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Analysis & Development of Vertical Plantation to the Building Structures

Sanmit Patil, Sameer Pradhan, Pratik Sangle and Sachin Sharma

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ANALYSIS & DEVELOPMENT OF VERTICAL PLANTATION TO THE BUILDING STRUCTURES

SANMIT PATIL , SAMEER PRADHAN , PRATIK SANGLE , SACHIN SHARMA
BACHELOR OF ENGINEERING DEPARTMENT OF CIVIL ENGINEERING
MUMBAI UNIVERSITY/ VIVA INSTITUTE OF TECHNOLOGY
MUMBAI- 401305

ABSTRACT

'Vertical Gardening' reveals the way of employing wide range of plants allowed to extend upwardly in lieu of growing them along the soil surface. It is the way to implant a patch of gardening both in extramural and interior segment of urban dwelling areas. Equivocality of having own garden at open premises and hasty expansion of concrete structures are the root cause of owning this contemporary style of gardening in modern era. The development of 'Green Wall' at office premises or corporate places will fetch a chic look as graceful adornments along with an enlivened ambiance being created enriched microclimate supplemented with oxygen offering good health for workers. Presently in market availability of its variegated designs for both aesthetic and creative gardens upgrading its popularity and versatility gingerly. So it is easy to mount at apartment balconies or any other appartment place receive least care and maintenance Thus, anyone suffering from encroachment of spaces year after year can rescue from the captivity being implemented this 'horizontal garden' form willsurely add a height to their life styles.

Green walls not only fetch a picturesque effect but also make livelier environment being imbibed green house gases ultimately lower both indoor and outdoor heat along with healthier interior air quality as well as more beautiful space by its assistance (Yeh, 2012). Few small herbaceous species such as ivyleaved toadflax, wallflower and others such as mosses, lichens and grasses can grow on walls itself by its root although climbers and twinners naturally adapted to climb up over obstacles such as rock faces, trees and shrubs are most apposite (Johnston and Newton, 2004). Collaterally, little bit of technical knowledge in search of appropriate position for installation is essential also, for example narrow corridors with heavy traffic may not serve the intention. In fine, 'Vertical Gardening' is the blend of green and art promote the city quality.

Keywords : vertical garden, green wall, façade, sustainable design, nature

Introduction

Gardening considered as an ancestral categories of art, interlaces a bond of green and art from the level between material and spirit (Thompson and Sorvig, 2000). Keeping global warming in consideration eradication of air pollutants to make healthier air to breath becomes mandatory with aid of plants as they have immense contribution on human life and

environment. Side by side, the increase in the urban living and lifestyle has raised the number of apartments in India ultimately led to the infringement of spaces all over the city. Limited scope for developing vegetation surface in urban environment although a troublesome job to get accessible surfaces lastly bound decision-makers to adopt the concept of 'Vertical Gardening' build with assist of wide range of vegetations may be a viable option to renew our climate (Bisgrove, 2010). The term 'Vertical Gardening' is self-explanatory. It alludes to different forms of vegetated wall surfaces, synonymously familiarized with the term 'Green Wall' globally (Green roof organization, 2008). Green walls not only fetch a picturesque effect but also make livelier environment being imbibed green house gases ultimately lower both indoor and outdoor heat along with healthier interior air quality as well as more beautiful space by its assistance (Yeh, 2012). Few small herbaceous species such as ivyleaved toadflax, wallflower and others such as mosses, lichens and grasses can grow on walls itself by its root although climbers and twinners naturally adapted to climb up over obstacles such as rock faces, trees and shrubs are most apposite (Johnston and Newton, 2004). Collaterally, little bit of technical knowledge in search of appropriate position for installation is essential also, for example narrow corridors with heavy traffic may not serve the intention. In fine, 'Vertical Gardening' is the blend of green and art promote the city quality. The ancient concept of 'Green wall' was built in Babylon about 2500 years ago. In ancient Babylon, King Nebuchadnezzar II built the Hanging Gardens of Babylon: a wonder of the ancient world, and ancestor of the modern green wall. The actual inventor is Stanley Hart White, a Professor of Landscape Architecture at the University of Illinois who patented a green wall system in 1938. But it was the legendary botanist Patrick Blanc who experimented with this concept and made it popular (Blanc, 2008). In India, Anuradha and Pradeep Barpande, Directors of Elevated Landscape Technologies (ELT) had drawn inspiration from Blanc's work and had created absolute stunners on the Indian walls too, such as vertical gardening in Mughal garden, adjacent to the Rashtrapati Bhavan at New Delhi. They started their business in 2013 with a small nursery called 'Nandini Garden' at Manjri, Pune (Times Property, 2010). Elevated Landscape Technologies (ELT) introduced a Canadian modular system made of high-density polyethylene (HDPE) to the Indian market. The first vertical garden was installed in five places of India *viz*. **Delhi, Bengaluru, Chennai, Mumbai and Pune**. After observing the impact of weather on the green plants, theygained confidence and sold this new concept to patrons with one-year warranty (El-Zoklah, 2016).

Literature Review

Literature review help you accomplish the following:

- Evaluate past research
- Identify expert view
- Solution of questions
- Some ideas of design methodology in past studies

This project related 6 research papers on vertical plantation and their case studies carried out in various areas such as urban and rural.

1. **Vertical Garden – A Solution To Mounting Air Pollution?**

In august 2018

Conlusion : Vertical Gardens help the environment exactly in the same way a normal horizontally placed garden does. Plants play a huge role in cleaning the air, they help to reduce noise pollution as they possess noise reduction capabilities. Another important function of the plants is to reduce the amount of carbon monoxide in the air and filter out the pollutants by breathing them in and then exchanging them for clean, fresh, clear oxygen. Coming to noise reduction, for long plants have been used to reduce noise levels on raucous roads and highways across the globe. Vertical gardens expand on this idea, as vegetation naturally helps in blocking high-frequency sounds. The use of vertical gardens could significantly change the urban environments by eradicating the noise of the hustle and bustle we have actually adapted to. Vertical gardens can be fitted to both refurbishments and new builds, from small independent houses to huge commercial developments. These are totally versatile and can be installed both inside and outside the building structures.

2. **Vertical gardening for enlivening the ambiance (September, 2017)**

Authors : Moumita Malakar

Conclusion : The development of ‘Green Wall’ at office
premises or corporate places will fetch a chic look as graceful adornments along with an enlivened ambiance being created enriched microclimate supplemented with oxygen offering good health for workers. Presently in market availability of its variegated designs for both

aesthetic and creative gardens upgrading its popularity and versatility gingerly. So it is easy to mount at apartment balconies or any other appartment place receive least care and maintenance Thus, anyone suffering from encroachment of spaces year after year can rescue from the captivity being implemented this ‘horizontal garden’ form will surely add a height to their life styles.

3. **VERTICAL GARDENS AS AN ADAPTATION STRATEGY FOR URBAN AREAS: A REVIEW (April 2018)**

Conclusion : Vertical garden is all about indoor and outdoor upwards and up stands design, which is, grow in vertical straight surfaces. It can applicable on wall of any kind of building. Vertical garden help to cool the environment .It give fresh air and aesthetic look also insulate the building too and reduce the cost of air conditioning. Growing plant in the Building can help to filter air particle and help to control air quality as well as some level of humidity. It also helps to save water by reducing the need for irrigation and watering.
Here we understand about vertical green garden which is very widely spread all over the world which is very good symbol of sustainable life. Today, with the rapid growth of industrial cities, where fifty percent of the world`s population dwell, plants can provide better air quality, in the meantime sustaining the wellbeing of the environments, human health and the psychological aspect.

4. **Vertical Gardens (author** Özgür Burhan Timur)

Conclusion : Vertical Gardens provide economic and ecologic benefits as well as aesthetic value. The benefits change with options such as different buildings, green wall technologies, plant selections and plant coverage. In this part is examined important values of Green Walls. One of the biggest benefits of vertical gardens is how they manage water.

3 Methodology

3. Study of Vertical Plantation

3.1. What’s The Vertical Plantation?

Vertical garden is a unique technique that allows us to grow plants on a suspended panel that is vertically placed by using hydroponics. These structures can either be attached to the wall or be self-supporting.This concept isn’t new, as Vertical Gardens have been around since

ancient civilizations. Lack of trees, lack of land space, increasing pollution levels and rising temperatures has today necessitated the need for more and more vertical gardens to add a pop of nature around our concrete jungles.

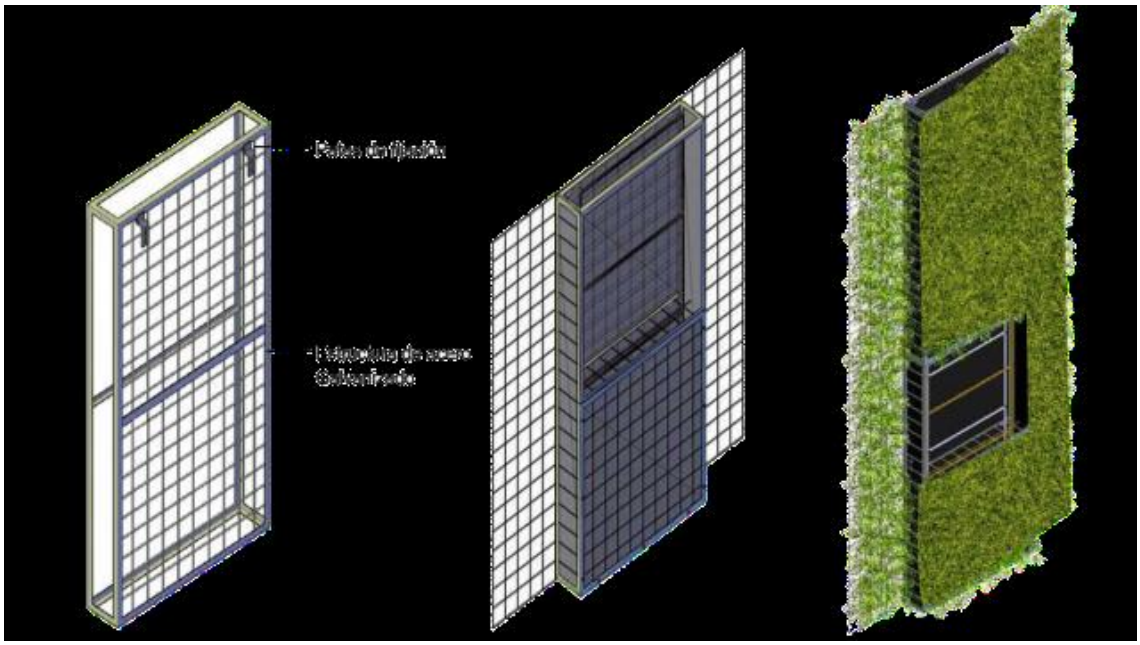

Fig.1 Vertical Plantation

Vertical gardens are known by many different names, living walls, live walls and moss walls are just a few to name. Now a days we all are talking about green and clean environment and this green is related to building facade, livingwall, and vertical freestanding structure. Here we understand about vertical green garden which is very widely spread all over the world turns to good symbol of sustainable life. Vertical Garden is also called green wall, living wall, green garden which is totally and partially filled with vegetation. Including vegetation also filled with some of the soil medium, which depend on the types of plant and shrubs that we use in any vertical frame. Most Green walls also features as integrated water system. It is useful to distinguish green walls from Green Facades. We improve green wall function by understanding the interactions between its ecosystem elements, especially the relationships among growing media, soil biota, and vegetation, and also use of freestanding frame and building facade. Further things into green wall maintaining should assess the efficacy of green garden compared to other maintenance with similar ends, and ultimately focus on estimates of aggregate benefits at landscape scales.

Fig.2 Frame shape

3.2. Function

- Green walls are found most often in urban environments where the plants reduce overall temperatures of the building. "The primary cause of heat build-up in cities is insolation, the absorption of solar radiation by roads and buildings in the city and the storage of this heat in the building material and its subsequent re-radiation. Plant surfaces however, as a result of transpiration, do not rise more than 4–5 °C above the ambient and are sometimes cooler.
- Living walls may also be a means for water reuse. The plants may purify slightly polluted water (such as greywater) by absorbing the dissolved nutrients. Bacteria mineralize the organic components to make them available to the plants. A study is underway at the Bertschi School in Seattle, Washington, using a GSky Pro Wall system, however, no publicly available data on this is available at this time.
- Living walls are particularly suitable for cities, as they allow good use of available vertical surface areas. They are also suitable in arid areas, as the circulating water on a vertical wall is less likely to evaporate than in horizontal gardens.
- The living wall could also function for urban agriculture, urban gardening, or for its beauty as art. It is sometimes built indoors to help alleviate sick building syndrome.

Fig.3 A green wall in Longwood Gardens in Pennsylvania.

- Living walls are also acknowledged for remediation of poor air quality, both to internal and external areas.

Green walls provide an additional layer of insulation that can protect buildings from heavy rainwater which leads to management of heavy storm water and provides thermal mass. They also help reduce the temperature of a building because vegetation absorbs large amounts of solar radiation. This can reduce energy demands and cleanse the air from VOC's (Volatile Organic Compounds) released by paints, furniture, and adhesives. Off-gassing from VOCs can cause headaches, eye irritation, and airway irritation and internal air pollution. Green walls can also purify the air from mould growth in building interiors that can cause asthma and allergies. Vegetation in green walls can help with the mitigation of the heat island effect and contribute to urban biodiversity.

3.3. Methods and Types Vertical Plantation :

- Vertical Plantation
  1. Green facades
     - Flower pots
     - Rewind wall
       a) Modular trellis
       b) Grid system
       c) Wire rope net system
  2. Living wall
     - Landscap walls

- Vegetated mat walls
- Modular living walls

1. Green facades

Green facades are a type of green wall system in which climbing plants or cascading vegetation. Green facades can be anchored to existing walls or built as freestanding structures, such as fences

Fig.4 Vertical green facades

a. Modular trellis panel system

The building block of this modular system is a rigid, light weight, three-dimensional panel made from a powder coated galvanized and welded steel wire that supports plants with both a face grid and a panel depth. This system is designed to hold a green facade off the wall surface so that plant materials do not attach to the building, provides a “captive” growing environment for the plant with multiple supports for the tendrils, and helps to maintain the integrity of a building membrane. Panels can be stacked and joined to cover large areas, or formed to create shapes and curves, are made from recycledcontent steel and are recyclable . Because the panels are rigid, they can span between structures and can also be used for freestanding green walls (Gren roof organization 2008)

Fig.5 Modular trellis panal

b. Grid and wire-rope net systems

Planning the Grid and wire-rope net systems used cables and wires Grids are employed on green facades that are designed to support faster growing climbing plants with denser foliage. Wire-nets are often used to support slower growing plants that need the added support these systems provide at closer intervals. Both systems use high tensile steel cables, anchors and supplementary equipment. Various sizes and patterns can be accommodated as flexible vertical and horizontal wire-ropes are connected through cross clamps.

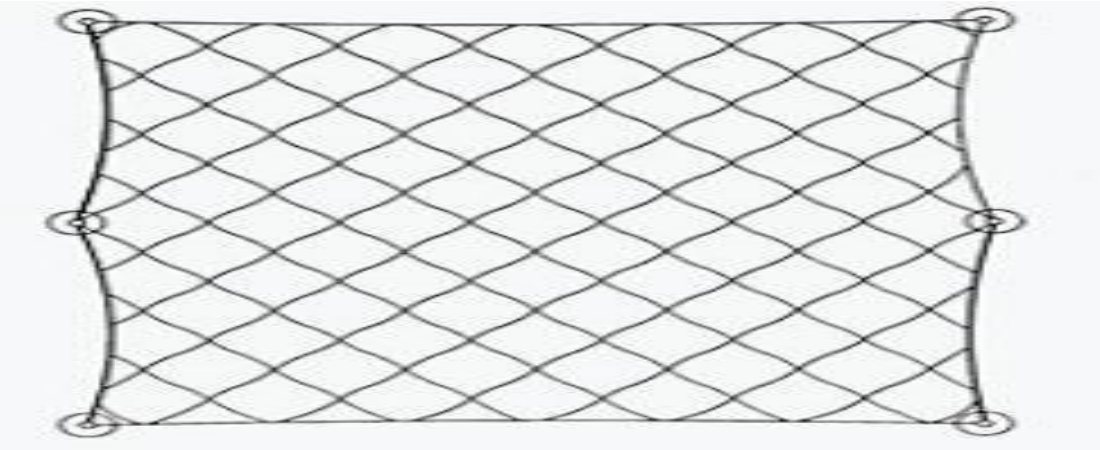

Fig.6 Grid or wire net system

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2.Living wall

Living walls, also called bio-walls or vertical gardens. Living wall systems are composed of

pre vegetated panels, vertical modules or planted blankets These panels can be made of plastic, expanded polystyrene, synthetic fabric, clay, metal, and concrete, and support a great diversity and density of plant species. Living walls need more protection than green facades because of its diversity and density of vegetation. Living Walls are made with three parts: a metal frame, a PVC layer and an air layer (do not need soil). This system supports a variety of plant species, such as a mixture of vegetation, perennial flowers, low shrubs, and ferns etc . It performs well in various climate environments. However, the selection of better species may adapt to the prevailing climatic condition, so that the maintenance of the system be made easy. Generally is used self-automated watering and nutrition system, to make maintenance of the living walls easy.

Fig.7 Indoor living wall

- **Landscape walls :**

These walls are an evolution of landscape 'berms' and a strategic tool in an approach to 'living' architecture. Landscape walls are typically sloped as opposed to vertical and have the primary function of noise reduction and slope stabilization They usually are structured from some form of stacking material made of plastic or concrete with room for growing media and plants.

- **Vegetated mat walls :**

The ‘Mur Vegetal’ is a unique form of green wall pioneered by Patrick Blanc It is composed of two layers of synthetic fabric with pockets that physically support plants and

growing media. The fabric walls are supported by a frame and backed by a waterproof membrane against the building wall because of its high moisture content. Nutrients are primarily distributed through an irrigation system that cycles water from the top of the system down.

Fig.8 Vegatated Mat wall pocket

- **Modular living walls :**

A modular living wall system emerged in part from the use of modules for green roof applications, with a number of technological innovations. Modular systems consist of square or rectangular panels that hold growing media to support plant material

- **Fig.9** Modular living wall

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