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Vertical Gardening: Nature Climbs Your Building

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With the advent of modernization and urbanization, people are shifting from rural to urban areas, thereby, urban population is increasing day by day resulting in congested cities and towns. All around the world, a huge number of buildings are being constructed adding many more in future. Throughout the years, replacement of vegetated surfaces with paved and impervious surfaces in the urban areas have increased the temperature as compared to rural areas, because the paved surfaces absorb, retain and reradiate more solar energy than vegetation. The ambient temperature in urban area can be as much as 6 degrees higher than the air in rural areas. Urban landscaping is gaining popularity nowadays as people are becoming more conscious about green and clean environment.

History of Green Walls

The concept of the green wall dates back to 600 BC with the Hanging Gardens of Babylon, one of the seven wonders of the ancient world. Romans used to train grapevines, on garden trellises and on villa walls, climbing roses were the symbols of secret gardens. In 1920's British and Americans encouraged the integration of garden features and plant usage, for example, using pergolas, trellis structures and self-climbing plants. In 1988, there was the introduction of the stainless steel cable for green facades. In 1990s, cable and wire rope net systems and modular trellis panel systems were introduced. In the year 1993, the first major application of the new trellis panel system was featured at the Universal City Walk in California. In 1994, In Canada, Life Building in Toronto (an indoor living wall) was created with bio-filtration system. Perhaps the world's most famous vertical garden designer is Paris-based botanist Patrick Blanc who named it "vegetal walls". His creations can be seen in cities as diverse as São Paulo and Singapore. In 2001, his remarkable interior garden helped establish Paris's Pershing Hall hotel as an eminent address. In the year 2005, around thirty different modular systems for vertical gardens were available.

Benefits of Green Wall

- ✓ Aesthetic benefits
- ✓ Improved thermal efficiency of the building
- ✓ Indoor air quality improvement
- ✓ Economical benefits
- ✓ Improvement of Health and Wellness
- ✓ Reduction of Urban Heat Island effect (UHI)

Other Benefits of Green Wall Includes

- ✓ Reducing internal room temperature by 5 to 10 degrees in summer by installing
- ✓ them from outside.
- ✓ Plants are away from soil- borne diseases.

- ✓ More plants with in limited space.
- ✓ Helps in saving water.
- ✓ Helps in hiding less attractive portions of landscape.
- ✓ Provides excellent air circulation for the plants.
- ✓ Can provide privacy and a disguise from unattractive views.

Classification of Vertical Gardens/Green Walls

There are two main categories of green walls: green façades and living walls. Green facades are made up of climbing plants either growing directly on a wall or, more recently, specially designed supporting structures. The plant shoot system grows up the side of the building while being rooted in the ground. With a living wall, the modular panels are often made of stainless steel containers, geo textiles, irrigation systems, a growing medium and vegetation.The vegetation for a green façade is always attached on outside walls; although some living walls can also be green walls for interior use.

1. Container/trellis system: Commonly known as Green façades, refer to vines and climbers that grow from the ground or from large containers at various locations around the building supported either by the wall itself or by a supporting trellis/mesh. The wall-climbing type is the very common and traditional green walls method. Although, it is a time consuming process, climbing plants can cover the walls of building naturally. Sometimes, they are grown upwards with the help of a trellis or other supporting systems.

2. Modular panel system: Commonly known as living wall, the panel system composed of pre planted panels, vertical modules that hold growing media to support plants that are fixed vertically to a structural wall or frame. The module type is the latest concept compared to the previous two types. It requires more complicated design and planning considerations before a vertical system is ready.

Planning for the Vertical Garden

Planning includes suitable location, local climate, availability of plant material, set up of supporting structures including necessary preparations for integrated drip-tube irrigation etc. A vertical garden can be built virtually in any location and key to success is the selection of the right species for the right location.

Green wall consists of……

- ***Plant Material:*** Plants selections are site-specific and determined by light availability, location, size, color, texture, and growth habits.
- ***Planting Matrix:*** Medium for the plants to root and anchor onto a vertical surface. These can be in the form of organics, such as soil, or inorganic like plastics or synthetic fibers.
- ***Irrigation System:*** To supply the plants with water and nutrients for proper growth.
- ***Waterproof Barrier:*** To protect the building's façade from moisture.

• ***Structural Support:*** For supporting, the structural load of the vertical garden system onto the building façade.
• ***Lighting:*** To supply plants with sufficient lighting to photosynthesize and promote natural growth habits. Lighting can either be supplied by a natural source (the sun) or artificial source (metal halide, high-pressure sodium, and LED lights).

Plants Suitable for Vertical Garden

Plant selection should be based on local climatic conditions. Plants should have compact growth habit which is likely to provide thick and dense cover. Plants with short growth habit should have shallow fibrous root system, long life cycle. Plants should be capable to cope with full sun or full shade according to the location. Most commonly used plants in vertical garden are

Green Façades: *Hedera helix, Parthenocissus* spp, *Hydrangea petiolaris, Polygonum bauldschianicum, Lonicera* spp. *Clematis* spp. *Aristolochia* spp., *Jasminum officinale, Passiflora caerulea,* etc.

Living Wall: *Dracaena, Phalaenopsis* spp, *Asparagus sprengeri, Kalanchoe,Cordyline* spp.*Chlorophytum* spp., *Haworthia* spp., *Tradescantia* sp, *Fittonia* spp, *Nephrolepsis, Clematis, Gardenia* spp., *Asplenium nidus, Maranta* spp., *Cotoneaster, Euonymus fortune, Hedera, Hydrangea, Lonicera, Parthenocissus, Polygonum, Pyracantha, Selaginella, Wisteria, Rose, Petunia, Nasturtiums,* Daisies, Bromeliads and even some vegetables like tomato, chillies, cucumber, peas lettuce, *etc*.

Exterior Wall: *Lavendula, Thymus, Rosmarinus* or *Salvia* for full sunlight while *Begonia, Arum, Davallia, Asplenium,* and *Fuchsia* for shady locations.

Interior Wall: *Philodendron, Epipremnum, Aeschynanthus, Columnea, Saintpaulia, Begonia* or different ferns like *Nephrolepis, Pteris*andmany species of *Peperomia*.

Steps Involved in the Preparation of Vertical Garden

• The Vertical Garden is composed of three parts: a metal frame, a PVC layer and a layer of felt.
• The metal frame is hung on a wall or can be self-standing.
• PVC sheet of 1.00 cm thickness is riveted to the metal frame. This layer brings rigidity to the whole structure and makes it waterproof.
• A felt layer, made of polyamide, is stapled on the PVC. This felt is rot proof and its high capillarity allow homogeneous water distribution and the plant roots grow well on felt.
• Slits are cut in the outer felt layer to create pockets into which the plants are placed.
• Plants are installed on this felt layer as seeds, cuttings or already grown plants. The density is about thirty plants per square meter.
• The watering is provided from the top supplemented with nutrients. Watering and fertilisation are automated.

A pump and drip irrigation system supply nutrient-laden water, which slowly cascades down the wall through the felt material layers until reaching the bottom where a collector recovers the excess for reuse .

• The whole weight of the vertical garden including plants and metal frame is lower than 25 kg per square meter.

Thus, the vertical garden can be implemented on any wall, without any size or height.

Future Thrust

The study in Vertical garden is a new field to investigate, regarding the insulation properties, durability aspects, maintenance, choice of plants suitable to the existing climatic conditions, materials involved, etc. Effect of the factors such as the physical structure, materials and dimensions of the panels, substrate type, composition, depth on the performance of vertical greenery systems need to be studied. The study of Green walls with respect to Indian conditions must be done. Developing green wall requiring minimum cost and maintenance is one of the challenges which must be fulfilled.