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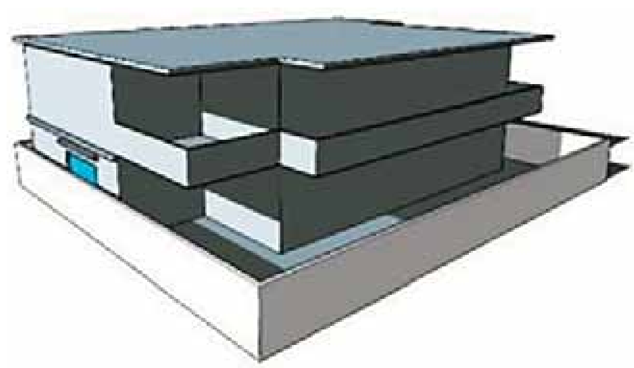

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Introduction

Focusing on research works relevant to the fields of architecture and planning, the Journal of Research in Architecture and Planning (JRAP) explores issues of relevance to both scholars and practitioners in the field of architecture, urban design, urban planning, built form heritage and conservation. JRAP was initiated in 2000 as a peer reviewed journal, initially published annually, however, since 2011 its frequency has increased to biannual. In addition to the papers received through our regular submission process, the two volumes also include papers selected from those presented at the annual Conference of Urban and Regional Planning, hosted by the Department of Architecture and Planning at NEDUET. Contributions to the journal on general topics are accepted any time of the year, and incorporated in upcoming issues after going through a peer review process. A post conference review is also undertaken for the selection of conference papers, before their publication. JRAP holds the privilege of being the first peer reviewed journal in the discipline of architecture and planning, published from Pakistan. Contributions are received from across the globe and on average half the papers included in JRAP are from international scholars.

As of 2018, the category entitled 'Young Scholar's Contribution' has been included in the Journal. In this category, papers from young faculty and early career scholars are accepted and editorial assistance and peer review feedback is provided to improve the research papers. One such paper is published under the head 'Young Scholar's Contribution' within each issue of JRAP.

Aims and Scope

The primary objective of JRAP is to provide an international forum for the dissemination of research knowledge, new developments and critique in architecture, urban design, urban planning and related disciplines for the enrichment and growth of the profession within the context. The journal focuses on papers with a broad range of topics within the related discipline, as well as other overlapping disciplines. JRAP publishes a wide range of research papers which deal with indepth theoretical reviews, design, research and development studies; investigations of experimental and theoretical nature. Articles are contributed by faculty members, research scholars, professionals and other experts. The Editors welcome papers from interested academics and practicing architects. Papers published so far have been on topics as varied as Housing, Urban Design, Urban Planning, Built Environment, Educational Buildings, Domestic Architecture, Conservation and Preservation of Built Form. All back issues are openly accessible and available online on the Journal's official webpage:
http://jrap.neduet.edu.pk/online_journal.html.

CONTENTS

Note: All the photographs included in this issue have been taken by the authors unless otherwise mentioned.

EDITORS' NOTE

Climate change across the globe is changing the approach of academics and researchers to this subject, and the second volume of 2023 includes papers that all focus on researches oriented to the analysis of built environments that create a better relation to the natural environment. The volume includes four papers. Two papers included are based in Nigeria, one of these appraises Green Building rating systems for the country. The other paper from Nigeria highlights how poor housing conditions create a major impact on health and wellbeing of residents. The other two papers in the volume share area specific research on use of passive strategies in house design, one based in the big city of Lahore in Punjab province and the other based in the mountainous city of Mansehra, KPK province of Pakistan.

The first paper presents evidence on how poor housing quality leads to various health risks, illnesses, infectious outbreaks and distresses. It points towards the causes of poor habitability, recommending housing processes to include policies that minimize health risk. The long-term impacts of these health issues on people are of significance. The paper thus addresses an important concern with its research focus in Nigeria.

The second paper studies how there has been a transformation in the use of passive design elements from houses over decades, selecting houses for study from three different time periods. The study highlights the development of more aesthetically pleasing elements over those that offer comfort and better climatic relation in the city of Mansehra. Lack of proper enforcement and presence of building regulations are pointed out to be some factors responsible for this change.

The third paper studies awareness and implementation of passive design strategies by architects in Lahore city of Pakistan, through a survey method. It highlights that client demands compel architects to prefer aesthetically pleasing devices over considerations for passive design.

The fourth and the last paper of the volume presents an appraisal of Green Building rating systems with particular focus on their effectiveness in achieving sustainable development in Nigeria. Despite its regional focus, the analytical approach is applicable in other parts of the world too and can be a good reference.

The volume includes a book review of 'Saints, Sufis and Shrines - The Mystical Landscape of Sindh', authored by Zulfiqar Ali Kalhoro, in 2022. The book is reviewed by Sarah Sarmad.

Editorial Board

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MINIMISING HEALTH RISKS AND ENHANCING RESIDENTIAL BUILDING OCCUPANTS' SAFETY IN NIGERIA

Akande O. K., Obi-George L. C.**, Makun C. Y.***, Ekeke C. O.**** and Basil A. M.******

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ABSTRACT

Housing as an essential component of human life has not been given prominence in global health. Meanwhile, housing conditions can significantly impact the physical, mental, and social well-being of residents. In Nigeria, poor housing habitability is a threat to public health which has exacerbated building-related illnesses (BRI), and triggered outbreaks of infectious diseases among the residents. This research examined the quality of housing and habitability provision in Nigeria with a view to minimise health risks and enhance the residents' physical, mental, and social well-being. A structured questionnaire was administered to 120 respondents to solicit relevant data for the study. Descriptive and inferential statistics were used to analyse the collated data at various levels of the research. Findings indicate a significant effect of poor housing conditions such as inadequate ventilation, dampness, and overcrowding on the wellbeing of occupants in dwellings, which lead to outbreaks of infectious diseases such as respiratory illnesses, allergies, and psychological distress. The study concludes that inadequate and poor housing quality promote poor building habitability, causing outbreak of infectious diseases and increased health risk for occupants. The study recommends that authorities in the housing sector should provide policies to ensure adequate and well-constructed housing for adequate habitation, promoting health and safety of occupants and reducing the rate of outbreaks of infectious diseases. Also, there should be continuous public enlightenment among the people on the health implications of their living conditions to minimise health risk.

Keywords: Building habitability, diseases outbreak, health risk, residential houses, occupants safety, Nigeria.

INTRODUCTION

Housing is a significant factor in determining health, and inadequate housing is a serious public health problem (Krieger and Higgins 2002). Globally, World Health Organisation WHO (2009) evaluated the health status of Nigerians and reported that there is evidence that the main health indicators are impacted by housing conditions that results in outbreak of infectious diseases. Despite slight improvements, these problems have either persisted or gotten worse, and Nigeria's health outcome indicators are still high. Household and ambient air pollution is responsible for 99 deaths per 100,000 people (Anaemene, 2017). Housing quality, cost, location, social and community features are main factors that research has consistently shown to have significant impact on health (Rolfe et al., 2020).

For most countries in the globe, especially the developing ones, providing appropriate, high-quality housing for the populace has always been a big issue and task (Asa et al., 2017). Based on a variety of housing and health data sources, poor housing is linked to an increased risk of cardiovascular diseases, respiratory diseases, depression and anxiety, rheumatoid arthritis, nausea and diarrhoea, infections, allergic symptoms, hypothermia, and physical injury from accidents (Rolfe et al., 2020). Improving housing conditions can both improve health and save money, as people with poor health and wellbeing are more likely to reside in subpar housing (WHO 2009). Numerous illnesses have been connected to substandard housing habitability. Few African nations are exempt from the housing shortage (Anaemene, 2017) while in Nigeria, between 14 and 16 million people lack access to suitable housing (Fakunle et al., 2018).

It is imperative that people's living conditions be improved in every society. The residential space of a person's house has a significant impact on his or her health and well-being. People's everyday lives are fundamentally shaped by where they live (Olukolajo et al., 2013). Howden-Chapman et al., (2011) posited that physically safe homes are essential for maintaining good physical and mental health. It can significantly improve health when suitable housing shields people and families from risky exposures and gives them a sense of security, privacy, stability, and control. Contrarily, poor housing adds to health issues such of injuries, chronic illnesses, infectious diseases, and a lack of healthy children development (Krieger and Higgins 2002). Poor housing habitability, such as crowded living quarters, insufficient ventilation, dampness, and mould, can cause a variety of health issues, such as allergies, asthma, and respiratory disorders (Holden et al., 2023).

It has been demonstrated that the well-being of people is significantly influenced by the standard of housing conditions. Furthermore, the housing stock has been under strain due to rapid urbanisation and population increase in many regions of the world, which has resulted in the spread of overcrowded and substandard housing (Odoyi and Riekkinen 2022). This trend is especially noticeable in developing nations like Nigeria, where the rise of slums and informal settlements was fueled by a lack of affordable housing. Furthermore, poor housing conditions can worsen social isolation, stress, and mental health consequences, particularly in low-income and vulnerable groups (Novak et al., 2019).

There is currently a dearth of research that examines the connection between housing conditions and well-being, particularly in low-income and marginalised groups, despite growing recognition of the significance of housing conditions for people' well-being (Sano et al., 2021). This research gap emphasises the importance of policymakers and practitioners in understanding the effects of substandard housing circumstances and creating practical plans for enhancing housing habitability and enhancing inhabitants' wellbeing and reduce health risk. The objectives are: (i) To investigate the links between housing conditions, occupants' well-being and the rate of outbreak of infectious diseases (ii) To identify factors that influence the quality of housing that result to poor building habitability. (iii) To determine strategies for improving housing conditions and minimize health risk by promoting the well-being of residents. The research is guided by examining the following hypothesis:

H0: There is no significant relationship between housing conditions on the well-being of occupant in residential dwelling

H1: There is a significant relationship between housing conditions on the well-being of occupant in residential dwelling

LITERATURE REVIEW

Housing is defined by the World Health Organisation (WHO, 2009) as a residential environment that comprises the physical structure used for shelter as well as any services, facilities, equipment, and devices required or wanted for the family's and individual's social, physical, and mental well-being. The built environment and housing have a significant impact on how people's health is shaped. Inadequate housing has historically contributed to the spread of disease, impacted people's physical and mental health, and raised mortality rates. To maintain wholesome living circumstances, public health measures have been implemented throughout modern history, including slum clearance, sanitation, and the provision of inexpensive housing (Ferguson et al., 2020).

Increased human well-being and ultimately decreased health care expenses should result from the provision of sufficient housing. But there is little research to back up these assertions; rather, it primarily focuses on the health effects of outside risks in the vicinity of residences (Palacios et al., 2020). Housing is more than just a physical structure; it also refers to the quality and condition of a home, as outlined in Maslow's hierarchy of needs (Hablemitolu et al., 2010). Proper housing is crucial for security, healthy growth, and overall well-being. Poorly maintained housing increases the risk of harm and injury, impacting the entire family's wellness (Krieger and Higgins 2002).

Several strategies can be used to reduce health risks and improve the safety of residents of residential buildings. Investigating the application of architectural strategies to improve building occupant safety is one strategy (Isah et al., 2023). Understanding how indoor environmental quality (IEQ) affects occupant health and designing buildings with the best possible IEQ to protect health are also crucial (Glauberman, 2020). Furthermore, it is critical that residential building design take into account the unique needs of vulnerable groups, including the elderly, those with disabilities or chronic illnesses, and those from socioeconomically disadvantaged backgrounds (Awada et al., 2020). The indoor environmental quality, building design, and security measures are the main factors that affect health risks and safety of occupants of residential buildings. In addition to having an impact on indoor air quality (IAQ), factors like temperature, humidity, natural lighting, ventilation, and privacy in the room are crucial for overall comfort satisfaction (Mewomo et al., 2021).

Improving occupants' health and wellbeing requires ongoing building monitoring as well as fixing technical or design flaws. In order to promote zero-energy buildings, maintain indoor air quality, and lower health risks, ventilation must be balanced. Well-being and health are significantly impacted by housing conditions. Poor housing, linked to respiratory, cardiovascular, and infectious diseases, is especially valie for vulnerable populations like low-income individuals, ethnic minorities, and indigenous peoples (Howden-Chapman et al., 2022). Living space shortage has been identified as a risk factor for mental and behavioural illnesses, such as schizoaffective and schizophrenia disorders (Pevalin et al., 2017).

Furthermore, housing conditions may have an impact on indoor air quality and increase the chance of contracting infectious diseases (Akande et al., 2023). The necessity of safe and comfortable living conditions has been underscored by COVID-19 pandemic, as evidenced by lockdowns and reduced mobility (Capasso and D'Alessandro 2021). When viewed holistically and inclusively, housing retrofits and urban development have the potential to improve health and wellbeing. Housing is regarded as a critical infrastructure for enhancing and maintaining health and wellbeing outcomes (O'Sullivan et al., 2023). In relation to public health and well-being, housing conditions including the calibre of the building materials used, the structural integrity of the building, and the spatial arrangement have been the subject of research and policy (Stachura, 2013).

The total quality of living is largely influenced by the state of the internal and external housing environments. Empirical studies have demonstrated that the state of housing can directly impact homeowners' contentment with their homes (Kumar et al., 2021). Multidimensional approaches have been used to evaluate the quality of internal housing conditions, including the presence of sanitary and technical installations and standards of use (Wooszyn et al., 2023). It has been discovered that characteristics of high-quality buildings have a direct impact on homeowners' happiness, underscoring the significance of taking building quality into account when developing low-income housing (Stachura, 2013).

Adequate housing is essential for mitigating health risks and enhancing climate resilience; however, many homes still struggle with issues like excessive heat, cold, and ventilation, which can result in mould and dampness (Aigbavboa and Thwala 2014). More efficient housing policies that take into account the triple win of health, equity, improved public health, climate resilience, and environmental sustainability are required in order to address the intricate relationships that exist between housing, health, and the larger environment (Sharpe et al., 2018). These policies should adopt systemic approaches.

The well-being and health of residents can be greatly impacted by substandard housing conditions, which include inadequate ventilation, cramped living quarters, and homes that are wet, mouldy, and cracked. The way people interact with their neighbours and take part in community events can be impacted by these circumstances. Research have indicated a strong correlation between housing circumstances and mental health consequences, such as stress and anxiety (Newton et al., 2022). Physical health problems, including respiratory disorders and general poor health, can also result from inadequate housing (Jackelyn and Bina 2023). Furthermore, children's behavioural and emotional development, physical health, and academic performance can all suffer from homelessness and unstable housing (Gaylord et al., 2018). To protect people's health and wellbeing and that of communities, it is imperative that these housing conditions be addressed.

The spread of infectious diseases like cholera, meningitis, TB, and chickenpox can be aggravated by overcrowded housing conditions (Akande et al., 2018). A study by Lorentzen et al. (2022) reported that lead, cadmium, microorganism distribution, dust mite and cockroach allergens, peeling paint, and mould are among the characteristics of crowded housing that have been linked to adverse health effects. Furthermore, negative health effects like stress, sleep disturbances, and infectious diseases have been connected to crowded households (Jackelyn and Bina 2023). Further, crowding has been positively associated with

COVID-19 case rates, independent of density, socioeconomic and racial composition in neighborhoods (Mehdipanah, 2023). Therefore, overcrowded housing conditions can indeed facilitate the transmission of infectious diseases and have negative health consequences (Capasso and D'Alessandro 2021).

Numerous contexts have examined housing-related issues, including mould, dampness, noise, air quality, and material issues. Research has indicated that there are serious shortcomings in the habitability of houses and the surrounding area, such as moisture problems, crumbling facades, and hygienic concerns. Studies have revealed that mould and moisture are relatively common in European housing stock; estimates indicating that one in six homes in Europe may have these issues (Agyekum et. al., 2017).

A study carried out in Chieti, Italy revealed that a considerable proportion of homes had problems with mould and moisture, in addition to having insufficient floor space and not meeting the minimum legal requirements (Haverinen-Shaughnessy, 2012). Additionally, research on the relationship between housing and sleep health has shown that, among older adults from disadvantaged backgrounds, exterior housing issues are associated with reduced overall sleep time, more wake time following sleep onset, and lower sleep efficiency (Capasso and Savino, 2012).

The housing shortage in Nigeria is severe, especially in metropolitan areas with rapidly expanding populations (Idonije et al., 2022). Informal settlements lack basic utilities and are characterized by poor construction, insufficient maintenance, air pollution which exacerbates the outbreak of infectious diseases and increase the health risk among occupants (Udoh, and Uyanga 2013). However, a number of studies have found a link between substandard housing and residents' wellbeing in Nigeria. Approximately 28% of Nigerians live in housing units without toilet facilities, whereas 16% of the population does so, according to the Nigerian Bureau of Statistics (NBS 2020) report on housing and household survey. Manisalidis et al., (2020) suggested that these factors have been associated to adverse health outcomes, such as an increased risk of infectious infections, respiratory troubles, and mental health problems. Awe et al., (2023), specified that residents of subpar housing in Nigeria have a lower quality of life than those who live in appropriate housing. According to the study, people who live in subpar housing units score lower on measures of their physical, emotional, and social well-being.

Alabi and Balogun (2021) stated that residents of substandard housing in Nigeria were more likely to experience depression. According to the study, those who live in overcrowded and inadequately ventilated housing have a higher chance of developing depression than people who live in suitable housing. Based on the data on wellbeing in Nigeria related to housing circumstances, a poor living environment is linked to worse health outcomes and a reduced quality of life. For both people and communities, improving housing conditions can have major advantages. For instance, a study conducted in the US discovered that rehabilitating low-income housing with energy-efficient modifications improved health outcomes, such as decreased asthma symptoms, as well as reduced energy expenses for inhabitants (Breysse et al., 2017). Some of these dwelling issues that may have an impact on residents' wellbeing include indoor air quality, noise pollution, temperature extremes and housing quaility.

Factors influencing adequate housing habitability

Income and affordability

Nigerians struggle to afford housing, leading to overpopulation, poor living conditions, and informal settlements, with 70% living on less than $2 per day (Adedeji, et al., 2023).

Urbanization and population growth

Nigeria faces a housing shortage due to rapid urbanization and population growth, resulting in informal settlements and slums, unofficial settlements, and subpar housing in urban areas (Daniel et al., 2015; Akande, 2021).

Building materials and construction standards

Nigeria's subpar housing is due to inadequate materials, construction standards, and disregarded codes, resulting in unstable structures and collapsed structures. Factors include substandard workmanship, inadequate supervision, and subpar materials (Adedeji, et al., 2023).

Climate and environmental factors

The tropical climate in Nigeria can be hard on structures. The health of residents may be impacted by dampness and mould caused by poor drainage and ventilation systems. In some areas of the nation, flooding is a major issue that damages homes and forces evictions of citizens. Okon et al., (2021), stated that environmental degradation and climate change have a substantial impact on housing habitability in Nigeria.

RESEARCH METHODOLOGY

This study employed both qualitative and quantitative research methods. At its core, qualitative research asks open-ended questions like "how" and "why" that do not readily lend themselves to numerical replies. This type of study offers a deeper knowledge of experiences, phenomena, and context. Through qualitative research, it is possible to comprehend issues that are difficult to quantify, such as the human experience.

A comprehensive understanding of housing laws and housing needs planning in Bosso Minna was obtained through mixed-method research, which blends qualitative and quantitative research techniques. Both quantitative data and qualitative insights from focus groups and interviews were gathered, analysed, and interpreted with the help of mixed-method research. This method was used to evaluate the efficacy of current housing laws and pinpoint areas in need of development. In-depth insights into the experiences and viewpoints of people impacted by housing regulations were obtained through qualitative research techniques like site visits and interviews. Statistical information on housing trends and patterns were obtained through quantitative research techniques like census and GIS analysis. By integrating these methods, scholars can develop a comprehensive picture of Bosso Minna's housing predicament and offer well-informed suggestions for planning and policy.

Study Area

The study area Bosso estate is located in Minna the state capital of Niger state. Minna, the capital city of Niger State, in Nigeria's north central geopolitical zone. It is a large neighborhood that connects the cities of Abuja, Kano, Ibadan, and Lagos. It has a land size of 76,363 square kilometers. It is situated between the latitude and longitude values of 9.58 and 6.54 east of the Greenwich Meridian (see Figures 1 and 2). In Minna, there are 25 local government areas, one of which Bosso is one of the local governmet area that houses the study location “Bosso Estate” (Abd'Razack, 2012). The estate (Figure 3) is made up of 210 houses which comprises of 2 bedroom, 3 bedroom, and 4 bedroom apartments and the questionnaire distribution is 37%, 33% and 30% respectively. 36 houses were randomly selected for sampling based on the conditions of the houses.

Determining the population of the study location, NPC (2006) estimates that an average of 6 people live in a household which give the study population of 216. In research, various approaches are employed to determine the sample. The sample size is determined by the study's need for reliable and authentic findings in order to establish final conclusions (Akande, et al. 2015). According to Bulmer and Warwick (1993), "the size of the sample is more a question of convenience," and a compromise among various criteria (expenses and precision, for example). The sample size for this study was determined using Krejcie and Morgan (1970) reference. The sample size for the questionnaire survey was 120 respondents.

The study area was chosen because of the neglected, dilapidated condition of the homes here. The residents are now experiencing health issues as a result. Bosso Estate in Minna has subpar housing conditions compared to adequate housing quality, which results in issues with mould, dampness, noise, poor air quality, and thermal comfort. Additionally, poor housing conditions at the study site were associated with the selection of building materials, the construction method, and the availability of adequate professional services. In addition, properties with the worst environmental and property characteristics such as overcrowding and tenant abuse are found in high-density neighbourhoods like Bosso Estate. Furthermore, the community's dissatisfaction stemmed from their performance and inadequate infrastructure. The poor quality of housing in the area is a result of these factors as well as rapid urbanisation of the area and the absence of suitable housing regulations.

The Questionnaire Survey

Survey research design which involves the administration of questionnaires to the target population was applied so as to extract necessary information for this study. A total of 140 questionnaires were distributed, with 120 returned, with a ratio of 60 male respondents to 60 females. While, data were collected from 120 respondents who live in the study area using close ended questionnaires that were made easy to understand. The collected data was analysed using Statistical Package for Social Sciences version 22 and the results presented using texts, tables and charts for easy comprehension. The Cronbach’s alpha was used to establish the reliability and validity of the variable data in this study. Cronbach’s alpha factor typically varies within 0 and 1. Significantly the data collected factored a coefficient of 0.71 with 5 items (Table 1) analysed. Acceptable according to Ruchi et al., (2014), this in acceptable asserting that there is actually no lower limit to the coefficient, the closer Cronbach’s alpha coefficient is to 1.0, the greater the internal consistency of the items in the scale.

Figure-1: Map of Nigeria Showing Niger State.

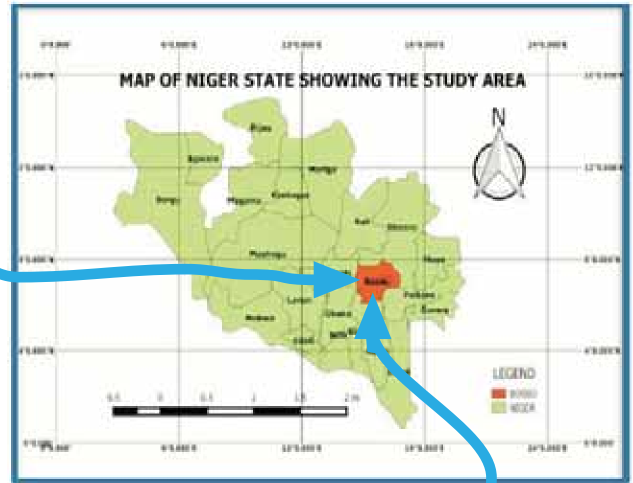

Figure-2: Map of Niger State Showing Niger Bosso.

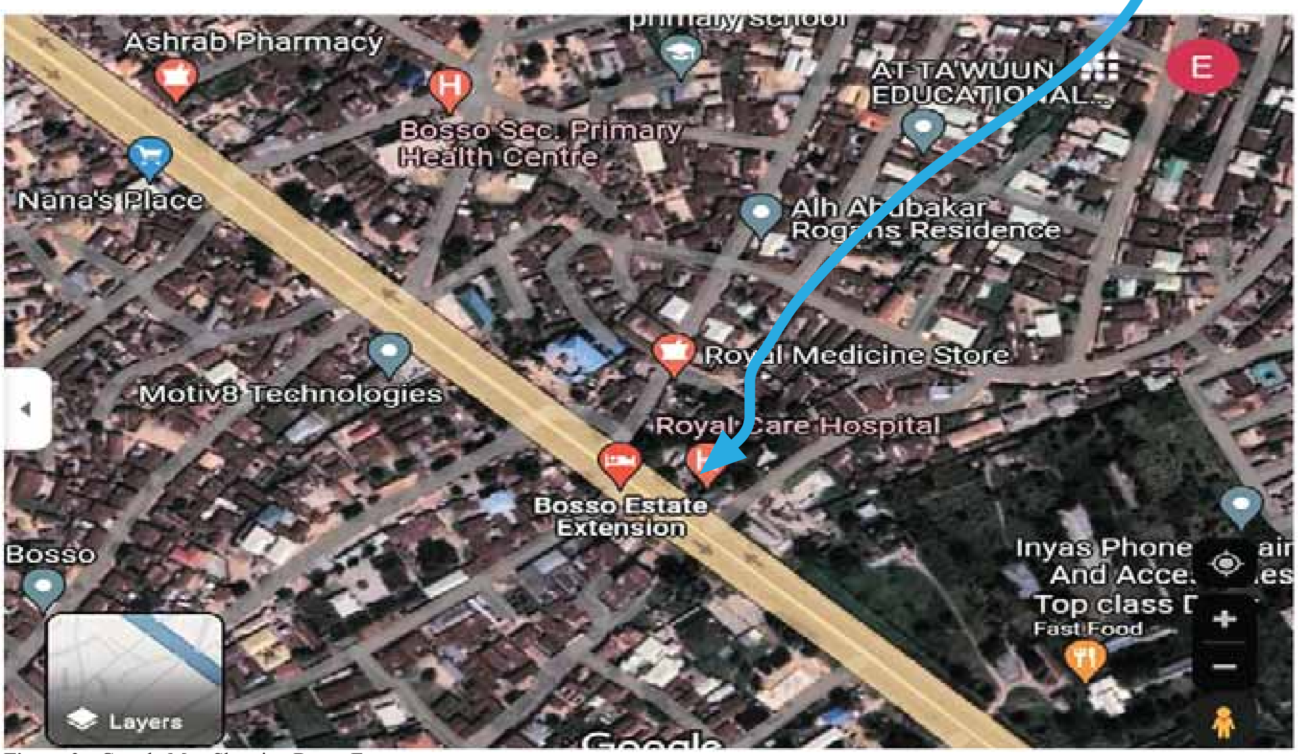

Figure-3: Google Map Showing Bosso Estate.

Data Presentation and Analysis

Quantitative data presentation involves arranging analyzed data that has been collected and interpreting the obtained findings or results. Statistical Package for Social Sciences (SPSS) version 22 was utilized to analyze the quantitative data. To display the results, tables and charts were utilized. An online questionnaire were administered through the use of Google form. A total of 120 responses were recieved. This represented 100% response rate and considered adequate for the analysis carried out according to Moser et al., (1984).

RESULT AND DISCUSSION

Table 2 shows the age range of respondents in the study. As shown, there are 22 respondents (18-24 years), 34 respondents (25-30 years), 22 respondents (31-45years), 42 respondents

(46 and above). This implies that most of the respondents are 46 and above years followed by 25-30 years. This data is in support of Balloun et al. (2011) research where there is need for multiple respondents in survey research for sufficient supporting evidence.

As revealed, there are 60 male respondents (50%) and 60 female respondents (50%). This implies that both male and female gender has equal respondents in the study. The analysis also shows the educational background of the respondents. The data shows that 40% of the respondents have bachelor degree, 15% had Master degree, 18.3% are HND holders, 5% are doctorate degree holders and 10% are ND holders while 8.3% have passed secondary school holders. This implies that the majority of the respondents are educated and the questionnaire will be well understood by the respondents. Table 3 present the findings on the effects of housing condition and its impact on building occupants. It can be seen that the respondents agreed on two of the six questions, with mean value of approximately 3. The result implies that the listed items affects the resident's wellbeing and health condition.

Similar result is demonstrated in Figure 4 which shows the outcome of the survey conducted to gather respondents' views on poor housing habitability and its impact on wellbeing and health. The findings obtained agrees with those of Owoeye, and Omole (2012) study that poor housing conditions and insufficient household services contribute 52.3% to environmental quality, air pollution, and infectious diseases.

Table-1: Reliability Test.

Section	Cases	Reliability	Interpretation
Section2	4	0.544	Moderately reliabe
Section3	5	0.606	Strongly reliable
Section4	6	0.677	Strongly reliable
Section5	10	0.699	Strongly reliable
Section6	6	0.718	Strongly reliable
Overall	33	0.659	Strongly reliable

Table-2: Demographics of Respondents.

Variable	Frequency	Percentage	Variable	Frequency	Percentage
Age			**Employment Status**		
18-24	22	18.3	Employed full-time	37	30.8
25-30	34	28.3	Employed part-time	12	10
31-45	22	18.3	Self-employed	41	34.2
46 and above	42	35	Unemployed	12	10
Gender			Retired	6	5
Male	60	50	Student	12	10
Female	60	50	**Monthly Income**		
Marital Status			Less than N50,000	42	35
Single	85	54.2	N50,00-N100,000	20	16.7
Married	53	44.2	N100,000-200,000	29	24.2
Divorced	2	1.7	N200,000-500,000	14	11.7
Educational Background			N500,000 and above	15	12.5
Secondry School	10	8.3	**Housing Type**		
HND	22	18.3	Self-contained apartment	17	14.2
ND	12	10	Room in a share apartment	7	5.8
Bachelor Degree	48	40	One bedroom apartment	9	7.5
Master Degree	18	15	Two bedroom apartment	44	36.7
Doctoral Degree	6	5	Three bedroom apartment	37	30.8
Other	4	3	Other	6	5
			How Many People are Living in Your Household		
			1-5	67	55.8
			6-10	37	30.8
			10 and above	16	13.3

The effects of housing condition on the occupants physical, mental and social well-being is presented in Table 4. From the result, over 2.50 mean value obtained indicates a positive relationship between them. This implies there is a strong relationship between variables or datasets presented. These findings are generally in agreement with study Cowie et al., (2015); Lorentzen et al., (2022) which examine the associations between the built environment and mental health and found strong relationship among the presented data.

The analysis also shows that 48.3% of the respondents occasionally experience temperature fluctuation, 39.2% frequently experience temperature fluctuation, and 8.3% always experience it while 4.2% never experience temperature fluctuation in their residence with a mean value of 2.51. This implies that the respondents frequently experience temperature fluctuation in housing. This can result in poor air quality which leads to increased respiratory infections and coughing. Cowie et al. (2015) found that air pollution

Table-3: Effects of Housing Condition and its Impact on Users.

Variable	Frequency (percentage)	Mean Value
How would you rate the overall condition of your current hoursing		2.34
Excellent	22(18.3)	
Good	48(38.3)	
Fair	41(34.2)	
Poor	11(9.2)	
How often do you experience cracked wall, dampness, mold or mildew in your house		2.81
Never	7(5.8)	
Rarely	25(20.8)	
Sometimes	71(59.2)	
Frequently	17(14.2)	
How Satified are you with the natural light in your house		2.51
Not at all satisfied	17(14.2)	
Slightly satisfied	46(38.3)	
Moderately satisfied	36(30)	
Very satisfied	21(17.5)	
How satisfied are you with the ventilation and air quality in your home		3.02
Not at all satisfied	2(1.7)	
Slightly satisfied	30(25)	
Moderately satisfied	52(43.3)	
Very satisfied	36(30)	
How satisfied are you with the assess tobasic amenities such as clean water and sanitation in your home		2.21
Not at all satisfied	32(26.7)	
Slightly satisfied	51(42.5)	
Moderately satisfied	17(14.2)	
Very satisfied	20(16.7)	
How satisfied are you with the level of noise pollution or disturbances from outside your home		2.95
Not at all satisfied	8(6.7)	
Slightly satisfied	28(23.3)	
Moderately satisfied	46(38.3)	
Very satisfied	38(31.7)	

causes harmful health outcomes, including increased mortality rates from heart attacks, strokes, lung cancer, chronic non-cancer lung disease, asthma attacks, and respiratory problems. Short-term exposure to PM and ozone also contribute to these issues.

A survey found that noisy housing conditions negatively impact occupants' mental well-being, with 49.2% of the respondents occasionally experiencing noise disturbance from their neighbourhood, 15.8% frequently experience noise disturbance, 3.3% always experience noise disturbance while 31.7% never experience noise disturbance with a mean value of 1.91 which implies that the respondents experience noise disturbance from their neighbourhood. This aligns with Akande et al., (2022) findings, which suggest high noise annoyance is linked to impaired mental health. The study suggests improved environmental quality in the built environment and synergistic interventions from architects, professionals, and environmental protection agencies to address urban environmental noise pollution in residential environments. Housing conditions that are noisy can have detrimental effects on mental health, such as contributing to anxiety and depression (Riva et al., 2022). Respiratory issues, infections, allergies, and asthma can result from damp or mouldy living conditions (Torresin et al., 2022; Agyekum et al., (2017).

In order to identify the factors that influence the quality of housing that result in poor building habitability, Relative Important Index (RII) was used. The Relative Important Index formula is given as:

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

Where W= Weight given to each statement by the respondent
A=Highest response integer which is 4
N=Total number of respondent for users=120

Findings as shown in Table 5 present the factors that influence the quality of housing resulting in poor building habitability. As can be seen, cultural and traditional beliefs and practices were ranked first as the factors that influence quality of housing and poor building habitability. Corruption and inefficiency in the housing sector, natural disasters and climate change, poverty were ranked 2nd, 3rd and 4th factors

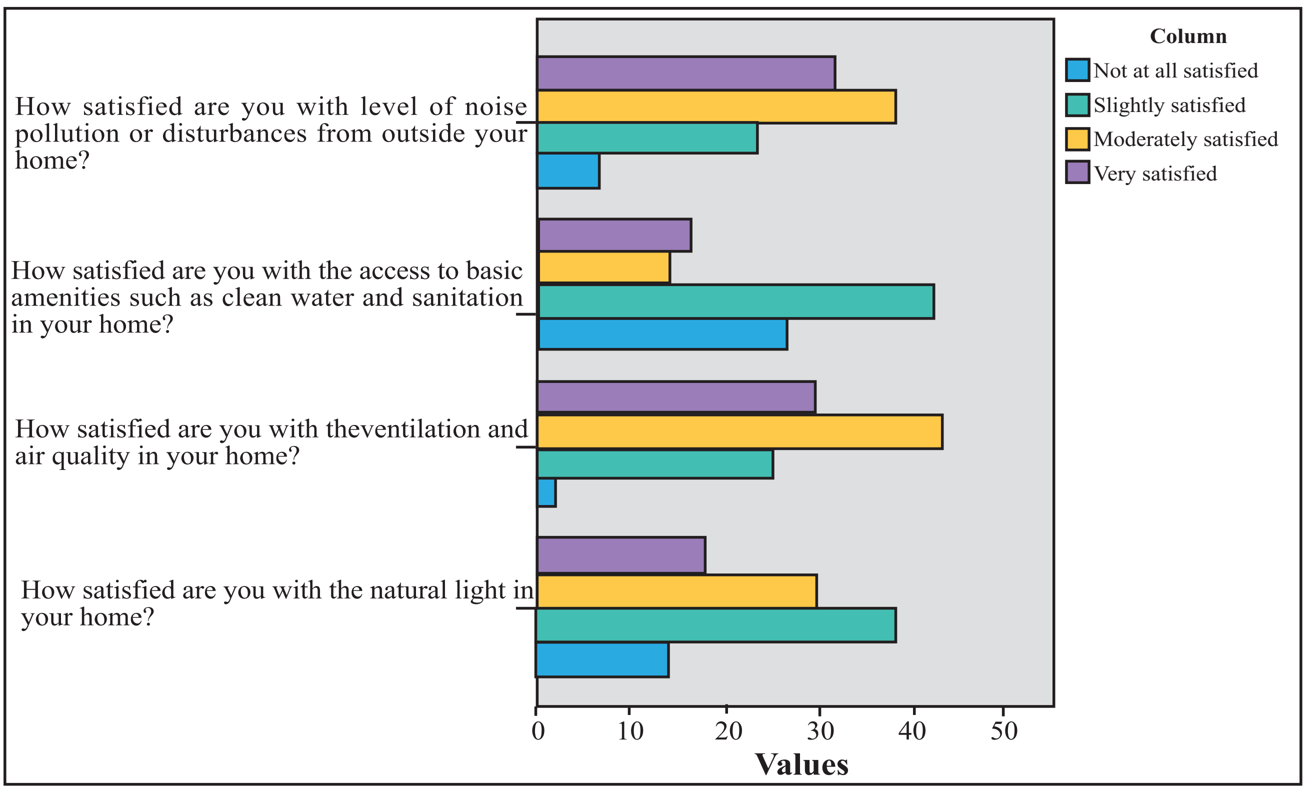

Figure-4: Effects of housing condition and its impact on users.

Table-4: Effects of Housing Condition on Physical, Mental and Social Well-Being.

Variable	Frequency (percentage)	Mean Value
How does the condition of your living space affect your ability to relax and unwind		2.50
Positively	29(24.2)	
Negatively	22(18.3)	
No effect	49(40.8)	
Don't know	20(16.7)	
How often do you feel stressed or anxious because of the condition of your living space		2.1
Never	30(25)	
Occasionally	50(41.7)	
Frequently	38(31.7)	
Always	2(1.7)	
How often do you experience noise disturbance from your neighbour		1.91
Never	38(31.7)	
Occasionally	59(49.2)	
Frequently	19(15.8)	
Always	4(3.3)	
How does the noise level affect your daily life and well-being		1.74
Not at all	47(39.2)	
Slightly	57(47.5)	
Moderately	16(13.3)	
Significantly	0	
How often do you experience temperature fluctuation in your housing?		2.51
Never	5(4.2)	
Occasionally	58(48.3)	
Frequently	47(39.2)	
Always	10(8.3)	
How does temperature fluctuation affectr your daily life and well-being		2.4
Never	14(11.7)	
Occasionally	56(46.7)	
Frequently	38(31.7)	
Always	12(10)	
How often do you experience physical injuries or accidents in your home due to poor lighting, cracked floors or other damages in the house		1.95
Not at all	44(36.7)	
Slightly	42(35)	
Moderately	29(24.2)	
Significantly	5(4.2)	

that influence housing condition while government policies and regulations, lack of access to finance, lack of maintenance and repair of housing, power shortage were ranked 7th, 8th, 9th and 10th.

Table 6 shows the strategies for improving housing conditions. From the analysis, six factors were suggested as ways to improve the condition of housing in the case area location. Upgrading existing houses has a mean value of 1.47, building new affordable housing has a mean value of 1.7, subsidising tax for first-time house buyers has a mean value of 1.9, enforcing building codes and regulations has a mean value of 1.8, improving personal hygiene has a mean value of 1.79, proper maintenance and repair of housing has a mean value of 1.55. This finding is in agreement with Tilburg (2017), who stated that strategies for improving housing conditions and minimising health risks include legal and policy interventions, housing improvement, economic crises, creation of a social housing stock, and behavioural factors. Legal and policy interventions can assist communities in addressing the adverse impacts of poor housing conditions and improving the health and safety of residents, especially vulnerable populations.

To examine if there is any relationship between housing conditions and the well-being of occupant in residential dwelling, a test of correlations between housing conditions on the well-being of occupant was carried out. This is to determine if there was any or no significant relationship between housing conditions on the well-being of occupant in residential dwelling. According to the findings from Table 7, there is a significant relationship between housing condition and its effect on well-being. The correlation coefficient of -0.360 and a p-value of 0.000 which is less than 0.05 obtained implies a negative relationship between the housing condition and well-being i.e. as the housing condition moves from not satisfied to satisfied by the respondents, its effect on physical, mental and social well-being reduces.

The individual relationship (one to one) relationship is presented in Table 8. From the Table, result shows there is a significant relationship between how often the respondent

Table-5: Factors that influence the quality of housing that result to poor building habitability.

Factors Influencing Housing Condition	**SA**	**A**	**SD**	**D**	**ΣW**	**RII**	**Rank**
Government policies and regulations	45 (37.5)	53 (44.2)	6 (5)	16 (13.3)	233	0.485	7
Poverty	39 (32.5)	45 (37.5)	13 (10.8)	23 (19.2)	260	0.542	4
Lack of access to finance	37 (30.8)	66 (55)	10 (8.3)	7 (5.8)	227	0.473	8
Poor urban planning and management	32 (26.7)	66 (55)	6 (5)	16 (13.3)	246	0.513	5
Rapid population growth	42 (35)	53 (44.2)	7 (5.8)	18 (15)	241	0.502	6
Corruption and inefficiency in the housing secotr	33 (27.5)	35 (29.2)	10 (8.3)	42 (35)	301	0.627	2
Cultural and Traditional Beliefsand Practices	13 (10.8)	45 (37.5)	31 (25.8)	30 (36.8)	308	0.642	1
Natural disasters and climate change	24 (20)	67 (55.8)	13 (10.8)	16 (13.3)	261	0.544	3
Lack of maintenance and repair of housing	36 (30)	69 (57.5)	12 (10)	3 (2.5)	222	0.463	9
Power shortage	55 (45.8)	48 (40)	4 (3.3)	2 (1.7)	217	0.452	10

experience cracked walls, dampness, mold or mildew in their homes and how often they feel stressed or anxious because of the condition of their living spaces, with a coefficient os 0.181 and a p-value of 0.048 which is less than 0.05. This implies that as their experienced of cracked wall, dampness, mold or mildew in their homes increases the property's they became more stressed or anxious about the condition.

A significant and positive relationship was found between cracked walls, dampness, mold or mildew and how noise level affects occupants daily life and well-being. Such a relationship was also fund between cracked walls, dampness, mold or mildew and the experience of temperature fluctuations in housing. This implies that the frequency of temperature swings in the house is connected to issues like cracked walls, moisture, mould, or mildew. High relative humidity and precipitation are linked to self-reported home mould, wet spots, and water damage.

A negative relationship between satisfaction with natural light and how the condition of their living spaces affect their ability to relax and unwind with a coefficient of -0.220 and a pvalue of 0.016 which is less than 0.05. This implies that as their satisfaction level increases from not satisfied to satisfied, the condition of their living spaces affecting their ability to relax and unwind reduces.

A significant and negative relationship was found also between how satisfied the respondents are with natural light in their home and how the respondent feel stressed or anxious because of the condition of their living spaces with a coefficient of -0.378 and a pvalue of 0.00 which is less than 0.05. This implies that as their satisfaction level increases from not satisfied to satisfied, the stressed and anxiety of the condition of their living reduces. Lastly there is a significantly negative relationship between how satisfied the respondents are with natural light in home and how often they experience temperature fluctuation with a coefficient of -0.233 and a pvalue of 0.010 which is less than 0.05. This implies that as their satisfaction level increases from not satisfied to satisfied, their experience of temperature fluctuation in the homes reduces. A negative relationship was found between how satisfied the respondents are with the ventilation and air quality in their home and how the respondents felt stressed or anxious because of the condition of their living spaces. This produced a coefficient of -0.341 and a pvalue of 0.00 which is less than 0.05. This implies

Table-6: Strategies for Improving Housing Conditions and Minimize Health.

Strategies for Improving Housing Condition	SA	A	SD	D	Mean Value	Decision
Upgrading existing houses	67 (55.8)	51 (42.5)	0	2 (1.7)	1.47	A
Building new affordable housing	38 (31.7)	76 (63.3)	6 (5)	0	1.7	A
Subsidizing tax for first time house buyers	50 (41.7)	45 (37.5)	10 (8.3)	15 (12.5)	1.9	A
Enforcing building codes and regulations	41 (34.2)	66 (55)	8 (6.7)	4.2	1.8	A
Improving personal hygiene	48 (40)	54 (45)	12 (10.8)	5 (4.2)	1.79	A
Proper maintenance and repair of housing	64 (53.3)	51 (42.5)	0	5 (4.2)	1.55	A

Table-7: Correlations Between Housing Conditions on the Well-Being of Occupant.

			Housing Condition	Effect on Well Being
Spearman's rho	Housing Condition	Correlation Coefficient	1.000	-.360**
		Sig. (2-tailed)	.	.000
		N	120	120

that as their satisfaction level increases from not satisfied to satisfied, the stressed and anxiety of the condition of their living reduces.

Further there is a significantly negative relationship between satisfaction are with ventilation and air quality in of home and the experience temperature fluctuation in their homes with a coefficient of -0.432 and a p-value of 0.00 which is less than 0.05. This implies that as their satisfaction level increases from not satisfied to satisfied, their experience of temperature fluctuation in the homes reduces. There is a negative relationship between satisfaction with ventilation and air quality in home and experience of noise disturbances from the neighourbood, and the effect of noise level on daily life and well-being with a coefficient of -0.186 and -0.207 and a p-value of 0.042 and 0.023 respectively. This implies that as their satisfaction level of ventilation and air quality increases from not satisfied to satisfied, their experience of noise disturbance and its affect on their well-being reduces.

There was a negative relationship between respondents satisfation with the access to basic amenities such as clean water and sanitation and now temperature fluctuation affect their daily life and well-being in homes with a coefficient of -0.182 and a p-value of 0.049 which is less than 0.05. This implies that as their satisfaction with the access to basic amenities level increases from not satisfied to satisfied, their effect of temperature fluctuation on their daily life and well-being reduces. There is a negative relationship between satisfaction with access to basic amenities such as clean water and sanitation and how they experience physical injuries or accidents in their home due to poor lighting, cracked floor or other damages and the noise level affect their daily life and well-being with a coefficient of -0.198 and -0.388 and a p-value of 0.030 and 0.00 respectively. This implies that as their satisfaction level of access to basic amenities such as clean water and sanitation increases from not satisfied to satisfied, their experience of physical injuries or accidents in home due to poor lighting, cracked floor or other damages and the noise level affect on their daily life and well-being reduces.

A negative significant relationship was found between satisfaction of respondents with the level of noise pollution or disturbances outside their home and condition of their living spaces affecting their ability to relax and unwind in their homes with a coefficient of -0.266 and a p-value of

Table-8: Relationship Between Housing Condition and Well-Being.

			How does the condition of your living space affect your ability to relax and unwind?	How often do you feel stressed or anxious because of the condition of your living space?	How often do you experience noise disturbances from your neighbours?	How does the noise level affect your daily life and well-being?	How often do you experience temperature fluctuations in your housing (too hot or too cold)?	How does temperature flusctuations affect your daily life and well-being?	How often do you experience physical injuries or accidents in your home due to poor lighting, cracked floors or other damages in the house?
Spearman's rho	How often do you experience cracked walls, damages, mold or mildew in your home?	Correlation Coefficient	-.99	**.181***	.160	**.271****	**.359****	**.370****	**.305****
		Sig. (2-tailed)	.283	**.048**	.081	**.003**	**.000**	**.000**	**.001**
	How satisfied are you with the natural light in your home?	Correlation Coefficient	**-.220***	**-.378****	.081	.056	**.233***	**.055**	-.137
		Sig. (2-tailed)	**.016**	**.000**	.378	.544	**.010**	.550	.135
	How satisfied are you with the ventilation and air quality in your home?	Correlation Coefficient	-.075	**-.341****	**-186***	**-.207***	**-.432****	.053	**-.270****
		Sig. (2-tailed)	.415	**.000**	**.042**	**.023**	**.000**	.567	**.003**
	How satisfied are you with the access to basic amenities such as clean water and sanitation in your home?	Correlation Coefficient	.031	-.071	-.125	**-.388****	.150	**-.180***	**-.198***
		Sig. (2-tailed)	.735	.438	.174	**.000**	.103	**.049**	**.030**
	How satisfied are you with the level of noise pollution or disturbances from outside your home?	Correlation Coefficient	**-.260****	**-.189***	**-.203***	**-.424****	-.053	-.174	.126
		Sig. (2-tailed)	**.004**	**.038**	**.026**	**.000**	.565	.058	.169
		N	**120**	**120**	**120**	**120**	120	120	120

0.004 which is less than 0.05. This implies that as their satisfaction with the level of noise pollution or disturbances from outside their home increases from not satisfied to satisfied, their condition of living spaces affecting their ability to relax and unwind in homes reduces. There is negative and significant relationship between satisfaction of respondents with the level of noise pollution or disturbances from outside and how often they feel stressed or anxious because of the condition of their living spaces, how often they experience noise disturbances from their neighbourhood, and how noise level affect their daily life and well-being in their homes with a coefficient of -0.189, -0.203, and -0.424 and a p-value of 0.038, 0.026, and 0.000 respectively. This implies that as their satisfaction level of noise pollution or disturbances from outside their home increases from not satisfied to satisfied, their experience how often they feel stressed or anxious because of the condition of their living spaces, how often they experience noise disturbances from neighbourhood, and how the noise level affect their daily life and well-being in their homes reduces.

CONCLUSION AND RECOMMENDATION

The research examines building habitability towards the outbreak of infectious diseases with a specific focus on minimising health risk for adequate physical, mental, and social well-being of the occupants in residential housing. Based on the study, the habitability of residential housing in the study location is poor, which promotes conditions like inadequate ventilation, dampness, and overcrowding lead to various health problems such as respiratory illnesses like allergies and psychological distress. Therefore, it is recommended that the government, housing developers, and stakeholders in the housing sector take measures to ensure that housing are designed and constructed to meet basic standards of health and safety. This can be achieved through the enforcement of building codes, policies and regulations, provision of adequate infrastructure and services, and promotion of sustainable and affordable housing initiatives. Additionally, there is a need for increased awareness and education on the importance of good housing conditions and their impact on the well-being of occupants. This can be done through public campaigns, community engagement, and provision of information to prospective tenants and homeowners.

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TRANSFORMATION OF PASSIVE DESIGN ELEMENTS FOR ACHIEVING THERMAL COMFORT IN RESIDENTIAL BUILDINGS OF MANSEHRA CITY, PAKISTAN FROM 1990 TO 2019

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ABSTRACT

Among the most evolving issues in recent years, there is growing concern over global warming throughout the world. The construction industry has been considered among the major contributors to global warming. The use of building envelope along with the heating, cooling, and lighting design, operations, and infrastructures are the prime factors of this contribution. Due to this reason, the thermal comfort of buildings has become a major concern in building design globally. The following research explored the building design elements used for thermal comfort in residential buildings of Mansehra City of Khyber Pakhtunkhwa province in Pakistan and analyzed its transformation during the last three decades. The study proceeded by documenting and comparing various design elements to understand their transformation within documented time periods i.e. thermal mass, fixed shading devices, and the ratio of open and closed spaces. These elements were evaluated for their effectiveness in providing thermal comfort. It was concluded that these design elements have been adapted and modified with time with little concern for sustainability. It was found that the focus has shifted from building orientation, sun path, and wind directions to aesthetically pleasing forms only which makes them saleable and lack human comfort. The use of passive means to achieve thermal comfort was neglected. The research concludes by suggesting incorporation of appropriate thermal comfort components and methods into effective solutions for improved building designs, lower energy demand, and a better indoor atmosphere.

Keywords: Thermal Comfort, Passive Design, Residential Building, Mansehra City, Global Warming

INTRODUCTION

Urbanization is a serious concern in today's world. Rapid urbanization makes people more vulnerable to climate change impacts (Chai et al, 2022). Buildings are one of the primary sources of climate change and contribute significantly to global warming. Building construction, operation, and utilization have led to emissions of massive CO_2 in the ambient air (Neill, 2020). According to International Energy Agency (IEA) (2019), buildings and their construction are responsible for one-third of total global energy consumption and nearly 40% of annual global CO_2 emissions due to increase in energy consumption by structures. Numerous problems and challenges arise from the building sector in reducing CO_2 emissions (Ali et al., 2020). The exploitation of non-renewable energy resources, poor building design, and lack of sustainability consideration in urbanization have been holding back CO_2 emission mitigation measures in the building sector (Shaikh, 2021). Numerous factors contributed to this increase, including the growing demand for energy used in heating and cooling, increased house air conditioning capacity, and extreme weather conditions. The current state of climate change and the high level of energy consumption in building development are directed to address these global challenges using sustainable building practices.

Pakistan is no exception as a developing country in South Asia, in facing an energy crisis with its shortage and an imbalance between demand and production. Along side, the country is also facing a high population growth rate. The population of the country has increased by 57% and expected to double in the next 30 years (Umar, 2018). Although Pakistan contributes not more than 1% of global Greenhouse Gas (GHG) emissions but has been amongst the most vulnerable country in the region facing climate change and global warming disasters (Abubakar, 2019). The effects of global warming may already be evident in terms of monsoon start and end dates, extreme weather conditions, floods, drought, and other natural disasters (Abbass et al., 2022). Almost 50% of the total primary energy is consumed by residential and commercial buildings in Pakistan that produce more than one-third of total CO_2 emissions (Ghafoor et al., 2020; Rehman et al., 2021). The global energy consumption in residential buildings is highest at 22% (Anwar et al., 2021) with the increase in demand for energy in buildings reaching 24% globally by 2050 (Khan et al., 2022). In this context, the construction of buildings with enhanced energy characteristics is extremely inappropriate. Development in the use of passive techniques in new housing is undoubtedly an avenue that is being reconsidered in many parts of the construction industry (Tatarestaghi et al., 2018).

In Pakistan, the energy consumption by the residential sector is at the highest rate with 45% of overall energy consumption (Maan et al., 2021; Finance Division GoP, 2020). For designing energy-efficient buildings, the building codes of for mager cities are available but most cities are unable to develop proper codes of building bye-laws. Houses are constructed with no climatic considerations. Active systems based on personal choices are used to offer comfortable temperatures inside the houses with more energy use resulted in increase in cost eventually (Mahar et al., 2019). Taking advantage of natural energy flows to achieve thermal comfort is all about passive design. From building orientation to the building envelope, there is a variety of techniques that can be provided to achieve thermal comfort in residential buildings (Rajapaksha et al., 2003). By using appropriate passive design strategies buildings have the potential to save 50 – to 60% of energy (Ali & Rakshit, 2019). Studies reported that building orientation, layout, materials, envelope, thermal mass, window design, and shading provision, provision of courtyards, verandas are fundamental elements that maximize the use of natural ventilation and daylight to improve a building’s performance and enhance indoor thermal comfort (Tatarestaghi et al., 2018; Maleki, 2011; Nugroho et al., 2020; Jamaludin et al., 2018; Shaheen et al., 2016; Chahal & Aulak, 2018; Loo et al., 2021).

Climatic challenges in developing countries tend to force the population towards survivability limits. The Earthquake of 2005 in Pakistan was such an event that resulted in revisiting some of the major applicable bylaws across the country. Being a major city hit by the incident, Mansehra as one of the largest cities in the KPK province had to revisit the design paradigm and shift to structural prioritization. Belonging to a highly mountainous region, the city is surrounded by dense forests and serene environments, a large population influx occurred leading to enhanced urbanization. Mansehra today has a better formulation of bylaws after the 2005 earthquake as compared to other small cities of Pakistan. However, these codes focused only on the building’s structural elements rather than considering it as a unit. Even so, it was seen that there is a big difference between the existing standards in terms of structure and built form. There are no standards in the regulations relating to passive construction like thermal insulation or air leakage-tightness, etc. This has led buildings to overheat or cool during the changing of summer and winter seasons respectively. The study aims to contribute to the understanding of use of passive design elements in residential buildings to achieve thermal comfort and their transformation over a selected time period in Mansehra city. Multiple studies discuss the residential buildings of Pakistan, relating climatic conditions with the parameters of thermal comfort (Mahar, Amer & Attia, 2018; Nicol et al., 1999; Shaheen et al., 2016; Maan et al., 2021) and found knowledge gaps between the building design and climatic considerations (Mahar et al, 2019).

Not enough literature was available related to the residential buildings of Mansehra region. The purpose of the study was to assess the transformation of residential buildings with time and the objective was to evaluate and compare selected passive design parameters including thermal mass, fixed shading, and the ratio of open and closed spaces in residential buildings of Mansehra over three decades. Three houses were selected, documented and examined from each decade that is 1990-1999, 2000-2009, 2010-2019 as a sample for a true representation of the population based on the similarity of design replication in the explored overall context.

STUDY AREA:

Mansehra, situated in the Hazara Division of Khyber Pakhtunkhwa province has a total area of 4579 km² and has urban population of 87,657 out of a total population size 1,556,460 comprising about 49% male and 51% female population (Pakistan Bureau of Statistics, 2017). Located at 34°14' and 35°11' North latitude and 72° 49' and 74° 08'

East longitude, Mansehra is surrounded by Batagram and Kohistan districts from the north, Muzaffarabad district of Azad Jammu and Kashmir in the east, Abbottabad and Haripur districts in the south and Swat district in the west (Shakir & Ahmed, 2011) as shown in Figure 1. The city serves as a catchment area for towns such as Kaghan Valley, Batgram, Balakot, Shinkiari, and Baffa and provides urban infrastructure, social services, transportation, and employment to these smaller towns.

The climate of the district is warm in summer and cold in winter. The northern part, where there are high mountains, is cold in summer and very cold in winter due to the snow-capped mountains. Mansehra City consists of three types of land uses including residential, commercial, and industrial (Shakir & Ahmed, 2014). Most of the building stock is between ten and fifty years old. As stated by the Pakistan Bureau of Statistics (2017), the annual population growth rate of the city is 4.62%, which is higher than the annual growth rate of 3.58 percent projected (Pakistan Bureau of Statistics, 2017). The expansion of the city can be seen in Figure 2.

METHODOLOGY:

The research was primarily a comparative study in which diverse types of data were collected. The total housing units recorded an increase of 239275 in 2017 as against 172040 in 1998 (Pakistan Bureau of Statistics, 2017). The urban development of the city was visualized through Google Earth images. From the images, the housing growth was studied and marked in different sectors including housing growth during the 1990s, 2000s, and 2010s. Three of these areas were identified as having a representation of houses from each decade based on their construction period. The areas included are Safdar Road, Mohalla Dub No. 1, and

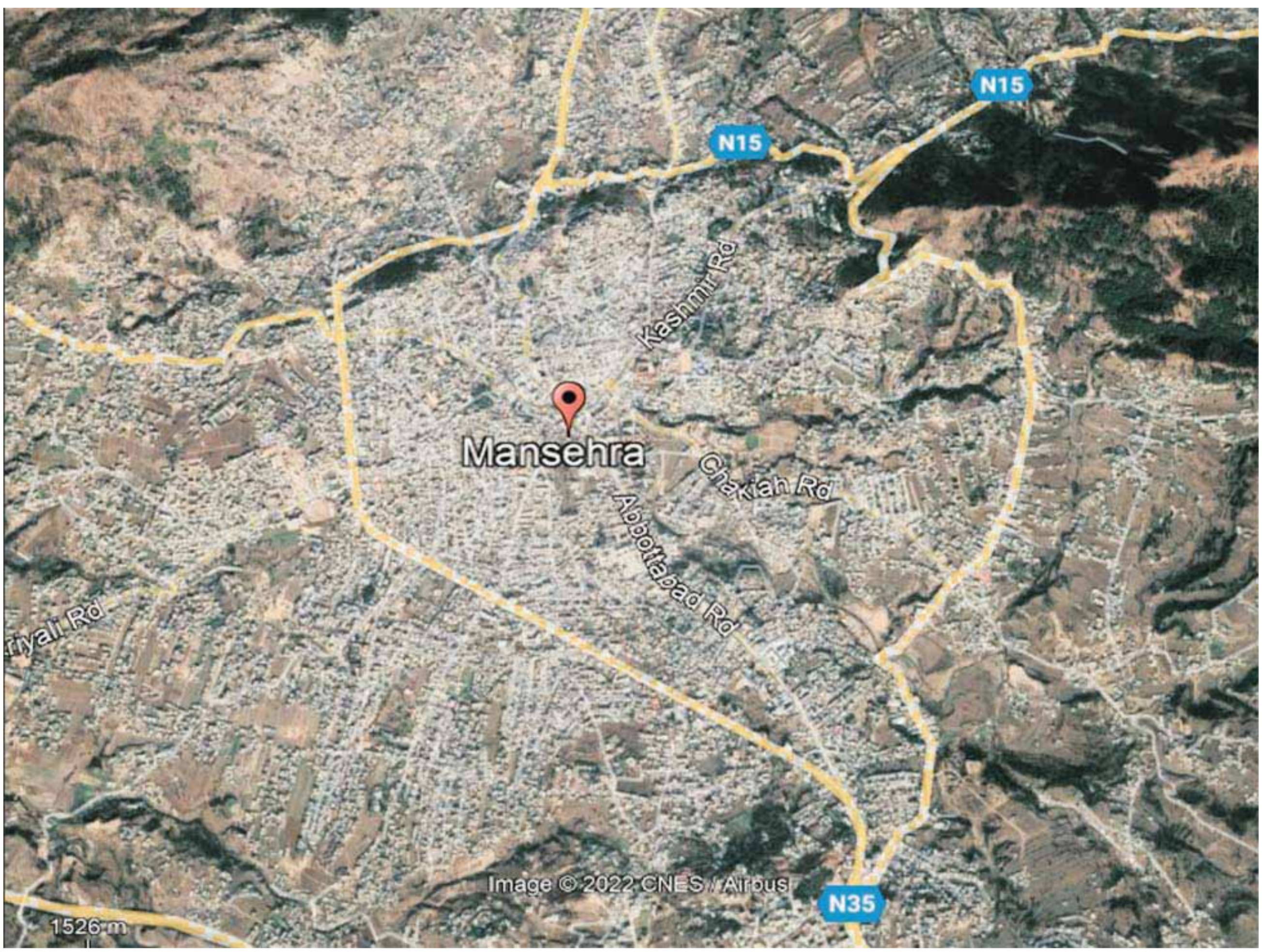

Figure-1: Location map of Mansehra district.
Source: Google Earth, 2022.

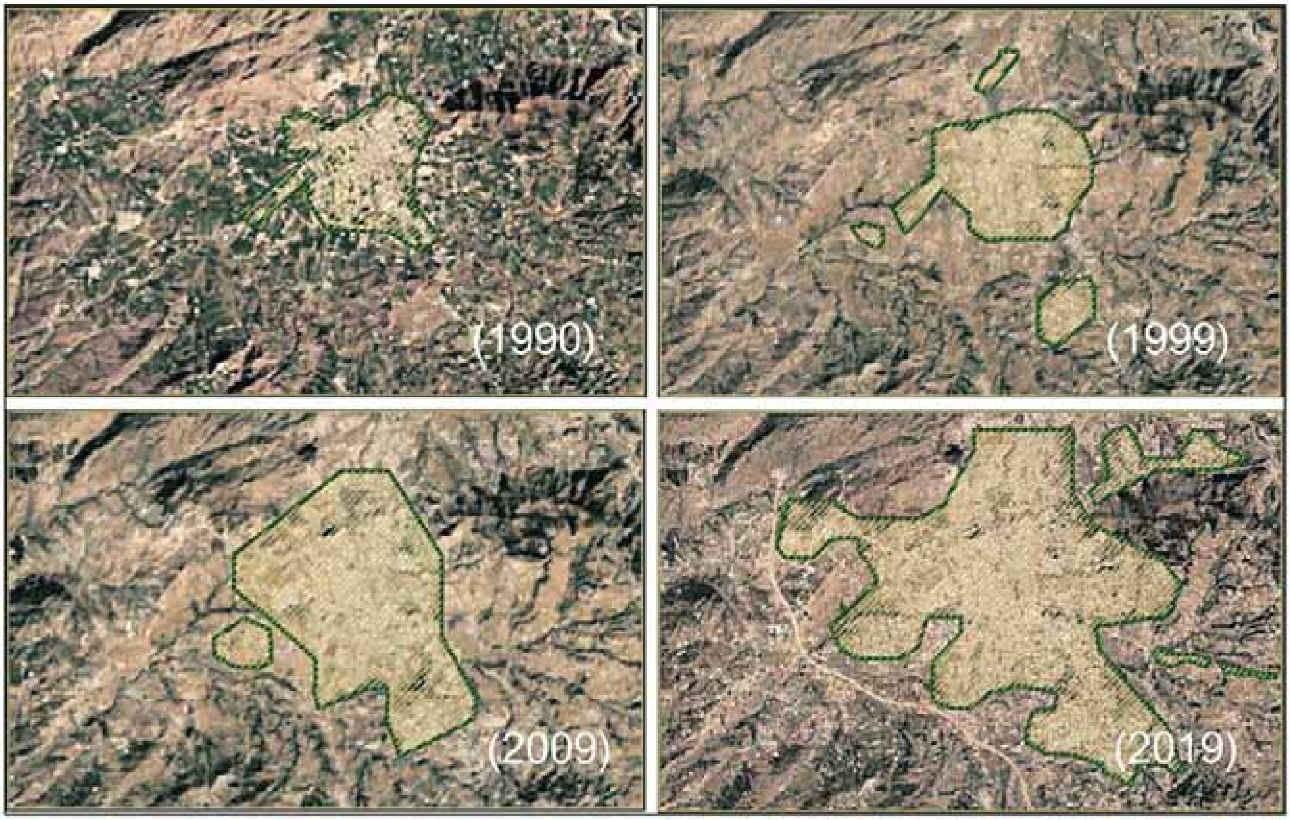

Figure-2: The expansion of Mansehra city from 1990 to 2019.
Source: Google Earth, 2021

Dub No. 2 as mentioned in Figure 3. Three houses were carefully chosen from each area. The selection criteria of houses were determined by the plot sizes that is one house from 5 to 7 Marla (152-212 sq. yds.), one house from 8 to 10 Marla (242-302 sq. yds.), and one house from 18 to 22 Marla (544-665 sq. yds.). After selection, analysis was done by comparing the selected passive design elements in selected houses. Software including Google Earth, AutoCAD, and Google Sketch up were used for the task.

FINDINGS:

Initially, in the context of Mansehra city, the concept of Mohallah or Neighbourhood respect was followed and people preferred to have similar size plots but over the last two decades the morphology has been segregated and even the most common form of land and development now have variation of plot sizes as well as housing units. Hence based on the housing unit size, economic and social groups have also originated breaking a monotony previously followed. The selection of areas was based on the availability of houses represented from each decade with size variations. All houses were evaluated based on the provision of selected passive features including thermal mass, fixed shading devices, and the ratio of open and closed spaces. Primary data was collected by mapping out a target area where houses from all three decades were located. Further, the data was analyzed by comparing selected passive elements in houses representing different decades. The collected data were tabulated and interpreted as percentages in SPSS version 22 and Microsoft Excel 2016 for analysis. Following are the details of selected houses from different decades.

Figure-3: Selected areas of Mansehra city.

Selected Houses from 1990-1999:

The houses were evaluated from selected localities to examine the passive features representing during 1990-1999. The variations in plot size contribute to differences in the design elements and open areas. The comparative analysis offers insights into shared and distinctive passive design features that characterizes the region. From thermal mass to open courtyards, the synergy of construction elements and their response to climatic conditions paints a vivid picture of thoughtful, context-specific architectural choices in this vibrant urban setting. The plan of the first house with 20 marla (600 sq. yds. approx.) plot size from Safdar Road shown in Figure 4 contains a front courtyard and veranda (a). No setback on the west side, resulting in west side windows with projections opening directly into the street (b). Veranda projection provides shade and serves as a sitting area (c) and east side windows with overhang projection (d). The next house from Dub No. 1 with 10 marla (300 sq. yds. approx.) plot size is shown in Figure 5. It consists of front courtyard and veranda acting as a sunspace, covered with a glazed surface partition (a). Internal windows in the courtyard have projections for reflected and diffused sunlight (b). There is a sitting area under the covered veranda for shade (c) and windows provided at the west side with projections and roof projection for shading (d).

The house details exhibited in Figure 6 from Dub No. 2 have a plot size of 7 marla (210 sq. yds. approx.) showing a courtyard and semi-covered veranda on the front side (a).

Table-1: Comparison between selected passive design elements of houses from 1990-1999.

S. #	Selected Elements	Passive Design		House No. 1	House No. 2	House No. 3
1	**Thermal Mass**	Walls	Material	Brick	Brick	Brick
			Width	9 inches	9 inches	9 inches
		Floors	Material	PCC	PCC	PCC
		Roof	Materi	RCC	RCC	RCC
			Width	6 inches	6 inches	6 inches
2	**Fixed Shading Devices**	North	Material	-	-	-
			Size	-	-	-
		East	Material	-	-	RCC with a roof extension
			Size	6’x 2’ x 5’	-	2’extended from wall
		West	Material	RCC with a roof extension	RCC with a roof extension	-
			Size	Shed from all sides of windows	Shed from all sides of windows	-
		South	Material	RCC with all roof extension, Veranda	RCC with all roof extension, Veranda	RCC
			Size	70’x 8’x 6’	-	32’x 10’x 6’
3	**The Ratio of Open and Closed Space**	Total Area		600 sq. yds	300 sq. yds	210 sq. yds
		Covered Area		230 sq. yds	150 sq. yds	80 sq. yds
		Semi Covered Area		60 sq. yds	42 sq. yds	42 sq. yds
		Open Area		300 sq. yds	78 sq. yds	48 sq. yds
		% Covered Areas		40	50	58
		% of Open Areas		60	50	42

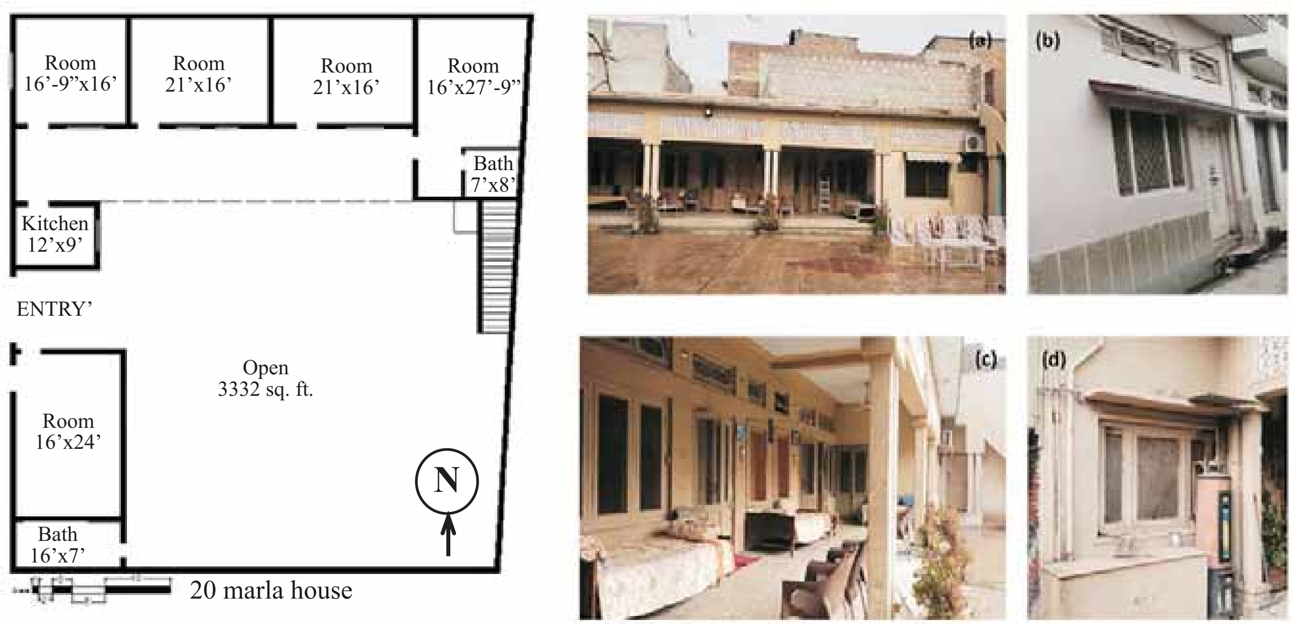

Figure-4: Plan and views of house no. 1, Safdar road.

Figure-5: Plan and views of house no. 2 Dub no. 1

Projections over the veranda, windows, and ventilators allow protection from direct sunlight (b). Roof extensions toward the south, some merged with the front side courtyard (c) were also recorded. Table 1 shows a detailed comparison of all three selected houses. All houses have 9 inches-thick brick walls, plain cement concrete flooring, and common use of RCC roofs in all houses. All houses had roof extensions toward the south, sometimes merged with the front side courtyard. Veranda was identified as a significant element in all houses, varying in size. Provision of windows with shading and projections is also a common characteristic of these houses. East side windows are shaded with a 2-feet projection due to roof extension. Courtyards with Semi-open areas were located on the south side. The percentage of open area ranged from 43 to 60 percent based on plot sizes. The comparison highlights the common passive design features in houses from 1990-1999, including the use of verandas, roof extensions for shading, and specific window shading strategies. The variations in plot size contribute to differences in the design elements and open areas.

Selected Houses from 2000-2009:

Further, the selected houses from 2000-2019 reveal nuanced approaches to passive design and spatial organization. While

Figure-6: Plan and views of house no. 3, Dub no. 2.

the structural fundamentals remained consistent, the introduction of front terraces, changes in flooring materials, and strategic use of roof projections reflect an emphasis on both aesthetics and functional considerations. The varied approaches in each house highlight the adaptability of architectural designs to the specific needs of different plot sizes and orientations on Safdar Road during this timeframe. Figure 7 shows the first house has a plot size of 17 marla (512 sq. yds. approx.) from Safdar Road where windows and projections detailed in the front view (a). East side window carries an overhang, which is more of a design element (b). The south side has a roof extension acting as a projection, thus no overhangs are given for windows (c). The next house with 10 marla (300 sq. yds. approx.) plot size from Dub No. 2 is shown in Figure 8. A terrace can be seen on the first floor acting as a semi-covered area on the ground floor (a). South side windows along the setback are extended and have overhang projection (b). A shaded front area on the west side due to the terrace, allows indirect light (c). Northside has car porch covered with a terrace to give shade from direct sunlight (d).

The house mentioned in Figure 9 from Dub No. 1 covers the area of 7 marla (210 sq. yds. approx.). The front courtyard was attached to a semi-covered veranda (a). Well-lit veranda with indirect sunlight and sitting facilities (b) makes a comfortable semi outdoor space. East side window has extended roof projection acting as overhang(c). Table 2 shows a detailed comparison of selected houses. The wall size remained 9 inches thick, but a shift to marble flooring was observed. RCC roof thickness is standardized at 6 inches. Front terraces emerged as a common element, creating semi-covered verandas on the ground floor. Verandas are characterized by linear planning, covering the entire length with widths ranging from 7 to 12 feet and occupying 10 to 20 percent of the plot size. 2 feet of fixed RCC roof projections are provided on the east and west sides. Absence of shading is observed on the north side. The open area constituted approximately 30 to 36 percent of the total plot size. These are setbacks of 1.5 to 2 feet from boundary walls. Courtyards were paved with limited or no vegetation among selected houses. The analysis indicates a shift in flooring materials, the introduction of front terraces, and a decrease in the percentage of open areas during the 2000-2019 period. The strategic use of roof projections and setbacks reflects an evolving approach to passive design, emphasizing both aesthetics and functionality in the architectural landscape during this period of construction.

Selected Houses from 2010-2019:

The dynamic architecture during 2010-2019, found traditional design elements coexist with contemporary materials and spatial considerations. The blend of functionality, aesthetics,

Figure-7: Plan and views of house no. 1, Safdar road.

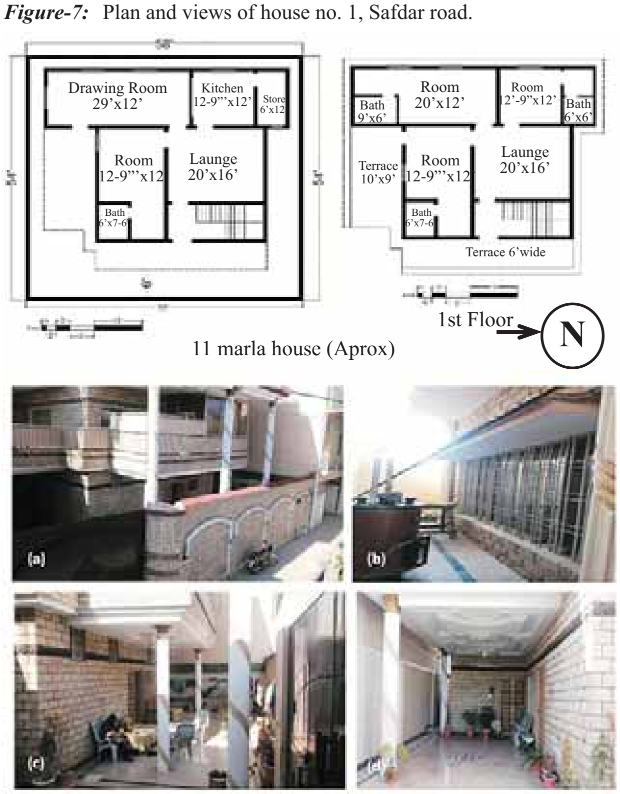

Figure-8: Plan and views of house no. 2, Dub no. 2.

and adaptability to modern construction practices suggests a distinct approach to architectural design during this period. The house mentioned in Figure 10 is 17 marla (512 sq. yds. approx.) located at Dub No. 2. There is an open courtyard (lawn) and semi-covered veranda at the front (a). Setback at the west side have windows with overhangs along with extended roof projections (b). The other house is at 9 marla (272 sq. yds. approx.) from Safdar Road is shown in Figure 11. A semi-covered veranda and terrace were visible from the front side (a). No specific projections over windows are noted, but an overall wall projection is present (b). Figure 12 shows the front view of the house located at Dub No. 1 (a). West side has windows with projections (b). The front view showcases a semi-open and open area (c), while the east side has a window with its projection detail (d).

Table 3 has a detailed comparison of all three selected houses from the selected houses of 2010-2019. Consistent 9-inch wall thickness was used across all houses. Two out of three houses were constructed using blocks, indicating a shift in construction materials. Common use of 6-inch RCC roofs in all houses. Marble emerged as the prevalent flooring material. Two houses featured 2 feet roof extensions from the east and west sides, complementing window projections.

Figure-9: Plan and views of house no. 3, Dub no. 1.

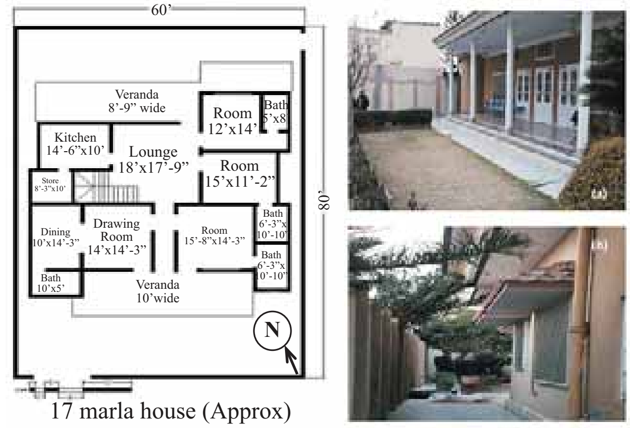

Figure-10: Plan and views of house no. 1, Safdar road.

Table-2: Comparison between selected passive design elements of houses from 2000-2009.

S. #	Selected Elements	Passive Design		House No. 1	House No. 2	House No. 3
1	**Thermal Mass**	Walls	Material	Brick	Brick	Brick
			Width	9 inches	9 inches	9 inches
		Floors	Material	Marble	Tiles	Tiles
			Width	1 inches	1 inches	1 inches
		Roof	Material	RCC	RCC	RCC
			Width	6 inches	6 inches	6 inches
2	**Fixed Shading Devices**	North	Material	-	-	-
			Size	-	-	-
		East	Material	RCC	RCC roof extension	-
			Size	2.5 feet projected roof	8' x 12" x 6"	-
		West	Material	-	-	RCC window projections
			Size	-	-	6' x 1.5' x 6"
		South	Material	RCC	RCC Veranda & Windows shade	RCC Veranda
			Size	7'x 2.5'x 6'	14' x 16" x 6" & 6' x 1.5' x 6"	40' x 8' x 6'
3	**The Ratio of Open and Closed Spaace**	Total Area		512 sq. yds	330 sq. yds	210 sq. yds
		Covered Area		300 sq. yds	219 sq. yds	135 sq. yds
		Semi Covered Area		30 sq. yds	39 sq. yds	38 sq. yds
		Open Area		120 sq. yds	72 sq. yds	53 sq. yds
		% of Covered Areas		70	67	58
		% of Open Areas		30	42	42

Figure-11: Plan and views of house no. 2, Dub no. 1.

Figure-12: Plan and views of house no. 3, Dub no. 2.

Where one house had a roof projection from the north side, serving as parking and laundry space. A reduction in the percentage of open area, now ranging from 27 to 30% of the total area. Semi-covered areas are utilized for parking. Therefore, a continuation of certain design elements, like semi-covered areas and roof extensions, with changes in construction materials were observed during 2010-2019. The shift towards block construction and the utilization of marble for flooring signify adaptability to contemporary construction practices. Additionally, the reduction in open area percentages suggests a more compact use of space.

Table-3: Comparison between selected passive design elements of houses from 2010-2019.

S. #	Selected Elements	Passive	Design	House No. 1	House No. 2	House No. 3
1	**Thermal Mass**	Walls	Material	Brick	Hollow Brick	Blocks
			Width	9 inches	6 inches	6 inches
		Floors	Material	Marble	Marble	Marble
			Width	1 inches	1 inches	1 inches
		Roof	Material	RCC	RCC	RCC
			Width	6 inches	6 inches	6 inches
2	**Fixed Shading Devices**	North	Material	RCC window Shade	RCC roof extension	Veranda
			Size	6' x 1.5' x 6"	2 to 4 feet wide	8' x 12" x 6"
		East	Material	RCC roof extension	RCC roof extension	RCC roof extension / RCC Window shade
			Size	5' x 1.5' x 6"	2 feet wide	2 feet wide / 5' x 1.5' x 6"
		West	Material	RCC roof extension	RCC roof extension	RCC roof extension / RCC Window shade
			Size	2 feet wide	2 feet wide	2 feet wide / 5' x 1.5' x 6"
		South	Material	Veranda	-	-
			Size	25'x 8" x 6'	-	-
3	**The Ratio of Open and Closed Space**	Total Area		512 sq. yds	270 sq. yds	210 sq. yds
		Covered Area		360 sq. yds	195 sq. yds	15 sq. yds
		Semi Covered Area		23 sq. yds	60 sq. yds	15 sq. yds
		Open Area		128 sq. yds	15 sq. yds	33 sq. yds
		% of Covered Areas		70	72	71
		% of Open Areas		30	28	29

DISCUSSION:

Protection from radiant solar gain is the prime strategy in warmer climates for achieving thermal comfort. Without incorporating shading, building surfaces absorb excessive heat, raising the surface temperature. Therefore, it is important to shade the openings in buildings in such a way that it protects from summer sun and allows winter sun within the building. A transitional change can be seen in the selected case studies from 1900 to 2019. The concept of the veranda is observed to disappear from 2010 onwards. The reduction in the south shading area from 20% to 5% with an increase in build-up area from 50% to 70% was recorded. East and west side shading remained consistent but no separate shading for windows was used from 2010 onwards. The orientation of rooms toward the south with the presence of a courtyard and veranda enters air into the internal spaces during summer as well as allows ambient sunlight to come into the rooms as shown in the typical section of the model house from 1990-1999 (Figure 13).

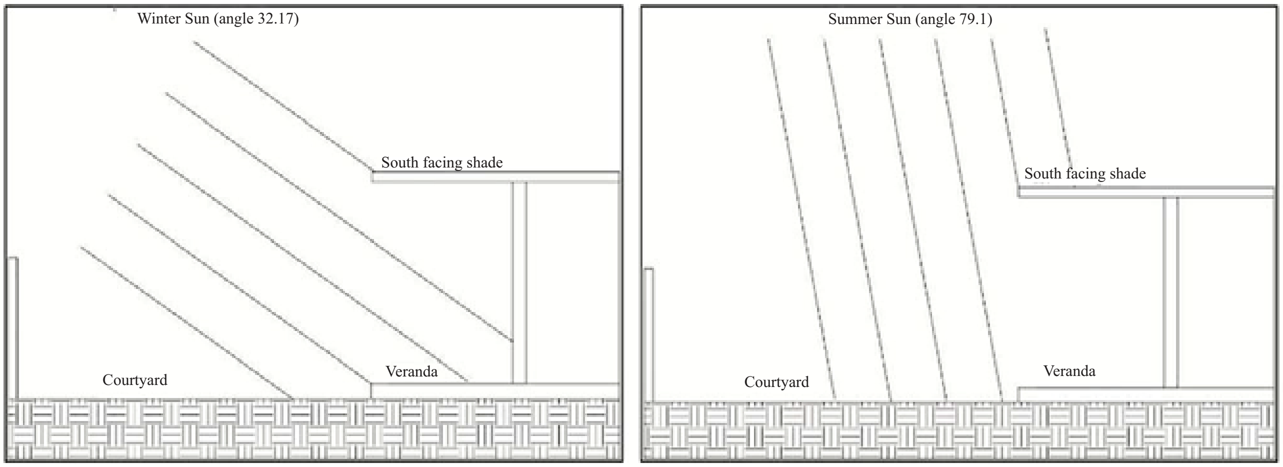

Figure-13: Section of typical house from 1990-1999 with summer and winter sun angle.

It is quite evident from the figure that the walls are completely protected from direct exposure to the sun during summers and winters. East and west sun exposures are problematic. Summer morning and afternoon sun altitude angles are so low that overhangs are seldom effective. The best alternative for these orientations is egg-crate shading. The windows and walls of 1900-1999 houses were totally exposed on the west and east sides. Exposed walls with window projections of 1.5 feet from the west and east sides allow morning and afternoon sun. A typical section of the 2000-2019 house (Figure 14) depicts that the walls are exposed to the south side with 2 feet setback from boundary walls and the central veranda provides shading and protection from direct solar gain into the rooms.

The walls are not completely protected through the roof projection during summer and are completely exposed on the south side. Also, the roof extended projection failed to protect the wall and windows from the summer heat, whereas during winters the boundary wall blocked some portion of the sun heat but the exposed walls take maximum sunlight. The east and west sides of the buildings were partially protected because of the small setback from the boundary walls. Illustrations shown in Figure 15 are model of houses developed in Google Sketch from the three-decade time period showing the effectiveness of overhangs on different sides during summer and winter seasons.

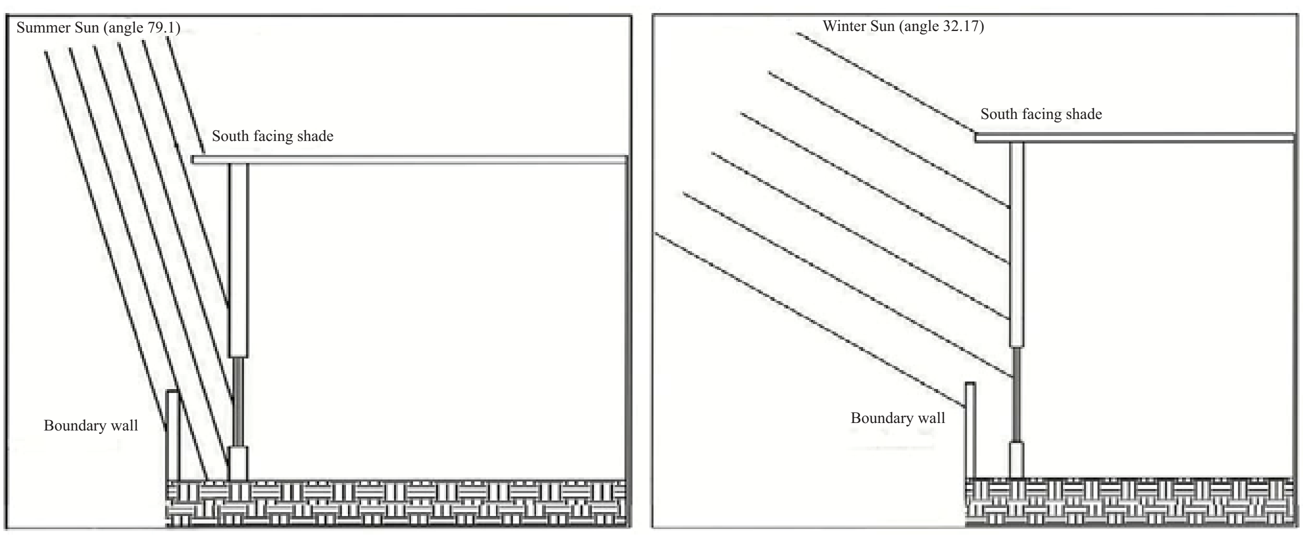

Figure-14: Section of typical house from 2000-2019 with summer and winter sun angle.

The existence of courtyards varied from 1900 to 2019. In the selected houses, the courtyards have been observed on the south side for maximum solar gain during winter seasons. Air circulates within buildings due to incident sun rays in the courtyard during summers. During 1990-1999, the open area was observed to be between 43 to 60 percent. Oriented on the south side, semi-open and open areas help in unobstructed and high airflow. Whereas, the percentage of open area during the 2000-2019 time is between 30 to 36 percent. During this time, the concept of a courtyard starts to vanish from the houses as only one house of this time was found with courtyard. The sizes of open spaces were also reduced and not sufficient to create a good airflow pressure difference. Setbacks of 1.5 to 2 feet from boundary walls on the right and left have also been observed but these cannot be considered as open space.

Finally, from 2010 to 2019, the open area is seen to further reduce to between 27 to 30 percent. With the increase in the covered area, open areas are now also used for parking. Although, the veranda as a semi-covered space can be seen in a few cases. Setbacks of 2 feet from the right and left sides form boundary walls that cannot be treated as open space for proper airflow and can be used for circulation only. Figure 16 shows the transition of open areas during the selected time frame.

The use of thermal mass in houses from 1990-2019 has not changed much but shifted from bricks to blocks. Since blocks are more economical and take less time to construct as compared to bricks. Both materials have heat retention and compensate for their low insulation value. The insulating rating (R-value) for the 4-inch-thick brick wall is 0.8 per

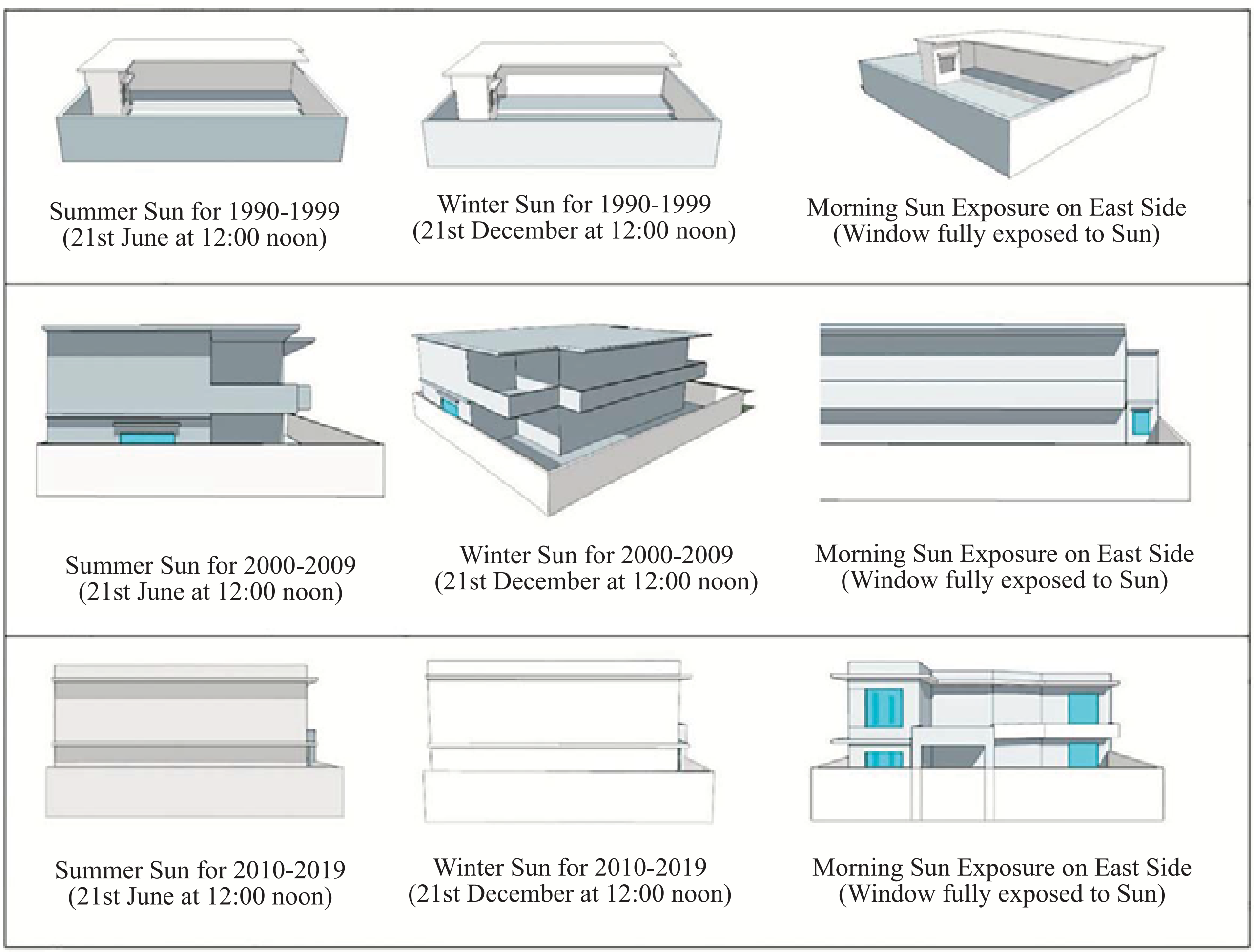

Figure-15: Effectiveness of shading devices during different times of the year of selected houses.

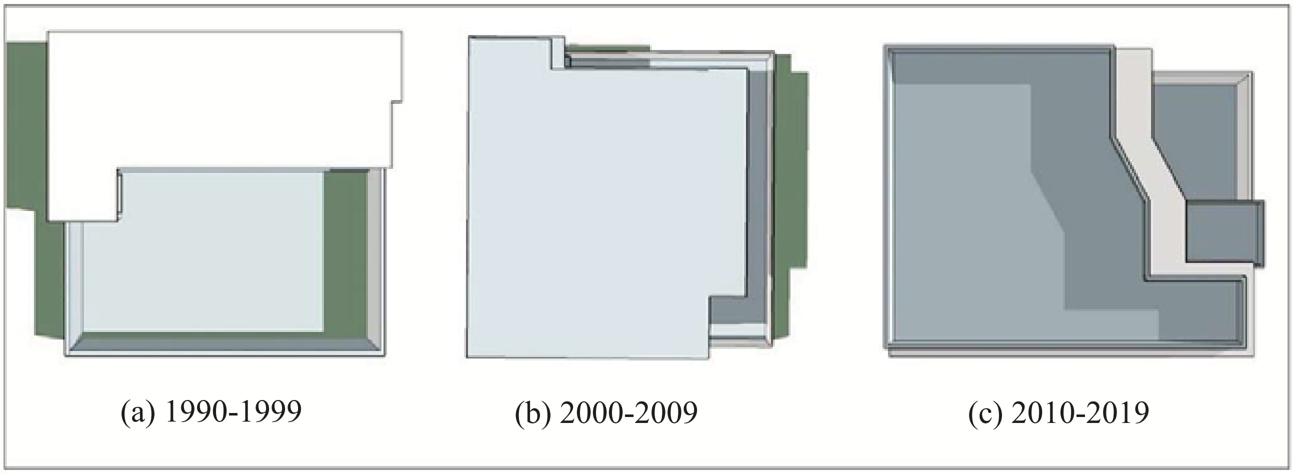

Figure-16: Transition of the open area from the top view of the model houses.

square feet whereas, the R value of the 8-inch conventional concrete block wall is 1.11 per square feet. Bricks have higher thermal mass than blocks which allows them to absorb more heat.

CONCLUSION

With lack of exploration of the passive design elements of the housing units towards end users' satisfaction and transformation from multiple timelines explored, the study was able to contribute to the existing body of knowledge in the following ways.

The study concluded that the windows or roof projections were consistent features from all selected houses. It clearly showed that people do consider the climatic conditions of Mansehra city over the modern-day outlook though in the current context it adds value to the saleable price of the housing unit as an asset. Sufficient shading was found in the south side but at the east and west sides shading with projections was not enough to fulfil the thermal comfort needs. It was though not comfortable as per discussion with multiple respondents, yet considering Mansehra a cold city in the overall context of the country, public lack of Eastern side projects and having ample sun during winters was evident. Though, the orientation of houses according to the sun's path was not the focus of design but people do have considered it along with Qibla direction (direction to Holy Kaaba) in the design of internal spaces. Kiln fired bricks was the main material or construction element that was extensively replaced by concrete blocks that have low insulation value though cost effective and easy to manufacture and procure in the context. Open and semi-open spaces including verandas and terraces are missing in recent times. This highlighted a transition from the traditional to more synthetic approach of a modern day villa without considering the implications of local culture and climate in design of a housing unit. Hence it has resulted in an increase of the ratio of the covered area from the previously built houses. The use of passive design elements to achieve thermal comfort was neglected and more space was occupied through built form. The new designs (2000-2019) are more focused on aesthetics than previous times (1990-1999). Hence the aesthetic transformation has started taking the respondents or indeed end users towards a loose target resulting in poor thermal performance of the house in long run. As a result, they consume more energy for heating and cooling of spaces and also have a negative impact on the overall environment along with increased energy demand. These have triggered lack of thermal comfort and increase cost of running and operations of houses. The study directs that building design should incorporate both passive and active strategies for thermal comfort with respect to the environment and climatic conditions in future design of the housing units in Mansehra. Local passive practices like south open courtyards with vegetation, verandas, and open terraces need to be revived with a modern touch to keep intact the aesthetics need. This will help to reduce energy demands and will help to maintain rising temperatures. It will also revitalize the old aspects of deep beauty, and sustainability with a sense of place, which is completely missing in modern design.

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ADAPTATION AND AWARENESS OF PASSIVE DESIGN STRATEGIES IN CONTEMPORARY HOUSES OF LAHORE, PAKISTAN

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ABSTRACT

Passive strategies help us to achieve sustainable and environment-friendly, low-impact designs and solutions. Adaptation of these depends on climatic constraints and specific use, for instance, ventilation and natural lighting. To achieve a low carbon economy, mitigation approaches are incorporated worldwide where thermal comfort is achieved without using active means. These techniques can be adopted in all climates around the world, with respect to ventilation, orientation, thermal mass, shading devices, daylighting, etc. To cater to the challenges of climate change, mitigation approaches are being incorporated worldwide in the architecture industry to reduce reliance on active means. Their application not only improves health and well-being but is also energy efficient regarding electricity consumption and provides economic benefits for the users. The application of passive design is well-seen in commercial and residential projects. To understand the prospects of passive strategies, the research is carried out to identify current awareness and adaptation potential among architects and their clients in the residential sector of Lahore, Pakistan. The research survey has been done in the form of a questionnaire designed to analyze the application of passive design strategies by architects, awareness among their clients in contemporary residential architecture of Lahore, Pakistan. The research findings show that architects are well aware and positively use these strategies, however there is a gap in the awareness of clients. Most clients preferred active means, while a few clients were inclined towards passive means. The need to make clients more aware of the benefits of these strategies was a highlighted outcome.

Keywords: Passive design, passive strategies, energy efficient, sustainable, contemporary, residential, architecture.

INTRODUCTION

Passive design adaptation in building envelopes is among subjects discussed globally along discourses on climate change and related emerging theories. It addresses factors like greenhouse emissions and evident temperature discrepancies. Passive strategies encourage using natural sources and move towards sustainable and environment-friendly solutions. The benefits of the applications are a high level of comfort to the occupants and the provision of healthy living situations both in residential and commercial projects. Its awareness and adaptation are topics of consideration in changing world scenarios. Although, passive design strategies are not widely observed in residential buildings of Lahore, a prominent city major of Pakistan, the objective of this research is to investigate the reasons for their limited use. A questionnaire survey was conducted among practicing architects to investigate their point of view regarding the use of passive strategies and to study the demand of clients, in the context of Lahore city. Firstly, various form strategies including the orientation and building shape with respect to sun and wind directions, building materials, and addition of landscaping and water bodies were studied. Second, factors including daylighting, sun shading, screening and filtering devices, additional cavity walls, use of basements and courtyards were also studied in designing of projects.

The results of the study display that most architects are willing to adopt passive strategies while most clients are little aware of their benefits. Most of the clients are stuck to specific strategies and do not take risks to adopt others. They rather prefer to opt for trendy facade house designs.

RESEARCH METHODOLOGY

The mixed method research began with a literature review from books, websites, and was followed by an online questionnaire survey. Lahore is selected as the focus of this study as it experiences a broad range of climatic conditions, from very hot summers to cold winters. This makes the city a potential area to study that how buildings can be designed to naturally cope with this range. Additionally, many well-known architects have designed contemporary residential designs in Lahore, providing significant examples to analyze how they have used passive design techniques. Selected residences are analyzed considering the climatic conditions and corresponding use of passive strategies studied by conducting a virtual survey with a structured quantitative questionnaire. To propagate the survey among architects, the snowball sampling technique was used. 60 practicing architects responded and their data was used to frame this research. To augment the research, two design firms of practicing architects in Lahore shared their house design drawings. Their analysis illustrates the professional practice being carried out to address the passive strategies. The discussion brings together the essential findings to derive the conclusions. (Figure1)

LITERATURE REVIEW

The passive design addresses climate change which is a matter of extreme importance worldwide where several theories are emerging and under discussion (Saeed et al., 2013). Research shows that the factors of greenhouse emissions due to fossil fuels are resulting in evident effects on temperature variations and proposes a dire need for architects to design energy-efficient buildings (Saeed et al., 2013), where climate responsive strategies should be adopted to achieve sustainable solutions (Figure 2). It means that to get sustainable results, natural resources should be utilized rather than active means of energy resources. This also promotes healthy living conditions and economic benefits.

Passive design strategies encourage the use of natural sources in particular climates for lighting, heating, and cooling, considering various techniques to provide human comfort and well-being and sustainable solutions to the users. It is the domain of environmental design where comfort is achieved through various measures to attain the maximum benefit of natural means and non-reliance on artificial energy resources (Altan et al., 2016).

Passive strategies adaptation benefits

Passive strategies are considered to be modest and low cost as it takes the benefits of the available potential land opportunities of the site. Developed countries have sufficiently established the guidelines for the use of passive design for the builder to take benefit. Like in the United States of America, where passive solar adaptation and the use of passive strategies that enhance the internal comfort with use sunlight is in practice considered energy efficient according to the climate, advanced guidelines are available (Building & Associates, n.d.).

In the hot-dry region of Indonesia, an experimental approach was carried out to study the effect of courtyard design on energy efficiency. The research indicated that indoor temperature was lower by 4.9 – 7.3 C than outdoor temperature, thus illustrating that use of courtyard in contemporary houses was a feasible means to achieve cooling effect through full-day ventilation system (Nugroho, 2020).

Research by Udo Dietrich (2019) conducted in Brazil, compared contemporary and traditional houses with passive strategies. Through practical survey and simulations, the research concluded that passive measures as significantly valid solutions to protect against solar heat transfer.

An energy-efficient building design assures maximum comfort level to the occupants in performance and the designed activities. It reduces the usage of non-renewable

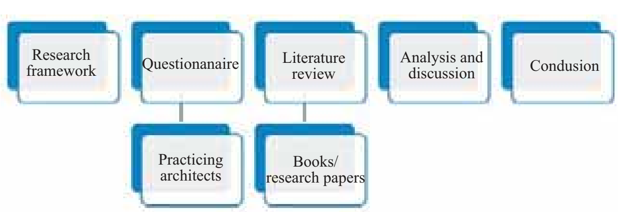


Figure-1: Methodological Framework.

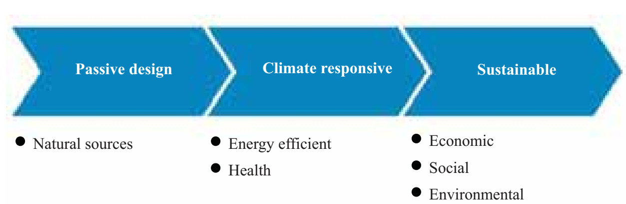


Figure-2: Sustainable Design Through Passive Strategies.

energy and considers the factors of energy cost. The socio-economic and environment-friendly design of the buildings should be considered to get sustainable solutions. This is conceivable with the low energy usage, providing a suitable indoor environment and resulting in good health. Eminent researchers showed that use of energy-efficient means in the designing of buildings have produced sustainable results and have effective results on human health and wellbeing. Naturally ventilated spaces considering the orientation and shape of the building, in comparison to other enclosed spaces, have proven to have given higher satisfaction levels for human health conditions (Sherali, 2014).

In the context of Lahore city, traditional house designs within the Walled City area were based on passive strategies with no use of air conditioning while contemporary houses are inseparable from air conditioners. These have become part of the contemporary lifestyle (Malik et al., n.d.). This study aims to fill the reseach gap, on how the client’s demands and their view of buildings effect the use and design of passive strategies.

Passive house design

Passive house design principles revolve around the coordination of energy-related components to formulate design concepts and ultimate functions. The results are mostly taken into the building envelope by simple geometries fulfilling the passive requisite either heating or cooling depending on the requirement of site. Ultimately ensuring the appropriate level of comfort for the users (Gonzalo and Vallentin, 2014).

The building envelope contributes significantly in achieving thermal comfort through solar shading and orientation, controlling solar heat gains. Proper remodification, strategies and techniques application lower energy cost and promote sustainability (Mujahid et al., 2022). Moreover, to make good use of the wind in hot, tropical climates, courtyard, wind towers, and cross ventilation are considered where the desired comfort level is achieved in the buildings through stack effects (Malik, 2020). The following table outlines the academic and experimental approaches with examples identifying with different passive design strategies.

Table-1: Potential Passive Strategies for House Designs.

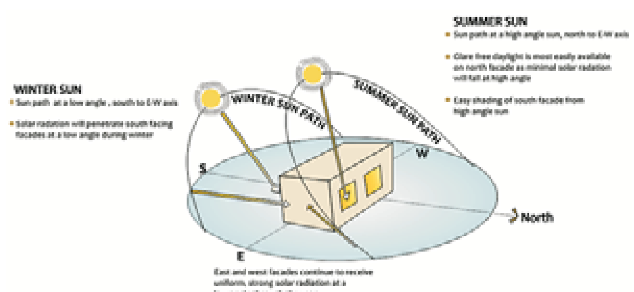
<table>
<tr><th>Strategies</th><th>Description</th><th>Benefit</th></tr>
<tr><td>Orientation</td><td>Orientation is defined as the placement of the building according to the direction of the sun and prevailing winds. The orientation of the building directs the size and location of the openings (Altan et al., 2016).


Figure-3: Building Orientation.</td><td>The building should be oriented to maximize winter sun and minimize summer sun (Jones 2004).

North-facing windows benefit the most as they suffer the least solar gain. East-west facing is not recommended as they face the direct sun while south windows allow both direct and diffuse radiations (Jones 2004).</td></tr>
<tr><td>Materials</td><td>Environment-friendly materials are chosen according to the climatic conditions of the site. While choosing the materials, three properties of color, insulation, and assembly type should be considered, as these properties play a role in heat gain and loss (Altan et al., 2016).</td><td>The amount of heat and loss is also affected by the color of the finishing material (Altan et al., 2016).</td></tr>
</table>

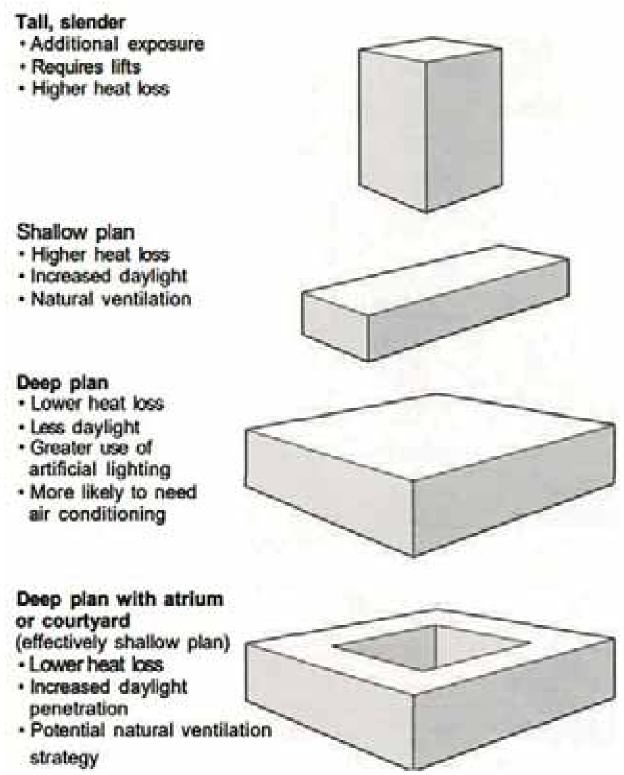
<table>
<tr><th>Strategies</th><th>Description</th><th>Benefit</th></tr>
<tr><td>Building Shape</td><td>The shape of the building, its length, width, and height plays a major role in defining the building's thermal capacity and visual comfort (Altan et al., 2016).


Figure-4: Building Shape (Jones 2004).</td><td>Building block designs can influence wind flow, heat gain & loss, and natural ventilation achieved inside the building.</td></tr>
<tr><td>Landscaping</td><td>The use of landscaping helps to enhance or reduce the effect of microclimatic conditions on site.
Designing soft and hard landscapes will affect the efficiency of the building.

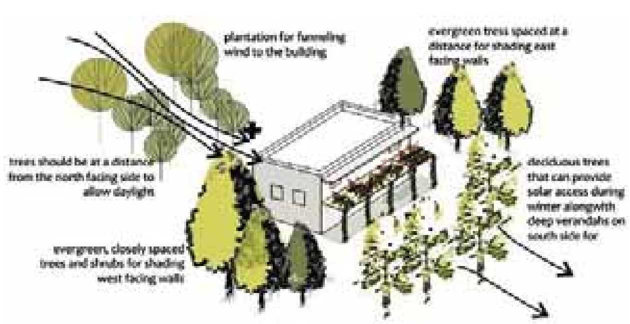
Trees and shrubs play a vital role in directing wind flow, providing shade, and acting as noise barriers (Altan et al., 2016).


Figure-5: Landscaping (Songa 2021).</td><td>Deciduous trees and vines help to reduce the solar heat and glare in reflected light from neighboring structures, water, or ground finishes (Jones, 2004).</td></tr>
</table>

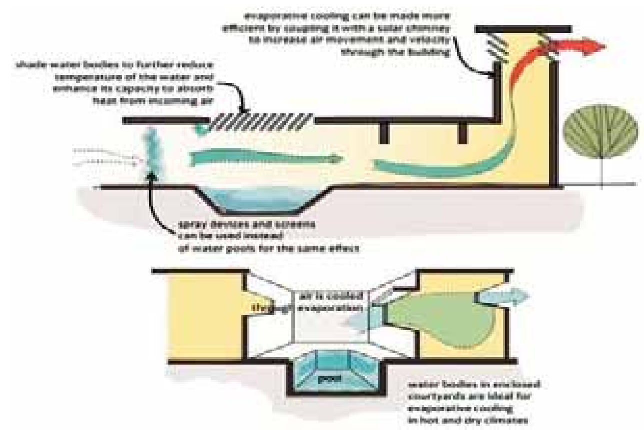
<table>
<tr><th>Strategies</th><th>Description</th><th>Benefit</th></tr>
<tr><td>Water bodies</td><td>Water bodies are adapted to dry and hot climates. Using waterbodies for temperature reduction is a common method. With the process of evaporation, it gives a cooling effect.


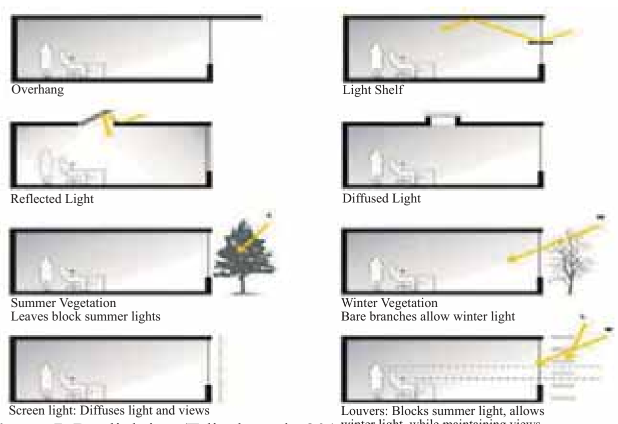
Figure-6: Waterbodies work as evaporation (Songa, 2021).</td><td>Waterbodies help to cool the surrounding space by the removal of latent heat, thus providing cooling.</td></tr>
<tr><td>Daylighting</td><td>Daylighting is one of the most used passive strategies. It directs the location and size of the windows and shading devices, which helps to integrate daylight into the building (Jones 2004).


Figure-7: Daylighting (Ediael, et al., 2019).</td><td>If daylighting is designed according to the sun's path while considering its surroundings, it reduces the running cost and internal heat gains. This will also reduce the need for mechanical air conditioning.

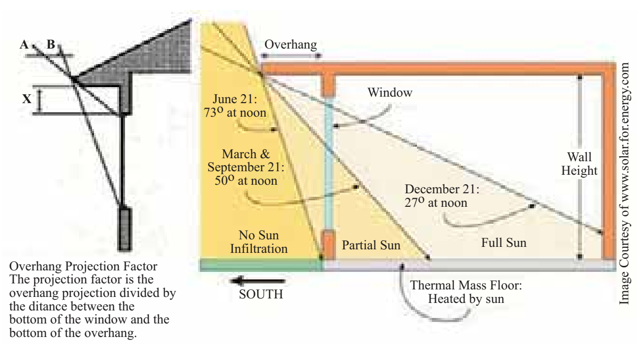
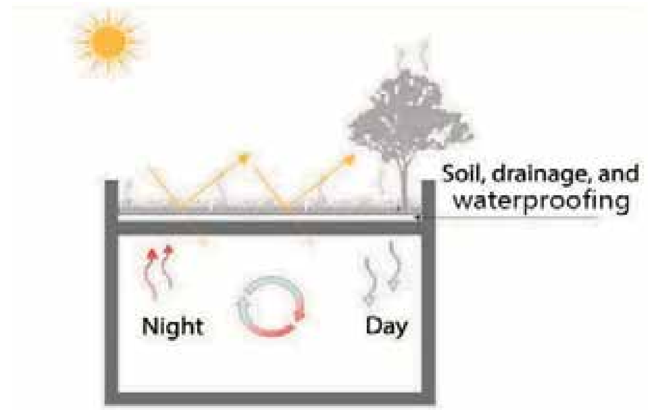
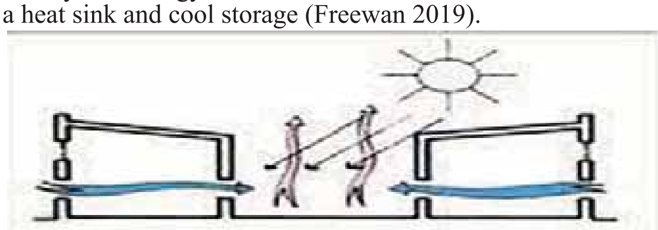
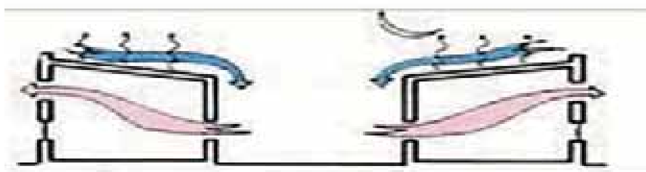
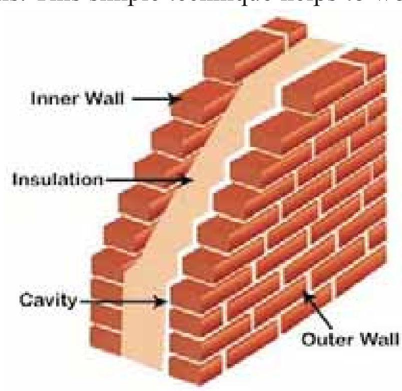
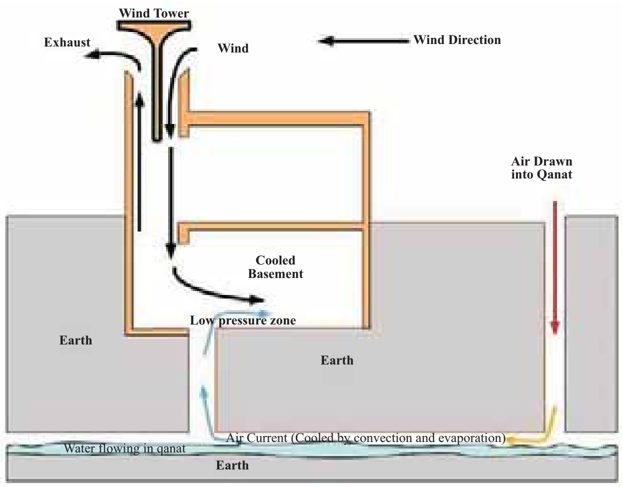
Daylight allows the natural light to penetrate up to 6 meters inside the window (Altan et al., 2016).</td></tr>
<tr><td>Shading/Louvers</td><td>Generally, horizontal shades work better in north and south orientations while vertical shades work better in east and west directions. While the combination of both will be required for harsh sun (Altan et al., 2016).


Figure-8: Shading (Associates 2016).</td><td>Shading is used to reduce heat gains during day and night temperatures. Shading devices do not allow the direct sun to penetrate but rather receive diffuse sun light (Altan et al., 2016).</td></tr>
</table>

Strategies	Description	Benefit
Roof garden	Roof gardening is the strategy that ceases solar radiation to reach the building below (Shrikant Pandey 2012).  **Roof garden** ***Figure-9:*** Roof Garden Strategy (Gou and Zhonghua 2018).	Roof garden helps to reduce the stormwater run-off, heat island effect, and CO2 from the atmosphere and maximizes the cooling effect of the building .
Courtyard	Courtyard strategy works to enhance microclimate and act as a heat sink and cool storage (Freewan 2019).  **Courtyard effect (day)**  **Courtyard effect (Night)** ***Figure-10:*** Courtyard Effect (Park, 2015).	Buildings with internal courtyards are solutions for hot climates to provide inner space with cool air and daylight (Freewan 2019).
Cavity Wall	It is the technique of creating a cavity (insulation) between two separate walls. This simple technique helps to work building efficiently.  ***Figure-11:*** Cavity Wall (Patel 2019).	Cavity wall works as a thermal insulator, and sound insulator, does not permit moisture content to penetrate, reduces weight on the foundation, prevent efflorescence, and are cheaper than a solid wall (The Constructor n.d.).

Strategies	Description	Benefit
Basement	At a depth of a few meters, the temperature of the Earth is below ambient temperature, which allows it to serve as a heat sink for basement rooms. The temperature of the Earth is constant, near to comfort zone, which makes this strategy applicable for different climates.  ***Figure-12:*** Cooled Basement.	The basement works best in hot arid climates. This strategy is useful for direct and functional responses. It provides cooler temperatures in summer. As the rooms are connected with Earth, it decreases the heat exchange with the outside temperature (Ahmadreza, 2015).

Analysis and Discussion

Contemporary house designing among architects of Lahore is showing up with a share of innovative experimentation and implementation of the latest technologies including passive strategies and techniques. Among many of the contemporary leading firms in Lahore, two examples have been studied in the research to get an idea of design practices regarding passive strategies. One of these is the architectural firm named, Galleria Design, working on concepts of passive strategies. With the analytical study of some of projects of Galleria design shows that architects have considered courtyard, cross ventilation, and roof garden to minimize the dense climate of Lahore while designing thier projects. With the creative use of such strategies in contemporary houses, clients are now inclined towards passive design techniques (Figure 13).

Another example of residential design is courtesy of Kaswa Design Services shows use of open patios in design and provision of cavity walls (Figure 14).

After reviewing the latest contemporary house design of leading firms, it is evident that clients are now informed and interested to adopt passive design solutions to mitigate the intense heat of Lahore. However, there is still a noticeable gap in their optimal use.

A survey was conducted of experienced architects in the field (Fig.15). The survey questionnaire was based on the idea of awareness of passive strategies among architects and demand of their clients. Identifying strategies that are observed to work better in Lahore's climate, the survey investigated their adaptation and architects' and clients' awareness and perceptions about using these strategies.

Passive design strategies adaptation in Lahore

On average, 35.7% of Lahore's practicing architects are familiar with the term passive design strategies. The graph bars from 1-5 show the lowest to highest scale according to awareness about passive strategies (Figure 16)

According to a survey most of the architects consider passive strategies while designing a contemporary house (refer to Figure 17).

While several architects are working on passive design strategies, the gap in the actual use of passive strategies is noticeable (Figure 18). Architects who are aware of these

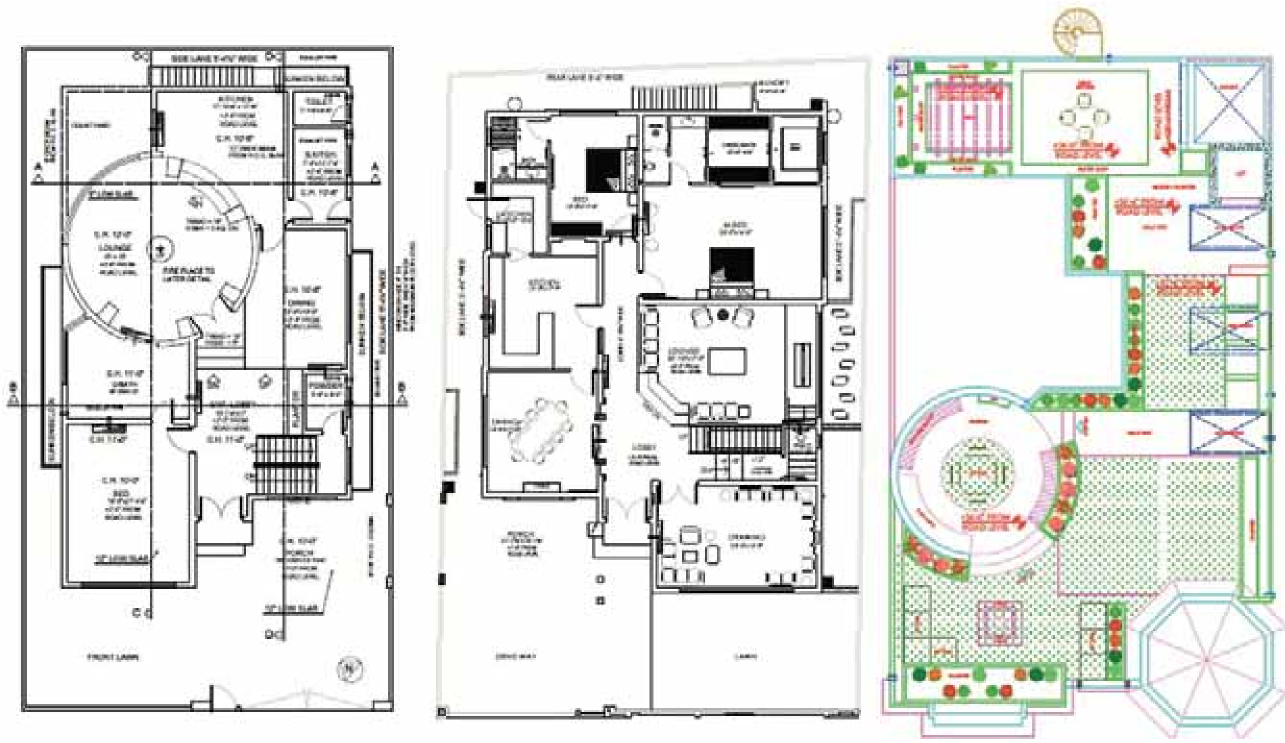


Figure-13: 4500 sq. ft. Area House Designs with Courtyard, Cross Ventilation, and Roof Garden Concepts. (Source: Galleria Design)

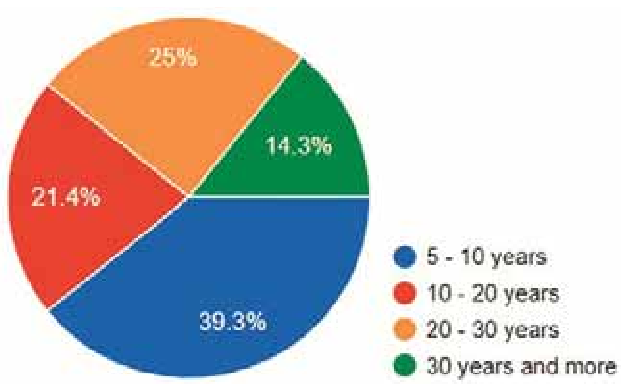


Figure-14: Field Experience.

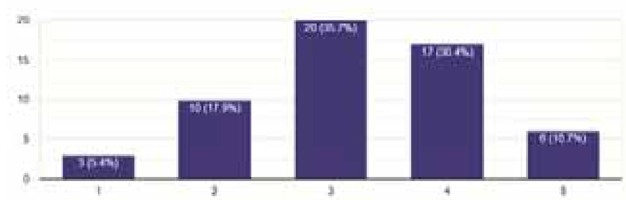


Figure-15: The Fame of Passive Design Strategies Among Practicing Architects of Lahore (1-5 Lowest to Highest).

Figure-16: Adopting Passive Design Strategies While Designing a Contemparary House (1-5 Lowest to Highest).

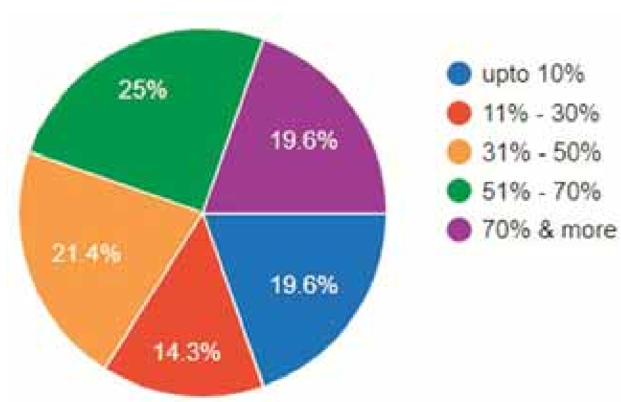


Figure-17: Percentage of Residential Projects based on Passive Strategies.

strategies, are not able to apply them in most of their projects. This is probably because of a lack of awareness among clients. According to the survey, 19.6% architects used passive strategies in only 10% of their projects, while another 19.6% architects have used passive strategies in more than 70% of their projects (Figure 19).

Passive Strategies Preference among Architects of Lahore

Building orientation is the most commonly used strategy by architects in residential projects to channel wind and optimum natural light. Among other well-utilized strategies are use of daylighting, environmentally friendly materials and finishes, landscaping, shading, use of shadows and courtyards (Figure 19).

Given Lahore's climatic conditions, the most workable strategies preferred by architects are orientation of building, use of materials, landscaping, daylighting, shading, and cavity wall. Although, basements are now allowed in residential societies and work best for hot summers and cold winters of Lahore, the use of the basement as a passive strategy is comparatively low. Similarly, waterbodies and building shapes are the lowest on the list of preferences. This is due to the use of large spaces and the high initial cost of these strategies, which makes them less workable (Figure 20).

It is clear from the pie chart that most architects prefer passive strategies due to their efficient working, while cost is the least consideration among architects when choosing the appropriate strategy (Figure 21).

Client Concentration on Passive Strategies

By contrast, survey results revealed that clients have greater preference for active means of ventilation. Social status, comfort parameters and norms are subjected to this, along with perhaps a lack of awareness of efficient passive strategies among clients (Figure 22).

Questions asking architects' opinion about clients brought out the sheer lack of motivation (46.4 percent) for adopting passive strategies, while 37.5% mentioned that clients were neutral about application of passive strategies (Figure 23).

While clients are familiar with passive strategies such as orientation, landscaping, daylighting, and use of basement, the most preferred strategies included orientation, landscaping, use of daylighting, louvers for shadow and cavity walls.

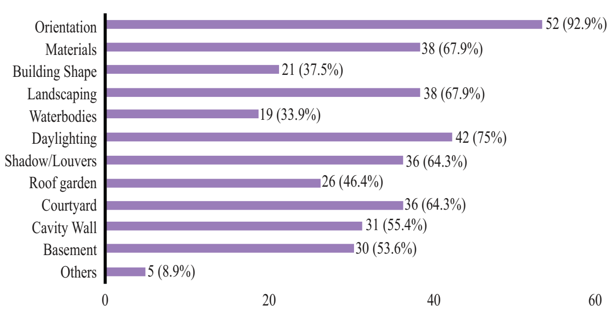


Figure-18: Familiar Passive Strategies Among Architects.

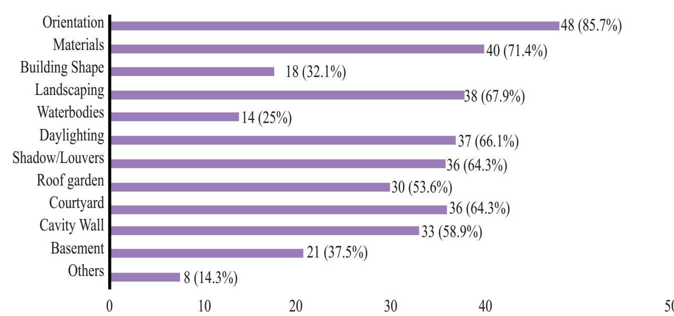


Figure-19: Strategies Preferred by Architects According to Lahore Climatic Conditions.

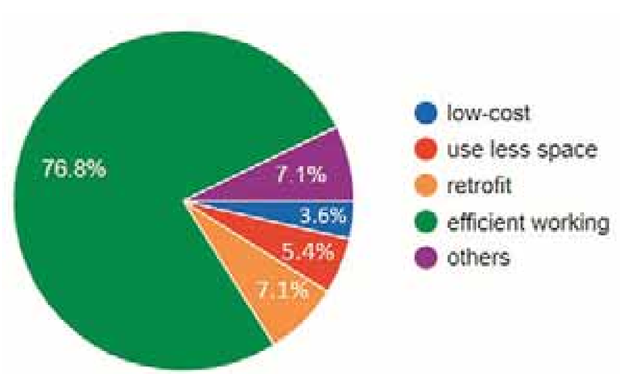


Figure-20: Preference of Specific Strategy by the Architects.

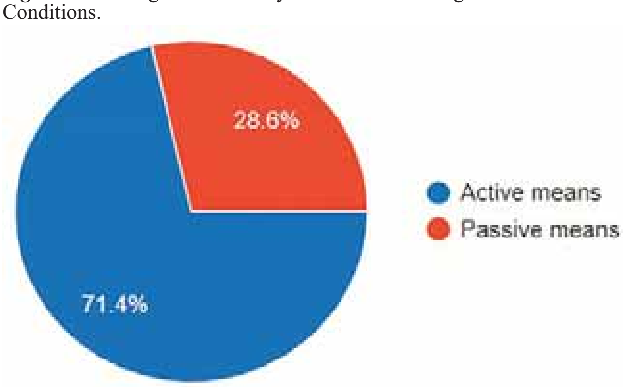


Figure-21: Client's Focus on the Ventilation System.

Clients prefer the above strategies because of their efficient working and consider the installation's cost effective and other minor factors (see figure 24).

FINDINGS

Out of 60 responses, 40% architects had experience of more than 30 years in their field. The first part of survey outlines adaptation of passive strategies among architects. Survey shows that while architects are much aware of benefits of adopting of such strategies but not all architects are able to use these in all of their projects. Only 19.6% of the architects have applied these strategies in more than 70% of their projects.

Considering the climate of Lahore and effective workability of the strategies, most architects preferred building orientation, shading, cavity wall, daylighting and landscaping in their projects. For study about clients demand, only 21% of architects believe that clients have basic knowledge of common passive strategies. Thus, 71% architects pointed that client demand for active ventilation over passive means.

CONCLUSION

This research contributes to existing body of knowledge by exploring the adaptation and awareness of passive design strategies in contemporary houses in Lahore. The research focuses on the current state of adaptation of passive strategies. By analyzing built residential designs, the research also points out practices being adopted in architectural projects. Findings from the study addresses an important gap between academic and practice knowledge, as it aims to highlight the level of awareness for use of passive strategies among clients. This research supports the hypothesis that there is a major need to impart and inculcate awareness among clients. By identifying the barrier, this study promotes the use of passive strategies in residential architecture of Lahore and similar climatic regions in the country.

The survey results depict the contrasting component of awareness and adaptation among clients and architects in contemporary residential architecture in Lahore, Pakistan. Most architects are knowledgable about the benefits of passive strategies and prefer to use these in residential projects. However, most of the client's knowledge is somewhat limited to adaptation of orientation and building shape and they prefer to use active means rather than passive and focus to have a trendy house design over adapting passive strategies. This also becomes the reason that only 20% of the architects have worked on more than 70% of their projects with passive strategies. Among adapted strategies, building orientation is preferred by most architects for Lahore's climatic conditions. Other strategies used by architects are landscaping, daylighting, cavity wall, and the use of environment-friendly materials. According to the survey building shape and waterbodies are the least preferred strategies by architects. Although Lahore's hot and dry summers can work well for evaporation, however the addition of waterbodies would take up a large area and is comparatively costly, thus making it least preferable. This paper concludes that architects are aware of passive strategies and try to adopt them in their designs. With time, the relation of architects and clients are evolving in better terms. Now, while clients seem positive to adopt passive strategies due to the climatic condition of Lahore, but their knowledge and awareness of adaptation require endorsement to encourage

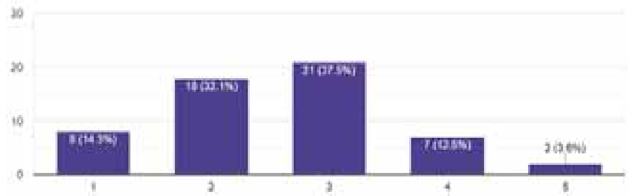


Figure-22: Client's Motivation for the Adaptation of Passive Strategies (1-5 Lowest to Highest Scale).

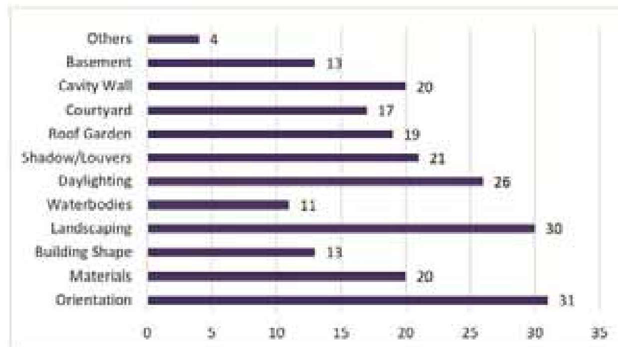


Figure-23: Familiar Strategies Among Clients.

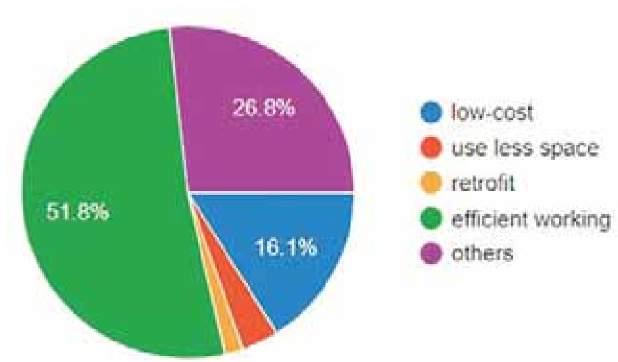


Figure-24: Reason for thePreference Above Strategies.

the acceptance of climate-responsive designs and sustainable environments.

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APPRAISAL OF GREEN BUILDINGS RATING SYSTEMS: FOCUS ON RELEVANT PARAMETRICS FOR ACHIEVING SUSTAINABLE DEVELOPMENTS IN NIGERIA

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ABSTRACT

Green rating systems for buildings are standardized measuring systems that quantify different buildings' sustainability levels. These have been proven to enhance the adoption of design methods that are less harmful to the environment, thereby making buildings environmentally, socially and economically viable in the long run. For any building to qualify as green certified, six crucial criteria need to be met, including the use of energy effectively, water use, sustainable sites, effective use of resources, operations while occupied resulting in its associated repair works while also considering the comfort levels of the building occupants. Several reasons might be responsible for non-availability of green building standards in Nigeria, including knowledge levels of the stated standards, an absence of regulatory policies, and an absence of clear certification standards in the country. The study seeks to identify green rating systems currently being used to access buildings globally and their current use in Nigerian building industry space assessment. This study aims to understand critical variables lacking towards attaining green building standards and certification of Nigerian houses. The study will also identify the use of an existing rating system in certifying a green building in Nigeria to highlight the levels of sustainability attained by the building and propose actions of improvements that will make green building ratings systems the norm while putting up a building to serve the various functions assigned in the Nigerian building construction space. A comprehensive literature review using search engines like Researchgate, Scopus and Google Scholar and articles found useful for the research spanning from 2008 to 2023 were included in study. The advantage of this study is that it serves as a reference for policymakers to effectively develop a green building policy for Nigeria. Secondly, it draws attention to building regulatory bodies for enforcing greening compliance building standards implementation within projects domiciled in the built environment. It also highlights advantages associated in terms of revenue generation for the respective bodies through payments for green rating systems applications in building construction projects. Thus, green building rating systems can increase sustainability levels of construction projects in the Nigerian built environment.

Keywords: Green, Buildings, Rating, Systems, Built, Environment, Nigeria

INTRODUCTION

Building construction significantly improves the quality of life of man and his household while addressing his societal needs and associated significant environmental challenges. Construction activities contribute 40% of powering and functional activities, 30% of harmful gas pollutants, and 17% of freshwater consumption (Li, et al., 2023). As a result of climate change and associated risks directly linked to the built environment affecting humanity at large scale, it has become expedient to find alternative solutions to environmentally friendly design and construction techniques at addressing these challenges (Michael, 2013). The author further believes that while these unique solutions have been adopted worldwide, Nigeria has not been left out of these adverse climatic conditions that have threatened to harm the built environment globally. Therefore, building green and applying technologies associated with green standards and rating systems have been recognised as cutting-edge solutions to combat these issues. With its Green Building Councils, Europe has become a global leader in reducing wastages associated with building construction, thereby striving for net-zero resource usage (Anzagira, Duah, and Badu 2022).

However, adopting green building rating systems with their associated technology within less developed economies faces barriers related to both country-specific factors related to design and construction (Akcay 2023). These challenges have led to a call for a shift away from carbon-intensive construction techniques towards more environmentally friendly approaches (He, et al. 2018). Green buildings meet specific performance requirements while minimizing disruptions and providing ecological benefits (Li et al. 2023). These buildings often earn certifications through Green Building Rating Systems (GBRS) (Chaldy, et al. 2023). Governments worldwide promote green buildings for their sustainable use of materials and natural resources, enhanced living conditions for occupants, and environmental benefits (Li, et al., 2023).

Green buildings offer various advantages, including lower development and operating costs, increased user comfort, improved indoor air quality, enhanced durability, and reduced maintenance expenses (Zafar, 2017). They also contribute to resource efficiency and minimize environmental impacts. One essential tool for managing and measuring a building's green compliance level and success depends on its ability to comply with existing standards as set out by a green building rating system (GBRS) (Akinyemi, et al., 2017). This rating system provides a structured framework to monitor and enhance sustainability in construction. In South Africa, green buildings have great value for their economic benefits, such as reduced energy costs and recognition by industry rating systems (Sanboskani, et at., 2022). Standardised compliance systems associated with the greenness of a building's compliance levels relating to its environmental impact on the built environment qualitatively assess the structure's sustainability compliance level with the surrounding built environment. (Weerakoon, et al., 2023). They help inform assessors about a building's eco-friendliness and the extent of green features incorporated in its design and construction (Shan and Hwang 2018). These rating systems express a building's sustainability attributes (Ampratwum, et al. 2021).

Establishing a regulatory body that regulates green buildings within the practising environment is the first step in enforcing a building's greenness compliance levels with standardised systems, yardsticks and scaling techniques. (Akinyemi et al. 2017). These non-profit organizations shape tools to objectively rate a building's performance regarding ecology, environment, and spatial surroundings. Therefore, these already established greening tools (Building Research Establishment Environmental Assessment Methodology) domiciled in the U.K., and (Leadership in Energy and Environmental Design) in the US, emerged in the 1990s to promote sustainability in construction (Nduka and Sotunbo 2014). These systems provide scores for buildings' environmental performance, facilitating comparisons between different structures. Despite the growing awareness of the importance of measuring a building's greenness level in the Nigerian built environment by construction industry professionals, it still needs an effective green building rating system. This gap prevents buildings in Nigeria from being rated using established systems like LEED and BREEAM. Therefore, the research objectives highlight knowledge of greening tools in Nigeria's construction industry and identify the greening tools currently used by Nigerian construction stakeholders to achieve a robust, sustainable built environment for the Nigerian built Environment space. Additionally, the study aims to examine an existing green building in Nigeria certified by an established adopted green building rating system.

LITERATURE REVIEW

Green Building Drivers in the African Built Environment

Many vital drivers exist towards implementing green buildings in the built environment towards reducing carbon dioxide emissions into the environment, but Windapo (2014) defines a construction projects greenness level as those projects which have been subjected to a certified green rating system and therefore qualify it for an approved certification while also further noting that this is quite a new concept in Africa. The author then identifies the drivers of green buildings as two arguments: mainly due to preserving the environment and the ecology within its immediate environment and secondly due to economic factors which have seen the need to reconsider the cost of running buildings, providing financial savings and competitive advantages. According to Atanda and Olukoya (2019), the Nigerian built environment at both the urban and rural settings are faced with diverse challenges that range from urban sprawl, slum and squatter developments, land air and water pollution, flooding and erosion all contributing to serious environmental, economic and social challenges necessitating the need for a green building rating system to combat these challenges.

A recently conducted Southern African study on the advantages of building green, which is still in its infancy stage (Simpeh and Underwood 2018), has identified several advantages of these types of construction developments. These have been categorized as environmental, financial, economic, and social benefits, meaning that the buildings are comfortable for the occupants, healthy and aesthetically pleasing. In addition, these types of buildings are said to have market and industry benefits, opportunities for research and development in the green building field, advantages for collecting more tax revenue for the government from construction stakeholders for going green and climate-change-related benefits.

The Concept of a Buildings Greenness and Their Rating Systems in Construction Projects

Critical deficiencies identified by King (2008) in the greenness and sustainable development assessment of structures while embarking on construction deliverables is that the assessment process goes far beyond the design stage of a project. It is believed that this can be improved if the selection of more environmentally friendly designs are considered during the project appraisal stage. The author further suggests that as a rule of thumb, environmental issues regarding a project may be classified as principal and addressed earlier in project conceptualization phase, thereby mitigating adverse consequences that construction projects pose to the built environment as environmental hazard. Secondly and of significant importance is the possibility of using natural resources during the building construction phase and, finally, emphasizing reductions in remediation techniques and associated costs. Buildings consume much energy while using available resources in the built environment during construction. They are also major emitters of CO2 into the atmosphere, causing significant environmental risks and also causing unhealthy indoor quality to building occupants and the planet at large (Cascone, 2023). Thus among the numerous advantages of designing and constructing green buildings are the fulfilment of the essential elements of comfort and enhancing the health of the users (Purwaningsih, et al., 2018). While there is a lot of information on building green, there has been limited attention paid to using these environmentally friendly building construction techniques by construction stakeholders in the field of associated use of these construction techniques, which enhances sustainability in the long run. This, therefore, is responsible for the lack of adequate information on this current construction technique available in the body of knowledge regarding green design in less developed economies of the world.

Green buildings, according to Chen, et al. (2023) are considered buildings that offer their occupants more significant health benefits while also applying principles that emphasize their ecological balance which reduce environmental impacts on the immediate vicinity of the building construction site. This improves the productivity of the society in which the building is domiciled. Traditional buildings have been observed to have environmental issues associated with them while also consuming a lot of energy, causing a lot of environmental pollution and further leading to wastage of resources believed to be the dangers associated with these kinds of buildings, according to Wu, et al. (2023). Before the advent of a green building rating system, Song, et al. (2023) identified three milestones that initiated the establishment of this standard evaluation with the third being the most important. The authors identified this as a milestone discovery in winning the noble peace prize in 2007, acknowledging the influence of humans regarding climate change issues, the value of green building and their greenness levels for the construction stakeholder and the buildings occupants. Therefore, it is suggested that a green building evaluation system, which will be based on the building's physical framework, be constructed to achieve energy savings and consumption. Environmental challenges associated with high energy consumption levels of buildings have formed the bedrock in applying standard rating systems in construction projects worldwide (Nocerino & Leone 2023). These standards, which are used in measuring a construction projects sustainability by an assessment criteria is suitable for the purpose and encourages an adoption system of environmentally, socially and economically sustainable practices in three phases associated with the development of a construction project (design of the project, constructing the project and eventually demolition the building when its useful life has been exceeded) and therefore being a precious tool in assessing and guiding the construction industry towards becoming greener and environmentally friendlier (Marchi, et al., 2021).

Assessment tools in the view of Akhanova, et al. (2019) attempt to improve building functional performance systems while also aiding in decreasing the environmental burdens associated with buildings. Other deliverables are estimating the building's environmental influence, thereby objectively assessing and evaluating the building's development during construction. As a result of measuring the environmental friendliness of buildings and other associated deliverables, a measurement that meets a certified standard is necessary in guiding the ways buildings are rated (Purwaningsih et al. 2018). Further fall outs of these are the recommendations by the authors that greening tools are required for its measuring in buildings. Therefore, existence of a wide range of institutions and standards for greening in buildings abound and these include the British greening tools BREEAM, the American greening tool-LEED, the Australian greening tools NABERS and GREEN STAR, and GREEN MARK which is widely used in Singapore. These rating systems mostly target critical criteria including passive design aspects, energy efficiency, life cycle assessment, incorporation of renewable energy systems and site planning, which Chodnekar, Yadav & Chaturvedi (2021) approve are well highlighted in most of the countries rating systems. In addition, the authors agree that wlmer worldwide, most countries are using international and nationally developed greening tools, it is noted that using these different tools depends on variant climatic conditions in each clime, building typologies and the respective economic and social priorities. Thus there is no one best fit all system for a particular climatic region.

Greenness Levels and Compliance Standards of Buildings in Nigeria

In order to achieve compliance levels of sustainable development by the building construction sector in developed and developing economies, it has been suggested that there are four basic actions that need to be taken by both governments and the private sector (Umar, et al., 2013). These are in the form of regulations, education and training programs, financial incentives and measures to changing market demands. It is the belief of construction stakeholders that the end state of the building sector is to ensure that the construction market demands for buildings that are high performance and sustainable. Developmental strides at enhancing standardization practices of green building developments and standard assessment tools within the Nigerian context need to be improved, which Akhanova et al. (2021) suggest are because there is no standard rating tool for use in the Nigerian Built Environment. The authors further allude to the fact that buildings also consume a lot of natural resources that harm the environment, which they statistically present as consuming 70% of cementitious materials and 25% of steel and virgin wood. In many developing countries and economies of the world, it is believed that there exist measures and practices developed to support sustainability and the greenness initiatives of buildings that has been in existence for quite some time now, but there have been many impeding factors that have been responsible for the slow advances in these societies as compared to global advances (Karaca, et al. 2020). Green buildings as a concept and development process started around 1960s during the world energy crisis which Zhang, et al. (2019) attributed to the reasons that spurred research into energy efficiency and decrease of environmental pollution and further led to the introduction of environmentally friendly building construction practices by construction stakeholders. Green buildings and their systems of ratings emerged in building construction projects in 1990 with the introduction of BREEAM and by 2010, 382 types of greening tools softwares worldwide were already available (Khan, et al. 2019). Such rating systems, in the long run, have the advantage of using tools in assessing a building's green aspects or sustainability attributes, thereby being able to establish building greenness compliance level based on the total points obtained during assessment criteria in the long run (Prabhakar, et al., 2023). These became an effective way of monitoring and enhancing the building's roles in reducing their environmental effects. This becomes necessary in developing economies due mainly to social, economic and environmental issues associated with neglecting these key strategies (Ali and Nsairat 2009).

As the upsurge in the attainment of green buildings in the built environment has continued to gain relevance, most developing and developed economies have adopted this all-encompassing phenomenon of a building greenness level, and Nigeria is also compliant with this (Nduka and Sotunbo 2014). The authors further highlight the need for facing the current challenges in the Nigerian region, like evolving performance standards evolvement of codes and standards at mitigating and developing the built environment. Nigerian enforcement agencies' in government have established laws like the Federal Environmental Protection Agency Act (1988), Policies on regulating the Nigerian Built Environment (1989) and the Environmental Impact Assessment Act of (1992). In addition, the authors highlight the influence that professional bodies and private organizations in Nigeria have contributed to this discussion through the establishment of the Greening Council of Nigeria with affiliation with the World Green Building Council.

This newly developed Green Building Council of Nigeria, according to the authors is yet to produce a rating tool, which has necessitated the willingness of the Green Building Council of South Africa (GBCSA) to allow a rating system in Nigerian Buildings known as the Green Star SA (South Africa) adoption pending using greening tools in the Nigerian construction industry in accessing building construction projects.

Advantages of Greenness Levels and Compliance Standards of Buildings in Sub-Saharan Africa

Bernardi, et al. (2017) highlight that Rachel Carson's book titled Silent Spring (1962) gave birth to the discussion on the harmful activities of humans on the environment, which gave rise to the current environmental movement the world over. Climate change repercussions and adverse effects are predicted to be experienced in different ways in Sub-Saharan Africa through both Natural and Human systems. These point to a warming trend most observable in the inland subtropics, with increases in temperatures being estimated at (4 Degrees) warming scenarios (Serdeczny, et al. 2017). Nigeria, despite being the largest economy in Sub-Saharan Africa, has faced challenges in the introduction and creation of an effective rating system. This can ensure that buildings are not only environmentally friendly but enhance comfort levels of building occupants (Olawunmi, et al. 2020). Therefore, it is essential to submit that greening tools are applied in determining the environmental damages buildings cause to the built environment, including urban projects and provisions of infrastructural facilities (Bernardi et al. 2017). Greening tools and software are currently applied in construction projects in Sub-Saharan Africa as an effective performance evaluation system ranging from civil works to infrastructural projects that have been embarked upon (Olawunmi et al. 2020).

The Council for the Regulation of Green Buildings in Nigeria

Nigeria has recently established a council for the regulation of green buildings. It is non-governmental, formed around 2011, with its primary mandate for advocating, educating, and setting greenness compliance levels of construction projects in the Nigerian built environment space. As an advocacy based organization, it is the voice of Nigeria's green building sector by catalyzing a positive change in the Nigerian Built Environment through direct engagement with the building construction stakeholders. On the other side, as an educational enhancement group on deficiencies regarding issues related to green buildings and enhanced built environments that are free of greenhouse gases and carbon dioxide emissions, the Green Building Council of Nigeria bridges this gap by organizing seminars and courses while also developing standards in delivering greenness within built environments. Thirdly, part of their mandate is establishing local greening tools for evaluating building construction projects which, in the long run, will guide developers, professionals and building construction stakeholders. Finally, the Green Building Council of Nigeria's certification system provides designers and developers with recognition of the greenness of their designs/buildings. Also, it offers products endorsement to vendors and manufacturers on the sustainability of their products.

RESEARCH METHODOLOGY

In embarking on the study, it was essential to systematically analyze secondary data obtained from existing literature from forty-five relevant articles through detailed content analysis from journal and conference articles obtained from Google Scholar, Semantics, and Scopus covering the period from 2008 to 2023.

Search for Publications

Information relevant to the study's key themes was obtained from the secondary database, which focused on the existing green building rating systems. For ethical reasons, the data was inspected thoroughly, categorized and synthesized for semantic reasons. In achieving this scientific review, the articles selected were the most relevant to the study's area of focus. These were Greening tools applications in Africa, the concept of greening and ratings systems in construction projects, the emergence of greening tools in Nigerian the advantages of greening tools in sub-Saharan Africa and the emergence of regulatory institutions and bodies and the application of the South African greening tools system, Green Star South Africa Rating tool for use in Nigeria and LEED certified buildings in Nigeria.

Selection Criterion

A thorough method of intensive exclusion and inclusion techniques enabled the researcher to remove all irrelevant data and concentrate on critical parameters associated with green buildings, green rating tools, climate change, and environmental impacts. The findings identified advantages and disadvantages associated with the programs and policies targeted at Green Building Rating Systems and their implementation in Nigeria. These were thoroughly evaluated to crystallize key findings as highlighed in Figure 1.

Data Analysis

As this was a qualitative study, all data were presented by content analysis structured design. These were done in order to identify the current gaps existing in the compliance levels of buildings and their greenness standards within the construction industry in Nigeria and the adopted strategies established for implementation.

Table-1: Green Star SA Category Weighting System for Use in Nigeria.
Source: South African Greening Tool for Implementation in the Nigerian Building Space 2014.

Credit No.	Management	Scores
MAN-1	South African manpower attendant	2
MAN-2	Applications during commissioning of the project	2
MAN-3	Deliverables	2
MAN-4	Third party input	1
MAN-5	Manual	1
MAN-6	Environment and associated deliverables	2
MAN-7	Wastes	3
MAN-8	Compliance with tightness of the structure	
MAN-9	Recycle- retail	
MAN-10	Man-10: managements and systems – retail & peb	1
MAN-11	Green lease - retail	
MAN-12	Compliance rules – multiple units residential	
MAN-13	Learning resources - peb	1
MAN-14	Life cycle costing - peb	1
MAN-15	Maintainability - peb	1
	Total	**17**
Credit No.	**Indoor Environmental Quality**	
IEQ-1	Rates of ventilation movement	2
IEQ-2	Change in air movement	
IEQ-3	CO2 compliance	1
IEQ-4	Daylighting	3
IEQ-5	Glares during daylighting	1
IEQ-6	Ballast	
IEQ-7	Lightings	1
IEQ-8	Building facades	2
IEQ-9	Temperature comfortability levels	2
IEQ-10	Building occupants comfortability	
IEQ-11	Materials that cause harm	1
IEQ-12	Acoustics	3
IEQ-13	Dangerous compounds	3
IEQ-14	Harmful organic compounds reductions	1
IEQ-15	Dryness levels	1
IEQ-16	Tenants exhausts and risers	1
IEQ-17	No Smoking	
IEQ-18	Places of respite and recreation – retail	
IEQ-19	space and outdoors for privacy- multiple units residential	
IEQ-22	universal access - multi unit res	
IEQ-23	stairs - peb	1
	Total	**23**
Credit No.	**Energy**	
ENE-0	CRs	0
ENE-1	GHEs	20
ENE-2	Metering’s	3
ENE-3	LPD	
ENE-4	Lightings and Zonings	2
ENE-5	PEBs	3
ENE-6	Metrerings - RETAIL	
ENE-7	Heated Water - MULTIPLE UNITS RESIDENTIAL	
ENE-8	Usage of Energy - MULTIPLE UNITS RESIDENTIAL	
ENE-9	LEEG- MULTIPLE UNITS RESIDENTIAL	
ENE-10	EEAs - MULTIPLE UNITS RESIDENTIAL	
ENE-11	Unoccupied Spaces - PEB	2
	Total	**30**

Credit No.	Transport	Scores
TRA-1	Parking Provision	2
TRA-2	Transportation and Fuel Efficiency	2
TRA-3	Cycling Provision	3
TRA-4	Transportation for users	5
TRA-5	Accessibility Locally	2
TRA-6	Trip Reduction – Mixed Use – RETAIL	
TRA-7	VOEs– RETAIL & PEB	2
	Total	**16**
Credit No.	**Water**	
WAT-1	Occupant Amenity Water / WAT-1: Potable - PEB	12
WAT-2	Metering's for water usage	3
WAT-3	Watering of Landscaping	
WAT-4	Heat Rejection Water	
WAT-5	Consumption of water for fire emergncies	
WAT-7	Potable Water Efficient Appliances - MULTI UNIT RES	
WAT-8	Swimming Pool / Spa Water Efficiency - MULTI UNIT RES	
	Total	**15**
Credit No.	**Materials**	
MAT-1	Recycle	3
MAT-2	Reusability	5
MAT-3	Reusable materials	2
MAT-4	Fit-outs	
MAT-5	Natural concreting	3
MAT-6	Reinforcement	3
MAT-7	PVC minimisation	
MAT-8	Sustainable timber	2
MAT-9	Design for disassembly	1
MAT-10	Dematerialisation	1
MAT-11	Local materials	2
MAT-12	Efficient dwelling size - multi unit res	
MAT-13	Masonry - multi unit res & peb	2
	Total	**24**
Credit No.	**Land Use and Ecology**	
ECO-0	Conditional Requirement	0
ECO-1	Topsoil	1
ECO-2	Reuse of Land	2
ECO-3	Reclaimed Contaminated Land	2
ECO-4	Change of Ecological Value	4
ECO-5	Urban Heat Island – RETAIL	2
ECO-6	Outdoor Communal Facilities - MULTI UNIT RES	
ECO-7	Urban Consolidation - MULTI UNIT RES	
ECO-8	Community Facilities - PEB	1
	Total	**12**

Credit No.	Emissions	Scores
EMI-1	Refrigerants/gaseous ozone depleting potential (odp)	
EMI-2	Refrigerants/gaseous global warming potential (gwp)	
EMI-3	Refrigerant leaks	
EMI-4	Insulant odp	
EMI-5	Watercourse pollution	3
EMI-6	Discharge to sewer	5
EMI-7	Light pollution	1
EMI-8	Legionella	1
EMI-9	Boiler and generator emissions	1
EMI-10	Kitchen exhaust emissions - retail	
EMI-11	Atmospheric deterioration avoidance	1
	Total	**12**
Credit No.	**Innovations**	
INN-1	Innovative Strategies and Technologies	
INN-2	Exceeding Green Star SA Benchmarks	**5**
INN-3	Environmental Design Initiatives	
	Total	**5**

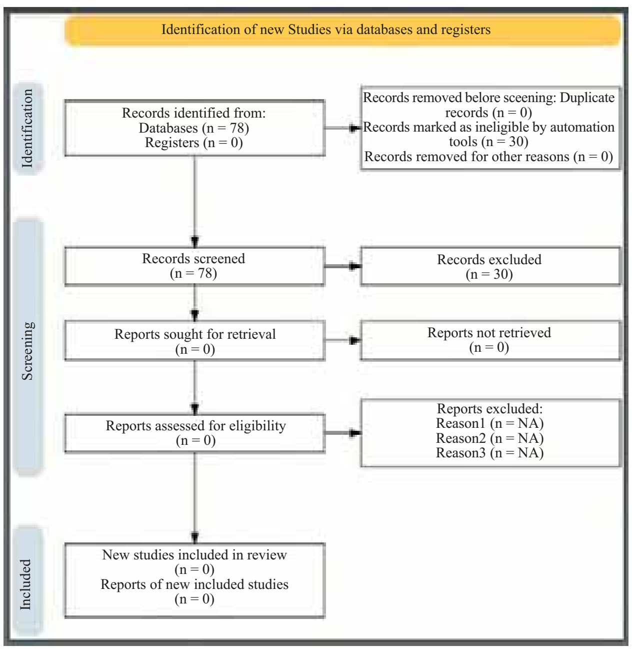

Figure-1: Prisma Template.
Source: https://estech.shinyuapps.io/prisma_flowdiagram/2024.

FINDINGS

Green Star South Africa Rating Tool for use in Nigeria

Efforts were made at implementing a regulatory policy framework for greenness levels of buildings in Nigeria, its environs and city spaces. Shaba and Noir (2014) in their study on the South African greening tool to be used in the Nigerian construction industry highlight that this rating system was used by the Australian Greening Council allowing use in Ghana, South Africa, Mauritius and Namibia. As a result of having an effective greening tool and rating system in the Nigerian built environment, the South African Greening Council is seeking approval from their Australian counterparts to use their adopted rating tool effectively in Nigeria for compliance and monitoring purposes. This they have further achieved by insisting on applying all Green Star SA v1 Design/As Built Rating tools for offices, retail centres, and multi-unit residential, public and educational buildings domiciled within Nigeria and referring to the certification as Green Star SA-Nigeria. This rating tool deals with nine different categories, each with a credit unit attached.

Leadership in Energy and Environmental Design (LEED)

Sustainability-related concerns are urgent issues that need worldwide solutions according to Bisegna, et al., (2018) are believed to have started in 1973 and 1979 when the energy crisis informed man of the dangers of over-relying on nonrenewable energy sources as a means of energy consumption and production. Since then, this has necessitated the concept of global warming, which has further exacerbated the need by several countries to reduce their Greenhouse gas emissions and energy consumption patterns and rates from their building construction projects (Jeong, et al., (2016). Bisegna et al. (2018) In addition, believe that a measure of sustainability is essential when a level of comparison is sought from different and competing alternatives in terms of materials, production, energy resources, and production processes. Green buildings are a system whereby building construction professionals use and apply energy efficient designs with healthy advantages to building occupants, improving their comfort levels thereby reducing negative impact on environmental conditions within the surroundings (Larson, et al., 2008). In the US, the Green Building Council was formed in 1993, which was an agglomeration of a wide building construction influencers in the private and public spaces with a common interest in addressing the environmental issues related to building construction. Closely related to this was the establishment (LEED) greening tools in 1998, which intended to transform the building market with a system of compliance rules in the development of green buildings. It is also a rating system associated with various construction projects (Roosa 2020). Therefore, the LEED Green Building certification systems limit the energy use of buildings and address the sustainability aspects in construction (Amiri, et al., 2019). LEED is currently the best greening tool that is widely recognized for its versatility and compliance levels, which insists on taking actions that limit the energy consumption levels of buildings, thereby constructing them more sustainably (Amiri, et al., 2021). Rodriguez, et al., (2023) highlight in their research that having greening parameters involves categorizing buildings in a systematic hierarchy. They conclude that the first early building assessment tools like LEED and BREEAM allow for a complete greening assessment of multiple sets of building construction projects. The authors highlight that the two best rating tools in the building industry today comprise BREEAM and LEED, which can be applied to different building construction projects.

Amiri, Ottelin and Sovari (2019) highlight that the LEED rating system currently has five certification types, namely LEED building design and construction, LEED interior design and construction, LEED neighbourhood development, LEED building operations and maintenance and LEED for homes. Building certification levels are based on points

Table-2: Green Rated Buildings in Nigeria.
Source: United States Green Building Council 2023.

S. #	Name of Building	Project Type	Location	Rating
1	The Patheon	New Construction	Lagos, Nigeria	LEED v4
2	African Reinsurance Head office Building	New Construction	Abuja, Nigeria	LEED v4
3	Plot 989 Yedserem Steer Maitama	New Construction	Abuja, Nigeria	LEED v4
4	Our First Home	New Construction	Abuja, Nigeria	LEED v4
5	Karishma C.K. Manufacturing Ltd Factory	New Construction	Ogun State Nigeria	LEED v4
6	Prime City	New Construction	Lagos, Nigeria	LEED v4
7	Olarewaju Bello	New Construction	Lagos, Nigeria	LEED v4
8	World Bank Abuja	New Construction	Abuja, Nigeria	LEED v4
9	Place OC	New Construction	Owo, Ondo, Nigeria	LEED v4.1
10	Mr Emeka Ndu	New Construction	Lagos, Nigeria	LEED v4
11	U.S. Consulate General Lagos	New Construction	Lagos, Nigeria	LEED v4
12	Misa	New Construction	Lagos, Nigeria	LEED v4
13	No4 Bourdilon Street	New Construction	Lagos, Nigeria	LEED v3
14	P&G Nigeria MDO Warehouse	New Construction	Agbara, Ogun Nigeria	LEED v3 Silver
15	AfDB Nigeria Field office	New Construction	Abuja, Nigeria	LEED v3
16	U.S.Embassy Abuja-New Annex	New Construction	Abuja, Nigeria	LEED v3
17	Procter and Gamble Lagos Facility	New Construction	Agbara, Ogun Nigeria	LEED v3
18	Asdsds	New Construction		LEED v3
19	Procter and Gamble Lagos Master Site	New Construction	Lagos, Nigeria	LEED v3
20	1913-Ssa-Nigeria-D&M Base Ph	Existing Buildings	Port Harcourt, Nigeria	LEED v4
21	FDE1911 Blue Base Nigeria	Existing Buildings	Port Harcourt, Nigeria	LEED v4
22	3250-SSA-Nigeria-NTC Camp	Existing Buildings	Port Harcourt, Nigeria	LEED v4
23	AFREXIM Bank-Abuja Regional office	Core and Shell	Abuja, Nigeria	LEED v4
24	Heritage Place	Core and Shell	Lagos, Nigeria	LEED v3
25	Nestoil Tower	Core and Shell	Lagos, Nigeria	LEED v3 Silver
26	bba's Heart Montessori School	Schools	Lagos, Nigeria	LEED v4
27	RFA SH-Classroom South	Schools	Abuja, Nigeria	LEED v3
28	RFA SH-Classroom North	Schools	Abuja, Nigeria	LEED v3
29	Microsoft Nigeria	Commercial Interiors	Lagos, Nigeria	LEED 4 Silver

Table-3: LEED Scorecard Nestoil Corporate Headquarters.
Source: United States Green Building Council 2023.

	Sustainable Sites	**19/28**
SSP1	Control of environmental pollutants	0/0
SSC1	Effective selection of building construction site	1/1
SSC2	Building Density	5/5
SSC3	Brownfield Redevelopment	0/1
SSC4.1	General transportation access	6/6
SSC4.2	Green bicycle storage and changing rooms	2/2
SSC4.3	fuel-efficient vehicles	3/3
SSC4.4	parking	0/2
SSC5.1	Maintenance of the natural habitat	0/1
SSC5.2	open spaces provisions	0/1
SSC6.1	Storm water design -	0/1
SSC6.2	Storm water design -	0/1
SSC7.1	Heat island effect – non-roof	1/1
SSC7.2	Heat island effect - roof	0/1
SSC8	Light pollution reduction	0/1
SSC9	Tenant design and construction guidelines	1/1
	Water Efficiency	**6/10**
WEP1	Efficient use of water	0/0
WEC1	Landscaping and water efficiency	4/4
WEC2	Innovative Wastewater Technologies	0/2
WEC3	Water reuse Reduction	2/4
	Energy And Atmosphere	**15/37**
EAP1	Fundamental commissioning of building energy systems	0/0
EAP2	Minimum energy performance	0/0
EAP3	Fundamental refrigerant management	0/0
EAC1	Optimize energy performance	5/21
EAC2	On-site renewable energy	0/4
EAC3	Enhanced commissioning	0/2
EAC4	Enhanced refrigerant management	2/2
EAC5.1	Measurement and verification - base building	3/3
EAC5.2	Measurement and verification - tenant sub metering	3/3
EAC6	Green power	2/2
	Materials and Resources	**0/13**
MRP1	Storage and collection of recyclables	0/0
MRC1	Building reuse - maintain existing walls, floors and roof	0/5
MRC2	Construction waste management	0/2
MRC3	Materials reuse	0/1
MRC4	Recycled content	0/2
MRC5	Regional materials	0/2
MRC6	Certified wood	0/1
	Indoor Environmental Quality	**4/12**
EQP1	Internal air control quality	0/0
EQP2	No smoking	0/0
EQC1	Outdoor air delivery monitoring	0/1
EQC2	Increased ventilation	1/1
EQC3	Construction IAQ management plan - during construction	1/1
EQC4.1	Less harmful use of materials	0/1
EQC4.2	Less harmful materials usage in terms of paintings and coatings	0/1
EQC4.3	Less harmful materials flooring materials	0/1

EQC4.4	Less harmful composite and agri fibre	0/1
EQC5	Indoor chemical and pollutant source control	0/1
EQC6	Controllability of systems - thermal comfort	0/1
EQC7	Indoor temperature comfort - design	1/1
EQC8.1	Daylight and views - daylight	0/1
EQC8.2	Daylight and views - views	0/1
	Innovation	**2/6**
IDC1	Innovation in design	+1
IDC2	LEED Accredited Professional	+1
	Regional Priority Credits	**4/4**
EAC1	Optimize energy performance	+1
EAC5.2	Measurement and verification - tenant submetering	+1
WEC1	Water efficient landscaping	+1
WEC3	Watter use reduction	+1

Figure-2: Nestoil Corporate Headquarters.
Source: www.researchgate.net (2023).

allocated on how healthy buildings satisfy these criteria, which consist of Certified (40-49 points), Silver (50-59 points), Gold (60-79 points)and Platinum (80+ points). It further allows points for six other basic deliverables like sustainable sites, water efficiency, atmosphere and energy, materials and resources, indoor environmental quality and innovation. Energy-related credits have the highest score regarding this rating system, with 30% of overall credit scores, which usually results in a higher overall certification score.

LEED Certified Green Buildings in Nigeria

The United States Green Building Council believes buildings and communities will regenerate and sustain the vitality of all life within a generation. Their mission further states that transforming how buildings and communities are designed, built and operated enables an environmentally and socially responsible, healthy and prosperous environment that improves the quality of life (USGBC 2023). They intend to achieve this by subjecting buildings to the LEED Greening building tool. According to the US Greening Buildings Body, there are a total of 29 green buildings in Nigeria (Table 1).

According to the architects that designed this commercial complex (Adeniyi Coker Consultants Limited), it comprises 15 Storeys which is subdivided into different functional uses consisting of 7,500sqm of offices, 350sqm of accommodation spaces, a multi-storey parking facility as well as a recreational facility. This gigantic building is located at the intersection of Akin Adesola and Saka Tinubu streets in the Central Business District of Victoria Island Lagos State Nigeria. The buildings form was created using gentle curved horizontal surfaces of high performance glass with horizontal tubular details which accentuate the sweeping effects of the curved façade. Further to this are the functions of the arched curtain walls which are defined by surrounding of solid white metal panels to complete the contemporary composition of the magnificent edifice.

The LEED Score card for the Nestoil Building Project was categorized into seven sub-divisions namely:

1 Sustainability of the site
2 Efficiency in using water
3 Efficiency in using energy
4 Efficiency in the use of materials of construction
5 Efficient quality of the indoor environment
6 Creativity
7 Credits based on points gained

RESULTS

Buildings, which could take the form of houses, are essential for man's needs, as they not only shelter him but also act as man's investment, in hold, for future profit at retirement or old age. While this is notably important, these buildings continue to harm the ecosystem and the built environments in which they are domiciled. As a result of these harmful and costly associated damages to the built environment, countries worldwide have joined resources together to find a lasting solution to the menace of global warming and environmental pollution. Further moves at enhancing eco-friendly sustainable development practices resulted in the signing of memorandums of understanding between countries like the Kyoto Protocol in 1997 and the Washington Earth Observation Summit in 2003 (Alotaibi, et al., 2023). A key component in determining the building compliance standards is adhererence to current environmental sustainability conditions. In addition, (Song, et al., 2023) all green building rating systems arrive at a best-fit green compliance rating system (Song et al., 2023). Another major determining factor for green building rating systems is consumption patterns of energy that have become alarmingly high, leading to the search for a globalized solution. Cai and Gou (2023) have suggested using rating systems to appropriately guide and promote building compliance ratings with green building construction methods and materials usage. The overall environmental efficiency of the world's building stock has seen the effects and advancements at which climate change has negatively impacted them. Therefore, the construction industry needs to discover newer ways and practices that are more environmentally friendly (Maqbool, et al., 2023). These may be in the form of green construction materials with more environmental advantages when applied. Therefore, by using both BREEAM and LEED and other recognized certification rating systems, they could enhance the attainment of low cost energy efficient buildings. While conducting a study in Kano, Alotaibi et al. (2023) believe that greening tools need to be adopted for compliance and greening standards in creating a sustainable building environment. They highlight the importance of green rating systems in establishing more sensible approaches to the current issues regarding environmental control and dominance. In addition, they agree there are few sustainable construction projects in Nigeria, which they attribute to a paucity of experience in greening processes and an absence of adequate government regulations and laws. lack of knowledge and derived advantages of greening construction projects in Nigeria are identified, thereby calling for more research in this area of awareness studies. This also aligns with the study by (Ibrahim and Raji 2018), who assert in their research of adoptions of greening tools in the city of Kano, North Western Nigeria, but efforts towards enhancing their high implementation compliance levels are not in synergy between concerned stakeholders. Atolaibi et al (2023) additionally, point that Nigeria’s national laws and policies responsible for compliance with green construction and rating systems are ineffective towards enhancing compliance; as such, these should be further strengthened for sustainability and sustainable built environments. Agyekum, et al., (2020) in understanding adoption of greening tools in Ghana, also a developing economy like Nigeria, identify that there is little literature available on this subject in Ghana highlighting key variables responsible for adoption. These are observability of the benefits, government’s commitment level, incorporation of green building certification codes by professionals and their regulatory organizations, and enactment of green certification concepts.

CONCLUSION

The study appraised green building rating systems focusing upon relevant parametrics at achieving sustainability within Nigeria as a case point. The study further identified the different green building drivers in the African Built Environment as environmental, financial, economic, and social benefits, meaning that the buildings are comfortable for the occupants and healthy while also being aesthetically pleasing. This was closely followed up by the concept of greening in buildings. The essentials of green buildings is that they are a system of assemblages that cause less harm to the areas they are domiciled. Green Buildings as a concept first came into existence after the energy crisis of 1960 with the introduction of which led to the introduction of BREEAM in 1990 further saw an increase in developments of other green building rating tools the world over as a way of addressing the threats of global warming. The study further discussed the world's leading green building rating tool, LEED and identified 29 projects in Nigeria that have been certified with the LEED rating system. The Nestoil Corporate Headquarters was used as a reference building to highlight the use of LEED as a rating tool on an existing project, reflecting the various aspects that were used in certifying this building as green. Although the Green Building Council of Nigeria in collaboration with the Green Building Council of South Africa, have agreed to use the Greening tool of South Africa in Nigerian as a certification system for ensuring green buildings, the Nigerian Built Environment still falls short of an effective local rating tool for certifying buildings green which has further exercabated the effects of building construction projects in the short term and the long run. There still appears a lack of willingness on the part of government at implementing regulatory and policy frameworks that will further reduce the effects of buildings on the Nigerian Cityscape. The GBCN of Nigeria continues to play its part in enlightening construction stakeholders regarding the harm caused by non-green-compliant buildings in the environment through training and workshop programs, but more is needed to mitigate the effects of construction projects in Nigeria. Therefore, further research concerning encouraging implementation of regulatory and policy frameworks within the built environment landscape in Nigeria will effectively enhance certifications and green building standards. There should be the introduction of desk officers at the building regulatory agencies on the insistence of design and construction of green projects, which will further act as revenue generation for this arm of governments towards having resources to implement green building construction. Tax incentives are also suggested for building construction professionals and vendors that want to engage in the purchase and supply of green building construction materials. Policy and Regulatory frameworks that emphasize implementation strategies at improving the green building rating systems in Nigeria towards achieving sustainability and sustainable development should be the foremost priority and focus of all stakeholders concerned.

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SAINTS, SUFIS AND SHRINES - THE MYSTICAL LANDSCAPE OF SINDH

Zulfiqar Ali Kalhoro

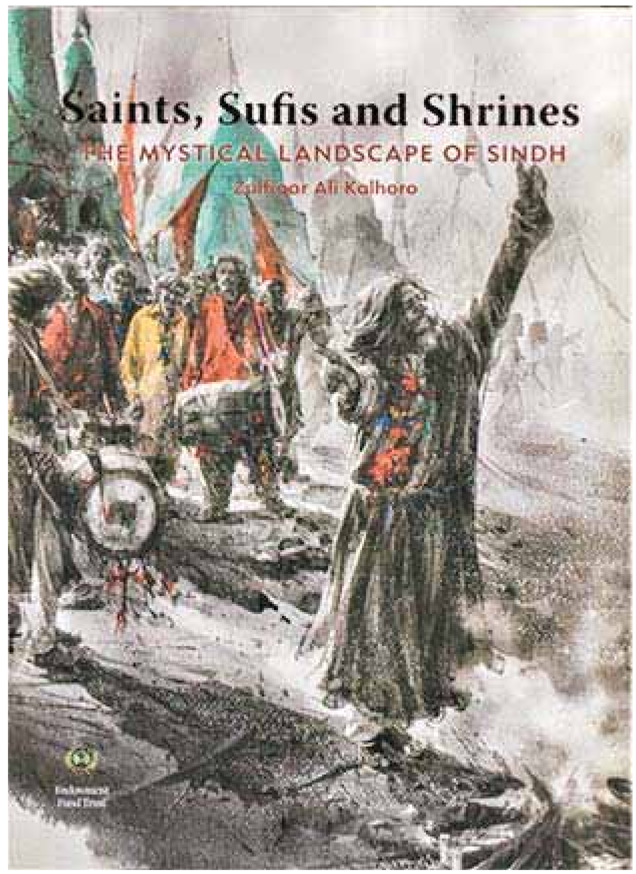
Reviewed by Sarah Sarmad*

BOOK REVIEW

Saints, Sufis and Shrines - The Mystical Landscape of Sindh authored by Zulfiqar Ali Kalhoro examines the intricate social, religious, and cultural contexts in which Sufism flourished in Sindh. The purpose of the book is to develop the interest of international academics in Sindh's rich Sufi heritage. The author plans to write three volumes in this series, with this one being the first. It comprises saints and shrines from every region of Sindh from the thirteenth to the twentieth centuries, both known and less known. This book has around fifty-five articles on various saints and shrines. These articles discuss the saints and talk about their significance in Sindhi society and culture in bringing socio-political and religio-cultural changes in the mystical landscape of Sindh.

This engaging and thoroughly researched book offers insight into Sindhi Sufism in its multiple facets. It goes into detail on how Sufism is Islam's preserved spiritual path. Drawing on a thorough study of Muslim writings and traditions, the author posits that Sufism is not an innovation but rather the continuation of a thinking process that connects Muslims to their religious predecessors.

It presents a perceptive analysis of how Sufism interacts with both Muslim and non-Muslim society. This book discusses both Muslim and Hindu saints as well as their shrines. All of these shrines serve as examples of religious harmony and tolerance where people of many faiths can mingle and communicate while letting go of prejudice through the enjoyment of Sufi music and poetry. Families of Hindus from marginalised castes are frequently spotted at the shrines, which reflects both their widespread appeal and inclusivity. The centuries-old shared heritage of Sindh



has been carried on by devotees of both religions. One of the many Sufi shrines in Sindh where people of various religions gather to seek comfort and transcend all religious boundaries is the shrine of Shah Abdul Latif Bhitai.

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Pictures of all the shrines discussed makes the book even more interesting. It also discusses the architecture of the shrines from inscriptions to the tileworks which gives insight into the preservation of the shrines. It covers the people who are guardians of the shrines who welcome both Muslims and Hindus and proudly tell that they themselves belong to both religions.

Readers are free to escape the illusion of putting Sufism in a box with restrictions and rigid boundaries. The meaning of Sufism is liberated by Kalhoro's work. He describes how Sufism is not like a structured phenomenon with a clear beginning and end. Instead, it is a complicated world, all on its own.

The subject of *Saints, Sufis, and Shrines - The Mystical Landscape of Sindh* is a one that has not received much scholarly attention, and this book is a commendable contribution to it. Based on 244 pages, the book is simple to read and can readily capture the interest of both layman readers and scholars. Academics may use this publication as important reference on the subject in the years to come.

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