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STUDY ON IMPLEMENTING VEGETATION IN HIGH RISE BUILDING

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Abstract: *Urbanization has resulted in reduced agriculture and farming spaces. In the next decade, 70% of the entire world population will shift to urban areas. Over the past decade, the farming community has been significantly reduced. Thus, toppling the ratio of built and unbuilt spaces. Integration of vegetation in buildings has become an essential part of a sustainable future. Green Infrastructure has benefits on both urban and building scales. In a high-rise building, there's a significant number of negative spaces which are left unused that can be converted into green spaces. This paper is meant to analyze the various technologies involved in the implementation of vegetation in a building along with the possibilities and difficulties based on different climatic conditions.*

Keywords – Vertical Farming, Urbanization, Highrise Building, Vegetation

1. INTRODUCTION:

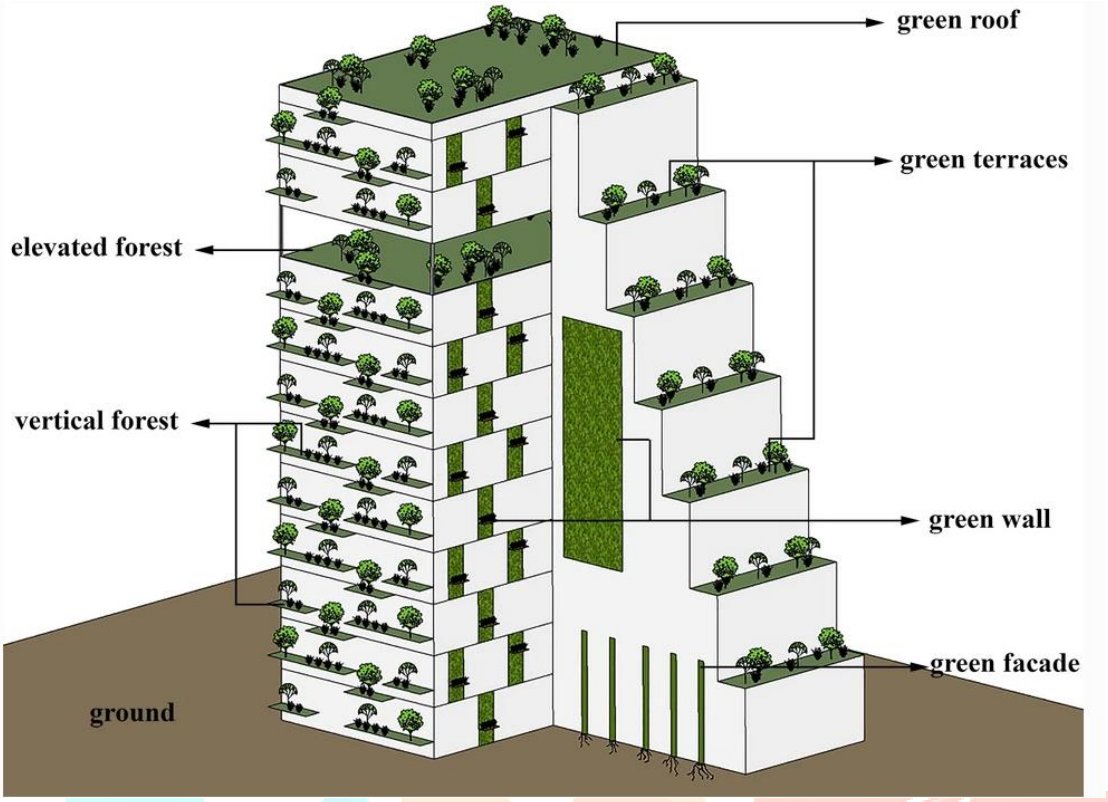
Currently, the world population escalating to a projection of 9 billion by the middle of this century. This population along with urbanization leads to a major spike in city population, with an expected projection of 80% living in the cities. This leads to many problems such as pollution, climate change, and many more (Contributing up to 70% of total global CO2 emissions – UN-Habitat).

Due to the increase in population, urban is getting more denser, hence Highrise buildings are predominantly constructed over the years, which leads to the lack of urban landscape and greens in the urban areas. These buildings play a major role in the emission of CO2. As per the United Nations Environment Programme report, the building sector emitted more than a third of global energy-related Carbon-dioxide (CO2) a record 10 gigatons in the year 2019, Also there is an increase in the Urban heat island effect and energy consumption, relevant to dense urbanization. The challenge is that the building should minimize energy use, reduce water usage, enhance wastewater recycling, and provide a comfortable and healthy environment for the people.

Plants help maintain a steady energy flow and improve people's health by lowering pollution levels and keeping temperatures stable. Plants help maintain a steady energy flow and improve people's health by lowering pollution levels and keeping temperatures stable. Green cover on walls, roofs, and open areas in buildings, both inside and out, can mitigate these climatic effects. This research study deals with Vertical Forest Engineering and includes a current development and its impacts on the various climate conditions.

2. TYPES OF VERTICAL VEGETATION:

Vegetation can be integrated into a building in many forms: horizontal, vertical, Interior, and exterior. Depending on the direction in which they spread, indoor plants fall into one of two types. Green roofs and elevated forests are examples of horizontal greening systems, whereas green facades, green walls, green terraces, and vertical forests are examples of vertical greening.



Source: Vertical greenery systems: from plants to trees with self-growing interconnections

Horizontal System:

Green roofs and raised forests make up the horizontal system. These roofs can be categorised as either intensive or extensive depending on the depth of the substrate, the area of the roof, and the amount of foot activity. Some of the good effects that they have on the structure are improved stormwater management, temperature regulation, and reduction of the effects of urban heat islands. In order to create a forest that is suspended in the air, trees can also be cultivated in horizontal regions that are shielded from the weather.

Vertical System:

A green facade, a green wall, a green terrace, and a vertical forest are all included in the vertical system. Plants, the medium in which they are planted, a supporting structure that can house the plants, and an irrigation system are the four primary elements that make up any vertical greenery system.

a) **Green Façade**: roots of the plants are planted on the ground and used either on the wall or as an independent supporting system for climbing.
b) **Green wall:** made using geotextiles, pots, panels, and boxes, where per-cultivated vegetation has been planted.
c) **Green Terrace:** the facade is covered in plants that are growing on the terraces that run horizontally.
d) **Vertical Forest:** accommodating trees to grow by providing cantilevered balconies around the envelope of the building.

3. TECHNOLOGIES IN VERTICAL VEGETATION

Implementing vegetation in a building involves the integration of multiple technologies such as data analytics, artificial intelligence, etc. so crops/plants can be cultivated/grown without any agronomic constraint.

a) Hydroponics: growing plants without soil in a water-based mineral nutrient solvent in an aqueous space. The yields from hydroponic farming are very high. It's a perfect example of how high production can be accomplished on a little plot of land at any time of year and in any climate. Veggies cultivated in hydroponic systems are of the best quality and have the right proportions of fibre, minerals, and vitamins. This method pioneers the ability to cultivate plants without the need of soil for the first time.

b) Aeroponics: It's a way to cultivate plants without using dirt. Instead, a nutrient-rich mist is sprayed onto roots that are suspended in midair. This is in contrast to hydroponic systems, in which a nutrient-rich solution is constantly pumped over the plant's roots.

c) Aquaponics: Aquaponics is a technology that combines aquaculture with hydroponics to grow fish and plants together. In aquaponics, the water from nutrient-rich aquaculture is used to water plants that are grown hydroponically, while at the same time, nitrifying bacteria convert ammonia into nitrates.

d) Greenhouse: The unusual practise of growing crops in enclosed greenhouses made of translucent or partially transparent materials. A greenhouse's principal role is to provide plants with ideal growth conditions while also protecting those conditions and the plants themselves from elements like wind and rain as well as pests.

4. CHALLENGES IN IMPLEMENTING IN HIGHRISE BUILDING

A. Lighting:

Most systems in vertical farming use both natural and artificial light, as the plants inside the buildings will require sufficient light for the process of photosynthesis (intensity and light) and the photoperiodic (time and length) and structural (dimensional light dissemination).Providing natural light in large-scale vertical farming is a challenging process, so the use of artificial lighting consumes a considerable amount of energy. This affects the equilibrium of sustainability.

B. Energy:

The energy required for heating, cooling, plumbing, lifting, and resources such as construction material, water, and artificial nutrients required for growing crops in buildings is much higher than that of traditional farming techniques. exceeding the waste of those profligate operations not by just a few percentage points but by several multiples.

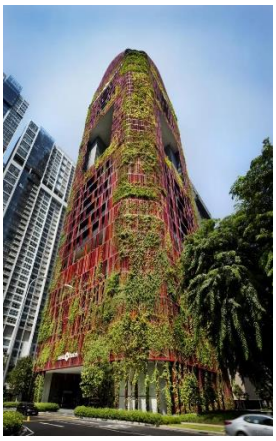
C. Water demand and supply:

The transportation of water from lower levels to upper levels in a tall building demands a huge amount of energy. The irrigation and sewer system required for vertical farming requires maintenance and It's important to standardise the delivery of fluids throughout all production floors, not just the cultivation ones.

D. Recycling of Organic waste

Buildings produce a great deal of waste, such as heat loss, grey water accumulation, and other forms of filth. The run-off from farms is a major contributor to pollution worldwide.

5. CASE STUDIES

Building Name	Bosco Verticale 	Oasis Downtown Hotel 	One Central Park 
Location	Milan, Italy	Singapore	Sydney, Australia
Building Type	Residence	Mixed-use -Office, Hotel	Mixed-use -Residence, Commercial
No Floors/ Height	27 Storey/ 111 meters	27 storey/ 193.3 meters	34 storeys/ 117 meters
Type of Vegetation	Vertical Forest	Green Wall	Green Wall, Vertical Forest
Climate	Mediterranean climate	Tropical Climate	Humid Sub-tropical
Awards	International Highrise award- 2014 Best Tall Building (CTBUH)- 2015	Green good design Award – 2017 Best Tall Building (CTBUH)- 2018	Best Tall Building (CTBUH)- 2014 International green Infrastructure Award- 2014
Bio-diversity	No of tree species: 23 No of plant and herbs species: 94	21 different species to achieve an 1100% ratio of green space to non-green space in order to make up for the urban environment.	350 different species with 250of them being native species.
Maintenance	The volume of water for irrigation: 3.5 m3 / year Average expense for maintenance: 63euros/sq.m/year	Automatic irrigation system	The recycled water used for the irrigation system comes from a treatment facility that is located on the premises.

Impacts	The pollution is reduced, CO2 and dust are absorbed, oxygen is produced, and air quality is enhanced, all while the 20,000 plants convert around 44,000 pounds of carbon annually. CO2 Absorption :19000kg/year O2 production: 18980 Kg/year	There is no need for air conditioning or fans in any of the 314 guestrooms or 100 office spaces because to the hotel's surrounding grounds. A large portion of the irrigation system's water supply comes from collected rainwater.	The recycled water is to be used for thermal plants, irrigation, and domestic residential needs. This reduces the urban heat island of the area And reducing the emission of CO2

6. CONCLUSION

The cultivation of vertical vegetation is essential to achieving sustainability and finding solutions to a variety of urban issues, including a dearth of vegetation, urban heat islands, and carbon emissions. Vertical cultivation of vegetation is essential to achieving sustainability and finding solutions to these issues. Having buildings that employ on-site water recycling systems to provide water for irrigation as well as other technology improvements to help with creative resource management is a huge step forward.

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