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Biomimicry in Architecture

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ABSTRACT: *In the search of sustainable building design and technology Biomimicry is an alternative solution. The inspiration from nature is driving force in architecture, resulting in majestic works of architecture. Biomimicry is about solution refined and developed by nature. For any sustainable building design, need to consider structural efficiency, water efficiency, zero-waste systems, thermal environment, and energy supply. Biomimicry is about solutions. Biological organisms refined and developed by natural selection over a billion year research and development period can be seen as embodying technologies, functions, and systems that are solutions to the problem of surviving in nature. These problems are often equivalent to those encountered by humans as we seek new ways to design and live sustainably, and in many cases have solved the same problems with a far greater economy of means. This paper aims at revealing how radical increase in resource efficiency can be achieved by looking to the nature for inspiration. Exploring the application of Biomimicry in current architectural design, resulting in a set of design approaches, levels and principles. The paper also discuss about the architects work inspired by nature.*

Key Words: architecture, biomimicry, sustainable building, zero waste system.

1, INTRODUCTION

Biomimicry from bios, meaning life, and mimesis, meaning to imitate is a new discipline that studies nature's best ideas and then imitates these designs and processes to solve human problems. Studying a leaf to invent a better solar cell is an example, it as "innovation inspired by nature." The core idea is that nature, imaginative by necessity, has already solved many of the problems grappling with. Animals, plants, and microbes are the consummate engineers. They have found what works, what is appropriate, and most important, what lasts here on Earth. This is the real news of Biomimicry: After 3.8 billion years of research and development, failures are fossils, and what surrounds us is the secret to survival. Biomimicry is a new science that studies nature’s models and then emulates these forms, process, systems, and strategies to solve human problems – sustainably. Biomimicry uses an ecological standard to judge the sustainability of our innovations. After many years of evolution, nature has learned what works and what lasts. Biomimicry is a new way of viewing and valuing nature. It introduces an era based not on what we can extract from the natural world, but what we can learn from it.

2, INSPIRATION FROM NATURE

One of the earliest examples of Biomimicry was the study of birds which enabled humans to gain the technology of flight. Though, it could be argued that our ancestors mimicked the techniques of the animals around them to become more successful hunters or gatherers, or to create better shelter. Sustainable development is moving to a new level where buildings are integral to nature, supporting nature's work rather than interfering with life-sustaining ecosystems. Nature has been offering immense ideas and inspirations to designers for creating architecture.

Venus flower Basket sponge (Fig, 1) sits in an underwater environment with strong water currents and its lattice like exoskeleton and round shape help disperse those stresses on the organism. Architect Norman Foster inspired by this Venus flower designed Gherkin tower, (Fig.2) which has hexagonal skin.

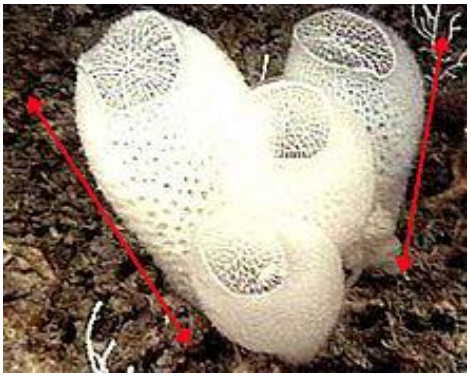

Figure 1: Venus Flower Basket

Figure 2: Gherkin Tower

From an architectural point of view it is an exciting to watch the construction of amazing new stadium like the Bird's Nest (Fig.4) and water cube. These buildings are not only energy efficient and eco-friendly but also inspired by the nature. The Watercube's (Fig. 3) architectural design is based on water bubbles in foam, this structure is derived from principles of geometry and crystaline systems. The building's structure is framed in steel, while the bubbles themselves are made from Ethylene tetrafluoroethylene pillows. The membrane lets in more light and heat than traditional glass does, which keeps all 5 pools warmer, thus reducing energy costs by 30%.Rainwater from the roof is collected and recycled with efficient filtration and backwash systems.

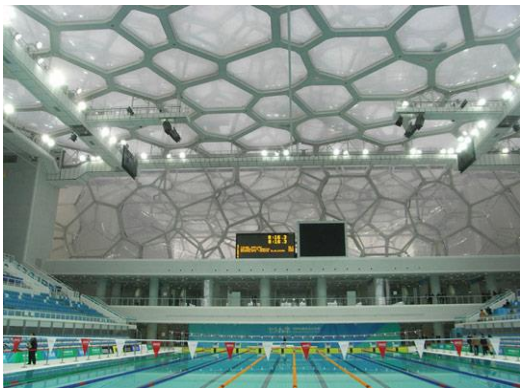

Figure .3 Water Bubble

Figure 4: Bird's Nest stadium

3. INFLUENCE OF BIOMIMICRY IN ARCHITECTURAL DESIGN:

Biomimicry design is not only adapting the design from the nature but also considering how to use nature's effective functions such as heating and cooling system, protecting natural light and ventilation.

Figure 3: Habitat 2020, china

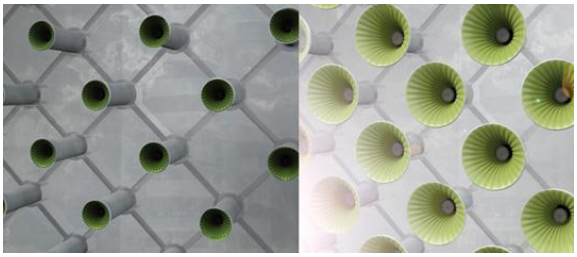

Figure 4: Living skin of Habitat 2020

One of the most effective ways to cut down the ecological footprint of buildings is to follow the lead of nature through biomimicry. The Habitat 2020 building envisioned for china (Fig.3) is a future forward example of biomimetic architecture that fuses high-tech ideas with basic cellular functions to create 'living' structures that operate like natural organisms. This nature-inspired approach to city living looks at the urban landscape as a dynamic and ever-evolving ecosystem. Within this cityscape, buildings open, close, breathe and adapt according to theirenvironment. The Habitat 2020 building radically alters perception of a structure's surface. The exterior has been designed as a living skin, rather than a system of inert materials used only for construction and protection. The skin (Fig.4) behaves like a membrane which serves as a connection between the exterior and interior of the habitat. Alternatively, the skin may be considered as the leaf surface having several stomata cellular openings involved in gaseous exchange

and transpiration in plants. The surface would allow the entry of light, air and water into the housing. It would automatically position itself according to the sunlight and let in light. . The air and wind would be channeled into the building and filtered to provide clean air and natural air-conditioning. The active skin would be capable of rain water harvesting where water would be purified, filtered, used and recycled. The skin could even absorb moisture from the air. The waste produced would be converted into biogas energy that could be put to diverse uses in the habitat.

Fig.5 Tree pod

One of the interesting examples of beneficial biomimicry are the Treepods designed by Influx Studio. These Treepods (Fig.5) take the working concept of trees and incorporate these elements into the design of the structures. The aim of this project is to create air cleaning by creating a system that catches CO2. The tree that Influx Studio focused on mimicking is the Dragon tree because of the large canopy that provides maximum shading which also allows the structure to support solar panels used to power the air cleaning system. This approach to creating biomimicry is successful in many ways, it takes in consideration of the visual aspects as well as the working and functional aspects of the Dragon tree.

These Treepods are not designed to replace natural trees, but to act like small air cleaning infrastructures, increasing in many times CO2 absorption. This is interesting because the structures are not only mimicking the qualities of trees but pushing them further by enhancing the working aspects of the Treepods. Taking this approach to biomimicry is more beneficial to the earth than sculptural and visual biomimicry.

Fig.6 : Tent tower

Another example of Biomimicry is Looking like a strange sort of man-made volcano, the All-Seasons Tent Tower (Fig.6) by OFIS Architecture is a multi-function cylindrical tower powered with solar energy and covered in a mesh skin that filters sunlight for temperature regulation. As the city of yerevan is situated in a region prone to earthquakes, the main driver when deciding on a suitable structural system for the building was safety during earthquakes. The vertical structure, which resists gravity load and forces resulting from earthquake action, was rationalized to reinforce the tower's concrete cores and composite columns. Special care has been taken to optimize environmental conditions and minimize the energy demands of the tower. The external facades will feature a high performance skin with an adaptable external shading device to reduce solar gains in the summer. A concrete slab embedded pipe system provides cooling without draft problems and in winter comfortable heating. In the summer, the cooling of internal spaces is achieved primarily through the use of the slab system. During winter, the fresh air will be heated inside the units and distributed into the rooms using the displacement ventilation principle.

Fig. 7: Lily pad, a floating city

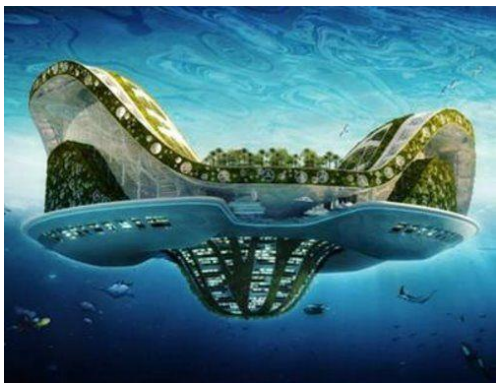

Fig. 8 Lily pod

There are very few urban design solutions that address housing the inevitable tide of displaced people that could arise as oceans swell under global warming. Certainly none are spectacular as this one. The Lilypad, (Fig.8 & 9) by Vincent Callebaut, is a concept for a completely self-sufficient floating city intended to provide shelter for future climate change.

Biomimicry concept implemented in the building Lilypad created as a water lily is planned to be a nil emission city floating in the deep. By means of several technologies, it is predicted that the plan would be capable of not only generating its individual power, but also dealing with CO2 in the surroundings. A fully self-reliant floating city aimed to afford protection for upcoming climate variation immigrants.

Figure 9: Mangal city

People thought cities deriving from nature in the past, but they have evolved that nature is coming inside cities central. The city space is a live organism. 'Mangal City' (Fig. 9) is an 'urban ecosystem' that mimics the nature of the Mangrove plant, spiraling plant growth patterns, and the interaction of natural ecosystems. It is Chimera design team is a series of futuristic spiraling skyscrapers for London, a beautiful example of Biomimicry. This project is an 'urban ecological system' composed of modular pod capsules that shift to adapt to environmental and contextual conditions.

CONCLUSION

These kind of nature inspired projects are allowing architects and designers to develop eco-performance principles that can be used by industry professionals worldwide to build Biomimcry solutions into their own designs. In fact, under this new order of sustainability, buildings, outdoor art and other manmade structures would function like trees, meadows, flora and fauna, capturing, cleaning and storing rainwater; converting sunlight to energy and carbon dioxide to oxygen; protecting soil from erosion; disseminating seedlings; and eliminating waste. There is need for future young Architects and designers to Create bio-inspired design adaptations that emulate nature's best ideas, so that all futuristic buildings will be sustainable.

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BIOGRAPHY

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