BIOCLIMATIC ARCHITECTURE IN THE TROPICS

Over 40% of the world's population are already living in the Tropics, expected to increase to 50% by 2050. These countries have a high demand for housing infrastructure to support their population. This means an exorbitant increase in energy consumption in this region as well as a substantial increase in GHG emissions. It is time to reconsider the way buildings are designed, and to adapt the bioclimatic principles of vernacular architecture to present day requirements.

A hundred and twenty years ago there was no large-scale electricity, and by and large only locally sourced building materials were accessible. Vernacular architecture based on local needs, construction materials and reflecting local traditions assured the comfort of the building occupants. With the right site planning, landscaping, building orientation, building envelope and passive design elements, it was possible to achieve desired comfort levels at low energy.

Today, we have shifted from such low-energy buildings of the past to energy intensive buildings. With easy access to rapidly dwindling resources, our building approach has changed over time. Most contemporary buildings are not optimised in terms of cost, comfort or energy. Improper building form, inappropriate orientation, use of unsuitable building material and inefficient appliances have become common practice. Buildings are creating indoor environments that are disconnected to the geographical location and use high-energy consuming appliances. All these factors have led to over-dependence on artificial lighting and ventilation, leading to increased energy consumption.

There is an increasing compulsion to reduce our dependence on fossil fuels without compromising on the comfort of the building occupants or the construction costs of the building. For instance, taking comfort levels into account, air-conditioning does not always provide the best solution in tropical areas, particularly when energy supply is inadequate and unreliable. Unless adequate measures are taken to construct low energy buildings that incorporate bio-climatic features, it may be too late to contain the energy demand later.

HOW SHOULD WE DO IT

The first step in the process is a good understanding of the local climate and designing the building to suit the local climate. By focussing on aspects of bio-climatic Architecture, the energy consumption of the building can be reduced by a large extent at the design stage itself. Bio-climatic architecture plays an essential role in ensuring human comfort without any adverse impact on energy consumption, or on the overall cost of the building. Some of the bioclimatic design principles include:

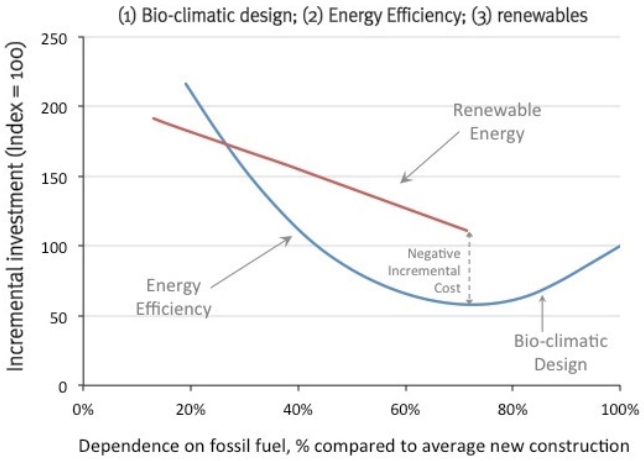
- Orientation: Selecting an orientation of the building that maximises the use of natural daylight and natural ventilation according to function and time of the day, thus reducing operational energy demand.
- Adapting to site limitations: Designing with respect to the microclimate of the site arising due to surrounding factors such as open spaces, vegetation, water bodies, proximity and massing of other buildings, concrete and asphalt roofs and pavements, etc. This also highlights the need to apply bioclimatic principles to the urban planning context, since it is not just a building that must be designed to fit to its surroundings, but also the surroundings itself which should be initially

planned to mitigate the harmful effects that it may cause such as the Urban Heat Island(UHI)effect.

- Solar protection: Avoiding direct solar radiation into the building or on its exposed areas in order to minimise the heat gain, thus avoiding the need for artificial cooling to achieve thermal comfort. For example, if the façades are oriented for natural ventilation and the building has a smaller glass façade to lessen heat intake, then the need for air conditioning is reduced, while still allowing natural lighting. The walls of the building can be shielded from the direct solar radiation by using various types of shading devices.
- Building envelope: Ensuring control of air flow, heat flow and moisture infiltration into the building by insulating roofs and walls, choosing climate appropriate building materials, optimal positioning of openings, using high performance glazing etc.

The use of energy efficient appliances will further reduce the energy demand of the building. Through a step-by-step process of incorporating features of bioclimatic design and energy efficiency, we can improve in all three areas - cost, comfort and energy.

For the more technically oriented, here is a graphical explanation of sustainable architecture. The graph refers to the standard building construction as the base case and compares the performance of the building as different measures are adopted in the sequence: (1) bio-climatic design; (2) Energy efficiency; (3) Renewable energy. The objective is to reduce the dependence on fossil fuel to the maximum extent possible without incurring any costs over and above that of the base case. The x-axis shows the dependence on fossil fuel, assuming that all the energy used in the building in the base case comes from fossil fuel. The Y-axis has Incremental Investment for each of these cases. Some of the bio-climatic design features can actually result in lowering the capital cost of the building as compared to the base case, shown as negative incremental investment. Some other bioclimatic features measures may result in further reduction in fossil fuel dependence without any incremental investment. When one adopts energy efficient equipment and appliances, the incremental investment increases. At some point, energy efficiency measures results in higher incremental investment in comparison to the adoption of renewable energy solutions. The slope of the curve would be very much location-specific and would depend on the energy prices and the availability and costs of energy efficiency and renewable energy devices.



WHY THIS WEBSITE

This is an initiative to mainstream the practice of bio-climatic architecture particularly in the tropics. It is aimed at:

- Bringing together a broad spectrum of actors involved in sustainable construction in tropical climate zones
- Serving as a forum for sharing experiences and best practices in this field targeting decision-makers, researchers, experts and enterprises from all sectors
- Undertaking joint action to amplify the positive impacts in terms of reduction of GHG emissions and improved energy efficiency in tropical buildings

The initiative will have a leveraging effect by capitalizing on exemplary construction methodologies and practices in tropical climates, through the following specific measures:

1. Develop and disseminate integrated design methodologies and tools for buildings in tropical climates
2. Mobilize key actors to address tropical construction issues
3. Strengthen competences
4. Accompany public policy and regulations, drawing upon specific examples of implementation.
5. Facilitate access to financing

The website presents case studies of passive and low energy buildings from various Tropical countries. The aim is to compare and analyse bio-climatic features used in different countries sharing similar climates so as to share knowledge gained from traditional building practices as well as new technological advancements in these countries. This website also provides data on legal framework and policies so as to understand the factors that support or deter the use of bioclimatic strategies in construction. Such data will help in identifying the best practices of bio-climatic Architecture in the tropics, and can initiate a dialogue on the legal framework that will make these practices and processes more mainstream.

We invite case studies of houses using bio climatic architecture on our website. Sign up for an account and upload your case study for wider dissemination. For queries, contact us at info@tropicalbuildings.org