International Journal of Research in Engineering, Science and Management
Volume-1, Issue-10, October-2018
www.ijresm.com | ISSN (Online): 2581-5782

Biomimicry in Architecture

Krati Mittal[1], Ayush Jindal[2], Utkarsh Jain[3]
[1]*Student, Department of Architecture, SDPS College, Indore, India*
[2,3]*Associate Professor, Department of Architecture, SDPS College, Indore, India*

***Abstract*—Biomimicry, where entire ecosystems are emulated as a basis for design, is a growing area of research in the fields of architecture and engineering. This is due to the fact that it is an inspirational source of possible new innovation and has a potential to create more sustainable design.**

The objective of this study is to study biomimicry, its principles and also the various technologies and materials those have either been evolved through biomimicry or have been developed to demonstrate the forms and techniques of biomimetics in architecture.

***Index Terms*—Biomimetics, Biomimicry, bio-inspired design, ecosystem, ecology, ecomimicry, industrial ecology**

I. Introduction

Biomimicry is referred as the science of taking inspiration from nature, its models, systems, processes and elements, to solve design problems sustainably. It finds the unique approach to solve design problems creating sustainable and beautiful design. Biomimicry is still in its early stage in the built environment. It is expected that it will be applied most widely in architecture in the future, particularly as a tool of sustainable design.

II. Technology

Evolution is a rule of nature. The more adaptive an organism is, the easier becomes its existence. So is the case with building construction technologies.

A. Disaster- Proof Construction

The continuous urge of developing methods of construction that may lead to no or minimal damage to the building drove the designers' attention to bio inspiration.

All season's tent tower

All- Seasons Tent Tower in Armenia is designed by OFIS Architects. It is two terraced cylindrical shaped towers connected in ground floor and embraced with a green tent shape layer.

Fig. 1. All- seasons tent tower

As the city of Yerevan is situated in a region prone to earthquakes, the main driver while deciding 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.

The two cores on the inner perimeter of the taller tower are required to ensure structural stability, one core in case of lower tower. The core wall thickness and column dimensions are reduced with the height of the building.

Fig. 2. Inter-changing skin, interior view

Tent-Towers Inter-changing skin:

In winters, the skin covers the terraces of the towers, creating openings and full structural elements made up of metal mesh. It is white, partially covered with snow in winters. In summers, mesh is covered by greenery that is planted at the fence of the tower's terraces.

B. Multi-Layered Building Skin- Space Framing

Esplanade Theatre

Fig. 3. Esplanade Theatre

The design consists of two rounded space frames fitted with triangulated glass elements and sunshades, which balance outward views and solar shading. Controlling sound, temperature and humidity was the main issue. The unique architectural design has been said to have an appearance similar to a durian, a tropical fruit. Hence, the building is known to locals as 'the big durians'. It consists of more than 7000 triangular aluminum sunshades.

III. Materials

Building material is a crucial element in defining the properties, characteristics and behavior of a building and has notable effects on its surroundings.

A. Bird's Nest: Steel

Beijing National Stadium, also known as the Bird's nest was the stadium used for 2008 Summer Olympics, located in the Olympic Green. It is the world's largest steel structure.

Fig. 4. Beijing National Stadium

B. Habitat 2020

Habitat 2020 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.

The exterior has been designed as a living skin. The skin behaves like a membrane which serves as a connection between the exterior and interior of the habitat alternatively, the skin must 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 it in. the active sk9n would be capable of rain water harvesting where water would be purified, filtered, used and recycled. The waste produced would be converted into biogas energy that could be put to diverse uses in the habitat.

Fig. 5. Habitat 2020

IV. Approaching Design Through Biomimicry

A. The Way of Thinking about Nature

Nature as model: Biomimicry studies nature's models and then emulates these forms, processes, systems and strategies to solve human problems sustainably.

Nature as measure: Biomimicry uses an ecological standard to judge the sustainability of our innovations (i.e.; what works and what lasts)

Nature as mentor: new way of viewing and valuing nature.

B. Design Approaches of Biomimicry

1) Direct approach-problem based approach

In this approach, designers look to the living world for solutions and are required to identify the problem and then biologists need to match these to the organisms that have solved the similar problems.

2) Indirect Approach-Solution Based Approach

Identifying particular characteristics and behaviors in an organism or ecosystem and then translating them into human designs.

C. Levels of Design in Biomimicry

1) Organism Level

Many organisms on earth have created different survival mechanisms for themselves and adapted to constant changes over time by solving their problems in energy effective ways.

Namibian Desert Beetle: Fog-catcher design for Hydrological Centre for the University of Namibia, by Mathew Parks of KSS Architects.

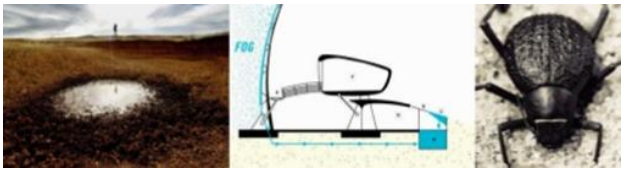

Fig. 6. Hydrological Centre

Principle: This beetle lives in desert with negligible rainfall and is able to capture moisture however from the swift moving fog that moves over the desert by tilting its body into the wind. Droplets form on the rough surface of the beetle's back and wings and roll down into its mouth.

2) Behavior Level

It is not the organism that is mimicked, but its behavior.

1. Mick Pearce's East-gate Building in Zimbabwe
2. CH2 Building in Melbourne, Australia

Principle: Techniques of passive ventilation and temperature regulation observed in Termite mounds, in order to create a thermally stable interior environment.

3) Ecosystem Level

Ecomimicry: used to describe the mimicking of ecosystems in design.

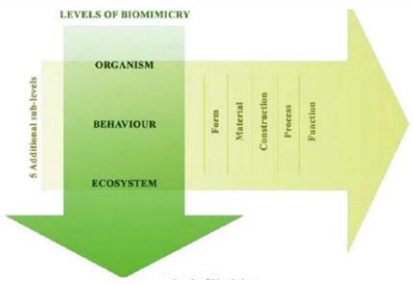

Fig. 7. Levels of Biomimicry

5 sub-levels were further added to the three levels of biomimicry for understanding the application of biomimicry.

V. Conclusion

Biomimicry can be applied to obtain practical ways of implementation that simplifies bio-inspired architectural work at various stages (approach to design, design solutions, planning) at various levels (organism, behavioral and ecosystem) and through different mediums (technology and materials).

References

[1] https://issuu.com/ateebhussein/docs/biomimicry-_ateeb_hussein_ _090106
[2] https://issuu.com/pragyabharati/docs/biomimicry_as__a_tool_for_sustainab
[3] Biomimicry in Architecture-by Michael Pawlyn
[4] https://inhabitat.com/habitat-2020-off-the-grid-future-abode/
[5] https://www.designboom.com/architecture/ofis-architects-all-seasons-tent-tower/
[6] https://www.esplanade.com/