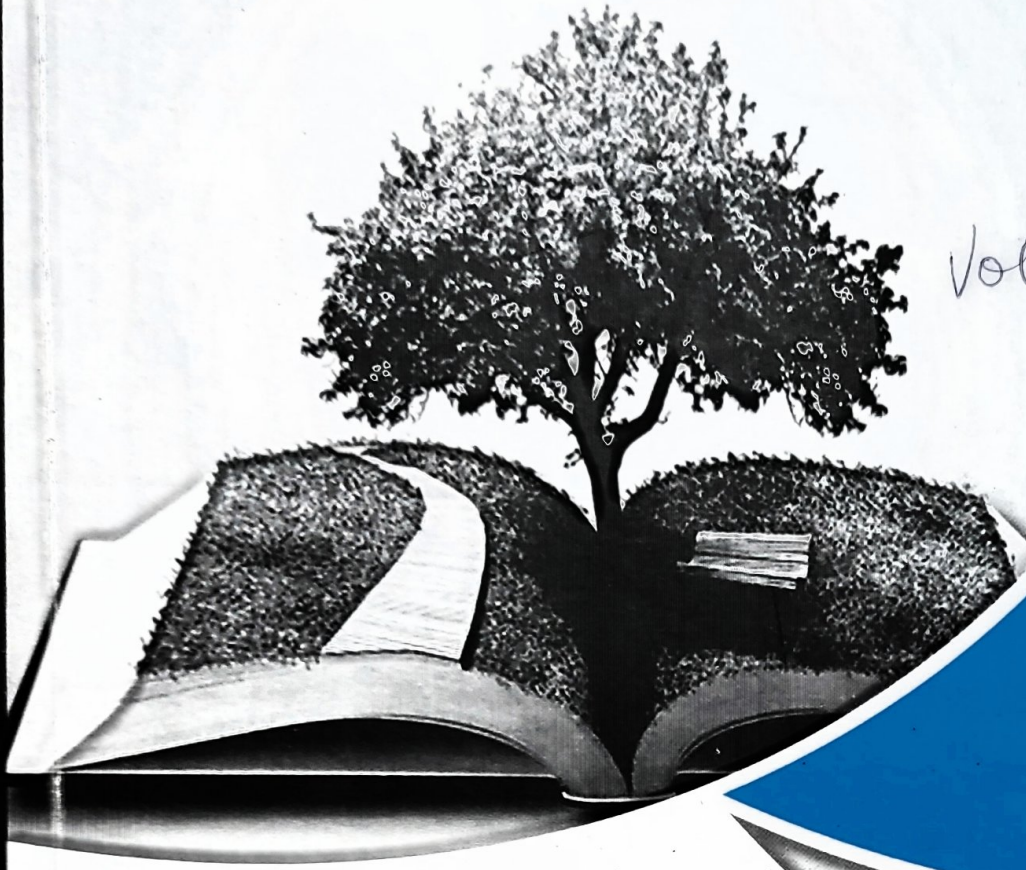

Vol 29(1)

Book of

PROCEEDINGS

29-12-2023

BUK-2023

THE 29TH MULTI-DISCIPLINARY ACADEMIC CONFERENCE

THEME: UNLOCKING SUB-SAHARA AFRICAN POTENTIALS FOR SUSTAINABLE DEVELOPMENT IN THE 21ST CENTURY: MULTI-DISCIPLINARY APPROACH.

PROCEEDINGS

ON THE
AFRICAN POTENTIALS FOR SUSTAINABLE DEVELOPMENT IN THE 21ST CENTURY: MULTI-DISCIPLINARY APPROACH

THEME
UNLOCKING SUB-SAHHARA AFRICAN POTENTIALS FOR SUSTAINABLE DEVELOPMENT IN 21ST CENTURY: MULTI-DISCIPLINARY APPROACH.

DATE:
DECEMBER, 29TH 2023

VENUE:
BAYERO UNIVERSITY, KANO, KANO STATE, NIGERIA, WEST-AFRICA.

PROCEEDINGS

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THEME

UNLOCKING SUB-SAHHARA AFRICAN POTENTIALS FOR SUSTAINABLE DEVELOPMENT IN 21ST CENTURY: MULTI-DISCIPLINARY APPROACH.

SUB THEME:

- Pure and Applied Science
- Medical and Pharmaceutical Sciences
- Engineering
- Environmental
- Humanities and Social Sciences
- Management Science & Entrepreneurship

PROCEEDING OF THE ACADEMIC CONFERENCE ON AFRICAN POTENTIALS FOR SUSTAINABLE DEVELOPMENT IN THE 21ST CENTURY: MULTI-DISCIPLINARY APPROACH

Vol. 29 No. 1 on the 29th December, 2023 at Bayero University, Kano, Kano State, Nigeria, West-Africa.

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PROCEEDING OF THE ACADEMIC CONFERENCE ON AFRICAN POTENTIALS FOR SUSTAINABLE DEVELOPMENT IN THE 21ST CENTURY: MULTI-DISCIPLINARY APPROACH

Vol. 29 No. 1 on the 29th December, 2023 at Bayero University, Kano, Kano State, Nigeria, West-Africa.

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DATE:
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VENUE:
BAYERO UNIVERSITY, KANO, KANO STATE, NIGERIA, WEST-AFRICA.

VENUE: BAYERO UNIVERSITY, KANO, KANO STATE, NIGERIA, WEST-AFRICA.

Time	Activities
08:00 - 10.00am	Registration
10:00 – 10:30am	Arrival of Guests
10:30 - 10:45am	Introduction and Recognition of Distinguished by The Master of Ceremony.
10:45 - 11:10am	Opening Prayer
11:00 - 11:20am	National Anthem
11:21 - 11:31am	Address by Chief Guest.
11:31 - 12:00noon	Lead Paper presentation by Prof. A. Usman
12:30 – 03:00pm	Plenary Session/Paper Presentation
03:00 - 03:15pm	Vote of thanks by Secretary LOC
03:15 - 03:30pm	National Anthem
03:30 – 03:45pm	Group Photograph

PROGRAMME OF ACTIVITIES

Days	Time	Activities
Day 1: Thursday, December 28, 2023		Arrival/Pre-conference Meeting
Day 2: Friday, December 29, 2023	8.00-10.00am	Registration
	10.00-1.00pm	Opening Ceremony
	1.00-2.00pm	Launch/Break
	2.00-3.00pm	Plenary Section
	3.00-5.00pm	Paper presentation
	5.00-600pm	Certificates Presentation
Day 3: Saturday, December 30, 2023		Departure

REGISTRATION VENUE
BAYERO UNIVERSITY, KANO, KANO STATE, NIGERIA, WEST-AFRICA.

THEME
UNLOCKING SUB-SAHHARA AFRICAN POTENTIALS FOR SUSTAINABLE DEVELOPMENT IN 21ST CENTURY: MULTI-DISCIPLINARYAPPROACH.

BUK KANO-2023
BAYERO UNIVERSITY, KANO, KANO STATE, NIGERIA
Proceedings of the Academic Conference of Sub-Sahara African Academic Research Publications on African Potentials for Sustainable Development in the 21st Century: Multi-disciplinary Approach Vol. 29 No. 1, 29th December, 2023

APPLICATION OF SUSTAINABLE DESIGN ELEMENTS IN THE DESIGN OF A MULTI-FAMILY HOUSING ESTATE IN ABUJA.

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Department of Architecture, Federal University of Technology, Minna, Nigeria

ABSTRACT
In recent years, the use of sustainable design elements in residential neighbourhoods has drawn a lot of attention in response to the urgent need for ecologically friendly and resource-conserving communities. Lack of regard for the environmental effects of the built environment is one of the main issues currently faced by humans. Buildings account for the majority of the world's energy use, greenhouse gas emissions, unsustainable building materials, construction methods, and infrastructure these all contribute to rising energy costs, operating expenses, and carbon footprints. The aim of this study is to integrate sustainable elements in the design of a multi-family housing estate in Abuja, Nigeria. The research was done through quantitative evaluations and the use of case studies and questionnaires. Three hundred and eighty (380) questionnaires were administered and two hundred and fifty (250) questionnaires were returned and analysed. The study revealed that the respondent agreed that the use of energy-efficient lighting fittings and appliances in public housing and that the use of renewable energy such as solar panels could meet the energy needs of the public housing (MIS = 4.53 and 4.49, respectively) were the most significant passive design strategies. The findings revealed that the most significant effect of non-green architectural components that negatively influence the overall comfort of occupants of public housing was ranked first, with a mean score of 4.08 and a corresponding level of significance of 0.00, making it a statistically significant effect of non-green architectural components in public housing. In conclusion, the adoption of sustainable design practices in construction helps to reduce greenhouse gas emissions, thereby creating a healthy living environment. It is recommended that energy-efficient features like landscaping, building orientation, sustainable material specification, sun shading devices, and cross ventilation be incorporated into the design of buildings, especially residential buildings, to reduce running costs, lower energy requirements, and lessen the negative environmental effects that energy has.

Keywords: Design, Elements, Housing Estate, Multi-Family, Sustainable Design

INTRODUCTION
The earth's temperature has been steadily rising as a result of global warming, and this is seriously giving concern to human existence. Since it produces a gentle, constant temperature, the earth's atmosphere sets it apart from other plants (Umair, 2015). The presence of greenhouse gases has an impact on this constant temperature.
Multi-family housing refers to housing developments or structures that are built to include several independent dwelling units. It is a style of housing that offers private living quarters for a number of neighbouring homes or families (Almahmoud and Doloi, 2020). Multifamily housing refers to a structure with more than one dwelling unit based only on design (Gardner *et al.,* 2020). Apartment complexes, condos, town homes, duplexes, triplexes, and even bigger projects with several units can all be classified as multi-family housing. Common areas, parking lots, recreational spaces, or landscaped areas are frequently included in the construction of these buildings and are open to all occupants (Saidu and Yeom, 2019). Multifamily housing has a variety of challenges, such as how to appropriately manage waste created, indoor air quality through clean air and well-ventilated areas, energy optimization, issues with social integration, and challenges with building services and maintenance (Zarghami *et al.,* 2019).
Given its importance to urban growth, mass housing needs to incorporate sustainable design components to lessen its environmental effect. A sustainable design that makes it simple to address the fundamental difficulties associated with multifamily living and this is what is meant by the term "sustainable architecture (Giyasov and Giyasova,2018)." A concept in architecture known as "sustainable architecture" promotes the use of renewable energy sources, energy efficiency, the safe reuse of building materials, and the placement of structures in order to minimize their impact on the environment (Adenikinju, 2019). The components of sustainable design work together to provide a structure or collection of buildings that fulfils all requirements for a favourable environment. According to Zubairu (2019), passive solar design, energy optimization (the use of renewable energy), locally sourced building materials, indoor air quality, water efficiency, waste management, and environmental effect are some of these factors. An innovative design that incorporates this special idea into the difficulties of multifamily living will provide a hospitable microclimate for occupants as well as the building itself. The adoption of renewable energy sources, natural ventilation, proper landscaping, building insulation, rain and storm water harvesting, proper building orientation, and exterior shading makes up some of the sustainable design elements that helps to improve the microclimate of our environment. The government cannot address the housing concerns on its own due to its severity. Public-private partnerships are therefore becoming more popular as a means of financing addressing the housing shortage and providing sustainable dwelling units (Ibem & Aduwo, 2012).
As relates to with waste management, energy optimization, indoor air quality, well-landscaped surroundings, and the use of non-renewable materials are factors that are mostly visible in the housing units available, the existing

housing units are not effectively built. It has been found that several poor architectural approaches have been adopted in the construction of mass housing, necessitating the incorporation of green architecture (Gan *et al.*, 2019). The use of imported materials caused the project to be abandoned due to the 1983 oil depreciation, the improper waste disposal network, and the supply of water was primarily dependent on the public mains, which was inefficient and borehole became an expensive alternative. These approaches also include: ignoring the culture of the populace in the articulation of spaces; not considering alternative sources of energy; and not taking into account the national grid's poor electricity supply (Mehrotra and Carter, 2017). Hence The study aims to incorporate sustainable design elements in the design of a multi-family housing estate in Abuja with the intent to propose a multifamily public housing scheme that incorporates green architectural components.

LITERATURE REVIEW

Multifamily Housing

Aurand (2010) discovered that housing in multi-unit and other connected buildings, which is normally smaller than single-family homes, is more likely to be found in the inexpensive sub-market than the non-affordable sub-market. According to Al-Jameel & Al-Hafith (2012), the development of multifamily housing dates back to the Roman era and continued through the post-World War II in Europe. In the history of multifamily housing developments.

Apartments, a kind of multifamily housing where residential units are occupied by household tenants, are frequently used as rental units. Zivkovic & Jovanovic (2012) said that the housing unit is a key structure in multi-family residential complexes that would, via its adaptable organisation, contribute to the quality of life in an area. However, according to Brissi & Debs (2023), the multifamily housing market in the USA is sizable, with over 22 million units in 2019, and it has been expanding rapidly in recent years. Between 2009 and 2019, the market grew by more than 16%. Housing is therefore a fundamental physical component of the family, a core social group, and it should adapt as society changes in terms of its technical, economic, environmental, and demographic demands. As a result, the orientation of the housing unit, in terms of the location and quantity of facade planes, has a significant impact on the obtained level of flexibility and the spatial organisation of the apartment. In practise, there are three main types of housing unit orientations that Zivkovic & Jovanovic (2012) identified: one-sided orientation (where the housing unit only has access to one side of the facade), two-sided orientation (where the housing unit has access to two adjacent or opposite exterior sides), and three-sided orientation (where the housing unit has access to three exterior sides).

If appropriately planned, multifamily housing lowers the cost of utilities like water supply, power, phone, and sewage by shortening the length of these providing networks. Al-Jameel & Al-Hafith (2012) also discussed how multifamily housing lessens the city's continual horizontal expansion, which is brought on by single-family housing patterns. Lessening the city's horizontal expansion will lower the cost of its infrastructure, transportation, and services. Furthermore, compared to single-family housing, multifamily housing is more economically efficient and allows for the construction of a greater number of housing units faster, making it possible to house a greater number of people in appropriate housing. According to recent research, in order to fulfil the demand of families from various income categories in the USA by 2030, it would still be necessary to create around 4.6 million new rental units (Brissi & Debs, 2023). Plate 1 below shows a typical detached duplex within a multi-family housing estate.

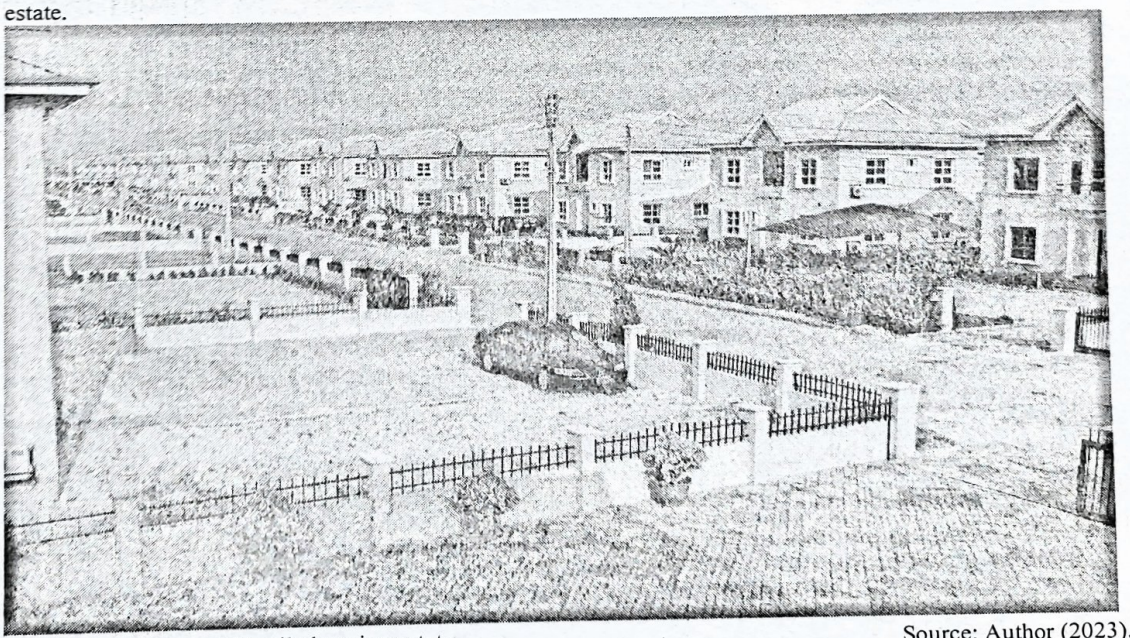

Plate 1: A typical multifamily housing estate

Source: Author (2023).

Problems of Multifamily Housing

Numerous difficulties are encountered when designing multifamily housing, particularly multilevel and terrace housing (Ahvenniemi *et al.*, 2018). These issues include:

i. The difficulty of establishing ideal day lighting design;
ii. The difficulty of cross ventilation
iii. Family disputes over the cleanliness and administration of common areas
iv. Ineffective trash management and disposal techniques
v. Security issues
vi. The difficulty of preventing passive fire outbreaks;
vii. Building upkeep and conservation

Building Types Related to Multifamily Housing

Building types for multifamily properties can be divided into two categories based on two criteria's: the number of storeys and the flexibility of the design as shown in Figure 2.1.

a) Based on the number of floors, there are three different types of multifamily housing buildings:
   i. Low-rise
   ii. Mid-rise
   iii. High-rise

b) The following building styles exist for multifamily housing based on the flexibility of the design:
   i. Condominiums or mixed-use houses
   ii. Terraces
   iii. Apartment buildings
   iv. Detached buildings

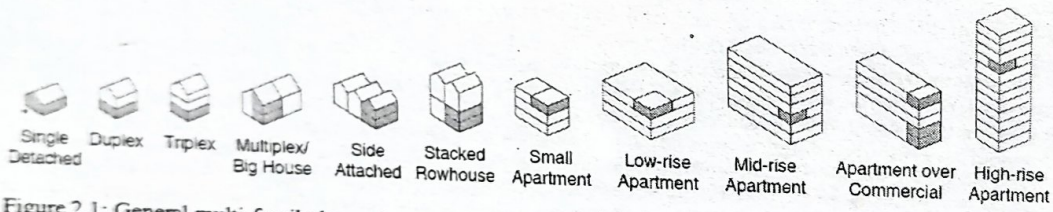

Figure 2.1: General multi-family house types
Source: Darp, (2017).

Nevertheless, low-rise terrace, detached buildings, and apartment buildings (with a range of 1-2 suspended stories) are the building types to be considered for the purpose of this study.

Terrace housing

Houses that are identical or mirror images of one another and share side walls or floors and *end terrace* is the name for the first and last of these homes. While terraces that are divided by floors have access points on each story with a central access point, terraces that are side by side have an outdoor entrance on the ground floor (Brunes *et al.*, 2020). Figure 2.2 displays a terrace housing style.

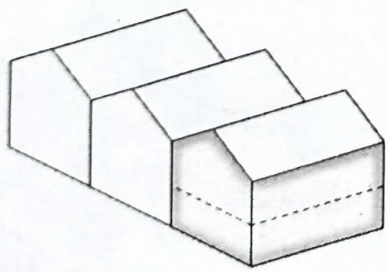

Figure 2.2: Row terrace housing.
Source: Darp, (2017)

Plate 2: A typical terrace housing type
Author (2023)

Apartment housing

Apartment buildings do not share walls and are not planned in rows of similar building types, which is how they vary from terrace housing (Sanusi, 2019). As a standalone structure with a central circulation, it may house a number of dwelling units in a single block. The overall building form of an apartment building can be categorized into the following;

I. The block: The block has more width than height. The single- or double-loaded flats are situated off a hallway. Figure 2.3 below shows a block of apartment building.

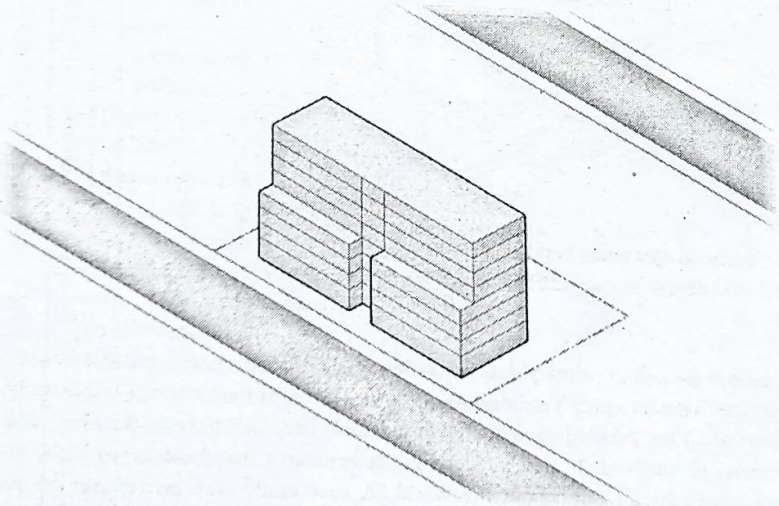

Figure 2.3: A block apartment building
Source: Auckland design manual (2018).

II. The tower: The tower has a single central core, is vertical in shape, and is higher than it is wide as shown in Figure 2.4. There could be a base to the tower. The podium's roof might be planted and used by apartment dwellers as a common area. A tower building is a unique type of building defined by its significant height and verticality (Akinyode et al., 2018).

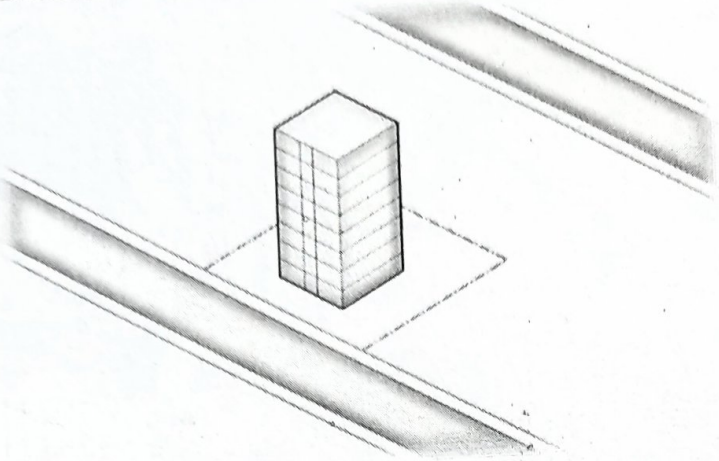

Figure 2.4: Tower apartment building
Source: Auckland design manual (2018).

III. The courtyard: Courtyard flats provide the 'sides' (courtyards) open areas as shown in figure 2.5. These buildings are characterized by their centre courtyard or open space, which functions as a gathering place for inhabitants and frequently include amenities like seating sections, gardens, and other features.

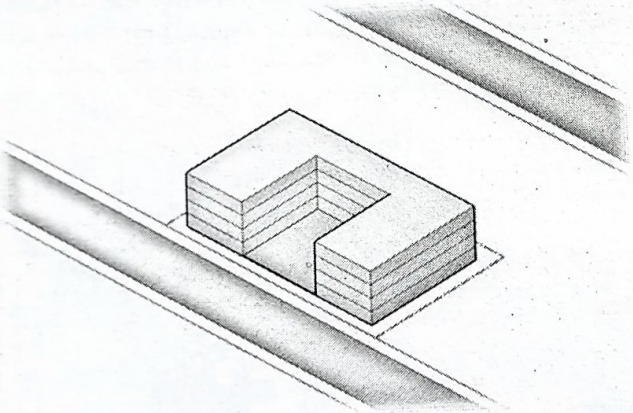

Figure 2.5: Courtyard apartment building
Source: Auckland design manual (2018).

METHODOLOGY

This research work employs the use of primary data collection method; case studies, questionnaires, checklists, and observation guides. The Federal Capital Territory, Abuja, was selected as the location for this study. The study population is the entirety of all the housing components in the study area. All terrace, detached, and apartment housing in Abuja, Nigeria, is involved. It also includes green structures that have successfully incorporated sustainable architecture principles all throughout the world. A case study was carried out on five existing multifamily housing estates in Abuja, with 250 structured questionnaires distributed and analysed using SPSS software. These individuals were selected based on their relevance to the research objectives and their ability to provide valuable insights. The data obtained from the fieldwork was documented and organised for analysis. Descriptive statistical tools such as tables were used in result analysis.

Table 1, shows the summary of data preparation and reliability. Three hundred and eighty questionnaires were administered to the research population, and two hundred and fifty (250) were retrieved, representing a response rate of 66%. After that, the data was imported into SPSS for analysis to assess its reliability. The main purpose of the reliability test is to assess the reliability and internal consistency of the overall research data. Generally, the reliability in terms of Cronbach Alpha for the entire data set (0.795) is good because it is greater than 0.500.

Table 1: Summary of Data Preparation and Reliability

Total Responses			Cronbach Alpha
Administered	Received	Response Rate	
380	250	663%	0.795

Source: Author's Field work, (2023)

RESULTS AND DISCUSSION

Passive design strategies

The results of the Mean Item Score (MIS) employed to rate the strategies for developing sustainable practices for energy efficiency are summarised in Table 2.

Table 2: Passive design strategies

S/NO	Strategies	S.D(1)	D.A(2)	N (3)	A (4)	S.A (5)	Mean	Rank	Decision
PDS1	Do you agree to the use of energy-efficient lighting fittings and appliances in public housing?		4(1.6)		105(42.0)	141(56.4)	4.53	1st	Strongly Agree
PDS2	Do you agree that the use of renewable energy such as solar panels could meet the energy needs of the public housing?		2(0.8)	7(2.8)	107(43.8)	134(53.6)	4.49	2nd	Agree
PDS3	Do you agree that architectural design (such as building orientation and layout) can help to maximize natural light and minimizes the need for artificial lighting during the day?		2(0.8)	9(3.6)	106(42.4)	133(53.2)	4.48	3rd	Agree
PDS4	Do you agree that the use of water management practises conserves and minimize wastage in public housing?	2(0.8)		9(3.6)	109(43.6)	130(52.0)	4.46	4th	Agree

PDS5	Do you agree that implementation of effective insulation and shading techniques reduces the need for heating and cooling in public housing?	2(0.8)	20(8.0)	103(41.2)	125(50.0)	4.40	5th	Agree
PDS6	Do you agree that the use of environmentally friendly materials contributes to the sustainability of public housing?		13(5.2)	128(51.2)	109(43.6)	4.38	6th	Agree
PDS7	Do you agree to the implementation of waste reduction and recycling programs for public housing occupants?		15(6.0)	131(52.4)	104(41.6)	4.35	7th	Agree
PDS8	Do you agree that active collaborations with local sustainable energy initiatives and community efforts help in promoting sustainability in public housing?	2(0.8)	2(0.8)	30(12.0)	128(51.2)	88(35.2)	4.19	8th	Agree
PDS9	Do you agree that the use of smart HVAC systems could adjust temperature and ventilation based on occupancy and external conditions?		2(0.8)	52(20.8)	103(41.2)	93(37.2)	4.14	9th	Agree

PDS10	Do you agree that traditional means of construction contributes to the sustainability of public housing?	21(8.4)	62(24.8)	85(34.0)	82(32.8)	3.91	10^{th} Agree
	Average MIS					*4.33*	*Agree*

Source: Author's Field work, (2023)

Key: PDS: Passive design strategies S.D(1) = Strongly disagree, D.A(2) = Disagree, N (3) = Neutral, A (4) = Agree, S.A(5) = Strongly Agree)

Table 2 indicates that the respondent agreed that the use of energy-efficient lighting fittings and appliances in public housing and that the use of renewable energy such as solar panels could meet the energy needs of the public housing (MIS = 4.53 and 4.49, respectively) were the most significant passive design strategies. This is followed by the architectural design (such as building orientation and layout), which can help to maximise natural light and minimise the need for artificial lighting during the day. The use of water management practices conserves and minimises waste in public housing, and the implementation of effective insulation and shading techniques reduces the need for heating and cooling in public housing (MIS = 4.46, 4.40, and 4.38, 3rd, 4th, and 6th). The least significant passive design strategy is whether traditional means of construction contribute to the sustainability of public housing? (MIS = 3.91). On average, in terms of level of agreement with the identification of passive design strategies in the existing buildings, they all appear to agree with the passive design strategies (average MIS = 4.33).

Effects of Non-green Architectural Components in Public Housing

The use of MIS to explain the effects of non-green architectural components in public housing Table 3 reveals the result of MIS for the five identified effects of non-green architectural components in public housing. It was shown that the most significant effect is that non-green architectural components negatively influencing the overall comfort of occupants of public housing was ranked as the first, with a mean score of 4.08 and a corresponding level of significance of 0.00, making it a statistically significant effect of non-green architectural components in public housing. It also recorded a standard deviation of 0.69, indicating the existence of agreement between responses. Non-green architectural components increase energy consumption in public housing, ranking second with a mean score of 4.07, well above the hypothesised level, and a corresponding level of significance of 0.00, making it a statistically significant effect of non-green architectural components in public housing. It also recorded a standard deviation of 0.83, which is less than one. Ranking 3rd was the application of non-green architectural components, which negatively impacts the indoor air quality of public housing, with a mean score of 3.92 and a corresponding level of significance of 0.00, making it a statistically significant effect. It also recorded a standard deviation of 0.83, indicating the existence of agreement between responses. The respondents agreed that non-green architectural components negatively influence the overall comfort of occupants of public housing, which was ranked as the 5th most important effect. It recorded a mean score of 3.77 and a standard deviation of 0.89, with a corresponding level of significance of 0.00, making it statistically significant.

Table 3: Summary of T-Test Showing Rankings and Significance of Effects of Non-green Architectural Components in Public Housing

S/No.	Effects	Mean	Std. deviation	Rank	Sig. (1 tailed)	Statistically significant
1	Do you agree that non-green architectural components negatively influence the overall comfort of occupants of public housing?	4.08	.69	1st	0.00	Yes

2	Do you agree that non-green architectural components increase energy consumption of public housing?	4.07	0.70	2nd	0.00	Yes
3	Do you agree that the application of non-green architectural components negatively impacts indoor air quality of public housing?	3.92	0.83	3rd	0.00	Yes
4	Do you agree that the application of non-green architectural components increases the cost of building maintenance?	3.84	0.90	4th	0.00	Yes
5	Do you agree that non-green architectural components negatively influence the overall comfort of occupants of public housing?	3.77	0.89	5th	0.00	Yes

Source: Author's Field work, (2023)

Preference of passive sustainable elements to be use in construction of public housing

The use of MIS to explain the preference for passive, sustainable elements to be used in the construction of public housing Table 4 reveals the result of MIS for the seven identified preferences for passive sustainable elements to be used in the construction of public housing. It was shown that the element with the highest preference to be used in the construction of public housing is solar panels. ranked as the first, with a mean score of 4.60 and a corresponding level of significance of 0.00, making it statistically significant. It also recorded a standard deviation of 0.59, indicating the existence of agreement between responses. Natural ventilation was ranked 2nd, with a mean score of 4.46 well above the hypothesised level and a corresponding level of significance of 0.00, making it statistically significant. It also recorded a standard deviation of 0.68, which is less than one. Ranking 3rd was green landscaping, with a mean score of 4.42 and a corresponding level of significance of 0.00, making it a statistically significant preference. It also recorded a standard deviation of 0.64, indicating the existence of agreement between responses. The respondents also expressed a preference for natural lighting to be used as the 7th most important preference. It recorded a mean score of 3.98 and a standard deviation of 0.68, with a corresponding level of significance of 0.00, making it statistically significant.

Table 4: Summary of T-Test Showing Rankings and Significance of Effects of Non-green Architectural Components in Public Housing

S/No.	Effects	Mean	Std. deviation	Rank	Sig. (1 tailed)	Statistically significant
1	Solar Panels	4.6040	0.58	1st	0.00	Yes
2	Natural ventilation	4.4600	0.68	2nd	0.00	Yes
3	Green Landscaping	4.4200	0.64	3rd	0.00	Yes
4	Building Insulation	4.2600	0.64	4th	0.00	Yes
5	Sun shading	4.1640	0.80	5th	0.00	Yes
6	Rain and Grey water conservation	4.0160	0.81	6th	0.00	Yes
7	Natural lighting	3.9800	0.68	7th	0.00	Yes

Source: Author's Field work, (2023)

Conclusion And Recommendation

This research is aimed at incorporating sustainable design elements in the design of a multi-family housing estate in Abuja with the intent to propose a multifamily public housing scheme that incorporates green architectural

components. Based on the findings of this study, it was concluded that the respondent agreed that the use of energy-efficient lighting fittings and appliances in public housing and that the use of renewable energy, such as solar panels, could meet the energy needs of the public housing were the most significant passive design strategies. In conclusion, the adoption of sustainable design practices in construction helps to reduce greenhouse gas emission thereby creating a healthy living environment. It is recommended that energy-efficient features like landscaping, building orientation, sustainable material specification, sun shading devices, and cross ventilation be incorporated into the design of buildings, especially residential buildings, to reduce running costs, lower energy requirements, and lessen the negative environmental effects that energy has.

REFERENCES

Adenikinju, A. F. (2019). Bridging housing deficit in Nigeria: Lessons from other jurisdictions. *Economic and Financial Review, 57*(4), 5.

Al-Jameel, A. H. & Al-Hafith, O. A. (2012) Investing the Concept of Courtyard for Sustainable Adaptable Multifamily Housing. *Journal of American Transactions on Engineering & Applied Sciences,* 1(3), 319-334.

Almahmoud, E., & Doloi, H. K. (2020). Identifying the key factors in construction projects that affect neighbourhood social sustainability. *Facilities, 38*(11/12), 765-782.

Ahvenniemi, H., Pennanen, K., Knuuti, A., Arvola, A., & Viitanen, K. (2018). Impact of infill development on prices of existing apartments in Finnish urban neighbourhoods. *International Journal of strategic property management, 22*(3), 157-167.

Akinyode, B. F., Khan, T. H., & Ahmad, A. S. B. H. (2015). Socio-economic factors in measuring the demand for residential neighbourhood in Nigeria. *Asian Social Science, 11*(12), 235.

Auckland Design Manual (2018). *Design Advice for your next project.* [Slide Format]. Retrieved from www.aucklanddesignmanual.co.zn/sites-and-buildings/apartment-building-types-basic-forms on 9th September, 2023.

Aurand, A. (2010) Density, Housing Types and Mixed Land Use: Smart Tools for Affordable Housing. *Urban Studies Journal,* 47(5), 1015–1036

Brissi, S. G. & Debs, L. (2023) Principles for adopting offsite construction in design and construction companies focused on multifamily projects in the USA. *Journal of Engineering Construction & Architectural Management,*

Brunes, F., Hermansson, C., Song, H. S., & Wilhelmsson, M. (2020). NIMBYs for the rich and YIMBYs for the poor: analyzing the property price effects of infill development. *Journal of European Real Estate Research, 13*(1), 55-81.

Darp, K. S (2017) Housing typology of Pune: A case study from Nal stop to Chandni Chowk, Pune. *International journal of New Technology and Research.* 4(2), 80-84

Ibem, E. O & Aduwo, E. B. (2012). Public-Private Partnerships (PPPs) in Urban Housing in Nigeria: Evidence from Ogun State, *International Journal of Architecture and Urban Development,* 2(2), 5 – 14.

Gan, X., Zuo, J., Wen, T., & She, Y. (2019). Exploring the adequacy of massive constructed public housing in China. *Sustainability, 11*(7), 1949.

Gardner, D., Lockwood, K., & Pienaar, J., (2020). Nigeria's housing construction and housing rental activities: cost benchmarking and impact on the economy. In: Housing and the Economy. Centre for Affordable Housing in Africa (CAHF), Johannesburg, South Africa. [2020-11-30]. http://housingfinanceafrica.org/

Giyasov, B., & Giyasova, I. (2018). The impact of high-rise buildings on the living environment. In *E3S Web of Conferences* (Vol. 33, p. 01045). EDP Sciences.

Mehrotra, S. N., & Carter, D. R. (2017). Determinants of Growth in Multiunit Housing Demand since the Great Recession: An Age-Period-Cohort Analysis. *Urban Studies Research.*

Saidu, A. I., & Yeom, C. (2020). Success criteria evaluation for a sustainable and affordable housing model: A case for improving household welfare in Nigeria Cities. *Sustainability, 12*(2), 656.

Sanusi, A. R. (2019). Addressing Housing Deficit in Nigeria: Issues, Challenges and Prospects. *Economic and Financial Review, 57*(4), 14

Umair, S.R., (2015), Global Warming: Causes, Effects and Solutions, in *Durreesamin Journal* (ISSN: 2204 - 9827) 1(4)

Zarghami, E., Fatourehchi, D., & Karamloo, M. (2019). Establishing a region-based rating system for multi-family residential buildings in Iran: A holistic approach to sustainability. *Sustainable Cities and Society, 50,* 101631.

Zivkovic, M. & Jovanovic, G. (2012) A Method for Evaluating the Degree of Housing Unit Flexibility in Multi-Family Housing. *Journal of Architecture and Civil Engineering,* 10(1), 17-32.

Zubairu S. N (2019) *The Use of Sustainable Building Materials in Nigeria,* ARC 516 Course Material. Department of Architecture, Federal University of Technology Minna, Niger State. 1-5.