IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

An Alternative Strategy For Sustainability: Biomimicry

Ms. Ruchi Gandhi 1st Author,

[1] Assistant Professor 1st Author,
[1] School of Architecture & Planning 1st Author,
[1] P P Savani University 1st Author, Surat, India

Abstract: It makes sense that we would want to learn from nature's long history of problem-solving and improvement in order to address our own sustainable design challenges, given that nature has spent billions of years refining and solving many of the issues that humans face today. While plenty of research has been done on the design of more sustainable buildings, little has been done on ecologically sustainable design approaches that might decrease resource waste by understanding how natural systems adapt. The purpose of this study is to study biomimicry in architecture as a possible remedy for environmentally friendly building design. In order to look into how biomimicry has been used in the built environment so far, it examines two case studies in addition to evaluating the fundamental ideas and developments in the field. It is anticipated that this study will show how taking cues from nature in the form of skeletal efficiency, water efficiency, thermal environment, and energy supply can lead to more sustainable building designs.

***Index Terms* -** Component, formatting, style, styling, insert.

I. Introduction

The imitation or mimicry of nature in all of its forms, systems, and processes is known as biomimicry, and it is used for solving some of the most critical problems facing our planet right now. Currently, biomimicry techniques have shown to be highly efficient and sustainable, especially in the areas of building and design. But this increasingly popular method has also led to developments in a variety of other fields, including robotic navigation, aerodynamics, medicine, clothing design, and water pollution detection. (Michael pawlyn, 2011).

Early illustrations of mimicry can be found in Leonardo Da Vinci's drawings of a flying machine that was simulated after a bat's wings. Another example comes from Fillipo Brunelleschi, who in 1436 generated a lighter, thinner dome for the Florence Cathedral after investigating the strength of eggshells. By watching dolphins, naval architect Sir George Cayley created more streamlined ship hulls in 1809. A more popular example happened in 1948 when Swiss engineer George De Mestral was out hunting with his dog and it came out of some burr-covered bushes. Examining the tiny hooks on the burrs, he found a hook system that the plant used to attach itself and disperse seeds; this finding inspired De Mestral to create Velcro. Architects have historically mostly drawn their building forms and aesthetics from the natural world. However, biomimicry in architecture is an applied science that draws upon nature's aesthetic qualities as well as its lessons to tackle functional problems with buildings.

Instead of adopting a stylistic approach, a multidisciplinary approach adheres to a set of ethical standards. Building designs that are vital to the environment and should complement rather than undermine nature's processes are now possible thanks to advancements in sustainability. In the past ten years, it has become increasingly popular as a means of addressing sustainability concerns and reducing adverse effects on the environment. (PEDERSEN. 2005).

According to Head (2008), there are three targets to accomplish the so-called "Ecological Age" by 2050: "reducing CO2 emissions by 80%, minimising the ecological footprint to 1.44 ga/person, and increasing the improvement of the human development index." It is the duty of architects to create the most environmentally friendly design, construction, and performance techniques. This involves incorporating natural ecological systems while taking human behaviour patterns consideration when designing.

This research will analyse biomimicry in architecture critically. It is an examination of its central ideas and principles. It serves as a framework for understanding the different biomimicry approaches and degrees of design. It addresses some of the unique advantages and disadvantages fundamental in each biomimicry. This research will examine biomimicry in architecture critically. It is an examination of its central ideas and tenets. It serves as a framework for absorbing the different biomimicry approaches and degrees of design. It goes over the different advantages and disadvantages inherent in each degree of biomimicry as a method for designing sustainable buildings. In order to gain insight into the level of biomimicry that designers have attained, the research will examine two completed projects in which the designers used natural inspiration to overcome difficulties encountered during the design process. The purpose of this study is to clarify biomimicry as a methodology and demonstrate how it can improve the problems of sustainability and regenerative design in architecture.

II. Literature Review

Although it was first used in 1962, the term "biomimicry" has only lately become more well-known. "Biomimicry" is derived from the Greek words "bios," which means life, and "imimesis," which means to imitate. Janine Benyus provided one of the earliest recorded accounts of biomimicry in a 1997 text. as “The conscious emulation of nature’s genius” (Benyus J.M. 1997), while for Pawlyn it is “Mimicking the functional basis of biological forms, processes and systems to produce sustainable solutions” (Pawlyn M., 2011). Many believed that applying a biomimicry approach can save costs in addition to significantly reducing CO2 emissions. “It is possible to cut carbon emissions and save money.” Says Michael Pawlyn. “The key to it is innovation.” It is our duty as architects to make sure that the buildings we design are consistent with their users and the environments in which they are situated. Buildings have certain characteristics that influence how they are produced, viewed, and designed. We are unable to separate ourselves from the immediate environment in which we are constructing.

“The most irrevocable of these laws says that a species cannot occupy a niche that appropriates all resources- there has to be some sharing. Any species that ignores this law winds up destroying its community to support its own expansion” (Benyus J.M. 1997).

According to McDonough and Braungart, applying biomimicry in design offers a way to create a built environment that can be more sustainable, regenerative, and ecological.

“From my designer’s perspective, I ask: Why can’t I design a building like a tree? A building that makes oxygen, fixes nitrogen, sequesters carbon, distils water, builds soil, accrues solar energy as fuel, makes complex sugars and food, creates microclimates, changes colours with the seasons and self-replicates. This is using nature as a model and a mentor, not as an inconvenience. It’s a delightful prospect…” (McDonough and Braungart, 1998).

III. RESEARCH METHODOLOGY

Examining the most recent studies on biomimicry in architecture is the type of research that was used in this study. The study looks into the how and why different designers used biomimicry in their designs. The following is a list of the projects:

a. Sahara Forest Project Qatar, Tunisia and Jordan
b. The Eden project, United Kingdom

3.1 Sahara forest project

The Namibian fog-basking beetle, which has evolved to provide its own fresh water in a desert and control its body temperature by storing heat during the day and gathering water droplets that the fog forms on its wings, served as the model for this greenhouse project. In an arid climate, the greenhouse design mimics this beetle to fight climate change.

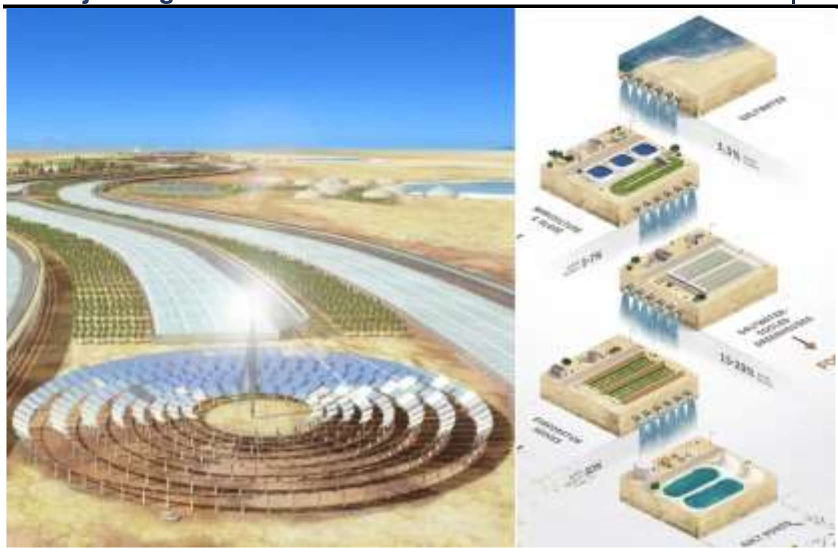

Figure 1. Sahara Forest project Tunisia

The objective of the Research Architecture design team was to create a regenerative and sustainable eco-system. The design of the greenhouse was mainly influenced by three factors: the development of technologies for desert vegetation, concentrated solar power (CSP), and a saltwater-cooled greenhouse. (A Green Building Oasis, n.d.) Greenhouses with saltwater cooling provide ideal conditions for year-round farming. Charlie Paton developed a system to use saltwater for evaporative cooling and humidification within the greenhouse's structure in order to create a greenhouse that was cooled by salt. The greenhouse maintains its temperature throughout the night as the evaporated air condenses into fresh water. This system produces excessive water, which is then sprayed outside for the surrounding plants to grow in instead of being used by the plants inside. To extract different elements, the salt that is extracted from the evaporation process is crystallised at different stages.

Sodium chlorite and calcium carbonate are the first substances to crystallise from the evaporated saltwater; both of these substances can be crushed into building blocks. To reduce waste, many other elements found in seawater are used in different ways (Michael Pawlyn 2011).

Concentrated solar power is twice as effective as photovoltaics because it produces zero carbon electricity by concentrating solar heat using solar tracking mirrors to create steam that powers conventional turbines (Biomimicry and the Sahara Forest Project, n. d.). In an otherwise resource-constrained region of the world, this project offers a way to restore forests and create vegetation in deserts as a source of food, water, and energy.

"…the Sahara Forest project is a model for how we can create zero carbon food, abundant renewable energy in some of the most water stressed parts of the of the planet as well as reversing desertification in certain areas" (Michael Pawlyn 2011).

3.2 The Eden Project (2001) in Cornwall, England

This project was designed by Grimshaw architects, a firm where Michael Pawlyn worked and was a key member of the design team for the Eden project. in the year 2000. Grimshaw Architects used natural materials to create a functional spherical shape. It features two enormous man-made enclosures that each simulate a different biome. The hexagonal frames were inspired by cellular structures, and the forms of the biomes were inspired by soap bubbles. A biome is a group of naturally occurring plants that occupy a significant habitat. A humid tropical rainforest and a Mediterranean biome are two of the artificial biomes found in the Eden project. (Michael Pawlyn, 2011)

Figure 2. The Eden Project

The natural habitat of a tropical rainforest can be observed in the humid tropical biome. Hundreds of trees and other plants from South American, African, Asian, and Australian rainforests, including giant bamboo, coffee, rubber, and banana plants, indicate this warm and humid enclosure home. The environment is maintained at a tropical temperature and moisture content. The dome is 110 metres wide at its widest point, 240 metres long, and 55 metres high. (Michael Pawlyn, 2015)

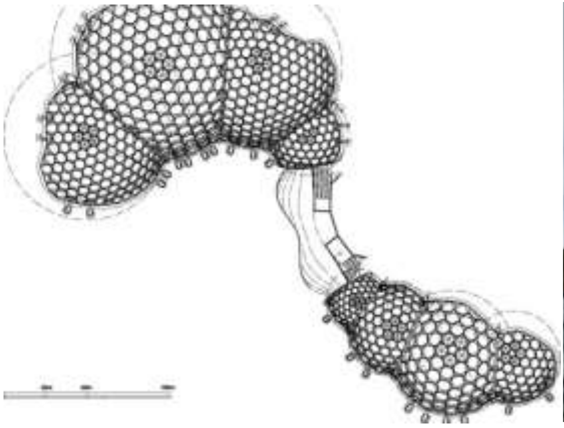

Figure 3. The Eden Project

Figure 4. ETFE pillows

Figure 5. Cross section of Eden project

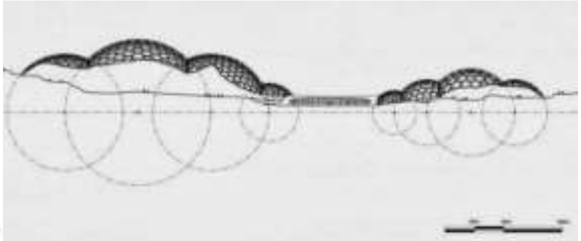

Figure 6. Schematic site section

The plant diversity of the Mediterranean biome includes temperate rainforests found in California, the Mediterranean, and Southern Africa. The 1.6 acres that make up the Mediterranean biome are 35 metres high, 65 metres wide, and 135 metres long. It is home to well-known warm temperate and arid plants like grape vines and olive trees, as well as a variety of sculptures.

Every biome is made up of multiple geodesic domes connected to one another. The hexagonal pillows that make up these domes are constructed from three layers of a substance known as ethylene tetrafluoroethylene (ETFE), which are fused together along their edges and atop one another. Air is pumped into these layers to improve insulation without reducing the amount of light that can pass through the material. The air between the layers can be changed; in the winter, the pillows are inflated more to provide insulation, and in the summer, they are partially deflated to increase the amount of cooling in the room. Because the pillows are designed to be easily detached from the steel frame, they can be changed out if a better material becomes available. (Murray-White, 2010)

Implementing inflated Ethylene Tetrafluoroethylene (ETFE), a robust and lightweight material that makes up 1% of the weight of

Other advantages of double glazing include a lighter steel frame, increased solar gain, increased sunlight penetration, and a cost that is one-third lower than that of the conventional glass solution. The final superstructure has a lower weight than the air inside of it. (Michael Pawlyn, 2015.

IV. Discussion

This study examined the integration of biomimicry into sustainable design methods to produce environmentally friendly designs that use resources and energy carefully on a large scale. It also examined the current applications of biomimicry in the field of architecture, both theoretically and practically. The application of biomimicry to architectural design offers a workable answer to the contemporary sustainability problem that doesn't harm the environment. The results of the two case studies carried out for this study show that biomimicry promotes resource efficiency. It has the potential to significantly impact human life in general and work with nature rather than against it by creating the way for the creation of ecologically sustainable designs, zero-waste systems, and an overall regenerating built environment. The development of design methodologies that take behaviour modelling, material constraints, and environmental influences into account are necessary for an effective biomimetic approach to architectural design. This necessitates a thorough comprehension of form, material, and structure—not in isolation, but rather as intricately interwoven systems. The field of biomimicry is still in its infancy and is not yet widely used in design principles. The cooperation of various disciplines, including biologists, ecologists, and designers, is necessary to carry it out successfully on a large scale. These professionals can establish the connections between the needs of humans and the organisms and systems found in nature, enabling them to make moral decisions that will contribute to the creation of a more sustainable built environment.

IV. Conclusions

Demand for an efficient ecologically sustainable design approach that does not sacrifice societal requirements is rising quickly. Few approaches to sustainable design in architecture have shown to be successful on a large scale, despite the abundance of approaches available today. One relatively recent approach to addressing our sustainability problems is biomimicry. It necessitates the blending of various disciplines to create structures and systems that are both more advantageous to their users and environmentally friendly. When done correctly, imitation may be beneficial for both human life in general and the field of architecture. The biggest drawback of this research is that, despite the fact that many architects are drawn to nature for inspiration, biomimicry as a design approach is not yet widely used. Buildings that collaborate with nature to create a regenerative built environment are becoming more and more necessary, so architects can no longer disregard the applicability of theories and methods inspired by biology in order to create a more sustainable future.

References

[1] Baumeister, D. (2007). Evolution of the Life's Principles Butterfly Diagram. In M. P. Zari, Biomimetic Approaches to
Architectural Design for Increased Sustainability. [Personal Communication].

[2] Gamage, A. (2015). Exploring a Biomimicry Approach to Enhance Ecological Sustainability in Architecture.

[3] Pawlyn. M. (2015). Using nature's genius in architecture. Retrieved from https://www.ted.com/playlists/28/sustainability_by_design.

[4] Pawlyn. M. (2011). Biomimicry in Architecture. London. UK: RIBA Publishing

[5] Sahara Desert Project to grow 10 hectares of food in Tunisian desert (n.d). Retrieved from https://inhabitat.com/sahara-desert-project-to-grow-10-hectares-of-food-in-tunisian-desert/.