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BIOCLIMATIC ARCHITECTURE

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ABSTRACT

Architecture is always inspired by nature. For saving optimal thermal comfort inside building designs climate and environmental conditions must be taken into account. It deals with designing the architectural elements by avoiding complete dependence on mechanical systems, which are regarded as support.

This paper discusses bioclimatic architecture which refers to the design of buildings and interior, exterior or outdoor spaces based on local climate. The paper aims at providing thermal and visual comfort by making use of solar energy and other environmental sources. Passive solar systems that are incorporated into buildings and utilize environmental sources like sun, air, wind, vegetation, water, soil, sky for heating, cooling and lighting the buildings are the basic elements of bioclimatic design.

The paper addresses the use of bioclimatic architecture and energy efficient systems and technologies, such as passive solar systems the reduction of energy consumption in buildings that can be achieved by simple methods and techniques. Passive solar systems are divided into three categories:

Passive Solar Heating Systems, Passive (Natural) Cooling Systems and Techniques Systems and Techniques for Natural Lighting

KEYWORDS: Active and Passive Solar Architecture, Renewable Energy, Self-Sufficient House

INTRODUCTION

There are many traditional architectural styles that are based on bioclimatic principles. Air conditioning was rare and expensive and today also it's still the same for many places. The main point of bioclimatic design is to build with the climate and its surroundings with recommendations of **optimization of resources** by

- The ecosystems of the environment, weather and hydrography must be considered in which buildings are built for maximum performance with the least impact.
- Priority must be given to low energy content compared to high energies by giving efficacy and moderating the use of construction materials.
- By reducing energy consumption for heating, cooling, lighting and equipment and covering the remaining load with renewable energy sources.
- By minimizing the building overall energy balance, covering the design, construction.
- The requirements must be fulfilled for hydrothermal comfort, safety, lighting and occupancy of buildings.

FACTORS TO BE CONSIDERED FOR BIOCLIMATIC DESIGN

Location

For the overall layout of the design location of the building is a very important factor. Solar radiation must be utilized for proper design of the building during the wintertime and at the same time protects the building from overheating in the summer time. The best location for a building to be constructed in all depends on the climate, and also the direction of the wind in that area, if there is natural shading like trees or other landscaping features, and also how the owner wants the internal layout of the built form, its spatial arrangements and layout are configured and planned so it relates to that of the environment, and the meteorological data of the locality as a passive response. Before shaping, building form the following considerations need to be considered such as to use up low energy cost for site layout, to capture the site's wonderful views, and to achieve privacy or security. By reducing the heating energy requirements that is influenced by its form, orientation on the site, and its ratio of volume to the built form, its spatial arrangements and layout are configured and planned. It relates to the environment, and the meteorological data of the locality as a passive response.

Solar Heat Gain

Local Climatic conditions must be considered in Bioclimatic design for which the following principles must be followed:

The external envelope of the building is developed by doing adequate insulation, air tightness of the building and its openings and heat protection of the buildings in winter as well as in summer is done by using appropriate techniques.

- The openings must be oriented towards south direction for proper use of solar energy for heating buildings in the winter season and for day lighting all year round and also by doing the layout of interior spaces according to their heating requirements. Passive solar systems which collect solar radiation act as "natural" heating as well as lighting systems.
- By the appropriate treatment of the building envelope, i.e. use of reflective colors and surface protection of the buildings from the summer sun can be done.
- Heat accumulated in summer in the building to the surrounding environment is removed mostly during nighttime by using natural means like passive cooling systems and techniques such as natural ventilation.
- By adjusting the environmental conditions in the interiors of buildings comfortable and pleasant conditions for the inhabitants can be created by increasing the air movement inside spaces, heat storage, or cool storage in the walls,
- For providing sufficient and evenly distributed light in interior space insulation combined with solar control for day lighting of buildings must be utilized.

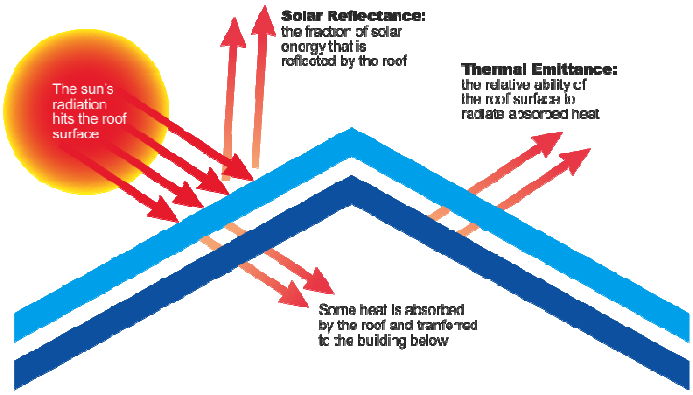

Figure 1

Wind and Ventilation

Plants can be used as a way to control airflow in place of structural materials. For keeping the windy side relatively calm and sustainable small plants and trees, and the combination of fences put together with other materials can be used as very effective windbreaks. External wind effects of the building and temperature changes are the categories of Natural ventilations in most cases that are used for personal comfort in the building. By using a properly designed natural ventilation solutions capital cost and energy savings could be achieved. By cutting down the need for mechanical ventilation and air conditioning systems for a bioclimatic building so the owner can have a healthy building. Comfort can be improved through ventilation by increasing the indoor air speed in interiors to make the occupants feel cooler. Ventilation increases the rate of sweat evaporates from the user's skin, leaving a cooling sensation as a result. There must be provision of low-level inlets and high level exhaust openings for natural ventilation in buildings to encourage fresh air to be drawn in and foul air to be expelled. To induce internal air movement inside the building while expelling the hot air inside the building through the law of buoyancy the use of stack ventilation and wing walls are also a helpful technique in the passive cooling systems of the buildings.

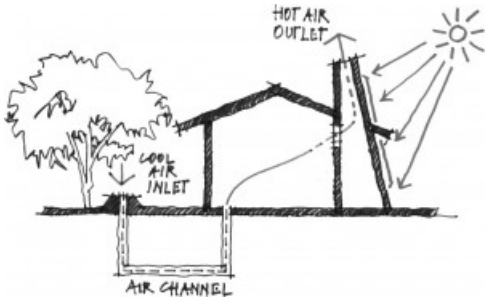

Figure 2

Terrace Gardens

A terrace garden helps the environment, saves energy and has economic advantages. Green roof can also be an option to cut down the need for mechanical heat depending on the thickness of the soil and the amount of plants in the garden. Depending on the thickness and density of soil and plants act as an extra insulation. Terrace gardens reduce cooling costs by saving energy during the summer time. Green roof absorbs many of the harmful pollutants given off by city air will keep the inside of a building 10 to 20 degrees cooler than the outside temperature. Introducing terrace gardens in the cities improve the balance of the ecosystem within cities.

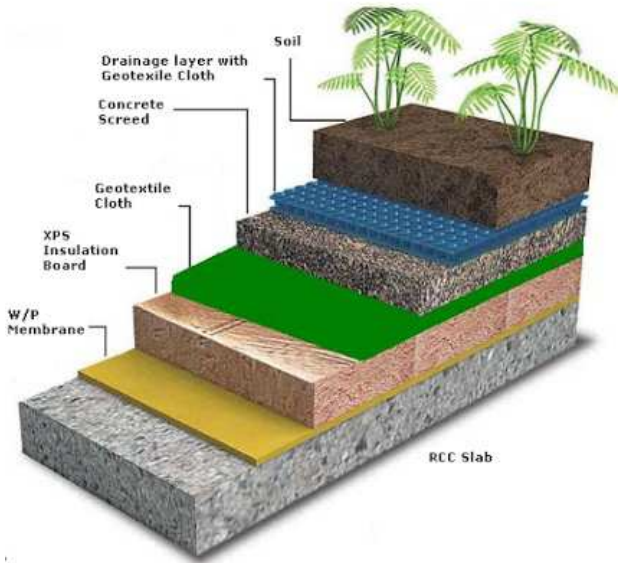

Figure 3

Comfort Zone

Comfort is the maintenance of thermal balance between human body and the environment. The knowledge of nature, of comfort is essential in design with climate with the aim of maintaining comfort within buildings. Six major factors that affect thermal comfort:

The Air Temperature: This is an important factor affecting thermal comfort. When the temperatures are low, people feel cold and when they are high people feel hot. Comfort can approximately be achieved between 16 degree C and 28 degree C.

Air Velocity: When sweating occurs, air movement is very effective in increasing heat loss from the body in high temperature. The air movement cools down the body by enhancing the evaporation of sweat from the body. Air velocity of up to 0.1 meters per second may lead to a feeling of stuffiness indoors. Air velocities of up to 0.1 to 1.0m/s are comfortable indoors when air movement is required but above this level there is discomfort. Outdoors wind speeds up to 2.0m/s lead to considerable discomfort.

The Relative Humidity: Relative Humidity (RH) is an important factor in human comfort and discomfort indices especially in hot climate. When there is low humidity the air is very dry and sweating is more effective in cooling down the body. On the other hand, when the humidity is high the air is damp and sweating is no longer very effective in cooling down the body. Thermal comfort can be achieved when the relative humidity is between 20% and 90%.

Energy Management

Energy management is the key to saving energy in which importance is given for energy saving stems from the global need to save energy. Energy should be saved because this global need affects energy prices, emissions targets, and legislation. We need to save energy in order to:

- Damage done to our planet Earth must be reduced.
- Dependence on the fossil fuels must be reduced that are becoming increasingly limited in supply.

- **Reduce Costs**: this is important due to energy costs rise.
- **Reduce Carbon Emissions:** Carbon footprint must be reduced to promote a green, sustainable image and the environmental damage that they cause.
- **Reduce Risk**: The more energy consumption increases the energy price or supply shortages could seriously affect the profit, or even make it impossible for the organization to continue. With energy management, risk can be reduced by *reducing* your demand for energy and by *controlling* it so as to make it more *predictable*.

With Bioclimatic approach the design does not focus much on these active systems rather on the passive ways through built form and orientation of the building can provide the optimum design to reduce energy use.

Day Lighting

For providing satisfactory visual and thermal environment in indoor spaces daylight must be incorporated into the building. Daylight affects the building in indoor space and architectural elements to be incorporated into the design.

The following design factors must be taken into account in order to use daylight to an advantage.

- Directions of the incident daylight must be varied in the amount.
- Luminance (photometric, brightness) and luminance contribution of color,
- Variation in sunlight intensity and direction

Glare the main discomfort need to be solved in order to have an acceptable amount of daylight in the house. Planning the good lighting strategies is the best way to solve glare that have ties with the energy performance of the building. Glare results cause a bright light source that is viewed from a surrounding area that is usually in a dark place like a light bulb or a flashlight. Glare can be solved by increasing brightness of the surrounding area.

Envelope Design

A simple building envelope can yield important energy savings. A building's heat, air, and its visual transparency must be managed and modified, so the building will react to changing weather conditions. Solar screening; glare protection, temporary thermal protection and adjustable natural ventilation are the variable that need to be considered. The external wall having direct solar insulation must be insulated and therefore thought of the building materials used is also important. In hot wet climates, it's necessary to use materials with high thermal lag. Thermal lag is the ability of a fabric to obtain heat from one side of a surface to another side of the surface.

Efficiency towards solar protection of the external wall is that the selective absorption and emission characteristics of sure materials, particularly beneath hot conditions. Materials that replicate instead of absorb radiation have lower temperatures inside the building.

CONCLUSIONS

Architects must understand the importance of bioclimatic design and also the significance of sustainable technological aspects of design in architecture. Bioclimatic homes will not only be good for the owner of him, but will be even better for the environment. Bioclimatic buildings provide not only a large reduction of the environmental impacts, but also a reduction of operational costs with a minimum of additional investments which makes a more appealing design for

many new builders. Sustainable bioclimatic design has a huge impact on the economy, but also not only much smarter, money saving, environmentally safe way to design buildings.

Buildings contribute significantly to the greenhouse effect, climatic change and have a severe overall environmental impact and are intensive energy consuming, so following are the recommendations for a perfect bioclimatic design:

- By preserving the environment and using its resources appropriately as inhabitants of buildings, we can make our lives, our health and well being more comfortable.
- We must ask ourselves who pays for this consumption and why because the energy we consume in buildings is costly.
- For getting maximum energy benefits we must be aware of proper design, materials and use of technologies, we can apply them as far as possible in each case.
- We all affect the energy performance of the buildings we live in and every action and can have energy benefits of our building.
- By utilizing bioclimatic design strategies we can make use of this knowledge for passive heating. Buildings should be well insulated from cold and heat using suitable insulation. We must protect the buildings from the sun as we protect our self.
- Natural cooling, compared to air conditioning, not only provides energy saving, economic and environmental benefits for the sake of human comfort and well-being.
- We can reduce the internal loads of buildings and utilize natural resources accordingly.
- We must solve the problem of glare and must understand to utilize daylight.
- For the rational functioning of buildings we should ensure the efficiency of passive systems and energy saving techniques and we should not forget to open and close windows and blinds appropriately.
- Bioclimatic energy efficient buildings improve the quality of life for their users and we should not forget that energy consumption causes environmental degradation.

Finally bioclimatic architecture cooperates with energy saving for acclimatization regarding self-sufficiency that refers to a house independent from centralized supply networks like electricity, gas, water, and even food that is accomplished by use of locally available resources like water from wells, streams or rain, energy from the sun or the wind, electricity from the sun, food from orchards, producing enough energy to not need the grid, etc.

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