



Biomorphic example with butterfly form in architectural design

H. Derya Arslan*, Assistant Professor, Department of Architecture, Necmettin Erbakan University, 42060 Konya, Turkey

Suggested Citation:

Arslan, D.H. (2019). Biomorphic example with butterfly form in architectural design. *Global Journal of Arts Education*. 9(1), 009–016.

Received from November 16, 2017; revised from January 16, 2018; accepted from January 8, 2019.

Selection and peer review under responsibility of Prof. Dr. Ayse Cakir Ilhan, Ankara University, Turkey.

©2019 SciencePark Research, Organization & Counseling. All rights reserved.

Abstract

Since his existence, mankind tends to arrange his environment according to his own needs. He has designed spaces that he can make use of and benefit from in nature. He has made use of the order in nature and various objects in the environment. In architectural design, the nature-based design is called as the biomorphism. Referring to the biological formation and of which point of origin is the living organism in nature, biomorphism is used in architecture by taking the functions and systems of nature as an example along with the support of the technology and biology in urban planning and structural design. In this study, Konya Tropical Butterfly Garden, an example of biomorphic design, which hosts many butterfly types has been analysed. The garden reminds a butterfly form on an overall basis. When assessing the relationship between the architecture, construct and concept of the garden, it can see that it has a pioneering perspective.

Keywords: Biomorphic architecture, nature, form, concept, Konya butterfly garden.

* ADDRESS FOR CORRESPONDENCE: **H. Derya Arslan**, Assistant Professor, Department of Architecture, Necmettin Erbakan University, 42060 Konya, Turkey. *E-mail address:* deryaarslan@konya.edu.tr / Tel.: +90 (332) 221-0699

1. Introduction

Architecture is a way of designing spaces that will meet the social, cultural and entertainment needs of people in their lives. Beginning to live in a community, man has tried to obtain information that is useful to keep his life alive and to observe nature's formations with the need for accommodation. Observing or mimicking the natural forms and structures, he made the first bar with the use of materials obtained from nature. This is an indication that architectural works can be designed by learning from nature, by inspiration, by modelling and adapting the assets found in nature. There are many methods used in architectural design. The methods to be investigated in this study are biomorphism and zoomorphism which are nature-based design method. The concept of biomorphism, which is the form of biological formations, is used in architecture in urban planning, structure design, support of technology and biology and functions and systems of nature.

From the perspective of architectural design, nature has been an interesting example of inspiration and solution since long ago. In the interest of this interest, since ancient times human nature has been explored; by mimicking, interpreting or using metaphoric/analogical approaches. In this context, the person's approach to nature, which is in need of space creation, is the main character of the architect. In other words, the main element in determining space culture is the relationship that people establish with nature.

In this study, the Konya Tropical Butterfly Garden has been examined in terms of biomorphic and zoomorphic. The distance of the project from the location to the important settlements is included in the design, technological and analogical examination of the studied project. In the field of architecture, various opinions and examples about nature learning, inspiration, modelling and adaptation or application process, which are increasing in effect every day, argued and practiced frequently, are given.

2. Human nature interaction and architecture

'Human beings need to observe and learn to observe natural forms and structures, and feel the necessity of marriage. Human beings who have learned to live in communities have observed the formations in the nature together with the necessity of the living and have not used the materials obtained from nature but also started to develop the techniques of building the first buildings by observing or imitating the conscious or unconscious structures in the nature' (Arslan and Gonenc, 2007). This metaphorical relationship with nature has continued from past to present. Nature has scientific concepts that are innovative, universal, objective and so on, which has been seen as a potential resource for finding solutions to questions for architects.

'The first reason for the attractiveness of biology for designers comes from methods that integrate form and function in a harmonious way, usually by living things. In any form of life, it can be observed that the methods of nature provide a perfect balance between internal and stimulating external forces. Another point of interest in biology is the simplicity of some geometric order, rules and tools used by nature to produce an almost infinite number of forms' (Couceiro, 2006). In this context, the interaction between nature and architecture is equivalent to better understanding of architectural design and potential enhancement in form.

Given the architectural discourses of recent years, it is seen that almost all approaches are associated with nature and living organisms because architects now integrate nature and the terminology of biology with design. This leads to confusion between the terminology of biology and architecture. Although biology and architecture as disciplines are similar, they differ in terms of purposes, methods and discourses. What is important here is to determine how these concepts of nature are interpreted in architecture and how the design is reflected. If this is clarified, the link between architecture and biology branches will become easier to understand.

In addition to biology, geometry, mathematics, physics, chemistry, as well as knowledge acquired from nature through improvements in interaction, information and computer technology enables architecture to acquire a new language in architecture and other design areas, enabling architecture to acquire a new language. Architecture is interacting with these disciplines, both intellectual sense and directly within the design practice. This interaction enables architecture to use more sophisticated tools in terms of technique and allows the design process to become a more interdisciplinary space.

3. Biomorphic and zoomorphic concept in architectural design

Biomorphy: 'The term used to describe abstract forms derived from biological organisms or resembling biological organisms' (Morgan, 2007). The biomorphism that started as an art movement coincided with the end of the 19th century to the beginning of the 20th century. This term was first used in 1936 by Alfred H. Barr, an art historian. It uses the organic forms and deformities of nature and of the living things. These forms are associated with natural processes; allowing artists to explore nature without direct description.

The concept of biomorphism emerging from the interaction between architecture and biology is necessary not only for the narrow context that is discussed today but also for understanding the essence of ecological and sustainable design within the discipline of architecture.

The Zoomorphic concept is also used in structure design such as biomorphology. The biomorphic uses different forms of zoomorphy animals as a symbol. Zoomorphology refers to the fact that animal characteristics imply non-living beings, events, people and gods.

'Zoomorphic models animal morphology in architectural projects. It constructs 2-D sketches of animals or embodies them as 3-D imitations. The symbols attributed to the animal's body by various civilisations define the chances of communicating ideas and confirming collective values for architects. The characteristics of animals and every part of their bodies are sometimes transferred to the building to create a magical impression' (Aldersey-Williams, 2003).

In architectural design, since the beginning of the 20th century, machine aesthetics are replaced by healthy living, human body and return to nature. Biology has been dominated by cultural terminology with all its terminology and insights, and animal-specific qualities have been perceived as the highest level to be reached. From this period, architects have tried to understand the nature of nature instead of looking at nature only for formal inspiration. The use of animal forms as aesthetic or analogical in the early ages and functional after 1930s reveals a current and controversial current, zoomorphology, which emulates animal forms. With this approach, some designers are inspired by animal structures, some have resorted to animal imagery to create urban symbols, others have converted their learning from animal to personal design language using organic architecture in building units. Others formed urban symbols with structures reminiscent of giant animal sculptures.

The sampling of nature has taken place in the architecture since the classical period of imitation of biological forms. When nature was approached from the point of view of the human-nature interaction that has been a source of inspiration for people since the early ages, people studied nature and organisms in detail and investigated and in this direction; they built their buildings by interpreting nature and by applying various metaphorical meanings. Since antiquity, human animal and plant forms have been used to decorate the structure. As a result, the past has been influenced by natural and biological forms in the daily architectural design process. From time to time, the individual is applied, used as a structure, or imitated physical features.

Although many architectural authorities refer to zoomorphic designs as a 'bad joke', it is quite old in the history of cultures to be influenced by natural forms. Eero Saarinen's project 'TWA Terminal' ([http://nyc-architecture.com/BKN/TWA\(3\).jpg](http://nyc-architecture.com/BKN/TWA(3).jpg)) in New York, the Allamilo Bridge in Santiago Calatrava (http://www.yapi.com.tr/haberler/marifet-eserde-degil-onu-sunus-seklinde_49586.html) and <http://arch1390-2013jc.blogspot.com.tr/2013/08/studio-week-1-update-on-chosen-designer>.

html) and Calatrava’s train station in Lyons Satolas (<http://www.arcspace.com/exhibitions/unsorted/santiago-calatrava-the-architects-studio/> and <http://www.arcspace.com/exhibitions/unsorted/santiago-calatrava-the-architects-studio/>) giant reinforced concrete wings are some of the most up-to-date examples of this trend.



Figure 1. Eero Saarinen “TWA terminal’ (New York). (<https://portfolio.panynj.gov/tag/eero-saarinen/>)



Figure 2. Santiago Calatrava, ‘Satolas train station’ (Lyons). (<https://vdocuments.mx/mimari-tasarimda-metafor-deyimsel-yoentemi.html>)

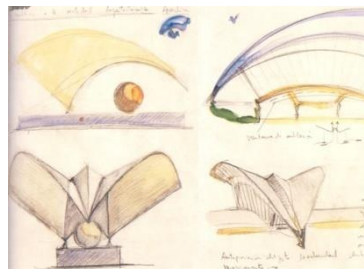


Figure 3. Santiago Calatrava, Satolas train station. (https://es.slideshare.net/omar_987/santiago-calatrava-10027356)



Figure 4. Santiago Calatrava—Alamillo bridge. (<https://www.pinterest.fr/pin/329677635205962621/>)

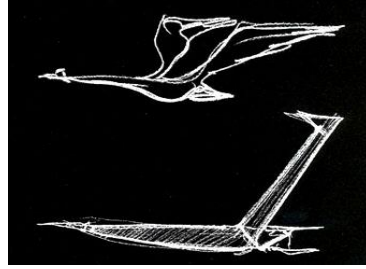


Figure 5. Santiago Calatrava—Allamilo bridge. (https://calatrava.com/projects/chicago-airport-chicago.html?view_mode=gallery&image=1)

4. Case study on Konya tropical butterfly garden

Zoomorphic concept modelling animal morphology in architectural projects and architects; they have the opportunity to express themselves in organic forms taken from the nature, with the thoughts they want to convey, the characteristics of animals and the structures they have inspired by body structures. In this design, animal and plant forms are used in architectural designs; inspired from nature, combining the forms of organic life with the high technologies of humans, spaces, where different needs are met are produced.

Konya Tropical Butterfly Garden is one of the few architectural examples designed with zoomorphic design method in our country. Biomorphic, analogic, zoomorphic designs inspired by butterfly form, organic form is found atiff for the purpose of construction and it is seen to be integrated with interior and exterior designs by complementing each other.

The Konya Tropical Butterfly Garden has Europe’s largest butterfly flight area, biomorphically, analogously shaped as a butterfly figure, to examine the effects of analogy in architecture (Figure 6).

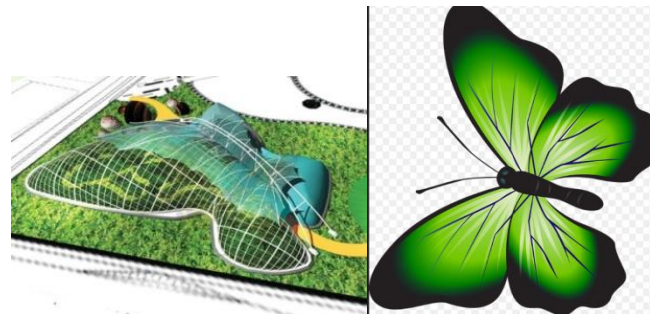


Figure 6. General view of butterfly garden and real butterfly. (<https://www.posta.com.tr/kelebek-bahcesi-270754>)

4.1. Techniquel features of Konya tropical butterfly garden

Konya Tropical Butterfly Garden project is the first of its kind in Turkey and gives visitors a unique opportunity to observe butterflies and insects in their own habitat. The largest butterfly flight area in Europe with 1.600 m², the Konya Tropical Butterfly Garden has a total area of 7.600 m² with a trip area of 3.500 m² (<http://www.konyakelebeklervadisi.com/BahcemiziTaniyalim>). The Konya Tropical Butterfly Garden, which was built for 2 years and opened in 2015, has an indoor and outdoor area of 3,85,000 m² (Figure 7), providing resting areas besides providing an environment for Konya (<http://www.hurriyet.com.tr/basbakan-ahmet-davutoglu-tropikal-kelebek-bahcesini-acti-29454810>).



Figure 7. The Konya tropical butterfly garden

The Butterfly Garden (Figure 8) offers 20,000 tropical plants of 98 species and a natural habitat of about 6,000 butterflies in 15 species.

The structure, a design inspired by the body of a butterfly, will have a doubly-curved lattice steel shell supported by reinforced concrete shear walls at ground level. This doubly-curved structure will provide high resistance to out-of-plane buckling, enabling to use of relatively slender tubular sections.

The main entrance of the building is provided from the west side. With the formation of the butterfly figurine, the two parts separated from each other by the knuckle of the wing of the butterfly came to the square.

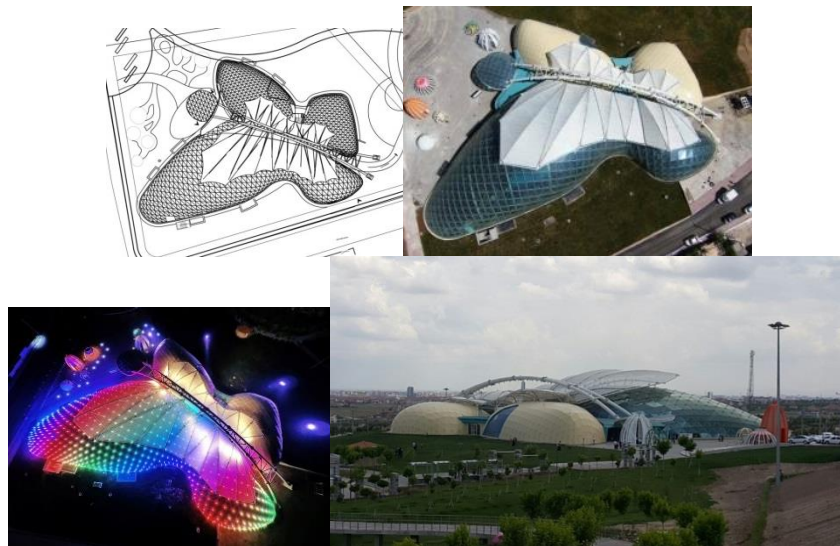


Figure 8. General view of Konya tropical butterfly garden. (<https://ledmagazine.nl/nieuws/i10207/philips-verlicht-heilige-vlinder-met-led-verlichting>)

Konya Tropical Butterfly Garden has a footprint of approximately 3,500 m². The structure, a design inspired by the body of a butterfly, will have a doubly-curved lattice steel shell supported by reinforced concrete shear walls at ground level (Figure 9). This doubly-curved structure will provide high resistance to out-of-plane buckling, enabling to use of relatively slender tubular sections.



Figure 9. The entrance of the building

The museum, designed for Konya Selcuklu Municipality, has a showroom presenting of the lifeline of butterflies and insects plus a mini cinema showing documentaries (Figure 10).

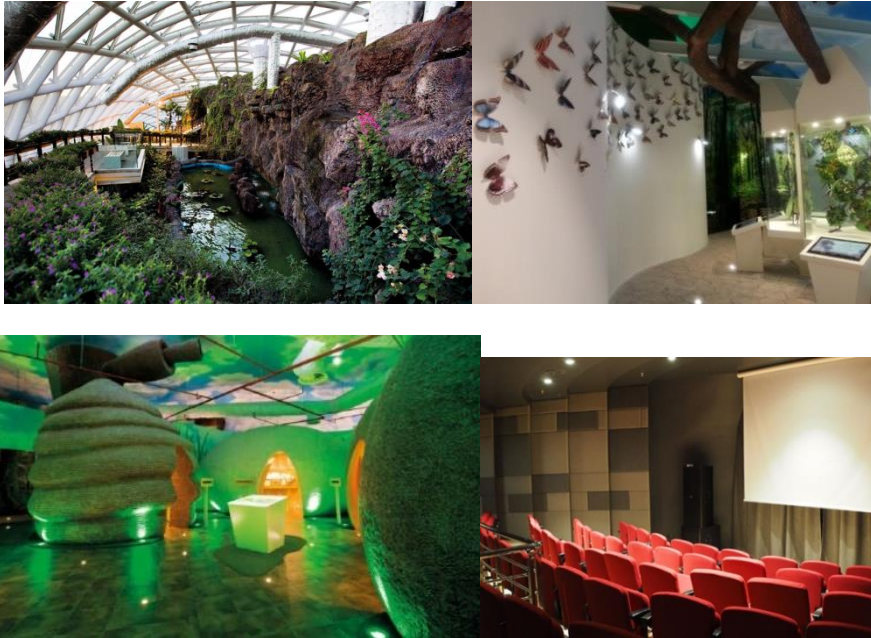


Figure 10. The inner of the building

Guests who have completed their journey through the designated route from the entrance of the guest leave the western point of the building and finish their trips in the square in front of the building (Figure 11).

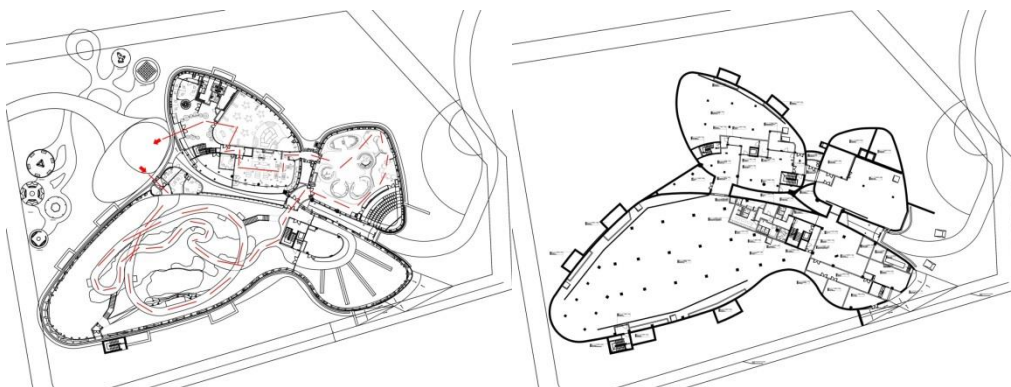


Figure 11. Story plans of the building. (<http://www.konyakebektelervadisi.com/Muze>)

5. Results and conclusion

In the Butterfly Garden in Konya, it can be seen an amorphous structure that emulates in the form of butterflies. The carrier of any axle system and structure without a fixed height is provided by steel, which is the most challenging and challenging point of the project. Designed with a tropical butterfly garden concept, the Butterfly Museum has created a living environment, a structure in which butterflies are described in butterflies and at the same time is built with an ecological, sustainable and intelligent system.

Structure; where the living spaces for butterflies are formed, organised by various exhibitions giving information about butterflies; it is seen that it is an architectural structure which attracts the people living in the city and those who come to the city as domestic or foreign tourists. It has been seen that the structure that contributed to the cultural tourism of the city has become a focal point in the region. It was also constructed with an ecological, sustainable and intelligent system used by today's technologies.

In this building, human beings have taken nature as a guide and benefited from the structures and forms of nature in their designs.

References

- Aldersey-Williams, H. (2003). *Zoomorphic: new animal architecture*. London, UK: Laurence King.
- Arslan, S. & Gonenc, S. A. (2007). The impact of biomimesis on the paradigm of architectural design. *Gazi University Engineering Architecture Journal*, 22(2), 451–459.
- Couceiro. (2006). Architecture and biological analogies, *eCAADe*, 23, 599–60.
- Morgan, A. L. (2007). *The Oxford dictionary of American art and artists* (p. 44). New York, NY: Oxford University Press.
- Retrieved from [http://nyc-architecture.com/BKN/TWA\(3\).jpg](http://nyc-architecture.com/BKN/TWA(3).jpg)
- Retrieved from http://www.yapi.com.tr/haberler/marifet-eserde-degil-onu-sunus-seklinde_49586.html
- Retrieved from <http://arch1390-2013ic.blogspot.com.tr/2013/08/studio-week-1-update-on-chosen-designer.html>
- Retrieved from <http://www.arcspace.com/exhibitions/unsorted/santiago-calatrava-the-architects-studio/>
- Retrieved from <http://www.konyakelebeklervadisi.com/BahcemiziTaniyalim>
- Retrieved from <http://www.hurriyet.com.tr/basbakan-ahmet-davutoglu-tropikal-kelebek-bahcesini-acti-29454810>