



Physical Building Attributes and Place Performance of Green-Certified Buildings in Lagos State, Nigeria

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ABSTRACT

The growing adoption of green-certified buildings has increased the need to evaluate not only their environmental efficiency but also their capacity to function as comfortable, accessible and user-responsive places. This study assessed the relationship between physical building attributes and place performance in selected LEED- and EDGE-certified buildings in Lagos State, Nigeria. Anchored on Post-Occupancy Evaluation theory, the study adopted a quantitative case study design involving 1,004 valid responses from users of nine operational green-certified buildings. Physical building attributes were measured across material quality, energy efficiency, water efficiency, waste management, site/environmental sustainability, indoor environmental quality, and safety/maintenance conditions, while place performance was measured using a composite index covering comfort, accessibility, functionality, environmental quality, productivity, social interaction, privacy, and satisfaction-related indicators. Reliability analysis showed strong internal consistency for the Place Performance Index (Cronbach's $\alpha=0.876$) and the overall instrument ($\alpha=0.855$). Pearson correlation analysis revealed that indoor environmental quality had the strongest positive relationship with place performance ($r=0.837$, $p<0.001$), followed by safety and maintenance ($r=0.611$, $p<0.001$), material attributes ($r=0.534$, $p<0.001$), energy efficiency ($r=0.392$, $p<0.001$), and site/environmental sustainability ($r=0.388$, $p<0.001$). Multiple regression analysis showed that the model significantly predicted place performance, $F(7,996)=594.035$, $p<0.001$, explaining 80.7% of the variance. Indoor environmental quality emerged as the strongest predictor. The study concludes that sustained place performance in green-certified buildings depends not only on certification status but also on indoor environmental quality, effective maintenance, material performance, energy reliability, and context-sensitive site planning.

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INTRODUCTION

The growing concerns over climate change, environmental degradation, rapid urbanization, and excessive resource consumption have intensified global efforts toward sustainable development within the built environment. Buildings contribute significantly to global energy use, greenhouse gas emissions,

and material depletion, making the construction industry a critical focus in sustainability discourse (Ding, 2008). In response, green building practices have emerged as a key strategy for reducing environmental impact while enhancing resource efficiency, occupant well-being, and overall building performance (Zuo & Wu, 2013). Consequently, internationally recognized

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certification systems such as Leadership in Energy and Environmental Design (LEED), Building Research Establishment Environmental Assessment Method (BREEAM), and Excellence in Design for Greater Efficiencies (EDGE) have been developed to assess and promote sustainable building performance.

In developing countries such as Nigeria, the adoption of green building principles is gradually increasing, driven by rising awareness of environmental sustainability and resource efficiency within the construction sector. Institutions such as the Green Building Council of Nigeria (GBCN) have played a key role in promoting sustainable construction practices and encouraging the development of green-certified projects across the country. However, despite these advancements, the level of adoption and performance evaluation of green-certified buildings in Nigeria remains relatively limited when compared to developed economies (Ebekozien *et al.*, 2022). Existing studies in the Nigerian context have largely concentrated on technical indicators such as energy efficiency, material selection, and environmental impact, with limited attention given to how these buildings perform in terms of user experience and functional effectiveness (Nkini *et al.*, 2022).

Recent discourse in sustainable building research emphasizes that building performance should extend beyond environmental efficiency to include functional and experiential dimensions that reflect users' needs and satisfaction. This broader perspective is captured in the concept of place performance, which refers to the extent to which buildings support occupant comfort, accessibility, safety, environmental quality, and overall satisfaction in use. According to Preiser and Vischer (2004), building performance encompasses not only technical efficiency but also behavioral and experiential outcomes that determine how effectively built environments support human activities. In this regard, the performance of green-certified buildings is not only dependent on certification standards but also on how their physical characteristics influence user experience and spatial functionality.

Physical building attributes such as spatial configuration, architectural design, building envelope, construction materials, ventilation systems, daylighting strategies, thermal performance, and building services significantly influence occupant experience and overall building usability. Prior studies have demonstrated that these attributes affect comfort, productivity, health, and satisfaction within buildings (Azhar *et al.*, 2011; Zuo & Wu, 2013). In tropical urban environments such as Lagos State, issues such as thermal comfort, natural ventilation, daylight access, acoustic quality, and energy efficiency are particularly critical in determining building performance and livability. Although green-certified buildings are expected to perform better environmentally and functionally, there remains limited empirical evidence on their actual place performance within the Nigerian context.

Lagos State provides a relevant context for this investigation due to its rapid urbanization, high population density, infrastructural pressure, and growing environmental challenges. The state continues to experience increased demand for sustainable building solutions that can improve environmental quality while maintaining functional and social efficiency (Olaniyan & Babatunde, 2020). Although the number of green-certified developments in Nigeria is gradually increasing, sustainability research has largely focused on compliance-based assessments such as energy and material efficiency, with less emphasis on occupant-centered performance evaluation (Ismaila *et al.*, 2021). More recent studies, however, have begun to highlight the importance of social sustainability and user experience in determining building effectiveness (Nwogu & Emedosi, 2024).

Despite these developments, there is still limited empirical evidence on how physical building attributes influence the place performance of green-certified buildings in Lagos State. Furthermore, many existing evaluation frameworks are derived from foreign standards that may not fully reflect the climatic, cultural, and operational realities of the Nigerian built environment. This creates a contextual knowledge gap regarding the actual performance of green-



certified buildings in Lagos. Therefore, this study examines the relationship between physical building attributes and place performance of green-certified buildings in Lagos State, Nigeria. It aims to determine how sustainable design features influence occupant comfort, environmental quality, and overall building functionality within green-certified building settings

LITERATURE REVIEW

Green-certified buildings have emerged globally as a key strategy for addressing environmental degradation, climate change, rapid urbanization, and excessive resource consumption within the built environment. These buildings are designed to reduce negative environmental impacts through efficient use of energy, water, materials, and other natural resources, while also enhancing occupants' comfort, health, and productivity (Ding, 2008; Zuo & Wu, 2013). Consequently, internationally recognized certification systems such as Leadership in Energy and Environmental Design (LEED), Building Research Establishment Environmental Assessment Method (BREEAM), and Excellence in Design for Greater Efficiencies (EDGE) have been developed to promote sustainable construction practices and evaluate building performance across environmental, economic, and social dimensions.

In Nigeria, awareness and adoption of green-certified buildings have gradually increased due to rising concerns about sustainability and environmental management within the construction industry. The Green Building Council of Nigeria (GBCN) and related sustainability initiatives have contributed significantly to the promotion of environmentally responsible building practices across the country. Despite these developments, studies show that the adoption and post-occupancy evaluation of green-certified buildings remain relatively limited compared to developed countries (Ebekoziem *et al.*, 2022). Existing literature has largely focused on technical sustainability indicators such as energy efficiency, water conservation, construction materials, and carbon emission reduction, while less attention

has been given to occupants' experiences and the actual place performance of these buildings (Nkini *et al.*, 2022).

The concept of place performance has therefore gained importance in contemporary sustainable building discourse, as buildings are expected not only to achieve environmental efficiency but also to provide functional, comfortable, safe, and user-responsive spaces. Place performance refers to the extent to which a building effectively supports occupants' activities, comfort, accessibility, satisfaction, and overall well-being within a given environment (Preiser and Vischer, 2006). In green-certified buildings, place performance is strongly influenced by physical building attributes and operational conditions, including thermal comfort, ventilation, indoor air quality, lighting quality, acoustic conditions, spatial organization, and maintenance practices. Studies have shown that these physical characteristics significantly shape users' perceptions, behaviors, and experiences, thereby influencing the overall effectiveness of sustainable buildings (Kalantari and Shepley, 2021).

Although green-certified buildings are designed to achieve both environmental and human performance outcomes, several studies have identified a performance gap between design intentions and actual operational outcomes after occupancy (Li *et al.*, 2022). Many buildings meet certification requirements during design and construction stages but fail to fully satisfy occupants' functional and experiential expectations due to poor maintenance, operational inefficiencies, and inadequate integration of users' needs. This challenge is more pronounced in developing countries such as Nigeria, where sustainability assessment frameworks are often adapted from foreign contexts that may not adequately reflect local climatic, socio-cultural, and economic conditions. As a result, there remains limited empirical evidence on how the physical characteristics of green-certified buildings influence their actual place performance within Lagos State.

This study is anchored on the Post-Occupancy Evaluation (POE) theory, which provides a systematic framework for assessing



building performance after occupation based on users' experiences and functional outcomes (Preiser and Vischer, 2006). Unlike conventional performance evaluation methods that emphasize technical compliance, POE incorporates occupants' perceptions of comfort, satisfaction, and usability as key indicators of building effectiveness. This makes it particularly relevant to green-certified buildings, where design intentions do not always align with actual operational performance. Through the assessment of environmental quality, spatial functionality, maintenance conditions, and user satisfaction, POE serves as an important feedback mechanism for improving sustainable building design and management practices (Ackley and Ukpog, 2019). Therefore, it provides a suitable theoretical foundation for examining how physical building attributes influence place performance in green-certified buildings.

METHODOLOGY

This study adopted a quantitative case study research design to evaluate the physical characteristics and place performance of green-certified buildings in Lagos State, Nigeria. The study population comprised users and occupants of selected green-certified buildings certified under the Leadership in Energy and Environmental Design (LEED) and Excellence in Design for Greater Efficiencies (EDGE) rating systems. The selected buildings included residential and commercial developments that were fully operational and accessible during the field survey.

Both primary and secondary data were utilized for the study. Primary data were obtained through structured questionnaires, physical observation, and on-site building assessment, while secondary data were sourced from relevant literature, certification databases, and official records from LEED and EDGE directories. The questionnaire captured information relating to the physical characteristics and operational conditions of the buildings as well as users' perceptions of place performance indicators such as comfort, functionality, accessibility, environmental quality, and satisfaction.

This sampling method involves a complete enumeration and deliberate selection of buildings that are certified under established green rating systems, and for this study, LEED and EDGE benchmarks are used basically because they are the only bodies that have certified buildings in Nigeria (Adewolu, 2023), and also because the overall number of certified buildings is relatively low (Unegbu *et al.*, 2025). Ten accessible and operational green-certified buildings were selected for the study. Cluster and systematic sampling techniques were subsequently employed to select building users and occupants. Based on the estimated occupant population of 4,473 users across the selected buildings, a sample size of 1,119 respondents representing 25% of the study population was adopted, this is in line with Makinde *et al* (2024), and also a recommendation by Bassi and Camble (2011). A total of 1,004 valid questionnaires were retrieved and used for analysis, representing an 89.72% response rate.

Data collected were analyzed using descriptive and inferential statistical techniques. Descriptive statistics including frequency distribution, percentages, mean scores, and ranking analysis were used to assess the physical characteristics and place performance indicators of the buildings. Inferential statistics such as Pearson correlation and regression analysis were employed to examine relationships between physical building characteristics and place performance variables. The reliability of the research instrument was tested using Cronbach's Alpha coefficient. Results were presented using tables and charts for clarity and interpretation.

Physical building attributes were organized into seven composite predictor variables: material attributes, energy efficiency, water efficiency, waste management, site/environmental sustainability, indoor environmental quality, and safety/maintenance performance. Composite scores were computed using the mean score of the items within each scale. Pearson correlation analysis was used to determine the bivariate relationship between each physical attribute and place performance, while multiple linear regression was used to estimate



the combined and relative predictive influence of the physical attributes on the PPI. Statistical significance was evaluated at the 0.05 level.

Place performance was operationalized as a composite Place Performance Index (PPI) using twenty-three (23) questionnaire items. The items assessed outdoor space usability, accessibility to services, perceived affordability, productivity and wellbeing, neighbourhood integration, access to public transport, landscaping, climate responsiveness, groundwater recharge, stormwater management, disabled access, environmental performance, communal spaces, community contribution, ecological improvement, privacy, and acceptable surrounding noise levels. Higher scores indicated stronger perceived place performance.

RESULTS AND FINDINGS

The findings of this study reveal that green-certified buildings in Lagos State are

predominantly commercial and corporately owned developments, reflecting the increasing institutional adoption of sustainable building practices within the state. The assessment of the physical characteristics of the buildings indicates that commercial buildings account for the highest proportion of the assessed developments, while residential buildings constitute a relatively smaller proportion. Similarly, most of the buildings are owned and managed by corporate organizations, suggesting that the implementation of green certification is largely driven by institutions and private organizations with greater financial and technical capacity to adopt sustainable building technologies. The findings further show that a majority of the buildings possess floor areas exceeding 15,000 square meters and have remained operational for over five years after certification, indicating a relatively mature and large-scale green building sector within Lagos State.

Table 1: Characteristics of the Green-certified Buildings in Lagos State

Building	Building Type and Use		Ownership of the Building		Total Floor Area Occupation		Duration of Use Since Certification		
	Commercial	Residential	Corporate Body	Individual	0 - 15,000 SQM	More than 15,000 SQM	0 - 5 Years	More than 5 Years	
Lekki Pearl Estate		•		•		•	•		
Peridot Parkland Est.ate		•		•		•	•		
Bluewater Lagos		•	•		•			•	
4 Bourdillon		•	•			•		•	
Heritage Place	•		•			•		•	
Alliance Place	•		•		•		•		
Kings Tower	•		•			•	•		
Cornerstone Tower	•		•			•		•	
Alpha 1	•		•		•			•	
Total	Frequency	5	4	7	2	3	6	4	5
Count	Percentage (%)	55.6	44.4	77.8	22.2	33.3	66.7	44.4	55.6

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The analysis of building envelope and construction materials demonstrates a significant level of compliance with sustainable construction practices among the assessed buildings. All the buildings utilized locally sourced or recycled construction materials, reflecting adherence to green building principles aimed at reducing embodied energy and promoting environmental sustainability, this is consistent with findings by Gil-Ozoudeh *et al.* (2024). Concrete roofing systems were predominantly used due to their durability and thermal performance suitability for tropical climates (Basher, 2023), while ceiling finishes largely consisted of gypsum boards and

plaster of Paris, indicating modern interior finishing standards (Esan, 2024). The findings also reveal widespread use of sandcrete block wall systems (Livingston *et al.*, 2025), glazed window insulation, and energy-efficient glazing technologies such as double-pane and tinted low-emissivity windows, all of which contribute to improved indoor environmental quality and thermal regulation (Teixeira *et al.*, 2025). In addition, floor finishes mainly comprised ceramic and marble materials combined with natural elements, suggesting an effort to balance durability, aesthetics, and sustainability considerations.

Table 2: Building Envelope and Construction Materials

Building	Material Source	Roof Material		Ceiling Material	Wall Material	Insulation Type		
	Locally / Recycled	Aluminum / Zinc	Concrete	Plaster of Paris / Gypsum Boards	Concrete Blocks	No Insulation	Window Glazing	
Lekki Pearl Estate	•	•		•	•		•	
Peridot Parkland Est.ate	•	•		•	•		•	
Bluewater Lagos	•		•	•	•	•		
4 Bourdillon	•		•	•	•		•	
Heritage Place	•		•	•	•		•	
Alliance Place	•	•		•	•		•	
Kings Tower	•		•	•	•		•	
Cornerstone Tower	•		•	•	•		•	
Alpha 1	•		•	•	•		•	
Total Count	Frequency	9	3	6	9	9	1	8
	Percentage (%)	100.0	33.3	66.7	100.0	100.0	11.1	88.9

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Table 3: Building Construction and Finishes Materials

Building	Window Type			Door Type			Floor Finish Type		
	Double Pane	Tinted / Low-E	Double Pane, Tinted/Low-E	Steel, Aluminum	Wooden/Vegetated	Steel, Aluminum Wooden/Vegetated	Ceramic/Marble	Ceramic/Marble, Wooden/Vegetated	
Lekki Pearl Estate	•				•		•		
Peridot Parkland Est.ate	•				•		•		
Bluewater Lagos		•			•			•	
4 Bourdillon			•			•		•	
Heritage Place		•				•	•		
Alliance Place			•	•				•	
Kings Tower			•	•				•	
Cornerstone Tower			•			•		•	
Alpha 1			•			•		•	
Total Count	Frequency	2	2	5	2	3	4	3	6
	Percentage (%)	22.2	22.2	55.6	22.2	33.3	44.5	33.3	66.7

Findings relating to energy efficiency indicate that all the assessed buildings rely on hybrid energy systems combining public electricity supply, backup generators, and renewable energy sources such as solar energy. This reflects the need for energy resilience within Lagos State due to instability in public power supply (Akinnubi *et al.*, 2024). The buildings also demonstrate substantial integration of energy-efficient technologies including LED lighting systems, smart meters, motion sensors, and energy-efficient HVAC systems (Segun-Falade *et al.*,

2024). Hybrid ventilation systems combining natural, mechanical, and HVAC ventilation strategies were dominant across the buildings, indicating the application of climate-responsive design approaches aimed at enhancing thermal comfort while reducing energy consumption, this is consistent with the findings by Oleiwi and Mohamed (2022). Furthermore, most respondents reported no significant power outages within the buildings, suggesting that the installed hybrid energy systems effectively support operational reliability and occupant comfort.

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Table 4: Energy Efficiency

Building	Primary Energy Source	Energy -Efficient Features				Type of Predominant Ventilation System in Place			Frequency of Power Outage	
	Hybrid (Multiple source)	LED Lighting, Smart Meters	LED Lighting, Smart Meters, Motion Sensors/ Controls	LED Lighting, Smart Meters, Motion Sensors/ Controls, Energy Efficient HVAC	Natural, HVAC	Mechanical, HVAC	Natural, Mechanical, HVAC	Occasionally	None	
Lekki Pearl Estate	•	•			•			•		
Peridot Parkland Estate	•	•			•			•		
Bluewater Lagos	•		•			•			•	
4 Bourdillon	•			•			•		•	
Heritage Place	•			•		•			•	
Alliance Place	•			•			•		•	
Kings Tower	•			•			•		•	
Cornerstone Tower	•			•			•		•	
Alpha 1	•			•			•		•	
Total Count	Frequency Percentage (%)	9	2	1	6	2	2	5	2	7
		100.0	22.2	11.1	66.7	22.2	22.2	55.6	22.2	77.8

The findings on water efficiency and conservation reveal that borehole systems remain the dominant source of water supply within the assessed buildings, either independently or in combination with rainwater harvesting and greywater recycling systems. This indicates continued dependence on groundwater resources due to inadequacies in municipal water supply infrastructure (Ogunba, 2015; Shiru *et al.*, 2019). Nevertheless, the integration of rainwater harvesting, low-flow fixtures, and water recycling systems across several buildings demonstrates

increasing adoption of sustainable water management strategies (Gil-Ozoudeh *et al.*, 2023). The majority of respondents also reported minimal or no water shortages, suggesting that the combination of alternative water supply systems contributes significantly to water reliability and operational sustainability within the buildings.

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Building	Primary Water Source			Water - Saving Fixture(s) Installed			Frequency of Water Shortage		
	Borehole	Borehole, Greywater	Borehole, Rainwater harvesting	Low-flow fixtures	Low-flow fixtures, Rainwater harvesting systems	Low-flow fixtures, Rain water harvesting systems, Water recvcilina svstems	Occasionally	None	
Lekki Pearl Estate	•				•		•		
Peridot Parkland Est.ate	•			•			•		
Bluewater Lagos		•			•			•	
4 Bourdillon			•				•	•	
Heritage Place			•				•	•	
Alliance Place	•			•				•	
Kings Tower		•					•	•	
Cornerstone Tower			•				•	•	
Alpha 1			•				•	•	
Total Count	Frequency	3	2	4	2	2	5	2	7
	Percentage (%)	33.3	22.2	44.5	22.2	22.2	55.6	22.2	77.8

With respect to waste management and sustainability features, the study reveals varying levels of adoption of integrated environmental management systems. While some buildings still rely mainly on conventional waste collection systems, others incorporate recycling facilities and sewage treatment systems, indicating a gradual transition toward more holistic sustainability practices (Jorge-Ortiz *et al.*, 2023). The landscaping assessment further reveals

widespread implementation of permeable pavements and native or drought-resistant plant species (Yazıcı and Eroğlu, 2025). These features contribute significantly to stormwater management, urban flood mitigation, biodiversity enhancement, and reduced water demand for landscaping purposes, thereby supporting broader environmental sustainability objectives.



Table 6: Waste Management and Sustainability Features

Building	Type of Waste Management System in Place			Sustainable Landscaping Features		
	Regular Collection	Regular Collection, Recycling	Regular Collection, Recycling, Other Sewage Treatment System	Permeable Pavements	Permeable Pavements, Native/Drought-resistant Plants	
Lekki Pearl Estate	•				•	
Peridot Parkland Est.ate	•				•	
Bluewater Lagos		•			•	
4 Bourdillon			•		•	
Heritage Place		•			•	
Alliance Place	•			•		
Kings Tower			•	•		
Cornerstone Tower			•	•		
Alpha 1			•	•		
Total Count	Frequency	3	2	4	4	5
	Percentage (%)	33.4	22.2	44.4	44.4	55.6

The assessment of building maintenance and operational performance indicates that all the assessed buildings undergo regular quarterly maintenance, reflecting a strong commitment to facility management and preventive maintenance practices. The findings further reveal that the majority of respondents observed no significant signs of physical deterioration within the buildings, suggesting that the buildings remain in relatively good operational condition, a benefit from high-quality construction materials, effective design, and proper facility management systems, all of which contribute to

their durability and performance (Atakul and Ergönül, 2022; Putra and Putra, 2025). However, a few cases of roof leaks, plumbing defects, and electrical faults were identified in some residential developments, indicating minor maintenance challenges and early signs of wear. These issues were more noticeable in individually occupied residential estates compared to corporately managed buildings, implying that management structure and maintenance culture significantly influence long-term building performance and durability.

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Table 7: Building Maintenance and Performance

Building	Frequency/ Percentage	Noticeable Signs of Deterioration					Frequency of Maintenance		
		None	Electrical	Plumbing leaks	Roof leaks	Total	Quarterly	None	Total
Lekki Pearl Estate	Frequency (%)	139 66.2	14 6.7	26 12.4	31 14.8	210	210 100.0	0 0.0	210
Peridot Parkland Estate	Frequency (%)	138 76.2	7 3.9	15 8.3	21 11.6	181	181 100.0	0 0.0	181
Bluewater Lagos	Frequency (%)	96 100.0	0 0.0	0 0.0	0 0.0	96	96 100.0	0 0.0	96
4 Bourdillon	Frequency (%)	60 100.0	0 0.0	0 0.0	0 0.0	60	60 100.0	0 0.0	60
Heritage Place	Frequency (%)	110 100.0	0 0.0	0 0.0	0 0.0	110	110 100.0	0 0.0	110
Alliance Place	Frequency (%)	48 100.0	0 0.0	0 0.0	0 0.0	48	48 100.0	0 0.0	48
Kings Tower	Frequency (%)	110 100.0	0 0.0	0 0.0	0 0.0	110	110 100.0	0 0.0	110
Cornerstone Tower	Frequency (%)	99 100.0	0 0.0	0 0.0	0 0.0	99	99 100.0	0 0.0	99
Alpha 1	Frequency (%)	90 100.0	0 0.0	0 0.0	0 0.0	90	90 100.0	0 0.0	90
Total Count	Frequency Percent(%)	890 88.6	21 2.1	41 4.1	52 5.2	1,004 100	1004 100	0 0	1,004 100

Overall, the descriptive and inferential findings indicate that green-certified buildings in Lagos State exhibit considerable compliance with sustainable building principles through the integration of energy-efficient systems, water conservation measures, sustainable materials, and structured maintenance practices. The study further demonstrates that the physical characteristics and operational conditions of these buildings contribute positively to their environmental functionality, user comfort, and overall place performance within the urban context of Lagos State.

Reliability, correlation and regression Analysis

Reliability analysis was conducted to establish whether the survey items provided a dependable basis for measuring physical building attributes and place performance. The Place Performance Index recorded strong internal consistency (Cronbach's alpha=0.876), while the overall Likert-scale instrument also demonstrated strong reliability (alpha=0.855). The combined physical attributes scale recorded an acceptable but comparatively moderate reliability coefficient (alpha=0.682), suggesting that the physical attributes represent related but diverse dimensions of building performance rather than a single homogeneous construct.

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Table 8: Reliability analysis of survey scales

Scale	Items	Cronbach's alpha
Overall physical building attributes	44	0.682
Place Performance Index	24	0.876
Overall Likert instrument	68	0.855

Mean score analysis showed that respondents rated indoor environmental quality highest (M=4.558), followed by the Place Performance Index (M=4.445), safety and maintenance (M=4.297), and site/environmental sustainability (M=4.161). Waste management recorded the lowest mean score (M=3.711), indicating that recycling, composting, waste-to-energy and related environmental management practices remain less developed than energy, indoor environmental quality and maintenance-related features.

Table 9: Descriptive statistics of composite variables

Composite variable	Mean	Std. deviation
Material attributes	4.15	0.286
Energy efficiency	4.13	0.292
Water efficiency	3.9	0.45
Waste management	3.71	0.535
Site/environmental sustainability	4.16	0.366
Indoor environmental quality	4.56	0.424
Safety and maintenance	4.29	0.28
Place Performance Index	4.45	0.329

Pearson correlation analysis revealed statistically significant positive relationships between place performance and most physical building attribute dimensions. Indoor environmental quality had the strongest positive relationship with place performance ($r=0.837$, $p<0.001$), followed by safety and maintenance ($r=0.611$, $p<0.001$), material attributes ($r=0.534$, $p<0.001$), energy efficiency ($r=0.392$, $p<0.001$), and site/environmental sustainability ($r=0.388$, $p<0.001$). Waste management had a weak and

non-significant relationship ($r=0.048$, $p=0.128$), while water efficiency showed a weak negative correlation ($r=-0.110$, $p<0.001$). This negative relationship should be interpreted cautiously because water-related systems may reflect building-specific operational arrangements rather than direct user-perceived place quality.

Table 10: Pearson correlation between physical building attributes and place performance

Physical building attribute	Pearson r	p-value
Material attributes	0.534	<0.001
Energy efficiency	0.392	<0.001
Water efficiency	-0.11	<0.001
Waste management	0.048	0.128
Site/environmental sustainability	0.388	<0.001
Indoor environmental quality	0.837	<0.001
Safety and maintenance	0.611	<0.001

Multiple regression analysis was performed to determine the combined predictive influence of physical building attributes on place performance. The regression model was statistically significant, $F(7,996)=594.035$, $p<0.001$, and explained 80.7% of the variance in place performance ($R^2=0.807$; adjusted $R^2=0.805$). Indoor environmental quality was the strongest predictor ($\beta=0.637$, $p<0.001$), followed by safety and maintenance ($\beta=0.180$, $p<0.001$), energy efficiency ($\beta=0.138$, $p<0.001$), water efficiency ($\beta=-0.122$, $p<0.001$), material attributes ($\beta=0.111$, $p<0.001$), site/environmental sustainability ($\beta=0.100$, $p<0.001$), and waste management ($\beta=-0.037$, $p=0.048$).

The findings indicate that indoor environmental quality, maintenance responsiveness, energy performance, material

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quality and site sustainability are central to the perceived place performance of green-certified buildings in Lagos State. The negative coefficients for water efficiency and waste management are

likely suppressor effects arising from the overlap among sustainability variables and should not be interpreted as evidence that water or waste features reduce building performance.

Table 11: Multiple regression predicting place performance

Predictors	B	SE	β	t	p-value
Material attributes	0.128	0.024	0.111	5.308	<0.001
Energy efficiency	0.155	0.024	0.138	6.507	<0.001
Water efficiency	-0.089	0.013	-0.122	-6.802	<0.001
Waste management	-0.022	0.011	-0.037	-1.977	0.048
Site/environmental sustainability	0.09	0.016	0.1	5.68	<0.001
Indoor environmental quality	0.494	0.013	0.637	37.012	<0.001
Safety and maintenance	0.211	0.02	0.18	10.4	<0.001

CONCLUSION AND RECOMMENDATIONS

This study evaluated the physical building attributes and place performance of green-certified buildings in Lagos State, Nigeria. The findings revealed that the assessed buildings generally comply with sustainable building principles through the integration of energy-efficient systems, sustainable materials, climate-responsive design features, water conservation technologies, and regular maintenance practices. The study established that physical building attributes such as the ventilation systems, glazing technologies, lighting systems, landscaping features, indoor environmental quality, and maintenance conditions significantly influence environmental functionality and overall place performance, particularly through such factors as indoor environmental quality, safety and maintenance, material characteristics, energy efficiency, and site sustainability.

The results further showed that hybrid energy systems, natural and mechanical ventilation, sustainable water management practices, and environmentally responsive materials contribute positively to occupants' comfort, environmental quality, usability, and operational efficiency. Corporately managed buildings generally demonstrated superior maintenance and operational performance compared to some residential developments, highlighting the critical role of effective facility management. Although the buildings recorded satisfactory place performance overall, the

occurrence of minor defects such as plumbing faults, roof leakages, and electrical issues indicates that green certification alone does not guarantee long-term performance without continuous maintenance and post-occupancy evaluation. The inferential analysis also confirmed that place performance is statistically associated with specific physical and operational attributes, with indoor environmental quality emerging as the strongest predictor of user satisfaction and building effectiveness.

Based on these findings, architects, developers, and construction professionals should prioritize climate-responsive and user-centered design strategies, including natural ventilation, daylight optimization, sustainable materials, energy-efficient technologies, and environmentally responsive landscaping. Building owners and facility managers should implement proactive maintenance frameworks and continuous performance monitoring to sustain the benefits of green certification. Government agencies and sustainability regulators should strengthen policies, incentives, and enforcement mechanisms that encourage both the adoption and effective management of green-certified buildings in Nigeria.

Furthermore, sustainability assessment frameworks should extend beyond technical performance indicators to include place performance measures such as occupant comfort, accessibility, functionality, environmental quality, and user satisfaction. Greater adoption of

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renewable energy systems, water recycling technologies, and sustainable landscape management practices should also be encouraged to improve environmental resilience and operational sustainability. Finally, professional institutions and academic bodies should intensify capacity-building initiatives and awareness programs on sustainable building performance evaluation and post-occupancy assessment to support the long-term success of green buildings in Nigeria.

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