very high impact in developing the framework for developing the final indicators of the architectural model of Iranian residential buildings based on the philosophy of structuralism in the three historical periods from Qajar to after the revolution. The detailed and extensive results related to the implementation of the first stage of questionnaire distribution are given in the table below. Natural ventilation, innovation in space production, local sustainability, climate adaptability, and alignment with different needs were removed from the Delphi process due to their average importance of less than 2.5. (Tab. 4)

Second round

After the first stage of measuring and evaluating the panel experts' views on the factors proposed and extracted from the theoretical foundations and also receiving the suggestions of the panel members, in this round, in order to observe caution, all the factors extracted from the theoretical foundations were again made available to all panel experts along with the average of the members' opinions in the first round and the previous opinion of the same member. The panel members identified 11 factors out of the 18 factors presented in the second round as having a high and very high impact (with an average greater than 3.5) on the research framework. The detailed and extensive results related to the implementation of the second stage of questionnaire distribution are given in the table below. The Kendall's coefficient of agreement for the members' responses regarding the order of the 11 factors that had a high and very high impact in this round was 0.765. (Tab. 5)

Round Three

In the third round, the research framework for the final indicators was developed, along with the average opinions of the members in the

Table 4: The first stage of the fuzzy method in developing the final indicators of the architectural modelability model of Iranian residential buildings based on the philosophy of structuralism in the three historical periods from Qajar to after the revolution.

Row	Factor	Number of Responses	Mean	Standard Deviation	Min	Max
1	Functional Interaction	15	4.02	0.52	1	5
2	Spatial Hierarchy	15	4.15	0.63	1	5
3	Environmental Light Reflection	15	3.11	0.45	1	5
4	Spatial Accessibility	15	4.07	0.76	1	5
5	Functional Flexibility	15	3.86	0.51	1	5
6	Cultural Identity	15	3.96	0.34	1	5
7	Localism	15	3.66	0.38	1	5
8	Sense of Place	15	3.22	0.45	1	5
9	Physical Resilience	15	3.96	0.65	1	5
10	Connection to Nature	15	3.87	0.48	1	5
11	Historical Values	15	4.05	0.53	1	5
12	Climatic Responsiveness	15	3.95	0.71	1	5
13	Climatic Adaptability	15	4.01	0.46	1	5
14	Social Interactions	15	3.33	0.35	1	5
15	Legibility	15	3.95	0.54	1	5
16	Spatial Congruence	15	3.85	0.34	1	5
17	Functional Extraversion	15	3.19	0.41	1	5
18	Spatial Composability	15	4.10	0.39	1	5

Table 5: The second stage of the fuzzy method in developing the final indicators of the architectural modelability model of Iranian residential buildings based on the philosophy of structuralism in the three historical periods from Qajar to after the revolution.

Row	Factor	Number of Responses	Mean	Standard Deviation	Min	Max
1	Functional Interaction	15	4.08	0.45	2	5
2	Spatial Hierarchy	15	4.21	0.52	2	5
3	Spatial Accessibility	15	4.13	0.62	2	5
4	Functional Flexibility	15	3.92	0.45	2	5
5	Physical Resilience	15	4.2	0.46	2	5
6	Connection to Nature	15	4.1	0.41	2	5
7	Historical Values	15	4.15	0.39	2	5
8	Climatic Adaptability	15	4.09	0.38	2	5
9	Legibility	15	4.05	0.41	2	5
10	Spatial Congruence	15	4.02	0.36	2	5
11	Spatial Connectivity	15	4.16	0.29	2	5

second round and the previous opinions of the same member, and was made available to all panel experts. The detailed results related to the implementation of the third stage of questionnaire distribution are given in the table below. In this stage, all factors were recorded as having a very high impact by the elite panel with an average score of over 4, and the Kendall coefficient of agreement for the members' responses regarding the order of the 11 factors was 0.790. (Tab. 6)

RESULT AND CONCLUSION

Reasons for stopping the survey

The results of the four rounds of implementing the Delphi method in the research show that consensus was reached among the panel members for the following reasons and the repetition of the rounds can be ended:

- In the second round, more than 50% of the members selected 18 factors that were effective in compiling the final indicators of the architectural modelability of Iranian residential buildings based on the philosophy of structuralism in the three historical periods from Qajar to after the revolution, which had an average greater than 2.5, as their factors.
- The standard deviation of the members' responses regarding the importance of the factors in the third round has changed significantly compared to the previous rounds.
- The standard deviation of the members' responses regarding the importance of the factors in the fourth round has changed significantly compared to the previous rounds.
- The Kendall coefficient of agreement for the members' responses regarding the order of the factors in the third round is 0.790. Considering that the number of panel members was more than 10, this level of the Kendall coefficient is considered to be completely significant.
- The Kendall coordination coefficient for the order of the 11 factors effective in developing the research framework in the third round increased by only 0.025 compared to the second round, which does not show a significant increase in this coefficient or the level of consensus among the panel members between two consecutive rounds.
- The scores given to the factors by the experts and elites indicate that the indicators of spatial hierarchy, spatial connectivity, and historical values have the highest scores and, as a result, the greatest impact on the realization of the extraction of the mechanism model.

Table 6: The third stage of the fuzzy method in developing the final indicators of the architectural modelability model of Iranian residential buildings based on the philosophy of structuralism in the three historical periods from Qajar to after the revolution

Row	Factor	Number of Responses	Mean	Standard Deviation	Min	Max
1	Functional Interaction	15	4.10	0.35	3	5
2	Spatial Hierarchy	15	4.52	0.42	3	5
3	Spatial Accessibility	15	4.51	0.46	3	5
4	Functional Flexibility	15	4.20	0.35	3	5
5	Physical Resilience	15	4.08	0.36	3	5
6	Connection to Nature	15	4.07	0.31	3	5
7	Historical Values	15	4.20	0.29	3	5
8	Climatic Adaptability	15	4.51	0.28	3	5
9	Legibility	15	4.21	0.22	3	5
10	Spatial Congruence	15	4.17	0.29	3	5
11	Spatial Connectivity	15	4.32	0.21	3	5

As a conclusion, the final table of indicators for developing a model of architectural exemplaryness for Iranian residential buildings based on the philosophy of structuralism in the three historical periods from Qajar to after the revolution can be explained in the following table: (Tab. 7)

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Table 7: Proposed research framework for the architectural model of Iranian residential buildings based on the philosophy of structuralism in the three historical periods from Qajar to post-revolution

Index	Index Type	Description	Measure	Evaluation Type	Assessment Method
Functional Interaction	Quantitative	Alignment of different functions in the building and assessment of the overlap between nodes and axes of spaces to understand spatial network functionality	Node–Axis Overlap	Quantitative Evaluation	G-Graph
Spatial Hierarchy	Quantitative	Spatial contracts and connectivity of nodes with main axes at architectural decision level, focusing on connectivity and access level	Node–Axis Connectivity	Quantitative Evaluation	Gephi/Graph (G-Graph)
Spatial Access	Quantitative	Assessing the quality of integration and access between spaces and key pathways for ease of user movement	Quality of Integration	Quantitative Evaluation	Depth Map (Integration)
Functional Flexibility	Qualitative/ Quantitative	Ability to repurpose spaces and respond to variable needs by analyzing spatial layout styles and functional changes	Type and Quality of Spaces	Functional Performance Analysis	Data analysis
Physical Resilience	Qualitative	Assessing quality of materials, details, and structural aspects for resilience against climate changes and diverse uses	Quality of Materials, Details and Structure	Survey	Questionnaire
Connection to Nature	Quantitative	Degree of connection of space with natural elements (light, view, landscape, natural ventilation) and degree of extraversion/introversion of architecture	Degree of Extraversion	Survey	Questionnaire
Historical Values	Qualitative	Assessing alignment with cultural and historical context of the neighborhood and history-driven architecture	Degree of Fit with Cultural-Historical Context	Survey	Questionnaire
Climatic Adaptability	Qualitative	Building adaptation to regional climatic requirements (ventilation, shading, openings frequency, use of local materials)	Degree of Adaptability	Survey	Questionnaire
Legibility	Quantitative	Visual and structural depth of spaces, focusing on clarity of understanding space function and visual overlap between elements	Visual-Structural Depth	Quantitative Evaluation	Depth Map (Overlap of Connectivity and Visual Integration)
Spatial Congruence	Quantitative	Ratios of spatial dimensions and geometry in plans; analysis of length-to-width ratio to create balance and functional coherence	Length-to-Width Ratio	Plan Space Proportions Analysis	Data analysis
Spatial Connectivity	Quantitative	Qualitative measure of connectivity with spatial elements in an organization	Quality of Steps/ Connections	Qualitative Evaluation	Depth Map (Connectivity)

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