Bio-Climatic Tower/Eco-Tower

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1. Introduction

Bioclimatic architecture is one that has a connection to nature. Building designs that take into account climate and environmental conditions to help achieve optimal thermal comfort inside. It deals with design and architectural elements, avoiding complete dependence on mechanical systems, which are regarded as support.

1.1 Meaning of Bioclimatic

The bioclimatic architecture concept is far from being a new one, as many traditional architecture styles work according to bioclimatic principles. It was not long ago when mechanized air conditioning was rare and expensive, and still is for many places today. Examples of traditional architecture working in this manner are often vernacular archetypes, such as the Southern oriented windows and insulating blind Northern walls. As a random example, Spanish villages near Andalusía are nestled into South facing slopes, using materials with thermal mass (such as adobe) with an earth coating of lime on walls, creating a stable indoor microclimate. Depending on the actual climate, these manifestations differ but work on the same principle: a design process that takes more time but also understands the need to observe study and take full advantage of the building site, offering simple cheap local solutions to problems that, if ignored, can prove to be a major impediment in healthy, energy efficient living. In short, bioclimatic architecture has a connection to Nature, as building designs take into account climate and environmental conditions to help achieve optimal thermal comfort inside. It deals with design and architectural elements, avoiding complete dependence on mechanical systems, which are regarded as support. A good example of this is using natural ventilation as well as taking advantage of the sun's, earth and wind's energy providing potential. A nonconventional approach, it still struggles with the common preconceptions and lack of trust towards alternative energy and green design methods.

1.2 Principles of Bioclimatic design

In order for this type of project to be a success, certain site characteristics must be taken into consideration before beginning the design process, among which climate, vegetation, topography and geology of the soil are on the top of the list. The main goal this type of building aims to achieve is to minimize the energy needs of the building and to create a more comfortable environment by improving hydro-thermal and acoustic insulation of the structure as well as providing a healthy amount of natural light. In addition, special attention is paid to respect the existing landscape and integrate the building within it. One of the crucial elements that can establish the success of a bioclimatic designed environment is natural ventilation and the way it serves every room in the building, using planted/shaded surfaces to provide cool air intakes which is later disposed of when becoming hot through vents placed in the superior part of the elevation (Fig. 1).

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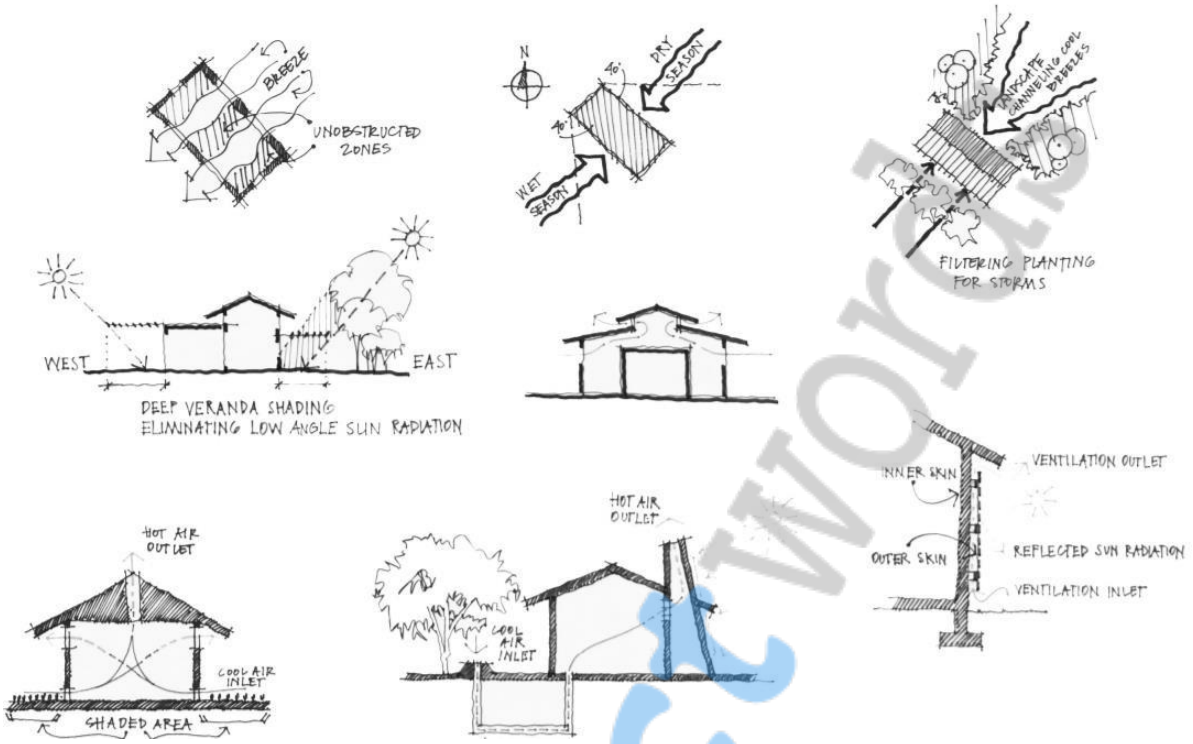

Fig. 1 – Passive bioclimatic architecture principles

This issue needs to be taken into consideration weather a small or big building is concerned, as a major factor in reducing energy consumption as well as the main cause for health and comfort problems that may occur in a poor lit and ventilated inside space. The natural ventilation and light intake of the space go hand in hand and can be easily controlled and optimized if proper orientation and geometry is provided. In the Northern hemisphere the preferred orientation of the glazed surfaces of buildings is South, a constant source of natural light.

The smart use of planted perimeters in the close proximity of the building is a major bioclimatic design factor that can be best addressed when building outside urban overpopulated centres. In the case of tall buildings placed in dense urban building areas, moderately deep loggia can be planted providing a natural shield against the powerful summer sun as well as freshening up the natural airflow (Fig. 2). Shading devices will be designed for the East façade, as well as bigger more dense such devices for the West façade. Additional solar energy intakes will be provided via multi story atriums that radiate heat in the cold season and can be closed during the summer, avoiding the greenhouse effect.

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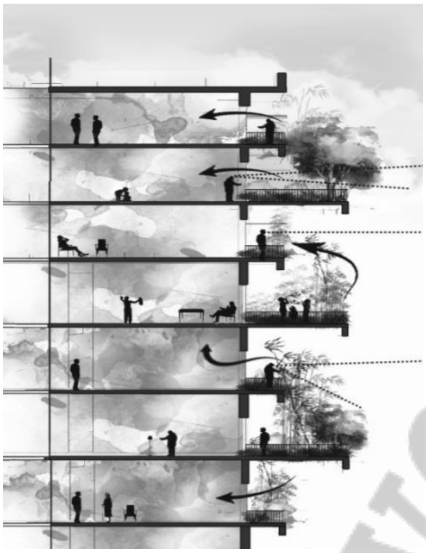

Fig. 2 – Landscaped sky gardens

The so called "landscaped sky gardens" also act as a green shield for the dust and rain, placed in an alternative depth pattern that offers double height spacing between them, offering clear sky visibility.

The form factor is another decisive aspect to take in consideration when designing in a bioclimatic manner, especially when referring to tall buildings. The plan takes shape in close connection with the site, orienting its living spaces to the South and buffer zones (kitchens, bathrooms, storage and other technical spaces) to the North. Surroundings must be studied and anticipated, as the elevation of the buildings' volumetric shape should think of future buildings and their geometrical characteristics, as noted in the general urban plan. This will assure continuity of the natural light and ventilation advantages, as well as reduction of urban heat isles so commonly met in overdeveloped urban areas. The movement of the sun, natural green surroundings and wind charts will dictate the way the exterior image develops, with carefully placed openings, smart shading façades and green roofs, irregular floor patterns and well placed inclined surfaces that may facilitate the use of solar and photovoltaic panels. (Fig. 3)

Fig. 3 – Bioclimatic architecture volumetry

Bioclimatic architecture involves looking at the big picture, shrinking the scale of the observer's perception over the construction site and resolving core problems in order to allow such manifestations to evolve naturally.

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2. Organizations involved

2.1 Indian Green Building Council

The Indian Green Building Council (IGBC), part of the Confederation of Indian Industry (CII) was formed in the year 2001. The vision of the council is, "To enable a sustainable built environment for all and facilitate India to be one of the global leaders in the sustainable built environment by 2025".

The council offers a wide array of services which include developing new green building rating programmes, certification services and green building training programmes. The council also organises Green Building Congress, its annual flagship event on green buildings.

The council is committee-based, member-driven and consensus-focused. All the stakeholders of construction industry comprising of architects, developers, product manufacturers, corporate, Government, academia and nodal agencies participate in the council activities through local chapters. The council also closely works with several State Governments, Central Government, World Green Building Council, bilateral multi-lateral agencies in promoting green building concepts in the country.

2.1.1 Green Building Movement in India

The Green Building movement in India was triggered off when CII-Sohrabji Godrej Green Business Centre building in Hyderabad (Fig. 4) was awarded with the first and the prestigious Platinum rated green building rating in India. Since then, Green Building movement in India has gained tremendous impetus over the years.

Fig. 4 - CII-Sohrabji Godrej Green Business Centre

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With a modest beginning of 20,000 sq.ft. green built-up area in the country in the year 2003, today (as on 26 September 2017) more than 4,289 Green Buildings projects coming up with a footprint of over 4.68 Billion sq.ft are registered with the Indian Green Building Council (IGBC), out of which 1182 Green Building projects are certified and fully functional in India. This growth has been possible with the participation of all stakeholders in the green building movement.

Today all types of buildings are going the Green way- Government, IT Parks, Offices, Residential, Banks, Airports, Convention Centre, Institutions, Hospitals, Hotels, Factories, SEZs, Townships, Schools, Metros etc.

2.2 GRIHA Council

GRIHA Council, is mandated to promote development of buildings and habitats in India through GRIHA. GRIHA Council an independent platform for the interaction on scientific and administrative issues related to sustainable habitats in the Indian subcontinent. It was founded by TERI (The Energy and Resources Institute, New Delhi) with support from MNRE (Ministry of New and Renewable Energy, Government of India) along with a handful of experts in the sustainability of built environment from across the country.

2.2.1 Activities

All activities related to issuance of GRIHA Rating are carried out by GRIHA Council.

- TERI-GRIHA framework was initially developed by TERI for new commercial, institutional and residential buildings. The rating was further modified when it was adopted by MNRE as GRIHA. Over 330 projects across India of varying scale and function are being built based on GRIHA guidelines. The Centre for Environmental Sciences and Engineering, IIT Kanpur (2009) and Suzlon 'One Earth' Office Complex (2010), Pune have been certified at GRIHA 5 Stars. Furthermore, ITC Grand Chola and several projects of Infosys are 5 Star GRIHA rated.
- With rising costs of fuel and energy and increasing awareness of connections between climate change and our life-styles there is a growing interest in the small residential development sector to adopt green measures. An easy to use and expedient way of designing green residences, resorts, motels and small offices is underway. With a Simple, Affordable and Versatile approach to green rating for small residences, SVA-GRIHA would be web enabled by giving universal access to information and guidelines on green buildings. This shall be made available by mid 2011.
- There are also a number of educational campuses and mixed use township developments seeking GRIHA certification for the projects. GRIHA Council has

launched GRIHA LD (Large Developments) for design and evaluation tool for large developments including campuses, townships, SEZs etc.

- Promoting Energy Efficiency within the existing building stock especially in urban areas offers the most cost-effective means of reducing peak demand, growth in electricity demand and carbon emissions associated with the production of electricity. Water supply and wastewater treatment are increasingly becoming critical issues in urban areas. Waste generation and management also count amongst the key Urban Sustainability Issues. GRIHA Council shall eventually develop a rating system for retrofitting existing buildings.

2.3 GBCI India

Green Business Certification Inc. (GBCI) is the premier organization independently recognizing excellence in green business industry performance and practice globally.

GBCI is comprised of 140+ staff experts and 600 consultants apportioned into three teams that form a paramount organization through certification, credentialing and customer support. With locations in the U.S., Europe and India, GBCI supports project teams and professionals in over 160 countries.

GBCI provides third party verification services for certification and credentialing through a scientific process by which a product, process or service is reviewed by a reputable and unbiased third party to verify that a set of criteria, claims or standards are being met. Certification and credentialing is used within the global green building industry to demonstrate credibility, provide a metric for comparisons and add significant value.

In 2015, GBCI opened an office in Gurgaon, India, to provide stronger, on-the-ground customer support for regional project teams. This new operational hub better positions GBCI to deliver full-service onsite certification and verification.

GBCI works with business and government officials to help address and meet the priority needs of a rapidly urbanizing India. Its new office improves India's access to resources, helping accelerate the greening of the nation's built environment.

Fig. 5 – Banner for GBCI expo

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3. Need for Bioclimatic Architecture

Though bioclimatic architecture is being practiced since ancient times, there is no doubt that with increasing global warming and climate change, and the need for accommodating growing population, Bioclimatic design is maybe the best path to take.

3.1 General issues (Global scale)

Bioclimatic architecture is essential because we are running out of resources to continue living as we have in the past. We want there to be enough resources for everyone now and in the future. Green building may seem like a tricky investment at first, but the rewards are great over time.

In the United States, buildings alone account for:
39% of total energy use
68% of total electricity consumption
30% of landfill waste
38% of carbon dioxide emissions
12% of total water consumption

Fig. 6 – Graph by NASA showing rise in atmospheric Carbon Dioxide levels

Environmental benefits of green building:
Enhance and protect biodiversity and ecosystems
Improve air and water quality
Reduce waste streams
Conserve and restore natural resources

Economic benefits of green building:
Reduce operating costs
Improve occupant productivity
Enhance asset value and profits
Optimize life-cycle economic performance

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Social benefits of green building:

Enhance occupant health and comfort
Improve indoor air quality
Minimize strain on local utility infrastructure
Improve overall quality of life

3.2 Specific Issues (Gurgaon Scale)

Gurgaon, one of Delhi's luxurious satellite cities, is apparently synonymous to India's urban awakening. But behind this veil of 'pseudo-development', is a city that may sink in its own sewage.

The 24 hour exposure monitoring on December 18-19 was recorded at 777 microgramme per cubic metre -- about 12 times higher than the standard of 60 microgramme per cubic metre. This travel during the day covered IFFCO Chowk-Cyber Green Office area- Sohna Road- Artemis hospital- Amity International School- Medanta-Rajiv Chowk- Civil Hospital-Sadar Bazar-Udyog Vihar. The hourly average of PM2.5 during evening peak at IFFCO Chowk was as high as 996 microgramme per cubic metre. In the late evening PM2.5 level even crossed 1,094 microgramme per cubic metre at Cyber Greens Office area. Also, the National Green Tribunal has recognized the fact that construction debris is contributing to the worsening quality of air in the entire NCR region, for remedying which it has issued several warnings in the near past. The respective governments are yet to take action on the same.

Fig. 7 – Concrete Jungle

Even with all its skyscrapers, swanky malls and luxury apartments, Gurgaon is a perfect example of how a city shouldn't be built. Activists and environment crusaders claimed that builders in Gurgaon have compromised with the basic aspects of construction that makes a city liveable. The growing concrete jungle and decreasing green cover are a threat to both animal and human life.

4. Narration of approach and methodologies

4.1 Designing an efficient mixed-use tower incorporating functions like commercial, offices and residential.

The first step towards designing is taking in account efficiency and usability in terms of functions. As the tower is visualized in the bustling city of Gurgaon, the primary functions would be Commercial (for public engagement and experience), Office (as Gurgaon is a business Hub) and Residential (the third element in Live-Work-Play theory)

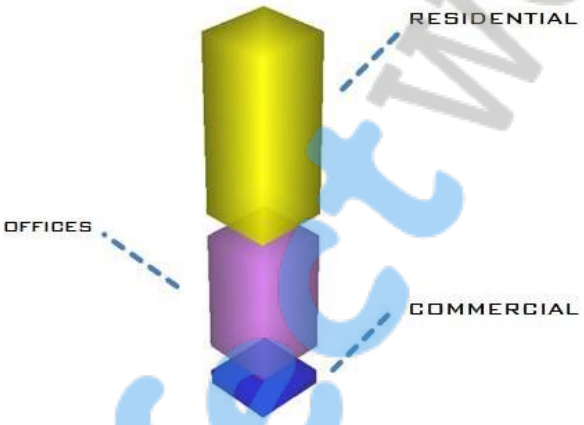

Fig. 8 – Functional distribution

4.2 Study of local climate of Gurgaon

4.3 Case studies (International and National).

4.3.1 International

1) Interlace, Singapore
2) Bosco Verticale, Italy
3) Rodovre, Denmark
4) Editt Ecological Tower, Singapore

4.4 Application of bioclimatic principles to the designed structure.

4.5 Study of qualitative and quantitative aspects of the design.

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5. Final Vision

The final vision of this thesis is to produce a design that is efficient both functionally as well as environmentally and has minimal to zero impact of local climate of the city.

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