

# Bio Architecture & Sustainable Architecture: An Inspiration for future building

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## Abstract :

**Organisms in nature confront the same challenges we do, but they meet them sustainably. Early people learned chasing, protect and survival strategies by observing creatures as they associating with their environment. Individuals have called on nature's motivation all through humans' history.**

**Today, with the rapid increase in population the construction industry is in boom which is affecting the Natural resources of building materials so the need to construct building which have less impact on environment & design based on the five climatic conditions is in demand.**

**Through a comparative analysis of case studies of building which are constructed based on the principles of bio Architecture and Sustainable Architecture conclusions are draw, that. The building bases on Bio-Architecture and sustainable Architecture principles offers built form which responding to climate and integrating with Surrounding Environment and Eco-System along with conserving more energy and increasing comfort-level. For engineers and Architects, these observations are helpful in both the design process and inspiring new inventions using natural technologies. With the concerns for the environment, Bio-Architecture may offer suggestions of how todays designs can be more sustainable and appropriate for different climates.**

## Keywords :

**Bio-Architecture, Ecosystem ,Energy conservation , Living organism , Green Building , Principles of nature , Sustainable Architecture.**

## 1. INTRODUCTION

Use natural geometries, shapes, forms, ratios and growth patterns to design our spaces in order to create life and truly sustainable systems. This is 'Full Spectrum Architecture' - not just 'green architecture'! [1]

"As nature uses shape to hold charge or life force, it makes complete sense to use nature's shapes and proportions for the shape of our spaces and buildings. In terms of architecture and design of space, I believe that by creating spaces that are based on the pure principles of natural design we provide a sacred environment that can nurture our bodies, minds and spirits. We can literally design to raise the vibration of the inhabitants. We can use our quantum consciousness to create the space, and to clear it of any stresses that do not serve life." [2]

- Michael Rice

Every living organism on Earth represents a wonderfully functioning system, well adapted to the environment as a results of the many years of evolution. The structures of biological systems are they beehives, termite nests, the cell wall or other organelles-are available to humankind. We may avail ourselves of nature as both an inspirational model also as a view of the progress of bio-materials and a way to interrupt faraway from stagnant patterns and realize the expanded possibilities afforded by technology and bios-centered thinking. The term of bio-architecture is not uniformly standardized in professional circles over the world. The term tends to be used in connection with a nature-friendly principle of creation of the living environment, for landscape disturbance by establishment of human settlements or other structures. Bio-architecture also comes into view in connection with a closer focus on the expression of architecture – its shapes, materials and used technologies, which have a positive effect not only on the living environment, but also on human health.

**1. INTRODUCTION**

The present scenario of the Conventional built environment does not go with the natural environment around so the need to integrate the two principles. So the objective of the study is to assets the benefit of Bio-Architecture to make building better by pushing for more natural, integrated efficient and healthy solutions.

The research was divided into two sections Bio-Architecture and Sustainable Architecture; the concept work on different level of principles, 4 and 6 respectively. All the level of principles was than studies individually in details with case studies. All the case studies than compare with the norms of Eco-Housing Rating System.

**2. APPROACH TO BIO-ARCHITECTURE**

**2.1 Nature as an Inspiration :**

The urban home is often “Machine to live in” rather than a place to retreat. The building bases on Bio-Architecture principles offers built form which responding to climate and integrating with Surrounding Environment and Eco-System along with con-serving more energy and increasing comfort-level.

Approaches to Bio Architecture as a design process typically fall into two categories: defining a human need or design problem and looking to the ways other organisms or ecosystems solve this, or identifying a particular characteristic, behaviour or function in an organism or ecosystem and translating that into human designs, referred to as biology influencing design. (Bio-mimicry guide, 2007)

**[3]**

The approach where designers see to the living world for solutions requires creators to distinguish issues and biologists to at that point match these to organisms that have illuminated comparative issues. This approach is successfully driven by creators recognizing initial objectives for design .

**Example 1 :**

In 1933, Fuller designed a car supported a shape. By studying the form of the raindrop, Fuller designed the Dymaxion automobile.

He found the solution by observing a drop of rain falls through the atmosphere, its spherical shape is modified: the front part of a raindrop remains rounded and supports most

of the fluid, while the back, lateral edge, is shaped by air currents. In this way, the friction of a raindrop against the air gives it shape of a tear.

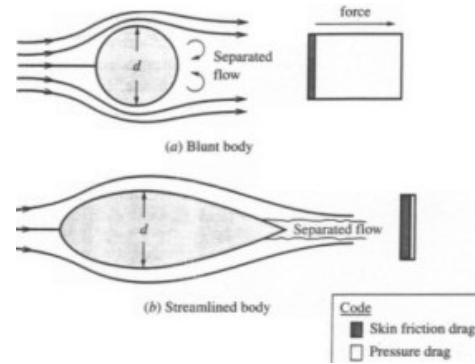


Fig. 1 : Rain drop form study

**3. BIO-ARCHITECTURE PRINCIPLES**

**3.1 Bio Architecture Principles :**

The Bio Architecture principles focus exclusively on nature’s attributes; thereby implying that humans have much to learn from the billions of years of the natural world’s evolutionary experience.

- Nature uses only the energy it needs
- Nature fits form to function
- Nature recycles everything
- Nature banks on diversity
- Nature demands local expertise

**3.2 Levels of Bio-Architecture :**

- Function in Nature
- Space in Nature
- Structure in nature
- Shape in nature

**Function in Nature:**

One of the essential aspects of both natural and man-made design is functionalism. Function is intimately related to form: there is no form without function, or function without form. Neither can exist without the other.

In 1896, Sullivan declared that: ‘shape comes after function.’ Le Corbusier wrote that as far as he was concerned, ‘Plants grow from the inside out, the exterior part being the result of the interior.’[4] However, on rare occasions, form can also determine function. In any case, form – function or function – form is an unreal dilemma. Once an artisan becomes fully acquainted with the materials they don’t debate whether form or function is the more important – they’re interrelated.

**[5]**

If we study the shape and characteristics of many things in nature, we discover that they need precise reasons for being as they are; their shapes fulfill functions, and that they are therefore always beautiful.

**Function in Nature:**

A very famous tower Swiss rebuilding form does not only resemble glass sponge (sea sponge) but also resemble to functional analogy. The curve shape of the building control the air around its base and inside circulate air allowing it to rise as it above and came hot by passing through the created atriums which results less space heating requirement and saving energy.



**Space in Nature:**

- The first experience any person has of space is that the mother’s womb. Bachelard described it as the: ‘closed, protected, limited confines that look after the event of the being, of that being which emerges from a reduced space on the within, so deep inside that it’s formed from the within out.’
- He also state that at the present time: ‘before being thrown out into the world, man is deposited in the cradle of the house and afterwards the house becomes a huge cradle.’ Long before Humans invented the cradle or began to build houses. Nature offered them generous caves giving the shelter and protection they instinctively sought.
- The design concept of Frank Lloyd Wright’s Falling water project is to build a structure that appeared to be part of the natural setting, part of the terrain, and part of the waterfall that flowed through the site.

Falling water was placed above a waterfall in a deep ravine and was done so in a daring manner. Its horizontal planes of cantilevered floors and terraces were designed to soar free without any apparent support, appearing to float above the stream and waterfall below. The terraces jutting out over the waterfall were suspended over the waterfall and were designed to be part of the living space.

- The main living area and its cantilevered terrace protrude out over the stream below and is enveloped by the sound of the water fall; it’s as though the house.



*Fig. 2 : Bird’s Nest (Creates nurturing space inside)*

**Structure in Nature:**

The finest engineer in the world of Animal kingdom is the spider. The net is as gentle as water an as flexible as tree. It is a marvel of construction in the simplicity and sophisticated. Termite built there colony’s as per the Solar passive architecture.



*Fig. 3 : Spider Web (Structure in nature)*

### Shape in Nature:

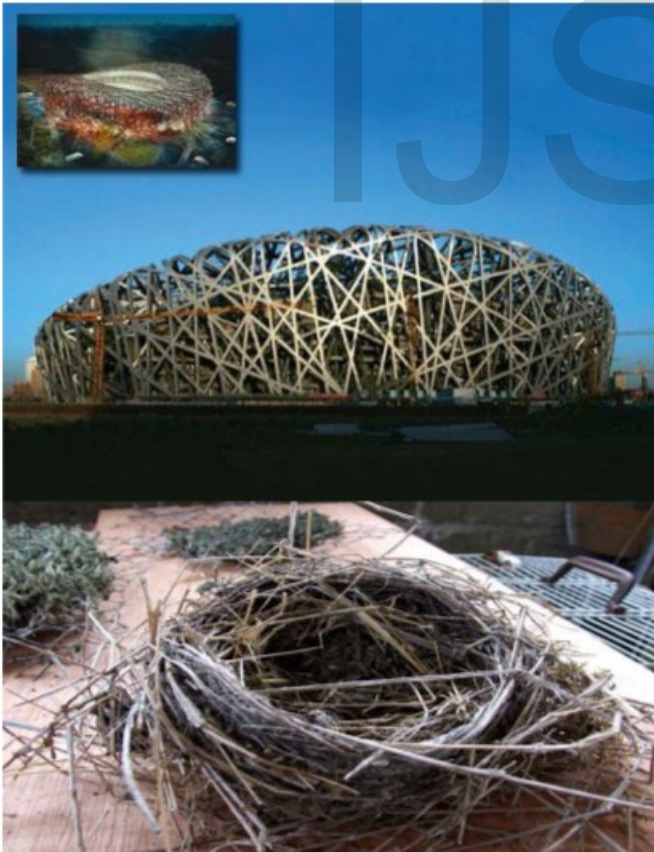
Undoubtedly, the Universe, Mother Nature as well, prefers everything not predictable with absolute certainty. For Randomness is the fundamental rule of totality. Only Homo sapiens, the intelligent life, attempts at creating perfect shapes or geometric shapes. In a perfect shape, the next element tends to be predictable with absolute certainty. The next point in a circle is situated, relative to a fixed point named center, at a distance equal to the distance of each preceding point.



Fig. 4 : Honeycomb (Shape in nature)

### 3.3 Levels of Bio-Architecture Precedents in Nature:

#### Beijing Olympic Stadium



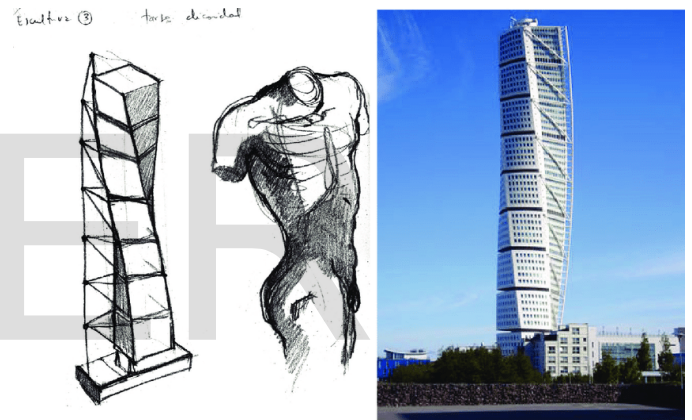
Beijing Olympic Stadium, a 91,000-seat arena under its 12-metre-deep steel exoskeleton, Inspired by Bird Nest because of its tightly woven lattice structure.

### Eastgate Centre:



This architectural marvel works on biomimicry principles. The mid-rise building, has no conventional air-conditioning or heating, it's design methods inspired by indigenous Zimbabwean masonry and the self-cooling mounds of African termites.

### Turning Torso



The gigantic tower stands 54 floors high and features a form inspired by the Spanish architect's studies on nature and human bodies. The fantastic tower is completely powered by renewable energy, and it twists a full 90 degrees from top to bottom.

## 4. SUSTAINABLE ARCHITECTURE

Sustainable architecture may be a general term that describes environmentally conscious design techniques within the field of architecture. within the broad context, sustainable architecture seeks to attenuate the negative environmental impact of buildings by enhancing efficiency and moderation within the use of materials, energy, and development space. Most easily, the thought of sustainability, or ecological design, is to make sure that our actions and decisions today don't inhibit the opportunities

of future generations. The principles of Sustainable Architecture are broadly divided into 6 level which are listed below:

#### **4.1 Levels of Sustainable Architecture :**

- Site planning
- Environment Architecture
- Energy conservation
- Water Conservation
- Building Material and Conservation
- Solid Waste Management

#### **Site Planning :**

- Site planning is a vital component and the first step to any type of building activity. It envisages perfect integration of the design and the parameters of the site, which is chosen for the said development.
- Since every site is unique in terms of existing landform, topography, vegetation and other environmental conditions, it is necessary to integrate the existing features and conditions within the site planning process.
- Through site analysis prior to initiation of planning can prove to be beneficial in achieving the objective of sustainable site planning.
- Some key impacts of unsustainability site development process include depletion of existing tree cover and loss of nutrients rich top soil that is conducive to plant growth. The uncontrolled sedimentation and disintegration from such irritated locales may result within the contamination of aquifers. Expansive zone of hard paved surfaces on developed sites gives rise to heat island impact. At the same time manicured landscape demand abundant amounts of water for support. The foremost economical and environmental-sensitive advancement is the one that requires negligible site disturbance.
- A sustainable site practice reduces the impact of the construction process on the Eco-system and the region. These measures simplify maintenance, reduces disturbance of habitats and help to revitalize urban areas.

#### **Environmental Architecture :**

- Environmental Architecture principle is aimed at taking maximum advantage of climate, by adopting passive architecture strategies, which involves blending architectural principles with solar and wind energy and the inherent properties of building materials, to fashion interiors which remains warm in winter and cool in summer, while at the same time reducing the consumption of conventional fuels and electricity. The Environmental Architecture principles addresses all the aspect of design such as :
  - The Environmental Architecture principles addresses all the aspect of design such as :
  - Building Orientation, space use allocation, space/ volume ratios and design of building components such as windows and fenestrations, walls roofs etc.

#### **Energy Conservation :**

The construction industry is one among the foremost energy intensive of all industries globally, utilizing almost 40% of all energy generation within the world. the development industry needs energy in the least levels of its activities. Building need huge amount of energy right from the planning stage, through the construction stage in the post-operative stage.

Energy conservation and management overlooks on following operative phase of the building:

1. Lighting
2. Electrical systems
3. Use of renewable energy sources
4. Water heating systems
5. Ceiling fans and HVAC

The criteria addresses energy conservation through, use of efficient equipment, products and systems, use of automation and control systems and use of renewable energy such as solar, wind, biomass, geothermal, etc.

### **Efficient Building Materials :**

- The construction industry is one of the most energy intensive of all industries globally, it solely utilizes more than 50% of all natural resources and gives out more than 50% of all natural resources and gives out 22% of all carbon dioxide emissions worldwide. In terms of consumption of natural stone, gravel and sand that is quarries. Also, building consumes about 25% of wood resources and 16 % of all fresh water resources available.
- Further, in developing countries like India, current, housing demand outstrips the housing supply. The advancement activity directly depends upon raw materials and resources that have a common or inferred origin, Subsequently we'd like to show a adjusted approach towards making a choice for alternative material in building.
- The use of Efficient Building material and technology, taking into consideration techno-economic feasibility ( affordability, local availability and technical capacity) along with the minimization of environmental and socio-economic impact occurring during the material life cycle.
- The use of efficient building material aims to reduce the overall environmental footprint of the building industry. Compliance with the criteria can be achieved by incorporating materials that have a less life cost, with high percentage of re-usability and recyclability in order to reduce wastage.
- It also encourages the use of by-product that is created during processing of other materials such as fly ash, bagasse, sawdust etc.

### **Water Conservation & Management :**

- Water is vital to life. The right to a good quality of life and environment implies availability of adequate water to fulfill basic health and sanitation requirements. Water conservation implies the preservation and efficient management of obtainable water resources. This doesn't mean compromising on comfort hygiene and health. Steps in water efficiency incorporate creating a water

balance through usage analysis harvesting recycle and reuse.

- The objective of any planned development should be to supply and ensure adequate, reliable and good quality potable water to its inhabitants. It's important that any sustainable urban development project integrates sustainable and environment-friendly water management plan at the planning stage.
- Minimizing the water demand in the building is the first and foremost step in water management. Water conservation helps make certain that this important useful resource are going to be available for several generations to return. Conserving water also circuitously saves energy, which is required to process, deal with and transport it, and for heating in cold climates. Hence to possess the utmost saving optimal and economical use of water through conservation be the precedence of latest construction. Additionally to technical measures like use of water efficient domestic home equipment.

### **Solid Waste Management :**

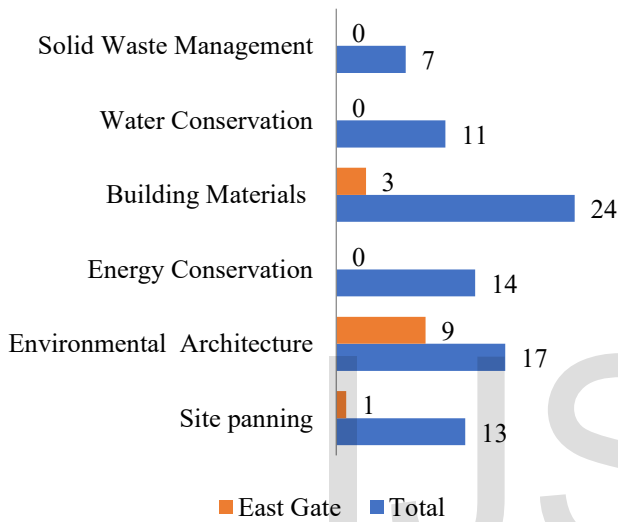
Building ate the foremost critical makers of waste – amid their entirety lifetime, and indeed after utilize. These wastes incorporate wastewater and solid waste. Planning of a construction venture ought to give due consideration for waste management.

- Metropolitan cities generate huge amount of usually unsegregated garbage which is transported by landfills to the city's land fill. For example the city of Mumbai generates nearly 7500- 10,000 metric tons of garbage daily. Of this, nearly 70% is organic waste. This waste can be easily segregated at source and composted on site by various methods.
- In Mumbai, where land is a highly priced commodity, dumping waste land renders it useless the cycle of food consumption and waste generation is unsustainable and likely to reach a yielding point. The residential sector of development also generates a huge quantum of waste and again, more than 50% of this waste is organic in nature.

- A good solid waste management plan should involve the provision of collection and disposal of wastes on site. Builders are required to keep space reserved for waste storage, collection and treatment in site planning and architectural design.

**5. OBSERVATIONS**

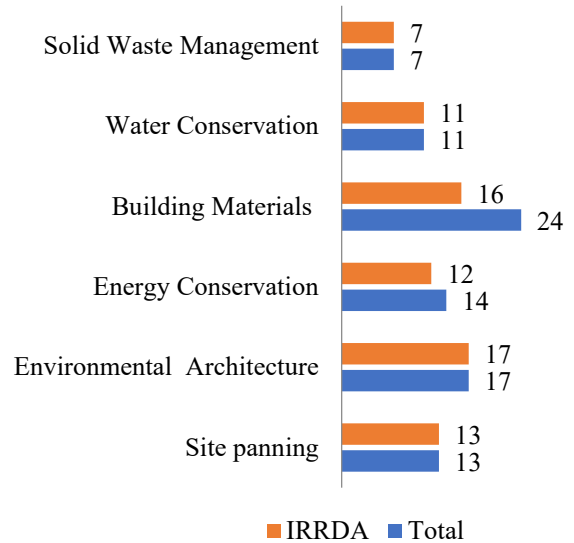
The study of above cases which are eg. of Bio-Architecture indicates that buildings design on the principle of Bio-Architecture are more responsive to site planning (Biodiversity), Climate Responsive Design and material.



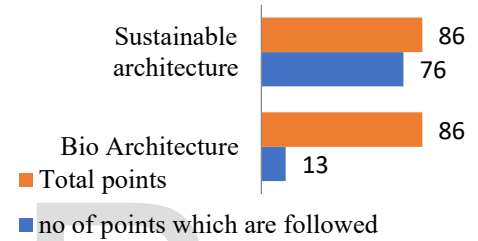
Graph 1

But the aspect of Water Energy and solid water management are not been catered. But the aspects of energy is catered by the climate responsive design and such as building form, envelop, material, ventilation system and strategies. Areas such as water management, solid waste management, energy efficiency and management can be dealt with effective initial scheme of Bio-Architecture.

Sustainable Architecture, it deals with all above focus area, the case study showing how all the criteria are incorporated in the building and how it is responding to climate and saving in terms of energy water and material.

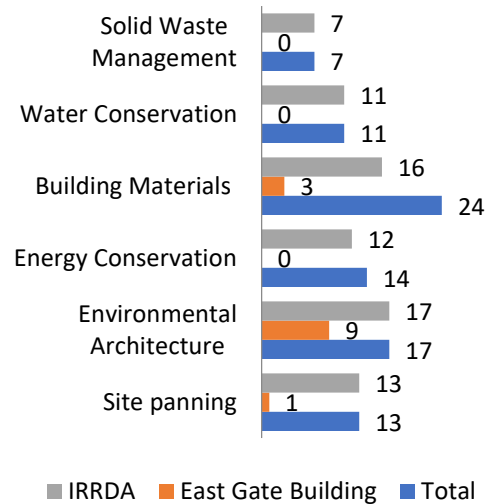


Graph 2



Graph 3

The Above comparison of both Bio- Architecture and sustainable Architecture put forward the result of response of this two kind of Architecture to various levels which makes building efficient.



Graph 4

Factors like climate, water and biodiversity are catered to make more efficient in Bio-Architecture whereas in sustainable Architecture it takes care of all focus areas- site planning, Environmental Architecture, Energy Management, Efficient Building Material, Water management and Solid waste management.

## **6. CONCLUSIONS**

Bio-Architecture is an integral part of Sustainable Architecture it focuses on Synergy of Nature and Passive Design practices whereas Sustainable Architecture encompasses a broader concept of Solar Passive Architecture. Understanding Bio-Architecture will always enhance designing concepts in Sustainable Architecture. Bio-Architecture technology would also help us also overcome environmental issues; by reducing impact on the surrounding environments. One has to predict that this impressive new branches of Architecture individually and also combined together can be used in the right direction using appropriate technologies and design approaches.

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## 7. REFERENCES

[1] - <https://www.breakthru-technologies.com/technologies/bio-architecture>

- <https://www.academysacredgeometry.com/online-courses/sacred-geometry-and-bio-architecture>

[2] - <https://www.architecturaldigest.com/story/biology-and-architecture>

- <http://www.theimploder.com/products/other-developments-fractal-technology/bio-architecture>

- Bio Architecture And Sacred Geometry By Michael Rice

[3] - Biomimicry Guide , 2007.

[4] - Bio-Architecture Book by Javier Sinasian.

[5] - Bio-Architecture Book by Javier Sinasian.

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