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EVALUATION OF NATURAL COOLING STRATEGIES OF FACULTY BUILDINGS IN NIGERIA: THE CASE FOR SUSTAINABLE FACULTY OF ARCHITECTURE

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ABSTRACT
This paper addresses the critical role of sustainable design in promoting energy efficiency in educational structures, with a specific focus on faculty buildings. Given the challenges posed by high energy consumption in these buildings, driven by factors such as energy-intensive equipment and extended operational hours, the study investigates users' perceptions of the efficiency of natural cooling strategies in Nigerian faculty buildings. Acknowledging the intricate relationship between thermal comfort and sustainable design, the research employs a quantitative approach, gathering insights from both staff and students through distributed questionnaires in two Nigerian universities. The robust 82% response rate from 328 returned surveys, coupled with secondary data, reveals the significance of design elements like tree shade, window placement, and functional corridors in establishing sustainable and comfortable learning environments. The study identifies variations in the effectiveness of natural cooling strategies, emphasizing the necessity for customized solutions. Thermal buffers

Introduction
In the modern world, the increasing energy demands in buildings, particularly for heating and cooling, have emerged as a pressing global concern (Aflaki *et al.,* 2012). Buildings play a significant role in the overall energy consumption, contributing to 48% of the total energy usage, with 40% attributed to operational phases (Maleki, 2011; Yang *et al.,* 2014). This surge is primarily fuelled by the widespread adoption of Heating, Ventilation, and Air Conditioning (HVAC) systems to meet the growing needs for indoor thermal comfort. Unfortunately, the reliance on traditional mechanical cooling systems, often powered by non-renewable energy sources, intensifies carbon dioxide emissions, thereby aggravating challenges associated with climate change.

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and strategic site planning are notably found to contribute to reducing energy consumption and enhancing indoor comfort in faculty buildings. The research advocates for tailored, context-specific sustainable building designs to address environmental concerns and promote healthier indoor environments in faculty buildings. It recommended continued exploration of natural cooling strategies in future studies for advancing energy-efficient and comfortable design of faculty buildings.

Keywords: educational buildings, energy efficiency, natural cooling strategies, sustainable faculty buildings, user perception.

Buildings, responsible for approximately 33% of annual CO2 emissions, contribute significantly to environmental degradation (Tormenta, 1999). In developing nations, the substantial dependence on fossil energy poses significant challenges, necessitating a paradigm shift towards sustainable and energy-efficient architectural design.

Faculty buildings are crucial spaces for education and research which must harmonize functionality with environmental responsibility. However, the prevalent use of energy-intensive mechanical systems, as highlighted by the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) (2013), presents sustainability challenges compared to more eco-friendly alternatives, such as the natural cooling approach. Natural cooling, as conceptualized by Cook (1989), involves strategically mitigating outdoor heat and channelling indoor heat to natural sinks through passive elements like natural ventilation, thermal mass, and shading. These strategies prioritize energy efficiency and occupants' thermal comfort through sustainable design, aiming to minimize reliance on artificial cooling methods. Currently, most faculty buildings heavily depend on energy-intensive mechanical cooling systems for their design and operation. This overreliance not only amplifies energy consumption and operational costs but add to environmental concerns and potential discomfort for faculty building users.

To address this challenge, this paper seeks to explore users' perceptions of the effectiveness of natural cooling strategies in faculty buildings in Nigeria. Acknowledging the crucial interplay between thermal comfort and sustainable design, the research aims to gather valuable insights from faculty building users, including both staff and students. By comprehending their experiences with the variables of natural cooling strategies, the study would contribute to the development of sustainable design practices that prioritize both environmental responsibility and the well-being of building users.

THEORETICAL FRAMEWORK

Theoretical Concept in Cooling Buildings

The concept of natural cooling is an extensively studied topic in sustainable architecture and building design, with researchers examining its effectiveness in achieving thermal comfort and energy efficiency, especially in high-demand tropical climates (Aflaki *et al.,* 2012). Natural cooling strategies, crucial in contemporary architectural practices, are evaluated for their potential to reduce energy consumption and address the impacts of climate change (Freewan, 2019). Freewan (2019) emphasizes that natural cooling harnesses nature's power to achieve thermal comfort without heavy reliance on mechanical or electrical cooling systems, aligning with the principle of harmonizing with nature for sustainable living or working spaces. The effectiveness of natural cooling relies on the interaction between a building's design and components with environmental factors such as sunlight, ambient air temperature, wind, and humidity. The goal is to achieve an energy equilibrium for occupants by reducing heat gain in the building and promoting the removal of excess heat, particularly in hot climates (Kamal, 2012). This approach highlights the importance of integrating sustainable and energy-efficient design principles into architectural practices.

Natural cooling strategies encompass a range of design and architectural techniques that leverage the surrounding environment's natural elements to regulate indoor temperatures, creating comfortable living or working spaces with minimal reliance on mechanical or electrical cooling systems. The efficacy of these strategies depends on the presence of a heat sink with a lower temperature than indoor air and the facilitation of heat transfer towards the heat sink. Holtz (2001) outlines various natural cooling strategies, such as building orientation, form, natural ventilation, shading devices, landscaping, and their applications. Marin (2007) further identifies five core principles of natural cooling tailored for humid/hot-dry climates, including natural ventilation, shading devices, building orientation, interior shading, thermal mass/insulation, and materials/construction techniques.

Natural Ventilation

Natural ventilation, defined by Etheridge (2015), involves utilizing air movement through a building's openings and internal spaces, leveraging natural forces like wind and buoyancy to regulate indoor temperatures and enhance air quality, particularly beneficial in tropical climates. Wang *et al*. (2007) found that natural ventilation offers substantial advantages over artificial cooling techniques, including other passive design strategies, particularly in tropical climates. Kleiven's (2003) study on wind-driven ventilation reveals positive and negative pressures on buildings, creating airflow through strategically placed openings. However, enhancing efficiency involves incorporating wind catchers, towers, or purposefully designed vents (Elwan *et al.,* 2018).

Kleiven (2003) categorizes wind-driven ventilation into two classes: Single-sided Ventilation, where air enters and exits on one side, and Cross Ventilation, where air circulates between two sides of a building. Thermal buoyancy-driven ventilation, as explained by Kleiven (2003), occurs when temperature differences create density disparities, facilitating air movement through strategically positioned openings, known as the stack effect. Efficiency is maximized when implemented over approximately five times the height between the floor and ceiling. The interplay of forces is crucial in combining Thermal Buoyancy and Wind-Driven Ventilation (Kleiven, 2003). Thermal buoyancy prevails in calm, frigid conditions, while wind-induced pressure differentials dominate on hot, windy days. The efficiency of this interplay depends on the positioning of inlet and outlet openings relative to the wind direction. In conclusion, understanding and combining these natural ventilation strategies can optimize airflow, contributing to energy-efficient and sustainable building design.

Shading Devices in Buildings

Solar radiation significantly affects visual and thermal comfort in buildings, with shading defined by Maleki (2011) as the deliberate placement of architectural elements to control sunlight, reducing solar heat gain and glare. Acting as a primary natural cooling method, shading is likened to wearing a protective hat. Maleki (2011) emphasizes the goal of enhancing indoor thermal comfort and reducing reliance on artificial cooling. Additionally, effective sun control and shading devices, integrated or separate, can substantially decrease peak heat gain, reduce cooling demands, and enhance natural lighting quality (Maleki, 2011). Hashemi (2019) highlights the efficiency of external shading, proving to be around 30% more effective in minimizing solar heat gain than internal shading. Various shading techniques, such as overhangs, louvers, awnings, and vegetation, are strategically incorporated into building designs to regulate direct sunlight, as outlined by Maleki (2011). Hashemi (2019) recommends horizontal external shading for south- and north-facing windows and vertical shading for east- and west-facing windows. While external shading is effective, Cellai *et al.* (2014) note its higher cost compared to internal shading.

External shading devices, including overhangs, louvers, and awnings, are engineered to mitigate solar heat gain and glare. Overhangs effectively block direct sunlight, louvers enable airflow and light control, and awnings, often made of durable materials, provide extensive shading without additional support (Nisar *et al.,* 2017; Maleki, 2011). Shading through trees and vegetation emerges as a potent strategy for energy conservation and thermal comfort in buildings. Krishan *et al.* (2001) emphasize the importance of proper landscaping, taking into account the building facade's orientation for effective natural treatment. Gut and Ackerknecht (1993) underscore roof shading, particularly through green roofs, as a noteworthy method for passive cooling in building design. Green roofs, categorized as extensive and intensive, offer sustainable approaches to enhance thermal performance. Succulents and moss, favoured for extensive roofs, contribute to sustainable and ecologically advantageous systems. In contrast, intensive green roofs support outdoor gardens and food production, demanding higher maintenance and structural requirements (Jamie, 2006).

Building Orientation

The absorption of radiation by a building is significantly influenced by its orientation and shape, with these factors playing a crucial role in the overall design. Nisar et al. (2017) highlight the importance of orientation, particularly with solar radiation and wind impact. The orientation of a building is a deliberate arrangement of its fundamental elements, including windows, walls, and roofs, with the primary objective of ensuring thermal comfort by protecting the structure against excessive heat (Nisar et al., 2017). Building orientation goes beyond mere placement; it involves a thoughtful and intentional configuration that considers the local climate and prevailing wind patterns. Akande (2010) emphasizes that properly oriented buildings can effectively harness solar radiation and take advantage of prevailing winds, contributing to a more sustainable and energy-efficient design. This strategic alignment is essential for

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optimizing natural cooling mechanisms within the building, thereby minimizing the reliance on energy-intensive mechanical cooling systems.

Thermal Comfort and Sustainability

Indoor thermal comfort is a pivotal factor influencing occupants' well-being and satisfaction within a building, ultimately impacting productivity (Frontczak and Wargocki, 2011). ASHRAE (2013) defines thermal comfort as a mental state influenced by physical, physiological, psychological, and environmental factors, highlighting the integral role of sustainability in fostering optimal indoor environments (Lin *et al.,* 2015). Moreover, passive design, a cornerstone of sustainable architecture, relies on natural energy flow without extensive use of electrical devices to achieve thermal comfort, especially in hot climates (Kamal, 2012). However, this sustainable approach emphasizes harmonizing with the environment, minimizing energy consumption, and reducing the carbon footprint associated with mechanical cooling systems. The Health and Safety Executive (HSE, 2012) classifies factors impacting thermal comfort into environmental and personal aspects, aligning with sustainable building principles. Environmental factors encompass air temperature, radiant temperature, air velocity, and air humidity. Sustainable temperature regulation methods are emphasized to minimize energy usage, including strategies like reflective surfaces to reduce reliance on energy-intensive cooling systems. Personal factors include work rate/metabolic heat and clothing, highlighting the importance of sustainable solutions to manage increased heat production and the significance of sustainable material choices and adaptive clothing design in promoting thermal comfort. These considerations not only contribute to individual well-being but also align with sustainability principles in building practices, recognizing the interconnectedness of environmental and personal aspects (HSE, 2012).

RESEARCH METHODOLOGY

The research adopted a quantitative approach to investigate users' perceptions of the sustainability of natural cooling strategies in faculty buildings in Nigeria. The study focused on crucial variables such as site selection, building design, shading devices, incorporation of green elements, integration of thermal buffers, and promotion of natural ventilation. The primary research instrument was a well-designed survey distributed to 400 participants across two Nigerian universities. These universities include Federal University of Technology Minna (200 questionnaires), and University of Lagos (200 Questionnaires). Of the 400 questionnaires distributed, 328 were retrieved and analysed appropriately amounting to 82% of the entire questionnaire distributed. To ensure the reliability and credibility of the survey, a validity assessment was conducted using Cronbach's Alpha, producing a commendable reliability coefficient of 0.852, indicating high internal consistency among survey items. The Relative Importance Index (RII) method was employed to rank the significance of various natural cooling strategies, revealing thermal buffers as the predominant strategy for achieving sustainability and comfort within faculty buildings. For a comprehensive analysis of the collected data, the researchers utilized the Statistical Package for the Social Sciences (SPSS) software. The data received is presented thus.

RESULTS, FINDINGS AND DISCUSSION

Background Information of Respondents

Table 1 presents the background information of respondents in the study, revealing that 75.9% are male and 24.1% are female. Additionally, 36.3% are 300L students, 28% are 500L students, and 12.8% are 200L students, with the rest comprising various academic positions. This information is crucial, as it suggests diverse perspectives, ensuring precise insights aligned with research objectives based on participants' unique backgrounds and substantial experience within their respective categories, enhancing the study's credibility.

Table 1: Background information of respondents

Variable	Frequency	Percentage (%)
Gender		
Male	249	75.9
Female	79	24.1
Category		
100L	3	0.9
200L	42	12.8
300L	119	36.3
500L	92	28.0
Masters L	39	11.9

Graduate Assistant	2	0.6
Lecturer 1	21	6.4
Senior Lecturer	4	1.2
Professor	6	1.8

Natural Cooling Strategies Adopted in Faculty Buildings

Table 2 presents survey respondents' perspectives on natural cooling strategies. Results show a consensus on key design elements, including the significance of tree shade (15.70%), windows on opposing sides (13.76%), green elements like shrubs (11.70%), open spaces (16.78%), and functional corridors (11.47%). However, limited agreement exists on roof shading (2.63%) and indoor plants (1.77%). Attributes with minimal support include double-skin facades (0.074%), cool roofs (0.040%), and natural materials like wood and clay (0.023%). Notably, green roofs, water elements, and operable skylights received no support in the survey.

Table 2: Natural cooling strategies adopted in faculty buildings

Variable	Frequency	Percentage (%)
Roof shading	46	2.63
Double skin facade	13	0.074
Corridors (buffer space)	201	11.47
Vertical shading	122	6.96
Horizontal shading	102	5.82
Egg-crate shading	96	5.48
Open spaces such as courtyards or atrium	294	16.78
Operable skylights	0	0
High-level windows	115	6.56
Windows on opposing sides of the building	241	13.76
Water elements such as fountains, pools, or ponds	0	0
Indoor plants	31	1.77
Tree shade	275	15.70
Green elements such as shrubs	205	11.70
Green roof (plants or vegetation on the roof)	0	0

Natural materials such as wood and clay	4	0.023
Cool roof (roof designed to reflect sunlight and heat)	7	0.040
Total sum	1752	

Effectiveness of Natural Cooling Strategies Employed in Faculty Buildings

Site selection and planning

Figure 1 illustrates varied perspectives on the effectiveness of natural cooling strategies in faculty buildings based on survey responses. Site selection and planning received mixed opinions, with 29% considering it effective, 18% strongly so, 25% moderately, 17.7% less, and 10% entirely ineffective. Soft landscaping, particularly shading trees, garnered more support, with 38.7% deeming it effective. This agrees with Holtz (2001), who stated that the presence of green plants in the building's vicinity, which absorbs solar radiation, leads to a decrease in the ambient temperature near walls by approximately 2 to 3 degrees Celsius. However, opinions on permeable pavements were largely negative, with 43% disagreeing. These findings highlight a diversity of opinions, suggesting factors like local climate, building design, and specific implementation may influence perceptions of natural cooling strategy effectiveness.

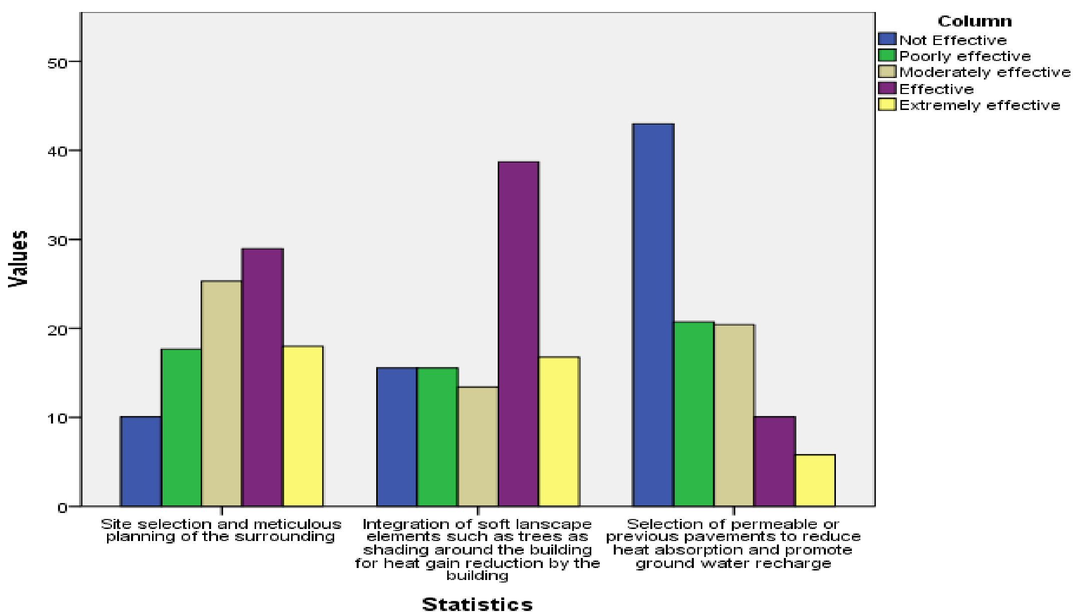

Figure 1: Site selection and planning

Building design and orientation

In Figure 2, 27.7% of respondents view optimizing building orientation for air circulation in faculty buildings as effective for natural cooling. Among them, 11.0% find it extremely effective, 22.3% moderately effective, 16.2% poorly effective, and 22.9% not effective. This finding agree with Nisar *et al*. (2017), who stated that orientation plays a crucial role in design, particularly concerning solar radiation and wind, as it influences and establishes thermal comfort inside a building by safeguarding it against excessive heat. Furthermore, this agrees with Akande (2010), who emphasized that properly oriented buildings can effectively harness solar radiation and take advantage of prevailing winds, contributing to a more sustainable and energy-efficient design. Additionally, 27.1% believe considering window types to reduce solar heat gain is effective, with 9.5% finding it extremely effective. However, 38% think selecting roof materials for energy efficiency in faculty buildings is not effective, and 15.5% find high ceilings for air circulation ineffective. These insights shed light on varying perceptions regarding strategies for natural cooling in educational structures.

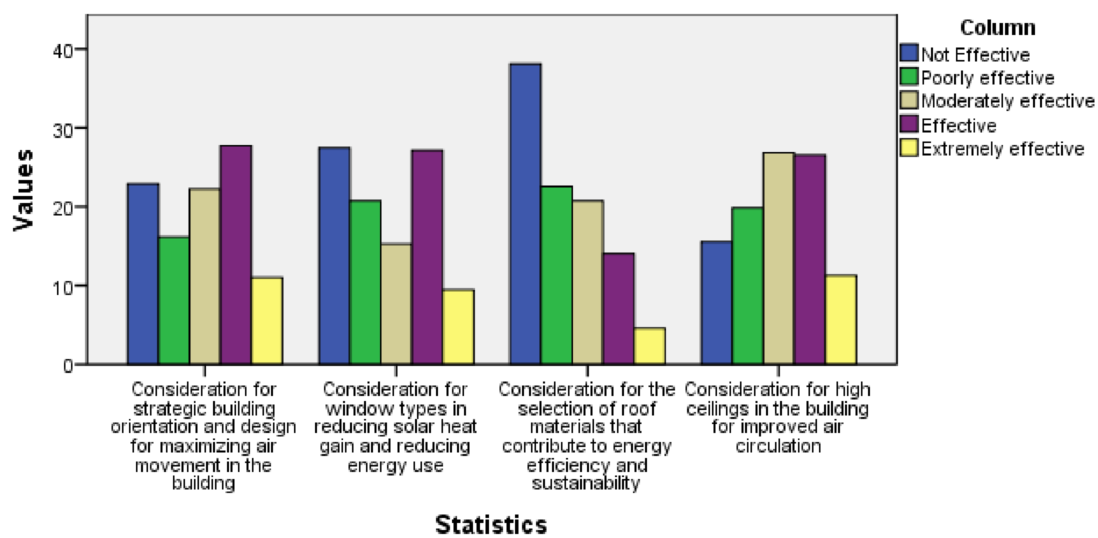

Figure 2: Building design and orientation

Survey respondents shared diverse views on the efficacy of natural cooling strategies in faculty buildings, revealing varying opinions on each method's effectiveness. The study indicates notable consensus on optimizing building orientation and window selection for natural cooling. However, opinions differ on strategies like roof material selection and high ceilings, with disbelief expressed by a significant portion of respondents.

Shading devices and solar control

In Figure 3, respondents' perceptions of natural cooling strategies in faculty buildings are detailed. Vertical shading (fins) was considered effective by 26.8%, with 11% rating it extremely effective. Horizontal shading (ledges) was deemed effective by 24.7%, with 10.7% finding it extremely effective. These findings agrees with Maleki (2011), who stated that effective sun control and shading devices, whether integrated into the building's structure or placed separately from the facade, have the potential to substantially decrease peak heat gain, reduce cooling demands, and enhance the quality of natural lighting within building interiors.

An egg-crate shading device was not seen as effective by 31.4%, while green features (trees) were perceived as effective by 38.7%. Overall, diverse opinions exist on the effectiveness of these strategies for solar control in faculty buildings. However, these findings provide insight into how different natural cooling strategies are perceived by the respondents. It's important to note that these perceptions can be influenced by various factors, including the specific context of the faculty buildings, the local climate, and individual preferences. The results may guide future decisions regarding which natural cooling strategies to prioritize in faculty building design or retrofitting based on their perceived effectiveness

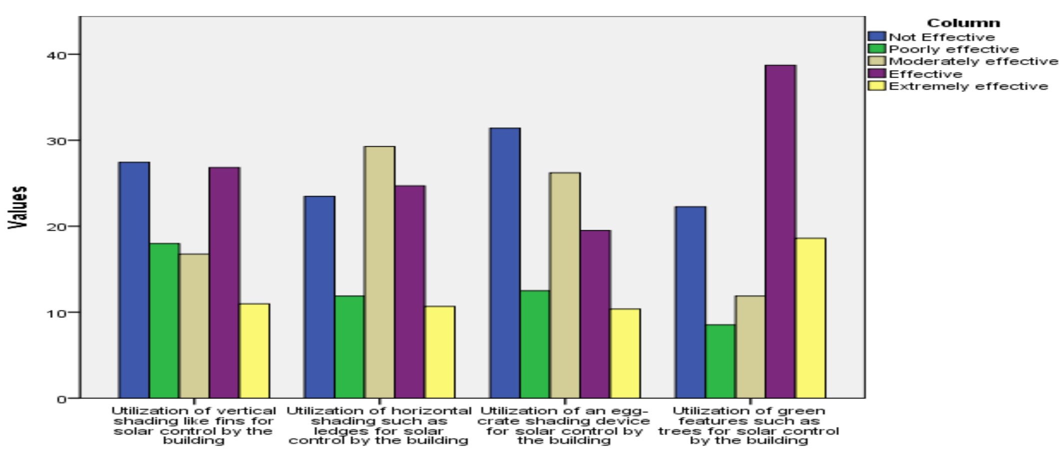

Figure 3: Shading devices and solar control

Green elements and water features

Survey results in Figure 4 reveal varied opinions on natural cooling strategies in faculty buildings. About 14.9% find indoor plants effective, with 6.1% rating it extremely effective. Green elements like trees are supported by 43.6%, with 12.8% deeming them extremely effective. This agrees with Krishan *et al.* (2001), who said that Landscape consideration is a good technique for achieving effective ventilation in a building, and concluded that this method reduces the temperature of ambient air by 50ºC. Water features, however, receive less favour, as 47.9% disagree with their effectiveness. Respondents expressed differing views on the efficacy of these strategies, emphasizing the need for tailored approaches to enhance cooling in educational spaces. Generally, the survey data suggests that there is some level of support for these natural cooling strategies in faculty buildings, with green elements being more favourably viewed than indoor plants and water features.

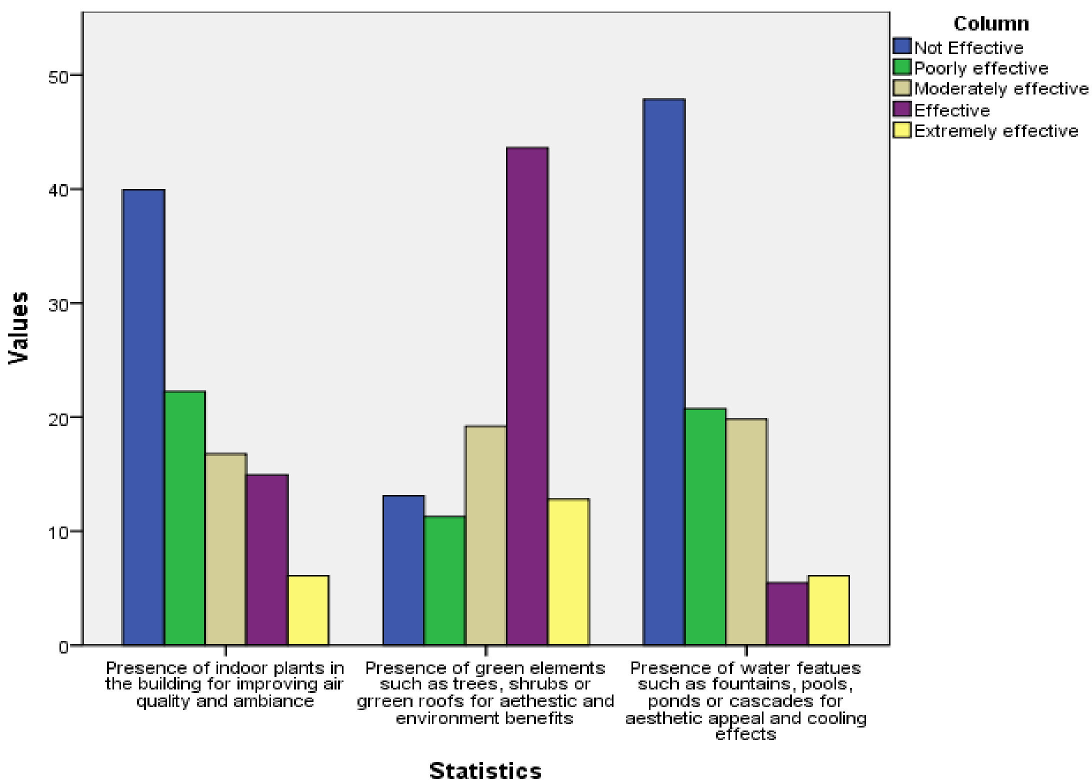

Figure 4: Green elements and water features

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Thermal buffer

In Figure 5, 44.2% of participants find incorporating buffer spaces such as corridors effective for improved thermal efficiency in faculty buildings. This finding agrees with Holtz (2001) who said that presence of buffer zones in buildings could help in reducing heat gain by the building. Conversely, feedback on the double skin façade strategy varies, with 38.4% expressing its ineffectiveness. Specifically, 15.9% find it extremely effective, 22.6% moderately effective, 8.2% poorly effective, and 9.1% ineffective. Additionally, 13.4% support using a double skin façade, with 4.6% finding it extremely effective, 28.4% moderately effective, 15.2% poorly effective, and 38.4% not effective. The discussion highlights an agreement on the positive reception of buffer spaces, while the double skin façade approach faces more diverse opinions, indicating potential disagreement on its efficacy. These insights inform sustainable building design, offering valuable perspectives for decision-making based on user preferences.

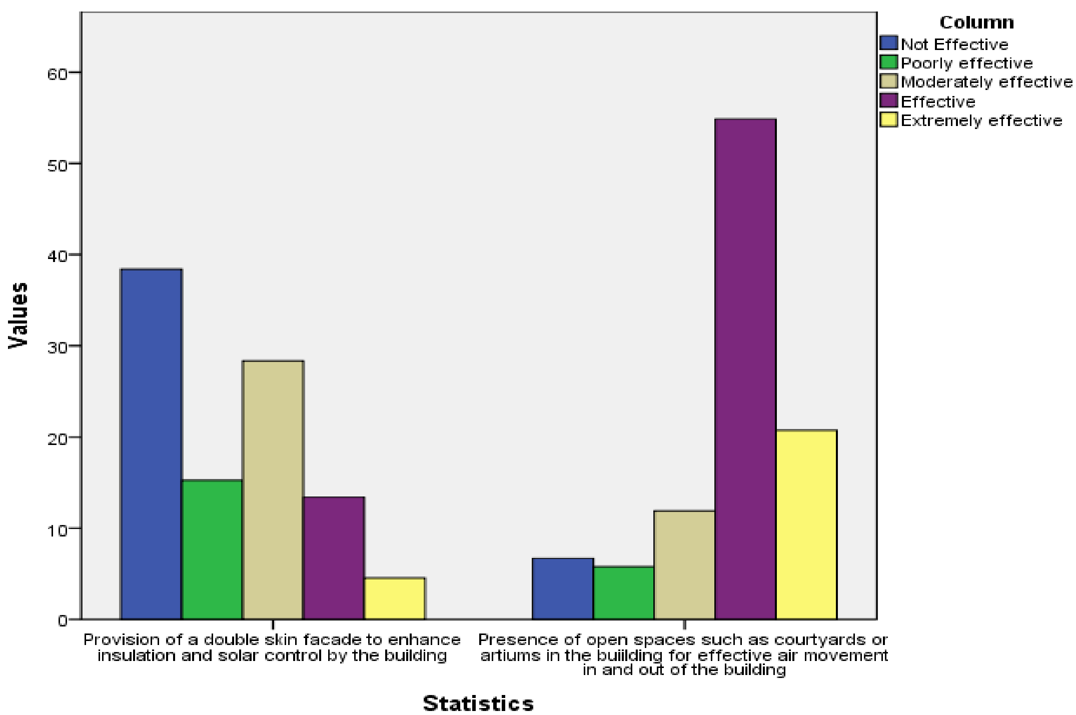

Figure 5: Thermal buffer

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Natural ventilation

In Figure 6, 54.9% of the respondents agreed that incorporating open spaces like courtyards are effective for adequate airflow in faculty buildings, with 20.7% considering it extremely effective. This is in agreement with Etheridge (2015), who defined natural ventilation in a building as the movement of air through openings in the building envelope and internal air motion which regulate indoor temperatures and improve air quality. Window type selection for balancing natural cooling and energy efficiency was deemed effective by 30.2% of the respondents, while 25.9% felt considering window size for the same purpose was ineffective. Placing windows strategically to the sun was seen as effective by 16.5%, and 29.9% agreed that high-level windows improve air circulation. These findings agree with Holtz (2001), who suggested that optimal placement of openings would improve cross-ventilation or stack ventilation within the building. The data emphasizes the need to recognize diverse perspectives among building occupants and stakeholders. Effective communication and education are crucial for bridging perception gaps and ensuring the successful adoption of sustainable and energy-efficient building designs. These insights underscore the importance of tailoring strategies to align with the preferences and beliefs of those involved in the decision-making process.

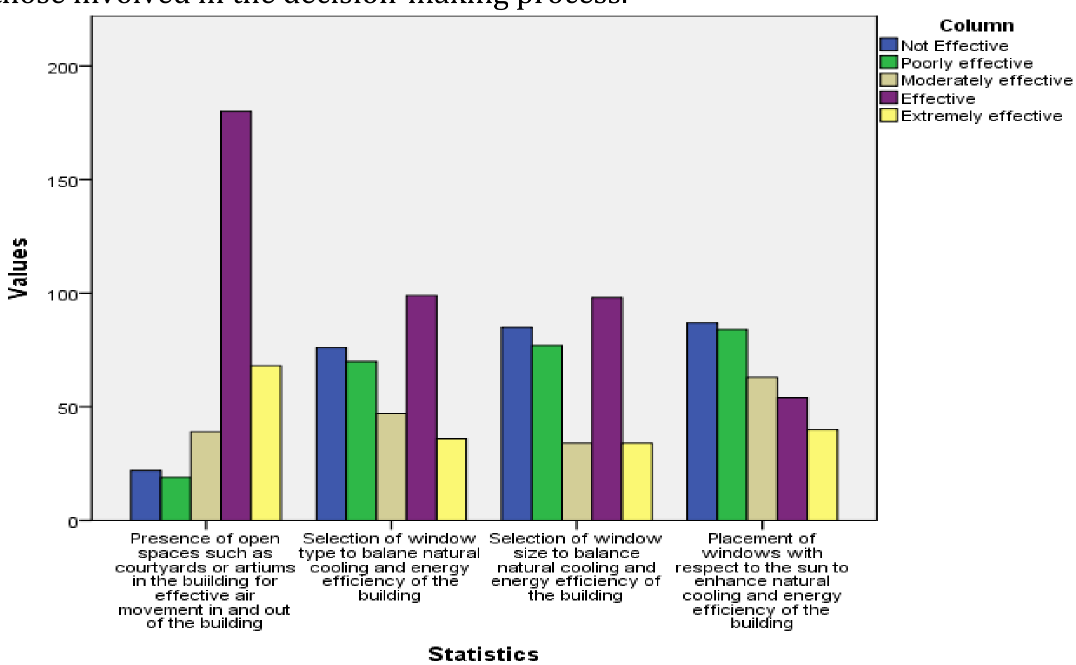

Figure 6: Natural ventilation

Relative Importance Index

The relative importance index was further used to examine which of the natural cooling strategies employed in faculty buildings is more effective and to rank each variable according to its importance. The Relative Important index formulae is given as:

$$RII = \frac{\sum W}{A * N}$$

Where W = Weight given to each statement by the respondent

A = Highest response integer which is 5

N = Total number of respondent

N =328 *5=1640

Table 3: Relative Importance Index of the most effective natural cooling strategy

Variable	Total RII	Average RII	Ranking
Site selection and planning	1.735	0.578	2
Building design and orientation	2.162	0.541	4
Shading devices and solar control	2.302	0.576	3
Green elements and water features	1.515	0.505	6
Thermal buffer	1.16	0.580	1
Natural ventilation	2.649	0.530	5

Results from Table 3 revealed that thermal buffer was ranked first (1st) as the most effective strategy in maintaining a comfortable indoor environment in faculty buildings while site selection and planning was second (2nd), shading devices and solar control were ranked third (3rd) while green elements and water features were ranked sixth (6th) in maintaining a comfortable indoor environment in faculty buildings.

Factors favouring mechanical cooling over natural cooling in faculty buildings.

The survey data, presented in Table 4, highlights respondents' perspectives on cooling strategies in buildings. Notably, 39.3% strongly agreed that mechanical cooling is more effective than natural strategies, with an additional 22.3% in agreement. Conversely, 34.1% believed natural strategies are less effective due to external factors, supported by 25.6% who strongly agreed. Regarding extreme temperatures, 30.5% agreed that mechanical cooling is essential, while 29.6% strongly agreed. Interestingly, 44.5% expressed openness to using enhanced natural cooling strategies in faculty buildings, with 42.1% strongly agreeing. The belief that natural strategies are more effective in providing indoor comfort received agreement from 43.9%, with 28% strongly agreeing. Cost savings associated with natural cooling were deemed significant by 39.9%, and 30.5% strongly agreed. Additionally, 35.4% believed concentration and productivity are easier with natural cooling, and 26.5% strongly agreed. In summary, respondents generally favour improved natural cooling strategies, acknowledging their potential cost savings and positive impacts on productivity and comfort. However, they also recognize the importance of mechanical cooling in extreme conditions.

Table 4: Factors favouring mechanical cooling over natural cooling in faculty buildings.

Variable	SD	D	N	A	SA	Mean Value	Decision
Mechanical cooling excels in sustaining optimal indoor conditions over natural methods	32 9.8%	48 14.6%	46 14%	73 22.3%	129 39.3%	3.67	Agree
Mechanical cooling means are more comfortable than natural cooling strategies in the building.	34 10.4%	60 18.3%	60 18.3%	80 24.4%	94 28.7	3.43	Neutral
Mechanical cooling system noise in the building doesn't bother me much.	84 25.6%	122 37.2%	52 15.9%	47 14.3%	23 7%	2.39	Neutral
Mechanical cooling systems are more reliable than natural cooling strategies in the building.	38 11.6%	54 16.5%	59 18%	93 28.4%	84 25.6%	3.39	Neutral

External factors, such as weather conditions, hinder natural cooling's building efficacy.	42 12.8%	46 14%	44 13.4%	112 34.1%	84 25.6%	3.50	Agree
Mechanical cooling means are essential for faculty buildings in regions with extreme temperature.	42 12.8%	49 14.9%	40 12.2%	100 30.5%	97 29.6%	3.50	Agree
I would be open to using natural cooling strategies if they were made more efficient and convenient in faculty buildings.	4 1.2%	13 4%	26 7.9%	146 44.5%	139 42.4%	4.23	Agree
I believe that natural cooling strategies are more effective in providing a comfortable indoor environment in the faculty building.	35 10.7%	21 6.4%	36 11%	144 43.9%	92 28%	3.72	Agree
The cost savings associated with natural cooling strategies in faculty buildings are a significant factor for me.	27 8.2%	26 7.9%	44 13.4%	131 39.9%	100 30.5%	3.77	Agree
I appreciate the connection to the outdoors that natural cooling strategies provide making the indoor environment more enjoyable.	4 1.2%	4 1.2%	47 14.3%	174 53%	99 30.2%	4.10	Agree
I am concerned about the environmental impact of using mechanical cooling systems in the building.	20 6.1%	25 7.6%	50 15.2%	132 40.2%	101 30.8%	3.82	Agree

It is easier to concentrate and be productive in a building with natural cooling strategies compared to those relying on mechanical cooling means.	53 16.2%	21 6.4%	51 15.5%	116 35.4%	87 26.5%	3.50	Agree
NOTE: SD=Strongly disagree, D=Disagree, N=Neutral, A= Agree, SA= Strongly agree.							

User Experience of Natural Cooling Strategies in Faculty Buildings

The study gathered responses from participants, revealing a strong consensus on the benefits of natural cooling strategies in educational environments. In Table 5, a significant 82% of participants agreed that users feel more at ease in naturally cooled spaces, with only 10.4% holding a contrary view. A notable 91.1% agreed that well-implemented natural cooling strategies ensure suitable temperature and ventilation in faculty buildings, garnering a mean value of 4.42, indicative of broad support for this notion. Additionally, 85% of respondents believed that natural cooling strategies contribute to a more conducive learning atmosphere by ensuring comfortable temperatures and air quality, as reflected in the average score of 4.18. The study also found that 85.4% agreed that a conducive indoor environment enhances teaching quality, with a mean value of 4.30 supporting this consensus. Moreover, 87.2% supported the provision of shaded outdoor areas for relaxation around faculty buildings, emphasizing the importance of creating a healthy environment.

Table 5: User experience of natural cooling strategies in faculty buildings

Variable	SD	D	N	A	SA	Mean Value	Decision
Users are likely to feel more at ease in a space that is naturally cooled	20 6.1%	14 4.3%	24 7.3%	144 43.9%	125 38.1%	4.20	Agree
Well-planned natural cooling maintains optimal temperature and	0 0	7 2.1%	22 6.7%	151 46%	147 45.1%	4.42	Agree

ventilation for faculty building users.							
Natural cooling strategies can help create a more conducive atmosphere for learning by ensuring comfortable temperatures and air quality	9 2.1%	4 1.2%	36 11%	150 45.7%	129 39.3%	4.18	Agree
Lecturers can better focus on delivering quality teaching sessions when the indoor environment is conducive to teaching	0	11 3.4%	37 11.3%	122 37.2%	158 48.2%	4.30	Agree
Providing more shaded outdoor areas for relaxation within and around the building can create a healthy environment for users	2 0.6%	7 2.1%	33 10.1%	127 38.7%	159 48.5%	4.32	Agree
NOTE: SD=Strongly disagree, D=Disagree, N=Neutral, A= Agree, SA= Strongly agree							

CONCLUSION AND RECOMMENDATION

This study highlights the crucial role of educational buildings, specifically faculty of architecture buildings, in supporting sustainability and energy efficiency amid the challenges of high energy consumption and climate change. In the Nigerian context, the research, involving insights from 328 participants across two universities, delves into perceptions surrounding natural cooling strategies. The results reveal a nuanced landscape, emphasizing the intricate relationship between thermal comfort and sustainable design. Notably, design elements such as tree shade, strategic window placement, and thoughtful corridors emerge as vital contributors to sustainable and comfortable learning environments. The effectiveness of thermal buffers and strategic site planning demonstrates their potential to significantly reduce energy consumption and enhance indoor comfort. The study's quantitative approach addresses the need for innovative solutions in the era of climate change, showcasing the efficacy of sustainable strategies and paving the way for energy-efficient educational structures. This not only aligns with broader initiatives for climate impact mitigation but also advances the adoption of environmentally conscious design principles within educational spaces, promoting long-term sustainability. The recommendations underline the need for customized, context-specific sustainable building designs to address unique environmental concerns and enhance indoor environments in faculty buildings. The key sustainability-focused recommendations are as follows:

1. Architects and designers are urged to consider local climate conditions, prevailing wind patterns, and sun paths throughout the year when implementing natural cooling strategies. Integrating these considerations can enhance energy efficiency and user comfort by aligning designs with the specific environmental context.
2. The study emphasizes the importance of continued collaboration among architectural practitioners, educators, and policymakers. This collaborative approach is essential to prioritize energy efficiency and the overall well-being of users in future faculty buildings. Integrating diverse expertise can lead to more sustainable and user-centric design solutions.
3. Advocacy should be extended for the promotion of certification programs such as LEED or BREEAM to prioritize the integration of natural cooling strategies. These programs, with established frameworks, can catalyse the widespread adoption of sustainable practices in constructing and retrofitting faculty of architecture buildings. Prioritizing natural cooling in these certification programs can significantly contribute to the overall sustainability and environmental responsibility of educational structures.

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