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A Brief Study on green walls technology benefits & design

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Abstract: *Plants have served humanity since the dawn of time, supplying food, clothing, building materials and a host of other goods. With the advent of the modern industrial city, now home to more than half of the world's population, planners, designers and urban advocates are once again turning to plants – green infrastructure- as a key strategy to provide cleaner air and water, while improving living environments, human health and mental wellbeing. The integration of the living, organic systems characterized by green walls and green roofs, with the inorganic and lifeless structures that have come to dominate modern architecture, holds the promise of a new type of 'living' architecture.*

Keywords: *plants, green walls and green roofs*

I. Introduction

Living design is multi-disciplinary, mixing the abilities of modelers, scene planners, specialists and horticulturalists. Its experts are focused on the greening of urban areas and structures and perceive that plants are an underutilized asset in the bigger green building development. Green framework includes the utilization of plants on the rooftops and dividers of structures. In spite of the fact that the idea is not new (e.g. turf rooftops and ivy-clad dividers have been around for a considerable length of time), contemporary frameworks are utilizing inventive materials and innovation to make a plant-building interface that is ideal for the plant while keeping up the auxiliary honesty of the building. Two such frameworks are broad green rooftops and living dividers. Broad green rooftops are described by sweeping territories of commonly low developing, dry spell safe and fire retardant vegetation developed in shallow substrates (e.g.2-15 cm thick) underlain with a progression of seepage and hindrance materials to shield the rooftop from water and root entrance. These green rooftops are intended for constrained upkeep: for instance, on industrial facility housetops. Living dividers comprise plants rooted in a vertical structure attached to a building, as opposed to traditional façade greening. In the façade greening configuration, plants are rootedand plantedin the ground and trained to grow up a wall. Contemporary green infrastructure has been widely adopted in central Europe, particularly Germany. More recently, it has been adopted in countries including the USA and Singapore. Overseas experience has shown that green roofs and living walls provide a myriad of social, environmental and economic benefits. Perhaps of most importance is the thermal buffer effect—during warm weather, evapo-transpiration and shading provided by the plants can markedly reduce temperatures inside the building. This, in turn, can lead to significant reductions in energy demand for air conditioning. Implementation of green roofs and walls on a large scale can reduce the urban heat island effect that many cities experience, thereby creating more livable urban environments with less energy inputs.

II. Review of Literature

In temperate North America, a cost-benefit analysis of an EGR on a retail store found small, but significant, reductions in energy consumption (Kosareo and Ries 2007). In warmer climates, much greater reductions in energy usage are likely to result. Wonget al. (2007) found that in Singapore over 60% of heat gain by a building could be stopped by an EGR.

The remainder was lost through evapo-transpiration, re-radiated to the atmosphere, or used in photosynthesis (Feng et al. 2010). Implementation of EGRs on a large scale has the potential to reduce urban heat island (UHI) effects. Susca et al. (2011) reported an average 2°C temperature difference between areas of New York city that have high and low levels of vegetation.

In terms of internal wall temperatures, the peoples found a difference of more than 2°C was maintained even late at night, indicating that green walls have significant ability to reduce power consumption for building cooling. At Hort Park in Singapore, various green wall systems were assessed for their thermal performance by Wong et al.(2010a).

Green walls comprise plants rooted in a vertical structure attached to a building as opposed totraditional façade greening, wherein plants are rooted in the ground and are trained to grow up a wall or trellis. The vertical structure in which the plants are grown usually takes the form of rigid modular panels filled with a

specialized lightweight growing medium or a two-layer blanket of synthetic fabric in which 'pockets' are filled with plants and growing medium (Hopkins and Goodwin 2011).

III. Objectives of Study

a. To review existing knowledge of plant selection and performance for extensive green roofs and living walls
b. To extent awareness of green wall concept among peoples.
c. To promote optimum usage of natural resources.

A 'Green Wall', also commonly referred to as a 'Vertical Garden', is a descriptive term that is used to refer to all forms of vegetated wall surfaces. Green wall technologies may be divided into two major categories: Green Facades and Living Walls, both of which are described below-

VI. Green Facades

Green exteriors are a kind of green divider framework in which climbing plants or falling groundcovers are prepared to cover exceptionally composed supporting structures. Established at the base of these structures, in the ground, in middle of the road grower or even on housetops, the plants regularly take 3-5 years before accomplishing full scope. Green exteriors can be moored to existing dividers or worked as unsupported structures, for example, wall or segments.

Self-sticking plants, for example, English Ivy have normally been utilized to make green dividers. Their sucker root structure empowers them to join specifically to a divider, covering whole surfaces. These forceful plants can harm unacceptable dividers as well as posture troubles when the time desires building support and plant evacuation. Mechanical advancements in Europe and North America have brought about the improvement of new trellises, inflexible boards and link frameworks to support vines, while keeping them away from walls and other building surfaces. Two green facade systems that are frequently used are Modular Trellis Panel and Cable and Wire-Rope Net systems. Each of these systems is described below.

4.1 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 recycled content steel and are recyclable. Because the panels are rigid, they can span between structures and can also be used for freestanding green walls.

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4.3. Cable and Wire-Rope Net Systems

The cable and wire-rope net systems use either cables and/or a wire-net. Cables 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. They are more flexible and provide a greater degree of design applications than cables. Both systems use high tensile steel cables, anchors and supplementary equipment.

4.4 Living walls

Living wall systems are composed of prevegetated panels, vertical modules or planted blankets that are fixed vertically to a structural wall or frame. 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 (e.g. a lush mixture of groundcovers, ferns, low shrubs, perennial flowers and edible plants).Due to the diversity and density of plant life, living walls typically require more intensive maintenance (e.g. a supply of nutrients to fertilize the plants) than green facades. There are various forms of living walls, with the main differences occurring between interior and exterior designs.

V. Benefits of green facades and living walls-

There are significant benefits to both the public and private sectors resulting from the successful use of green walls. Green walls have a great potential for positive environmental change in dense urban areas, particularly given the large surface areas on buildings that are available for retrofitting to these technologies. For example, the emissions that can concentrate in multi-level parking areas in downtown cores can be reduced by the presence of large leafy areas. A green wall with a mass of plant leaf material can absorb carbon oxides and heavy metal particles while shading and screening these large structures.The benefits accrued by a green wall depend on design factors that include leaf area, leaf density, site conditions and the scale of the project. Some benefits are shared by almost all green walls, herein referred to as 'common benefits'; while others are a function of the particular design/client objectives, herein referred to as 'design specific benefits.The discussion of common green wall benefits has been divided further into two major categories: Public and Private, since some benefits are for the building occupants while others are shared by the community at large.

5.1. Improved aesthetics –

Currently, aesthetic improvements are the primary design objective for most green wall projects. Large parking structures, campus buildings, urban streets with repetitive facades, public park buildings, transit shelters, retail buildings, all provide an opportunity to design with green walls to create aesthetic improvement. Implementing patterns, rhythms, and shapes and the use of plant textures and the inviting qualities of designing with nature can all contribute to aesthetic improvement.Wall mounted and freestanding green walls can be used

to screen and isolate views. They can be used to hide mechanical equipment, service areas, storage access and other aspects of a building's system requirements that detract from the aesthetic experience. These opportunities also exist for interior applications and for the integration into rooftop environments. Plant materials used for green facades and living walls can be flowering, may change color with the season's change, or may be deciduous and change their visual character significantly. Because of the vertical nature of a green "wall" they create large and efficient green areas while using a relatively small footprint. Aesthetic value relates to human interaction and not to the quantitative evaluation of materials and system performance aspects of a building. Creating green wall elements for a waiting zone, a healing garden, a building entrance, or a rooftop garden could take advantage of the measurable improvements to the human condition that plants can provide. This specific benefit is an improvement to the quality of the human experience in the built environment.

5.2 Increased biodiversity –

The use of green walls to support biodiversity is being explored and current research on the abilities of green wall systems to provide this benefit is scarce. Most studies have centered on green roofs in the urban environment and their ability to provide habitat for a wide range of animal and plant species.

VI. Urban agriculture

Green walls have yet to be extensively studied as a forum for urban agriculture, but this potential specific benefit is obvious. Where land is scarce, green walls of many sizes can utilize their vertical aspect to grow a variety of crops. The coordinator for the Urban Management Program for UN-Habitat has written that the research of the last two decades indicates that,"…urban agriculture has multiple roles and functions and plays an important role in: enhancing urban food security, nutrition, and health…and urban greening and maintenance of green open spaces…"

A green wall designed for urban agriculture can provide a multitude of benefits such as providing the basis for better community interaction (community gardening), improving access to fresh food (a significant problem in poorer neighborhoods); and reducing the environmental impacts associated with traditional food production and distribution.

VII. Factors For Successful Green Facades

Design, installation and maintenance considerations for green facades and living walls will vary by system type selected and the conditions of the built and natural environment. Green facade projects require that the designers, installers, manufacturers and maintenance staff take the following into careful consideration:

1. Attachment to building envelope – how the system will be secured to the building or freestanding structure.
2. Calculation of structural loads for larger systems, resulting from loads such as snow, plants, and wind.
3. Plant selection for wind and light exposure, hardiness zones, and amenity context.
4. Realistic expectations related to plant aesthetics and growth – some systems require 3 to 5 years to become fully established.
5. Plant maintenance and/or long-term maintenance plan to secure the health of these living systems, including proper soil and irrigation considerations.
6. Check with manufacturers who may have registered or specially trained installers that will be able to complete the project successfully.
7. Appropriate plant selection for the geographic region, correct plant spacing for desired coverage, and release from the temporary support structure used by the nursery.

VIII. Factors for flourishing living walls

Living Walls are robust when constructed in the correct manner. Success depends heavily upon the following:

1. Plants correctly specified by architects for hardiness zone and geographic location.
2. of the microclimates that may have different impacts on one part of a living wall relative to another (e.g. varying light, heat, humidity conditions).
3. Consideration Growing medium must be designed to sustain chosen plants and to provide the correct nutritional needs.
4. Indoor applications need to determine correct light for plant survival.
5. Check with manufacturers who may have registered or specially trained installers that will be able to complete the project successfully

IX. Conclusion

Green walls are a key component of living architecture and they will become increasingly important fixtures in our cities in the years to come. Green wall technologies provide a wide range of options for designers who are interested in using the building envelope to accomplish multiple objectives and to provide new free-standing design features on the interior and exterior of buildings. Those seeking more detailed technical information on green walls are invited to attend a full day course, Green Walls 101 (see website for dates and locations, www.greenroofs.com). It is always advisable to work closely with system providers and manufacturers when designing and planning a green wall, for they have the knowledge, experience and local installation support that can help your project succeed.The design, installation, and maintenance of green buildings are vital to the long-term health and sustainability of our communities. We welcome the opportunity to work with you to bring green walls into your suite of design options.

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