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INDOOR OUTDOOR GREEN PLANTATION IN BUILDINGS - A CASE STUDY

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Abstract

The green building approach goes beyond reducing energy use or improving indoor air quality, it's actually about addressing the whole system not just the pieces. In addition to direct cost savings, eco-friendly buildings can provide indirect economic benefits to both the building owner and society. For instance, eco-friendly sustainable building features can promote better health comfort, well - being and productivity of building occupants, which can reduce levels of absenteeism and increase productivity. The aim of this study is to know the importance and significance of the various factors, involved in construction of the eco-friendly.

Key words: Indoor plants, Outdoor plants, Environment and Building.

1. Introduction

Incorporating Green plants into the skyscrapers has some design possibilities. There are two options for building to make it green. Plants can be integrate at outside and at inside. For outside, it can be done on roofs, outer vertical walls and for inside, it can be a living wall or biofilter, or potted plants placed in atriums, indoor rooms to act as a pocket of green patch into these vertical cities. The study covers both the sectors of this aspect to a building design, i.e. green outer and green inner.

2. Green Roofs (Green outer)

An aerial view of most urban areas shows swathes of asphalt, black tar and gravel - ballasted rooftops. Heat radiates off of the dark roofs, and water rushes over the hard, impermeable surfaces. Studies shows that most traditional dark colored roof surface absorb 70 % or more the solar energy striking them, resulting in peak roof temperature of 65 - 88 degree Centigrade (Yeang, 2006). These heat absorption and monotony of these common roofs can be break though green roof tops. Green rooftops have begun to appeal to homeowners, businesses and even cities as an attractive way to promote environmentalism while solving the problems of conventional roofs. Green roofs supplement traditional vegetation without disrupting urban infrastructure to take a neglected space and make it useful. The term "green roof" is generally used to represent an innovative yet established approach to urban design that uses living materials to make the urban environment more livable, efficient, and sustainable. Other common terms used to describe this approach are eco roofs, and

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vegetated roofs. Green Roof Technology (GRT) is the system that is used to implement green roofs on a building (Banting *et al*., 2005). Green roofs replace the vegetated footprint that was destroyed when the building was constructed. The concept of rooftop gardens is introduced.

With the aim of reducing heat gain into a building and modifying, the ambient conditions through photosynthesis and evapotranspiration of plants. Results from several studies suggest that rooftop gardens can effectively cool down the immediate ambient environment by 1.5 degrees (Wong *et al*., 2002). Generally, the surface temperature readings collected from the rooftop garden were found to be lower than that recorded on a barren concrete rooftop. The thermal insulation of a building is improved in the presence of plants. High relative humidity (RH) at the rooftop garden was also observed due to the presence of plants. To prevent discomfort due to high humidity, adequate natural ventilation should be ensured (Wong, *et al.* 2002). According to Benting (2005), Green roofs are constructed using components that:

- Have the strength to bear the added weight
- Seal the roof against penetration by water, water vapour, and roots
- Retain enough moisture for the plants to survive periods of low precipitation, yet are capable of draining excess moisture when required provide soil-like substrate material to support the plants
- Maintain a sustainable plant cover, appropriate for the climatic region
- Offer a number of hydrologic, atmospheric, thermal and social benefits for the building, people and the environment; protect the underlying components against ultraviolet and thermal degradation.

Fig. 1: An extensive roof covers thegarage provi ding an aesthetically pleasing view for the building occupants

3. Green Wall (Green outer)

The green facade is the outer wall which can be free - standing or part of a building, partially or completely covered with vegetation and in some cases, soil or an inorganic growing medium. They are also referred to as living walls, bio walls, or vertical gardens. The vegetation for a green facade is always attached on outside walls, but some cases it can also be used interiors (Knowles, 2005). Green walls are regularly used throughout Europe and Asia, and in Tokyo they are considered more valuable than green roofs for cooling the city. But, the vegetated green wall as Sharp (2007) said is still new to the U.S. with the exception of ivy-covered buildings whose aggressive, self-clinging plants grow without specially engineered support and are known to damage walls and hinder building maintenance. The green walls being advocated today are designed and engineered with a support structure. Based on current applications and data from the experience of green roofs, green walls can offer considerable cost savings to both the public and private sectors. For example, the reintroduction of vegetation into cities has been correlated with the reduction of the urban heat island effect, and therefore will reduce energy consumption (Sharp, 2007). Cities are cooler and quieter through shading, evaporative transpiration, and the absorption of sound by green walls.

4. Green Wall Categories

There are two main categories of green walls: green facades and living walls. Green facades are made up of climbing plants either growing directly on a wall or in specially designed supporting structures**.** The plant shoot system grows up the side of the building while being routed to the ground. On the other hand, in a living wall the modular panels are often comprised of polypropylene plastic containers, geo textiles, irrigation systems, a growing medium and vegetation.

Invented a vertical garden that relies on an innovative way to grow the plant walls without soil. The garden walls are not heavy and can be installed outdoors or indoors and in any climatic environment. For indoors some type of artificial lighting is required, while the watering and fertilization is automated. The walls act as a phonic and thermal isolation system, as well as an air purification device.

Fig - 2: Vertical and verdant, living wall systems on buildings

About 150 plant species are growing at Quai Branly, where the wall is composed of a polyvinyl chloride (PVC) sheet on a metal frame. The sheet serves as a waterproof layer, provides rigidity, and prevents roots from penetrating the drywall and stud assembly beyond. The plants grow in a layer of acrylic felt stapled to the PVC. An automated drip irrigation system supplies water and periodic fertilization. Maintenance, primarily trimming of overgrown plants, is conducted about three times a year. However, the Aqua quest project uses rainwater collected from the roof and stored in an underground cistern to irrigate the living wall, as well as to flush toilets and refill freshwater fish tanks. Sharp (2007) says he is keen to design a vertical garden as part of a gray water recycling system that would capitalize on the water's nutrients as fertilizer and cleanse it for further use. The living wall is great for urban areas or dry and arid areas because the garden makes great use of vertical areas, which are abundant in cities, and allows for less evaporation than horizontal gardens.

5. Green wall support Methods

For the green vegetated wall the maximum height, built so far is about 40 feet high and 120 feet wide. For the skyscrapers which are above 50 stories or about 100 stories have a large amount of wall surfaces exposed to sun need to be covered with the green wall. But, the excessive height and the wind pressure need to be considered at the upper parts of the building. Some design consideration suggested could as follows.

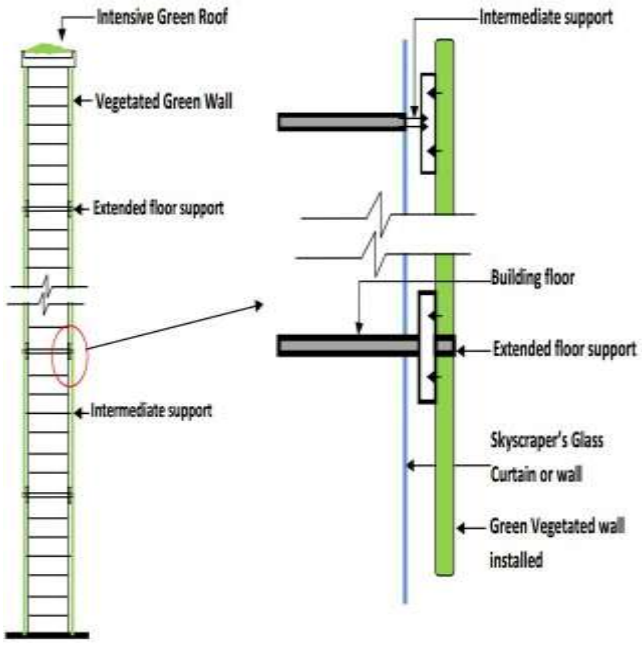

Fig - 3: Proposal for green wall Installation and details

At the upper most floors of a skyscraper, where height and wind pressure is excessive, more frequent intermediate supports or structural joints are suggested. Vegetation can be used as a curtain wall to cover the excessive glass surface of the skyscrapers. The glass windows need to be tinted instead of a highly reflective one. Adequate natural lighting and ventilation through the glass windows should be ensured**.**

6. Planting design in built forms for economic, social and environmental benefit

Ground coverage, green walls, sky courts, indoor plants and roof top gardens works together to make the skyscraper 'Green'. The vertical landscaping is one variation on the creation of roof top gardening another variation is the green wall, which encapsulates the principle of a single element with multiple functions (Yeang, 2006). The breathing wall with vegetated facade according with the sky courts tends to focus to develop the building as an ecologically complex and stable plant, microbial and human community, that helps to improve the air quality in an interface between natural processes and the built structure's environmental system. The whole system works for the social, ecological and environmental benefits. If this system multiplies and implemented to all the skyscrapers in an urban area the beneficiary will be all the species including the humans. The results will be the noticeable decrease in urban heat island, rapid reduction of energy consumption and refreshing air for a healthy environment.

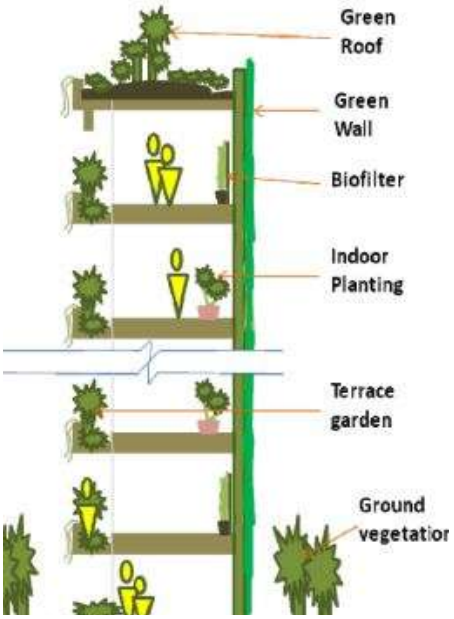

Fig - 4: Integrated planting design and Green roof, green walls create new urban habitats

7. Bio filters (Green Inner)

There is another type of green wall, known as 'Active living walls' or 'Bio filter', which is used in indoors incorporating with building's HVAC system based upon the sciences of biofiltration and phytoremediation. "Living walls with biofilters increase the capacity of air filtration". These biofilters replace high tech, energy consumptive air filtration systems with living walls that harness the natural phytoremediation capabilities by drawing air through the root system of the wall of tropical houseplants to effectively remove common airborne pollutants (Truett, 2003). Beneficial microbes actively degrade the pollutants in the air before returning the new, fresh air back to the building's interior (Knowles *et al.*, 2005). In the breathing wall filtration takes place right in the active living wall. Basically, dirty air, drawn in from indoor space, makes close contact with the constantly flowing water within the wall, pollutants are moved from air to water. Water flows over a rock wall covered by moss and other plants, then into a small pond. Contaminants in the air are absorbed by the vegetation and consumed

by microorganisms in the soil, improving air quality. Once dissolved into the water, pollutants are attacked by biological components on the wall itself, and are metabolized into a harmless.

Interior landscaping has become increasingly popular during the last 30 years. Most architects now include plants in their design specification for new shopping centers, office complexes and other public areas, and people expect to see when they walk through the door. Thus, plants became such important building accessory. The main reason is indoor plants look attractive people get charmed by the graceful arch of palm leaves or the exotic beauty of orchids. However, recent research has shown that the value of plants goes far beyond the purely aesthetic. Plants are actually good for the building and its occupants in a number of subtle ways and are an important element in providing a pleasant, tranquil environment where people can work or relax. Plants can be used to decrease noise levels in an office. According to Green Plants for Green Buildings, if plants are placed strategically, they can help to quite down the office. A small indoor hedge placed around a workspace will reduce noise by 5 decibels (Jacobs, 2008).

Fig - 5: Indoor Plants (Green Inner)

Along with decreasing noise levels, there is more benefit to adding green plants to workplaces. The presence of plants in the office not only aesthetically pleasing but also helps increase workers productivity, reduce stress and improve air quality. According to a Texas A & M University and Surrey University study, participants also reported feeling more attentive when plants were present. Participants who worked in an environment with plants were 12 % more productive and less stressed than those who worked in an environment with no plants (Gilhooley, 2002).

Plants can also improve the indoor environmental quality. Research from the Environmental Laboratory Center in Mississippi showed that rooms with plants contain 50 % to 60 % fewer of airborne molds and bacteria than rooms without plants (Gilhooley, 2002). The plans clean the office air by absorbing pollutants into their leaves and transmitting the toxin to their roots, where they are turned into food for the plant. With cleaner office air building occupants are less likely to be sick, thus increasing productivity and decreasing absenteeism. In buildings where sick building syndrome is common, employees should each have a plant within 6 to 8 cubic feet of where they spend most of the day (Jacobs, 2008).

8. Conclusion

Skyscrapers, though considered as a negative structure over the earth will remain constructed as the population increased and so their demands. These tall buildings posses a lot of bad affects over our economy, environment and society by their excessive energy consumption, toxic materials using and destroying ecological balance. But, as we cannot stop their construction all of a sudden, we need to search for alternative solutions to retrofit these harmful effects. A greater amount of energy consumption for its cooling as the effect of excessive heat gain by its exposed concrete roof, vast glass curtain and concrete wall facade. Poor indoor environment quality for using toxin materials which often emits Volatile Organic Components or VOCs. It also results for air tight situation for the air conditioning purposes. Negative impact on environment as its construction destroys the site's ecology, flora and fauna. Its highly reflective glass surface often confused the migrating birds

with the reflection of sky and trees cause the bird's death as they try to fly into it.

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