



nature has been institutionalized. Throughout the history of human evolution, when the path is of the nature, causes obvious phenomena as natural disasters or special dilemma arise. What are the special engineering design is that architecture and engineering specialists from different angles to try to move to the side but what is required in the design of buildings in the third millennium, balance and coordination issue in this case is the architecture and technology. (Mashayekhee, F., 2013: 3) Engineering art in its most complete form can be found in nature. The future architecture of the twentieth century model of the car did not, but will be inspired by nature and green spaces and live around them. For years, researchers have sought to prove the existence of the relationship between technology and nature, through to how the various systems, and they are living check to bring the investigation of "bionic" As technical knowledge to solve environmental solutions, have established. (Tarashee and Adel Ahmadian, 2011) In recent years the field of architecture is inspired by the metaphor of nature and concern to pave a complete architecture. What is today called "bionic architecture" called the result of efforts of the architects of the new approach to architecture and natural structures often try to resolve the problems and human errors in their construction. In this context, the paper first and brief definition of the concept of sustainable development and sustainable architecture is considered, then, a brief definition of bionic science and architecture will be discussed in biomimetic. To continue the process of general ideas presented in the form of a case study and the conclusions from this analysis features offered.

### **Sustainable development and sustainable architecture**

As a result of the loss of part of the environment in 1986, the International Committee of the development environment, the term sustainability as meeting the needs of the present without compromising the resources of future generations to provide appropriate solutions in front of the world. Sustainable development is the effective and efficient use of resources, including natural, human and technology, so that at the same time meet the needs of mankind involves meeting the needs of future generations as well. The main objective of sustainable development, the provision of basic needs, improve living standards for all, better manages the maintenance of ecosystems and a safer future prosperity more are listed. (Mahmoudi, 2013) Other objectives of sustainable development can reduce energy waste in the environment, reduction of pollutants, the materials return to the cycle of nature, compatible with the environment and utilizing the renewable resources such as wind energy, solar energy and geothermal energy point. The term architecture as sustainable architecture or green architecture has been proposed. In fact, the principle of sustainable architecture based on the fact that the building is a small part of the surrounding nature and should be done as part of the ecosystem and the life cycle is. Increasing the energy efficiency of buildings during the operation of the most important goals of sustainable architecture. This approach, which seeks to improve the environmental performance of the building's architecture, the industry strives to construction work, significant savings in energy, water and materials provided. Respect for nature and man-made structures in the peaceful use of the architecture is stable. Therefore, through Bionical creativity engineering any negative impact of buildings on the environment and human loss and the best approaches to improve sustainable architecture.

### **Science bionic and Engineering Bionic creative:**

Bionic word combination of two words biology biological means and techniques means the technology has been formed. The term first used by Jack.E. steel Air Force Maj America at a conference titled "Live model, the key to the new technologies" was held in 1960. Bionic in the sense of Art to apply the knowledge obtained from living organisms to solve technical problems. (Shojaee and Negate, 2010, p. 2) in parallel with Bionic, biomimetic word also means the application of biological systems and methods in nature in engineering systems and modern technology, it is also very common. (Zherarden, 2010) The science in copy or imitation of nature, but its main purpose to apply the principles and rules of nature and it is the correct model. (Be azar shirazi, 2006)

Some of the features available on the nature of the model:

- Towards optimization and effectiveness more
- Use less energy and higher performance
- compressibility and throws less materials
- evolutionary growth and versatility

- The organization of

Consciously modeled examples and mechanisms from natural organisms in which one part of bionic nature as a database of solutions that lie used performance has been confirmed. Natural organism that is the product of several million years of evolution during this period with the aim of adapting the nature of what has been destroyed. In the same way, we can develop the new mechanism we duplication technology on living organisms. Bionic idea is based on the fact that evolution occurs constantly in nature and technology are critical to our best and order, therefore, it is better to modern technology also modeled the evolution of life forms. (Missourian, 2003)

### **Architectural Bionic (Biomimetic)**

As mentioned at the beginning of the creation of the environment and natural surroundings inspired and put on creativity and design. Due to the energy crisis and Natural Resources, architects are trying a new approach to architecture and constructions in the form of bionic solution out of the crisis and find energy conservation. Bring the training is bionic architecture. Bionic architecture aimed at reaching a common architecture with the principles of sustainable architecture in harmony with nature. Enliven the buildings of architectural interest, in other words the purpose Bionic, bionic architects is that the building itself can induce alive. (Nataj, 2011, p. 55)

Bionic architecture modeled on nature actually consists of three parts:

1. The model of the structure and the main system
2. Modeling of mechanisms and functional elements
3. Modeled morphological

Nature has always been a source of endless inspiration and creative human will. By studying and analyzing human behavioral processes, form and structure Nature has solved many of the problems of his life and will continue to do so. It seems that among all creatures, humans are more intelligent than the rest of the design of internal talent. All entities that pay a construction in nature, the instinctive and the accuracy and high understanding of the Earth system that much wider range of positions they are included, do benchmarking process. Years of research have shown that the basic principles of nature in creating innovative and diverse forms its own, which can be among the follows:

1. The optimum use of materials
2. Maximize the power structure
3. The maximum volume of enclosed spaces
4. The creation of the highest strength to weight ratio constructions
5. The use of stress and strain as the basis for structural efficiency
6. Create an environment in terms of energy efficiency, is well insulated and comfortable, without the use of external energy
7. Create forms based on the rapid improvement of circulation
8. The use of local materials for building
9. The use of curved forms to spread the multidirectional forces
10. Aerodynamic efficiency by increasing the structural form
11. Non-toxic and harmful substances
12. Designs, which are manufactured only by an organism.

Development of evolutionary trial and error, the continuation of successful methods and replacement of inefficient systems, signs of ingenuity and creativity are outstanding architectural nature. (Rezai Hariri, 2005)

### **The design process**

After determining the literature, architecture design process bionic approach in terms of a case study as an example of regional health center project reaches full holiday examined Tour. The ideas in this regard must be common standards of living nature and architecture to explain and model the architecture specified. To begin the process of design, the Note is all the standards and specifications in nature cannot be imported technology and architecture. Some of these measures to be more important for the transfer of technology

and architecture. Features such as compressibility, process and function, energy, environment and materials to answer in this project are the criteria for transfer to the architecture.

**Open systems and Site Analytics**

One of the characteristics of natural organisms, the natural systems in the face of the surrounding environment. Natural organisms, the systems are combined with their ability. Open systems in nature that is systems with resource sharing environment, energy and information moved but the division of architectural addition to these criteria, it is an open system involving physical openness, including access, visibility and penetration is. In other words the building as an open system environment must pay to exchange energy and materials. In this regard, the first step in the design of sustainable architecture to avoid loss of materials and increase energy efficiency, locate the correct site, Understanding of the environment and the climate survey considered. In other words, the first step for environmental design basis, split-rated front and usage analysis is based on geometry from site the system according to the physical representation of mass and space and the project needs on one hand and inspired by geometry the natural structure of the basic structure of the project.



Figure 1: Location selected sites (source: authors)

The site selection is one of the most important factors in a quiet location away from urban stress and pollution that physical and psychological needs of the population away from the commotion and chaos of the city and in order to both needs (body and mind) to respond. In this regard, the choice of site location should be away from the urban environment, because most of the audience and at the same time should be relaxing environment with clean air and water and is suitable vision and perspective. Other important features of the natural elements such as water linked site selection, soil and plants. That is why international tourism region Co has been selected as the preferred option. According to the analysis made in the study of climate and site analysis to select the most appropriate form, form was studied. The selected parametric form based on regional climate, according to the maximum energy savings and use of aesthetics and optimal light also avoid annoying switching parameters are presented as a general conclusion:

1. In order to get more solar energy in cold seasons best geographic east-west orientation is the most solar energy absorbed through exposure to the South.
2. Since the prevailing wind from the East region favorable and unfavorable wind blowing in from the West, it is better for aerodynamic forms the western side of the project with a layout rotated 30 degrees to the south. (Increasing and decreasing the southern facade of the western façade)
3. In order to reduce heat transfer from the outer wall of the outer shell of the infrastructure in this region should be even-possible reduced. Select polygons due to lower level than the environment can be good.

4. to take advantage of a good view of the surrounding landscape and suggested the diagonal angles of  $120^\circ$  and polygon geometry used, in addition to having the best prospects and appropriate to the nature of the most relevant terms of extroversion to be maintained and surrounding areas, it can also be used with a height of more favorable view.

### Compressibility

After orientation the general form, the process of selecting the appropriate module according to biological structures found in nature look. Compressibility one of the main criteria for the design of nature. Always the most efficient compact geometric structures-they are created. Nature has always tried with minimal materials, energy and cost efficiency is highest. The components of living together and the physical laws such as "triangulation" and "Closest Packing" obey. In this way the natural structures in the most efficient way to fill the space together and the whole system will have the lowest energy. The triangular elements get together in the same hexagonal, to solve this problem and make-up and structure of space. (Golabchi and Khersand Niko, 2014) in addition to being smaller hexagons occupy, setting them next to each other than the two smaller gaps and cracks are created. In this case can be maintained with minimum use of materials more space. In addition, high energy absorption and strength-to-weight ratio in this module to be seen. In other words, the combination of hexagonal space with no walls divide the area. Just as when bubbles in a layer several together, we tend to take the hex. As seen in the figure, if two circles with the same radius and the modulus square and hexagonal consider inscribed in it, we can see an area about 1.3 times more likely to be hexagonal.

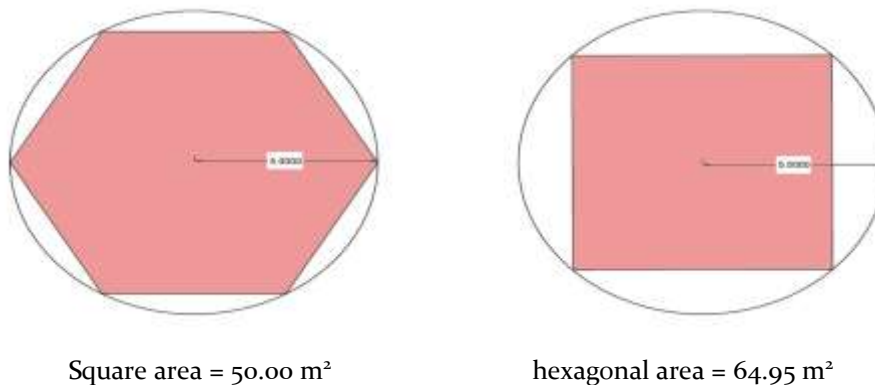


Figure 2: Comparison of enclosed space surrounded by a circle with a radius equal square and hexagonal (source: authors)

The result is less than the area of the hexagonal module inside the module is tetrahedral. These factors led to:

- A) The use of less materials
- B) Achieving greater modulus
- C) Throws less
- D) To define the maximum amount of interior space

Using the properties of compressibility and in the organization of hexagonal modules combine  $120^\circ$ -degree angles to achieve the idea of the project is the module architecture.

### Respond to the environment:

The ability to move elements, such as the nature of the climate, the building allows to adjust environmental impact. The use of hoods and down and moving, smart boards and also installation space module according to climate manifestations of the response of the environment. The first stage of human and climatic factors

such as thermal comfort (the angle of the sun, wind, etc.), as well as factors to quantify the distribution of audience measurement project with other parameters such as circulation and the layout of the spaces and distributed applications. For this reason, using software Grass Hopper through the genetic algorithm in parametric space layout view, the most optimal in terms of layout and space layout is selected. This process allows the designer to change any of the environmental parameters, feedback modules in the layout view. The designer can modulus of compressibility your space more or less depending on the quality and quantity parameters.

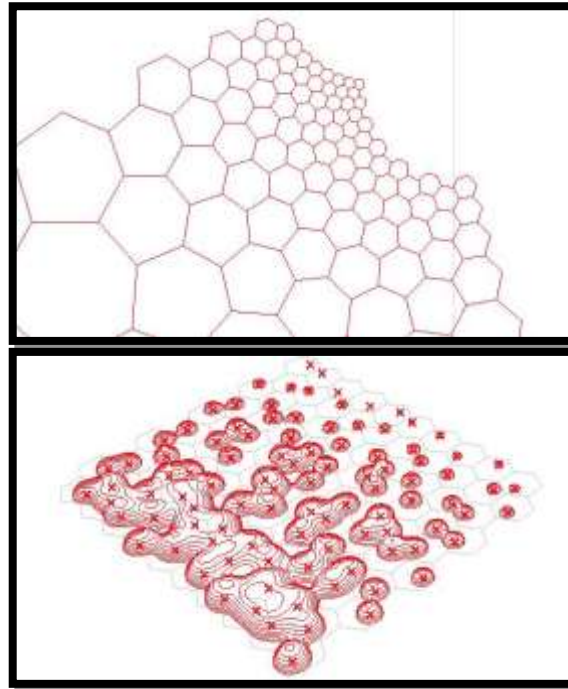


Figure 3: Distribution of modules based on quantitative and qualitative factors (source: authors)

In the next phase of the structural arrangement of modules according to the requirements of the project was considered. So that the division of environments and applications where the project is more structural tensions, smaller size modules and structures where structural tensions layout is bigger than the size of the module.

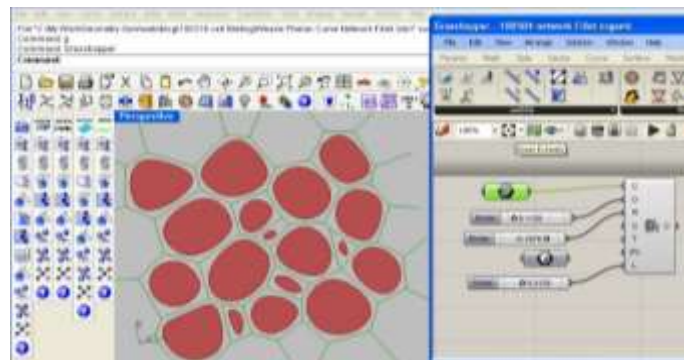


Figure 4: The use of genetic algorithms in the software Grass Hopper (source: authors)



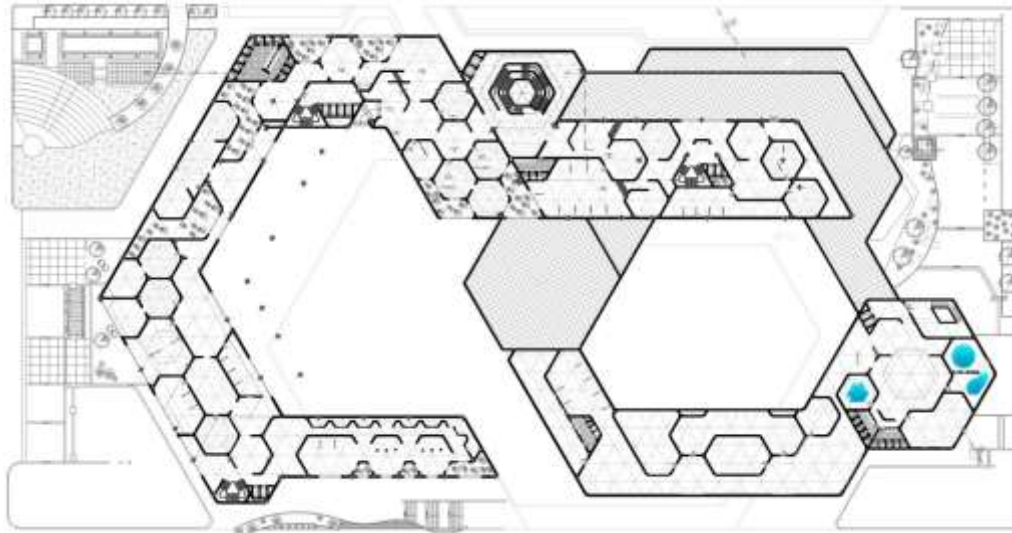


Figure 5: Layout module in the plan (source: authors)

This early form of combining climate parameters, structure and architecture was as follows. More important is to combine the angles of 120 degrees, Hexagonal modules play a role in improving the quality of the space and create a variety of organizational elements such as hallways and corridors and plays filters.

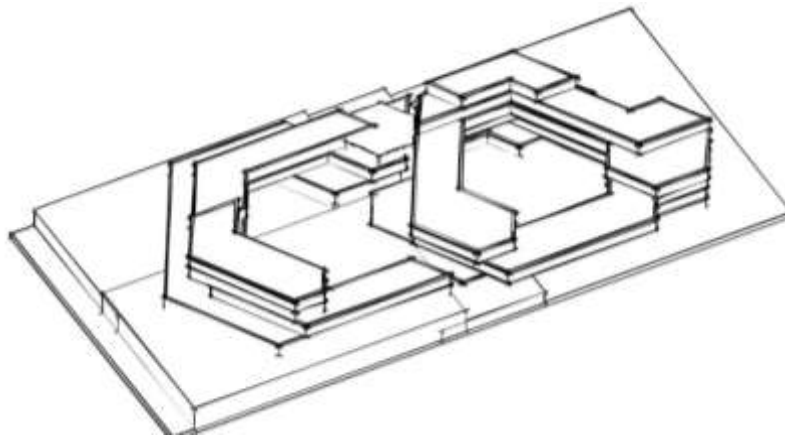


Figure 6: The formation of the original form on the basis of climate parameters, structure and architecture (source: authors)

### Form, structure and function

Form one of the most important criteria for architectural design. Upon transfer of bionic architecture natural form has little architectural value. The relationship between form, structure and function as well as it interacts with the environment are important issues. To design the shell project size and topography of the mountains, form the ideas Shells form a parametric process in a shell first origami model, then the process of morphological few options depending on the coverage obtained with the use of plug-in GrassHopper. The modules for the offshore coral skeleton shell of the structure of the ideas. This structure is hexagonal form of instruments most resistance between the divisions are similar.

Among the volumes intended for the shell must be:

1. Most of covering and ghosting
2. The integration of Central Plaza and create a username below
3. Climate orientation for maximum utilization of solar energy As factors to be selected.

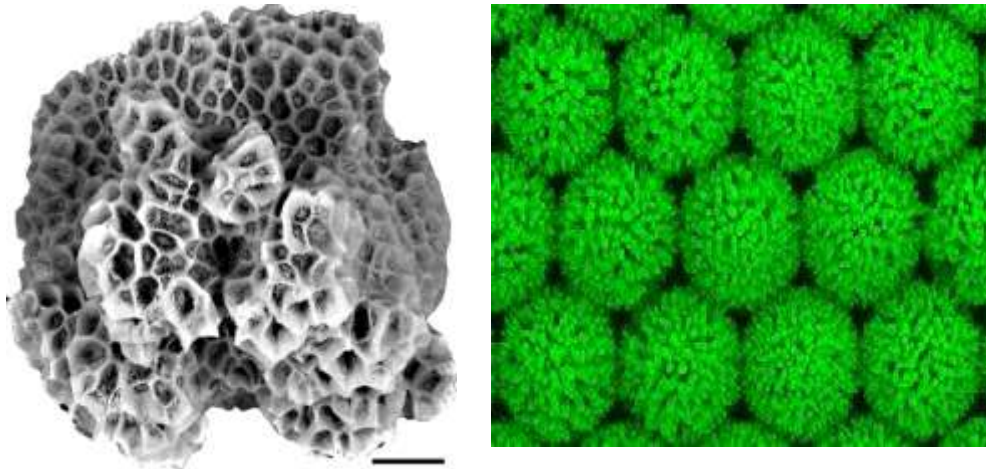


Figure 7: The use of natural organisms for module packaging structure of shells (source: Internet)

The basic idea of the model is obtained with respect to climate needs, and the user was formed.

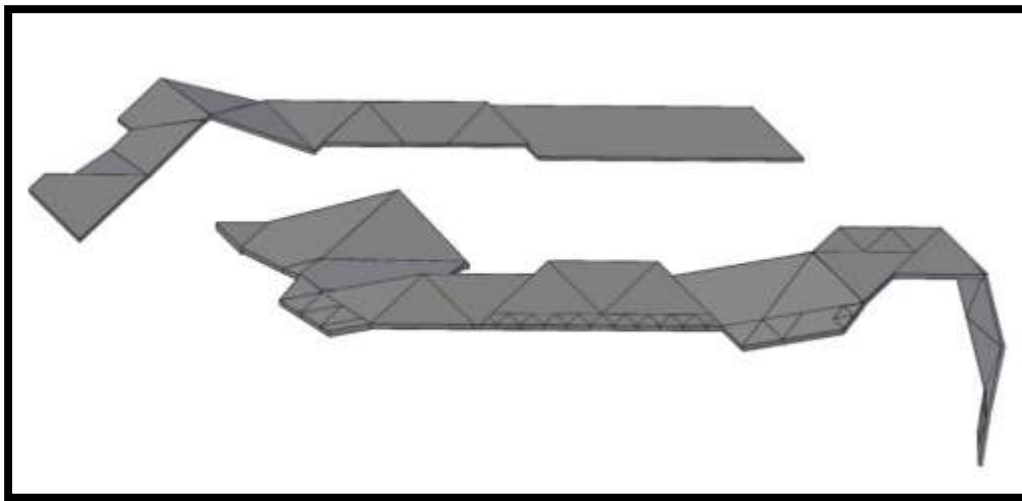


Figure 8: The idea of mapping the topography of the region to form shells (source: authors)

Next, the shell Origami software Grass Hopper was rated as hexagonal function module Hexagon.



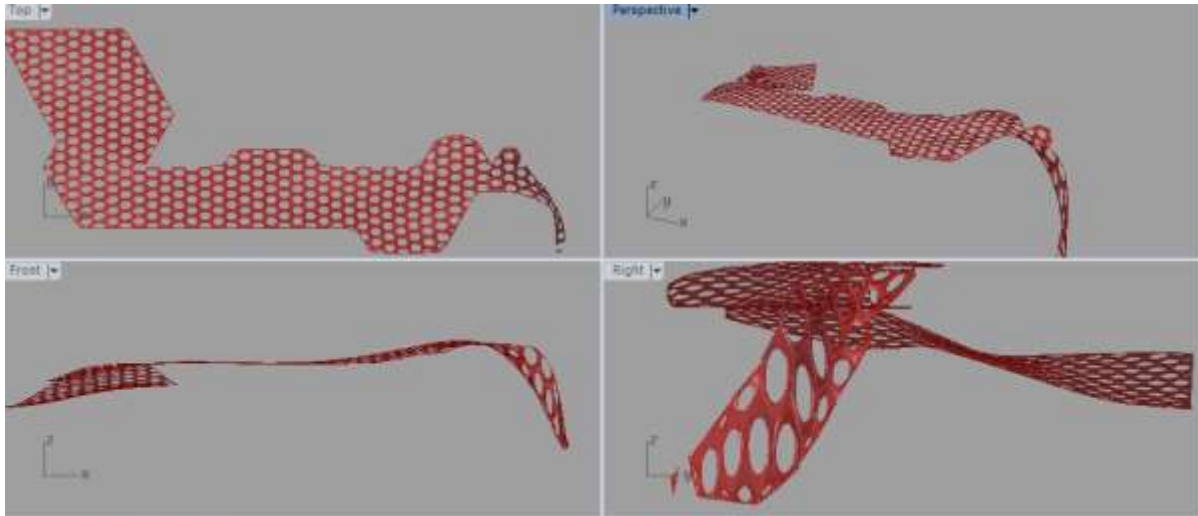


Figure 9: Classification module shell with respect to the structure of hexagonal in nature (source: authors)

In the third stage Voronoi algorithm and according to the needs of climate (absorption of energy and ghosting) in the cell was opened to the audience a sense of light and space in the best position to install photovoltaic panels and energy to be determined.

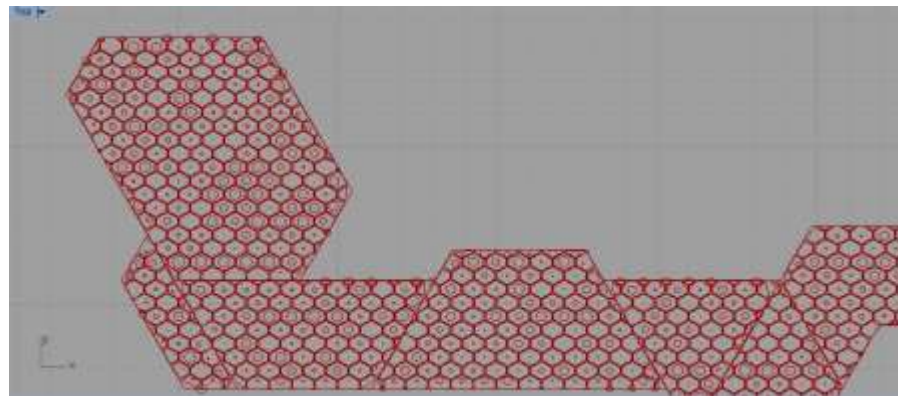


Figure 10: Use of algorithms Voronoi in the drawings, the opening of the mobile and smart boards in response to the environment (source: authors)

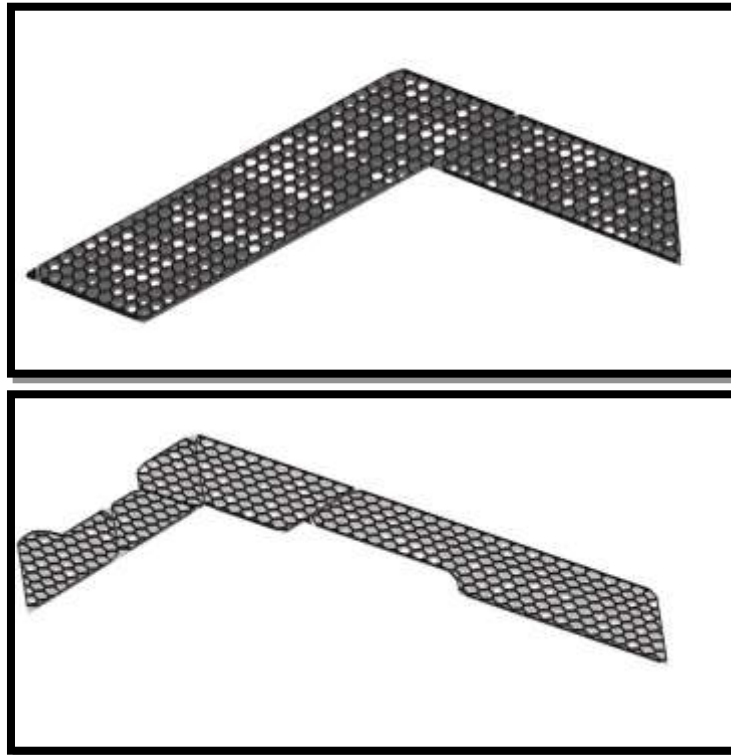


Figure 11.the final form of the shell with respect to the structure, function and response to the environment (source: authors)

And the outer shell of organic and geometric motifs inspired by origami project to be a parametric function and module comes in a regular hexagonal, depending on the internal space and the use of positive and negative impacts of climate change, opening holes can be increased or reduced. Although this pattern first appeared to be random but in fact, the exact answer to the position of the sun and wind and other parameters have been determined, agreed and annoying to the building.

**Energy-supply mechanisms**

Small wind turbines installed in the Western Front in front of the region's dominant power consumption 1000W, in the months that wind speed is 15 meters per second can provide part of the electricity consumption.

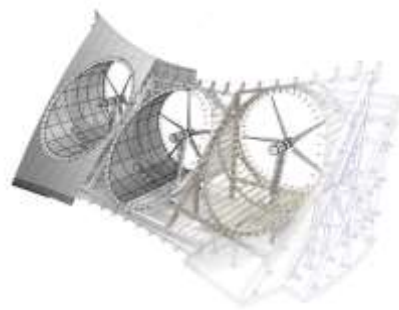


Figure 12: Wind turbines

For a maximum radiant energy over fixed PV panels and solar water heaters on the front that can be used at the highest absorption. To calculate the radiant energy efficiency during operation of the chart of the energy analysis software model and its maximum in July and GrassHopper value of 8.4 kilowatt hours per square meter on one day in February and the lowest amount of 3.43 kWh per square meter per day, respectively. By comparing the average amount of energy, solar radiation energy intake (more than 3,5 kWh)

photovoltaic solar panel use, is affordable. (Solar Energy Association of Iran, 2013)

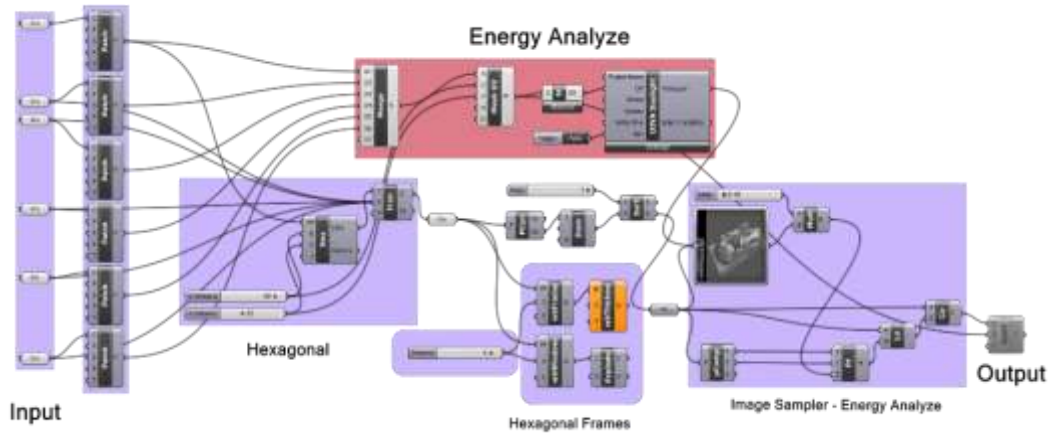


Figure 13: Energy analysis of shells according to the angle of the sun and changing seasons

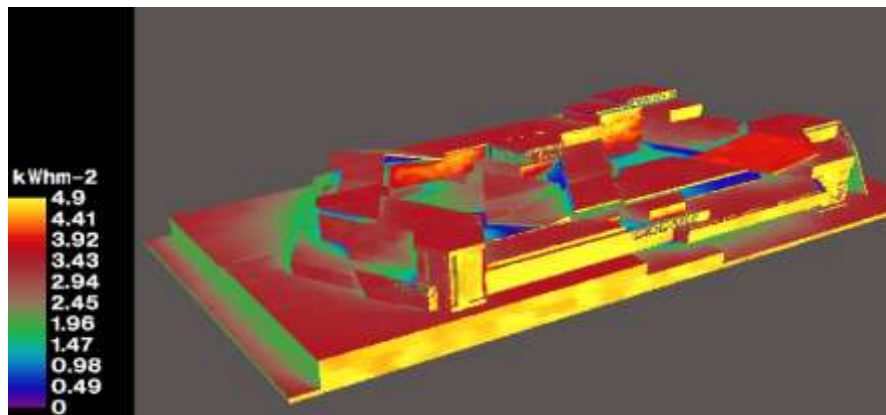


Figure 14: Analysis of the average annual solar energy

The project is part of the energy generation technology nanostructured photovoltaic cells based on quantum dots is the Nano-scale materials. The use of nanotechnology to develop appropriate materials with the desired properties in different sections of the project, directly and indirectly reduce energy consumption plays an important role. Because the cell in addition to the visible light from the sun can-can in the environment in order to take light induction, Their use in this project due to the lighting equipment can produce electricity again. Other advantages of organic photovoltaic cells on the project, transparency and light transmission. This feature allows us to use it on the glass-facade and the places where we need to pass the light. Thus the solar light and solar energy benefits to be, in this project, the interior spaces to the

sun during the day if need be light glass wall and crossed into the match .When electricity is needed sun during the day and organic photovoltaic cells on glass wall is Laminate Twisted, the process can be stored to be used at night for lighting. (Mollahzadeh, 2012: 5) Solar blinds other aspects of the use of organic photovoltaic cells in the screen shots of the collection is made up of two parts: flexible solar cells on each horizontal stripes and lights mounted curtain facade louvers L.E.D.On the day that the sun blinds or louvers to protect the environment is used, organic photovoltaic cells on the layout blinds have horizontal bands, in the sun and in this period will be charged. At night when the lighting is required, LED lighting strips in the inner edge horizontal blinds have been installed, are clear and so needed room to provide light throughput.

### Conclusion

One of the main causes of environmental degradation, changing architecture in decades past. So that by changing the architecture model based on environmental conditions for architecture based on new industrial technologies, the role of interaction with the natural environment, the built environment in the formation and development of urban architecture. This is less than the same cause feeling of belonging to the urban natural elements and on the other hand leads to the development of cities and environmental degradation is based on the new architecture. The crisis has increased the need for strategies to guide social behavior people close to nature more strongly felt. It should be noted that as awareness of environmentally sustainable manner tropism life, the more involved the construction and government for considering environmental issues in the choice of location, the design and will show tend. The algorithm used by the geometry of architectural structures from natural studies (morphogenetic), a production method in the form of bionic architecture (Biomimetic) that by studying the components of living organisms under conditions given context. In the field of architectural design, understanding of the environment and the climate, according to the site and apply them to the design is of great importance. It is made completely forgotten and buildings. That they do not pay attention to this issue and without considering the potential of the region are designed. As a result, to create comfort conditions, additional measures are needed which power consumption, Interest expense and losses due to changes in temperature are severe. Although today many developing bionic architecture and welcome the growing worldwide but generally it should be noted that detailed the nature and the surrounding environment is not easy for each project and to all the geopolitical, climatic, economic and taken into account.

### References

1. Byazarshyrazy, Karim. (2006). Bionic, or, inspired the creation of the industry. Tehran: Office of Islamic culture.
2. Tarashee, Mona, Adel, Ahmadian, Arash. (2011). structures designed based on natural studies (morphogenetic), the second international conference on architecture and construction, Tehran, Tehran University, Center of Excellence in Architectural Technology College of Fine Arts.
3. Rezaei Hariri, MT. (2005). Nature and architecture. In Proceedings of the nature of the art of the East. Tehran: Iran's Academy of Arts.
4. Zhrardn, leucine. (1389). Bionic technology is inspired by animals. (D. B., & c. Ghavami, Translator) Tehran: Soroush.
5. Shojaei, Seyyed Reza., and Nejatee, Akram. (2010). Bionic science, according to contemporary architecture. First National Conference and the Fourth Conference of the Institute of Higher Education the site. Mashhad.
6. Golabchi, Mahmoud., Khoursand, Nikoo, M. (2014). Bionic architecture. Tehran: Tehran University.
7. Mahmoudi, MM. (2013). Housing development compatible with sustainable development, Tehran, Tehran University Press.
8. Mostakhdemin, Hosseini, Mohammad Ali. (2013). Pavilion of Expo 2015 in Milan with biomimetic approach, Master Thesis, University of Architecture anymore
9. Mashayekhe Frieden, Said. (2013). Research in engineering and art inspired by nature, Journal of Housing and Rural Environment, No. 143.
10. Mansourian, Alireza. (2001). Bionic creative engineering applications in the aerospace industry. Journal of Creativity and TRIZ, the second issue.
11. Mollahzadeh Tehrani, Maryam. (2012). the use of nanotechnology in photovoltaic cells technology, design magazine, # 5.
12. Nataj, Attia. (2010). Bionic architecture. Journal of the effects, No. 6-5, pp. 57-54.
13. Scully Vincent Jr. Grosse Meister der Architektur Bd. 4, Frank Lloyd Wright Otto Maier : Bio-Architecture Elsevir , Oxford, 2003 ISBN-7506-02-5604
14. Benyus, Janine (1997), *Biomimicry, Innovation, Inspiration by Nature* ,William Morrow
15. Edward F. Rossomando, Stephen Alexander ;Morphogenesis: An Analysis of the Development of Biological Form
16. Michael Hensel, Achim Menges, Michael Weinstock; Emergence: Morphogenetic Design Strategies- Wiley-Academy