



Increasing the scope of roof and terrace gardens with new technology

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Introduction:

As Indians, we should collectively acknowledge that the true essence of India lies in its villages, where lush greenery and picturesque beauty provide a delightful visual experience, something that the current urban generation often misses out on. In fact, even in today's fast-paced urban life, families are increasingly engaging in religious and gardening activities more than ever before. In the modern lifestyle, where limited space in multi-storied flats and terraces restricts the possibility of home gardens, there is a pressing need for innovative solutions to help people stay connected with nature. Furthermore, the rapid growth of the real estate business, the emergence of towering corporate buildings, Western-style malls, luxurious hotels, and suburban green spaces have necessitated fresh approaches to landscape design. One notable trend in recent times is the proliferation of rooftop and terrace gardens, aligning with contemporary lifestyles. While designing such gardens presents a challenge for landscapers, the key ingredients for success are aesthetics, functionality, pollution control, and

contributions to combating global warming.

Urban Rooftop and Terrace Gardens

Roof gardens have a rich historical lineage, tracing their origins back to Babylonian kings in ancient times. Furthermore, the influences of various invaders, including the Mughals, French, and English, have enriched the art of Indian gardens. Additionally, the spiritual Zen scriptures have added a poetic touch of Japanese garden style to modern India. Yet, the prevailing garden styles and concepts from Singapore, Western Europe, and the United States are truly captivating.

A recent catchphrase about Singapore city is "city in the garden," emphasizing the city's commitment to green spaces. This systematic presentation of gardens and innovative approaches to urban garden design serves as an exemplary model for our country to address changing climatic patterns. Moreover, these concepts are gradually finding their way into the Indian landscape industry as well.

Revitalizing Rooftop Gardens:

The ingenuity behind Indian rooftop

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and terrace gardens is rooted in the notion of kitchen gardens. Presently, we witness the continued practice of utilizing artistic and recycled receptacles to cultivate vegetables, herbs, flowers, and fruits within the realm of rooftop gardens. Across nearly every major metropolis and urban center, a multitude of gardening enthusiasts and homemakers have embraced the shift towards establishing organic rooftop gardens. However, creating an aesthetically pleasing garden with lush lawns, shrubs, and flowers to transform the barren rooftops covered in black tar and gravel in urban areas remains a significant aspiration for many. Challenges such as water stagnation, drainage, structural load-bearing capacity, root penetration, water scarcity, space constraints, architectural design considerations, roof gradients, and high costs may explain this. Fortunately, modern innovations in rooftop gardening have solutions to address these issues. Fascinatingly, the concept of contemporary rooftop and terrace gardens has been warmly embraced by property developers, real estate magnates, corporate entities, and hoteliers as a means to captivate their desired clientele. Consequently, India's largest urban centers proudly showcase these skyline gardens today.

Contemporary rooftop and terrace gardens have entirely supplanted traditional container and kitchen gardens on rooftops,

ushering in a wave of fresh, pioneering ideas and methodologies, as outlined below:

Green roofs, Drainage cells, Water retention and storm water management, Grey water management / rooftop ponds, Moisture retention mats, Usage of hydrogel polymers, Waterproofing techniques, Protective fabric against soil chemicals and soil bacteria, Root barriers, Rainwater harvesting, Acoustic insulators, Photovoltaic panels and energy conservation, Soilless culture and hydroponics, Recycled materials for decking, Vertical gardens, Skyrise gardens, Fire-resistant technology, Biodiverse roofs, Therapeutic rooftop gardens, Eco-friendly structures with certification,

Revitalizing Green Roofs:

Green roofs are both functional and aesthetically pleasing structures that enhance energy efficiency and introduce greenery into densely populated areas. A green roof, also known as a living roof, constitutes a building's roof, either partially or entirely adorned with vegetation and a growing medium, all placed atop a waterproofing membrane. Such roofs often incorporate adequate drainage, irrigation systems, and a combination of various components, as elaborated below. Green roofs can be categorized into three types: extensive roofs, intensive roofs, and multifunctional use roofs, based on the planting depth and intended purpose.

Expansive Green Roofs:

These roofs are adorned with a delicate layer of vegetation featuring shallow-rooted plants, making them exceptionally low-maintenance. According to international standards, they can support an additional weight load ranging from 7 to 23 kilograms per square foot. Expansive roofs offer the perfect canvas for cultivating decorative grasses, edge plants, and a variety of herbs.

Intensive Rooftops:

Imagine an elevated park right on the roof, easily accessible and featuring everything from lush lawns to small trees, meandering pathways, comfortable benches, and a complex support structure. It also incorporates sophisticated irrigation, drainage systems, and layers to protect the roots. According to international standards, the weight load can range from 36-70 kg per square meter, depending on the structural integrity of the building. The inclusion of the intensive roof concept in apartments and villas has significantly boosted real estate values.

Multi-Functional Rooftop Environments:

Multi-functional rooftops have been devised to cater to an array of purposes, spanning pedestrian pathways, recreational havens, communal meeting areas, and even provisions for vehicle parking. This innovative concept has garnered widespread acclaim within corporate edifices, IT precincts, and

retail emporiums. To execute it successfully, it is imperative to give due consideration to imaginative architectural designs, judicious plant selection, and the inclusion of other essential amenities right from the outset of the building design process, ensuring a harmonious incorporation of green elements.

Sustainable Drainage Cells:

Beneath the growing medium, you'll find non-biodegradable, environmentally-conscious plastic drainage cells, strategically placed to promote water retention and efficient drainage. These cells incorporate a polystyrene core, accompanied by non-woven polypropylene filter fabric on both their upper and lower surfaces, effectively blocking the passage of particles within the drainage core and facilitating smooth water drainage. They offer a practical substitute for conventional drainage gravel in rooftop gardens.

Moisture-Retaining Mat:

This punctured, recycled synthetic fiber material is specifically designed to maintain moisture levels in rooftop gardens and is conveniently supplied in roll form. It proves to be a valuable and innovative solution, particularly beneficial in hot climate areas.

Waterproofing Solution:

The application of a waterproof system with a self-adhesive vapor barrier and an underlying layer is a valuable innovation that effectively prevents excess moisture and

rainwater from infiltrating the roof, thus mitigating dampness issues.

Water Retention Method and Storm water Management:

Efficiently harnessing excess drained water and rainwater can lead to meticulous utilization. This technique not only helps mitigate storm water runoff but also allows for the transformation of surplus water into an attractive rooftop shallow pond, serving both functional and aesthetic purposes.

Hydrogel Polymers:

Hydrogels, which are cross-linked polyacrylamide polymers, offer a potential solution for regions facing water scarcity. The scientific principle underlying hydrogels involves their remarkable ability to absorb water through osmosis, holding up to 500 times their weight in water. As the surrounding environment experiences drying conditions due to water shortage, they gradually release up to 95% of their stored water. When re-exposed to water, they rehydrate and repeat the water storage process. Employing hydrogel in rooftop gardens to conserve water and retain moisture represents an innovative and valuable approach, particularly for maintaining lawns that demand a consistent water supply.

Barrier Cloth:

In contemporary rooftop gardens, a non-biodegradable polypropylene non-woven needle-punched fabric acts as a protective

barrier, effectively limiting soil chemicals and soil-borne bacteria. It is crucial to ensure that the choice of containers and the placement of this protective fabric are well-suited for optimal plant growth.

Root Barrier:

Non-reinforced polypropylene sheets employed in arboricultural practices find utility in rooftop gardens for trees with shallow root systems. This barrier effectively limits the lateral and vertical growth of roots within the substrate and building structures.

Soundproofing:

It can be enhanced and the overall acoustic quality of the building improved by installing acoustic insulators on the roof, which can also accommodate the placement of rooftop lawns and garden plants as part of the building's design for an effective acoustic system.

Recycle Materials for Decking:

- Utilize waste wood and plastic efficiently to create a decking surface that complements any garden design featuring plants as a hard scape feature.
- Make use of discarded wood and plastic to craft an eco-friendly decking option that pairs beautifully with plant elements in your outdoor setup.
- Repurpose waste wood and plastic into a versatile decking solution that harmonizes

seamlessly with plant elements, enhancing your landscape design.

Graphite Technology for Fire Resistance:

Through this breakthrough, the flow of oxygen will be halted in the event of a fire, effectively stopping its propagation. The installation of green roofs and turf pavement now requires the incorporation of this mandatory fire-resistant graphite technology to enhance safety.

Renewable Energy:

To efficiently maintain a rooftop garden, you can satisfy the power needs by employing photovoltaic panels. Installing thin film photovoltaic panels conserves energy, and the renewable energy produced can be employed to power rooftop lighting, irrigation systems, and maintenance. This ensures year-round energy efficiency in contemporary greenhouses.

Soilless Culture and Hydroponics:

It's clear that using soil as a growing medium adds extra weight to rooftop gardens. To address this concern, scientific techniques such as soilless culture and hydroponics are now being embraced in rooftop and terrace gardens. Substances like cocopeat, perlite, sphagnum moss, compost, and others are gaining popularity in Indian rooftop gardens because of their excellent water retention capabilities. While hydroponics hasn't seen widespread adoption, it represents another

excellent innovation for contemporary rooftop gardens.

Vertical Garden:

Green facades adorned with flowering and foliage climbers, as well as living walls, represent the latest advancements in vertical gardening. By evaluating rooftop wind speeds, an ideal vertical garden component can be established on rooftops. Vertical gardens offer tremendous benefits to corporate offices, IT parks, and shopping centers alike.

Skyrise Gardening:

A groundbreaking vertical skyrise garden known as the "Super tree" has emerged in Singapore, featuring various amenities such as hotels, malls, and an amusement theater nestled within its lush, microclimate-controlled greenery. This awe-inspiring project showcases the beauty of plants and offers a compelling model for creating skyrise gardens as tourist attractions, aligning perfectly with our country's focus on addressing global warming.

Biodiverse Roofs:

Creating biodiverse roofs involves introducing vibrant flowers to rooftops, allowing beneficial insects and butterflies to thrive in urban heat islands and promoting the development of a natural ecosystem. The selection of plants for the rooftop garden significantly influences its transformation into a biodiverse green roof.

Therapeutic Roof Garden:

A therapeutic roof garden can encompass features such as a healing garden, a meditation space, and an area tailored for people with physical challenges, the elderly, and children seeking stress relief. Harnessing the benefits of abundant sunlight, one can incorporate elements like lotus ponds, a dedicated cacti section, comfortable turf seating, and a profusion of flowering plants to create a roof garden with therapeutic qualities. Moreover, there is room for additional innovations in the rooftop garden, serving both functional and aesthetic purposes.

Here's a list of plants that can be used for rooftop gardening:

Adenium obesum (Desert Rose), Brunfelsia americana (Lady of the Night), Cordyline terminalis, Duranta repens (Golden Dewdrop), Codiaeum variegatum, Galphimia glauca, Ixora species, Jasminum nitidum, Lantana camara, Murraya paniculata, Nelumbium sp., Tecoma stans (Yellow Bells), Tecomaria capensis (Cape Honeysuckle), Epipremnum aureum (Money Plant), Ficus pumila (Creeping Fig), Rhoeo spathacea (Dwarf variety), Tradescantia pallida 'Purpurea' (Purple Heart), Wedelia trilobata (Creeping Daisy), Agave americana (Century Plant), Ananas comosus 'Variegata' (Variegated Pineapple), Epiphyllum oxypetalum (Dutchman's Pipe Cactus),

Euphorbia milii (Crown of Thorns), Hylocereus undatus (Dragon's fruit), Kalanchoe pinnata (Life Plant), Nolina recurvata (Pony Tail), Pedilanthus tithymaloides, Sansevieria species (Devil's Tongue), small ornamental and fruit trees, Zoysia grass species, ornamental bamboos, and palms such as Phoenix sylvestris, P. roebelenii, Woedyia bifurcate, Rhapsis excelsa, Chrysalidocarpus lutescens, Cycas revoluta, and Caryota mitis.

Generally speaking, roof gardens should aim to achieve air quality improvement in urban areas, effective global warming control, energy conservation, natural insulation, environmental safety, and eco-friendly garden designs. The ITC Green Centre, Gurgaon: ITC Green Centre is the corporate office of ITC Limited, one of India's largest conglomerates with interests in various businesses such as tobacco, hotels, and consumer goods. This building is known for its sustainable and eco-friendly design. Suzlon One Earth, Pune: Suzlon One Earth is the corporate headquarters of Suzlon Energy, a renewable energy solutions provider. The building is known for its innovative and eco-friendly design and houses various offices and facilities related to renewable energy. Patni (i-GATE) Knowledge Center, Noida: This might be a reference to an office or knowledge center associated with iGATE Corporation, an IT

services company. Please note that the company has since merged with Capgemini. Olympia Tech Park, Chennai: Olympia Tech Park is a prominent IT park located in Chennai, India. It houses various IT and technology companies, including offices, software development centers, and other facilities. Infinity Benchmark, Kolkata: Infinity Benchmark is a commercial office building located in Kolkata. It's known for its modern architecture and houses various corporate offices and businesses. CRISIL House, Mumbai: CRISIL House is the corporate office of CRISIL Limited, a leading credit rating agency in India. It is located in Mumbai and serves as the company's headquarters. Indira Paryavaran Bhawan: Indira Paryavaran Bhawan is an office building in New Delhi that houses various government offices and departments related to the environment and forests. ITC Maurya Hotel, New Delhi: ITC Maurya is a luxury hotel in New Delhi, part of the ITC Hotels chain. It's known for its luxurious accommodations and fine dining options. Infosys, Hyderabad: Infosys is a multinational IT services and consulting company with offices and development centers across India. The Hyderabad location likely refers to one of its offices or campuses in the city. Cisco Building, Bangalore: Cisco Systems is a multinational technology company

specializing in networking equipment. The Cisco Building in Bangalore may refer to one of its offices or facilities in the city, given its significant presence in India serve as excellent examples of cutting-edge green buildings in India that incorporate modern roof garden innovation concepts. The ability to easily acquire mature ornamental plants for the rapid development of rooftop gardens is also a valuable advantage. Nonetheless, the pressing need of the moment lies in establishing cost-effective and sustainable rooftop gardens by leveraging these latest innovations. As landscape professionals, it is our foremost responsibility to embark on this endeavour promptly to transform our nation into a greener one.