NOVATEUR PUBLICATIONS
INTERNATIONAL JOURNAL OF INNOVATIONS IN ENGINEERING RESEARCH AND TECHNOLOGY
[IJIERT] ISSN: 2394-3696 Website: ijiert.org
VOLUME 8, ISSUE 5, May. -2021

GREEN SKYSCRAPER: A WAY TO SUSTAINABLE DEVELOPMENT

Riya Goyal
B.E 3rd year, Dept. of Civil Engineering,
Punjab Engineering College, Chandigarh, India
*riyagoyalpec@gmail.com

ABSTRACT
Green Skyscraper concept has emerged to mitigate the effects of the increasing impact on the environment and it can work as a smart solution to improve the building construction process. This paper presents the need of sustainable development especially in the developing countries like India. The provision of integrating plants into skyscraper includes the four possible options like Green Roof, Green Wall, Bio-filter and indoor potting plants which can be incorporated into the design. Green roof can reduce 50% of cooling load; Green wall can reduce 10% indoor temperature; whereas Bio-filter and internal plants purify air by 50-60%.

Keywords: Green skyscraper, Integration of plants, Green Roof, Green Wall, Bio-filter, Environmentally optimized solution.

INTRODUCTION:

Green Skyscraper refers to both the practice and product of creating tall buildings which are better for our health, environment and economy. It will be environmentally responsible and resource efficient throughout its life-cycle, as well as a sustainable and high-performance building for economy, utility, durability, and comfort (EPA). The theory of 'Green' Skyscraper has been notably shaped by the writing of Ken Yeang. He proposes, in his theories, the interconnecting measures regarding the use of energy, water and light. He further relates these to green plants, local climate, and ecology to the spatial conditions and the functions of the building [6].
Definitions of green skyscraper vary but the green movement has three main goals [8]:
• Ensure a healthy, productive indoor environment for occupants to work and live.
• Prevent negative impacts to our environment and improve its health.
• Reducing operating cost and increase profitability for building owners through energy and resource conservation.

1.1 TECHNIQUES OF INTEGRATING PLANTS:

Incorporation of plants can be both outside and 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.

1.1.1 Green roofs: Green Outer

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. 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℃ [14].

1.1.2 Green Wall: Green Outer

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 [12]. Cities are cooler and quieter through shading, evaporative transpiration, and the absorption of sound by green walls.

1.1.3 Biofilters: Green Inner

There is another type of green wall, known as 'Active living walls' or 'Biofilter', which is used in indoors incorporating with building's HVAC system based upon the sciences of biofiltration and phytoremediation. According to a study done at the University of Waterloo,[5] mentioned, "Living walls with biofilters increase the capacity of air filtration".

1.1.4 Indoor Plants: Green Inner

Most architects now include plants in their design specification for new shopping centres, office complexes and other public areas, and people expect to see when they walk through the door. Thus plants became such important building accessory. 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 [3] [4].

SPECIFIC AIM:

To assess how the integration of plants into the skyscraper design can help to reduce the energy use, improve the environment and enhance the living quality.

OBJECTIVE:

1.To Analyse the impact of green skyscraper on energy consumption and living environment
2.To suggest some alternative solutions to eliminate the drawbacks and propose some guidelines for good practice to make it viable economically, socially and environmentally.

RESEARCH BACKGROUND

1). Mr. Jiau Zuo and Mr. Zhen Yu Zhao (2014) carried out their research work on the "**Green Building Technology**" and stated the current status and the future agendas for the same. They presented a report on a critical review of the existing body of knowledge of researches related to green building. They focused on the common research themes such as the definition and the scope of green building, quantification of benefits of green buildings compared to conventional buildings, various approaches to achieve green building.They found that the existing studies predominantly focusses on the environmental aspects of the green building. According to them, the future opportunities such as effect of climatic conditions on the effectiveness of green building assessment tools, validation and real performance are unique demands of specific population. Their research showed that these studies can generally be classified into three categories namely the definition and scope of green buildings; benefits and costs of green buildings and the ways to achieve green buildings. The authors concluded that special population such as aged people, student and teacher could be made more aware about indoor environmental quality as they shape the attitude and behaviour of the future practitioners.
2). Ignacio Zabalza Bribian ; Antonio Velvo Capilla ; Alfonso Aranda Uson(2011) had published the paper on "**Building and Environment**" in which they presented the results of the study comparing the most commonly used building materials with same eco materials by using three different impact categories . They encouraged the study by analysing their possibilities for improvement and providing guidelines for materials selection in the eco design of new building and also in rehabilitation of existing buildings. The researchers concluded that in order to avoid the production of materials affecting the natural resources, it is necessary to promote the best use of these innovative techniques. Plants can replace the use of finite natural resources with the waste generated in different production processes. This also involves the commitment to reuse and recycle and always minimize the transport of the starting materials and products which would promote the use of natural resources.
3). Ries; Robert Bilec; Melissa M Gokhen; Nurvi Mehmet Needy and Kim Lascola(2006) had published a paper on the "**Economic Benefits Of Green Buildings**" which was a comprehensive study supported with a case study. They stated that in building design and construction, both the green building and standard construction techniques are considered for many building projects. Their research investigated the relationship between the composite conventional and green building features which would contribute to the development of the green building metrics. They also evidenced the increase in productivity along with health and safety with the help of green buildings.

4). T.Rameshravi & Prakash k.k Shukla(2010) carried out research on "**Life Cycle Energy Analysis of the Buildings**" in which they concluded that buildings demand energy in their life cycle right from its construction to demolition. Building lifecycles energy demand can be reduced by reducing its operating energy significantly through the use of active and passive technologies even if it leads to a slight increase in embodied energy. The researchers concluded that the analysis of cases found in literature showed that life cycle energy use of buildings depends on the operating (80-90%) and embodied (10-20%) energy of the buildings. Normalised life cycle energy use of conventional residential buildings falls in the range of 150-400 kwh/m2 per year and office buildings in the range of 250-550 kwh/m2 per year [4].Also their research stated that most of the case studies found in literature are from cold countries where oil or gas is used for large part of the operational phase, that is for space heating. However, according to the researchers in non-cold developing countries like India, Thailand etc., electricity is derived mostly from fossil fuels is been used in operation phase for space cooling, lightning and other purposes [4]

5). Omer Tatari, Murat Kucukvar(2011) published a paper on "**Cost Premium Prediction of certified buildings**" in which they stated that the buildings have a substantial impact on the economy, society and the environment. Along with the increasing environmental consideration of the building impacts, the environmental assessment of buildings has gained substantial importance in the construction industry. In their study, an artificial technique model was built to predict cost premium of LEED (Leadership in Energy and Environmental Design) based certified green buildings based on LEED categories. The researchers concluded that the planned future work included utilization of the expanded data sets and the closer study of the interdependence of LEED points and its effect in prediction.

CONCLUSION

The aim of the study was to find out the possible ways to integrate plants into skyscrapers and assess how the integration of plants into the skyscraper design can help reducing the energy use, and enhance the living quality. Throughout the work it was studied to establish the necessity of planting into skyscrapers, for the wellbeing of our economy, society and the environment. To fulfill the requirements of objectives the findings are organized accordingly throughout this study. For example, the provisions of integrate plants into skyscraper includes the four possible options like, Green roof, Green wall, Biofilter and Indoor potting plants. Discussion and recommendations were made to overcome some of the drawbacks and some guidelines were proposed for good practice to make the 'Green Movement' viable economically, socially and environmentally. Thus the study fulfilled its aim and objectives to its full extents for designing a Green Skyscraper with incorporating the plants into it.

People need nature for regeneration. Humans are only able to live on this earth through plants and vegetation in the first place, and they can learn a great deal from nature and its cycles[10]. 'Planting' concept requires integral and interdisciplinary planning. Even when determining the basics, and in the preliminary planning, it is necessary that the specialist engineers take part and contribute their knowledge. Exterior and interior planting require integral planning and a symbiosis between nature and technology. This concept is sustainable, ecological and with the correct planning, results in high acceptance and quality in both outdoor and indoor areas. Economically, the green architecture is cost effective and future-orientated with growing acceptance and increasing commercialization and, of course, it is beautiful.

'Planting' concept requires integral and interdisciplinary planning. Even when determining the basics, and in the preliminary planning, it is necessary that the specialist engineers take part and contribute their knowledge. Exterior and interior planting require integral planning and a symbiosis between nature and technology. This concept is sustainable, ecological and with the correct planning, results in high acceptance and quality in both outdoor and indoor areas are achieved. The concept protects our environment. Economically, the green architecture is cost effective and future-orientated with growing acceptance and increasing commercialization and, of course, it is beautiful.

For the ever growing cities, the construction of sky high buildings could not be stopped rather the demand increases day by day. So, this is the high time to look forward to restore the nature and bring back it into the built environment. Proper utilization of the benefits and more public awareness on this regards can change our environment drastically within near future if all the processes are followed. For the best benefit the building orientation and the climatic condition of the site should be necessary to consider while designing green

buildings besides incorporating plants into the design. We hope that the few drawbacks of technologies will overcome soon and more options to plant integration into the skyscrapers will draw the builder's attention. Thus we can have a better environment as well a better future for our next generation.

REFERENCES

1) Ignacio Zabalza Bribian, Antanio Valero Capilla (2011) "Life cycle assessment of building materials: Comparative analysis of energy and environmental impacts and evaluation of the eco-efficiency improvement potential," Building and Environment,2011, vol. 46, 1133-1140.
2) JianZuo and Zhen Yu Zhao (2014) "Green Building research- current status and future agenda: A review," Renewable and sustainable energy reviews, 2014, vol. 30, issue C, 271-281.
3) Jacobs, Hayley. (2008a) "Green Plants for Green Buildings," Retrieved on April 08, 2009 from http:// greenplantsforgreenbuildings.org/about.htm.
4) Jacobs, Hayley. (2008b) "Improving Environmental condition in the Workplace," Facility Management Journal. Retrieved on May 20, 2009.
5) Knowles,L.,(2005), Living Wall: A Feasibility Study for SLC, Final Report, University of Waterloo.
6) Lepik, Andres, (2004), SKYScrapers, PRESTEL, Germany, ISBN 3-7913-3155-8.
7) Omer Tatari; Murat Kucukvar (May 2011) "Cost premium prediction of certified green building- A Neutral Network Approach," Building and Environment 46(5): 1081-1086.
8) Rachael, Jamison, (2005), "Green Building Movement," Washington State Department of Ecology, Retrieved on Aug 12, 2009.
9) Ries, Robert Bilec, Melissa Gokhan(September 2006) "The economic benefits of a green building," The Engineering Economist 51(3):259-295.
10) Schempp, Dieter (2009), Green – Architecture, Plants in Buildings, the Cycle of Nature, Creating an Inspiring, Healthy Indoor Climate. Tübingen, Germany.
11) Shahrina Afrin (2009), Green Skyscrapers: Integration of plants into skyscrapers, KTH Stockholm.
12) Sharp, R. (2007) "6 Things You Need to Know About Green Walls", Building Design and Construction, BD&C News, Web Article, Retrieved on Aug 12,2009.
13) T.Ramesh, Ravi Prakash, KK Shukla (October 2010) "Life cycle energy analysis of buildings," Energy and Buildings 42(10):1592-1600.
14) Wong, N. Hien and et al., (2002). The Thermal Effects of Plants on Buildings, Architectural Science Review, Vol. 45, 2002.