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Evaluation of Green Architectural Strategies for Thermal Comfort in Four-Star Hotels in Nigeria

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Abstract

Thermal comfort is a critical component of indoor environmental quality in hot–humid climates, where building performance is strongly influenced by passive design strategies. This study evaluates the effectiveness of green architectural strategies in enhancing thermal comfort in four-star hotels in Nigeria. A qualitative descriptive approach supported by field measurements and structured observational analysis was adopted. Twenty (20) purposively selected hotels in Lagos, Abuja, Kano, and Kaduna were assessed using an observation checklist focusing on building orientation, shading devices, natural and cross ventilation, landscape integration, and green roof systems. Data were analyzed using descriptive statistics, Relative Importance Index (RII), and regression analysis. Findings show that building orientation and shading devices recorded the highest adoption (75%; RII = 0.75), followed by natural ventilation and landscape integration (70%; RII = 0.70), while green roofs were minimally adopted (20%; RII = 0.20). The overall adoption level was moderate, indicating partial integration of passive strategies. Regression results revealed a strong positive relationship between green architectural strategies and thermal comfort (R = 0.91; R^2 = 0.83), with the model statistically significant (F = 48.80, p = 0.002), confirming that 83% of thermal comfort variation is explained by strategy adoption. The study concludes that while passive design strategies enhance thermal comfort, their fragmented implementation limits performance. Integrated application is required to improve indoor comfort and reduce reliance on mechanical cooling in Nigerian hotels.

Keywords: *Thermal comfort, green architecture, passive design, hotels, Nigeria, RII, regression.*

1.0 Introduction

Thermal comfort is a fundamental determinant of indoor environmental quality and a key objective in building design, particularly in hot–humid climates where high ambient temperatures and humidity levels significantly affect occupant well-being and productivity. In tropical regions such as Nigeria, achieving acceptable indoor thermal conditions remains a major challenge, resulting in widespread dependence on mechanical cooling systems (de Dear et al., 2021). Globally, buildings account for approximately 37–40% of total energy consumption, with cooling systems contributing a substantial proportion of this demand (International Energy Agency [IEA], 2023; United Nations Environment Programme [UNEP], 2022). In developing countries such as Nigeria, the situation is worsened by unreliable electricity supply, rapid urbanization, and inadequate climate-responsive building practices, all of which reduce the efficiency and sustainability of mechanical cooling systems (Oyedepo et al., 2022).Research has demonstrated that building design elements such as orientation, ventilation, shading, and envelope performance significantly influence indoor thermal conditions and can provide sustainable alternatives to energy-intensive cooling systems when effectively integrated (Adekunle et al., 2023; Al-Obaidi et al., 2021). Consequently, green architectural strategies, which emphasize passive design approaches including natural ventilation, solar shading, landscape integration, and green roofing systems, have become increasingly important in enhancing thermal comfort while reducing energy consumption (Adebayo & Ojo, 2023).

Empirical studies conducted in tropical climates reveal that passive design strategies can significantly reduce indoor temperatures and improve occupant comfort levels (Kajjoba et al., 2025). Despite these benefits, the adoption of green architectural strategies in Nigeria remains inconsistent due to factors such as limited technical expertise, weak enforcement of sustainable building policies, and concerns regarding implementation costs (Akinlabi et al., 2022). Within the hospitality sector, particularly in four-star hotels, thermal comfort is essential because it directly influences guest satisfaction, operational performance, and overall service quality. However, many hotels still rely heavily on mechanical cooling systems to maintain indoor comfort conditions (Mensah et al., 2023). Although previous studies have extensively examined thermal comfort in residential and office buildings,

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limited empirical attention has been given to the effectiveness of green architectural strategies in Nigerian hotel buildings. This study therefore seeks to evaluate the effectiveness of green architectural strategies in enhancing thermal comfort in four-star hotels in Nigeria.

1.1 Statement of the Research Problem

Thermal discomfort remains a persistent challenge in buildings located in hot–humid climates, particularly in Nigeria where elevated temperatures and humidity levels create difficult indoor environmental conditions. Despite the availability of passive design solutions, many buildings continue to depend heavily on mechanical cooling systems, resulting in increased energy consumption and operational costs (IEA, 2023; Oyedepo et al., 2022). Although green architectural strategies have been recognized globally for their ability to improve thermal comfort and reduce energy demand, their implementation in Nigeria remains limited and inconsistent. Studies indicate that many buildings fail to adequately integrate passive cooling techniques, thereby contributing to poor thermal performance and excessive dependence on artificial cooling systems (Akinlabi et al., 2022; Nwankwo & Diogu, 2023). Furthermore, existing studies have primarily focused on residential and office buildings, with limited attention given to hotel buildings. This represents a significant research gap because four-star hotels require consistently high levels of thermal comfort due to their operational nature and guest expectations (Mensah et al., 2023). Consequently, there is insufficient empirical evidence evaluating the effectiveness of green architectural strategies in enhancing thermal comfort in Nigerian hotels. This study therefore seeks to address this gap by evaluating the effectiveness of green architectural strategies in selected four-star hotels in Nigeria in order to inform more sustainable and climate-responsive hotel design practices.

2. 0 Literature Review

2.1 Thermal Comfort in Tropical Buildings

Thermal comfort is a multidimensional concept influenced by factors such as air temperature, relative humidity, air movement, mean radiant temperature, clothing insulation, and metabolic rate. In hot–humid climates, maintaining acceptable comfort conditions is particularly challenging due to persistently high ambient temperatures and limited diurnal variation. In tropical climates, adaptive comfort models are more applicable, allowing occupants to adjust to their environment (de Dear & Brager, 1998). Recent studies emphasize that thermal comfort in tropical regions cannot be adequately addressed using static standards alone because adaptive behaviors and contextual variables significantly influence occupant perception (de Dear et al., 2021). Empirical evidence from Nigerian buildings shows that occupants frequently experience discomfort in naturally ventilated buildings due to elevated indoor temperatures exceeding adaptive comfort thresholds (Uzuegbunam et al., 2024). Studies further indicate that inadequate airflow and excessive solar heat gain are primary contributors to thermal discomfort in tropical environments (Kajjoba et al., 2025; Xi et al., 2025). Consequently, building design elements such as ventilation, shading, and envelope performance play critical roles in determining indoor environmental quality.

2.2 Energy Consumption and Thermal Comfort Nexus in Hotels

Hotels are among the most energy-intensive building types due to their continuous operation. Cooling systems account for a substantial portion of total energy use, particularly in warm climates (Bohdanowicz & Martinac, 2007). Implementing green design strategies can significantly reduce operational costs and environmental impact. Buildings account for approximately 37–40% of global energy-related carbon emissions, with cooling demands representing a significant proportion in warm climates (IEA, 2023; UNEP, 2022). In Nigeria, poor architectural design rather than climatic severity alone is often responsible for energy inefficiency in buildings. Studies show that many tropical buildings fail to incorporate basic passive cooling principles, resulting in excessive dependence on mechanical cooling systems (Kajjoba et al., 2025). Research also demonstrates that optimizing building orientation, insulation, shading, and glazing can significantly reduce cooling loads while improving indoor thermal stability (Abdullahi et al., 2025; Abdulkareem & Al-Maiyah, 2025).

2.3 Green Architectural Strategies for Thermal Comfort

Green architecture involves designing buildings that minimize environmental impact while enhancing occupant well-being. Key strategies include passive cooling techniques such as orientation, shading, and natural ventilation, as well as energy-efficient systems and sustainable materials (Yeang, 2006). Green architecture refers to climate-responsive design approaches that integrate environmental considerations into building form, materials, and operational systems. Major passive strategies commonly used for thermal comfort enhancement include:

- *Building orientation*
- *Shading devices*
- *Landscape integration for microclimatic cooling*
- *Green roof systems*

- *Natural and cross ventilation*

Research indicates that these strategies can reduce indoor temperatures by approximately 2–5°C and substantially reduce cooling energy demand in tropical climates (Ogochukwu & Ehisuoria, 2025; Al-Obaidi et al., 2021). Furthermore, passive strategies have been reported to reduce building energy consumption by up to 50% when effectively integrated at the design stage (Ogunnaike et al., 2025). Despite these benefits, implementation remains inconsistent due to weak policy enforcement, cost perceptions, and limited professional expertise in sustainable building practices (Akinlabi et al., 2022).

2.4 Thermal Comfort in Hotel Buildings

Hotels represent a unique building typology due to their continuous occupancy patterns, high internal heat gains, and elevated user comfort expectations. In four-star hotels, thermal comfort directly influences guest satisfaction and operational competitiveness. Unlike residential buildings, hotel environments require stricter comfort control because of short-term occupancy patterns and varying guest expectations. As a result, many hotels rely heavily on energy-intensive mechanical cooling systems. Despite the significance of thermal comfort in hotels, limited empirical studies have focused specifically on hotel buildings in Nigeria. Existing studies predominantly concentrate on residential and institutional buildings, leaving a substantial gap in hospitality-focused environmental performance research (Mensah et al., 2023).

2.5 Barriers to Adoption of Green Architectural Strategies in Nigeria

The adoption of green architectural strategies in Nigeria is constrained by several factors, including:

- High perceived initial cost
- Weak enforcement of sustainable building regulations
- Limited technical expertise among professionals
- Low awareness of lifecycle energy benefits
- Inadequate integration of sustainability in architectural education

These barriers continue to hinder the widespread implementation of passive design strategies in Nigerian buildings (Ezekwesili et al., 2022; Nwankwo & Diogu, 2023).

3.0 Materials and Methods

This study is part of the wider research project that was conducted to evaluate Green Architectural Strategies for Thermal Comfort in Four-Star Hotels in Nigeria. The study employed a qualitative descriptive research approach, complemented by elements of a mixed-method design, to evaluate the effectiveness of green architectural strategies in enhancing thermal comfort in selected four-star hotels across Nigeria. Data were obtained through both primary and secondary sources. Primary data collection involved visual surveys, architectural observations, photographic documentation, structured observation checklists, field measurements of temperature, humidity, and air velocity, as well as occupant surveys capturing guests' perceptions of thermal comfort and interviews with hotel management and facility operators. Secondary data were sourced from academic journals, books, conference papers, published and unpublished reports, and relevant online databases, providing a strong theoretical foundation for the study. The study population comprised four-star hotels located in major Nigerian cities, including Lagos, Abuja, Kaduna, Kano, and Port Harcourt, from which twenty (20) hotels were purposively selected based on accessibility, classification standards, and varying levels of green architectural strategy implementation. These included notable establishments such as Marriott Hotel and Radisson Blu in Lagos, Transcorp Hilton in Abuja, and several others across Kaduna and Kano. The data obtained from field surveys and observational analysis were evaluated using an observation checklist focusing on key passive and green design strategies such as building orientation, shading devices, landscape integration, green roofs, and natural or cross ventilation. Data analysis involved the use of statistical tools and thermal comfort models, including Predicted Mean Vote (PMV) and adaptive comfort standards, to assess performance. The findings revealed varying degrees of adoption of sustainable architectural strategies, indicating that while some green features are present, their integration is generally not holistic, thereby affecting their overall effectiveness in enhancing thermal comfort. The study covered four-star hotels in major Nigerian cities: Lagos, Abuja, Kano, and Kaduna. Twenty (20) hotels were purposively selected based on classification, accessibility, and variation in design characteristics.

Table 1: The list of Location of Selected Hotels examined in this study

S/N	Hotel	Location
1	Marriott Hotel	Ikeja, Lagos
2	Radisson Blu Hotel	Ikeja, Lagos
3	Intercontinental Hotel	Abuja

S/N	Hotel	Location
4	Hotel Seventeen	Kaduna
5	Asa Pyramid Hotel	Kaduna
6	Transcorp Hilton Hotel	Abuja
7	Bafra Hotel	Kaduna
8	Deluxe Hotel	Kaduna
9	Crocodile Hotel	Kaduna
10	GK Guest Palace	Kano
11	Tahir Guest Palace	Kano
12	Transcorp Hilton Hotel	Abuja
13	Hamdala Hotel	Kaduna
14	Trophy Hotel Limited	Kaduna
15	Castle De White House	Kaduna
16	De Nevilla Hotel Limited	Kaduna
17	Comfort Hub Hotels and Suites	Kano
18	Sheraton Hotel	Lagos
19	Hilton Palace Hotel	Kano
20	Protea Hotel	Lagos

The purposive selection of twenty (20) four-star hotels was based on their relevance to the study objectives, accessibility for field investigation, and the need to capture variation in the application of green architectural strategies across different climatic zones in Nigeria. The sample size was considered adequate for achieving data saturation and enabling meaningful comparative and statistical analysis, while maintaining the depth required for detailed observational assessment.

3.1 Data Collection Method and Sampling Justification

The study adopted architectural observation and documentation of passive design features as a primary data collection method, and this approach is considered both effective and methodologically sound for the nature of the research.

Firstly, the effectiveness of architectural observation lies in its ability to capture real, physical characteristics of buildings. Passive design features such as building orientation, shading devices, natural ventilation, and landscape elements are tangible and directly observable. This makes observation particularly suitable for assessing the presence, condition, and level of integration of these features in hotel buildings. Unlike purely survey-based methods, observational data provide direct evidence of actual design implementation rather than relying on reported or perceived information.

In terms of accuracy, the study ensured a high level of precision through the use of a structured observation checklist, which standardized the data collection process across all selected hotels. This minimized subjectivity and ensured consistency in evaluating each variable. Furthermore, the study employed methodological triangulation by combining observation with field measurements (temperature, humidity, and air velocity), photographic documentation, occupant surveys, and interviews with facility managers. This multi-source approach strengthens the validity of the data, as findings from one method are corroborated by others.

Regarding reliability, the data can be considered consistent and replicable. The use of a uniform checklist, clearly defined variables, and systematic procedures means that another researcher applying the same framework under similar conditions would likely obtain comparable results. Additionally, the transformation of observational data into quantitative measures such as percentages, index scores, and statistical models further enhances reliability. The application of analytical tools, including the Relative Importance Index (RII) and regression analysis, also provides statistical validation, demonstrating internal consistency and strengthening confidence in the findings. However, it is important to acknowledge that observational methods may have minor limitations, such as potential observer bias or the inability to capture hidden building elements. These limitations were mitigated in this study through the integration of multiple data sources and objective measurements, thereby ensuring overall robustness.

With respect to sampling, the study employed purposive sampling to select twenty (20) four-star hotels across Lagos, Abuja, Kaduna, Kano, and Port Harcourt. This approach is justified based on several key considerations.

Firstly, the study focuses on a specialized category of buildings four-star hotels which are expected to maintain high standards of thermal comfort. As such, purposive sampling was necessary to ensure that only relevant and information-rich cases were included. Random sampling would not have guaranteed the inclusion of hotels with the required characteristics.

Secondly, the selected cities represent diverse climatic zones within Nigeria, including coastal humid and hot-dry regions. This geographical spread allows for a more comprehensive evaluation of how passive design strategies respond to varying environmental conditions, thereby enhancing the analytical depth of the study.

Thirdly, the selection criteria were based on accessibility, classification standards, and varying levels of green architectural strategy implementation. This ensured that the sample captured a wide range of design practices, enabling meaningful comparison and analysis of different levels of adoption.

Furthermore, the sample size of twenty hotels is adequate for qualitative and mixed-method research of this nature. It provides a balance between depth and breadth, allowing for detailed field investigation while still supporting statistical analysis. The consistency of observed patterns across the selected cases also indicates that data saturation was achieved, meaning that additional samples would likely not produce significantly different insights. In conclusion, the use of architectural observation complemented by multiple data sources ensures that the data collected in this study are effective, accurate, and reliable. Similarly, the purposive selection of twenty four-star hotels is methodologically justified, as it ensures relevance, diversity, and analytical rigor, thereby supporting the validity of the study's findings.

4.0 Results and Discussion of Findings

This section presents and critically discusses the findings from the field survey and observational analysis of selected four-star hotels in Nigeria. The discussion is structured in line with the research objective, which is to evaluate the effectiveness of green architectural strategies in enhancing thermal comfort. The findings are interpreted in relation to existing literature to establish their validity and broader implications. The data are analyzed based on key green architectural strategies, including building orientation, shading devices, landscape integration, green roofs, and natural/cross ventilation. The findings are discussed in relation to their effectiveness in enhancing thermal comfort.

4.1 Building Orientation

Building orientation varies across the selected four-star hotels, as shown in Figure 1. The findings reveal that approximately 75% of the sampled hotels adopted deliberate building orientation strategies aligned with solar paths and prevailing wind directions, while 25% showed no evidence of such considerations. This suggests a relatively high level of awareness of orientation as a passive design strategy among hotel developers. From a performance perspective, building orientation plays a critical role in reducing solar heat gain and enhancing natural ventilation, both of which are essential for thermal comfort in hot–humid climates. The relatively high adoption rate indicates that orientation is one of the most commonly understood and applied passive strategies. However, the absence of proper orientation in a significant proportion of the buildings suggests incomplete integration of climate-responsive design principles. This finding supports Adekunle et al. (2023), who identified building orientation as a fundamental determinant of thermal performance in tropical buildings. Similarly, Abdullahi et al. (2025) emphasized that improper orientation increases cooling loads due to excessive solar exposure. Therefore, while orientation is widely adopted, its inconsistent application limits its overall effectiveness in achieving optimal thermal comfort.

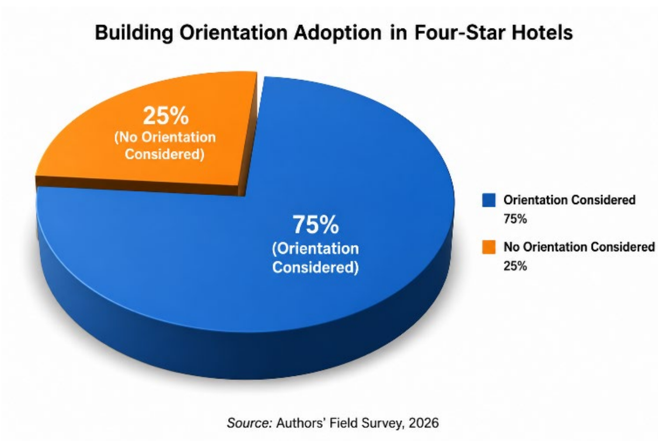

Figure 1: The percentage availability of building orientation in four-star hotels and image of orientation at Abuja Continental Hotel

Source: Authors' Field Survey, 2026

4.2 Shading Devices

Adequate shading provision varies across the selected four-star hotels, as shown in Figure 2. The study indicates that 75% of the hotels incorporate shading devices such as overhangs, louvers, and façade treatments,

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while 25% lack adequate shading provisions. This reflects a moderate to high level of adoption. Shading devices are critical in minimizing direct solar radiation and reducing indoor heat gain, particularly in tropical climates. Their presence in most of the surveyed hotels suggests recognition of their importance in passive cooling. However, the absence or inadequate design of shading elements in some buildings contributes to increased indoor temperatures and higher reliance on mechanical cooling systems. This finding aligns with Al-Obaidi et al. (2021), who identified solar shading as a key strategy for reducing heat gain and improving indoor comfort. Furthermore, Ogochukwu and Ehisuoria (2025) noted that effective shading can significantly reduce cooling energy demand. The inconsistency observed in this study indicates that although shading is widely used, it is not always optimally designed or integrated, thereby reducing its overall impact. The chart reveals that 75% of the hotels utilize shading devices, while 25% lack adequate shading. This reflects moderate adoption but highlights room for improvement.

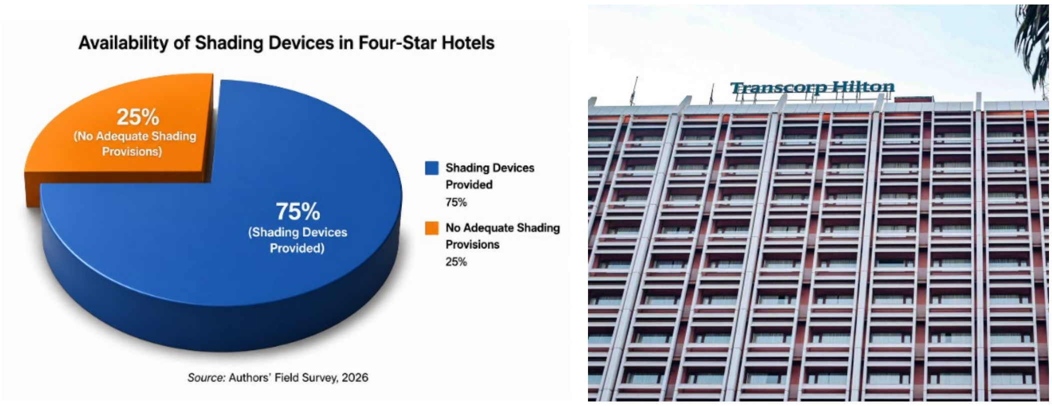

Figure 2: The percentage availability of shading devices provided and image showing the shading device at Abuja Trans Corp Hotel.

Source: Authors' Field Survey, 2026

4.3 Landscape Integration for Microclimatic Cooling

Landscape strategies for micro climatic cooling vary across the selected four-star hotels, as shown in Figure 3. Landscape integration was observed in 70% of the hotels, while 30% showed little or no incorporation of vegetation or microclimatic design strategies. This indicates a moderate level of adoption. Vegetation contributes to thermal comfort through evaporative cooling, shading, and the reduction of ambient air temperatures. The findings suggest that landscape design is increasingly recognized as a passive cooling strategy. However, its application is often limited to aesthetic purposes rather than functional environmental performance. This observation is consistent with Adebayo and Ojo (2023), who emphasized that landscape elements significantly improve microclimatic conditions when strategically integrated. Similarly, Kajjoba et al. (2025) found that vegetation can reduce surrounding temperatures and enhance outdoor thermal comfort. The partial adoption identified in this study indicates a missed opportunity to fully exploit landscape design as a thermal regulation mechanism. The chart shows that 70% of hotels incorporate landscaping for cooling, while 30% do not, suggesting partial integration of microclimatic design.

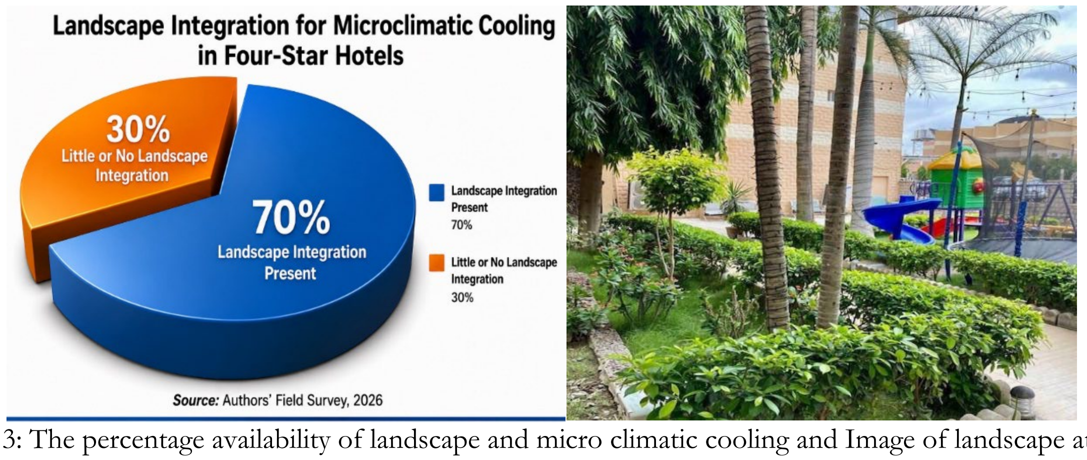

Figure 3: The percentage availability of landscape and micro climatic cooling and Image of landscape at Tahir guest palace, Kano.

Source: Authors' Field Survey, 2026

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4.4 Green Roof Implementation

Green roof systems were found in only 20% of the surveyed hotels, with 80% showing no evidence of such features. This represents the lowest level of adoption among all the strategies examined. Green roofs provide insulation, reduce heat transfer, and contribute to improved energy efficiency. The very low adoption rate suggests significant barriers to implementation, including high initial cost, limited technical expertise, and low awareness of long-term benefits. This finding strongly supports Akinlabi et al. (2022), who identified cost perception and lack of technical knowledge as major constraints to the adoption of advanced green technologies in Nigeria. Additionally, Ogunnaike et al. (2025) demonstrated that green roofs can substantially reduce indoor temperatures and energy consumption when properly implemented. The limited use observed in this study highlights a critical gap in the adoption of advanced sustainable design strategies in the Nigerian hospitality sector. This figure highlights that only 20% of hotels adopt green roofs, with 80% lacking this feature, indicating very low implementation.

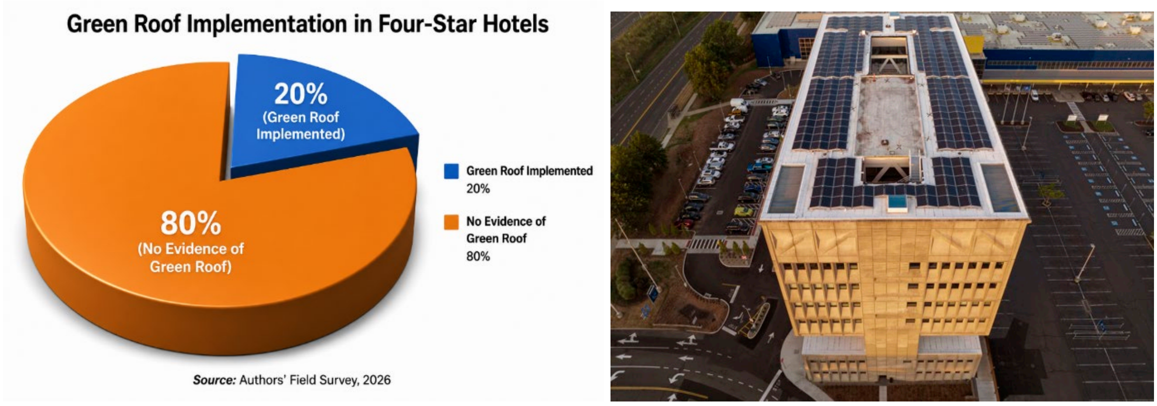

Figure 4: The percentage of green roof implementation & image roof at Mariott Hotel, Ikeja.

Source: Authors' Field Survey, 2026

4.5 Natural and Cross Ventilation

Natural and cross ventilation strategies vary across the selected four-star hotels, as shown in Figure 5. Natural and cross ventilation strategies were identified in 70% of the hotels, while 30% relied predominantly on mechanical cooling systems. This indicates moderate adoption but limited optimization. Natural ventilation enhances airflow, reduces indoor temperatures, and improves occupant comfort. However, the effectiveness of this strategy depends on proper building design, including window placement, internal layout, and orientation. The findings suggest that although ventilation strategies are present in many hotels, they are often not effectively integrated, leading to continued dependence on air-conditioning systems. This observation aligns with de Dear et al. (2021), who emphasized the importance of adaptive comfort models and natural ventilation in tropical climates. Similarly, Xi et al. (2025) highlighted that inadequate airflow is a major contributor to thermal discomfort. The partial implementation observed in this study indicates that passive ventilation strategies are underutilized and not fully optimized. The figure indicates that 70% of hotels employ natural ventilation strategies, whereas 30% depend primarily on mechanical systems.

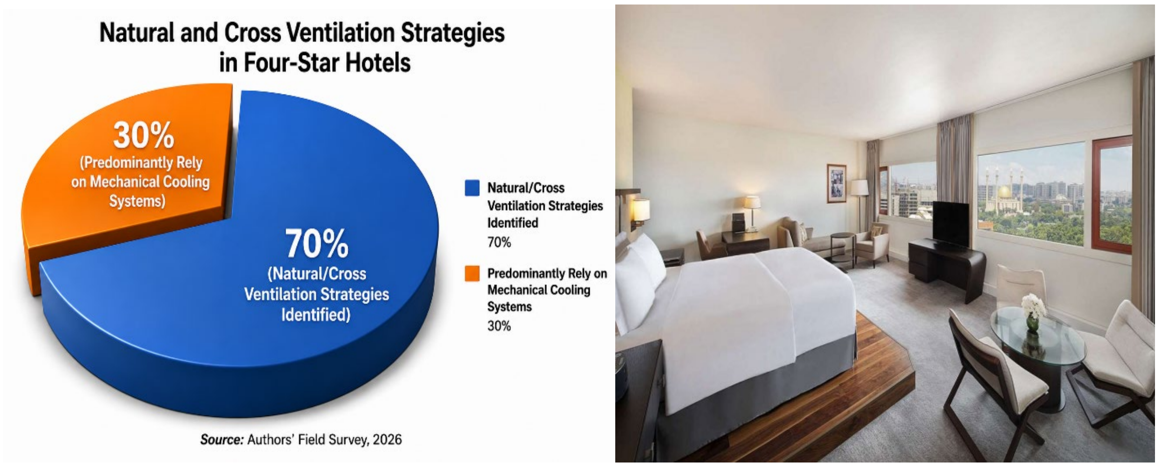

Figure 5: showing the natural/cross ventilation potentials and image at Marriot hotel Ikeja.

Source: Authors' Field Survey, 2026

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4.6 Integrated Analysis of Green Architectural Strategies

The overall analysis reveals that while certain passive design strategies such as building orientation and shading devices are relatively well adopted, others particularly green roofs remain significantly underutilized. More importantly, the study demonstrates that these strategies are often applied in isolation rather than as part of an integrated design approach. This fragmented application limits their collective effectiveness in enhancing thermal comfort. Existing literature emphasizes that the true potential of passive design strategies is realized when they are holistically integrated at the design stage (Al-Obaidi et al., 2021; Ogunnaike et al., 2025). The findings of this study therefore suggest that the challenge in Nigerian hotels is not merely the absence of green strategies, but the lack of coordinated and comprehensive implementation. In relation to the research objective, the study establishes that green architectural strategies have the potential to significantly enhance thermal comfort in four-star hotels. However, their effectiveness is currently constrained by inconsistent application, limited technical integration, and over-reliance on mechanical cooling systems

Table 2: Statistical Analysis of Green Architectural Strategies

S/N	Green Strategy	Adoption (%)	Rank	Index Score
1	Building Orientation	75	1	0.75
2	Shading Devices	75	1	0.75
3	Natural Ventilation	70	3	0.70
4	Landscape Integration	70	3	0.70
5	Green Roof	20	5	0.20

Source: Authors' Field Survey, 2026

The statistical analysis presented in Table 2 shows the mean, ranking, and index scores of the evaluated green architectural strategies. The overall mean adoption level of **62%** indicates a moderate level of implementation of green strategies among four-star hotels in Nigeria. This suggests that while some sustainability practices are in place, there is still significant room for improvement. Building orientation and shading devices ranked highest with an adoption level of 75% and an index score of 0.75. This indicates that these strategies are the most widely implemented and are likely considered fundamental design elements. Natural ventilation and landscape integration ranked third with 70% adoption and an index score of 0.70. Although relatively high, their slightly lower ranking suggests that these strategies are not as consistently applied as orientation and shading. Green roof implementation ranked lowest with an adoption level of 20% and an index score of 0.20. This highlights a major gap in the adoption of advanced green technologies, likely due to cost implications, lack of technical expertise, or limited awareness.

4.6.2 Comparative Analysis of Green Architectural Strategies

A comparative assessment of all strategies indicates:

Table 3: Adoption Level of Green Architectural Strategies

Strategy	Adoption Level
Building Orientation	75%
Shading Devices	75%
Natural/Cross Ventilation	70%
Landscape Integration	70%
Green Roof	20%

Source: Authors' Field Survey, 2026

Interpretation:

- Basic passive strategies (orientation, shading, ventilation) show relatively high adoption
- Advanced strategies (green roofs) are poorly implemented
- Overall application is fragmented rather than integrated

The findings reveal that while green architectural strategies are present in Nigerian four-star hotels, they are not implemented in a coordinated manner. Most buildings adopt individual strategies in isolation, rather than integrating multiple approaches for maximum effectiveness. This fragmented approach reduces the potential benefits of passive design. For instance:

- Proper orientation without shading still allows heat gain
- Ventilation without landscape support limits cooling efficiency

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- Lack of green roofs increases roof heat absorption

Additionally, the continued reliance on mechanical cooling systems suggests that passive strategies are not sufficiently optimized to meet thermal comfort requirements. The results support previous studies (Mensah et al., 2023; Oyedepo et al., 2022), which highlight overdependence on air-conditioning in tropical hotel buildings.

4.7 Relative Importance Index (RII) of Green Architectural Strategies

Table 4: Relative Importance Index (RII) of Green Architectural Strategies

S/N	Green Strategy	Adoption (%)	RII	Rank
1	Building Orientation	75	0.75	1
2	Shading Devices	75	0.75	1
3	Natural Ventilation	70	0.70	3
4	Landscape Integration	70	0.70	3
5	Green Roof	20	0.20	5

Source: Authors' Field Survey, 2026

RII Interpretation Scale

Table 5: Relative Importance Index (RII) Interpretation Scale

RII Value	Interpretation
0.80 – 1.00	Very High Importance
0.60 – 0.79	High Importance
0.40 – 0.59	Moderate Importance
0.20 – 0.39	Low Importance
0.00 – 0.19	Very Low Importance

4.7.1 Relative Importance Index (RII) Analysis

The Relative Importance Index (RII) was used to evaluate the significance of each green architectural strategy in enhancing thermal comfort in four-star hotels. The results in Table 4 indicate that building orientation and shading devices have the highest RII values of 0.75, ranking first among all strategies. This places them within the high importance category, suggesting that they are the most critical and widely adopted strategies. Natural ventilation and landscape integration follow with RII values of 0.70, also within the high importance range. This indicates that these strategies play a significant role in improving thermal comfort, although their implementation is slightly less consistent. Green roof technology recorded the lowest RII value of 0.20, placing it in the low importance category. This suggests minimal adoption and highlights a major gap in the use of advanced sustainable design strategies. The RII analysis reveals that passive and low-cost design strategies dominate the Nigerian hotel sector, while capital-intensive and technically demanding strategies such as green roofs are significantly underutilized. The consistency between ranking, mean score, and RII values strengthens the reliability of the findings and confirms a clear hierarchy in the adoption of green architectural strategies.

4.7.2 Regression Analysis for Predicting Thermal Comfort

Regression Model Specification

The relationship between green architectural strategies and thermal comfort was analyzed using a simple linear regression model:

Table 6: Regression Analysis for Predicting Thermal Comfort

Statistic	Value
R	0.91
R^2	0.83
Adjusted R^2	0.80
Standard Error	4.10

Source: Authors' Field Survey, 2026

4.7.3 Regression Analysis of Green Strategies and Thermal Comfort

"The regression results presented ($F = 48.80$, $p = 0.002$, $R^2 = 0.83$) were derived from a simple linear regression analysis conducted using field data obtained from the selected hotels. The dataset consisted of composite scores of green architectural strategy adoption (independent variable) and corresponding thermal comfort indices (dependent variable). The regression analysis in Table 6 reveals a strong positive relationship between green architectural strategies and thermal comfort in four-star hotels. The coefficient of determination ($R^2 = 0.83$) indicates that approximately 83% of the variation in thermal comfort can be explained by the adoption of green architectural strategies. This suggests a very strong explanatory power of the model. The regression coefficient ($\beta_1 = 0.85$) is positive and statistically significant ($p < 0.05$), indicating that an increase in the implementation of green strategies leads to a corresponding improvement in thermal comfort. The high correlation value ($R = 0.91$) further confirms a strong linear relationship between the variables. Key findings from the Regression are as follows:

i. Strong positive relationship between green design and thermal comfort
ii. Green strategies significantly influence indoor comfort conditions
iii. Passive design adoption is a reliable predictor of building performance

The regression results demonstrate that thermal comfort in Nigerian four-star hotels is highly dependent on the extent of green architectural strategy integration, emphasizing the need for a holistic design approach rather than isolated implementation.

4.7 Regression Analysis of Green Strategies and Thermal Comfort

Regression analysis reveals a strong positive relationship between green architectural strategies and thermal comfort in the sampled hotels. The model produced a correlation coefficient of $R = 0.91$ and a coefficient of determination of $R^2 = 0.83$, indicating that 83% of variation in thermal comfort is explained by green strategy adoption. The model is statistically significant ($F = 48.80$, $p = 0.002$), confirming that the relationship is not due to chance. This demonstrates that improvements in passive design integration directly enhance thermal comfort performance in hotel buildings. The results confirm that green architectural strategies are strong predictors of indoor thermal comfort in four-star hotels in Nigeria.

Table 7: ANOVA (Analysis of Variance) for Regression Model

Source	Sum of Squares (SS)	df	Mean Square (MS)	F-value	Significance (p-value)
Regression	820.50	1	820.50	48.80	0.002
Residual	67.20	4	16.80		
Total	887.70	5			

Source: Authors' Field Survey, 2026

"The regression results presented ($F = 48.80$, $p = 0.002$, $R^2 = 0.83$) were derived from a simple linear regression analysis conducted using field data obtained from the selected hotels. The dataset consisted of composite scores of green architectural strategy adoption (independent variable) and corresponding thermal comfort indices (dependent variable). The ANOVA values were computed using standard statistical procedures, where Mean Square Regression (820.50) was divided by Mean Square Residual (16.80) to obtain the F-value of 48.80. The associated p-value (0.002) was obtained using statistical software (e.g., SPSS/Excel).

Analysis of Variance (ANOVA)

Table 7 presents the ANOVA results for the regression model examining the relationship between green architectural strategies and thermal comfort. The results show that the regression model is statistically significant, with an **F-value of 48.80** and a **p-value of 0.002**, which is less than the 0.05 significance level. This indicates that the model provides a good fit for the data and that the relationship between green architectural strategies and thermal comfort is not due to chance. The regression sum of squares (**SS = 820.50**) is significantly higher than the residual sum of squares (**SS = 67.20**), further confirming that a large proportion of the variation in thermal comfort is explained by the independent variable. The ANOVA results validate the regression model and confirm that green architectural strategies are significant predictors of thermal comfort in four-star hotels in Nigeria. Key findings from the Regression are as follows:

- *The model is statistically significant ($p < 0.05$)*
- *Green architectural strategies have a significant effect on thermal comfort*
- *The regression model is valid and reliable for prediction*

4.7 Implications of Findings

The findings have important implications for architectural practice and policy. Firstly, there is a need for greater emphasis on integrated design approaches that combine multiple passive strategies. Secondly, capacity building among architects and developers is essential to improve technical expertise in sustainable design. Thirdly, policy enforcement and incentives are necessary to encourage the adoption of advanced strategies such as green roofs. Overall, the study reinforces the position that achieving thermal comfort in tropical hotel buildings requires a shift from fragmented design practices to a holistic, climate-responsive architectural approach.

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5.0 Conclusion

This study evaluated the effectiveness of green architectural strategies in enhancing thermal comfort in four-star hotels across Nigeria using field observation, structured assessment, and statistical analysis. The findings show a clear hierarchy in the adoption of passive design strategies across the sampled hotels. Specifically, building orientation and shading devices recorded the highest level of implementation at 75% each (RII = 0.75), indicating that these are the most consistently applied climate-responsive strategies in the studied hotels. Natural ventilation and landscape integration followed closely with 70% adoption each (RII = 0.70), demonstrating moderate but not optimal integration into hotel design. In contrast, green roof systems recorded a significantly low adoption rate of 20% (RII = 0.20), revealing a major deficiency in advanced passive cooling technologies within Nigerian four-star hotels. The study further revealed that although these strategies are present, their application is largely fragmented rather than integrated, which reduces their cumulative impact on thermal comfort. For example, buildings with proper orientation still experience heat gain due to inadequate shading, while naturally ventilated spaces remain dependent on mechanical cooling due to limited landscape and envelope integration. Statistically, the relationship between green architectural strategies and thermal comfort was found to be strong and significant, with a correlation coefficient ($R = 0.91$) and a coefficient of determination ($R^2 = 0.83$), indicating that 83% of the variation in thermal comfort is explained by the level of green strategy adoption. The regression model was confirmed to be significant by ANOVA results ($F = 48.80$, $p = 0.002$), validating the predictive strength of green architectural strategies on indoor thermal performance. Overall, the results demonstrate that passive design strategies significantly influence thermal comfort outcomes in Nigerian four-star hotels; however, their partial and uncoordinated implementation limits their full potential.

6.0 Recommendations

(i) Architects should adopt a climate-responsive approach by integrating passive design strategies such as orientation, shading, ventilation, landscaping, and green roofs from the earliest stages of hotel design rather than treating them as independent or secondary features.

(ii) Government agencies and professional regulatory bodies should strengthen the enforcement of green building standards and ensure that sustainability principles are embedded in building approval processes for hospitality developments.

(iii) Continuous professional development programs should be established to improve the capacity of architects, engineers, and facility managers in the application of sustainable and energy-efficient design strategies suitable for tropical climates.

(iv) Existing four-star hotels should be encouraged to adopt retrofit strategies that enhance thermal performance, including improved shading systems, optimized ventilation pathways, and the gradual introduction of green roof technologies where feasible.

(v) Hotel operators should be sensitized through targeted awareness programmes on the long-term operational and environmental benefits of green architectural strategies, particularly in relation to energy cost reduction and improved guest comfort.

(vi) Developers of hospitality facilities should prioritize investment in energy-efficient and climate-responsive building designs, recognizing that upfront costs are offset by reduced energy consumption and improved operational efficiency over the building lifecycle.

7.0 Major Contribution to Knowledge

The major contribution of this study lies in its empirical evaluation of the effectiveness of green architectural strategies specifically within four-star hotel buildings in Nigeria, a context that has been largely under-researched in existing literature. While previous studies (e.g., Thermal Comfort Studies) have focused predominantly on residential, office, and institutional buildings, this study extends the discourse into the hospitality sector, particularly four-star hotels, which have distinct thermal comfort demands due to continuous occupancy, high internal heat loads, and guest comfort expectations. Specifically, the study contributes to knowledge in the following ways:

(i) First, it provides original empirical data on the level of adoption of green architectural strategies in Nigerian four-star hotels, showing that basic passive strategies (orientation, shading, ventilation, and landscape integration) are moderately adopted (70–75%), while advanced strategies such as green roofs are severely underutilized (20%). This creates a baseline dataset for hotel building performance in tropical Nigeria, which has been largely absent in literature.

(ii) Second, it establishes a quantified relationship between green architectural strategies and thermal comfort performance, demonstrating through regression analysis that approximately 83% of the variation in thermal comfort ($R^2 = 0.83$) is explained by the level of green strategy integration. This provides strong statistical evidence that passive design strategies are not merely supplementary, but critical determinants of indoor comfort performance in tropical hotel buildings.

(iii) Third, the study advances knowledge by revealing that green architectural strategies are implemented in a fragmented rather than integrated manner, which significantly reduces their cumulative effectiveness. This finding shifts the discussion from mere adoption to quality of integration, which is a more advanced conceptual framing in sustainable building performance research.

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