

Advantages and benefits from vertical forests in the urban fabric

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The **Vertical Forests** is the prototype building for a new format of architectural biodiversity which focuses not only on human beings but also on the relationship between humans and other living species.

- Vertical Forest buildings and Living Walls (green walls or green facades) incorporate trees, shrubs, and plants into their design, bringing greenery and nature/biodiversity directly to urban settings.



Introduction



Bosco Verticale in Milan,
Stefano Boeri



CaixaForum in Madrid,
Spain, Patrick Blanc



Vertical greening system functions in the urban landscape (Whang et al., 2022).



Air quality regulation

Outdoor air quality



Filtering pollutants through leaves and bark by absorbing fine dust particles and gaseous pollutants, such as Fine Particulate Matter (PM2.5), carbon dioxide (CO2), SO2, NO2, and O3 or volatile organic compounds (VOCs)

Indoor air quality

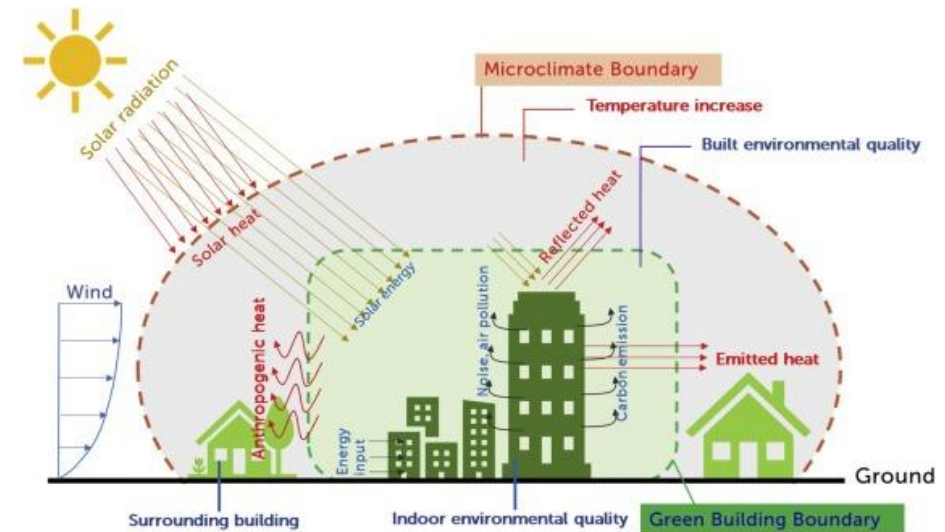


The natural process of filtering pollutants is extended indoors creating a healthier living and working environment for residents and poor air quality can lead to a range of health issues, including respiratory problems, allergies, and in extreme cases, "sick building syndrome."

Urban Heat Island Mitigation

- UHI Island effect is a phenomenon where urban areas experience higher temperatures than rural areas, mainly due to human activities, dense infrastructure and heat absorption materials such as concrete and asphalt.

Green facades and terraces of tall buildings provide natural shade with the consequence of preventing direct sunlight from heating the building surfaces. This natural shading created by the vegetation reduces the heat absorbed by the building resulting in a lower surface temperature.



Source: Bao-Jie He (2019).



Rainwater Management

Vertical green buildings have emerged as key solutions for stormwater management through a process known as “green infrastructure”.

- Play an important role in managing stormwater runoff, thereby contributing to sustainable development of urban environments.
- Absorbs rainwater and gradually releases it into the atmosphere.
- Mimics natural water cycles and contributes to balancing water resources and the environment.
- Retains rainwater in the leaves, stems and soil.
- Effectively reduces the total amount of rainwater runoff and helps regulate the amount of rainwater entering the drainage system and helps prevent flooding.
- Rainwater harvesting can support urban sustainability goals by reducing the demand for potable water and managing stormwater on-site through natural filtration and storage systems.



Sewage Treatment

- Leverages the natural purification capabilities of plants and engineered systems to treat wastewater, reduce potable water use, and enhance urban green spaces.
- Promotes the non-potable reuse of treated greywater, contributing to reduced potable water consumption and sustainable water resource management.



Source: Stefanatou et al., 2024



Enhancement of Urban Biodiversity

- Vertical forest buildings can transform traditional cityscapes into vibrant, living ecosystems.
- The integration of vegetation into these structures ensures that even in urban environments, ecosystems can thrive, promoting a harmonious coexistence between nature and urban living.
- The Bosco Verticale in Milan supports over 1,600 species of plants, contributing significantly to the biodiversity of the city (Chen et al., 2020).
- Such integration is crucial in urban areas where the rapid expansion of concrete and steel often leads to the depletion of natural habitats.
- The inclusion of greenery in high-rise buildings allows cities to maximize their spatial resources while still providing habitats for wildlife and green spaces for residents.

Nesting site inside a living wall.





Energy Efficiency

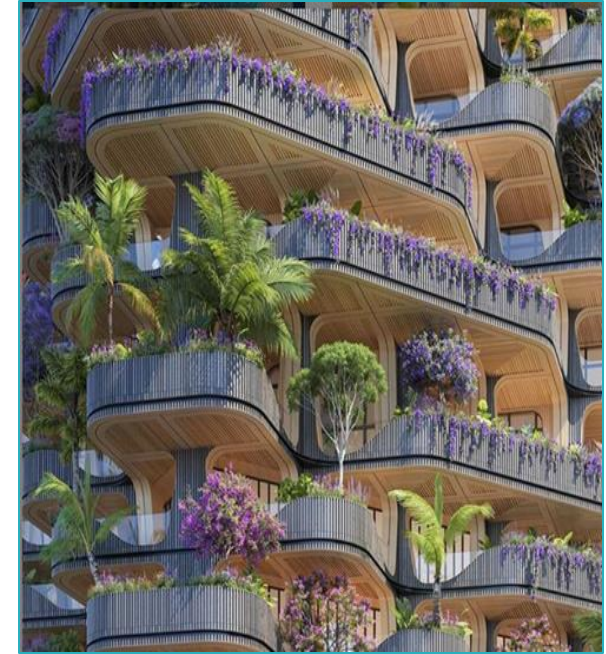
- Green walls and green roofs, bring substantial energy savings.
- Mitigate urban heat island effects and improve indoor environmental quality.
- Acting as effective insulation systems.
- Create microclimates that lower building temperatures and maintain humidity, leading to energy conservation.
- Tall buildings covered in greenery can incorporate solar panels, wind turbines or other technologies.
- Represent a paradigm shift in urban architecture towards energy-efficient and sustainable design practices.



Enhancing Aesthetics

Infuse natural beauty into the architectural fabric of cities.

- Provide greenery in spaces typically dominated by concrete and glass, creating visually pleasing landscapes that compensate for the lack of natural environments in densely populated areas.
- Enhance the visual appeal by integrating living flora into building exteriors, turning them into vibrant natural tapestries that improve both appearance and biodiversity.
- Serve as a bridge between nature and urban settings, integrating the aesthetic appeal of natural landscapes within the functionality of metropolitan architecture.
- Play an essential role in revitalizing cities and promoting livability.



Source: <https://interestingengineering.com/>

Psychological effects

- Greenery in built environments has been consistently linked to emotional well-being and stress reduction.
 - Has been shown to evoke positive emotional responses.
 - Exposure to green spaces reduced feelings of sadness and contributed to a general sense of emotional well-being.
 - Enhance social interactions and strengthen community ties.
 - Transform previously neglected urban spaces into welcoming, community-centric environments.
- The **positive influence** of these green spaces on social interaction is particularly **significant in densely populated urban areas**, where the lack of communal spaces often exacerbates feelings of isolation
- It can also evoke **negative emotions**, such as fear or discomfort, particularly **when the green spaces are perceived as unkempt or overgrown**.





Noise Reduction

- Acting as natural sound barriers and absorbing sound waves.
- Absorb sound through the structures of plants and substrate layers, reducing the transmission of external noise into buildings.
- Sound waves are partially absorbed rather than reflected when they hit these surfaces.
- Acoustic effectiveness, with different plant species and structural configurations enhancing noise attenuation.
- Disperse sound waves in multiple directions, thus preventing sound waves from concentrating in one direction





Protection of Building Structure

- Serve an important dual function of environmental sustainability and structural protection.
- Enhance the longevity and durability of building structures by
 - Providing thermal insulation,
 - Absorb UV radiation,
 - Reducing rain impact, and
 - Managing temperature fluctuations.
- All of which contribute to the overall stability and efficiency of the building.



Branding and Marketing

- Branding of vertical green buildings is becoming essential to differentiate products and attract consumers who value environmental responsibility.
- Branding and marketing of vertical green buildings are pivotal in establishing them as the new norm in urban infrastructure.
- By strategically highlighting their environmental, social, and economic value, VF can gain a competitive edge, foster consumer loyalty, and contribute to a more sustainable future.

Conclusion

- Vertical forests seem to provide an integrated solution to several urban challenges, including:
 - Air pollution,
 - Climate resilience,
 - Biodiversity loss,
 - Energy inefficiency,
 - Human happiness.

Vertical forests maybe is **the crucial green infrastructure** to be integrated in contemporary **decision-making** process, not only for city planning, as well as for a **unified City-Periurban-Nature development framework**.

Thank you for your attention!