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Introduction to innovation in Architectural Characteristics of urban building from Bionic Design Approach

Sina Razzaghi Asl- *Assistant Professor in Urban Desighn, Shahid Rajaee Teacher Training university, Tehran, Iran.*
Teymoor Heydary[1]- *Academy Staff, Islamic Azad University, Ardal Center, Shahkord, Iran*

Abstract
Biology has been a brilliant teacher and a precious textbook to man-made construction for thousands of years, because it allows one to learn and be inspired by nature's remarkable and efficient structural systems. Concepts unfortunately have this in common that in general use often specifies incorrectly some phenomena. There was a turning point in each period of time which human has discovered a new sight about the world and nature order in a way, and then has presented this relation by numeral, artful and industrial language. The relation between nature and human considers different periods. At first it was bio-utilization which degrades the value of nature as a source of energy and material. After revolution in science development and attention to the damages which they made to environment, they tried to change their look to this issue and expand the mean of relation between human and nature. Birth of such word like bio architecture emphasize on the new point of view at nature. The role of nature and importance of natural resources in human's social-economic (and even his psychological) life is undeniable, and also it is essential to note that God is the Creator and man the explorer. This paper aims to call a close multidisciplinary collaboration that promotes engineers to build more sustainable and smart structural systems for bridges in the 21st century. In this article survey the introduction of bionic architecture and related categories.

Key Words: *bionic, bionic architecture, nature, inspiration.*

1. Corresponding Author, Tel: +98-0913383944 Email Address: Tm-heidari@yahoo.com

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Introduction

Once earth created and all creatures were started to live on it; most of the creatures naturally start to create shelters for themselves like the birds, rabbits, and etc. human being as one of the creatures on the earth, start to makes hut and shelters to be protect from climatic conditions and their enemies. Humans also like other creatures from the old ages tried to look after themselves from the climatic conditions like rain, wind, snow and etc. and other possible dangers .To be able to survive they start to make shelters for themselves by available natural materials and by referring to some natural structures like the bird's nest and other animal huts. They were not considered on the aesthetic aspect of their shelters form as much as structure and stability. From the beginning of creation, human being was surrounded by nature. Everything in nature is well organized and in harmony with the other parts of it. Through the history, nature has been always a source of inspiration for the human begin in different aspects of their life. Architecture as one of the remarkable features in every society cannot be separated from nature. The usage of forming principles of wild life got the new quality and received a name of architectural and bionic process and became one of the trends of architecture in the world architectural practice for the last 40 years. Bionics is an innovative architectural style that took all the best from nature: relief outlines and forms. It can be called architecture of future and its aim is synthesis of nature and modern technologies. Although, there are a wider areas of inspiration from nature studies in architecture like organic architecture, constructive architecture, deconstructive architecture, and etc. but this study is not going through the philosophy of inspiration from nature and it focusing on the more engineering ones like bionic architecture, "Bio mimicry" and levels of inspiration.

Later on when humans started agriculture business instead of hunting, permanent settlements become a factor of that time (8000 BC). The story of architecture is beginning by evolving the tent-like structure into round houses as shown in figure 1.2 and figure 1.3. The technology of bricks, which is shaped by the mud and baked in the sun, is invented in that age of architecture. Later on the shelters are developed to the buildings by the straight walls with windows (6500 BC).

The first stage is the oldest and is characterized by the spontaneous use of constructive and special-functional means of birds, insects, and animals for building primitive houses. It is difficult to speak of the esthetic value of these usages. Evident enough is just their functionality. Often, within the artificial shape of constructions together with their function has been copied the natural shape too, so there was no great difference between, for instance, a South-American Indian house and a termite hill.

Later on in the same period of architectural history they shift the tent system up as a roof structure system of round houses and improved from the tents to the round houses (8000 BC) by the new technology of bricks made from mud and dried under the sun, this improvement started from the time that humans start the agricultural business by the side of hunting. Cities start do grow by the settlement of human begin and the houses is shaped the straight walls and windows; as the history shows "One of the best preserved Neolithic towns is Catal Huyuk covering some 32 acres in southern Turkey. Here the houses are rectangular, with windows but no doors. They adjoin each other, like cells in a honeycomb, and the entrance to each is through the roof."

After that the Stone Age is came; buildings are constructed from the block of limestone and later on the creation of arches, domes, vaults and etc. These improvements are continued up to the one of the biggest enlargements which was the industrial revolution and in side of it coming up the Iron Age, architec-

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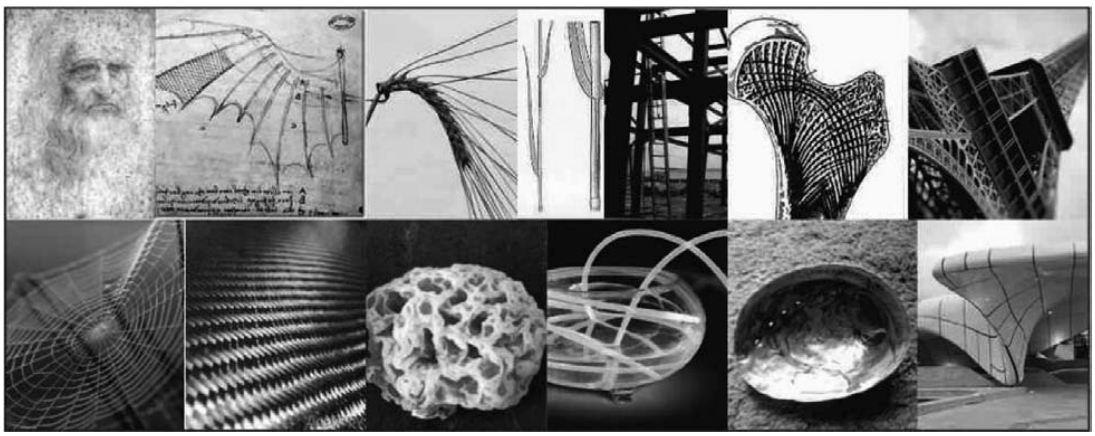


Fig 1. The Bionic's using; The first row: 1. A design for a flying machine, (c. 1488) Institute de France, Paris; 2. The analogy of the structure of culm and modern high-rise buildings; 3. The construction of the Eiffel Tower is based on the scientific work of Swiss professor of anatomy Hermann von Meyer, 1889. The second row: 1. Creating an artificial analogue of the web-Kevlar, based on the structure of DNA spiders; 2. Natural optovolono in the structure of marine sponges Euplectellas researchers found Bell Labs, Lucent Corporation; 3. Creating a layered building's structures based on the structure of the deep shell clam „abalone" Shells are composed of soft and hard plates.

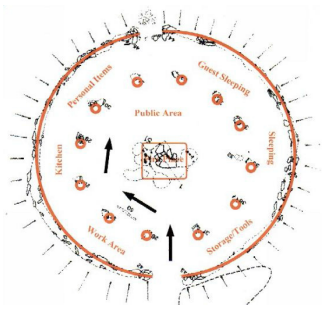


Figure 2. Round houses



Figure 3. pre-history shelters structure and design

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Figure 4. Analogy of South-American Indian house and a termite hill

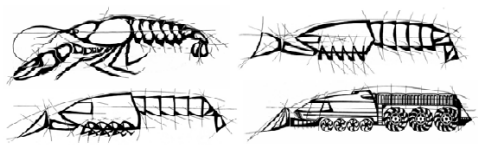


Figure 5. Principles of the bionic forming in machine designing

ture is also overturned in these age, structural systems and architectural forms turned to be more complicated as it comes to today's and going toward tomorrow .

Wright believed that architecture had to be developed integral satisfying all the human vital functions, taking into account these vital functions but not balancing them with "abstract" architectural forms. And practically, all the "seamlessness" of such architecture (at least in Wright's works) was turned into the establishment of the external constraint of architectural forms with the local landscape and also the usage of local building materials for the purpose of keeping of the national coloring of architectural constructions. Thereby an "organic" direction in architecture wasn't referred to bionic. But the very idea of architecture development "from within to outside" (such development that directs the similar ones on the way of forming of systems that are typical for the entire wild world) is very

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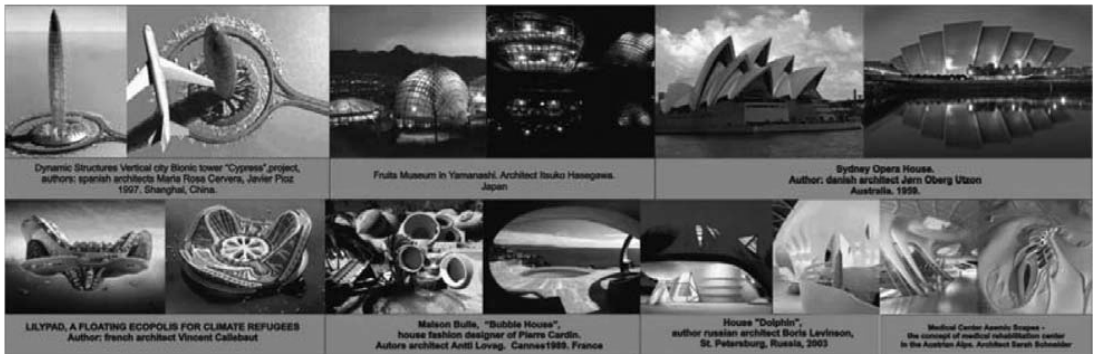


Fig 6. Bionics in architecture at the present stage

interesting and "bionic" .

Literature review

Janine Benyus base the new science in 1998 under the name of Biomimicry. Biomimicry means "innovation and inspiration from nature looking to nature as a teacher". She says that:

"in the 3.8 billion years since, life has learned to do some amazing things to fly, circumnavigate the globe, live at the top of mountains and the bottom of the ocean, lasso solar energy, light up the night, and make miracle materials like skin, horns, hair, and brains. In fact, organisms have done everything we humans do or want to do, but without guzzling fossil fuels, polluting the planet, or mortgaging their future."

Bionics in the dictionary means nature of the application of artificial organs. The term "bionics" was created in 1958 by Jack. E. Steele, a worker at the Aeronautics Division House at the Wright-Patterson Air Force Base in Dayton, Ohio; He Considered bionics and the foundation of all knowledge systems as living systems. Bionics science or study of organisms living today as one of the world's top science (IT, Nano, Bionic) has been introduced. Of a general definition can be said to "attentively bionics science foundation system that they are living systems or features live system or systems to survive"[6]. Bionics is combining of two words "biology" and "techniques" means the knowledge of technical solutions to biological responses.

This relationship in different eras has had various forms, which are generally divided into the following four courses [3].

1. Nature and organic template (the Hunting Age or Stone Age): In this course, human being has been dominated by nature on all aspects of life.
2. Nature and Hyper organic template (the farm): In this period, the expectation level of comfort to the people of the area of security, Vance was trying to tune "with nature" or "with nature" comes on.
3. Nature and dominate nature template (the industrial revolution): in this period human expectation level was security, justice and welfare. In this period, the maximum utilization of human nature is to win.
4. Nature and industrial quasi-organic template. Although well motivated in this period still exists, but the environ-mental damage up and global community is trying to adapt industry to nature [4].

Definition of bionic

Bionics is the science of studying the basic principles of nature (constructive, technologic, etc. shapes) and the application of these principles and process for finding solutions for the problems that humanity encounters [16].

Major Jack Steele, US Air force, coined the term "Bionics" in 1960 to describe what was then an emerging research approach at the interface between natural and synthetic systems. He defined bionics as "the analysis of the ways in which living systems actually work and having discovered nature's tricks, em-

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Man and nature from the eastern and Islamic thinkers' viewpoints	Man and nature from the western thinkers' viewpoints
All nature speaks of God	Belief in human domination over nature
Peace of society depends on the peace of nature	Lack of attention to metaphysics
Metaphysical cognition must be revived again	Conquer and domination over nature
Being happy with nature exactly means accepting its rhythms and norms	Secularized knowledge of nature
Inseparable connection between man, nature and religion in Islam	Nature can not give anything about God to man
Speculating about God, divine realm, revelation and wisdom is not a job just related to mystic, philosopher, scholar and leader. Everything in society must move in a coordinated direction.	The scientific knowledge is used to nature exploitative

Table1. The comparison between western and eastern thinkers' viewpoints about man and nature (Nazarizadeh, 1385, P.6)

bodying them in hardware" [17]. The Concise Columbia encyclopedias define bionics as follows: Bionics study of living systems with the intention of applying their principles to the design of engineering systems.

Bionics could be classified in five main categories as shown bellow:

1. Total mimicry; an object material chemical structure that is indistinguishable from the natural product e.g. early attempts to construct flying machines.
2. Partial mimicry; a modified version of the natural product, e.g. artificial wood.
3. Non-biological analogy; functional mimicry, e.g. modern planes and use of airfoils.
4. Abstraction; the use of an isolated mechanism, e.g. fiber reinforcement of composites.
5. Inspiration; trigger for creativity, e.g. design for architectural and engineering constructions alike to plants, animals and insects

Nature and inspiration

"Nowadays nature inspiring, where the most remnants create by at least effort, yet is attractive. Nature performs everything carefully in an effective and without error form"(margolius, 1389,p.94). "Dr. Willinsky (1998) says as: nature gives the most multi aspects, practical, harmless and friendly environment solutions and it's enough to have care and recognize them; then put them in industry by technical recognition and give practical aspect"(Tahermoghaddas and Kimiya, 1389, p.8). "As some mystics have said universe helps human to go to a world over the universe" (Nasr, 1386, p.130). "Human does not create but discovers, means that because all things are latent in nature forms, artificer just should go inside it and discover; therefore it is true to say all ways end in nature. Arthur Schopenhauer says: «only real remnant which directly arise from nature and life such as nature and life, always remain young and able; because it does not belong to certain age but humanity. In this beyond science that practices technical inspiring from buildings, behaviors and different relations in fauna world is called bionic science, i.e. bionic is systems science that their substitute is alive systems or have alive systems properties or are like alive systems"(sadeghi.1386, p.3).

Bionic has created some interdisciplinary fields such as morphology (the scientific study of the structure and form of either animals and plants or words and phrases), biomorphic (Biomorphic creating artistic artifacts based on naturally occurring patterns or shapes of nature and living organisms. Taken to its extreme, it attempts to force naturally occurring

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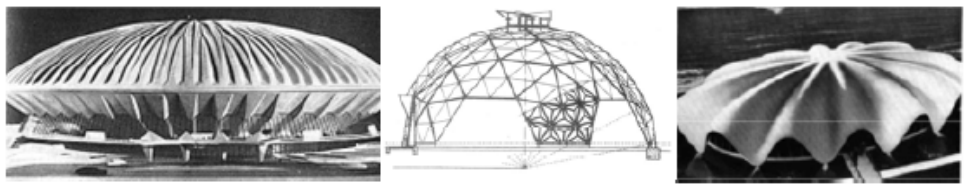


Figure 7. Tegument structure in forming of architectural constrictions

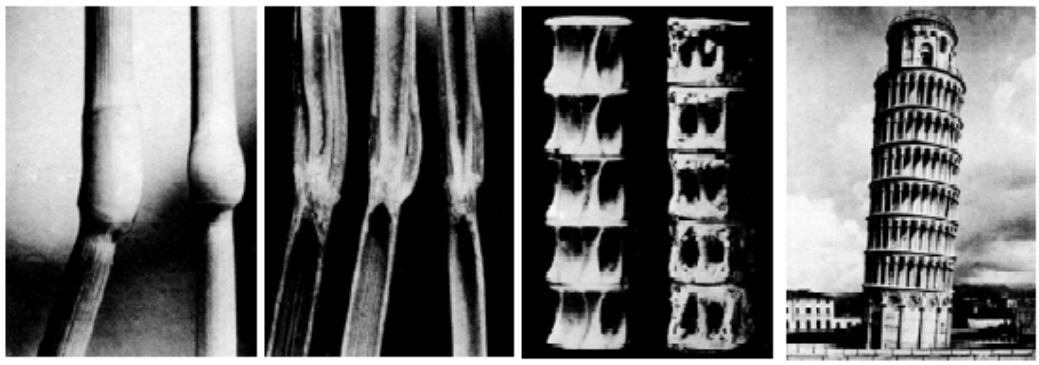


Figure 8. Constructive systems of column type

shapes onto functional devices.), bio design (Bio-Design is the integration of design with biological systems, often to achieve better ecological performance.) and organic (not using artificial chemicals in the growing of plants and animals for food and other products). Complicated design problems needs novel solution to solve and as most of the solution already done in nature we can get inspire from nature bay three different levels which are:

1. Visual inspiration;
2. Conceptual inspiration;
3. Computational inspiration.

The usage of laws and forms of wild nature is rather rightful in both technique and architecture. Everything is interdependent in the world; there are no things and facts that wouldn't be connected directly or between each other. There are no pathless barriers between wild and inorganic nature, there are the laws combining the entire world in unified whole and giving rise to the objective possibility of usage in the artificially created systems of laws and principles of building of wild nature and its forms. Its basis is a biological relationship of a man and wild nature.

Architecture and nature

"Architecture arises from need and indicating unique nature that is its existence cause"(colin cent john Wilson). "Architecture is the first human manifest that creates it's as nature, it gives up nature rules, rules that have authority on our nature and world. Gravity, static physics and dynamic physics rules appear on the base of reduction absurdum sentence means that things should close together to avoid destroying. A grand fate displays nature creatures and gives up a balanced, developed, changed and union thing secret" (Le Corbusier, 1389, p.44).

Naturalism and interesting to matching with nature has appeared in architecture since many years ago and Egypt pyramids especially and beside them smaller pyramids are as mountain range that say king is huge as mountain for subordinates.(Talaei delshad,1385,p.3-4).

Richard Bonser in his Biomimetics buildings looking to find out that: "What nature can teach us to improve sustainability?" there is question here which is "why copy nature?" and to get some answer for it maybe we can

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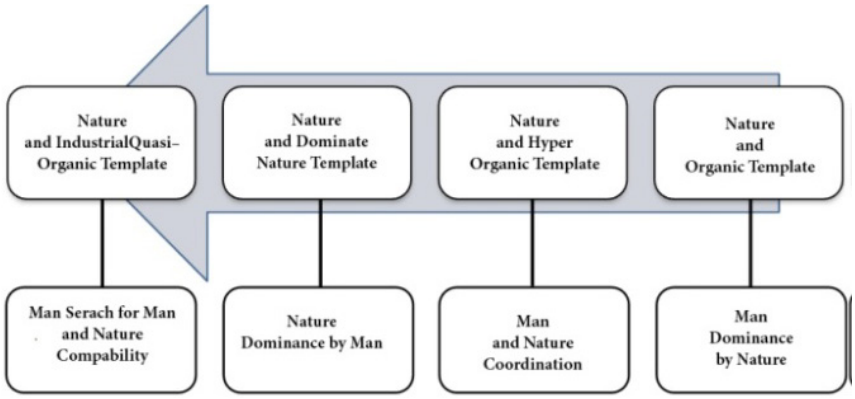


Figure 9. History of Nature Templates

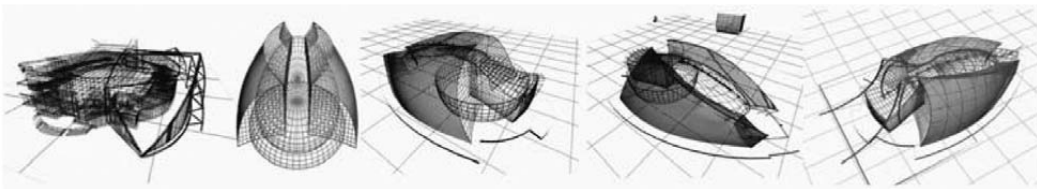


Fig 10. Stages of formshaping

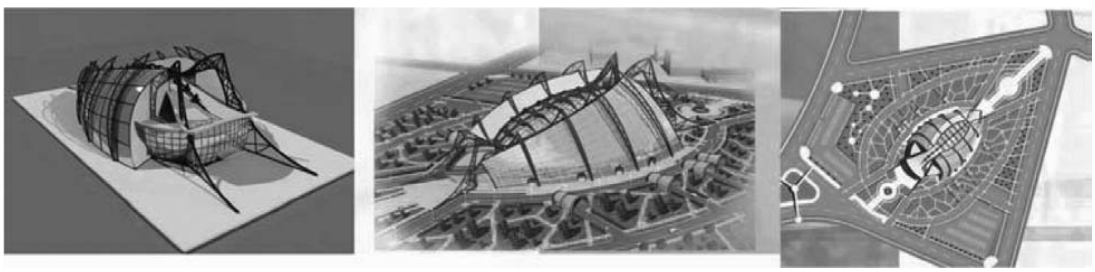


Fig 11. Search of a bionic form on a conception basis.

have look on what Leonardo Da Vinci said about nature:

"the genius of man may make various inventions, encompassing with various instruments one and the same end; but it will never discover a more beautiful, a more economical, or a more direct one than nature's, since in her inventions nothing is wanting and nothing is superfluous."

Another key sentence of him is "the shapes of objects surrounding us are connected to a general factor the environment where they take place"; for the first step from the architects' point of view to take inspiration from nature it can be a good point. Next idea is that "there is no shape without function in nature, as well as function without shape. Harmony between function and shape in material world is one of the most important tasks of the nowadays designer." Getting idea from nature (Bionic) has five main categories which are:

1. Total mimicry.
2. Partial mimicry.
3. Non-biological analogy.
4. Abstraction.
5. Inspiration.

The concept of biologic architecture invented by Dan Winter; such a kind of architecture is "a set of rules that determine which symmetry or quality of electric field allows all biologic structures to thrive. The premise behind biological architecture is that all life responds

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well to design that is in accordance with nature and avoids harmful materials and sharp corners which bleed capacitive charge." In the other paragraph he mentioned the goal of biological architecture and he says:

"The ultimate goal of biological architecture is to create fractal charge fields that are implosive in nature and encourage life. And they had done some research on the effect of biological architecture on human life on the large scale like city planning and etc."

Bionic also called biometric or creative biological engineering, is the collection of biological methods and systems existing in nature used in engineering and new technology. Beside bionic, the word of biomimix is also proposed. This word first was invented and used in 1950 by Otto Schmitt and jack steal when working on an astronomer project in Right Peterson aerial station in USA. They recognize the bionic as the science of systems based on living creatures.

Human, nature and architecture are triangle three points that are not opposite, but combine and complete each other; and by using experiences, nature sciences and techniques and creating a friendly bridge between human and nature by architecture help could create a trace that has nature inside its. Architecture duty is creating relationship among human, spiritual and body environment. "Often by hierarchy and disciplinary in nature components and elements recognizing could receive rules to life and do human activities and after nature elements recognizing and knowledge receiving about present phenomena in nature and also hierarchical system and how chain relations among them and each elements role recognizing as cause of another cause, entre second stage means attitude that includes learning analysis in the mind and purposeful 5th SASTech 2011, Khavaran Higher-education Institute, Mashhad, Iran. May 12-14. Conclusion from it to entre third stage means ability and skill for built creativity and create part of huge meanings and make Legal our life that of course this discipline is sign of nature discipline"(Golparvarfard, 1388, p63, 62).

Conclusion

Architectural and bionic practice gave rise to the new and unusual architectural forms which are useful from functional and practical point of view and original in their aesthetic qualities. It couldn't but kindle architects' and engineers' interest to these phenomena. To achieve the aim of the study a short review took place, all through the history, from the time that human were line with the nature up to the time that human hurts the nature right after the industrialization. From the very beginning, man has spent so much effort on discovering the nature in this unknown territory, and to extract art and technology from nature and after realizing its values, reuse them in different forms and shapes. Therefore, it is necessary for him to make the connection among machine and living systems. One of the main trends in bionic design is to enliven the building. To achieve this purpose, direct or curve lines and attributing the integrity to the building are essential elements for reviving the buildings. Bionic buildings such as aquarium are open to publics in order to show aquatic organism. Majority of public aquariums contain different species. After world's creation, nature, itself, has turned into a good source of inspiration for designers and architects and during this time, plants and animals could cope with environmental issues through decoration and designing. They have also been trying to be inspired by nature and its surroundings for making needed equipment. Accordingly nature has been a part of architecture from the time that human directly used it by living in the caves and using building material according to the nature of its surrounding up to the time after industrialization which the perspective has been changed by the new materials, tools and technologies and inspiration of nature took place in architecture. In this case all other creature in nature are strug-

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gling with this factors and by the help of the evolution, were find best and most effective way of facing with this factors is in nature. However the best way of facing with gravity is to face with it by inspiring from natural structure base on this study, but there are facts beyond this which take inspiration from nature to have most optimized architecture as optimization in nature, to face with new restraint, and limitation of resources, beside being in harmony with nature as medium we are living in. But it is not all what architecture took from nature, by short look to the development of architecture, form, function and space quality and some of the main factors which has been taken to the consideration, all through the history of classic architecture, and has been extend up to today's architecture. All of the mentioned factors are under the influence of environmental factors started from gravity up to the earthquake and thermal factors which are common point in the medium of the nature.

Modeling forms and structure of nature to design buildings any invention was rooted from human thought approached by unconscious source of natural talent. Architectural from and operation of nature is the process that we understand it as inceptions and growth by instinct. Most stable form of it is the obligation to life, that the person reveals in the frame of material and in fact it is a process which gives the schema a structure and gives the structure a schema. Architecture is a process that combines different connected powers in the general unit shapes.

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