

BIOMIMICRY AND ECHOMIMICRY IN IRANIAN ARCHITECTURE AND ITS SIMILARITY WITH THE IRANIAN DESERT ARCHITECTURE

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ABSTRACT

Iranian desert architecture contains unique features that in addition of aesthetic needs also matches its natural and ecological capacities. In fact, many of the techniques used in this architecture include modern architectural concepts such as bionics and ecotect. Studies show that due to the growth of technology and raised topics and modeling of the nature and preserve natural features and respect to canvas wall keeping with the nature and also existence of suitable sources of energy (solar, wind, water ...) in our country, special features of desert area of Iran and architecture which lies in the context of nature, similarities between biomimicry and echomimicry such as modern science in architecture and Iranian desert architecture can be Found. after getting familiar with the basic concepts and mentioned new technologies in this article, it is hoped that be able to enhance the Iranian architectural values and try to preserve and restore it. May this article link between two generations in architecture.

Keywords: *biomimicry, echomimicry, Iranian desert architecture, ecology, bionics, ecology*

INTRODUCTION

Man once were proud of his innovation and initiative power, but now come to the conclusion that invention power alone cannot cause survival of the generations on planet and to ensure its survival, he should also think about the lives of other living species.

In this crucial phase Human realized that the secret of survival and living is not in an arrogant individualist and relying on human knowledge, but is in harmony and modeling of nature.

Therefore, it is sought to maintain and try to keep the nature, and form support groups and in addition, depth study of meanings and concepts contained in it. thus, he achieved this entry that There are lessons in nature which originating from them can increase their knowledge day by day and traverse the way more quickly towards scientific horizons.

By looking to background of this entry, in the head columns of Persepolis or its relief can see the entry from the earliest examples of ancient architecture inspired from nature and belief in the gods formed from the pyramids which are indicative of the grandeur of the mountains to Architecture of Iran.

The human need for nature is not summarized in this issue and about 5 million years ago when man clauses were appeared and look for shelter, food and other necessities in nature and over time, he invent ways to combat adverse conditions of nature and vernacular architecture or ecotect was created.

Made fertile and experienced climatic characteristics of human in choosing how to deal with the specific problems of each territory by using elements of the land and construct tools appropriate to their needs in the interaction with nature and climate.

Human attempt to resolve environment anomalies in led to the numerous innovations in manipulation of the environment.

In general, today's architecture can be considered rely on the crystallization of these interactions with nature and based on vernacular architecture, traditions and culture of different countries.

Since the architecture of Iran, our country, also does not exclude the mentioned rules, one could say that it is a mixture of modeling art from nature and ecology.

RESEARCH METHOD

In this study which is an applied research. Surely, collecting the research required material is one of the basic steps and selecting resources has been done based on references and bibliography of books and articles on foreign and domestic valid related to this issue. In this article, information has been collected by using library method. After that, conclusion and analysis of them has been done and eventually, the main guidelines are provided.

The definition of basic concepts:

BIONIC

By a deep understanding of nature and attempt to recreate models in order to simulate it, actually we create a plan which as a major force can put plan into motion. A deep understanding of human and human extensive knowledge of the nature in this way are very efficient and profitable (Golabchi, 44: 1391). It should be noted what can lead to create innovative, modern and constructable piece with formation processes of buildings made by humans is inspired by nature and not an imitation of nature (the same: 64). Bionic is science studies of nature's models and inspiration from these plans and processes to solve human problems. Man lived and lives with nature and at the same time, for his better life in it, he does architecture (Mahmudinezhad 121: 1390).

By looking at the various periods of architecture, we will find that reflection of nature in body of building occurred in different forms and how this approach is is one of the most important criteria for understanding the intellectual roots of an architectural style and vision of architect towards the universe and nature. Architect of higher quality seeks primary source means the nature and discover qualities of nature by careful observation of nature. A group of experts in various disciplines consider bionic as science of using the results of evolutionary biology. They believe that bionic task investigates processes and biological structures of materials for future designs. Bionic ideas is based on the fact which evolution is constantly ongoing in nature and life technologies have the best manner and Order towards each other, therefore, its necessary for modern technologies to be modeled from the life evolutionary forms. Other specialists consider bionic as the art of applying knowledge of living systems to solve technological problems and have defined the purpose of nature .They believe that nature without creating pollution produce products that in terms of business functions more important than the production of man-made (Jaleh, 62: 1386).

In the architecture, we need comprehensive research in the nature biological structures for identification and investigation of form. Achieve a complete architecture by studying life and behavior of cohabited creatures will be possible and available (Rahimi, 141: 1387). Also, architecture should respect to herbal and natural patterns.

Calatrava believes that what needs to be done is shaping materials in a way that as response to the action in the different circumstances of new functions have an matching capability, like nature (Mashayekh Fereydani, 64: 1385). Bionic architecture as a sub-discipline of the bionics, is combining art of biology and technology in building.

In this approach, bionic architecture provides possibility of simultaneous design and innovation in two fields of architecture and architectural structures. Enliven the building is one of bionic architectural tendencies (Yazdanfar, 118: 1389). Actually, bionic architecture is benchmarking, inspiration and extraction of creative solutions to innovative issues and ideas of the nature and it is a new way which

looks at the problems of organisms and machines through the collection of researches of biologists, psychologists, mathematicians and engineers (Mahmudinezhad, 428: 1390).

BIOMIMICRY

Biomimicry is an approach in which plants, animals and entire ecosystems have exemplified as a basis for designing (Montazer, Shahbazi, 1).

Biomimicry is also composed of two words, bio means life and mimicry means modeling which is a new science that by inspiring from nature implement projects and processes to solve human problems and reviews on leaves in order to produce solar cells is an example of this cases. So this science can be called innovation inspired by nature (the same, 1).

BIOMIMITIC

In fact, basis of the science is natural biological models which by their physiological study, we can design and build modern technological systems.

Science of Creative innovationology has Categories or numerous sub-disciplines which one of them is creatology of model nature or natural creatology (Golestan Hashemi, 1382, 1379).

Subject of this field is "modeling the nature for creativity and innovation " by analytical study of types of structures, systems and mechanisms available in different parts of nature and organisms by approach of creative modeling and using them in science and technology and in other fields(The same).

-DEFINITION OF ECOLOGY

Ecology in Persian is literal translation of its European name that is ecology. The word ecology is composed of two words «oikos» means canvas, home, biological context or location and the word «logos» means identifying, science or knowledge. So in terms of lexical aspect and literal meaning of words forming, ecology means study the location of animals but technically refers to "environment effects on living organisms, living creature effects on the environment and the interrelationships between organisms." (ardakani 1388).

The term ecology was proposed for the first time by German biologist Ernest Hegel in 1869, as the field of new studies in biology. His intention of the ecology was understanding governing interactions between organisms and their environment (The Razaqyan et al., 158: 1391).

BIOMIMICRY

Echomimicry approach in which the vernacular architecture is using as the basis for modeling to design is composed of combination of two words echo means the canvas and mimicry means modeling.

IRAN DESERT

The biggest watershed area of Iran consists of central desert and the area of Loot desert. The central desert of Iran is surrounded by Alborz Mountains in the North and Zagros Mountain in the East. The mentioned mountains have prevented the entrance of rainy clouds into the watershed area. The central watershed area has the average height of about 1000 meter above sea level and generally has a considerable variety in height from the sea level, geographical directions, and prevailing winds (Qafari, 2000:34). The amount of rain in central desert of Iran has been estimated to be too little and limited (about 70 millimeter a year). Poor vegetation cover, barren land, and very low density of population, are of characteristics of central desert region (the same resource).

Low humidity and lack of cloud in the sky has resulted in the high temperature change in these areas. High temperature difference between days and nights during hot seasons, intense sunlight (700-800 kilocalories per hour in per square meter) are considered as climatic characteristics of desert regions. Temperatures in different areas of these regions are depended on geographical situation, sea level, and direction and features of winds. Most cities of Iran central zone are located on the edge of deserts

(Qafari, 2000:63). Geographical location, size of villages and their distances to each other have been directly affected by environmental factors and natural potentials of these regions.



Figure 1: Iran Shahdad desert

ARCHITECTURAL AND CIVIL CHARACTERISTICS OF DESERT AREAS

Although in many desert parts of Iran, climatic conditions for foundation of a city and settlement are not provided, with the invention of aqueduct the inventory of which by Iranians is obvious, water is transferred from the distances of 20, 30, and 40 kilometers to the earth surface and has been the continuity factor of cities and villages (BastaniParizi, 1987).

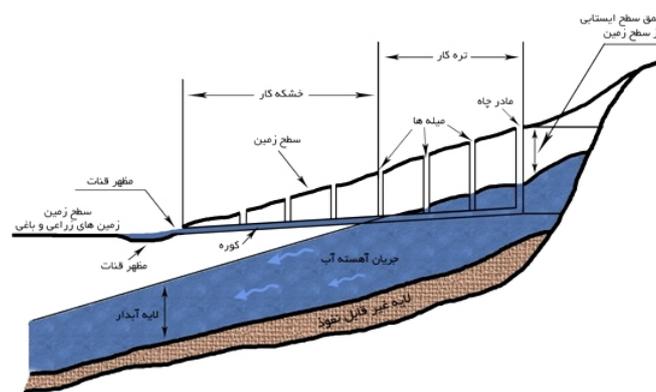


Figure 2: schematic view of aqueductoperation in providing water in desert



Figure 3: the image of corridors of aqueduct under the ground

Traditional cities of desert regions of Iran are mainly made of a compact and contiguous settlement. Providing climatic comfort and saving in energy consumption take place through reducing exposure of levels of solar radiation in urban buildings and settlement and through compact settlement. This principle in the body organization of Iranian urban desert happens through congested residential units in a way that sometimes some residential units are connected to other units even from four sides.



Figure 4: Yazd as the star of Iran desert

Compact settlement of most cities is enclosed by a green belt of orchards and farmlands as ecological measures. In this way the reflection of sun heat from the thirsty and scorching soil of desert is the least. Green spaces around cities have important roles in protecting central parts against desert winds, dust and dry climate of desert and are important factors in the cities' natural ventilation (Qafari, 2000: 27).

Networking the roads, land division and segmentation and organization of full and empty spaces follows two completely different methods. Road networks have been created with an organic order and hierarchy according to the tilt and direction of aqueduct water, while segmentation of land is disordered and that of buildings has geometrical order. Existence of indirect, meandering pathways and covered alleys and passages (lean), on the one hand prevent annoying winds and on the other hand due to their great depth, provide the most shade. The way of establishment of sunshades which is a distinctive feature of urban desert, keeps the walking man in a proper sequence in the shade through his direction. In many sunshades, the entrance of several houses are integrated which is important from the sense of neighborhood. Closeness, hierarchy and privacy, and social areas have come true by this urbanization which has resulted in the social survival of desert cities.

In traditional collections using natural resources and energy is one of their principles in construction and spatial organization. Old houses in desert settlements from establishment status are typically in the direction of Qibla. This orientation in terms of climatic has created conditions so that summer spaces and winter rooms are logically placed around a central courtyard.

Central courtyard is the main space of desert homes. Water pond in the middle of the yard, the size of which reaches the most, keeps solar energy in itself, and thus supply of cool and pleasant for each residential unit has become possible through preserving deep courtyards and houses tightly close inside these deep courtyards. Yards that are surrounded with indoor spaces on all sides, deposit cool air of night like a hole and makes use of it during the hot day. (Tahbaz, 83).

One of the common ways in desert architecture that contributes to energy conservation is the use of passive equipment and systems. Installation elements such as "air holes", "water storages", "icehouses", "windy and watery watermills" in desert cities, provide less expensive services that nowadays are provided by electric vehicles by consuming energy.

Air holes are considered as the breathing system of the city. Air holes which are typically considered as the obvious examples of clean energies are related to the hall, spring house, pergola and basement and provide conditions that the flow of air be established inside building and by having connections with natural elements such as pool, garden, trees, basement wall, stream and coastal, has compensated the lack of ground humidity and has provided a pleasant environment during hot and arduous days of summer for the residents.

Beside its function, air hole is the symbol of recognition and social status of its owner which is also realized by its height and type of decoration (the same resource, 131).

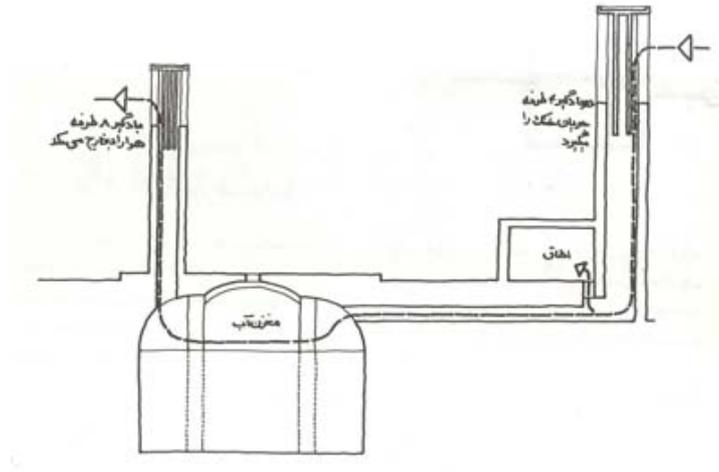


Figure 4: how the air hole functions

In some desert cities, improper winds in summer or winter or lack of financial and technical resources for constructing air hole has led to the construction of wind towers as the most beautiful and most wonderful hallmark of the city. Two perpendicular corridors that with the help of a high fan in an elevated location at the intersection of corridors, sucks the pleasant air of the yard through the openings which face the courtyard to itself and sends out warm air under the ceiling through ventilation. This process is in contrast with the operation of air hole which sucks the pleasant air above the city to itself and sends them to the rooms.

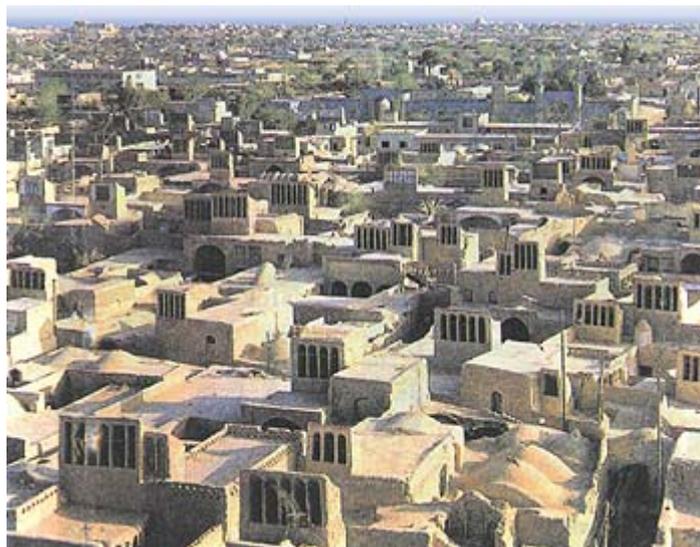


Figure 4: the picture of the direction of air holes in the desert city of Meybod

Preserving the coolness of room in summer and retaining its heat in winter in excruciating conditions of desert is an important principle.

Using thick adobe walls and inevitable curve ceilings, which are the only available material in desert, because of its heat accumulation feature and gradual direction of it, acts like a capacitor for preserving heat or the coolness inside the room and the existence of the least number of openings including windows and doors neutralizes this quality. The height of rooms which is the result of the curvature form of ceiling, keeps a large volume of air in itself and prevents rapid heating and cooling of the room (Tabbaz, 86).

Finally in conditions where none of the above mentioned solutions cannot fight the unbearable moments of summer afternoon, cool and wet rooms under the soil which because of the gradual absorption of heat and cold, depreciate severe fluctuation of daily and annual temperature and modify temperature significantly, is the last solution that is used by the people of the desert.

In addition to design and construction with ecological view, the production of building materials takes place with minimum destruction and damage to the environment and with minimum fuel consumption lack of hard and non-absorbable construction wastes. The type of construction materials used in monuments is mainly clay and brick which generally is gained from the soil resulted from excavation and foundation and have been used in constructing building. In other words, the used material such as "straw" is a byproduct of agriculture. In other words, providing material is all from local sources and is considered domestic.

In the school of desert architecture, disposal does not make sense. Everything is used, even "Kovareh" or the broken or splitted jug as gas an important structural role is assigned to it in constructing the building (Qahramani, 1996: 117). Recycling and re-consumption of building can be considered as another tradition of Iranian architecture and urbanism especially in desert. "Kamva" i.e. the contaminate resulting from the demolition of muddy buildings, gets back to production cycle by farmers and as the finest agricultural soil gets producing role again. At the same time the old mud of orchards are used for production of bricks and creating architectural space which means cycle in nature (the same source, 118).

This approach is in fact due to understanding natural processes. Since there is no waste in nature, a byproduct of any organic is the food of another organic. In other words, natural systems are composed of packaged circles. Clarifying natural circles and processes, revives the designed environment again. This principle is in fact an important principle in ecotact that is clearly seen in Persian architecture.

CONCLUSION

In the previous part it was tried to identify the factors and features in desert architecture which results in in-depth understanding of it. Also the above article aims to find evidence of similarities between desert architecture and modern technologies such as Bio mimicry and Echo mimicry which is the science of imitating from living systems and domestic architecture and in this section we briefly study these signs and then will mention their similarities with modern science.

- In Persian architecture respecting nature and peaceful use of it, was one of its stationary reasons and by getting familiar and understanding this we can understand the rightful place of nature in contemporary architecture of Iran and take nature back to nature.

- Iranian desert areas have specific environmental and climatic characteristics and traditional ecosystems, villages and towns of these areas are located and constructed based on certain principles and are adapted with environmental conditions and ecological capacities.

- Compact design of cities and orientation of passages as the communication arteries and the whole complex being surrounded by orchards and farmlands are ecological measures which are appropriate for climatic conditions of desert.

- Design and construction of buildings with ecologic approach from energy saving view in construction, use of domestic materials, considering the required energy for maintaining and adjustment of environmental conditions with designing empty and full spaces, the fine orientation of the building, making use of appropriate technology of construction by using natural energies are considered as the suitable patterns for stability of architecture.
- Desert buildings are considered as dynamic living organisms because their needs to water and energy are met in their sites and are not only compatible with their climate and site, but also contribute in the environment change.
- Iranian desert monuments like ecosystem cycle do not have waste, and do not produce building products which are not beneficial for environment and health, and provide well-being of residents in an integrated ecosystem and also promote environmental qualities.
- Desert monuments with regard to the identity and cultural, social, religious characteristics are distinct and separable and help to create stability and survival of the environment.

Since energy guarantees the survival of world and the majority of wars these days are to achieve better energy, it would be better to take steps in line with the mentioned modern sciences to energy and food self-sufficiency for future world. By using Bio mimicry and Eco mimicry sciences and considering Persian culture we can take a huge step towards the revival of Persian architecture.

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