CONSTRUCTION PROJECT MANAGEMENT

Assessing the Extent of Passive Energy Strategy Integration into Construction Project Management Practices in Lagos, Nigeria

Audu Afeez Olasunkanmi, Akinyele Joseph Olawale

Department of Civil Engineering, University of Ibadan, Ibadan, Nigeria

Published November 2026

Abstract

Integrating passive energy strategies in built projects improve the performance of buildings, especially in warmer and more humid urban environments. However, having an intention of integrating climate responsive designs does not guarantee passive energy strategies are systematically integrated within the construction project management process. This research investigated how passive energy strategies are currently being integrated in construction project management processes in Lagos, Nigeria. A convergent mixed methods approach was used. The questionnaire section employed a cross-sectional survey and the interview section comprised semi-structured interviews. Quantitative data was collected from 200 valid respondents in the construction industry. Ten interviews were conducted with experienced professionals. Data analysis involved frequencies, percentages and weighted mean scores of the questionnaire responses. Thematic analysis was undertaken for the interview data. The results show that there is moderate uneven integration of passive energy strategies. There was a higher frequency of high and very high integration at the design stage (70.0%), project planning (65.0%) and project initiation (59.0%). A lower frequency of integration was reported at monitoring stage (56.0%), contractor compliance with passive design requirements (53.0%), project completion (50.0%) and project performance indicators (energy efficiency) (47.0%). The overall mean score for the ten indicators was 3.51 out of five. Results from the interviews also indicated that passive energy strategies are more likely to be integrated at the architectural design stage. Overall, the study shows that passive energy strategies are acknowledged and partially implemented. Recommendations were made to include clear energy requirements, stages for review throughout the project lifecycle, verification at construction stage, clear responsibilities and review at project completion to improve continuity of integration.

Keywords: Passive energy strategies; construction project management; project lifecycle; integration; building sustainability

1 Introduction

1.1 Background to the study

The construction industry plays a key role in economic development by providing housing, commercial and institutional buildings. However, buildings can be very energy and resource intensive, with high levels of emissions. This is highlighted by reports from the United Nations Environmental Programme who showed that buildings and construction account for a high proportion of the world's energy demand and carbon dioxide emissions related to energy and processes (UNEP, 2022). Improving the energy efficiency of buildings is therefore an important factor for sustainable development.

Passive energy strategies utilise the shape, orientation, apertures, shading, daylighting and envelope of buildings to provide control of heat gain, natural ventilation and reduce dependence on mechanical cooling and lighting. However, passive energy strategies can be dependant on the location. Within tropical climates, passive strategies depend on how well solar radiation, humidity, wind speed and building shape and envelope work together to provide suitable solutions (Gamero-Salinas et al., 2021; Hu et al., 2023). Passives strategies are highly relevant in Lagos due to the hot and humid weather, rapid urban development.

Research has been conducted within Nigeria relating to technical passive energy strategies. Ochedi and Taki developed a framework to improve energy efficiency in residential buildings in Nigeria (2022). Atiba and Chwieduk investigated how construction could be designed to suit the weather conditions in Lagos (2024). Passive cooling and thermal comfort have been studied within Nigeria (Ezema et al., 2023; Dimuna et al., 2025). Within these studies it can be seen that passive strategies should be chosen based on the local climate and building factors. However, technical appropriateness may not be sufficient.

Within construction projects passive energy strategies must be incorporated into the project. This includes requirements, design outputs, cost, procurement requirements, construction methods and quality control. The passive energy strategy may be included within the concept design stage, however may be reduced based on how the costs are decided, materials changed, construction altered and no verification. Project management ensures the passive energy strategies are incorporated into the project by providing coordination between the environmental goals and the traditional project controls of scope, time, cost, quality and stakeholders (Kerzner, 2022; Stanitsas et al., 2021).

Including sustainability within project management ensures that environmental factors are included within the project. Sustainability increases the criteria for project success and impact (Silvius and Schipper, 2014). Within the construction sector, sustainability indicators have been identified covering economic, environmental and social/management aspects (Stanitsas et al., 2021). Sustainability within construction projects is an important aspect, as sustainability goals relate to the project team capabilities, planning, assessment and stakeholder management (Phung et al., 2026).

This can be seen to be an issue within Lagos due to the variety of roles within construction projects. Including the client, project manager, architect, engineer, quantity surveyor, contractor and regulatory body. Evidence from Nigeria has shown that technical knowledge, professional capabilities, policy support and stakeholder collaboration are important factors (Omopariola et al., 2024). Therefore, this study looks into the extent to which passive energy strategies are incorporated into construction project management.

1.2 Research problem

Passive energy strategies are becoming increasingly relevant for improving the energy efficiency of buildings within tropical environments. However, just because there are suitable options available it does not mean that they will be included, provided resources for, procured, installed and assessed. Passive energy strategies may not be incorporated within the project lifecycle as they may not be included within the initial project brief, limited focus during planning, poor coordination between the design team, not being followed during procurement and construction or not verified.

Studies have been carried out within Nigeria looking at energy efficient design and barriers to sustainable construction (Ochedi and Taki, 2022; Omopariola et al., 2024). However, there is a lack of evidence looking at how much passive energy strategies are incorporated within everyday project

management. It is important to understand how much passive energy strategies are included within the early stages of the project and carried throughout the project. If this is not understood it may seem like passive energy strategies are being used however there may be issues with the procurement, construction monitoring and assessment.

The issue within this paper is that passive energy strategies are not being incorporated into construction project management evenly within Lagos. This study looks into how passive energy strategies have been reported to be incorporated within the initialisation, planning, design, monitoring of construction, specification adherence, project completion, encouraging clients, decision making throughout the project lifecycle and using energy efficiency as a performance indicator.

2 Literature review

2.1 Passive energy strategies in building projects

Passive energy strategies are design and construction measures that use or moderate natural environmental processes to improve indoor conditions and reduce the demand for mechanical energy. Common measures include building orientation, natural ventilation, external solar shading, daylighting, roof and wall insulation, reflective finishes and the selection of materials with suitable thermal properties. These measures are not interchangeable: their suitability depends on climate, site conditions, building use, occupancy, security, noise and air-quality considerations (Gamero-Salinas et al., 2021; Hu et al., 2023).

For Lagos, the relevance of passive cooling and climate-responsive design is supported by studies examining local weather conditions and building design alternatives. Atiba and Chwieduk (2024) considered building materials, window dimensions, orientation and roof ventilation in a Lagos-based positive energy district assessment. Ogochukwu and Ehisuoria (2025) examined natural ventilation in low-cost housing in Lagos and identified practical conditions that influence its use. Fulani and James (2026) also reported the use of passive cooling measures among architects in Lagos, including insulation, orientation, building form and material choices. These studies indicate that passive strategies need to be selected and coordinated in relation to local conditions rather than adopted as a uniform package.

The present paper does not attempt to rank the technical effectiveness of individual passive measures. Instead, it examines whether the management processes required to incorporate such measures are evident across project stages. This distinction is important because an appropriate strategy can still fail to influence the completed building if the project does not preserve its requirements through design coordination, procurement, construction and handover.

2.2 Construction project management and lifecycle integration

Construction project management involves planning, organising, coordinating and controlling resources and activities to achieve project objectives within defined constraints. Its conventional concerns include scope, cost, time, quality, risk, communication and stakeholder management (Kerzner, 2022). The integration of sustainability adds the need to consider environmental and social consequences alongside immediate delivery outcomes (Silvius and Schipper, 2014).

The lifecycle perspective is relevant because decisions made at one stage shape the options available at later stages. Initiation establishes the client's objectives and project brief. Planning translates these

objectives into requirements, resources and delivery arrangements. Design converts requirements into coordinated drawings and specifications. Procurement selects suppliers, materials and contractors. Construction requires implementation, inspection and change control. Completion and handover provide an opportunity to verify deliverables and transfer relevant information to building operators. A lifecycle approach therefore requires continuity between decisions rather than isolated references to sustainability.

Stanitsas et al. (2021) demonstrate that sustainability indicators can be incorporated into construction project management, but the practical challenge lies in selecting indicators and assigning responsibility for their use. Phung et al. (2026) similarly identify the importance of sustainability goals, team capability, planning and assessment. In the context of passive energy strategies, these principles imply that project managers should ensure that energy-related requirements are documented, communicated and checked at relevant decision points.

A project management approach also needs to recognise that not all decisions are controlled by one professional group. Clients influence project priorities and budget approval; architects and engineers develop technical solutions; quantity surveyors advise on cost implications; contractors and specialist trades execute the work; and project managers coordinate delivery and control. Omoparíola et al. (2024) identify professional capacity, knowledge, policy and cooperation as factors affecting sustainable construction in Nigeria. These conditions help explain why integration may vary between project stages and organisations.

2.3 Integration as a project management practice

In this study, integration refers to the extent to which passive energy considerations are reflected in project management activities and decisions. It is broader than the presence of passive features on drawings. Integration includes early consideration in the project brief, incorporation during planning, design-team application, monitoring during construction, contractor compliance with specifications, evaluation at completion, client encouragement, influence on decisions throughout the lifecycle and inclusion of energy efficiency in project performance assessment.

This operational definition makes it possible to distinguish between design-stage adoption and lifecycle implementation. For example, a design team may incorporate shading and natural ventilation into a proposal, but the measures may not be retained if the cost plan does not accommodate them or if construction substitutions are not reviewed. Similarly, a completed building may contain passive features without project records showing whether their implementation was inspected or evaluated. The distinction between intention, implementation and verification is consistent with the systems perspective, which emphasises the interdependence of project activities and the consequences of decisions across organisational boundaries (Checkland, 1999).

The innovation perspective also provides a useful interpretive lens. Rogers (2003) explains that adoption is influenced by perceived advantage, compatibility, complexity, trialability and observability. In construction projects, passive measures may be more readily adopted when stakeholders understand their benefits, regard them as compatible with client requirements and conventional construction methods, and can access the expertise needed to specify and implement them. However, favourable perceptions do not in themselves demonstrate that the measures are installed correctly or maintained in operation.

The current study consequently treats integration as a management process that can be reported by project participants, while recognising that self-reported integration is not equivalent to verified

building performance. This boundary is important when interpreting survey responses and drawing conclusions from them.

2.4 Empirical evidence and research gap

Research on energy-efficient buildings in Nigeria has provided useful design-oriented evidence. Ochedi and Taki (2022) proposed a framework for energy-efficient residential building design and highlighted the role of coordinated stakeholder participation. Atiba and Chwieduk (2024) examined passive design variables under Lagos weather conditions. These studies provide a basis for understanding the technical relevance of passive measures, but they do not fully establish how project management activities maintain such measures across the entire delivery process.

At the broader construction-industry level, Omopariola et al. (2024) identify barriers to sustainable construction in Nigeria, including limited technical expertise, professional knowledge and policy support. Stanitsas et al. (2021) and Phung et al. (2026) provide project management perspectives on sustainability indicators and process-based management. Collectively, this literature supports the need to connect environmental objectives with project controls and stakeholder responsibilities.

The gap addressed here is empirical and managerial: there is a need to assess the reported extent of passive energy integration at different stages of building project delivery in Lagos and to identify whether integration is consistent beyond design. The paper contributes by presenting lifecycle-specific evidence from construction stakeholders and by comparing questionnaire results with interview themes.

3 Methodology

3.1 Research design

The study adopted a convergent mixed-methods design combining a cross-sectional questionnaire survey with semi-structured interviews. The quantitative component assessed respondents' reported level of passive energy integration across project management activities. The qualitative component explored professional experiences and provided explanations of how passive energy strategies are considered during planning, design, construction and completion. The two strands were considered together to provide a more contextual interpretation of current practice.

3.2 Study area and population

The study was conducted in Lagos State, Nigeria, with survey coverage focused on Lagos Island and Lagos Mainland. The target population comprised construction industry stakeholders involved in building development and project delivery. These included Project Managers, Architects, Engineers, Quantity Surveyors, Builders, Contractors and Subcontractors, Clients or Property Developers, and regulatory personnel. Respondents were eligible where they had professional involvement in building design, construction, coordination, development or oversight.

3.3 Sample and data collection

A total of 385 questionnaires were distributed through physical and electronic channels. Of these, 200 were returned and considered valid for analysis, representing a response rate of 51.9% (Table 1). The quantitative analysis was therefore based on 200 valid responses. In addition, semi-structured interviews were conducted with ten experienced professionals drawn from relevant stakeholder

groups. The interviews explored how passive energy strategies were integrated across project stages, examples of practice and organisational commitment.

Table 1. Questionnaire administration and response rate.

Questionnaire status	Frequency	Percentage (%)
Questionnaires distributed	385	100.0
Questionnaires returned and valid	200	51.9
Questionnaires not returned	185	48.1
Total	385	100.0

Note: Field survey (2026).

3.4 Research instrument and measurement

Within the questionnaire there was a section on the extent of passive energy strategy integration. This asked for a rating to be given out of 5 (Very High = 5, High = 4, Moderate = 3, Low = 2, Very Low = 1) for the 10 statements (C1-C10). The statements include: whether the integration was considered in the initial stages and planning of the project; integration within the design team; monitored by the project manager during construction; adhered to by contractors; assessed once completed; encouraged by clients; had any impact during the lifecycle; if energy efficiency was used as a performance indicator; and overall, how satisfied were they with the integration.

3.5 Data analysis

Statistical analysis was performed on quantitative data. The weighted mean scores and sample standard deviation was calculated from the frequency distribution of responses. The percentage of people answering either Very High or High indicates how many individuals felt there was a high level of integration. The interview responses were analysed thematically.

The interpretation of the data is limited due to it being a cross-sectional self-report survey. As there was no independent examination of project documentation or measurement of energy usage in completed buildings the results are based on the perception of integration by those surveyed.

4 Results and discussion

4.1 Level of integration throughout project management

The 10 indicators give an indication of the current level of integration throughout the lifecycle. Table 2 contains the raw frequency of responses and percentages from the field survey. It can be seen that there is not an even level of integration with responses indicating the highest level of positive integration when considering design related aspects. However, there was the lowest level of integration relating to using energy efficiency as a formal performance indicator.

Table 2. Extent of integration of passive energy strategies into construction project management practices (N = 200).

Code	Integration indicator	Very high n (%)	High n (%)	Moderate n (%)	Low n (%)	Very low n (%)
C1	Consideration during project initiation	42 (21.0)	76 (38.0)	46 (23.0)	26 (13.0)	10 (5.0)

Code	Integration indicator	Very high n (%)	High n (%)	Moderate n (%)	Low n (%)	Very low n (%)
C2	Inclusion during project planning	48 (24.0)	82 (41.0)	42 (21.0)	20 (10.0)	8 (4.0)
C3	Design-team integration into building designs	54 (27.0)	86 (43.0)	38 (19.0)	16 (8.0)	6 (3.0)
C4	Project-manager monitoring during construction	38 (19.0)	74 (37.0)	50 (25.0)	28 (14.0)	10 (5.0)
C5	Contractor compliance with passive design specifications	34 (17.0)	72 (36.0)	54 (27.0)	30 (15.0)	10 (5.0)
C6	Evaluation during project completion	32 (16.0)	68 (34.0)	56 (28.0)	32 (16.0)	12 (6.0)
C7	Client encouragement	40 (20.0)	70 (35.0)	52 (26.0)	28 (14.0)	10 (5.0)
C8	Influence on decisions throughout project lifecycle	36 (18.0)	78 (39.0)	50 (25.0)	26 (13.0)	10 (5.0)
C9	Energy efficiency included as project performance indicator	30 (15.0)	64 (32.0)	58 (29.0)	34 (17.0)	14 (7.0)
C10	Overall integration in Lagos projects is satisfactory	28 (14.0)	72 (36.0)	54 (27.0)	34 (17.0)	12 (6.0)

Note: Field survey (2026).

Initiation received a positive response of 59.0% indicating Very High or High consideration of passive energy strategies and 18.0% indicating Low or Very Low consideration. This suggests some consideration during the initiation phases but it does not appear to be integral to the process. During initiation, project goals and client requirements are set which will dictate the scope, budget and design decisions made.

Planning received a higher positive response with 65.0% indicating they consider passive energy requirements. This suggests that passive energy requirements are more likely to be considered during planning. However, 14.0% indicated that passive energy integration was Low or Very Low.

Design received the highest positive response with 70.0% indicating Very High or High. This indicates that passive energy strategies are more integral during the design phase than several other project management phases. However, this is consistent with the findings from previous studies in Nigeria which have highlighted that energy efficient residential buildings focus on the design phase (Ochedi and Taki, 2022). Furthermore, Lagos has been identified as having specific design options available (Atiba and Chwieduk, 2024). However, this should not be taken as evidence that the design features are purchased, installed or assessed.

During execution, the response decreased. 56.0% of respondents indicated that passive design requirements were Very High or High during monitoring by project managers. 53.0% indicated that passive design requirements were met by contractors. This suggests that there could be a gap between the development of requirements and how they are managed. During the execution phase design changes, replacements and quality of work can impact the original intention. This suggests that from a project management perspective there should be criteria for monitoring, replacement approval processes and defined roles for verifying features.

Evaluation during completion received 50.0% indicating Very High or High. However, 22.0% indicated Low or Very Low. This was one of the lowest responses indicating that passive energy provisions are not as consistently evaluated during the completion phase. Evaluation is important to ensure the features have been supplied. However, this study does not capture how well they perform after occupation.

Encouragement from clients received 55.0% indicating Very High or High. Passive energy considerations influencing decisions throughout the lifecycle received 57.0%. This indicates some support from clients during the lifecycle. However, this does not necessarily translate into requirements within project management. Energy efficiency as an indicator for project performance had the lowest positive responses (47.0%) and highest combined responses for Low or Very Low (24.0%). This indicates energy efficiency is less consistently integrated into the evaluation process.

Overall satisfaction with passive energy integration was 50.0%. The weighted mean scores range from 3.31 to 3.83. This equates to an average score of 3.51 out of 5 for the 10 indicators. This overall average was calculated for this manuscript based on the frequency distributions presented in the dissertation. It was not specifically mentioned in the dissertation. Overall, the findings suggest moderate, partial and inconsistent integration.

4.2 Weighted mean and ranking of integration indicators

Table 3 presents the weighted mean and ranking of integration indicators.

Table 3. Weighted mean and ranking of integration indicators.

Code	Integration indicator	Mean	SD	Rank
C3	Design-team integration into building designs	3.83	1.01	1
C2	Inclusion during project planning	3.71	1.06	2
C1	Consideration during project initiation	3.57	1.11	3
C8	Influence on decisions throughout lifecycle	3.52	1.08	4
C4	Project-manager monitoring during construction	3.51	1.10	5=
C7	Client encouragement	3.51	1.11	5=
C5	Contractor compliance with specifications	3.45	1.09	7
C6	Evaluation during project completion	3.38	1.11	8
C10	Overall integration is satisfactory	3.35	1.10	9
C9	Energy efficiency as performance indicator	3.31	1.13	10

Note: Means and sample standard deviations were calculated from the frequency distributions in Table 2 (Very high = 5 to Very low = 1). The average of the ten item means is 3.51.

The ranking reinforces the pattern observed in the frequency distributions. Design-team integration ranked first (mean = 3.83), followed by project planning (3.71) and project initiation (3.57). The relatively high design score suggests that passive energy strategies are more visible in the technical design process. However, the lower scores for completion evaluation (3.38), overall satisfaction (3.35) and energy efficiency as a project performance indicator (3.31) indicate that the management systems for verifying and evaluating integration are less developed.

The difference between the highest and lowest item means is modest in absolute terms, and the analysis is descriptive. No inferential test was conducted to establish whether the mean differences between the individual indicators are statistically significant. The ranking should therefore be interpreted as an indication of the relative pattern in respondents' ratings, not as proof of statistically distinct performance between lifecycle stages.

4.3 Qualitative findings on current integration

The interviews with ten experienced professionals provided additional insight into the quantitative pattern. Five themes were identified in the dissertation's thematic analysis. They are summarised in Table 4.

Table 4. Themes on the current integration level of passive energy strategies.

Major theme	Sub-theme	Summary of interview evidence
Limited integration	Early planning and initiation gaps	Passive strategies are considered mainly where sustainability objectives are specifically requested.
Design-stage consideration	Architectural involvement	Passive strategies are most commonly introduced during architectural design.
Weak construction monitoring	Implementation challenges	Monitoring of passive design requirements during construction is limited.
Limited evaluation after completion	Performance assessment gaps	Post-construction assessment of passive energy performance is uncommon.
Growing sustainability awareness	Emerging adoption	Some organisations are showing greater interest, but commitment varies with client priorities, budgets and professional knowledge.

Note: Interview data (2026), as reported in the dissertation.

The qualitative responses back up those from the survey. Passive design strategies are most commonly integrated within the design phase. Those who were interviewed mentioned that passive design strategies were mostly integrated by architects when designing the project; however, they could be affected by cost and time pressures within the construction phase. "Often passive decisions are made within the design phase, however we can sometimes see them be affected by cost and time pressures within the construction phase" (Project Manager).

There was mention that commitment to integration within organisations depended on the client, budget and knowledge within the organisation. Overall, it seems that integration is not currently a standard practice within project management within all organisations. Instead, it may depend on the interest within the project and individuals being proactive. Passive energy objectives may need to be specifically requested.

4.4 Discussion of findings

This has shown that within Lagos there is an imbalance as to when passive design strategies are integrated within construction project management. The highest integration was identified within the design phase, whilst planning and initiation phases had relatively positive responses. Integration decreased within the monitoring phase, contractor compliance, evaluation and performance measurement. It appears that the passive design strategies are most likely to be acknowledged within the design phase.

This ties into the wider argument that sustainability objectives need to be identified within specific project management processes. Stanitsas et al. (2021) demonstrate that sustainability indicators can be relevant within construction project management. Phung et al. (2026) have highlighted that having set objectives, skilled teams, planning and evaluation can all be important. However, from the findings this has shown that within Lagos passive design strategies are more likely to be integrated within the design phase. This is not due to lack of knowledge but due to not being maintained within the system throughout the procurement and construction.

The relatively high integration within the design phase is supported by the design literature within Nigeria. Ochedi and Taki (2022) demonstrate that collaboration with stakeholders is important when designing energy efficient homes. Atiba and Chwieduk (2024) have demonstrated how building materials, window sizes, orientation and roof ventilation can be considered when designing homes for Lagos. However, the findings from this study show that the integration within the construction and completion phases are lower. This shows that just considering passive design strategies within the design phase will not be enough. Even if the design is climate responsive, the passive design strategies may not be addressed throughout the procurement, monitoring and handover processes.

The relatively low integration of energy efficiency can be important from a project management perspective. If energy efficiency is not included within the monitoring and evaluation criteria, then there may not be much structure in place to monitor if the passive design strategies have been achieved. The traditional project controls will still focus on cost, time and quality. This fits in with the idea that sustainability indicators need to be integrated within the project management (Stanitsas et al., 2021, Silvius and Schipper, 2014).

The interview responses have shown that the integration throughout the project lifecycle depends on the clients priorities, budget and knowledge. This fits in with the idea that knowledge, skilled professionals, policy and cooperation can all act as barriers for sustainable construction within Nigeria (Omopariola et al., 2024). It also fits in with the idea that decisions made during the design phase may not be as strong due to decisions made later on within the project. This can happen if information and responsibility isn't passed on throughout the organisation and life cycle (Checkland, 1999).

These findings shouldn't be seen to mean that passive design strategies are not being integrated within Lagos construction projects. They just show that they are partially integrated. The design phase, planning phase have higher integration than the project completion and performance. These findings also do not show that projects with higher integration will produce lower energy consumption. This would have to be looked at through auditing the project documents, simulating building performance or measuring energy consumption post occupation. This paper focuses on the management processes.

5 Conclusion and recommendations

5.1 Conclusion

This study looked at how well passive design strategies are currently being integrated within construction project management within Lagos, Nigeria. Through the data from 200 valid questionnaires, and 10 interviews with professionals with experience, it was found that there was some integration with passive design strategies but it wasn't evenly distributed throughout the project. The design team had the highest percentage of Very High/High responses (70.0%), followed by those

within project planning (65.0%) and project initiation (59.0%). The lowest responses were from those involved in monitoring during construction (56.0%), contractor compliance (53.0%), project completion (50.0%) and energy efficiency as a performance indicator (47.0%).

The average across the ten indicators was 3.51 out of 5. The qualitative responses backed up the quantitative responses, showing that passive design strategies are more likely to be considered during the design by the architect and not monitored systematically during construction, or evaluated during project completion. This study has concluded that passive design strategies are acknowledged and partially integrated within construction project management. However they are not consistently integrated throughout the project lifecycle.

From a project management perspective this shows that passive design strategies should not just be integrated during the design phase. They should be maintained throughout the project by ensuring they are included within project initiation, planning, design coordination, procurement, monitoring, completion and ensuring that the correct information is passed onto those involved. These findings show how passive design strategies are currently being integrated but does not prove energy savings.

5.2 Recommendations

1. The project brief should include passive energy objectives and identify what strategies should be considered.
2. Passive energy requirements should be included within project plans, cost plans, risk register, design reviews and quality management.
3. Passive energy features should be recorded clearly within the design by the designers. Design reviews should be done to ensure that the passive design strategies are technically suitable, cost effective, and can be constructed. This will ensure that they are considered during design.
4. Procurement documents should include passive design requirements. This should include details on materials, products and workmanship. Substitutions should be reviewed and approved to ensure they meet the performance requirements.
5. Passive design features should be included within monitoring during construction. This should include inspection points for shading, openings, ventilation, insulation and specification for the building envelope. This should be recorded.
6. Energy efficiency should be considered as a performance indicator. This should be defined by the project team early on and who is responsible for recording and reviewing.

5.3 Limitations and further research

This study was partially based on self-reporting from construction professionals and therefore may not accurately reflect real practices. It was a cross-sectional survey. This means that it was limited to Lagos Island and Lagos Mainland. Therefore, it cannot be assumed that the findings can be applied to other states in Nigeria or other building markets. There was also no systematic audit of project documents or measuring of energy consumption post occupation.

Further research should be done to look at project documents and see if passive design requirements are being maintained throughout the brief, design, procurement, monitoring and handover. Longitudinal studies and post occupation studies should be done to see if passive design strategies being integrated are resulting in better thermal comfort, lower cooling requirements and lower energy consumption. Comparing studies within different regions of Nigeria will help to understand how applicable the findings are within Lagos.

References

[1] Adegoke AS, Abidoye RB, Sunindijo RY (2026). Addressing the misalignment in stakeholder perceptions of retrofitting barriers: A reflection of Nigeria's residential building sector. *Energy and Buildings*, 359, Article 117335. https://doi.org/10.1016/j.enbuild.2026.117335

[2] Atiba E, Chwieduk D (2024). Design of a positive energy district: A Nigerian case study. *Renewable Energy*, 237, Article 121635. https://doi.org/10.1016/j.renene.2024.121635

[3] Checkland P (1999). Systems thinking, systems practice: Includes a 30-year retrospective. *John Wiley and Sons*.

[4] Dimuna KO, Ekhaese EN, Mercy O, Akinola A, Ndimako OO (2025). Enhancing thermal comfort in high-rise condominiums through passive design strategies in Lagos, Nigeria. *International Journal of Sustainable Development and Planning*, 20(5), 1797–1811. https://doi.org/10.18280/ijsdp.200501

[5] Ezema IC, Ajanaku PA, Fulani OA, Johnson OP, Eyo MU (2023). Use of passive cooling strategies in selected mega-churches within Lagos-Ogun megacity, Nigeria. *Civil Engineering and Architecture*, 11(6), 3789–3810. https://doi.org/10.13189/cea.2023.110640

[6] Fulani OA, James ME (2026). Assessment of predominant passive cooling strategies employed by architects in contemporary building designs in Lagos. *Civil Engineering and Architecture*, 14(3), 2001–2008. https://doi.org/10.13189/cea.2026.140341

[7] Gamero-Salinas J, Monge-Barrio A, Kishnani N, López-Fidalgo J, Sánchez-Ostiz A (2021). Passive cooling design strategies as adaptation measures for lowering the indoor overheating risk in tropical climates. *Energy and Buildings*, 252, Article 111417. https://doi.org/10.1016/j.enbuild.2021.111417

[8] Hu M, Zhang K, Nguyen Q, Tasdizen T (2023). The effects of passive design on indoor thermal comfort and energy savings for residential buildings in hot climates: A systematic review. *Urban Climate*, 49, Article 101466.

[9] Kerzner H (2022). Project management: A systems approach to planning, scheduling, and controlling (13th ed.). *Wiley*.

[10] Ochedi ET, Taki A (2022). A framework approach to the design of energy efficient residential buildings in Nigeria. *Energy and Built Environment*, 3(3), 384–397. https://doi.org/10.1016/j.enbenv.2021.07.001

[11] Ogochukwu EW, Ehisuoria EO (2025). Utilization of natural ventilation strategies for improving thermal comfort and energy efficiency in low-cost housing in Lagos State, Nigeria. *ABUAD Journal of Social and Management Sciences*, 6(1), 206–224. https://doi.org/10.53982/ajsms.2025.0601.12-j

[12] Omopariola ED, Olanrewaju OI, Albert I, Oke AE, Ibiyemi SB (2024). Sustainable construction in the Nigerian construction industry: Unsustainable practices, barriers and strategies. *Journal of Engineering, Design and Technology*, 22(4), 1158–1184. https://doi.org/10.1108/JEDT-11-2021-0639

[13] Phung QA, Erdogan B, Nielsen Y (2026). An integrated framework for managing sustainability in construction projects. *Built Environment Project and Asset Management*, 16(4), 701–721. https://doi.org/10.1108/BEPAM-01-2025-0022

[14] Rogers EM (2003). Diffusion of innovations (5th ed.). *Free Press*.

[15] Shokouhi M, Bachari MS (2025). An overview of the aspects of sustainability in project management. *Progress in Engineering Science*, 2(1), Article 100048. https://doi.org/10.1016/j.pes.2024.100048

[16] Silvius AJG, Schipper RPJ (2014). Sustainability in project management: A literature review and impact analysis. *Social Business*, 4(1), 63–96. https://doi.org/10.1362/204440814X13948909253866

[17] Stanitsas M, Kirytopoulos K, Leopoulos V (2021). Integrating sustainability indicators into project management: The case of construction industry. *Journal of Cleaner Production*, 279, Article 123774. https://doi.org/10.1016/j.jclepro.2020.123774

[18] United Nations Environment Programme (2022). 2022 global status report for buildings and construction: Towards a zero-emission, efficient and resilient buildings and construction sector. *UNEP*, Nairobi. https://wedocs.unep.org/handle/20.500.11822/41133.