

# Green walls: benefits in the contemporary city



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## **INTRODUCTION**

### **Green wall and its necessity**

The living, organic systems characterized by green walls, are integrated with the inorganic and lifeless structures are dominating modern architecture and holds the promise of a new type of ' living' architecture. Green walls are generally walls that are part of the Building covered with vegetation. They are like vertical garden mostly formed with creeper system on the exterior wall with the roots on the ground or with free standing vertically framed wall with different native plants grown on the surface. They are also termed as bio walls or living walls since they act as natural air-conditioner as they purifies and cools the ambient air to a large extent creating a healthy environment.

The deepest threat of global warming is the rapid urbanization and deforestation. There is a considerable increase of co2 emission and heat transfer. This impact is extreme in the urban condition where the vegetation/ greenery are sparse. Also in the urban conditions mostly all the buildings are glazed and air-conditioned with out any ways of neither thermal insulation, nor are they shaded with thick surrounding landscape. This is basically due to the space constraints and optimization. In such challenging cases Green wall is the best alternative which acts as a good shading device against heat gain and energy losses, pollution etc. Hence, Green walls are must in urban conditions.

**Economic and Environmental benefits of Green walls**

The economic and environmental benefits are many. They result in substantial energy savings, extension of building life, CO2 capture, acoustics and Aesthetics.

- Energy Conservation: Vegetation on walls can assist in cooling buildings in summer and insulating them in winter. Reduction of thermal loading to buildings results lower heating and cooling costs which in turn lowers carbon emissions. Jacklyn Johnston and John Newton (2004)
- Health: These climbing plants on green walls filter out dust and other pollutants. Jacklyn Johnston and John Newton (2004)
- Reduction of heat island effect results in less reflected heat.
- Air purification: plants filter pollution especially when used inside buildings.
- Noise attenuation: It acts as sound barrier resulting in quieter buildings and streets.
- Green walls can collect over 30kgs per m<sup>2</sup> of rainwater.
- Increased urban biomass.

Jacklyn Johnston and John Newton (2004) clears the fact that ‘ There is a widespread belief that plants are inimical to built structures, ripping out mortar and prising apart joints with their roots. The evidence suggests that these problems have been greatly exaggerated, except where decay has already set in and then plants can indeed accelerate the process of deterioration.’ There is little evidence that plants damage walls. In fact in most of the cases the exact opposite is true, with plants covering the wall

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helps in protecting the wall from harmful elements, solar radiation which in turn reduces the thermic tensions within the structure.

### **Indigenous sustainable elements and their benefits**

Indigenous sustainable elements are the simple elements which are locally available and considered as waste or least prioritized. For example, the coconut shells in the country like India which are available in abundance are just disposed or burnt to ashes even though they have high thermal coefficient and suitability for insulation/ acoustics. Similarly, materials like Clay, Bamboo, Jungle/ Pine/Rubber wood, Cork etc carry untarnishing effect in the field of sustainable Architecture when used appropriately. Apart from their interesting characteristic they are also economic.

### **RESEARCH QUESTION/OBJECTIVE:**

#### **Does green wall need to be green?**

The realistic objective of this research is to create more enjoyable greener cities which in turn bring numerous benefits to the surrounding environment. In the almost all the Urban locations of the world where the CO<sub>2</sub> emission is extremely high due to various factors have hardly any good vegetation to control environmental pollution. Unfortunately, in such locations the concept of sustainability like ' Green wall' gets relegated to the second spot due to construction and maintenance cost. The idea is to address to these areas and also to enhance the benefits of " Green walls' with some medicinal value. This needs to be achieved by identifying native herbal plants and also, to study and innovate in the area of low cost indigenous elements like

coconut shells, bamboo, cane, Jute, cork, ect as construction materials to supplement to sustainable design.

### **LITERATURE REVIEW:**

Green walls are slowly gaining value and are considered valuable for cooling the Urban space than green roofs in countries like Japan. But the green wall is still new to countries like India and china. Jacklyn Johnston and John Newton (2004) states that ' This is a great pity, because even in those cities relatively well endowed with greenspace many areas can justifiably be regarded as deserts in biological terms.' Nigel Dunnett and Noel Kingsbury (2004) Green wall is widely practiced in Europe and it is quite common in France and Germany to see house covered in Virginia creeper or vines which are influenced by Mediterranean climate. Jacklyn Johnston and John Newton (2004) states that ' We need appropriate development which incorporates an ecological approach to building and landscape.' This means that the land lost in the construction of buildings and roads should be replaced with a layer of plants on the hard surfaces. By this way green skin can be strategically added to create a new network of vegetation linking roofs, courtyards, walls and open spaces.

### **Different types of green walls**

#### **There are two different types: Green facades and Living walls**

Green façades: are wall systems where plants cover supporting structures rooted at the base of the structure. Supporting structure can either be a existing wall or built as freestanding structures.

Living walls: (also called bio walls or vertical gardens) composed of pre-vegetated modular panels that are fixed to a structural wall or freestanding frame. Modular panels comprises of polypropylene plastic containers, geotextiles, irrigation system, growing medium and vegetation. Living walls can be installed on the exterior of a building in full sun, shade, and interior of a building. They grow well in both tropical and temperate climate. Due to huge variety of plants used, living walls require more intensive maintenance than green facades like regular watering, adding nutrients and fertilizers.

### **Different types of green façade support structures**

The two primary types are

- **Modular trellis systems:** Panels which are rigid and lightweight are installed vertically as wall-mounted or freestanding. They can also be used on tall buildings along side with intermediate planters. Modular trellis systems are essential where the physical growth of climbing plants is restricted.
- **Freestanding structures:** are rigid panels such as green columns or canopy forms that can be placed on either on building walls where either the space is limited or load is restricted. The panels can also be used as shading devices for a open parking area.
- **Cable and rope wire systems:** this system consist high-tensile steel cables, wire trellises, spacers, and additional equipment. Vertical and horizontal wires are connected through cross clamps to form a trellis system of desired sizes and patterns. Stainless steel wire-rope net is supported on flexible or rigid frames to cover large areas.

**Best plant types to use for green walls**

Jacklyn Johnston and John Newton (2004) Considering the relationship between the types of plant used and the aspect of the walls where they will grow is also a very important aspect.

Deciduous plants are the most suitable on the south side of a building. In the summer their dense foliage shields the building from sunlight and creates cooling effect. In winter leaves are shed, allowing sunlight to reach the surface of the wall so helping to warm the interior of the building. Similarly on a west-facing wall it is sensible to use evergreens to protect the building from rain and provide a cushion of air to help insulation. North facing walls are best for supporting native herbs and wider ranges of plants. East walls may fall into either category.

Plants used on exterior building walls are exposed to harsher climactic surroundings than those of indoors. Hence for building that intend to reach great heights, more hardy species of plants should be selected. Similarly, for less plant friendly climates, climbers that are tolerant for wind and heat should be selected. Nigel Dunnett and Noel Kingsbury (2004) On wooden walls and other structures, species with very heavy growth or a thick branching habit should be avoided, as the structure may not be able to support the weight.

Plant selection will have major impact on the design of the supporting system. For instance, a denser and faster growing plant will require a larger space between supports than less aggressive plant species. The density of

plant life further impacts the underlying structure. Greater the leaf surface area, the more impact rain will have on the weight of the system.

### **Green wall installation and maintenance**

Jacklyn Johnston and John Newton (2004) Small herbaceous species are able to grow on walls by taking root in the substance of the wall itself. But other species are naturally adapted to climbing up and over obstacles such as rock faces, trees and shrubs. Some kind of support structure is essential for these plants to grow successfully. For example, climbers such as hops support themselves by spiralling upwards around an object. They will require timber battens, trellis work, steel cables or plastic ropes. Although some creeper can cling directly onto walls by their roots, they require a rough surface to enable them to do so. Rambling plants such as bramble and climbing rose need wide-meshed grid structures to which they can be attached. A 50x50cm latticework of treated timber mounted on wooden posts (or an equivalent structure using cables, rope or netting) will provide an adequate support for a range of species. Whenever possible it is sensible to leave little gap between the façade of the building and the supporting structure to maximise the effects of summer cooling and winter insulation.

The structures help in distributing the weight of the plants across the supporting structure and wall. In cable and rope wire systems, anchors and turnbuckles have to be installed at the end of each cable for tightening and adjustments as and when required.



Jacklyn Johnston and John Newton (2004) Polypropylene cladding tiles incorporates waterproof membranes and their own irrigation system. Plants could be established on these and then hung on the outside of a building.

Depending on species, climbing plants generally require a good supply of water and occasional pruning. Supporting structures require less maintenance, with only occasional monitoring of the supporting structure.

Jacklyn Johnston and John Newton (2004) For climbing plants the ground should be prepared just like for any tree or shrub by creating a pit and adding in some compost to the top 30cm. Pre-grown panels for living walls needs 6-12 months for plants to grow prior to delivery and installation. The panels are grown horizontally until it is shipped to the site after which it can be mounted vertically.

Climbing plants should be selected that do not provide a food source for unwanted pests and insects. Excessive growth or dead wood should be removed periodically and standing water should be avoided.

### **LEED points for using green walls**

LEED has several credits for green walls when used in buildings.

- Sustainable Sites Credit 7. 1: Landscape Design that Reduces Urban Heat Islands (1 point). Solar reflectance of a building is greatly reduced by exterior green walls, thus reducing the urban heat island effect.
- Water Efficiency Credits 1. 1, 1. 2: Water Efficient Landscaping (1 to 2 points). Harvested stormwater can be used for watering the plants of

the green walls. Usage only collected, recycled, or nonpotable water may also add on to this credit.

- Water Efficiency Credit 2: Innovative Wastewater Technologies (1 point). Green walls can act as a medium for utilizing wastewater treatment.
- Energy and Atmosphere Credit 1: Optimize Energy Performance (1 to 10 points). Building's mechanical systems usage can be reduced greatly by green walls which acts as additional insulation for the structure and also provides natural cooling.
- Innovation in Design Credits 1-4: Innovation in Design (1 to 4 points). Green walls can contribute to innovative wastewater management or ventilation systems.

## **KNOWLEDGES AND GAPS**

### **What is the awareness on Green walls in the countries like India?**

Green Building Movement in India – Catalysts and Course India is witnessing incredible growth in infrastructure and construction sector. The construction industry in India happens to be one of the largest economic activities. As this sector is growing speedily, preserving the environment poses lot of challenges and at the same time presents opportunities. The construction sector therefore needs to contribute towards environmental responsibility. Green wall concepts are at emerging stage in India primarily due to high initial cost and lack of a native product to address the same. But still it offers great potential which asks for greater understanding and evolving an indigenous product by Indian Architects/ Landscape designers.

**How cost conscious developed countries are and how it is important?**

Most of the developed countries are focused on the technology of future and the art of modern architecture plays vital role where the value of simple indigenous elements gets neglected. In that case, even in the name of modernization most of the developing countries are also getting inspired by the developed countries. Cost effective design always carries value at the time of crisis and recession. It also speaks its untouched charm as they are formed mostly with natural elements.

**INNOVATION:**

- An Indian based Agriculturalist who tried organic farming ' elunkathir pannai' with the protection of bio fence created with the native herbals and plants. The result proved to be astonishing and achieved good yield. The interesting secrete behind it is, all the air born pests are filtered and killed by naturally available herbal predators. This inspires and even strengthens the concept of Green walls for the urban spaces also. And that is one of my initiative and part of the research using native herbals to achieve medicinal benefits.
- Sustainability is largely being practised in various fields. But in most of the cases they are not cost effective. The other part of my innovation is to adapt low cost sustainable design with simple indigenous elements like Coconut shell, Clay plaster, Cork, Bamboo, Jungle/pine wood etc. at appropriate areas.

**DATA AND INFORMATION TO BE COLLECTED:**

1. Details of Green wall construction/installation

2. Supports and frames
3. Plants species for indoor and out door
4. Irrigation system details
5. Lighting details
6. Maintenance
7. Samples

#### **How to collect data and How to analyse it?**

- Already gathering information from the service providers of various places on green wall construction and maintenance aspects.
- In the process of getting associated with a Horticulturalist/ Agriculturalist to get details on the plants species and their behaviour.

Apart from the above, I have collected sufficient literature to move forward. Also, analysis of each element will be carried out through models and tools by collecting all the required samples from the mentioned resources.

#### **PLANNING**

The concept of green wall has to be incorporated in design and the same will be detailed and fine-tuned towards the research topic as a study model. As part of innovative design the usage of indigenous sustainable elements will also be adopted.

Characteristics of the indigenous elements available in the developing countries like India are enormous. Will plan them appropriately in design specification based on their characteristics and also, complying with ergonomic standards.

**POSSIBLE OUTCOME**

Considering all the urban spaces which are completely responsible for the curse ' Global warming' on this mother earth, as a responsible Architect would work towards through my dissertation to manifest and prove Green walls and other simple indigenous materials as affordable solution for all the Urban conditions and justify the usage of green wall for a space which is non-Air-conditioned. The other issue which is threatening the world is the recession which also calls for innovative cost effective practise in the construction and specification. Initiative to achieve the same with cost effective indigenous materials is a challenge yet it will be proven possible.

“ It is always better to plan and protect, rather than repent and repair”

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