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Application of Biomimicry Architecture Concept on Lapau Panjang Buildings as A Tourism Icon

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Abstract. *Lapau-Panjang* / Side-walk-cafe is a supporting building of Padang City tourist attraction facility, where Danau Cimpago area becomes one of tourism objects in Pantai Padang. In this paper the author uses Architecture Biomimicry approach that is the study of Architecture through natural alignment that will be implemented to the built environment, with methodology of literature review / research and 3D modeling. In its application, it will create a form of imitation, where natural forms having measurable geometries are processed or tested to produce certain patterns to be transformed in the building envelope of the study objects, so that it can produce a new charming theme, and can become an icon for Cimpago Lake Tourism Area.

1. Introduction

Biomimicry is an approach to create form exploration innovation to look for solutions to answer challenges faced by humans by imitating any existing pattern and one tested by the nature. Biomimicry aims to reach new products, process and ways in order humans can live and adapt in the earth in long term period. Learning the nature to obtain ideas for solving of these new transdisciplinary problems can obtain new attention from the field of biomimicry [1], and this is supported by a statement, if the nature has willingness than it can be genius in its acts [2].

Biomimicry has been existed for a long time, when Wright and his brother created the first plane, when Da Vinci designed his flying machine, all of which are inspired from the nature. This proves that the nature is more advanced than us and it is tested in reality.

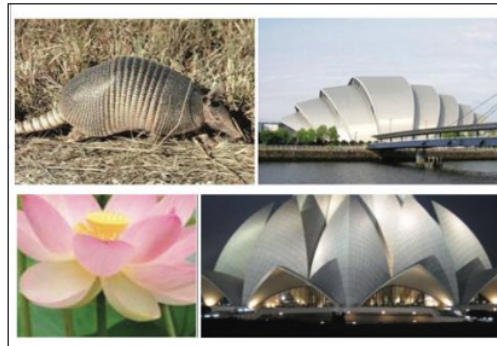


Figure 1. (a). Armadillo Concert Building; (b). Baha'i Building (Wikipedia, 2014)

1. Literature Review

There are approaches emphasizing on this object designing, among others are biological, typology and thematic approaches as well as observation on field conditions. [3] noted that biomimicry design is a design type that can make building skin energy efficient. In addition, [4] argue that biomimicry is furniture design which means that it design the interior from natures. Indeed, [5] state that biomimicry is a problem solving methodology in interior design. [6] give a statement that biomimicry design can



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enhance sustainable design ecologically. In brief, we can argue that biomimicry design is futureistic design which connected to natures.

2.1. Definition of Biomimicry Architecture

Natural shapes based on simple logic is geometry shapes that can be seen in our surrounding or nature, it can also be found some geometric shapes such as a shape of bee nest as a set of geometric shapes namely hexagon grouping in each side to form a unique unity. But we do not realize to some other things having many geometric shapes that can be explained using simple logics.

Biomimicry is more than to reproduce natural items or system. It does not only design a thing that is considered to be “green” or sustainable. This is the first close examination to an organism or ecosystem, then in its application, it pays attention to basic design principles in the natural solution [7]. The nature has tested-time pattern and solution in our surrounding and biomimicry is a study and application of natural solution to design challenges. “Nature is imaginative to needs and can solve our many problems until now,” [8], founder and president of Biomimicry Institute. Our surrounding world is natural intelligence life encyclopedia giving its beauty – including geometry – sometime it is difficult to reach’ by human logics [9].

2.2. Biomimicry as Architecture Criteria

Between biomimicry and biometric, there are new sciences observing materials in the nature and then it aims to result solutions for humans by imitating this design or by taking their inspirations. Biomimicry concept is a new work area selecting natural principles and material design and process, biomimicry can be defined as an ‘innovation to be inspired by the nature [10].

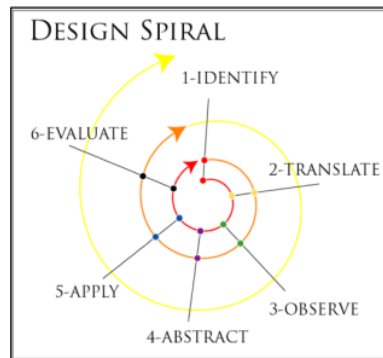


Figure 2. Source: Benyus, Janine, 2014.

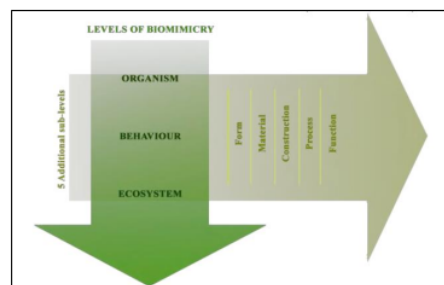


Figure 3. Source: Zari M, 2007; Salma Asraf, 2011.

2.3. Biomimicry level and approach

There are many term definitions related to biometric, as a study field. Biometric is a terminology with a number of synonyms or links to some following other terms.

- i. Biomimicry. It was firstly used group of Janine Benyus from United States discussing the use of ideas from the nature. Biomimicry is commonly used for progress in technology field.
- ii. Bioinspiration. It reveals the most common designs inspired by nature, including the level of abstraction, which is also purely a morphological interpretation.
- iii. Biomorphology. The study of construction and organization of living things and organ, tissue and cell components. Morphological structure refers to functional inner design in technology and functional anatomy in biology.

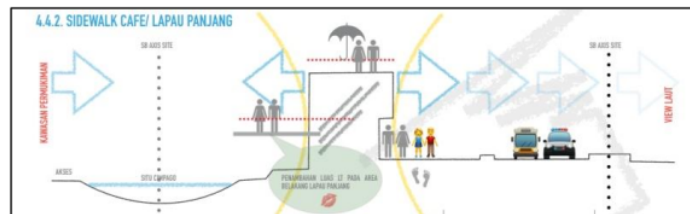


Figure 4. Framework to understand various forms of biomimicry, Source Mahmoud 2012

2.4. Principles of Biomimetic Architecture According to Lebedew

The relationship between architecture, nature and humans that are interdependent with each other like the anatomical structure of the human body, with organs that complement one another, is a model in the philosophy of biomimetic architecture. In this thinking the application of biomimetic architecture is required not only to imitate the forms of living things or from natural forms but must be able to present an environmentally friendly or with the surrounding conditions, in other words buildings that can adapt to living things, comprehensive, architecture with all components and scale, can be seen as something with corresponding characteristics to living thing characteristics. In his thesis, Lebedew proposed a viewpoint system seeing at living system and its criteria (biological criteria) that can be linked or translated into a system of architecture [11].

2. Research method

The object of this research is *Lapau Panjang* Building. *Lapau Panjang* building is located at Muaro, Padang city. This building currently has a business function operated by small medium enterprise (SME). The design of *Lapau Panjang* building is not attractive and creative. We use the secondary data, in term of detail drawing, function, space, and pattern of building. Besides, we also use the primary data regarding to society perception about future design of *Lapau Panjang* Building to supplement the primary data. design phases consists of six steps called "design spiral": (i) identify, (ii) translate, (iii) observe, (iv) abstract, (v) apply and (vi) evaluate. In this study, we follow this step to gain the biomimicry design.

3. Result and Discussion

3.1 Scope of Study Review [Identity]

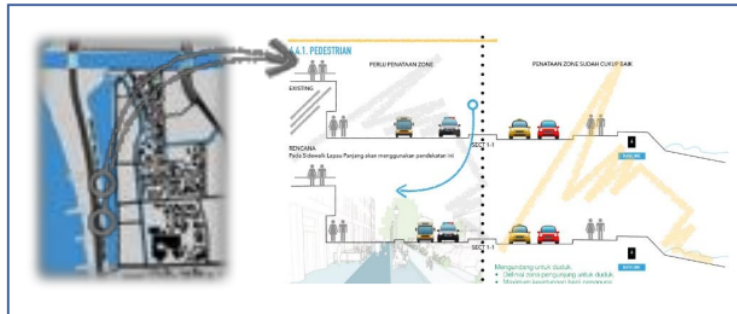


Figure 5. Lapau Panjang / Side-Walk-Cafe

3.2 Theme Transformation Process [Translate]

In this object imitation process, it uses biomimicry architecture theme. It is simply an architecture design concept to be transformed to life or nature criteria into architectural criteria realization or place.

When an architect or designer states that a design is influenced by the nature, he is probably tells about performance: it has organic shapes. Nature is the best teacher in this case, but imitation or being inspired by natural shapes, texture and color cannot be called as biomimetic. Quoting Dr Julian Vincent 'biomimetic must have some biology.' It means that a design must be seen in its some ways to be informed by natural science, not only performance to be the real biomimicry. But, the key to understand the role in architecture so that it can manage to explore its root to natural principle design is a good design sample! Biomimicry is a philosophy approach that can cause new ideas and innovative solutions with many profit potencies, such as from functional or sustainable perspective [12].

The approach through biomimicry design in this study object is through two stages, namely the first stage as comprehensive idea development consisting of 3 aspects, namely understanding on design object, understanding design theme and understanding existing location and sites. The second stage is the application using image-present-test method from Jhon Zeisel. In this stage process, an architect transforms the concept based on the data obtained from comprehensive ideas namely in the first stage. This transformation is initiated by imaging stage (idea concept thinking), followed by presenting stage (presenting concept into Figure or model) and ended by testing (repeated testing). This concept is based on certain testing criteria or through consultation process). Then, it reaches the testing stage, the transformation process is not directly ended, but it is through continuous repeated process such as a spiral. Imitating shape and borrowing shape will later be united in a summary media or abstract [13]

3.3 Adaption of Building Envelope [Evolute]

Building is a spatial structure established to protect people and their objects from outer environment in case of certain climate conditions such as wind, rain and excessive radiation. Building evolves from primitive structure providing catchment place only for sophisticated structure responding environmental context in which there are many features and elements from the needs for improving life convenience and quality [19]

Building an envelope consisting of basic elements such as window, wall, roof and floor, represents dimension between outer environment and space in the rooms, which significant energy saving can be reached when there is effectively responsive solution designing to specific climate factors [14]. Increasing changing environmental conditions create new challenges to build envelope to accommodate [15]. Resident activities and environmental factors such as air movement, humidity, temperature, sun radiation, air quality, sound influence on building convenience [16].

Regarding building envelope functions as a divider or shield such as for a solution to muffle quite high thermal, design threshold solution utilizes environmental changes and creates media to improve space in a more efficient manner. Solutions such as vernacular buildings that reflect the environment by utilizing wind, radiation, and temperature, increase the energy increase of buildings [17], but this solution is not always air and water resistant. In this case, implementing adaptive solutions that reflect

the environmental context can improve the performance of building envelopes, increase the comfort of residents, and potentially reduce energy requirements.

3.4 Implementation & Application

When biomimetic principles are applied during the design process, solutions will mimic the properties of nature. The Life Principle is a filter in which designers test solutions to natural attributes and are the most important step in the "biologization" or programming phase [18]. In applying biomimicry, taking a level or degree is an important step to any study exploration level, there are 3 levels or degrees of biomimicry namely organisms, behaviors, and ecosystems, and there are 5 sub-levels; namely shape, material, construction, process and function. Level selection depends on the complexity of the problem to be solved.

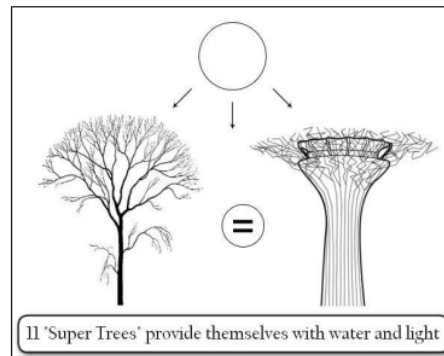


Figure 6. Source Wikipedia 2015

Biomimicry is considered a method to produce innovative design concepts when integrated during the initial design stage, especially the concept design stage. During this stage, possible design concepts are generated and evaluated to choose one design for the detailed one. It is known that the initial design stage is the most contributing to the final product quality. According to the product development paradox, the initial design stage is responsible for around 70% of the final product quality and the final cost, while there is still rare knowledge available to support the initial design phase. The main potential of biomimicry to drive innovative solutions is therefore, when applied during the initial design stage when there is determination of potential solution scope. Then, biomimicry primarily functions as a concept generator of possible design solutions. The design process with biomimicry applications at the initial design stage plays a very important role.

3.5 Model 3D [Modelling]

Modeling function is also referred to as functional analysis or functional decomposition, namely "a description of a product or process in terms of its basic functions needed to achieve its overall function or purpose". During this process, system overall functions are described by smaller sub-functions to change the system's main functions into alternative sub-functions that can be easily handled by the designer. This modeling process explains system architecture, structure and behavior. The generation of functional models during the design process provides many advantages to designers such as explicit responses to customer needs, a comprehensive understanding of design issues, enhanced creativity and innovation.

At this stage, the imitation process is only on one biological object applied in the design, in order to obtain maximum results. To achieve a form with capability of transforming as a certain value or icon in a building requires a long process. To create a level of comfort for visitors and their interests, the chosen biomimicry approach produces an integrated form of building based on the suitability obtained at the imitation state with the surrounding environment, resulting in a complete and real form of the building.

4. Conclusion

After going through a long process in implementing or applying biomimicry in Lapau Panjang, especially on the building envelope, it will bring changes to the building appearance, thus it can attract visitors and increase the activity in the area so that it becomes an icon for the region itself.

The biomimic project is a process of very complex activities in terms of complexity, in which themes are used, transformed or by transferring elements of natural criteria to architectural criteria. Given the condition of the study object, there are many typical masses and with similarity of spatial patterns providing little challenge. On the other hand, this can still be developed further to obtain a better final result, for that matter, it has willing to accept criticism, suggestions for information purposes. It is the authors' hope to be able to continue the biomimicry exposure as a methodology of problem solving so that it will help us find sustainable and effective solutions to the interior, lighting, thermal comfort, energy efficiency, material durability, and productivity.

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