ANALYSIS OF FUNDAMENTAL SYSTEMS IN ARCHITECTURE WITH NATURE ATTITUDE NATURAL SYSTEMS IN CASE STUDY OF ARCHITECTURE OF NIAKI NEIGHBORHOOD HOUSES, AMOL

ANÁLISE DE SISTEMAS FUNDAMENTAIS EM ARQUITETURA COM ATITUDE NATURAL SISTEMAS NATURAIS EM ESTUDO DE CASO DE ARQUITETURA DE CASAS DO BAIRRO NIAKI, AMOL

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Abstract: *As usual, in architecture the most important part would be possible through fundamental systems. Either soft or hard materials or a combination of natural inspiration and the nature generally form these kinds of structures. Attitude toward the universe and its phenomena has been raised since far past in ancient cultures and worldviews. It should note that human and nature are considered as architectural system environment. Because this system is firmly related to its environment, its great number of environmental impacts makes a subsystem in the whole architectural system. Research and inference process are based on case study analysis of case studies among which Niakie neighborhood houses in Amol are chosen through all the magnificent architectural works from Qajar period. The research achievements indicate that there are the greatest effects done by using the natural materials, the natural forms as well as climate principles on the manner of natural ten deny in the architecture of houses in Qajar era. The main question in this research is how the natural systems have been expressed in the architecture of old Iranian houses descriptive analytical techniques are used in research process. The required data for theoretical formulation of the topic, which collected by Briary Method and the analysis, is given for each work by field study. This study seeks to examine how some architectural art works interact with nature by analyzing a number of architectural artifacts through stem systems, applying the natural process and obtaining appropriate natural patterns.*
Keywords: *Fundamental Systems; Natural Systems; Nature-Inspired Methods; Qajar Houses of Amol.*

Resumo: *Como sempre, na arquitetura a parte mais importante seria possível através de sistemas fundamentais. Esses tipos de estruturas são geralmente formados por materiais macios ou duros ou uma combinação de inspiração natural e natureza. A atitude em relação ao universo e seus fenômenos têm sido levantados desde tempos remotos em culturas antigas e visões de mundo. Note-se que o ser humano e a natureza são considerados como ambiente do sistema arquitetônico. Como esse sistema está firmemente relacionado ao meio ambiente, seu grande número de impactos ambientais forma um subsistema em todo o sistema arquitetônico. O processo de pesquisa e inferência é baseado na análise de estudo de caso de estudos de caso entre os quais as casas do bairro Niakie em Amol são escolhidas através de todas as magníficas obras arquitetônicas do período Qajar. As realizações da pesquisa indicam que há os maiores efeitos feitos com o uso de materiais naturais, formas naturais e princípios climáticos na maneira de negar os dez naturais na arquitetura das casas na era Qajar. A principal questão nesta pesquisa é como os sistemas naturais foram expressos na arquitetura de antigas casas iranianas, técnicas analíticas descritivas são usadas no processo de pesquisa. Os dados necessários para a formulação teórica do tópico, coletados pelo Método Briar e as análises, são fornecidas para cada trabalho por estudo de campo. Este estudo procura examinar como algumas obras de arte arquitetônica interagem com a natureza, analisando vários artefatos arquitetônicos por meio de sistemas de tronco, aplicando o processo natural e obtendo padrões naturais apropriados.*
Palavras-chave: *Sistemas Fundamentais; Sistemas naturais; Métodos inspirados na natureza; Casas Qajar de Amol.*

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Introduction

Throughout his/her life on earth, human has been found the nature as a mysterious and vital source of life and has long sought to discover all its aspects, including the manifestation of nature in art as long as his/her life. Nature has always been one of the most important sources of human inspiration in history, from the earliest art works on the walls of caves to the present day. Aristotle, the philosopher of antiquity, was one of the first to write about nature as a great source of inspiration (Taghizadeh, 2006, 75).

In the field of architecture, by understanding the laws of nature and their application, human has been able to create high-performance structures, shapes and proportions that can be described as beautiful (Alexander, 2017, 228).

The relationship between human, nature and architecture based on the system attitude can refer to the naturalist attitude, which emphasizes the system relationship between human and nature. Nature does not just include the external environment such as clouds, trees, and animals, but also the interior of the building, its components and materials. Each system is composed of elements that together form a whole (Noghrekar et al., 2017, 48).

From a long time ago, the architecture of fundamental systems has been discussed and one can evaluate the degree of harmony and order in the works based on it. The climate, geometry, and structure are major systems influencing nature and architecture. What is important is the understanding of the principles governing the formation of natural structures (Ibid, 79).

Therefore, identifying the concepts of natural systems in the field of architecture and how to attitude nature in examples of Qajar, architectural works in Iran, is the most important goal of this research. To achieve this goal, nature-inspired method and the interaction between architecture and nature was analyzed topics that can explain the nature-inspired methods and naturalism in architecture, especially Qajar architecture in Iran were stated.

Research Structure

The research questions are: What do natural systems and nature tend to mean in the field of architecture? How has this interpretation influenced Qajar architecture in Iran? With regard to the subject of the research, it has been attempted to select case study from the prominent works of the Qajar period of Niaki Neighborhood, Amol in Mazandaran Province, Iran, where the theme of naturalism has been described in their descriptions and criticisms. Therefore, among the Qajar architectural works of Iran, 7 prominent works have been selected and analyzed in this research. These include Manouchehri, Malek, Darzi, Qureshi, Shafahi, Ebadi and Moghimi houses.

In the present research, a descriptive-analytical method was used to collect the documents and analyze the relationships among the field variables. According to the field research, the library data collection method was used to access the theoretical background of the subject and the field data collection method for physical data collection. Hence, using existing library methods, the theoretical foundations on the importance of naturalism in architecture are investigated and then natural systems are extracted and then selected samples properties will be analyzed using field methods. To convert qualitative parameters to quantitative, a table of extracted patterns was designed and tested in each case sample. Afterwards, the results of quantitative calculations are analyzed and finally quantitative results are presented. The process of the research is summarized in Fig. 1.

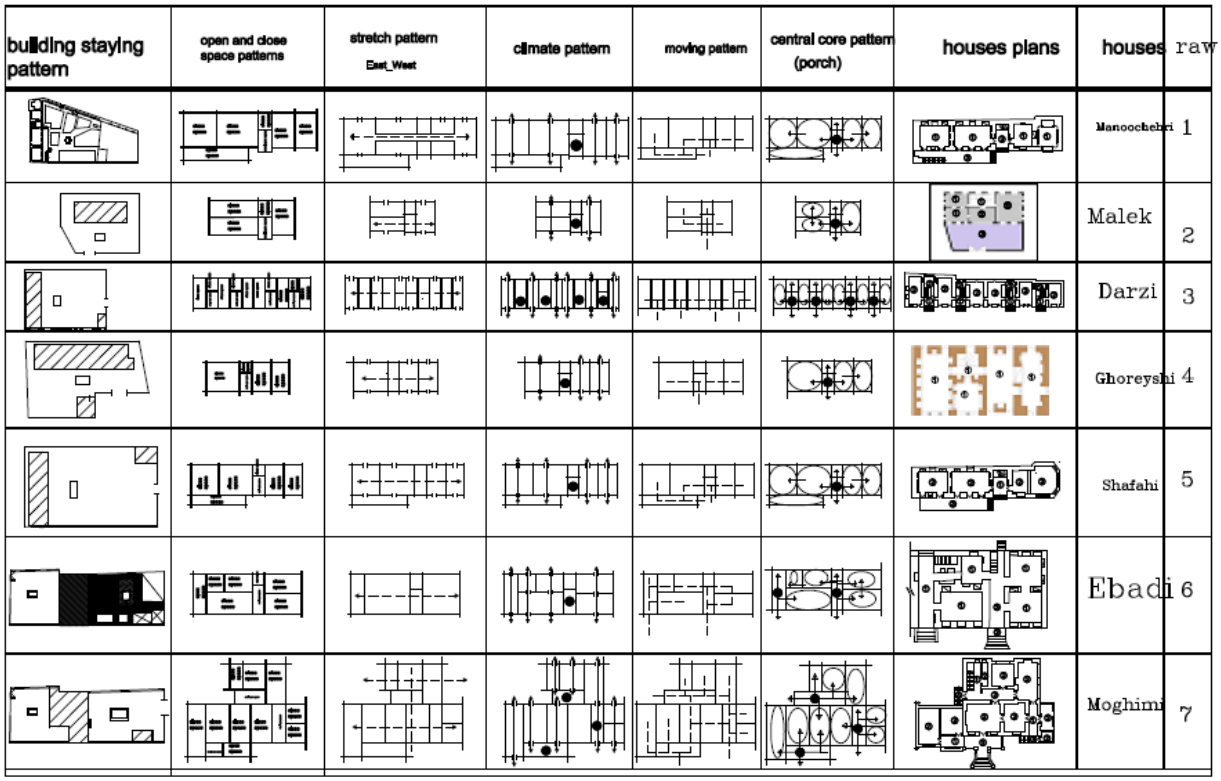


Fig 1. The process of the research

Systems Theory in Architecture

In their normal lives, people have inevitably given system structure to their lives during the history, though this process has been out of balance for several centuries. In fact, it is an attempt to combine mechanistic and organismic approaches to the interpretation of the world. In general theory, not only the elements of the set are emphasized but also the relationship between the elements and the complex system and the system generality (Farshad, 1983, 114).

Fundamental Systems in Architecture and Nature

Architecture has been the subject of four fundamental systems in the distant past and based on them one can evaluate the degree of harmony and order in the works, including 1- functional system; 2- structural System; 3- physical system; 4- human (productive) system. The functional, structural, physical and human systems correspond to the final, material, formal and actual causes, respectively.

Functional system: How to organize spaces together to accomplish specific functions, where no functions are disturbed other functions when performed.

Structural systems: The skeletal or physical structure of a building and the transfer of forces in a homogeneous network of structural components in which all components are involved and no component is idle.

Physical systems: Organizing the physic of the building with the appropriate structure (materials), utilizing a variety of visual and aesthetic relationships and generating weight and harmony in the physic and the interior and exterior of the building, which demonstrates how well the whole work is organized.

The human or productive system (climate and culture): Its actual cause is derived from the two sources of ideas, aspirations, motives and goals of the artist (Noghrekar, 2017, 57).

Humans and nature are considered part of the environment of the architectural system, and this system is intimately connected with its environment, the numerous effects of the envi-

ronment itself creating a subsystem in the whole architectural system. However, the subsystem is so strong that it is the main shaping of the whole system so that the architectural system can be considered the offspring of its environment (Nasr, 2000, 45).

Subsystems in Nature and Architecture

Climate, geometry, and structure are major systems that influence the relationship between nature and architecture. Adaptation to climate is one of the important factors shaping creatures and architecture, and what is important is understanding the principles governing the formation of natural structures (Fakhr Tabatabai, 1996, 171).

Environmental (Climate) Creator System

In each climate, plants and animals use special strategies for this adaptation, which make their comparative study with native and traditional architecture that is also valuable in adaptation to the environment (Ibid, 1996, 184).

Shape (Geometry) Creator System

Understanding and distinguishing between two types of inherent and adaptive geometry is important because the inherent geometry is intertwined with existing inherent behaviors and is unchangeable, but in adaptive geometry with changing environments, geometry also changes appropriately. In nature, there is regular geometry in flowers, fruits and animals and in particular in humans (Najib Aghlou, 2000, 260).

Different Dimensions of Structural Creator System

In the field of structure, examples such as the shape of the bone and each plant find the shape of their branches and body in resistance to environmental forces. In the field of design, form the elements in a manner that fully fulfills their functions. Bionic science is interested in creating functions, forms that are compatible with functions and forms of living organs. This is made possible through research, analysis, and synthesis that each model can potentially provide design ideas, and examine the structure of systems in organisms including the structure of without not live natural systems, the structure of plant systems, the structure of animal systems, and the structure of human systems (Senozian, 2010, 10).

Types of Modeling of Natural Structures in Architecture
Shape modeling of nature
Metaphorical modeling of nature
Modeling the laws of nature (Jenks, 2002, 41).

Analysis of Historical Models of Human Exposure to Nature in Architecture

On the evolution of human-nature relations throughout history, there have been theories, including ascending theory, that human beings have gradually supplemented their relationship with nature throughout history with a progressive course. The mankind descending theory gradually depart from nature, the best and most complete relation must be sought at the beginning of history. Finally, the theory of periodic evolution (the living progress of history) of the whole of the evolutionary process of mankind as a living creature grows to maturity and eventually dies. This general trend can be said to be true of all civilizations (Ibid, 58).

Some architects have considered the adaptation of the building with natural environment to be the source of nature's own inspiration. In the natural history, public law says that only the species are able to live that can adapt to their environment. It is a well-known fact that numerous natural forces demand materials and form combined with them for harmony and excellence. Therefore, the use of natural energies is the first step in harmonizing the environment with the prevailing climate conditions, or, in other words, it is a prerequisite for using

the natural conditions of the buildings to adapt to the climate conditions (Ayazyan, 1998, 84).

Nature as the Basis of Inspiration in Architecture

Interaction between Nature and Architecture

The relationship between human and nature has been formed since the moment he/she set foot on the earth, and human has always been influenced by nature in addition to being affected by nature.

Nature, as a set of models, has always answered many human questions and learned their laws. The interaction between architecture and nature can also be seen as a moment when the human being chooses a cave for its habitat or use leaves of trees and so on for shelter (Partogazi, 2006, 33).

Hence, one of the approaches to nature-based architecture is the inspiration of nature. The quality of the architect's look when compared to nature is different from that of others. In this section, it is tried to list the methods that architects have used to inspire nature.

How nature inspires architects?

Some architects try to show naturalism by showing the water in the building. The human interest in water is to the extent that designers sometimes take inspiration from natural beauty, including waterfalls and streams in parks, gardens, houses and even salons, to create corners of nature as much as possible and to make people available (Adibi et al., 2005, 76).

To identify other sources of architects inspiration from nature, one can refer to the ever-present human need to relate to nature and the open space that manifests itself in house architecture in the open spaces (courtyard) and semi-open spaces (porch) (Mahmoudi, 2005, 54).

Traditional and old housed courtyard is a manifestation of the Iranian garden. In Iranian architecture, the courtyard is a highly architectural space that also has the characteristics of a garden. In fact, it is a small garden plus functions for a continuous life (Ahmadi A, 2005, 63). One of the nature-inspired methods is to use the courtyard. The courtyard, as a natural place, brings together light, water, plants and wind and thus provides a comfort area for the inhabitants in adverse environmental conditions (Ahmadi, 2005, 112).

Another nature-inspired method is the use of natural forms.

The result of using natural forms in architectural design is to achieve an excellent design that combines structural efficiency, functional and aesthetic needs, lessons learned from nature and appropriately applied, not just a mere imitation of it (Taghizadeh, 2006, 75).

Another nature-inspired method is the natural structures. Modeling of natural structures in architecture can be done in three ways including form, metaphorical, and the laws of nature which the best possible example is modeling the laws of nature (Shahroudi, 2007, 51). The intricacies of nature at the microscopic level are another source of inspiration.

Zamani (1999) said about the relation between architecture and nature: 1) Architecture is replaced and linked to a point in the substrate of nature. Architecture encounters a world of natural data affecting its spatial system. The architecture that comes from the nature around it is somehow an extension of nature, in which human existence becomes an integral part of the body of nature in order to convince the return to nature. 2) The expansion of nature in architecture can also be experienced by using natural elements as part of the architectural structure. A variety of natural materials have been commonly used in architecture since ancient times. 3) Iranian architecture views nature as a manifestation of paradise on earth, drawing the buildings by inspiration from nature that form plant motifs in tiles is an example of this frozen nature.

As mentioned above, substrate, materials and ornamentations can be added to nature-inspired methods, but in addition to substrate, placing the building in a natural landscape can also be a method to inspire nature. In this method, architecture puts nature in the field of vision, both inside and outside the building thereby nature gives a relaxed atmosphere while purifying the air (Mehdi Nejad et al., 1999, 73).

The symbolization of nature is another way of dealing with nature that can be traced

in the works of Iranian architects (Ibid, 70). Some architects have considered adaptation of the building to the natural environment as their source of inspiration from nature. In natural history, public law says: Only the species are able to live that can adapt to their environment. It is a well-known fact that numerous natural forces demand materials and form combined with them for harmony and excellence. Therefore, to use natural energy, the harmonization of the environment with the prevailing climatic conditions is the first step, or in other words, a pre-requisite for enjoying the natural conditions is the harmony of the buildings with the climate (Ayazyan, 1998, 84). From the above review, the nature-inspired methods can be summarized in fig 2.

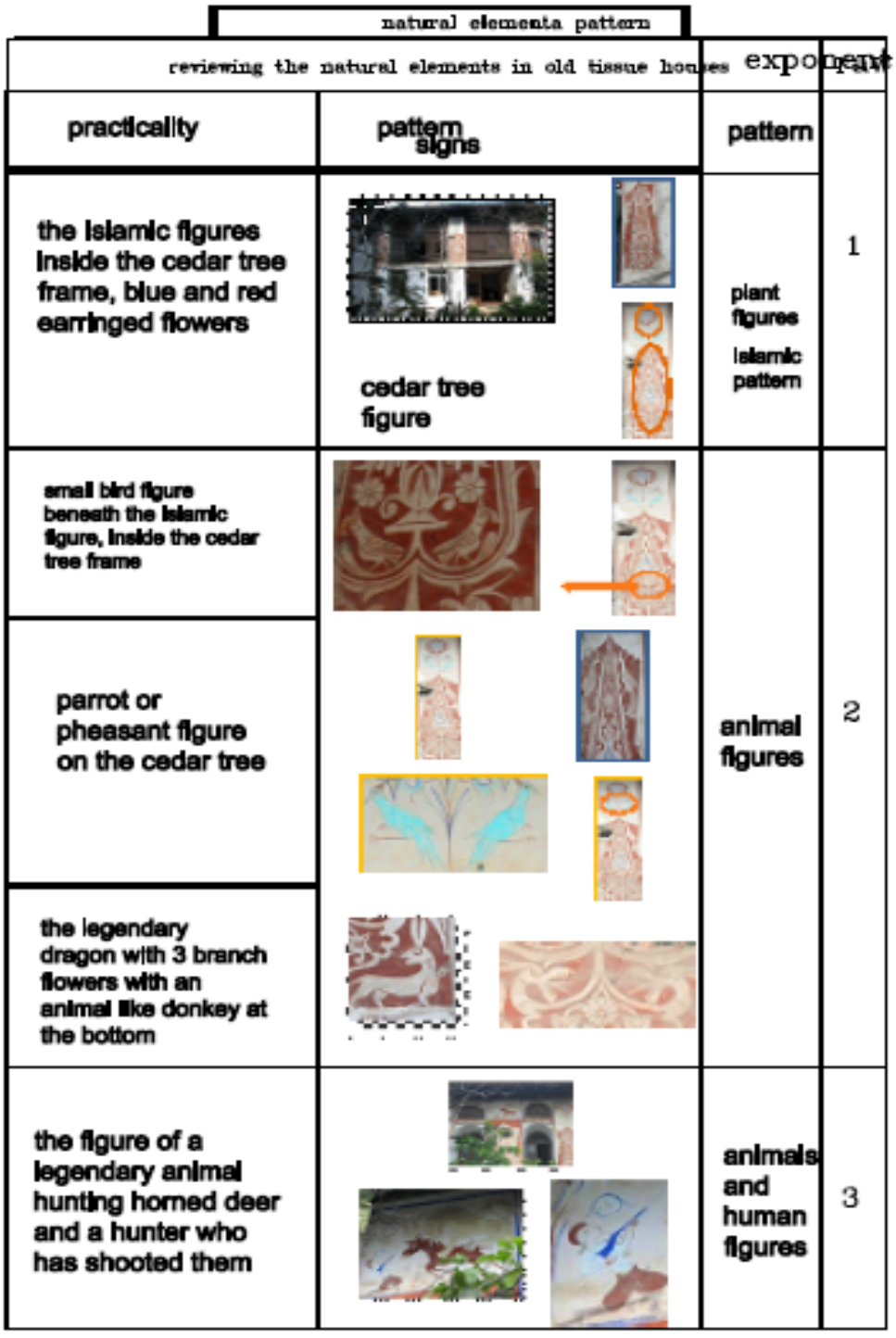


Fig 2. Nature-inspired methods

Case Studies of the Historic Houses of Niaki Neighborhood, Amol

Area and Territory of the Houses

Amol is one of the cities of Mazandaran province in Iran. The ancient context of Amol is composed of 13 neighborhoods. Neighborhood centers in the ancient context of Amol have been linear and square (Riahi, 2002).

As the Amol is divided into temperate and humid climates, the average annual temperature in these regions is 14.5 to 18 °C and its annual temperature fluctuates 25 to 35 °C (Kasmaei, 2005).

The studied area is the middle part of this traditional-historical context called the Niaki neighborhood, where the remarkable monuments are located and can be examined in the relics of ancient architecture. The architecture of Niaki neighborhood houses belongs to the Qajar and Pahlavi periods. Among the oldest architectural works in this neighborhood are Manouchehri, Malek, Darzi, Qureshi, Shafahi, Ebadi and Moghimi, which have been studied in this research (Authors).

Fig 3. South view of Qureshi house

In this section, seven sample cases were analyzed, which the results of the analysis were presented in this section.

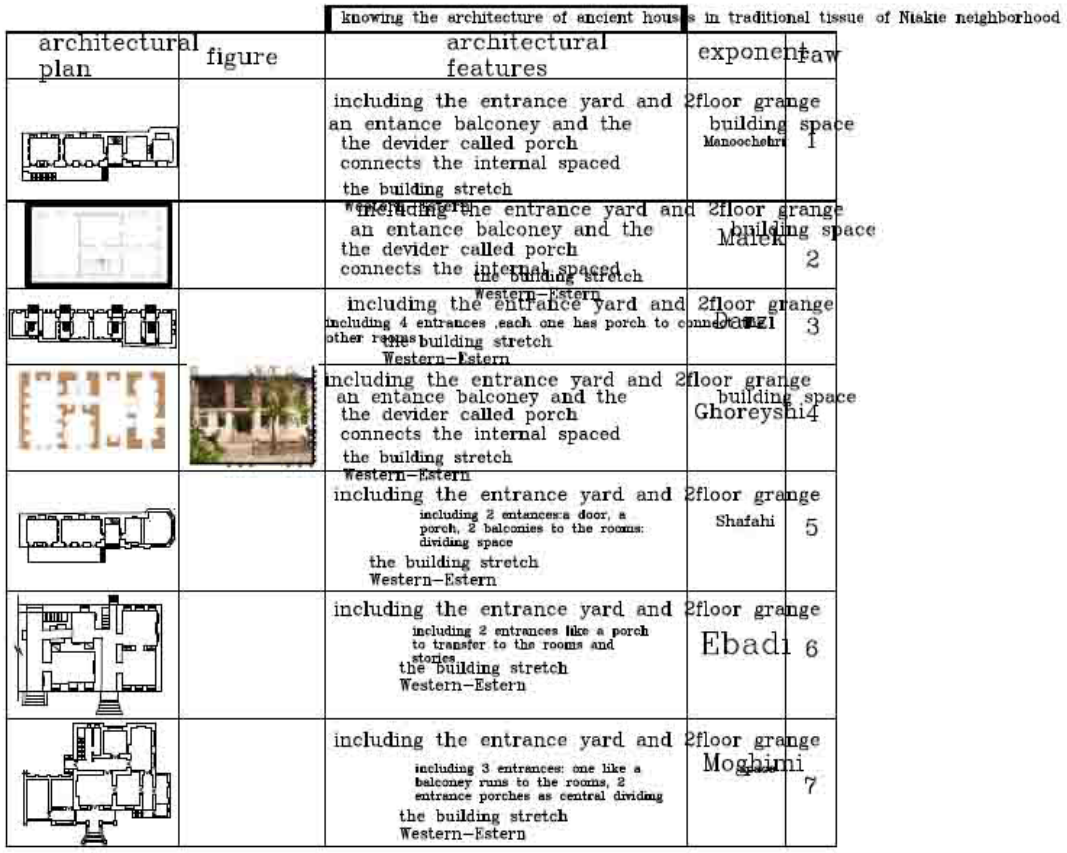


Fig. 4. Understanding the architecture of historic houses in the traditional context of the Niaki neighborhood

The Study of Natural Systems Case Studies of Houses of Niaki Nneighborhood, Amol

Water: The water pond is located on the main entrance axis of the houses, where the presence of water in the building is colored.

Climate: Mazandaran has a temperate and humid climate, and due to the climatic type, the buildings elongation are east-west, with north-south winds blowing in the daytime winds from north to south and winds blowing from south to north at night.

Porch: The entire house has a porch at the entrance.

Substrate: By elevating the building form ground, while the designing the volume and exterior, the open spaces layout changes.

Ornamentation: By examining the ornamentation elements of houses: The use of plaster, wood, iron, and colored glass ornamentations is summarized in fig 5.

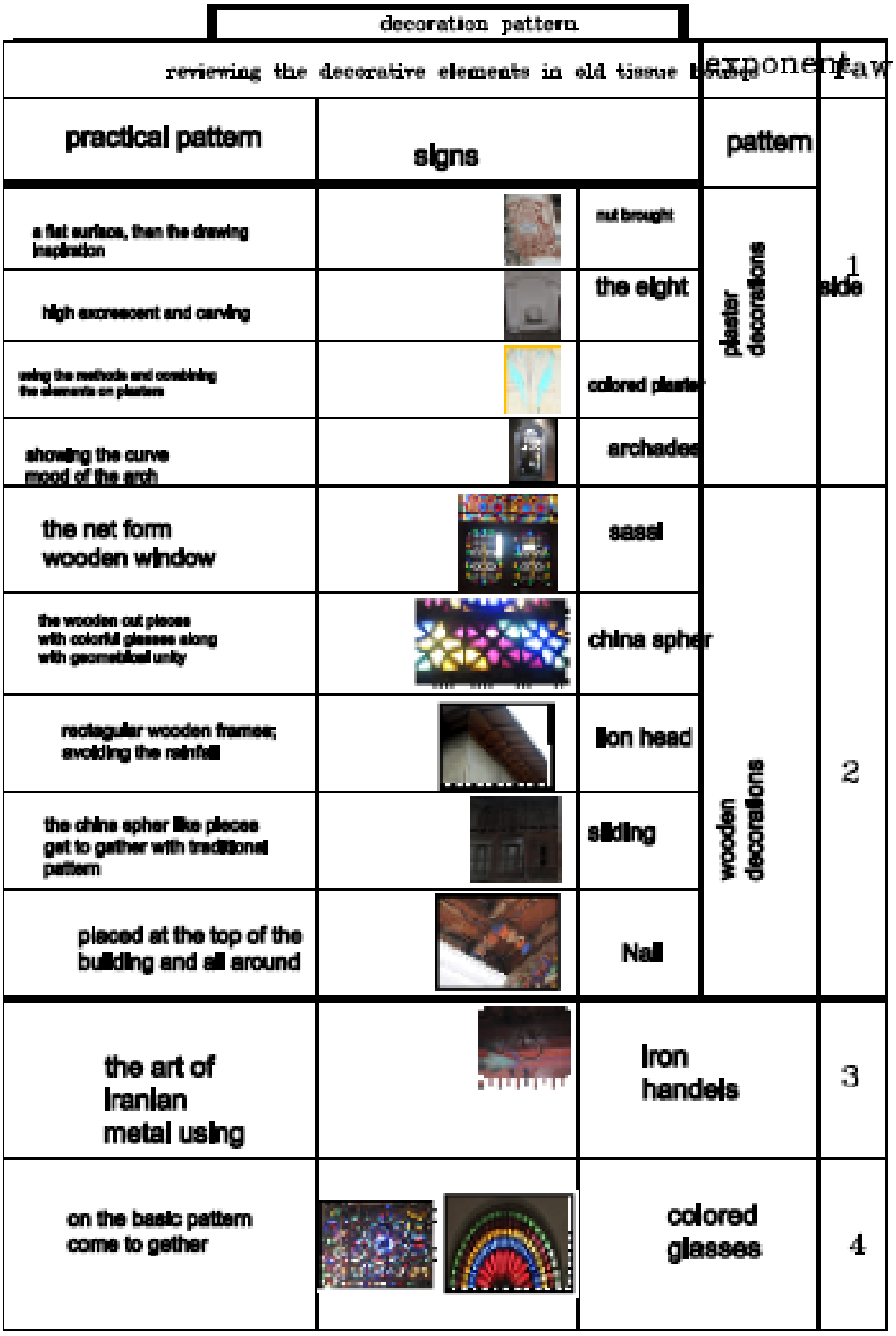


Fig. 5. The ornamentation system in historic houses of Niaki neighborhood

Courtyard: Houses have a main courtyard at the front of the building, some of which have a private courtyard due to their larger size.

Natural structures: The structure of houses is made of clay, wood and stone, walls with a width above 60 cm and also have a bearing role.

Natural forms: Houses are made of simple structures, an elongated rectangular shape

whose interior forms are squares that are all interconnected.

Symbolization and signs: It includes the use of vegetable and animal-human motifs inside and outside wall the buildings, processing and nurturing of nature in the houses, and use of motifs and geometry in the Arabesque design of the windows of the houses that the main elements and structure of these houses which is inspired by nature. In fig 6, the pattern of natural elements is examined.

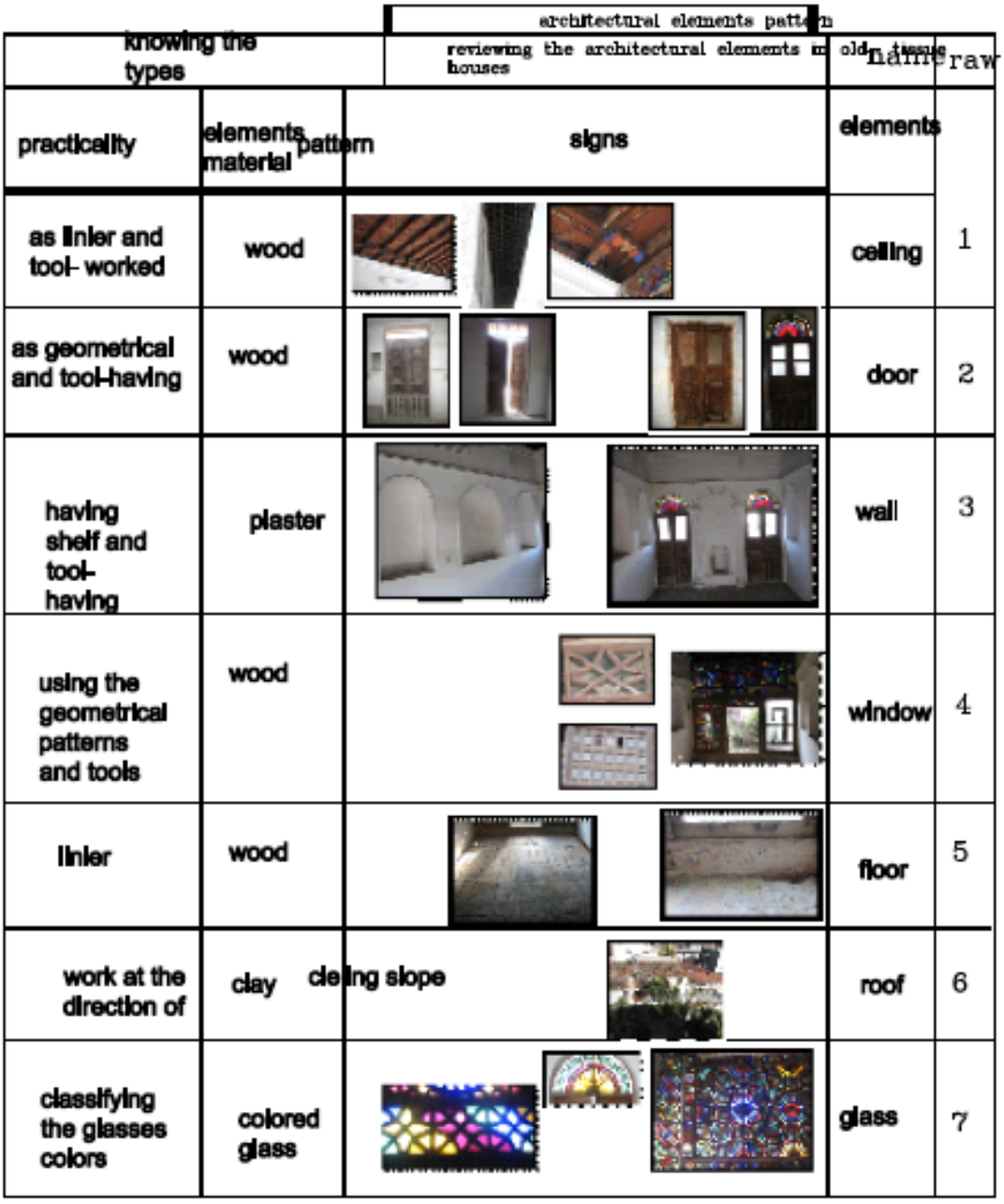


Fig. 6. Natural systems in symbol

natural elements pattern

reviewing the natural elements in old tissue houses exponent

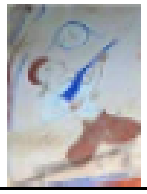
practicality	pattern signs	pattern	
the Islamic figures inside the cedar tree frame, blue and red earringed flowers	   cedar tree figure	plant figures Islamic pattern	1
small bird figure beneath the Islamic figure, inside the cedar tree frame	 	animal figures	2
parrot or pheasant figure on the cedar tree	   		
the legendary dragon with 3 branch flowers with an animal like donkey at the bottom	 		
the figure of a legendary animal hunting horned deer and a hunter who has shooted them	  	animals and human figures	3

Fig. 7. Symbols of historic houses in Niaki neighborhood (Architectural elements)

Analysis of Examples of Nature Inspiration in Architecture of Niakai Neighborhood Houses

Conclusion

Overall, it can be said the use of natural systems, such as the use of natural symbols and signs and ornaments, water and materials, plays a very important role in the relationship between architectural and nature works. After this concept, one can refer to water and the use of natural forms, which in a meaningful way establishes the relationship between architectural and natural forms. The concept of ornamentation and the use of natural elements or patterns in ornamentation appear to play a very important role in establishing the relationship between nature and architecture. The findings show that nature as a whole has had a significant impact on the Qajar architecture of Iran. The theme is of great importance in selected buildings and samples.

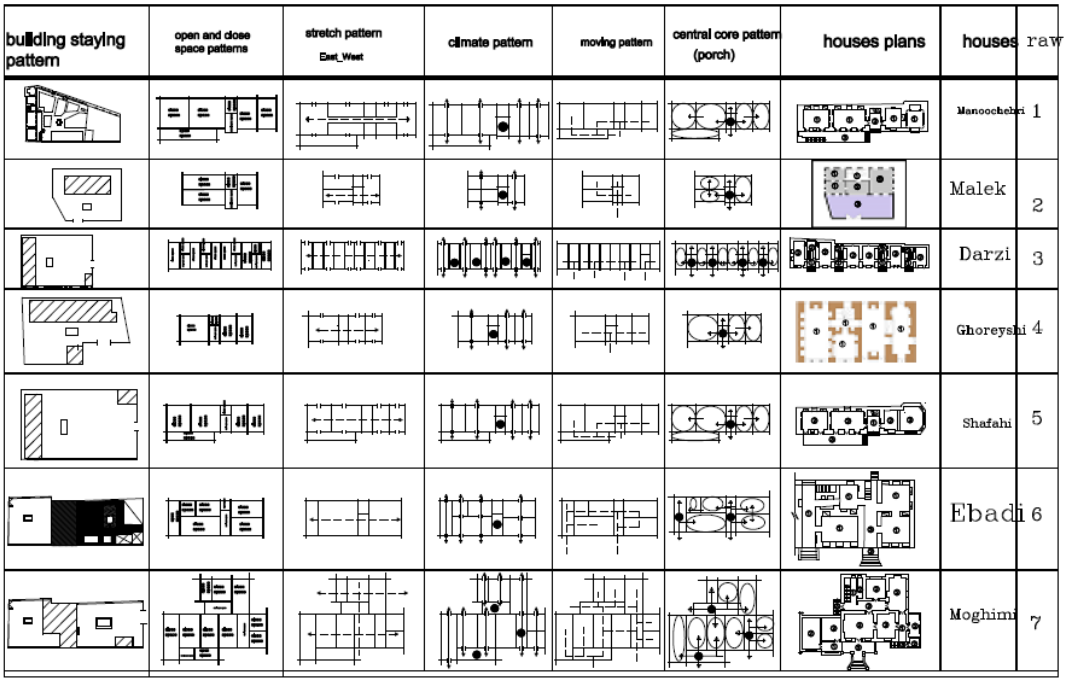


Fig. 8. Quantitative survey of historic houses in Niaki neighborhood

The process used in these examples to convey ideas from nature to architecture illustrates that, despite the importance of unique ideas that come from a moment's inspiration of nature, but the process of inspiration from nature can follow a very systematic and step-by-step path that is made possible by the teamwork of various experts.

Thus, finding the responses to many of the complexities and ambiguities of the technology world in nature does not require an unpredictable spark, and it was not in the minds of special people in unique circumstances and with the scientific process, one can obtain a desirable response at the end of the path.

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Recebido em 27 de julho de 2020.
Aceito em 20 de janeiro de 2021.