IJAAR PUBLISHING®

African Journal of Environment and Sustainable Development | ISSN: 3027-2718
Vol. 4, Issue 2 (2026) | https://doi.org/10.46654/4p47m768

ENERGY-EFFICIENT STRATEGIES IN SUSTAINABLE SPORT FACILITIES DESIGN: A CASE STUDY OF THE LEKAN SALAMI SPORTS COMPLEX, ADAMASINGBA, IBADAN

Taiwo Sidiq Okedele[1]
Department of Architecture, Lead City University, Ibadan
sidiqokedele@gmail.com

David Olaolu Oguntunde[1]
Department of Architecture, Lead City University, Ibadan
davidolaoluoguntunde@gmail.com

Adedamola Ibukunoluwa Adeniji[1]
Department of Architecture, Lead City University, Ibadan
damolaibk@gmail.com

Abstract

Sports facilities rank among the most energy-intensive typologies in the built environment, yet the outcomes of energy-efficiency retrofitting in Nigerian public sports infrastructure remain sparsely documented. This study assessed the design elements employed for energy-efficient strategies at the Lekan Salami Sports Complex, Adamasingba, Ibadan, a facility commissioned in 1976 and comprehensively retrofitted in 2021. A descriptive survey design was adopted, supported by photographic field documentation of the complex. A structured questionnaire comprising twenty-seven statements rated on a five-point Likert scale was administered to 381 facility users, staff, athletes, coaches, maintenance personnel, spectators, and visitors recruited by convenience sampling. Data were analysed descriptively using frequencies, percentages, means, standard deviations, and mean ranking against a decision benchmark of 3.50. The instrument returned strong internal consistency (α = .885). Respondents affirmed the facility's energy-efficiency design overall, yielding a grand mean of 3.73 (SD = 0.42). Twenty of the twenty-seven design elements attained the benchmark and were accordingly affirmed; the remaining seven fell within the undecided band, and none was rejected. The highest-rated elements were provision for multiple activity types (M = 4.33), natural ventilation achieved through building design (M = 4.16), and internal circulation and accessibility (M = 4.16). The lowest-rated were rainwater harvesting and greywater recycling (M = 3.03), water-saving fixtures (M = 3.17), energy-use monitoring (M = 3.18), and HVAC efficiency and renewable energy visibility (both M = 3.20). Passive architectural elements therefore outperformed engineered energy and water systems, indicating that the architectural objectives of the retrofit were realised more fully than its resource-management objectives.

Keywords: building retrofit, energy efficiency, passive design, sustainable, sport facilities, Nigeria

1. INTRODUCTION

Sport facilities are designed to celebrate human performance, yet the buildings in which these performances take place can themselves become significant consumers of energy and environmental resources. According to Katsaprakakis et al., (2023) across the world, Sports facilities are, by their functional nature, among the most energy-intensive typologies in the built environment. Large-span indoor halls, illuminated pitches, pool heating where applicable, and long daily hours of operation combine to place sustained heating, cooling, ventilation, and lighting loads on these buildings. Culley and Pascoe (2009) similarly note that the technological sophistication expected of modern sports venues, ranging from climate control to broadcast and spectator services, has steadily increased their absolute energy demand even as individual systems have become more efficient. Improving the energy performance of such facilities therefore carries both technical and economic significance, and remains a growing focus of architectural and engineering research (Papadakis & Katsaprakakis, 2023; Qian et al., 2024).

In Nigeria, however, the design of sports facilities have rarely been guided by a structured energy-efficiency framework. Many existing public sports complexes were conceived decades ago under design briefs that gave little consideration to passive design, envelope performance, or renewable energy integration; where upgrades have since occurred, they have tended to focus on discrete mechanical or electrical interventions rather than a holistic, design-integrated approach (Garba et al., 2024). This creates a gap between what is technically achievable and what is actually delivered on the ground, particularly for government-owned facilities operating under constrained maintenance budgets.

Despite the scale of investment such designs represent, the extent to which they actually deliver the energy-efficient design outcomes they set out to achieve is rarely evaluated once construction is complete. Post-occupancy assessment of Nigerian sports facility is particularly sparse, leaving facility managers, designers, and funding agencies with little evidence of which design elements perform as intended and which fall short in practice. This absence of documented evaluation is the specific problem this study addresses.

The Lekan Salami Sports Complex, Adamasingba, Ibadan, offers a useful lens on this gap. Originally commissioned in 1976 as the Adamasingba Stadium and substantially renovated in 2021, the facility has undergone a significant retrofit exercise that included the introduction of a Building Management System (BMS), high-efficiency HVAC and variable refrigerant flow (VRF) systems, and solar photovoltaic integration. Assessing what this retrofit achieved, and where it fell short, provides insight not only into the performance of this specific facility but also into the broader pattern of energy-efficiency retrofitting in Nigerian public sports infrastructure.The aim of this study is therefore to assess the design elements for energy efficient strategies in the Adamasingba sport complex Ibadan.

2.0 Literature Review

2.1 Energy Efficiency in Sports Facility Design

Energy efficiency in buildings is broadly concerned with reducing the amount of energy required to deliver a given level of service or comfort. This is achieved through a combination of passive design measures, which harness site conditions, orientation, and material properties to reduce mechanical load, and active systems, which manage the load that remains (Papadakis & Katsaprakakis, 2023). For sports facilities specifically, the literature identifies building envelope performance, natural ventilation and daylighting, high-

efficiency HVAC and VRF systems, renewable energy integration, and automated building management as the principal levers available to designers (Elnour et al., 2022, Sadineni et al., 2011, Zhang et al., 2025).

Zhang et al. (2025) demonstrate, in the context of dry sports halls in cold regions, that natural ventilation strategies can meaningfully offset the energy demand of large-volume indoor sports spaces when the envelope and opening design are well matched to local climate. In warmer, humid climates such as Nigeria's, the equivalent strategy is typically cross-ventilation and shading rather than heat retention, but the underlying principle that passive measures should carry as much of the load as possible before active systems are engaged holds across climates (Garba et al., 2024,Miletić et al., 2024).

Building Management Systems and continuous energy monitoring are consistently identified as high-value retrofit interventions because they allow facility operators to track, automate, and optimise consumption in real time, converting a static building into a responsive one (Elnour et al., 2022; Katsaprakakis et al., 2023). Renewable energy integration, particularly on-site solar photovoltaic generation, is similarly well established as a means of offsetting grid dependency in high-load sports operations (Artuso & Santiangeli, 2008, Papadakis & Katsaprakakis, 2023). Where the literature is more cautionary is on the question of scale: Qian et al. (2024) note that the sheer physical footprint and operational intensity of large sports complexes mean that absolute energy consumption can remain high even where individual systems are highly efficient an efficiency–consumption tension that is particularly relevant to campus-scale facilities such as Adamasingba.

A methodologically distinct strand of the literature establishes the legitimacy of occupant appraisal as an assessment instrument. Revel and Arnesano (2014) demonstrate that subjective user evaluation of the environment in sports facilities corresponds meaningfully with instrumented measurement and captures dimensions of the occupied building that sensors alone do not. Miletić et al. (2024) likewise integrate occupant comfort with assessed energy performance in evaluating the retrofit of a 1976 Belgrade sports centre, a facility of closely comparable vintage to Adamasingba. The aim of this study is to assess the design elements for energy-efficient strategies in the Adamasingba Sport Complex, Ibadan. This body of work supports the user-based design assessment adopted here, while establishing that such assessment measures design elements as encountered and perceived rather than as metered.

2.2 Building Specification and Context

The Lekan Salami Sports Complex is centrally located at Mokola, Adamasingba, in urban Ibadan, a position that gives it strong public accessibility relative to more peripheral sports facilities.



Plate 1: Bird's-eye view of the Lekan Salami Sports Complex, Adamasingba.
Source: Researcher's field survey, 2024.

3.1 Site Planning and Landscaping

The complex sits within a largely hard-landscaped setting, with paved pedestrian areas dominating over planted or vegetated ground. While the paving supports pedestrian access and gives the site a tidy, well-maintained appearance, it does little to promote ecological sustainability: indigenous planting is minimal, native biodiversity is not actively promoted, and the site layout does not appear to have been closely adapted to the natural topography. This represents the facility's weakest assessment parameter and stands in contrast to its comparatively strong performance on active energy systems, discussed below.

3.2 Building Envelope and Materials

The building envelope combines imported aluminium composite cladding with locally sourced bricks and cement, a hybrid approach that keeps a portion of embodied transport emissions down while achieving a contemporary external finish. Windows are medium-sized and positioned to admit natural light and reduce reliance on artificial lighting during the day. Energy-efficient glazing and modern insulation materials have been incorporated to improve thermal performance, and the durability of the chosen materials supports a longer maintenance cycle, which is itself a component of lifecycle sustainability.

3.3 Building Design and Form

Functionally, the complex houses multi-purpose indoor sports halls, a press room, conference rooms and exhibition spaces that can be reconfigured for non-sporting events, giving the building a versatility that few single-purpose stadia achieve. Figures 1 and 2 show the ground and first floor layouts, which are organised around large open interior spans with peripheral circulation and service cores. Round-the-clock armed security is provided, and accessibility features are incorporated into circulation routes. The principal design shortfall identified is car parking: provision is insufficient for peak-attendance events, and available parking is concentrated at the general stadium lot, some distance from other sporting activities on the campus.

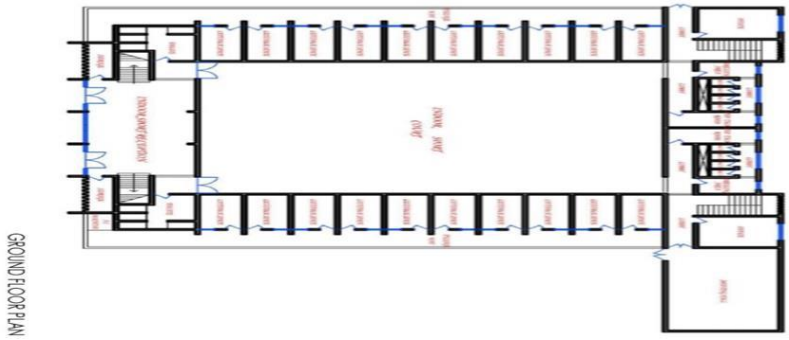

Figure 1: Ground floor plan of the Lekan Salami Sports Complex, Adamasingba.
Source: Researcher's field survey, 2024.

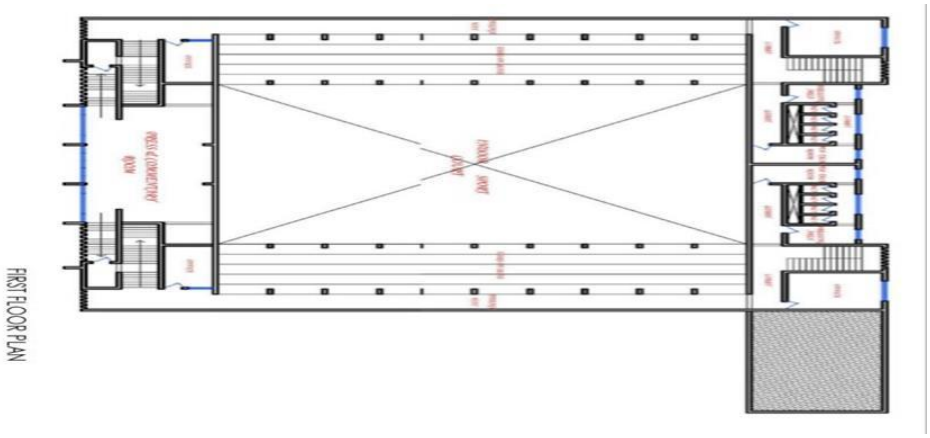

Figure 2: First floor plan of the Lekan Salami Sports Complex, Adamasingba.
Source: Researcher's field survey, 2024.
Researcher's field survey, 2024.



Plate 2: Exterior massing and the indoor athletics track at the Lekan Salami Sports Complex, Adamasingba.
Source: Researcher's field survey, 2024.

4. Methodology

4.1 Research Design

This study adopted a mixed-methods design, combining a quantitative descriptive survey with a qualitative case study approach. The qualitative component took the form of a case study of the Lekan Salami Stadium (Adamasingba Stadium), Ibadan, supported by photographic field documentation of the facility's design and energy-efficiency features. The quantitative component involved a structured questionnaire administered to stadium users to generate numerical data on their assessment of the facility's design elements. The two approaches were combined to allow the photographic case-study evidence to contextualise and corroborate the questionnaire findings, rather than treating either strand in isolation. The design is appropriate to the single descriptive research question posed, which seeks to establish the extent to which design elements for energy-efficient strategies are employed at the complex, rather than to test any relationship between variables.

4.2 Sample Population

The population comprised users of the Lekan Salami Sports Complex, taken as 10,000, corresponding to the stadium's spectator capacity.

4.3 Sample population

Yamane's (1967) formula was employed to determine the sample size from a total population of 10,000, corresponding to the stadium's spectator capacity, at a 5% margin of error:

$$n = N / (1 + N(e)^2)$$

where n = sample size, N = population size (10,000) and e = margin of error (0.05).

$$n = 10,000 / (1 + 10,000(0.05)^2) = 10,000 / 26 = 385$$

A minimum of 385 respondents was taken to field. A total of 381 valid, fully completed questionnaires were retrieved, a 98.96% retrieval rate.

4.4 Method of Distribution of Questionnaire

Questionnaires were administered on-site to respondents present at the facility during the study period, using convenience sampling. Respondents comprised facility staff/management, athletes/trainees, coaches/technical officers, maintenance personnel, and spectators/visitors all direct users with first-hand experience of the facility's design and operation.

4.5 Instruments

The questionnaire had two sections: Section A collected respondent profile data (six items); Section B contained 27 closed-ended statements on a five-point Likert scale (5 = Strongly Agree to 1 = Strongly Disagree), structured around the case-study assessment parameters. Cronbach's alpha for the 27-item scale was .885, and corrected item–total correlations ranged from .31 to .53, confirming internal consistency and that no item warranted deletion.

4.6 Method of Analysis

Data were coded and analysed descriptively in IBM SPSS Statistics. Frequencies and percentages were computed for respondent profile variables and each response category; means, standard deviations and rankings were computed per statement, and a grand mean was calculated across all 27 items. A benchmark of M ≥ 3.50 = Agreed, 2.50–3.49 = Undecided,

and < 2.50 = Disagreed was applied. As the study addresses a single descriptive research question with no hypotheses, no significance testing was conducted

5. Results and Discussion

All 381 retrieved questionnaires were complete across the twenty-seven assessment statements and the six respondent profile items. The dataset therefore contained no missing values, and neither imputation nor case deletion was required. Results are presented in two parts: the respondent profile and the assessment of design elements for energy-efficient strategies.

5.1 Respondent Profile

Table 1 presents the demographic composition of the sample. Spectators and visitors constituted the largest category (n = 167, 43.8%), followed by athletes and trainees (n = 63, 16.5%) and coaches or technical officers (n = 56, 14.7%). Facility staff and management (n = 46, 12.1%) together with maintenance personnel (n = 29, 7.6%) account for 19.7% of the sample and represent the operationally embedded users whose assessment of energy systems carries particular weight.

The sample was predominantly male (n = 273, 71.7%) and concentrated in the 30–49 age band (n = 241, 63.3%). Educational attainment was high, with 307 respondents (80.6%) holding an HND or B.Sc. qualification or above. Importantly for the validity of the assessment, 305 respondents (80.1%) had been associated with the facility for one year or longer, and 243 (63.8%) used it at least monthly, indicating a respondent pool with sustained rather than incidental exposure to the built environment under assessment.

Table 1

Respondent Profile (N = 381)

Characteristic	Frequency (f)	Percentage (%)
Category of respondent		
Facility staff/management	46	12.1
Athlete/trainee	63	16.5
Coach/technical officer	56	14.7
Spectator/visitor	167	43.8
Maintenance personnel	29	7.6
Other	20	5.2
Gender		
Male	273	71.7
Female	108	28.3
Age range (years)		
Below 20	4	1.0
20–29	83	21.8
30–39	146	38.3
40–49	95	24.9
50 and above	53	13.9
Highest educational qualification		

Characteristic	Frequency (f)	Percentage (%)
SSCE/O'Level	22	5.8
OND/NCE	45	11.8
HND/B.Sc.	199	52.2
M.Sc./PGD and above	108	28.3
Other	7	1.8
Length of association with the facility		
Less than 1 year	76	19.9
1–3 years	114	29.9
4–6 years	87	22.8
7–9 years	56	14.7
10 years and above	48	12.6
Frequency of use/visit		
Daily	50	13.1
Weekly	134	35.2
Monthly	59	15.5
Occasionally	138	36.2

5.2 Assessment of Design Elements for Energy-Efficient Strategies

Table 2 presents the full response distribution for each of the twenty-seven design elements, reporting the frequency and percentage of respondents selecting each point of the scale, together with the mean, standard deviation, rank, and decision for every element, and the grand mean for the instrument as a whole. Reporting frequencies alongside means is necessary here because several elements with similar means differ appreciably in the distribution of responses beneath them, and the concentration of respondents in the Neutral category is itself informative.

Table 2

Response Distribution, Mean and Decision for the Twenty-Seven Design Elements for Energy-Efficient Strategies (N = 381)

No.	Design element assessed	SD (1)	D (2)	N (3)	A (4)	SA (5)	M	SD	Rank	Decision
1	The facility's landscape design integrates well with the natural environment.	0 (.0)	16 (4.2)	92 (24.1)	181 (47.5)	92 (24.1)	3.92	.80	10	Agreed
2	Adequate planted or green areas are provided within the complex.	4 (1.0)	52 (13.6)	144 (37.8)	138 (36.2)	43 (11.3)	3.43	.90	21	Undecided
3	The site layout minimises disruption to the natural topography.	0 (.0)	14 (3.7)	88 (23.1)	207 (54.3)	72 (18.9)	3.88	.75	13	Agreed
4	The building is oriented to minimise direct solar heat gain into indoor spaces.	0 (.0)	7 (1.8)	80 (21.0)	211 (55.4)	83 (21.8)	3.97	.71	7	Agreed
5	The orientation of the building maximises natural daylight penetration without causing glare.	0 (.0)	5 (1.3)	62 (16.3)	203 (53.3)	111 (29.1)	4.10	.71	4	Agreed
6	The building's orientation takes advantage of prevailing wind direction	0 (.0)	9 (2.4)	94 (24.7)	200 (52.5)	78 (20.5)	3.91	.73	11	Agreed

No.	Design element assessed	SD (1)	D (2)	N (3)	A (4)	SA (5)	M	SD	Rank	Decision
	to support natural ventilation.									
7	The orientation of the building helps reduce reliance on artificial lighting and cooling.	1 (.3)	7 (1.8)	90 (23.6)	194 (50.9)	89 (23.4)	3.95	.75	9	Agreed
8	Pathways and outdoor spaces are well planned for pedestrian use.	1 (.3)	5 (1.3)	61 (16.0)	202 (53.0)	112 (29.4)	4.10	.72	5	Agreed
9	The building materials used are durable and well suited to the local climate.	1 (.3)	5 (1.3)	60 (15.7)	227 (59.6)	88 (23.1)	4.04	.68	6	Agreed
10	Windows and glazing allow adequate natural light into the building.	1 (.3)	9 (2.4)	93 (24.4)	199 (52.2)	79 (20.7)	3.91	.75	12	Agreed
11	The building envelope appears to reduce heat gain effectively.	3 (.8)	15 (3.9)	121 (31.8)	175 (45.9)	67 (17.6)	3.76	.81	15	Agreed
12	Insulation used in the building improves thermal comfort indoors.	4 (1.0)	30 (7.9)	116 (30.4)	176 (46.2)	55 (14.4)	3.65	.86	19	Agreed
13	The building form and layout support flexible use of spaces.	4 (1.0)	15 (3.9)	83 (21.8)	169 (44.4)	110 (28.9)	3.96	.87	8	Agreed
14	Natural ventilation is well achieved through the building's design.	1 (.3)	4 (1.0)	54 (14.2)	195 (51.2)	127 (33.3)	4.16	.72	2	Agreed
15	The facility is designed to accommodate multiple types of activities.	1 (.3)	1 (.3)	36 (9.4)	178 (46.7)	165 (43.3)	4.33	.68	1	Agreed
16	Circulation and accessibility within the building are satisfactory.	1 (.3)	3 (.8)	51 (13.4)	206 (54.1)	120 (31.5)	4.16	.69	3	Agreed
17	The facility makes effective use of natural lighting to reduce electricity use.	3 (.8)	33 (8.7)	109 (28.6)	172 (45.1)	64 (16.8)	3.69	.88	17	Agreed
18	Energy-efficient lighting (e.g., LED) is used within the facility.	6 (1.6)	34 (8.9)	140 (36.7)	138 (36.2)	63 (16.5)	3.57	.92	20	Agreed
19	The facility's HVAC/cooling systems appear to operate efficiently.	14 (3.7)	70 (18.4)	155 (40.7)	111 (29.1)	31 (8.1)	3.20	.95	23	Undecided
20	Renewable energy sources (e.g., solar panels) are visibly used in the facility.	16 (4.2)	63 (16.5)	166 (43.6)	102 (26.8)	34 (8.9)	3.20	.96	24	Undecided
21	There is a noticeable system for monitoring or managing energy use (e.g., a Building Management System).	15 (3.9)	72 (18.9)	157 (41.2)	105 (27.6)	32 (8.4)	3.18	.96	25	Undecided
22	Water-saving fixtures (e.g., low-flow taps) are used in the facility.	18 (4.7)	67 (17.6)	154 (40.4)	118 (31.0)	24 (6.3)	3.17	.95	26	Undecided
23	Rainwater harvesting or greywater recycling systems are evident and functional.	24 (6.3)	86 (22.6)	154 (40.4)	88 (23.1)	29 (7.6)	3.03	1.01	27	Undecided
24	Water usage within the facility is effectively monitored or managed.	12 (3.1)	59 (15.5)	153 (40.2)	120 (31.5)	37 (9.7)	3.29	.95	22	Undecided
25	Indoor spaces are well-lit with natural daylight.	4 (1.0)	27 (7.1)	121 (31.8)	157 (41.2)	72 (18.9)	3.70	.89	16	Agreed
26	Ventilation within indoor spaces is adequate and comfortable.	3 (.8)	27 (7.1)	114 (29.9)	183 (48.0)	54 (14.2)	3.68	.83	18	Agreed
27	The indoor environment supports occupant comfort and wellbeing during use.	4 (1.0)	16 (4.2)	102 (26.8)	177 (46.5)	82 (21.5)	3.83	.85	14	Agreed
	Grand mean / overall assessment						**3.73**	**.42**		**Agreed**

Note. Cell entries show frequency with row percentage in parentheses. SD (1) = Strongly Disagree; D (2) = Disagree; N (3) = Neutral; A (4) = Agree; SA (5) = Strongly Agree. M = mean; SD = standard deviation. Rank

the twenty-seven elements in descending order of mean. Decision benchmark: M ≥ 3.50 = Agreed; 2.50–3.49 = Undecided; M < 2.50 = Disagreed. Item numbers correspond to the statement numbering in Appendix A.

5.2.1 Overall Assessment

The grand mean across the twenty-seven design elements was 3.73 (SD = .42), which exceeds the 3.50 benchmark and is therefore designated Agreed. Users of the Adamasingba Sport Complex thus affirm, in aggregate, that design elements for energy-efficient strategies are employed at the facility. Individual element means ranged from 3.03 to 4.33, a spread of 1.30 scale points. Of the twenty-seven elements, 20 attained the benchmark and were designated Agreed, while the remaining 7 fell within the Undecided band. No element was rejected, and no element recorded a mean below 3.00. The overall picture is therefore one of a facility whose energy-efficiency design is affirmed rather than contested, but affirmed unevenly.

5.2.2 Highest-Rated Design Elements

The most strongly affirmed element was the facility's design to accommodate multiple types of activities (item 15, M = 4.33, SD = .68), endorsed by 90.0% of respondents with only two respondents in disagreement. This corroborates the multi-functional programming recorded in the field survey, whereby indoor sports halls, a press room, conference rooms, and exhibition spaces can be reconfigured for non-sporting use.

Two elements shared second rank: the achievement of natural ventilation through the building's design (item 14, M = 4.16, SD = .72; 84.5% agreement) and the satisfactoriness of internal circulation and accessibility (item 16, M = 4.16, SD = .69; 85.6% agreement). Also strongly affirmed were the maximisation of natural daylight penetration without glare (item 5, M = 4.10), the planning of pathways and outdoor spaces for pedestrian use (item 8, M = 4.10), and the durability and climatic suitability of the building materials (item 9, M = 4.04; 82.7% agreement).

A common characteristic unites these highest-rated elements: each is a passive architectural attribute inherent in the building's form, orientation, spatial organisation or material fabric. Notably, no respondent at all selected Strongly Disagree on items 4, 5 or 6, all of which concern building orientation, indicating an absence of adverse assessment of the facility's passive design logic.

5.2.3 Lowest-Rated Design Elements

The seven elements falling within the Undecided band form a coherent group. The lowest-rated element in the entire instrument was the evidence and functionality of rainwater harvesting or greywater recycling systems (item 23, M = 3.03, SD = 1.01). This element attracted the highest disagreement of any in the instrument (28.9%), the widest dispersion, and its mean sits barely above the scale midpoint. It corresponds precisely to the infrastructure that field observation recorded as designed but not operational, and the convergence of the two independent evidence sources on the same specific deficit substantially strengthens the finding.

The remaining undecided elements were the use of water-saving fixtures (item 22, M = 3.17), the presence of a noticeable energy monitoring or building management system (item 21, M = 3.18), the efficient operation of HVAC and cooling systems (item 19, M = 3.20), the visible use of renewable energy sources (item 20, M = 3.20), the effective monitoring or

management of water usage (item 24, M = 3.29) and the provision of adequate planted or green areas (item 2, M = 3.43).

The response distributions beneath these means are instructive. On items 19, 20 and 21, the three elements concerning engineered active systems, between 40.7% and 43.6% of respondents selected Neutral, and disagreement ranged from 20.7% to 22.8%. Respondent mass on these elements is thus concentrated in the middle of the scale rather than at its negative pole, a pattern examined in Section 6.2. Item 2, the provision of green areas, is the sole undecided element that is architectural rather than mechanical in character, and it attracted disagreement from 14.7% of respondents, consistent with the predominantly hard-landscaped site recorded during field survey.

5.2.4 The Passive–Active Pattern

Read together, the ranking discloses a consistent pattern. The twenty affirmed elements are dominated by passive architectural attributes: spatial configuration, orientation, daylighting, natural ventilation, envelope and materials, circulation and indoor comfort. The seven undecided elements are dominated by engineered resource-management systems: renewable generation, energy monitoring, HVAC efficiency, water fixtures, water monitoring and water recycling, with green area provision the single architectural exception.

This division corresponds closely to the distinction between attributes inherent in the original architectural fabric and its 2021 spatial reorganisation, and attributes introduced by the retrofit as add-on technical systems. Within the energy-related elements, a further split is visible: the two passive energy elements, effective use of natural lighting to reduce electricity use (item 17, M = 3.69) and the use of energy-efficient LED lighting (item 18, M = 3.57), both attained the benchmark, whereas the three active energy elements did not. The implications of this pattern are considered in the following section.

6. Conclusion

This study assessed the design elements employed for energy-efficient strategies at the Lekan Salami Sports Complex, Adamasingba, Ibadan, drawing on a twenty-seven-item user assessment administered to 381 facility users and read alongside photographic field documentation, the design elements for energy-efficient strategies are employed at the complex to a substantial extent. The grand mean of 3.73 (SD = .42) exceeds the decision benchmark of 3.50; the instrument demonstrated strong internal consistency (α = .885), 20 of the twenty-seven elements were affirmed by respondents, and no element was rejected. The 2021 retrofit has therefore delivered a facility that its users recognise as substantively energy-conscious in design.

That affirmation is, however, unevenly distributed in a manner carrying direct practical consequence. The elements most strongly affirmed are passive and architectural: provision for multiple activity types (M = 4.33), natural ventilation through building design (M = 4.16), circulation and accessibility (M = 4.16), daylight penetration without glare (M = 4.10) and material durability (M = 4.04). The seven elements on which respondents remained undecided are, with the single exception of green area provision, the engineered resource-management systems introduced by the retrofit: renewable energy visibility (M = 3.20), energy monitoring (M = 3.18), HVAC efficiency (M = 3.20), water monitoring (M = 3.29), water-saving fixtures (M = 3.17) and, lowest of all, rainwater harvesting and greywater recycling (M = 3.03).The overarching conclusion is that the Adamasingba stadium realized its architectural and passive-design objectives more fully than its active-systems and

resource-management objectives. The shortfalls identified lie predominantly in operation, visibility and maintenance rather than in original design specification, and are addressable through operational rather than capital-intensive intervention.

7. Limitations

Three limitations qualify these findings. First, the study assesses design elements as encountered and perceived by users rather than as metered; user assessment is an established and independently informative modality (Revel & Arnesano, 2014), but it cannot substitute for instrumented energy data, and the study accordingly reports how the facility is experienced rather than how much energy it consumes. Second, respondents were recruited by convenience sampling from those present during the survey period, which constrains generalisation to the wider user population, and spectators and visitors are correspondingly over-represented at 43.8% of the sample. Third, the design captures a single post-retrofit moment and cannot establish trajectory: whether the undecided assessment of the active systems reflects progressive degradation since 2021 or a condition present from commissioning cannot be determined from these data.

8. Recommendations

Based on the findings of the study, five recommendations are proposed: facility management should undertake a technical audit of the specified rainwater harvesting and greywater recycling installations, restore them to functional status, and install visible flow metering at principal draw-off points; management should install a public-facing real-time energy display in the main concourse showing current generation, consumption, and avoided emissions, signpost the photovoltaic array and BMS interface, and publish periodic performance summaries; a phased planting programme prioritising indigenous shade species along principal pedestrian routes, parking areas, and the western and south-western elevations should be implemented to reduce ambient and surface temperatures, mitigate solar heat gain on the building envelope, and address the ecological sustainability shortfall at a cost substantially below that of mechanical interventions of comparable thermal effect; a written preventive maintenance schedule should be established covering photovoltaic array cleaning and output verification, HVAC and VRF servicing, BMS calibration, sanitary fittings, and water metering, with a designated responsible officer, defined intervals, and a logged compliance record; and a programme of sub-metered electricity monitoring by end use, photovoltaic generation logging, and physical measurement of indoor temperature, relative humidity, illuminance, and carbon dioxide concentration across representative zones and occupancy states should be undertaken.

References

Elnour, M., Fadli, F., Himeur, Y., Petri, I., Rezgui, Y., Meskin, N., & Ahmad, A. M. (2022). Performance and energy optimization of building automation and management systems: Towards smart sustainable carbon-neutral sports facilities. Renewable and Sustainable Energy Reviews, 162, 112401. https://doi.org/10.1016/j.rser.2022.112401

Garba, B. M. P., Umar, M. O., Umana, A. U., Olu, J. S., & Ologun, A. (2024). Energy efficiency in public buildings: Evaluating strategies for tropical and temperate climates. World Journal of Advanced Research and Reviews, 23(3), 409–421. https://doi.org/10.30574/wjarr.2024.23.3.2702

Katsaprakakis, D. A., Papadakis, N., Giannopoulou, E., Yiannakoudakis, Y., Zidianakis, G., Kalogerakis, M., Katzagiannakis, G., Dakanali, E., Stavrakakis, G. M., & Kartalidis, A. (2023). Rational use of energy in sports centres to achieve net zero: The SAVE project (Part A). Energies, 16(10), 4040. https://doi.org/10.3390/en16104040

Miletić, M., Komatina, D., Babić, L., & Lukić, J. (2024). Evaluating energy retrofit and indoor environmental quality in a Serbian sports facility: A comprehensive case study. Applied Sciences, 14(20), 9401. https://doi.org/10.3390/app14209401

Nunnally, J. C., & Bernstein, I. H. (1994). Psychometric theory (3rd ed.). McGraw-Hill.

Papadakis, N., & Katsaprakakis, D. A. (2023). A review of energy efficiency interventions in public buildings. Energies, 16(17), 6329. https://doi.org/10.3390/en16176329

Qian, F., Shi, Z., & Yang, L. (2024). A review of green, low-carbon, and energy-efficient research in sports buildings. Energies, 17(16), 4020. https://doi.org/10.3390/en17164020

Revel, G. M., & Arnesano, M. (2014). Perception of the thermal environment in sports facilities through a subjective approach. Building and Environment, 77, 12–19. https://doi.org/10.1016/j.buildenv.2014.03.017

Sadineni, S. B., Madala, S., & Boehm, R. F. (2011). Passive building energy savings: A review of building envelope components. Renewable and Sustainable Energy Reviews, 15(8), 3617–3631. https://doi.org/10.1016/j.rser.2011.07.014

Tavakol, M., & Dennick, R. (2011). Making sense of Cronbach's alpha. International Journal of Medical Education, 2, 53–55. https://doi.org/10.5116/ijme.4dfb.8dfd

Trianti-Stourna, E., Spyropoulou, K., Theofylaktos, C., Droutsa, K., Balaras, C. A., Santamouris, M., Asimakopoulos, D. N., Lazaropoulou, G., & Papanikolaou, N. (1998). Energy conservation strategies for sports centers: Part A. Sports halls. Energy and Buildings, 27(2), 109–122. https://doi.org/10.1016/S0378-7788(97)00040-6

Yamane, T. (1967). Statistics: An introductory analysis (2nd ed.). Harper & Row.

Zhang, W., Li, L., & Li, Y. (2025). Natural ventilation and energy consumption research for dry sports halls within national fitness centers in cold regions: Case study of Qingdao. Buildings, 15(5), 734. https://doi.org/10.3390/buildings15050734