Bioclimatic Architecture In High Rise Buildings

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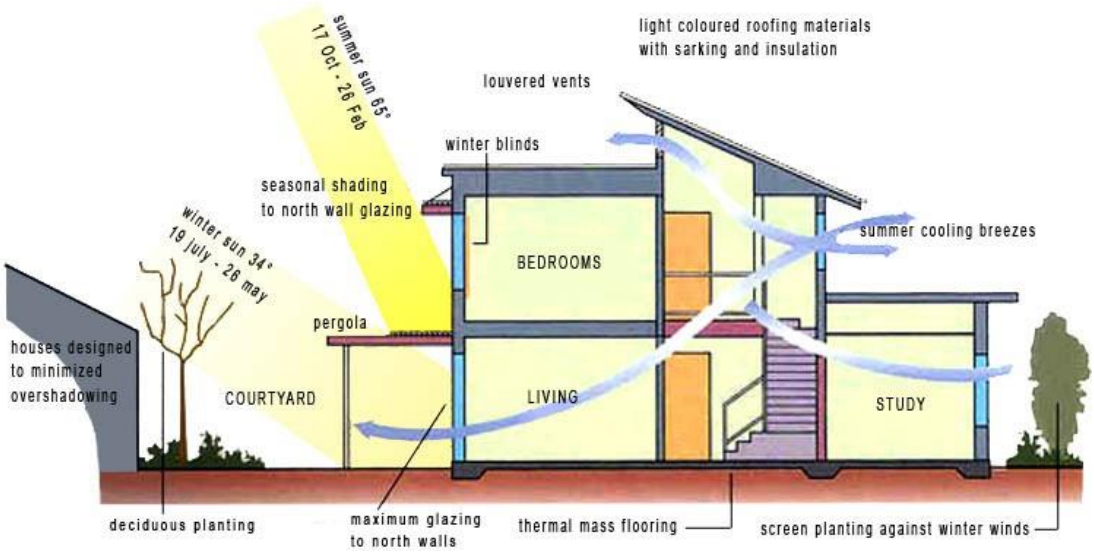
Abstract- The purpose of this research paper is to discuss the utilization of Bioclimatic Architecture in high rise building. Bioclimatic is a sector of architecture that dominated by the principles of ecology and sustainability. Building design that take into account climate and environmental conditions to help achieve optimal thermal and natural comfort into a low carbon emission building is essentially bioclimatic architecture. It emphasis on urban areas and buildings that are designed in order to fully cover their energy requirements without induce environmental damage. The paper brief on the concept and techniques such as Passive Solar Architecture, Active Solar Architecture, Renewable energy, Sustainable Architecture and Self- Sufficient house in High Rise Building through the bioclimatic tower of singapore.

Index Terms- Bioclimatic Architecture, Passive Solar Architecture, Active Solar Architecture, Renewable energy, Sustainable Architecture, Self Sufficient house.

I. INTRODUCTION

- Bioclimatic design is defined as an architecture which has a connection with nature and it refers to the design of buildings and spaces based on local climate, aimed at providing thermal and visual comfort, making use of solar energy and other environmental sources.
- The main aim of bioclimatic architecture is to bring about urban areas and buildings that are designed in order to enclose their energy requirements without induce enivironmental damage.



source: http://www.croftandassociates.com/croft-and-associates-architecture/bioclimatic-design

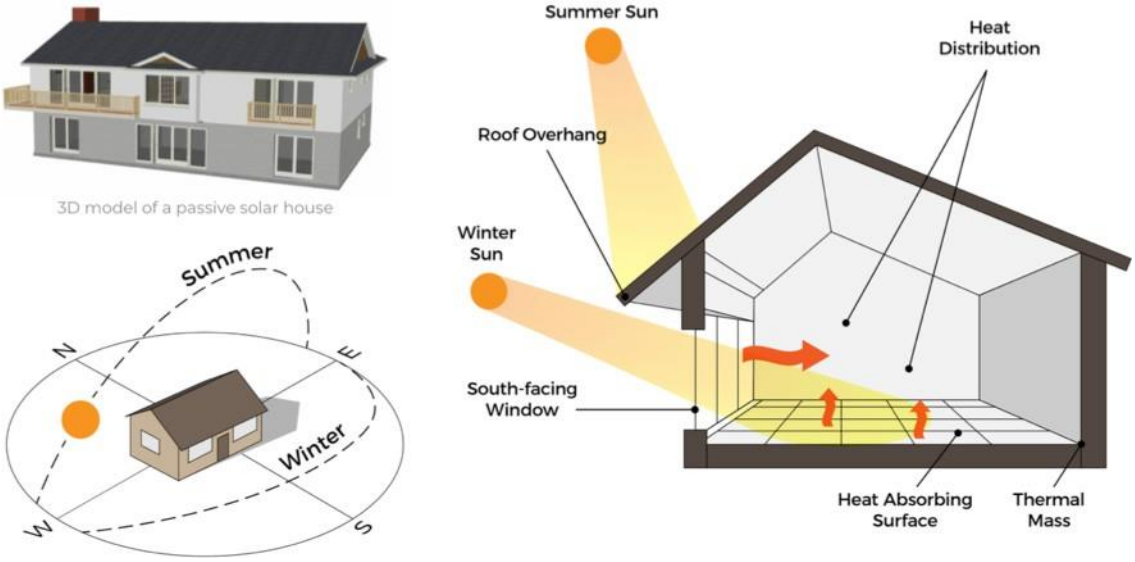
- This architecture seeks perfect cohesion between design and natural elements (such as the sun, wind, rain and vegetation), leading us to an optimization of resouces.

- 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 or mixed mode ventilation.

1.1. Basic Concepts and Techniques

Bioclimatic architecture deals exclusively with building design and materials to achieve energy efficiency.

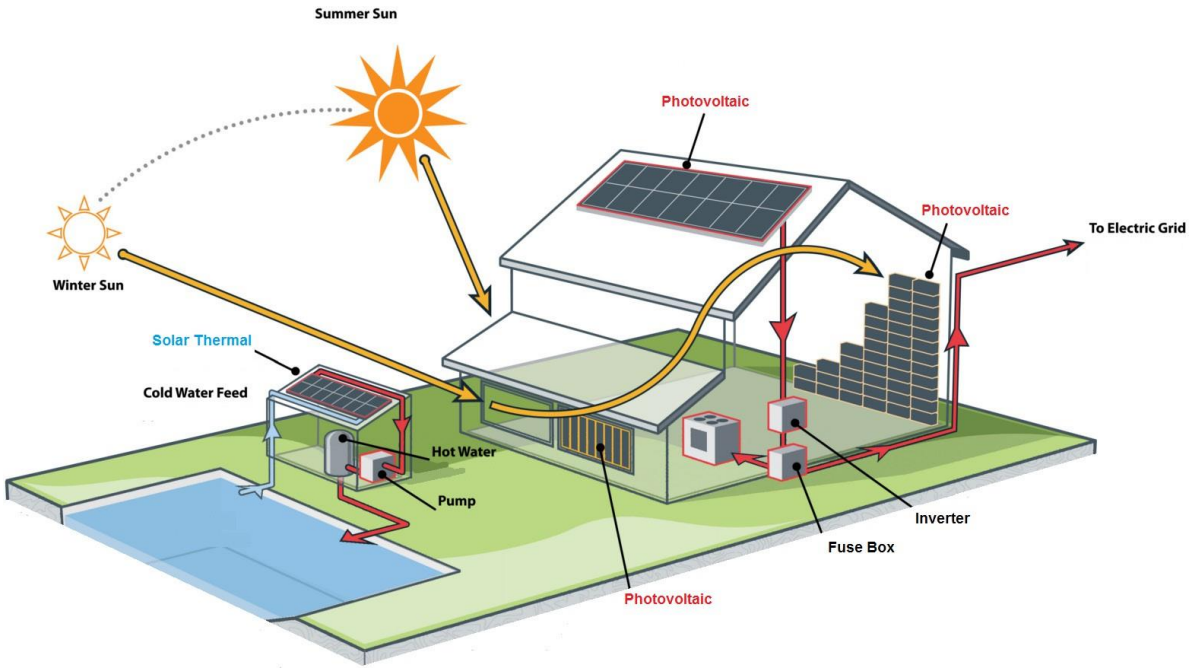
*** Passive solar architecture.**
These techniques refer to design of buildings for the efficient use of solar energy. This architecture type doesn't use mechanical system (thus the term passive) hence it is firmly



source: http://www.dkcontractors.biz/passive-solar-design.html

connected to bioclimatic architecture, though the later also deals with other non-solar cli- matic elements. That's why the term bioclimatic is a little bit more general, and inclusive, although both work in the same direction.

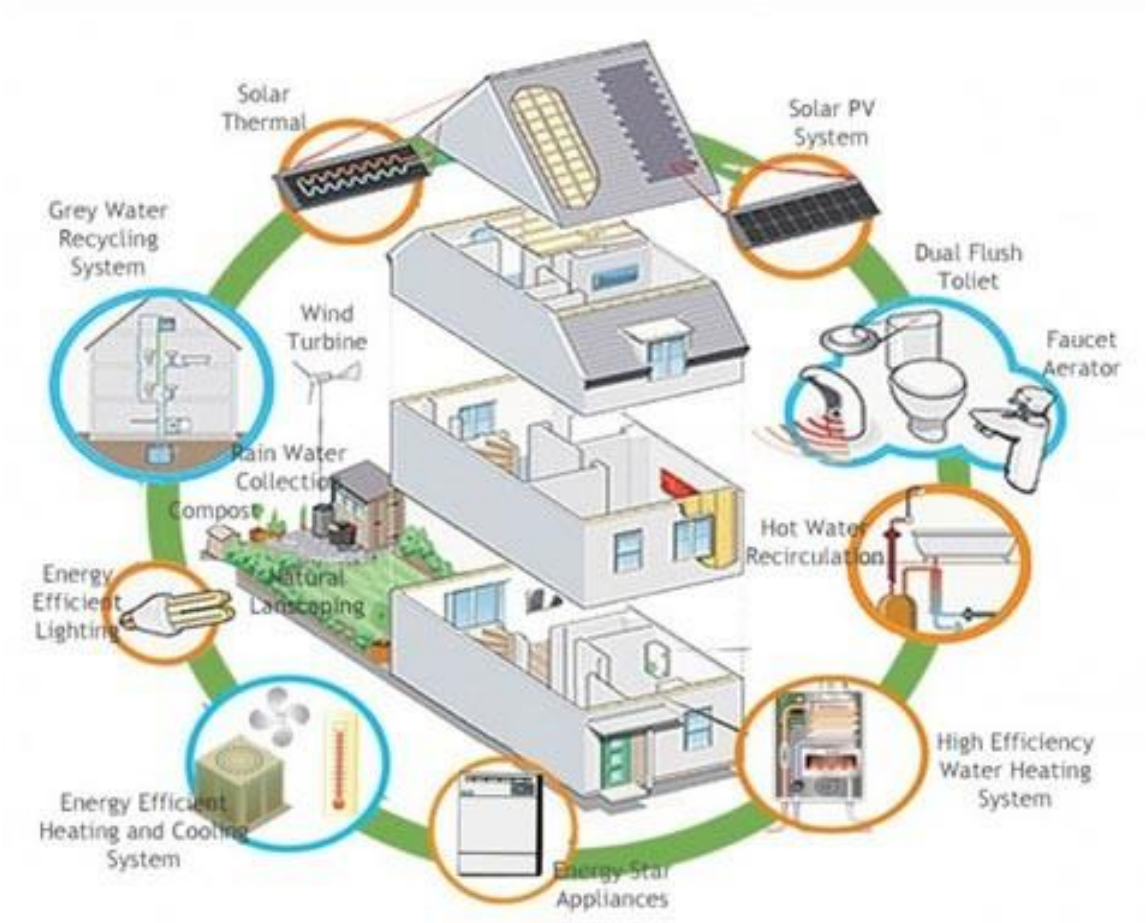
*** Active solar architecture.**
These techniques refer to taking advantage of solar energy by the means of mechanic and/or electric systems for heating and electric conversion that is photovoltaic panels. They may accompaniment a bioclimatic house and it helps with energy loads of the users.



source: http://sisahub.com/home-5/

* **Renewable energy.**

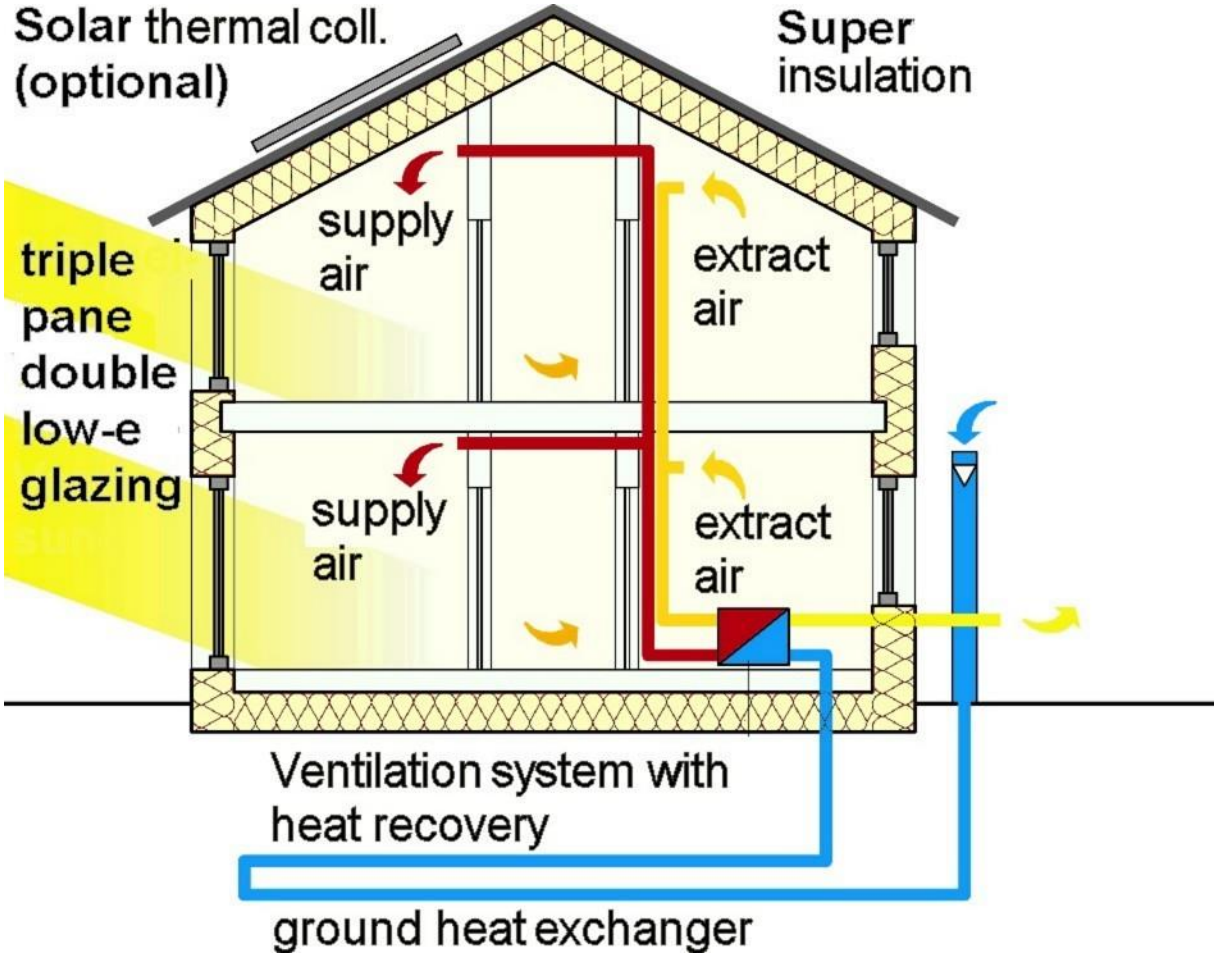
Sources of energy that cannot be enervated. Bioclimatic architecture incorporates solar radi- ation for heating and cooling. Other kinds of renewable energies include as wind or hydro, and methane generation from organic waste that is biomass.



source: https://altaintegra.com/publications/articles/green-building-sustainable-renewable-energy/

*** Sustainable architecture.**

These techniques aiming to a minimum environmental impact of all the processes implied in building from materials in which manufacturing processes that don't produce toxic waste and don't consume much energy, also building techniques are being used for minimum environ- mental damage, building location also its environmental impact, energy consumption and its impact, and the recycling of materials when the building has achieve its function and is demol- ished.

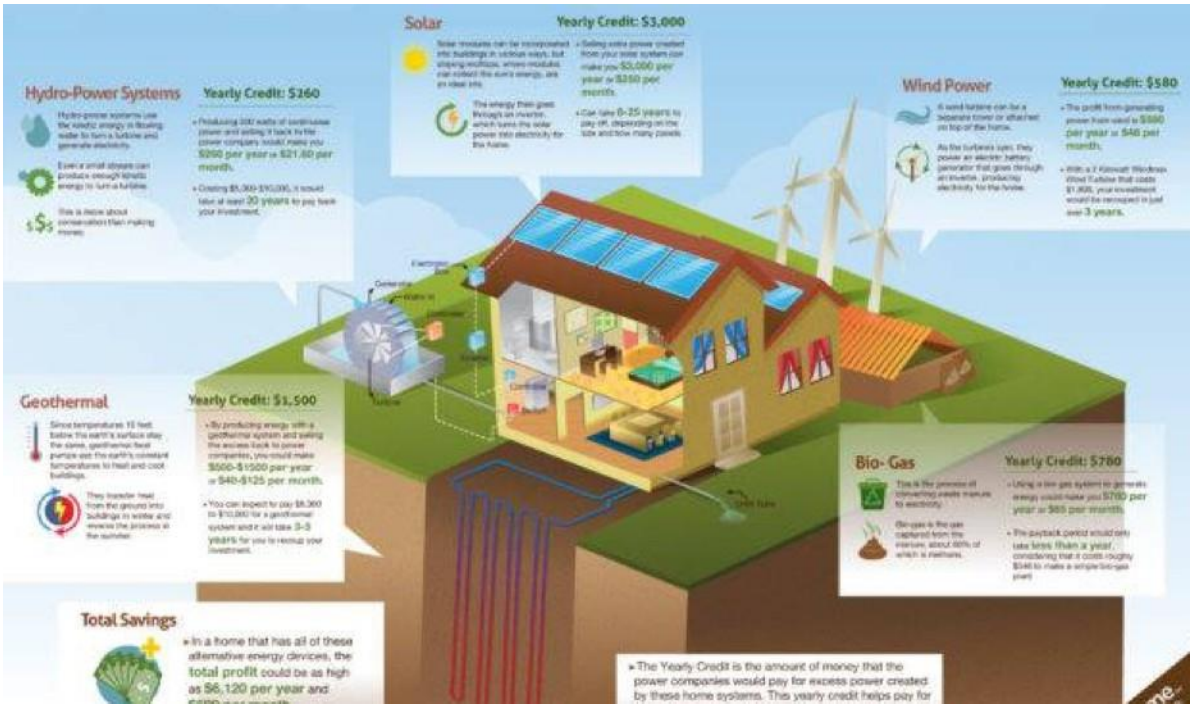


Source: https://en.wikipedia.org/wiki/File:Passivhaus_section_en.jpg

Bioclimatic architecture helps in reducing the energy consumption of the building and also enhanced when merged with sustainability architecture techniques.

*** Self-sufficient house.**

It refers to a house independent from centralized supply networks that is electricity, gas, water, and even food, accomplished by use of locally available resources. Examples include, water from wells, streams orpics" rain, energy from the sun or the wind, electricity from the sun, food from orchards. Bioclimatic architecture cooperates with self-sufficiency regarding energy saving for climatizaton



source: https://cdn.senaterace2012.com/wp-content/uploads/self-sufficient-home_867697.jpg

The main considerations of Bioclimatic Design are:

1. The study of natural elements of the site: topography, geology, air, sun and wind and vegetation including the specific microclimate of the site to determine optimal position of the building.
2. Consideration of complexity of form vs. building compactness and its impact on energy use; i.e. compact shape in cold climate and maximizing exterior wall area to encourage natural cooling breezes in hot and humid climate.
3. Use of correct landscaping features and planting to minimize water use, provide shading, windbreak
4. Designing building form to optimize natural ventilation.
5. The use of breathable exterior wall system using breathable exterior wall finish, breathable house wrap, natural insulation and mineral-based interior paints to create synergistic effect that passively regulates interior climate.
6. Selection of colors of exterior finishes to either reflect or accumulate heat, depending on climate; interior colors will influence the amount of artificial light required to light up a room.
7. Solar access analysis to determine building solar orientation.

Data collection

II. The Bioclimatic Tower of Singapore

Singapore, also known as garden city is now rising up with a new inspirational green concept,' ecological design in the tropics '(EDITT) ttower by Ar. Ken Yeang of TR Hamzah and Yeang Architects from Malaysia and sponsored by the National University of Singapore

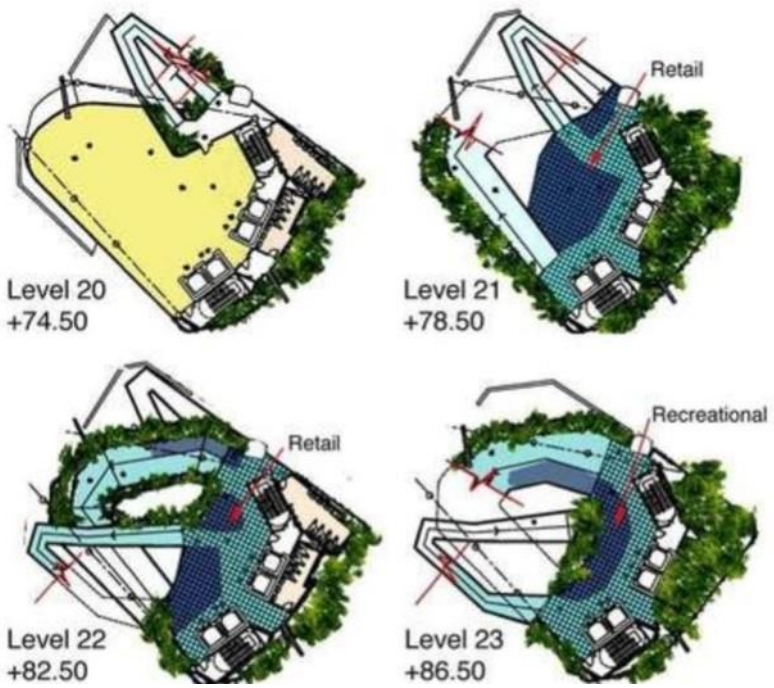
- It ia a 26 storey building
- Sited at the junction of Waterloo Road and Middle Road
- Tropical climatic zone and rainforest vegetation zone
- Structure is considered as a 'loose-fit' multi-use high rise building
- Site area is 838 SQM
- Gross area is 6,033 SQM (gross floor area is at a plot ratio of 7:1)
- Net useable area 3,567 SQM (FSR 4.3:1) with an area of planting and vegetation of 3,841 SQM

Source: Editt tower singapore by tr hamzah & yeang

This building is initially conceived as an exhibition building incorporating exhibition spaces, auditorium, retail and office use, with the potential convert later into a full office tower or apartment building.

2.1. Featuring

1. Planted courtyard and walls
2. Recycled water system
3. Photovoltaic panels
4. Natural ventilation
5. Biogas generation
6. Removable floors
7. Reducing use of mechanical air conditioning systems
8. Less use of artificial lightning
9. The EDITT building is very green based and eco friendly



1. Walls and Courtyards

Indigenous plants within a 1 mile radius of the site were identified to be incorparted in the design that will not compete with the previous indigenous species of locality.

Species are selected not to compete with others within surroundings. “vegetation percentages” represent of area’s landscape character. Factors influencing planting selection are:

- Planting depths
- Light quality
- Maintenance level
- Access
- Orientation
- Wind walls/ solar panels/ special glazing

Vegetation placements within the tower at different heights respond to the microclimate sof each individual sub-zone at the tower.

source: Singapore's Ecological EDITT Tower

2. Water system

Water-recycling

- Water self-sufficiency (by rainwater collection and grey- water reuse) in the tower is at 55.1%
- Water requirements = 20 gallons/day/10 sq.m. gross area + 10% wastage
- Total rain-fall catchment area = 518 sq.m.
- Singapore average rainfall / annum = 23.439m
- Total rain-water collection = 12,141 m^3 per annum
- Water self sufficiency = 12,141/22,019 * 100 = 55.1% Water-purification

- Rainwater collection system comprioses of roof catchment pan and layers of 'scallops' located at the building's façade to catch rain-water running off its sides. Water flows through gravity-fed water purification system, using soil –bed filters.
- The filtered water accumulates in a basement storage-tank, and is pumped to the upper- level storage-tank for reuse (e.g. for plants-irrigation and toilet-flushing)

3. Energy

855 square meters of photovoltaic panels will provide for 39.7% of the building's energy needs.

4. Natural ventilation

The use of natural ventilation is incorporated into the building to maximize fresh airflow to the vegetation and help minimize energy use. Wind is used to create internal conditions of comfort by "wind-walls" that are placed parallel to the prevailing wind to direct wind to internal spaces and skycourts for comfort cooling.

5. Biogas generation

Is the process of using decomposed material to provide gas in which can be used to produce energy along with fertilizer for the living walls .
The biogass system will provide all the fertilization for all plants on site.

III. Conclusion

At last I would like to conclude, this technique of Bioclimatic architecture in high rise buildings are to create good, healty and comfortable environment for those who work or live in the building, in respect of livelihood environment and green space. This is the new medium for inhabitants of building who can connect to natural world and can also save the source of energy by replacing to biogas, water- system, thermal system and many more.

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