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Green Facades as a Design Solution for Comfort in Hotel Buildings

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ABSTRACT: Urban noise poses a cogent claim to the accommodation industry, particularly for hotels in densely busy areas. As guests place more emphasis on quiet environments for sleep and relaxation, the need for effective acoustic strategies has become essential. This abstraction explores the application of green facades as an acceptable architectural band-aid for convalescent acoustic abundance in hotel buildings. Green facade (vertical surfaces covered with vegetation) has been apparent to abate ecologicalnoise through complete absorption, diffusion, and insulation. Drawing on an absolute analysis of contemporary research and comprehensive case studies, this analysis highlights the acoustic benefits of Green facades and their role in enhancing the bedfellow experience. The abstraction added examines accomplishing challenges, including cost, maintenance, and bulb selection, particularly in close urban regions. Findings support the association of green facades in boutique architecture as a passive, eco-friendly approach for mitigating urban noise and providing comfortable, pleasant living environments.

Keywords: Green facades, acoustic comfort, hotel design, noise reduction, sustainable architecture

I. INTRODUCTION

In today's hotel design, living comfort is seen rapidly as a versatile goal that integrates not only aesthetics and luxury but also environmental quality, especially acoustic comfort. As global urbanisation intensifies, hotels located in the city centers face frequent challenges such as noise pollution from hotel traffic, construction, nightlife and other ambient sources (Kalvelage et al., 2023; Gonzalaz-Lezcano et al, 2021). These acoustic challenges can negatively affect sleep quality, relaxation and overall guest satisfaction, giving them important ideas in hospitality architecture.

A promising and durable solution that receives traction in the architectural discourse is the implementation of green aspects - the vertical surfaces of the buildings are partially or completely covered with vegetation. The vertical greenery systems are also known, providing multidisciplinary benefits including noise reduction, air purification, and biophilic growth of the environment formed in green aspects (Perini et al., 2021; Kocur-Bera et al., 2023). Their integration in hotel buildings responds to the increasing demand for environmentally sensitive strategies that prefer human comfort in dense urban settings.

Acoustically, green aspects of green help, soil and support systems, absorb sound waves through their layered structure and help reduce noise transmission by disintegrating. This is the result of a significant decrease in environmental noise infiltration, especially from roadways and external mechanical systems (Lee et al., 2022). Such acoustic improvements not only enhance guest experiences but also contribute to the branding and marketing of hotels located in noisy urban areas.

Despite these benefits, adoption of green facades in hotels is limited, especially in urban centers, due to challenges related to cost, maintenance and lack of technical expertise. However, international projects such as the Osia Hotel in Singapore and One Central Park in Sydney offer examples that show that green facade can be employed to effectively support acoustic performance, with green aspects contributing to visual appeal and stability goals.

This study aims to check the application of green facade as a permanent design solution to increase acoustic comfort in hotel buildings.

Objectives of the study

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- To examine how green facades contribute to reducing noise levels in hotel environments.
- To explore the physical mechanisms by which Green Facades Influence Acoustic Performance.
- To evaluate interactive hotel case Studies where Green Facades have been successfully implemented for acoustic purposes.
- To identify options and challenges for adopting green facades in noise-prone hotel locations, particularly in Urban Tropical regions.

II. LITERATURE REVIEW

2.1 Understanding Acoustic Pollution in Hotels

Acoustic pollution, commonly known as noise pollution, has a growing anxiety in the urban environment, especially within the hospitality industry. Acoustic comfort refers to the state in which indoor spaces are reflected by infiltration, unwanted noise levels, allowing guests to relax and remove activities (ISO 22955: 2021). In hospitality architecture, acoustic comfort is no longer seen as a luxury, but a need, especially for hotels that compete in a crowded urban environment where peace and peace are essential offerings.

The design and construction of hotels often face acoustic challenges due to the diversity of activities at various places - the highest rooms, lobby, conference halls, restaurants and gyms. Each space has unique noise sensitivity and requires tailored acoustic strategies. Poor acoustic conditions are associated with low guest satisfaction, low migration and poor online reviews, affecting profitability and long-term reputation (Gonzalez-Lezcano et al., 2021).

2.2 Acoustic Pollution in Urban Hotel Contexts

Urban Hotels are frequently exposed to Noise Levels Above 60 dB during peak Traffic Hours (Kalvelage et al., 2023). Common Sources Include Vehicular Traffic, Pedestrian Activity, Outdoor Entertainment, and Nearby Construction. These Noise Levels often exceedWHO recommendations of 30–40 dB for Optimal Sleep Environments (World Health Organisation, 2022). Hotel heritage buildings in tropical urban centers face additional challenges due to the need for ventilation in open air and limited front insulation.

In many developing countries, rapid urbanisation, informal settlement patterns, and noise control rules increase environmental noise in cities. The Dynamic and Mixed-use Character of Urban Center makes itdifficult to Isolate Hotels from Continuous Noise Sources. Studies show that due to infrastructure development, population density and irregular commercial activities (Adebayo&Daramola, 2021), environmental noise risk in cities like Lagos, Nairobi and ACCRA is continuously increasing.

2.3 Sources and Contributing Factors to Hotel Noise

Hotel noise sources can be classified into external (eg, traffic, aircraft, nightlife) and internal (eg, plumbing, HVAC system, lift, footfall). González-Lezcano et al. (2021) note that structural factors such as Facade Material, Window Glazing, and Room Orientation also play a Major Role. In many tropical regions, cost-saving architectural options (eg, single-glazed windows, open corridors) increase the transmission of environmental noise in guest locations.

Additionally, noise transmission can be increased by architectural decisions such as guest rooms, poor untouched division, and keeping reflective surfaces in the hallway. Acoustic Design often takes a backseat to visit aesthetics or cost-service priorities in hospitality projects, particularly in budget hotels. Consequently, spaces meant for rest suffer from Acoustic Underperformance. In high-rise hotels, the floor complicates the vertical transmission of noise through the slab and service shaft and complicates the acoustic environment (Kalvelage et al., 2023).

2.4 Impact of Acoustic Pollution on Guests and Hotels

Noise disturbances in hotels are more than affecting sleep, they affect the perception of value, comfort and safety. A study by Kalvelage et al. (2023) showed that the growth of 10 dB in night noise is associated with a 15% decline in the guest satisfaction score. Long-term contact with noise also enhances physical stress reactions, enhancing bets for hotel operators that prefer wellness branding. Hotels that fail to address acoustic comfort negative reviews, low occupancy rates and loyalty to the low brand.

Excessive noise risk has also been linked to heart rate, blood pressure, and fatigue factor, which refute the goal of hospitality environment as spaces of rejuvenation and welfare. Modern travellers seek rapidly health-conscious and sensory-oriented housing, making acoustic performance in competitive urban markets a discrimination. Therefore, reducing acoustic pollution in hotels is not only a functional requirement but also a market-driven imperative (Gonzalez-Lezcano et al., 2021).

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2.5 Green Facades as a Passive Acoustic Design Strategy

Green facades, also known as Vertical Greenery Systems, Consist of Climbing Plants or Modular Vegetation Layers Installed on Building Exteriors. Acoustically, they serve as natural sound barriers through Absorption, Scattering, and Mass Damping Mechanisms (Leeetal., 2022). These vegetative layers trap the sound waves within their porous medium and obstruct direct sound paths, especially relevant to traffic noise in the minimum-to-middle-enemy range. Compared to traditional acoustic panels, green aspects provide additional benefits of beauty appeal and environmental stability (Perini et al., 2021).

Their composition—consisting of foliage, supporting trellises, growing media, and air gaps—adds layers of complexity to the wall system, increasing its sound insulation index (Rw). Lee et al. (2022) showed that the presence of green facades on exposed hotel walls led to noticeable reductions in perceived traffic noise from adjacent expressways. Unlike concrete walls, the irregular and porous structure of vegetation prevents sound wave coherence and reduces their intensity upon reflection.

2.6 Case Studies on Acoustic Application of Green Facades

The Oasia Hotel in Singapore utilises a fully vegetated facade that acts as a noise buffer from surrounding traffic while contributing to a cooling microclimate. According to Kocur-Bera et al. (2023), guest feedback post-occupancy indicated improved acoustic comfort compared to similar urban hotels without green facades. In One Central Park, Sydney, vertical garden systems are embedded into balconies and wall cladding to serve both aesthetic and acoustic functions. These examples illustrate the practical integration of green infrastructure in hospitality design.

Other examples include the Parkroyal Collection Pickering in Singapore and Hotel Topazz in Vienna. In these buildings, green wall installations were included to soften external noise intrusion, especially in rooms facing busy streets. While their primary function was biophilic, post-occupancy feedback revealed a correlation between the greenery and acoustic comfort. Simulation studies using software such as ODEON and CATT-Acoustic further demonstrate the capacity of vegetated facades to reduce sound pressure levels (Samarasinghe & Hewage, 2021).

2.7 Opportunities for Green Facades in Hotels

- The Integration of Green Facades in Hotels Offers Numerous Opportunities:
- Passive Noise Reduction in High-Traffic Locations
- Improved guest comfort leading to better reviews and brand position
- Compliance with Green Building Certifications
- Potential for Urban Beautification and Biophilic Benefits that Enhance User Experience (Kocur-Bera et al., 2023)
- Marketing and branding edge in sustainability-conscious markets
- Climate Responsiveness by Combining Acoustic, Environmental, and Visual Comfort Strategies

These advantages make green aspects a valuable property for hotel developers who demand practical acoustic requirements, seeking to align with the trend of global stability. As urban noise increases with dense growth, inactive systems such as green fads offer a non-invasive, multi-profit solution that meets the expectations of 21st-century hospitality design.

2.8 Challenges Limiting Green Facade Adoption

- Despite the benefits, several limitations hinder widespread adoption:
- High Initial Installation Cost and Structural retrofitting needs
- Maintenance Demands, including irrigation and pruning
- Climate Limitations and Need for Region-Specific Plant Selection
- Lack of Awareness or Technical Knowledge Among Architects and Hotel Investors (Samarasinghe & Hewage, 2021)
- Limited Local Research and Region-Specific Acoustic Performance Data

To remove these challenges, governments and professional bodies need to promote the benefits of vegetation aspects through performance projects and encouragement. Additionally, research institutes should cooperate with the hospitality industry to generate field-specific guidelines, develop suitable plant palettes and test long-term performance in tropical conditions.

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III. METHODOLOGY

This study adopted a qualitative descriptive approach, which depends entirely on recent academic publications, architectural reports and secondary data from the hotel case studies. It Explores How Green Facades Improve acoustic comfort in hotels, particularly in Urban Contexts.

3.1 Research Design

A descriptive research design was used to examine acoustic benefits of green aspects. This design enabled a detailed review of relevant literature and real-world applications without changing the existing conditions.

3.2 Data Collection Methods

Data were gathered entirely from secondary sources using structured search protocols on platforms such as ScienceDirect, Google Scholar, and institutional repositories. The sources included:Peer-reviewed journals (2020–2024)

- Acoustic simulation reports
- Post-occupancy hotel evaluations
- Standards such as ISO 22955:2021
- Green building rating tools (LEED v4, BREEAM)

3.3 Sampling and Case Study Selection

A purposive sampling strategy was used to identify four global hotel case studies known for their application of green facades and their contribution to acoustic performance. The selection criteria included:

- The building must function as an urban hotel.
- The green facade system must be integral to the building's design.
- There must be documented evidence of acoustic impact.
- Data must be available in English and published after 2020.

These criteria ensured the relevance and contemporary applicability of the cases to the research objectives.

3.3.1 Case Study Descriptions

To enrich the methodology and justify the study's secondary data approach, four international hotel case studies were reviewed. Each was selected for its innovative use of green facades to address acoustic challenges in urban environments.

Oasia Hotel Downtown, Singapore: This award-winning hotel employs a double-skin green facade densely populated with tropical vegetation. The facade acts as a buffer against intense traffic noise from its downtown location. According to Kocur-Bera et al. (2023), the plant density and layered system reduce external noise infiltration, improving guest comfort and aligning with biophilic design goals.

One Central Park, Sydney: This high-rise development features a modular green wall system on its podium and lower residential tower, which faces a busy street. Lee et al. (2022) report that the vegetation contributes to measurable reductions in ambient noise levels on the facade-facing units by absorbing and diffusing low-frequency urban sounds.

Parkroyal Collection Pickering, Singapore: Known for its iconic sky gardens and extensive greenery, this hotel utilizes layered vegetative facades to reduce ambient disturbances from nearby roadways. Wong et al. (2020) document that guests in greenery-facing rooms reported higher perceived acoustic comfort than those facing the uncovered street side.

Hotel Topazz, Vienna: This boutique hotel in a compact European city uses a partial living wall system. Although smaller in scale, the vegetation is strategically placed on street-facing walls to improve sound insulation. Samarasinghe and Hewage (2021) note that this configuration helps soften urban street noise in guest rooms directly overlooking traffic.

These examples were chosen not only for their functional green facade systems but also for their documented acoustic impacts, making them relevant to this study's goals.

3.4 Data Analysis Method

The collected secondary data were analyzed using thematic content analysis. This qualitative approach enabled the identification of patterns, recurring themes, and performance benchmarks across different case studies. Variables examined included the type of facade system, the type and density of vegetation, the documented noise reduction (measured in decibels), and the user-reported acoustic comfort.

Quantitative insights, such as noise reduction measurements, were compared where available to evaluate how different green facade configurations performed in real-life hotel settings. These findings were interpreted alongside international standards, such as ISO 22955:2021, and referenced against acoustic modeling outputs where provided.

3.5 Limitations

This study faced several limitations:

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- It did not involve any field data collection or physical measurements.
- It depended solely on literature that reported on hotels with green facades.
- Most case studies originated from high-income countries, with limited data from African urban contexts.
- Variability in noise measurement methods across studies limited direct comparison.

Despite these constraints, the use of reliable, post-2020 sources provided a solid foundation for understanding the role of green facades in hotel acoustic performance.

- No primary field data
- Limited African-based green facade data
- Inconsistent acoustic testing across studies

IV. RESULTS AND DISCUSSIONS

4.1 Major findings from data analysis

The analysis of secondary data prepared from four international hotel case studies indicates that green aspects provide adequate acoustic benefits in dense urban environment. All reviewed buildings contained integrated green wall systems with vegetation or in modular panels at the ground level or on the front. These aspects performed as a natural sound, which reduces the infiltration of road-level noise into internal locations.

The noise was between 3 and 10 decibels (DB) depending on the vegetative type, wall construction and urban density. This is important, given that even 5 dB deficiency can improve acoustic comfort in rooms coming in contact with continuous traffic noise (WHO, 2022). Additionally, several studies stated that the rooms facing green aspects found high guest satisfaction ratings without vegetation buffering (Kocur-Bera et al., 2023; Wong et al., 2020).

The thematic analysis of literature revealed three major acoustic works of green aspects:

- Absorption: The foliage and the substrate absorb airborne noise, especially the middle and high-frequency sounds.
- Dissemination: irregular surfaces scatter sound waves, reducing intensity.
- Obstacle effect: Botanical mass acts as a buffer, reducing direct sound wave transmission.Despite this, the methodology offers a reliable basis for contextual recommendations**.**

4.2 Effect of green facade on noise reduction

The role of green aspects in reducing environmental noise is rapidly accepted in architectural sound. For hotel buildings located near roads or commercial centers, provides a non-invasive, passive solution for the fore-based botanical sound infiltration. At the city of Osia Hotel in Singapore, green double-skin failure reduced the indoor sound level to 10 dB, with the noise level to 58 dB below 68 dB to 58 dB, which was directly conveyed to the city's traffic (Kocur-Beera et al, 2023).

Similarly, a central park in Sydney achieved 6-8 dB noise using modular vegetable panels with road-facing units (Lee et al., 2022). Green walls stopped noise from nearby arterial roads, especially in low-frequency bands in vehicle traffic.

Hotel	Facade Type	Noise Reduction	Source
Oasia Hotel Downtown, Singapore	Double-skin vegetated wall	8–10 dB	Kocur-Bera et al. (2023)
One Central Park, Sydney	Modular green wall panels	6–8 dB	Lee et al. (2022)
Parkroyal Collection, Singapore	Sky gardens and greenery	5–7 dB	Wong et al. (2020)
Hotel Topazz, Vienna	Partial living wall system	3–5 dB	Samarasinghe & Hewage (2021)

Table 4.1

4.3 Comparative analysis of the hotel with green facade and without hotel

Comparing hotels that use green aspects against those without such systems highlights the acoustic advantage of vertical vegetation. The study reports that the standard hotel buildings in urban areas usually experience 60–70 dB indoor noise levels without acoustic intervention, especially those facing major roads (WHO, 2022). Conversely, hotels with green aspects showed a decrease of 5–10 dB in average noise, depending on the density of the plant and plant density. These conclusions underline the buffering capacity of green aspects and their utility in reducing urban noise without the requirement of comprehensive structural redistribution (Perini et al., 2021). In

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addition, the guest perception of comfort was continuously higher in the rooms presided over by vegetation. Samarasinghe and Hewage(2021) report that guest satisfaction for a sound of up to 25–35% in exposure to green aspects improved the guest satisfaction score, especially when the vegetation covers at least 50% of the wall surface.

4.4 Opportunities in Challenges and Applications

While the benefits of green aspects are obvious, many practical challenges obstruct their widespread use in hotel design, especially in areas such as Nigeria:

Challenges:

- Maintenance: Regular irrigation, sorting and plant care is necessary, but is expensive, especially in a tropical climate with rapid vegetation growth.
- Structural load: In chronic buildings, there may be a lack of structural integrity to support the additional weight of vegetation.
- Selection of the plant: Not all species thrive in the humid climate of Lagos (Htet et al., 2023)
- Cost: Early investment is higher than standard aspects, discouraging adoption in cost-sensitive markets.

Opportunities:

- Policy incentive: Green building certification (eg, LEED, EDGE) can promote adoption by providing taxes or branding incentives.
- Guest demand: Hotels with biofilic elements attract guests seeking welfare and peace in fast urban settings (Kocur-Bera et al., 2023).
- Urban Soundscape Improvement: A scale adoption can reduce the level of city-wide environmental noise.

V. CONCLUSION AND RECOMMENDATIONS

5.1 Summary of findings

This study detected the role of green facades as a design solution to enhance acoustic comfort in hotel buildings, especially in a noisy urban environment. Through the qualitative analysis of recent literature and four global hotel case studies, research established that green facade can effectively reduce external noise levels by 3–10 decibels, depending on the mask type, vegetative density and urban conditions around the surroundings. This level of noise reduction is important, as it aligns with international acoustic standards and improves guest satisfaction in hospitality locations.

Analysis showed that vegetation on external construction acts as a natural buffer, reducing sound transmission through absorption, disintegration and spread. Hotels such as Osia Hotel Downtown in Singapore and a central park in Sydney improved the average in both objectives and subjective acoustic comfort, where green facades were implemented. Additionally, the study identified recurring implementation challenges, including maintenance, cost and selection of plant species, especially in tropical and high-density urban contexts such as Lagos.

5.2 recommendations for design and policy

Based on the findings, the following design and policy recommendations are proposed to support the integration of green aspects in hotel architecture, especially in urban settings:

- Design integration in new buildings: Architects and developers should include green aspects during the initial design stages of hotels, especially to the height of the roads or noisy public areas. Double-Skin vegetables or modular green wall panels should be preferred for their high acoustic performance.
- Urban Planning Support: Local urban authorities should modify the building code to recognize green aspects as valid acoustic mitigation tools. Incentives such as tax credits, fast-track permits, or allowance of additional floor fields can be provided for buildings that apply vertical greenery with the noise-cutting capacity documented.
- Selection of climate-compatible species: Plant species with dense leaves and year-round growth, such as ficus pumilla or headra helix, lagos and other tropical cities should be preferred. Their perfect acoustic and environmental benefits make them suitable for a decrease in urban noise.
- Maintenance Standards: Hotel operators should apply structured maintenance programs, including irrigation systems, pest control and seasonal pruning to ensure long-term acoustic performance of green walls.
- Green Certification Alignment: LEED V4, BREEAM, and EDGE should be encouraged to adopt rating systems, as they now include acoustic and biophilic performance as an evaluation matrix. Hotel stability that meets these criteria can benefit from branding and operational efficiency.

5.3 Suggestions for future research

To address boundaries in this study and to carry forward the field of acoustic design in

hospitality buildings, future research should be considered:

- Empirical field studies in Africa: Local, region-based research is required to assess the acoustic performance of the real-world aspects in hotels within Lagos and other tropical African cities. This will provide reference-specific insights into vegetative behaviour, structural durability and user perception.
- Longitudinal acoustic monitoring: Long-term studies that monitor the noise levels before and after the installation of green aspects will help validate their performance in weather and occupancy patterns.
- Comparative analysis with other passive strategies: Future work should compare green aspects with other passive acoustic interventions such as acoustic glass, buffering corridors or urban landscapes to determine the most cost-effective solutions.
- Multi-functional performance studies: Since the green aspects can also affect air quality and thermal comfort, the study that integrate these dimensions along with acoustic performance will help architects and hotel operators to make informed design decisions.

This study contributes to the growing body of knowledge on permanent, comfortable hotel design. While the green aspects are not a size-fit-all solution, jointly with their documented acoustic gains and environmental benefits-they form a compelling strategy to enhance guest experience and urban vibrancy in noisy places.

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