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Rethinking The Building Performance Gap: A Multi-Perspective Stakeholder Analysis of Passive Cooling in Nigeria's Sahelian School Context

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Abstract- ***The gap between design intent and real thermal conditions in buildings is well-documented, but its institutional and stakeholder aspects in public-sector architecture in hot-dry regions remain unexplored. This study examines passive cooling in public schools in Nigeria's Sahelian zone, analysing published case studies from many perspectives. The study investigates the competing logics of architects, public works authorities, and school users using secondary analysis of 32 carefully chosen case studies. The performance gap is caused by competing stakeholder logics, including officials' cost- and schedule-driven decisions, security policies embedded in institutional rules, and professional norms that equate "modern" with concrete. Institutional theory explains how coercive (procurement rules), mimetic (industry imitation), and normative (professional expectations) influences work together to maintain this disparity. This study presents the Institutionally Mediated Thermal Performance (IMTP) paradigm, which combines adaptive comfort, performance gap, and institutional theories to explain how these influences consistently change design results and limit occupant adaption. The article presents a stakeholder-centered analytical approach for analysing building performance in Global South contexts. Policy recommendations include implementing interim thermal compliance checkpoints during construction and changing procurement criteria to incorporate life-cycle cost analysis.***

I. INTRODUCTION

Nigeria's Sahelian zone which includes Borno, Yobe, Jigawa, Katsina, and portions of Gombe has some of the most-harsh meteorological conditions in West Africa. The region has a hot semi-arid climate (Köppen classification BSh), which is characterised by intense solar radiation, very low humidity, and large diurnal temperature swings, with mean maximum temperatures frequently exceeding 38°C during the hot season and daily variations of up to 15°C. Climate change forecasts show that such high heat events will become more frequent, with hazardous heat days anticipated to quadruple by 2060, impacting all sectors of society (Dosio, 2017; Abdulkareem & Al Maiyah, 2025). These environmental challenges are exacerbated in public schools by the near-complete lack of mechanical cooling. Nigeria's power grid is famously unreliable: just 15% of metered customers receive up to 20 hours of daily supply, while more than 25% of homes do not have connection to the grid at all (Abdulkareem & Al Maiyah, 2025; NBS, 2020). In the Sahelian states, where grid coverage is even more low, most public schools do not have fans or air conditioning, leaving indoor settings totally dependent on the building's passive performance.

Consequently, classrooms become thermally uncomfortable. Field investigations in public elementary schools in Yobe and Borno found mean interior air temperatures of 35.38°C, mean radiant temperatures of 37.33°C, and relative humidity as low as 35.60% during school hours (Abdullah, Salisu, & Dahiru, 2023; Toyinbo, et al., 2019). Such situations jeopardise children's health and well-being while also substantially impeding learning results. Thermal discomfort, according to research, affects cognitive function, attention span, and school attendance, with long-term ramifications for educational achievement (Wargocki & Wyon, 2013; Teli et al., 2012). In Nigeria, where educational infrastructure is already under pressure, the extra cost of thermally unpleasant classrooms exacerbates existing disparities.

Architectural theory and climatic design have long provided clear principles for passive cooling in hot,

dry climates: building orientation to minimise east-west exposure, high thermal mass to dampen internal temperature fluctuations, external shading to block direct solar radiation, and carefully controlled natural ventilation to allow night flush cooling (Givoni, 1998; Santamouris & Kolokotsa, 2013). Traditional Hausa architecture in northern Nigeria exemplified these ideas with extraordinary elegance. Thick Tubali mud walls (typically 500-600 mm) supplied high thermal mass; steep roof eaves (Indororo) shielded walls from the hot sun; and inward-facing courtyards offered microclimatic buffers that cooled incoming air before it entered residential areas (Batagarawa & Baba, 2022; Dmochowski, 1990). These vernacular tactics were more than just aesthetic; they were finely honed adaptations to the Sahelian environment spanning generations, representing a type of indigenous wisdom that has been largely ignored in current architectural practice.

Despite this extensive local knowledge and the availability of current passive design approaches, contemporary public schools in the Sahel zone seldom meet their specified thermal performance. According to studies conducted in Nigerian residential structures, more than 75% of residents are unsatisfied with interior thermal conditions, with temperatures surpassing 30°C for 70-90% of the evaluation period (Abdulkareem & Al Maiyah, 2025; Agada, & Yakubu, 2022). Public schools, which are frequently built using low-bid procurement with no regard for thermal quality, are likely to have even worse conditions (Shwarka, & Anigbogu, 2012). The core concern of this study is the continual disparity between what designers want and what occupants actually experience, known as the building performance gap.

II. LITERATURE REVIEW

A growing corpus of research has created thermal comfort standards for Nigerian educational facilities. According to a comprehensive assessment by Abba, Abdul Majid, and Ahmed (2020), comfort temperature ranges from 24.88°C to 36.20°C across different building types, with educational institutions sitting in the middle to upper end of this spectrum. More recent field studies have employed adaptive comfort models to evaluate children's thermal preferences, indicating that over 68% of Sahelian pupils are unsatisfied with their thermal environment, with over two-thirds preferring colder circumstances (Abdullah, Salisu, & Dahiru, 2023). Post-occupancy evaluations of government buildings in Kwara State have similarly revealed moderate user satisfaction and considerable problems in ventilation and temperature management (Makinde et al., 2024; Nwankwo & Nwankwo, 2025). These studies give a quantitative baseline, but they typically ignore the root causes of low performance.

The building performance gap has been extensively examined in industrialised nations, with studies identifying variables such as design construction disconnects, occupant behaviour, and poor commissioning as important drivers (Bordass et al., 2001; Menezes et al., 2012). However, in emerging countries like Nigeria, the reasons of the difference may be quite different. Institutional issues, such as fragmented procurement procedures, lax enforcement of building rules, and a lack of post-occupancy feedback, may have a greater impact than technical design flaws (Shwarka, & Anigbogu, 2012; Oyedele, & Tham, 2005). Nonetheless, these institutional elements are underexplored. The voices of architects, public works officials, school administrators, teachers, and students are rarely combined in a single analysis to investigate the design reality gap the difference between what is designed and what is lived (Schiano Phan, 2012; Bordass et al., 2001).

Specifically, the following questions are substantially lacking from the extant literature: How do opposing priorities (thermal comfort vs. cost) impact procurement decisions? How can security regulations overrule night ventilation, a basic passive cooling strategy? Why is established vernacular knowledge routinely removed from current practice? What processes keep these patterns consistent between projects and across time? An assessment of Nigeria's National Building Code and Building Energy Efficiency Code indicates a clear missing of basic sustainable design criteria, as well as a lack of enforcement capability (Abdulkareem & Al Maiyah, 2025; Ogunsote & Prucnal Ogunsote, 2002). According to Rimamtanung, et al., (2023), more than 40% of construction experts are uninformed of energy efficiency rules, and even more do not follow

them. This indicates an institutional gap that has not been thoroughly examined. This study addresses the single, dominant gap by creating an Institutionally Mediated Thermal Performance (IMTP) framework that combines adaptive comfort theory, performance gap theory, and institutional theory to explain how conflicting stakeholder logics cause and maintain the performance gap.

This study uses a multi-perspective stakeholder analysis to investigate the link between design intent and thermal experience in public schools throughout Nigeria's Sahelian zone. The study uses secondary analysis of published case studies of Nigerian public schools, such as peer-reviewed publications, post-occupancy reviews, and recorded architectural assessments. These sources give detailed descriptions of design intent, procurement decisions, building techniques, maintenance limitations, and occupant experiences, making it possible to reconstruct stakeholder views without conducting direct research. This technique is particularly well adapted to the research issue because it allows for the integration of fragmented material from diverse settings into a cohesive analytical model while avoiding the logistical and security problems of primary fieldwork in the Sahel region.

This research contends that the performance disparity in Nigerian public schools is not largely technical, but rather institutionally created by competing stakeholder logics. It makes two contributions. First, it reframes the performance disparity as the result of institutional mediation rather than a simple difference between projected and actual performance. Second, it creates the Institutionally Mediated Thermal Performance (IMTP) framework, which combines adaptive comfort theory, performance gap theory, and institutional theory to construct a cohesive model. The framework contends that institutional logics coercive pressures (e.g., procurement laws that require lowest bid awards), mimetic pressures (e.g., industry imitation of low bid practices as the norm), and normative pressures (e.g., professional expectations that prioritise project completion over performance) mediate the translation of design intent into built reality and shape the adaptive opportunities available to occupants. These forces do not work in isolation; rather, they reinforce one another, resulting in a self-sustaining equilibrium that maintains the performance disparity between projects and across time.

By focusing on the various logics of architects, public works officials, school administrators, and users, the study goes beyond physical performance measures to discover the social, institutional, and cultural processes that affect thermal results. The core study issue is: How do proposed passive cooling measures compare to thermal experiences of occupants in public schools in Nigeria's Sahelian zone, and what institutional and professional variables contribute to any differences?

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III. METHODOLOGY

A qualitative interpretative method was used, with the premise that thermal comfort is socially and culturally influenced (Creswell & Poth, 2018). The study is based on three theoretical frameworks: the adaptive thermal comfort model (de Dear & Brager, 1998; Nicol & Humphreys, 2002), building performance gap theory (Bordass et al., 2001; Menezes et al., 2012), and institutional theory. These are included in the Institutionally Mediated Thermal Performance (IMTP) concept, in which institutional logics (procurement regulations, security policies, and professional standards) mediate design implementation and adaptive opportunities, resulting in a performance gap.

The study relies only on published case studies of Nigerian public schools in the Sahel zone. A purposeful selection was made to locate sources that give comprehensive, multi-stakeholder evidence on passive cooling. Sources included peer-reviewed publications, post-occupancy evaluation reports, and architectural evaluations found in academic databases (Scopus, Google Scholar, African publications Online). The selection prioritised studies that provided firsthand descriptions of design intent, procurement procedures, building practices, maintenance restrictions, or occupant thermal experiences in Yobe, Borno, Jigawa, and Katsina states. After analysing the literature, 32 case studies were chosen to reflect the viewpoints of architects, public works officials, school administrators, and users. Thermal comfort research (Abdullah, Salisu, &

Dahiru, 2023; Toyinbo, et al., 2019; Agada, & Yakubu, 2022), post occupancy assessments (Makinde et al., 2024; Nwankwo & Nwankwo, 2025; Shwarka, & Anigbogu, 2012), and vernacular architecture studies (Batagarawa & Baba, 2022; Oyedele, & Tham, 2005) are important sources.

Braun and Clarke (2006) developed a theme analysis paradigm for data analysis. Case studies were manually categorised based on stakeholder viewpoints, including architects' design intents and specifications, public works officials' procurement rationale and oversight, school administrators' operations and security, and users' thermal experiences and adjustments. The IMTP framework directed the grouping of codes into four themes, as seen in the findings. Triangulation among sources, an audit trail, and explicit connection of conclusions to source documents all helped to assure trustworthiness. A reflective notebook and the careful inclusion of counter-narratives helped to preserve reflexivity.

IV. RESULTS AND DISCUSSION

Theme 1: Design Dilution – Where Intent Meets Institutional Constraints

Case studies show that architects' design intents include deep roof overhangs (≥1.2 m), thick brick walls (300 mm), and courtyard layouts for natural ventilation (Agada, & Yakubu, 2022; Shwarka, & Anigbogu, 2012). However, post-construction reviews revealed regular changes: contractors replaced smaller blocks (225 mm) and lowered overhangs (to as little as 600 mm), with ministry clearance claiming cost limitations (Shwarka, & Anigbogu, 2012). "Architects reported" that these adjustments were made without thermal evaluation, but "public works authorities" justified them as required to keep on budget. The National Building Code (2006) does not include any mandatory thermal performance standards for school buildings; Section 3.2 on "Environmental Planning" simply states that "buildings should be designed to ensure adequate ventilation," but does not specify shading, thermal mass, or orientation. This regulatory gap makes specifications susceptible to replacement at any point. This disagreement highlights how procurement regulations requiring lowest-bid wins might overrule design intent. Architects' understanding of passive cooling is rendered worthless when officials, under pressure to reduce cost overruns and delays, allow substitutes without doing any thermal analysis. The lack of enforced code standards eliminates any counter-pressure. The procurement system prioritises short-term savings above long-term performance by not requiring life-cycle cost analysis. Officials interviewed for the case studies said that they rarely address thermal outcomes since they are not assessed; their performance criteria are project completion and budget adherence.

This conclusion is consistent with the worldwide performance gap research (Bordass et al., 2001), which highlights design-construction disconnects as a major factor. However, according to this study, the gap is the result of institutionally established conflicts of interest, rather than a technological blunder. In contrast to the UK, where post-occupancy evaluation is more institutionalised and architects have more supervision, Nigerian officials lack accountability for thermal results. The UK's Building Research Establishment Environmental Assessment Method (BREEAM) and required POE for public buildings establish feedback mechanisms that Nigeria lacks. This comparison demonstrates that the disparity is not unavoidable, but is exacerbated by the lack of accountability measures.

Procurement policies that prioritise technical expertise over cost might narrow this disparity. To align incentives, consider requiring at least 30% technical expertise in bid review and demanding life-cycle cost analysis for projects over ₦100 million. Reforms that prioritise long-term success above initial capital spending may affect officials' decision-making.

Theme 2: Thermal Experience – Adaptive Capacity Constrained by Institutional Rules

Post-occupancy studies show an average interior air temperature of 35.38°C and a 68.86% occupant dissatisfaction rating (Abdullah, Salisu & Dahiru, 2023). Teachers and students describe oppressive circumstances, and remedies include going to shaded outside areas, employing cardboard fans, and situating on the cooler side of the classroom (Toyinbo, et al., 2019). However, building design

rusted, inoperable windows and institutional rules windows closed overnight to avoid theft often limit changes (Makinde et al., 2024). Principals said that security considerations take precedence over ventilation needs, and that they have no ability to change security measures. One school was an outlier: a newer building with reinforced grilles enabled windows to stay open at night, indicating that design may balance opposing needs (Shwarka, & Anigbogu, 2012).

Users' adaptive behaviours are consistent with the adaptive comfort paradigm, which states that occupants tolerate broader temperature variations when they have control over their surroundings (de Dear & Brager, 1998). However, normative pressures security rules that prioritise property protection prevent nocturnal ventilation, a basic passive cooling approach. This demonstrates that the model's premise of user control is inappropriate in situations where institutional constraints routinely limit adaptability. Even when users are willing to adapt, they lack the authority to change the building's functioning. This conclusion calls into question a restricted view of adaptive comfort theory, implying that it has to be expanded to account for institutional restrictions beyond the power of individual inhabitants.

International study highlights the importance of human control in adapting comfort (Janda, 2011; Indraganti, 2010). However, Nigerian security concerns outweigh adaptive potential, a context-specific obstacle that is rarely addressed in Western research. In industrialised nations, security is often controlled via alternative methods (e.g., monitoring, alarm systems) that do not necessitate window sealing. The Nigerian example highlights an often-overlooked trade-off between thermal comfort and physical security. This conclusion implies that adaptive comfort models created in save situations may not be readily applicable to settings where security concerns predominate.

Secure night-ventilation alternatives (e.g., strengthened grilles) and shaded outdoor places might encourage adaptive behaviour within institutional limits. Maintenance methods should verify that the windows are operational. Security regulations might be re-evaluated to provide regulated ventilation without sacrificing safety. The unique situation of grilles demonstrates that such solutions exist; their absence elsewhere indicates a failure to promote thermal comfort in design standards.

Theme 3: Systemic Institutional Barriers – Self-Reinforcing Equilibrium

According to Shwarka, & Anigbogu, (2012) and Agada, & Yakubu, (2022), architects complain about their lack of control over procurement and construction, while authorities acknowledge to inadequate oversight. Principals also cite a lack of post-occupancy review. Procurement standards award contracts nearly completely based on price, with no independent quality evaluation. Some administrators argue that this is important given severe budget limitations and the priority of increasing school access (Shwarka, & Anigbogu, 2012). Notably, even when architects attempt informal monitoring, they are ignored until ministry officials are present a strong indication that professional authority is subject to administrative hierarchies.

According to institutional theory, persistence is explained by a combination of pressures: normative pressures, which place a higher value on project completion than performance, shape professional expectations; coercive pressures, such as procurement laws, force lowest-bid decisions; and mimetic pressures, which cause industry actors to imitate this practice, assuming it is the accepted norm. In a self-sustaining cycle, these stresses reinforce one another. When a new official enters the system, for instance, they notice that lowest-bid is the established practice (mimetic), internalise it as normal (normative), and implement it without challenging the original legislation (coercive). There is no way to upset this balance by proving that cost-cutting causes long-term performance problems in the absence of POE.

Post-occupancy assessment may bridge the gap by fostering responsibility and feedback, according to international best practices (Bordass & Leaman, 2007; Nwankwo & Nwankwo, 2025). Iterative changes in design rules have resulted from the UK's mandated POE for government buildings. Nigeria, on the other hand, does not have this kind of feedback

system. Research from Ghana and Kenya also shows that fragmented procurement is a quality hurdle (Agyekum et al., 2023), indicating that this institutional structure could be common in the area.

In order to close the gap, concurrent changes must upset this balance. These include changing procurement regulations to incorporate quality standards, requiring POE to establish feedback mechanisms, and educating experts to prioritise performance above completion. The equilibrium would be maintained by the other pressures, therefore a single intervention (such as changing procurement regulations alone) would be inadequate. Reform needs to take into account all three aspects.

Theme 4: The Vernacular Alternative – Excluded by Institutionalised Norms

Thick Tubali walls (500–600 mm), steep eaves, and courtyard designs that offer exceptional comfort are characteristics of traditional Hausa architecture (Batagarawa & Baba, 2022; Dmochowski, 1990). However, case studies reveal that modern schools do not employ vernacular solutions; instead, conventional concrete block construction is required with no thermal performance goals (Oyedele, & Tham, 2005). Due to customer preferences for contemporary materials and durability concerns, architects rarely propose earth construction while acknowledging the thermal advantages (Oyedele, & Tham, 2005). Stabilised earth blocks are essentially not taken into account because procurement criteria only identify conventional materials. "I have utilised stabilised earth blocks in a few community projects, but gaining clearance for a public school would be practically impossible the procurement lists do not contain them," an architect pointed out as a partial exception (Oyedele, & Tham, 2005).

The omission reflects normative constraints that prioritise concrete as "modern" while stigmatising earth as "backward," a legacy of colonial architecture education that disregarded indigenous knowledge (Fry & Drew, 1964). Coercive hurdles reinforce these normative views: the National Building Code makes no mention of earth building, and procurement rules only identify traditional materials, making it impossible to propose alternatives. The two pressures interact: the coercive lack of code rules strengthens the normative perception that earth is "unofficial," and mimetic imitation of specific behaviours across projects normalises exclusion. As a result, even when architects realise the thermal benefits, the institutional structure limits their options.

According to Meuser and Dalbai (2021), traditional architecture in Sub-Saharan Africa is becoming more climate-smart. Countries such as Burkina Faso and Senegal have begun to include modernised earth construction into public building projects. Nigeria's construction codes overlook this, indicating a serious policy vacuum. Recent pilot projects using stabilised earth blocks show promise (Banjo, et al., 2025), indicating that contemporary methods may attain concrete-like strength while providing greater thermal performance. These initiatives, however, remain marginal since they do not adhere to mainstream procurement and professional standards.

Revitalising vernacular strategies necessitates challenging professional norms through education and advocacy, updating building codes (for example, including a section on stabilised earth construction with thermal performance standards), and investing in demonstration projects and training for masons and contractors. Without institutional backing, knowledge will remain underutilised, and a proven remedy to the performance gap will be unavailable.

Cross-Theme Synthesis: A Causal Model

The four themes constitute a causal chain, explaining why the performance difference persists. Theme 3 (institutional constraints) sets the stage for Theme 1 (design dilution): coercive procurement regulations force cost cuts, and fragmented delivery undermines accountability. This dilution immediately affects buildings' adaptive ability, as seen in Theme 2: architectural concessions (thin walls, short overhangs) combine with security regulations to prohibit night ventilation, transforming design inadequacies into experienced discomfort. Meanwhile, Theme 4 (denial of vernacular alternatives) eliminates a corrective feedback loop: the same institutional standards ban the information and materials that may help close the gap. Thus, the performance disparity is not a linear failure, but rather a self-reinforcing institutional structure. Intervening at a single point (for example, just changing building standards) may be inadequate;

change must address the interrelated factors that maintain the equilibrium. The IMTP framework lays forth a plan for such systemic intervention by defining the distinct processes (coercive, mimetic, and normative) that operate at each level.

V. CONCLUSION

This qualitative research aimed to "rethink" the building performance gap in passive cooling for public schools in Nigeria's Sahelian region. The study indicates that the performance difference is not largely a lack of design expertise, but rather the result of institutionally induced conflicts between stakeholder logics. Architects strive for thermal comfort but lack authority; bureaucrats prioritise cost and time; users adapt but are limited by security regulations; and professional standards reject traditional knowledge. These institutional forces systematically alter design intent and limit adaptive capability, resulting in a gap that endures across generations of infrastructure.

Theoretical Contribution

This paper presents the Institutionally Mediated Thermal Performance (IMTP) paradigm, which combines adaptive comfort theory, performance gap theory, and institutional theory into a single model. It demonstrates that the adaptive comfort model's premise of user control is insufficient in situations when institutional security policies supersede individual agency. The performance gap hypothesis is expanded by proving that the gap is not a deviation but rather the result of institutional mediation. Institutional theory explains how coercive, mimetic, and normative forces combine to form a self-reinforcing equilibrium. The IMTP framework offers a stakeholder-centered analytical tool for measuring building performance in Global South environments.

Implications for Policy and Practice

Based on the causal model, the following acts may be considered:

- Add 30% weight to technical expertise in bid review and demand life cycle cost analysis for projects over ₦100 million to mitigate coercive pressures (Theme 1).
- Implement thermal compliance checkpoints during construction, such as obligatory inspections of overhang depth and wall thickness before plastering, to prevent substitutes (Theme 1).
- Require post-occupancy review for all public-school projects, publicise findings, and change design rules to disrupt the self-reinforcing equilibrium (Theme 3).
- Add minimum thermal transmittance (U value) criteria and a section on stabilised earth construction with technical standards (Theme 4).
- Demonstrate current vernacular techniques and teach masons and contractors to fight normative exclusion (Theme 4).

These findings may be applicable outside Nigeria, particularly in other hot, dry regions of Sub-Saharan Africa and the Sahel, where comparable institutional restrictions drive public sector building.

VI. LIMITATIONS AND FUTURE RESEARCH

This study is based on secondary analysis of published case studies and does not contain original fieldwork. The current case studies may not cover all variables in the Sahelian zone, and analysis is dependent on the quality of published sources. The researcher's positionality (as an architect) may have affected theme identification, although this was minimised by reflexive techniques. Future study should broaden its geographical coverage, include primary qualitative fieldwork, and assess the influence of improved procurement methods on building performance. Longitudinal studies that monitor the performance of passive features over time might also be useful

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