

A study on residential houses using shape grammar (case study: Houses of Pahlavi era in Tehran Province)

Un estudio sobre casas residenciales con gramática de formas (estudio de caso: Casas de la era Pahlavi en la provincia de Teherán)

Mahta Tari*

Islamic Azad University - Iran

mahtatari@gmail.com

Mohamad javad Abdolhoseini**

Islamic Azad University - Iran

abdolhoseini216@yahoo.com

ABSTRACT

This article aims to explain a new model and achieve a basic pattern for the shape of houses using shape grammar. This study is a qualitative research based on description, explanation and interpretation. Phenomenological research is one of the most widely used traditions of qualitative research. The phenomenological method of this study is based on van Manen's methodology. The data analysis is conducted using shape grammar. In shape grammar process, the data are the houses selected by the researcher (five houses of Pahlavi era in Tehran). Finally, the main themes of research, e.g. connection to environment, calm, happiness and separation from everyday life, are extracted from spaces such as the Iwan (porch), basement, Howzkhaneh (spring house), green space, Hashti (vestibule) and Shahneshtin (alcove room). Eventually, new patterns are created using shape grammar process in the decision tree. After understanding the concept, the basic shape pattern is created using shape grammar. Thus, the role of user in architectural quality of space and its types and evaluation of language pattern are identified by gathering the literature and researches, deepening the views of experts and architects and classifying them as introversion, privacy and types and typology.

Keywords: shape grammar, architecture, pattern, house, Pahlavi

RESUMEN

Este artículo tiene como objetivo explicar un nuevo modelo y lograr un patrón básico para la forma de las casas utilizando la gramática de formas. Este estudio es una investigación cualitativa basada en la descripción, explicación e interpretación. La investigación fenomenológica es una de las tradiciones de investigación cualitativa más utilizadas. El método fenomenológico de este estudio se basa en la metodología de van Manen. El análisis de datos se realiza utilizando la gramática de formas. En el proceso de gramática de formas, los datos son las casas seleccionadas por el investigador (cinco casas de la era Pahlavi en Teherán). Finalmente, los principales temas de investigación, p. La conexión con el medio ambiente, la calma, la felicidad y la separación de la vida cotidiana, se extraen de espacios como el Iwan (porche), sótano, Howzkhaneh (casa de primavera), espacio verde, Hashti (vestíbulo) y Shahneshtin (sala de alcoba). Finalmente, se crean nuevos patrones utilizando el proceso de gramática de formas en el árbol de decisión. Después de comprender el concepto, el patrón de forma básico se crea utilizando la gramática de formas. Por lo tanto, el papel del usuario en la calidad arquitectónica del espacio y sus tipos y la evaluación del patrón del lenguaje se identifican mediante la recopilación de literatura e investigaciones, profundizando las opiniones de expertos y arquitectos y clasificándolos como introversión, privacidad y tipos y tipología.

Palabras clave: gramática de forma, arquitectura, patrón, casa, Pahlavi

*Corresponding author. Faculty Member, Department of Architecture, Yadegar -e- Imam Khomeini (RAH) Shahre Rey Branch, Islamic Azad University, Tehran, Iran

** Barch student, Central Tehran Branch, Islamic Azad University

Recibido: 02/04/2019 Aceptado: 02/09/2019

INTRODUCTION

The pace of changes in architecture and the gap between its values have been so great in recent centuries, so that the dominant aspect of today's architecture is double change and evolution and most residents of modern buildings are not satisfied with their living spaces and, unfortunately, lose their natural and emotional reactions to their dwellings.

Despite the development of urban facilities, today's buildings are not as beautiful and humane as previous buildings and architecture has turned to a showcase for individual taste of architects or employers in some cases, especially in Iran. We live in a controversial era when opposing forces are dominant extremely and their chaos governs our destiny; despite our main duty as settlement, i.e. calm, the people's dissatisfaction with our built houses leads to tragedies such as Mehr Housing Project, Navab Avenue, towers with weird styles in the north of Tehran, etc.

On the other hand, it is necessary to recognize the nature of human needs, define the meanings of need from researchers' points of view, introduce models suggested for human needs and continue the opinions of other researchers such as Graves and Porter for responding to dwelling needs of today's human according to basic epistemological requirements.

In this paper, shape grammar analytic tool is chosen as a solution for this problem, used in production. Since it is aimed to explain a new model, it is necessary to describe the concept of model and its related concepts; the results show that the model is a subjective notion which creates order and connection between the components and elements of architectural space to meet human needs (Nowruz Borazjani, Hasani, 2018: 15).

Researcher questions

1. What is the basic shape in the composition of spaces in houses of first Pahlavi era?
2. What are today human needs in metropolises, especially in Tehran?
3. How can patterns of Pahlavi houses be extracted using shape grammar?

These questions represent the way to go through and this research procedure is nothing but finding the unknowns. In this article, architecture is considered as a context of material and non-material assets, which leads us to its purest facts.

Research objectives

Main objective: Explain a new model using shape grammar for the houses of first Pahlavi era

Secondary objectives: 1) Achieve the basic pattern for the houses of first Pahlavi era using shape grammar; 2) Find the meaning of shape and form in architecture of today's houses by explaining the existing regular definitions based on theoretical background

Necessity of research

Research shows that no comprehensive studies have been done yet about houses in the first Pahlavi era despite their special role, diversity and characteristics; while it is so necessary to investigate old houses due to valuable historical cases being destroyed by lifestyle changes, number of owners, migration and, generally, loss of attractiveness.

The recognition of these houses involves comprehensive knowledge of them. The first step is to reintroduce historical physical values. A variety of methods have been proposed to explain the shape of architectural spaces, among which shape grammar is selected in this paper; shape grammar has been used to teach the composition to architecture students at MIT, Harvard, UCLA and Yale since the early 90's (Knight, 1981: 174).

Research method

Undoubtedly, it is mostly impossible to answer research questions in terms of numbers but rather description and perception of phenomena. Proper understanding of research problem involves adequate studies and the qualitative method is used in this study; so this study is a qualitative research. This method is based on description, explanation and interpretation. The description is based on facts. The description justifies the nature of data processing, relationships and collection and promotion. The explanation searches for the cause and the interpretation enables the researcher to collect necessary information on the nature of specific events (Heidari, 2016: 188).

Phenomenological research is one of the most widely used qualitative research traditions. In this method, the perception of quality of selected houses is based on emotional dimensions of the place. This experience is referred to as the study of individual experience in phenomenology. In this study, the phenomenological approach is based on Van Manen's methodology as a qualitative analytic-interpretive method. The Van

Manen's methodology is focused on how people experience a phenomenon (Nowruz Borazjani and Hasani, 2018: 116).

This study is based on qualitative method and logical reasoning and shape grammar is used as data analysis method. The contents of this study are analyzed and described based on documents and library research. Qualitative research deals with the interpretation of conditions and especially emphasizes the role of researcher as a crucial element in the research result (Grout Wuang, 2010: 88). Data analysis is also done using shape grammar. In the process of shape grammar, the data are houses selected by the researcher, including Minaee House, Daferi House, Mehrban House, Shaeran House and Saleh House in Tehran. The shapes are drawn based on the layout of spaces in these houses. Finally, the main themes extracted through the research, e.g. connection to environment, calm, happiness and separation from everyday life, are represented in spaces such as the Iwan (porch), basement, Howzkhaneh (spring house), green space, Hashti (vestibule) and Shahneshin (alcove room) and the shape grammar process leads to new patterns in the decision tree.

LITERATURE REVIEW

Van Manen's phenomenology

Max van Manen adopted an interpretive phenomenological approach. As a research method, phenomenology focuses on how people experience a phenomenon and what the essence of this experience is (van Manen, 1997: 13).

House

In the Dehkhoda Persian Dictionary, the house means where human resides. Certainly, the house has a special place among all ethnicities, nations and cultures over the world. Since this place implies a kind of group coexistence between human beings related to each other, it can be considered as one of the oldest human settlements after the early shelters (Dehkhoda, 1955).

The house is a concept which all humans have understood at all times and everywhere and tended to consciously or unconsciously and shown their perception by selecting or constructing it (Nowruz Borazjani and Hasani, 2018: 29).

Rapoport, the well-known thinker of architecture and urbanism, argues: "The house is an institution with multi-dimensional functions rather than a physical structure; so that the construction of a house itself is cultural notion and its form and organization are influenced by the culture that the house produces. Rapport also believes:

If traditional societies determined the house and its spatial form and organization before climate, materials and technology, human understanding of the world, life and culture, e.g. religious beliefs, tribe and family structure and social organization, would determine the life style and social communication of people.

Societies have certainly had the opportunity to choose from a variety of patterns in their constructions. What was ultimately chosen not only occurred due to physical and biological constraints, but also the effective role of culture (Barati, 2003: 25).

Shape grammar

Architectural design has been based on the innate genius of designer over the years, but today's architecture is far from the rule of generation of a product; today what defines the design conditions is the process. In other words, product-oriented architecture is replaced with process-oriented architecture. Product-oriented architecture is the architecture where intervention is highly restricted and is often created through immediate intuition. In contrast, the process provides designers with a controllable and dynamic system which can govern and assess the design procedure and provides sufficient evidence of all steps of design development for critiques and modifications by designers and others (Yormaka and kohelman, 2013: 5).

Firstly, a history of shape grammar derived from the formal attitudes of Doran, Steadman and Rob Krier is explained. In this part, it is necessary to explain the design language. Since each architectural form can be interpreted as a formal grammar system through a set of rules, an architectural grammar is defined by the alphabet of symbols.

A grammar has four parts:

1. Formal vocabulary
2. Formal relationships
3. Formal rules
4. Resulted shapes

The grammar generates shapes which are created through the existing shapes of the collection in accordance with their spatial relationships. In other words, shapes produce a desirable feature by rules. Obviously, an investigation into the spatial relationships of elements and adaptation of their coordinate axes require defining an algebraic spatial system which can provide an accurate geometric basis for shape studies based on spatial relationships (Stiny, 1980: 343-351).

Herein it is essential to understand the experience of being in a place; Ralf emphasizes that places are concepts directly experienced by the world. Places are full of meanings, real things and current activities. Hence interviews are conducted to achieve the feeling of people on being in traditional houses.

The content of interviews is prepared for expressing people's feelings about the presence and living in the houses. The results of interviews indicated five main concepts: separation from life, peace of mind and body, happiness, connection to environment and freedom of thought. According to the results, the Hashti (vestibule) and basement are introduced as two important spaces in creating the sense of separation from everyday life; Iwan (porch) and green space and water elements are also introduced in creating the sense of connection to environment and providing peace of mind and body, respectively. The greatest motivation of happiness occurs in the Shahneshin (alcove room) and 76% of Interviewees tend to create attached spaces in their houses. Accordingly, the qualitative characteristics of Iranian house are manifested in the spaces of these houses (Nowruz Borazjani and Hasani, 2018: 184-185).

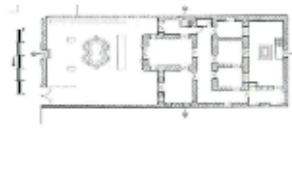

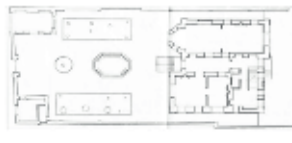

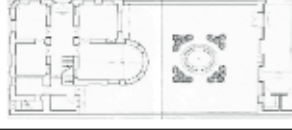

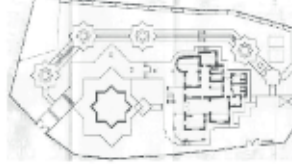

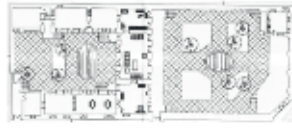

No	House name	Plan	Elevation	Description
1	Mirza House (Karimi alley, after Monirich St.)			This building has three stories. Its particular features include summer and winter courtyards, Shahneshin (alcove room), plasterwork and good segregation of public and private spaces.
2	Saleh House (No.27, Amiri alley, Hafiz St.)			The main scheme of building is a rectangular plan 11.5x13.5 m. Its main entrance is located in the south part at the center of building. Its most important feature is brick work.
3	Dafari House (Fallah alley, Palestine St.)			This house has spaces such as corridor, great room, living room, central pool, south courtyard, garden and a yard for the crew.
4	Shaeran House (Nemati alley, Dolar St.)			Its main entrance is located in the south part where a beautiful turquoise 16-sided pool inspired by the form of Persian Shamseh (sun) is observed.
5	Mehrban House (Javidi St., Amirkabir St.)			This house is located in Oudlajan neighborhood, Tehran, where the privileged lived in Qajar era. It has particular proportions that could meet the needs in the past.

Table 1. Introduction of case studies in Tehran (Authors)

Application of shape grammar in architecture

Parametric method is way to employ shape grammar as follows: In the book written by Nowruz Borazjani, three main elements of investigated houses are initially selected. These three elements include: courtyard (open space), closed space and Iwan (porch), based on which there are two kinds of two-courtyard and complex plans.

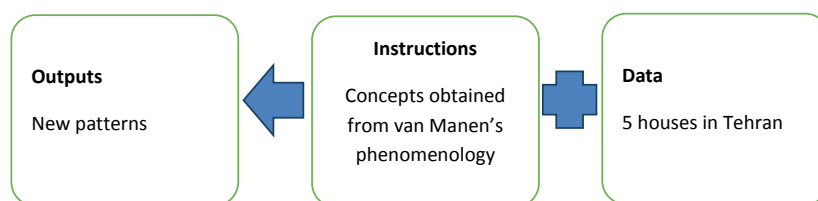


Chart 1. Algorithmic design process in shape grammar (Nowruz Borazjani and Hasani, 2018)

The production process begins with the arrangement of courtyard. As shown in Table 2, the houses include two-courtyard houses with construction on one side, combined two-courtyard houses with construction on one side, U-shaped two-courtyard houses and complex houses. The number and position of Iwans (porches) and basements are also specified. The number and layout of green space and pool are determined in the courtyard. In the process of shape grammar, a space is added to the primary space; for example, in a two-courtyard house with construction on one side, there is firstly the courtyard (C) and the closed space (R) is added. Then, the basement (B), Hashti (vestibule) (H), Iwan (porch) (E), green space (L), water (W) and attached space (S) are added according to Table 3.

In shape grammar, the basic shape is a point located in the coordinate system. The life element is defined by a quadrilateral. It should be noted that the two-dimensional grammar is used in this study.

In the set of rules (R1C) listed in Table 3, R represents the closed space, C represents the courtyard, B represents the basement, E represents the Iwan (porch), L represents the green space, W represents the water, S represents the attached space, SH represents the Shahneshin (alcove room) and H represents the Hashti (vestibule). R1C22 is the rule for converting the courtyard to the "courtyard-room". The "courtyard-room" is converted to the "courtyard-room-basement" through the rule R1C23. According to the rule R1C24, "courtyard-room-basement" turns to "courtyard-two rooms-Hashti". According to the rule R1C25, the "courtyard-room-basement" is converted to the courtyard-two rooms. A Shahneshin (alcove room) is added to the room through the rule R1C26; each room is also attached to an Iwan (porch) using the rules R1C27 and R1C28; according to the rule R1C29, the courtyard is connected to the green space and a pool. In the set rules (R2C) in Table 4 for two-courtyard houses, the rule R2C32 transforms the basic shape of "courtyard" into the "courtyard-two rooms" and the rule R2C33 turns that to the "two courtyards-two rooms". A room is connected to the basement using the rule R2C34 and another room is connected to the Hashti (vestibule) using the rule R2C35. Both rooms are connected to Iwans (porches) using the rule R2C36 and possess green space and pool using the rule R2C39. The attached space is added to the shape using the rule R2C60. In the set of rules (RNC) for multi-courtyard houses in Table 4, the RNC62 converts the "courtyard" to the "courtyard-room". The rule RNC63 converts the "courtyard-room" to the "four courtyards-two rooms".

The basement is added to the rooms in the basic shape of "four courtyards-two rooms" using the rule RNC64 and the Hashti (vestibule) is added to the rooms using the rule RNC65. Iwans (porches) are added to the rooms using the rule RNC66 and a Shahneshin (alcove room) is added through the rule RNC67. The green space and pool are added to the courtyards using the rule RNC68 and the attached space is added to the complex using the rule RNC69.

The characteristics expressed about the concept of pattern exist only in a comprehensive sense, so none of these concepts can play the role of pattern in architectural space. Sub-pattern is formed as a symbol or model of the product and does not seem complete for the subsequent products to have a superficial or formal similarity to the original model or, in fact, be an imitation of it; but the pattern is like the efficient software where changes in its conditions and platform lead to diverse results in its products. Pattern generation in explanatory and architectural form and space is recognizable and applicable in-built physical environment, while objective representation of concepts such as paradigm, schema and archetype can be addressed on a greater scale in metaphysical scopes, e.g. human ideas, traditions, rituals and behavior. When the concept of pattern is understood, the basic shape is created using shape grammar. The houses are classified as one-courtyard, two-courtyard and complex based on open and closed spaces using the four main themes, i.e. separation from everyday life, peace of mind and body, happiness and connection to environment. Finally, the interpretation of traditional houses by shape grammar leads to new schemes. This research aims at abstract perception of new designs through the essence and meaning of traditional architecture of original Iranian houses.

Relevant concepts	Similarity to pattern	Dissimilarity to pattern
Schema	It forms over time. Alike pattern, it is made of order.	Its order exists among subjective elements not objective elements. Its position and representation occur through behavior and psychology.
Archetype	It originates from basic and institutional human concepts. It is a general and subjective notion.	It is addressed on a higher scale in scope of concepts and leads to formation of patterns. It does not have any objective representative in built environment.
Typology	It recognizes patters by evaluation of common notions. Application of common patterns for production of cases is a criterion for classification and typology.	It is not applied in communication and order. It deals with criteria and is a tool for classification of cases.
Model	Alike pattern, it is used to interpret order of phenomena. It is subjective and general.	It does not generate form.

Table 5. Comparison of pattern and its relevant concepts (Shape grammar, Nowruz Borazjani and Hasani, 2018: 228)

CONCLUSION

The house has been something more than just a shelter since old times and its spiritual aspects is quite obvious in the whole process of construction, settlement and exploitation; today, however, inattention to qualitative and psychological needs of users, mere attention to economy and emphasis on characteristics of shelter in housing has diminished the role of home in human identity. Disrespect for and chaos in architecture has led to the loss of superior qualities (Haeri Mazandarani, 2009: 85).

Since the main concern of this paper is dissatisfaction of residents with their modern living spaces and loss of their natural and emotional reactions to their dwellings, it is attempted to initially understand the concept of house apart from formal and physical perspectives. In fact, the perception of truth of Iranian house and literature review lead us to the recognition of high quality architectural living spaces. Therefore, the role of user in architectural quality of space and its types and evaluation of language pattern are identified by gathering the literature and researches, deepening the views of experts and architects and classifying them as introversion, privacy and types and typology. In the contemporary century, some buildings are closer to the truth of architecture, while others are less architectural; hence today any building is considered as architecture.

The shape is also the physical crystallization of architecture in the sensory world and a window through which we can reach the previous level. These are themes which cannot properly take form and meaning and reveal a brilliant architecture without each other. This study briefly describes the way to reach these facts, shows what they are and how they are related to each other and, ultimately, tries to recognize architectural features of shape and form in order to represent the past architectural form. The results of these efforts must possibly provide intuitive experiences of quality in a comprehensive and generalizable method. Accordingly, it is possible to hope to restore the lost architectural qualities.

Ultimately, formal architecture possesses some features; it means that in addition to seeing the object through matter and geometry, there is a higher level of form which depends on meaning. Manifestation of meaning refers to revealing the nature, identity, function, target and type of a constructed object that its forms have correct proportions; this means that its substances determine the meaning; its valuable position is good for human life; the object reveals its context and makes it more coherent. Goodness necessitates settlement; i.e. putting the object on place to make the most suitable relation to its context and do something or, in other words, to complete its context and to help organize it. This includes the space emerged between the objects; the beneficial object helps to clarify the space of action. On the other hand, it is evident that goodness indicates the settlement in the right place. There is a hierarchy for goodness; it can range from not harmfulness to usefulness; the more the usefulness of a construction, the more comprehensive its goodness and vitality. The summit of goodness, i.e. comprehensive and intensive useful influence, is felicity which means that the object remains until the radii of life of surrounding phenomena is linked to its existence; this means that the object keeps its meaning obvious over time. The durability, authenticity, memorization and perpetuation of object are a hierarchy of continuity of architectural work. The durability of object mostly depends on the physical durability of architectural work; the architectural object should accommodate the human body over a period of time. Therefore, a built environment which withstands physical forces has a relative continuity, although this necessarily does not refer to the balance in a higher level. "There are many durable buildings abandoned or destroyed by human". Decision is made by the decision tree (Nowruz Borazjani and Hasani, 2018: 227-232).

Investigating the Minaee House, Saleh House, Daftari House, Shaeran House and Mehrban House, it is finally concluded that the human spirit is better in these houses than modern dwellings due to the spaces such as: pool, Hashti (vestibule), Shahneshin (alcove room), Iwan (porch), courtyard, green space and basement. In fact, despite all livelihood difficulties, humans lived in the houses in the past as a place for security, calm and comfort. One of our important tasks is to preserve and maintain this precious heritage and to employ them in the design of new houses.

BIBLIOGRAPHIC REFERENCES

- Barati, N. (2003), "Recognizing the concept of house in Persian language and culture", *Khial Magazine*, No. 8.
- Dehkoda, A. A. (1955), "Dehkoda Persian Dictionary", Tehran: Tehran University Press.
- Haeri Mazandarani, M. (2009), "House, culture, nature", Tehran: Ministry of Housing and Urban Development Publications.
- Hasani, K., & Nowruz Borazjani, V. (2018), "A new pattern of shape grammar in today's architecture of house", *Bagh Nazar Journal*, No. 63.
- Hasani, K., Nowruz Borazjani, V., Nasir Salami, M. (2016), "Recognition of form of courtyard and its dependent space using shape grammar in architecture of 100 Qajar houses in Kashan", *Bagh Nazar Journal*, No. 44.
- Heidari, Sh. (2016), "An introduction to architectural research method", Tehran: Fekr Now Publications.
- Knight, T. W. (1981), "The forty-one-steps", *Environment and Planning B9*.
- Nowruz Borazjani, V., Hasani, K., & Tari, M. (2018), "Application of shape grammar in architecture", Tehran: Jedikar Publications
- Registration Report: Daftari family's Old House, (2003), Cultural Heritage, Handicrafts and Tourism Organization of Tehran Province, Registration No. 10862.
- Registration Report: Mehrban House, (2005), Cultural Heritage, Handicrafts and Tourism Organization of Tehran Province, Registration No. 13390.
- Registration Report: Minaee House, (2006), Cultural Heritage, Handicrafts and Tourism Organization of Tehran Province, Registration No. 19168.
- Registration Report: Saleh House, (2001), Cultural Heritage, Handicrafts and Tourism Organization of Tehran Province, Registration No. 11186.
- Registration Report: Shaeran House, (2004), Cultural Heritage, Handicrafts and Tourism Organization of Tehran Province, Registration No. 11200.
- Stiny, G., Mitchell, W. J. (1980), "The grammar of paradise on the generation of mughil gardens", *Environment and Planning B7*.
- Van Manen, M. (2006), "Researching lived-experience: human science for an action sensitive pedagogy", 2nd ed., London, Ontario, Canada, The Althouse Press.
- Wang, D., & Grout, L. (2017), "Architectural research methods", translated by Eynifar, A., Tehran University Press.
- Yurmaka, C., Sherer, O., & Kohelman, D. (2012), "An introduction to architectural design methods", translated by Bazrafkan, K., Islamic Azad University of Central Tehran Press.