

Improving Sustainability Concept in Developing Countries

Biomimetic Potentials for Building Envelope Adaptation in Egypt

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Abstract

Biomimicry is a science that seeks sustainable solutions by emulating nature's time-tested 3.8 billion years of patterns and strategies. The paper is concerned with embodying the biomimetic strategies to building envelopes which shall offer a high potential to reduce the energy demand, save material and thus improve the sustainability of buildings, through accessing current practices process of natural ventilation biomimicry in buildings for a potential application in building envelope for environmental adaptation which could help for the emergence of a new generation of biomimetic building envelopes aiming at promoting biomimicry in Egypt by showing the benefits that could be harvested.

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1. Introduction

One of the key considerations in designing energy-efficient buildings is their skin. This element has the capability of improving the building's performance in natural ventilation, managing heating transfer, redirecting and filtering daylight and enhancing occupant well-being among several other functions. Therefore it could play an important role in reducing the energy consumed in cooling loads.

In the current context of climate change, insecurity of energy supply, rising prices of traditional energy sources, and economic crisis, the search for solutions to improve the energy performance of buildings, particularly of the

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envelopes, as responsible of the exchange of energy and other flows with the environment, sets out, in order to reduce energy consumption and achieve greater efficiency in the use of materials, by the use of adaptive building skins.

In Egypt the envelope of the building is responsible for a major part in controlling the climate and energy consumption. The paper elaborates distinct approaches to biomimetic design that have evolved through discussing theoretical fundamentals about the importance of the issue of biomimicry in architecture and the position of nature inspiration in building envelope adaptation using the historical and current examples based on natural organisms ,then discussing biomimetic ventilation solutions in building envelopes in international and local case studies.

The aim is to further the implementation of biomimetic principles and adaptive strategies to enhance adaptive behavior, take advantage of the evolutionary knowledge that nature provides, derive applying principles to achieve best architectural solutions, serve as a driver of innovation in architecture and promote efficiency and sustainability in building skins, using principles such as optimality in resource management, resilience behavior, exchange of information and energy with the environment, complexity by organization of simple elements, or multi functionality, which could help putting Egypt back on the road to sustainable architecture .

2. Biomimicry overview

All Biomimicry and biomimetics originates from the Greek words bios, meaning life, and mimesis, also meaning to imitate, it is the examination of nature, its models, systems, processes and elements that can provide solutions to human problems. Although various forms of biomimicry or bio-inspired design are discussed by researchers and professionals in the field of sustainable architecture, the widespread and practical application of biomimicry as an architectural design method remains largely un realized, as demonstrated by the small number of built case studies (Faludi, 2005).

One of the impressive biological processes is the ability of adaptation found in natural organisms. Flora and fauna offer numerous examples of adaptation methods to hot climate by means of physical characteristics, behavioral reactions.

2.1. Nature as Mentor, Model, Measure

- Nature as mentor: A new way of seeing and valuing nature as a resource that we can learn from and that we should preserve instead of uncontrollably extracting its resources. Biomimicry is a new way of viewing and valuing nature
- Nature as Model: Studies nature's Form, process, systems and strategies and then imitates or takes inspiration from these designs and processes to solve the problems of humanity in a sustainable manner.
- Nature as Measure: Using nature's 3.8 billion years of evolution, quality control and ecological standards to determine the sustainability of innovations. Nature has already learnt what works sustainably. Biomimicry uses an ecological standard to judge "rightness" of our innovations.

2.2. Historical background

Our problem solving has been inspired by nature since the Stone Age, but this activity has been established only recently as a formal method of inquiry. Below are a few historical examples:

Leonardo da Vinci considered it essential to observe the anatomy and flying techniques of birds to create a flying machine, see Fig 1. Although his machine was never completed, the mere principle of being inspired by nature introduces da Vinci as a biomimicry pioneer along with the Wright Brothers, who derived their inspiration from flying pigeons to construct the first airplane.

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