

SUSTAINABLE BUILDING RETROFITTING AND ENERGY EFFICIENCY

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PREFACE

This book introduces various topics related to energy efficiency and sustainable retrofitting. The topics cover researches and studies on the initiatives, strategies, reduction and improvements, applications, effect, and approach.

Chapter 1 discussed the steps of retrofitting initiatives that can implement to achieve building energy reduction. Retrofitting initiatives consist of three steps which are lean energy, green technology, and clean energy. Lean energy is also known as passive design, such as shading, glazing, green roof, green wall, daylighting. Green technology involves adopting technology such as occupancy sensors, automatic daylight harvesting systems, Variable Frequency Drives, energy-efficient lighting, and air-conditioning. Then, for the greatest effect of energy reduction and the demand for building energy, clean energy or renewable energy provides an opportunity for more significant energy reduction such as solar photovoltaic, wind power, and solar hot water. Chapter 2 focuses on giving an overview of green building assessment tools, the concept of retrofitting and retrofitting technologies. The retrofitting technologies categorized into three groups: supply-side management, demand-side management, and change of energy consumption pattern such as human factors.

Chapter 3 discussed the building lighting energy simulation for retrofitting the Rest and Service Area (RSA) at Ayer Keroh Malaysia, which conducted using the Revit BIM model. The simulations were performed to analyze the lighting performance and proposed retrofitting initiatives to reduce lighting consumption. Meanwhile, Chapter 4 presents the prototyping of retrofitting strategies in the educational building to reuse a building type or building design. This process needs to ensure compatibility of the design usage and functions.

Chapter 5 reveals the strategies for mitigating the influence of modernism towards sustainable retrofitting of Hausa traditional palaces. This is because traditional buildings are constructed from different materials and in different structural forms than modern buildings, and therefore, they perform differently. Thus there are some general qualities of traditional buildings that are worth defining compared to modern buildings, which require different understanding, skills, and material solutions.

Chapter 6 presenting the attitude towards energy consumption and strategies to encourage energy efficiency in a building. The attitude and strategies were obtained from a questionnaire survey conducted at the M50 office building, School of Civil Engineering Universiti Teknologi Malaysia. Consumers have shown a positive attitude towards energy savings by turning off the electrical appliances when they do not use them, utilizing natural sunlight to lighten the room, and setting up the air-conditioning temperature. Meanwhile, implementation of energy audit, information through seminars, and encouragement campaign ranked among the top 3 of other strategies to encourage energy efficiency.

The energy consumption and occupant's well-being based on the retrofitting implemented in the office building at National Primary Health Care Development Agency Abuja were highlighted in Chapter 7. This chapter aims to present the technical details of the building's current state and highlight the retrofitting projects since the building has consumed a lot of energy due to the light bulbs, heat gain from window units, continuous pumping of water, and poor indoor environmental quality. The case study grounded on 40% energy savings by providing adequate illuminance, ventilation, and thermal comfort for the occupants. Chapter 8 reveals cool paint application to the indoor temperature conducted at the student hostel room in UTM residential college. The study proved that the student's surrounding temperature in the residential college is lower after applying the cool paint. The paint also reflects more infrared light to reduce heat

absorption and decrease the level of energy consumption used to bring down the room's temperature. Lastly, Chapter 9 highlighted the passive design approach of building envelope for individual residents in achieving energy-efficient building. Selection of type, size, and location of glazing and windows at the building envelope and dominant wall areas for solar access is the most significant approach to site planning and orientation. A critical understanding of the energy efficiency problem is required in conjunction with the passive design approach of the building envelope. The related construction player should take a rule from the Overall Thermal Transfer Value (OTTV) as a tool for calculating the efficiency of the building envelope to achieve the minimum target value.

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CHAPTER 5

STRATEGIES FOR MITIGATING THE INFLUENCE OF MODERNISM TOWARDS SUSTAINABLE RETROFITTING OF HAUSA TRADITIONAL PALACES

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5.1 INTRODUCTION

According to Denyer [1] the myth of darkest Africa is persistent, and there are recast many people who hardly accept that traditional buildings of the continent merit more than passing consideration. Traditional architecture has gradually been sidelined and more attention is given to modernized facilities which is the new trend noticed in society today.

Before colonialism and its attendant modifiers, there had been a traditional practice of ornamentation in Makuba and external mural paintings for external walls in Hausa land, particularly concerning palace architecture. This decoration is mainly an urban phenomenon associated with wealth and sophistication, and it is primarily based on relief and abstract with some inanimate object [2]. A particular form of decoration known as graffito is used in Hausa land in which different color wall plasters are laid in layers, and the design is made by scratching away upper layers. Denyer [1] pointed out that this decoration may imbue some magical or religious significance.

Hausa architecture and settlement's essential lies in a hierarchy of spaces from the smallest village to the largest city, from the humble residences to the most complex

palaces [2]. It is all about spatial distinction, order, and growth or decay. Hausa culture is essentially urban, and consequently, Hausa architecture and urban design found their highest expression in urban centers and particularly palaces. A palace is a space where power is performed, and grandeur displayed. It is also the fulcrum of a state's political, economic, and spiritual activities [3].

Palace buildings which happen to be the focal points within the walled cities that is directly captured as significant historical buildings [4]. Art and artistic symbolism are integral aspects of communicating power and royal distinction. It is in this context that palace art and ornamentation can be appreciated. As most African art scholars argue, art and artistic objects in African contexts have both formalist and functionalist significance.

With the advent of modernism began the gradual shift in the Hausa land's palace architecture's status towards a modern phenomenon. The tragedy is that the design, plan, and construction of Hausa royal houses representing the rich Hausa cultural heritages are also affected by this movement. Bilyaminu [4] concluded that modern architecture failed to preserve and restore palace buildings in northern Nigeria. In light of this, this study's framework is developed and asserted that palaces while undergoing renovations need to bear several considerations.

5.2 OVERVIEW OF HAUSA LAND AND CULTURE

The Hausa ethnicity is one of the generally recognized ethnic groups in Nigeria. The three major ethnic groups are Hausa, Igbo, and Yoruba. The Hausa's are people with rich culture, beliefs, values and norms, and traditional practices. The origin of the Hausa's dated back to a time or almost 5000 years.

The Hausa aristocracy had historically developed an equestrian-based culture. Still a status symbol of the traditional nobility in Hausa society, the horse features in the eid day celebration known as Hausa Sallah (in English:

the day of prayer). They have a common origin (the Hausa's) and a common language, even though some differences are recorded in the spoken languages. This spoken language differs from place to place but as earlier mentioned, their origin remains the same. Tales about the origin of the Hausa's has a different school of thought. The most obvious and prominent was that of Bayajidda, who happens to be Hausa's founding father of Hausa Land. Bayajidda was said to be the prince of Baghdad. He arrived in Daura (the oldest of the Hausa city-state), riding a horse, and married the queen of the town known as 'Daurama.' Their seven sons founded the other states of Kano, 8 Katsina, Zazzau, Gobir, Rano, and Biram. According to the Bayajiddah legend, he arrived at Daura tirelessly and thirstless. He met an old woman called "Ayyana". He demanded water from her. She replied to him that here in this town we only got water from, she responded to him that here in this town we only got water on Fridays due to a single source of water from an old well known as 'RijiyarKusugu' (Kusugu well) and the well was now dominated by giant anaconda who allow us to fetch water there only on Fridays and unfortunately you arrived on Friday. He insisted on visiting the well and succeeded the anaconda, brought the water, and returned with its head to Ayyana. This incident made her much surprised, and she reported to the queen about it. Upon her description (Ayyana) had never seen a horse before, and she tough it was a cow and described him to the queen as a man who rides a cow. She said "wanda - ya "hau - sa" [5]. This braveness of his made the queen gets married to him, and they had seven sons. The seven son's of theirs founded the other seven Hausa city-states, known as the Hausa Bakwai.



Figure 5.1: Map of Nigeria showing area occupied by Hausas [6].

By the 12th Century, the Hausa were becoming one of the Africa's major trading powers. Competing with Kanem Bornu and the Mali Empire, the primary exports were leather, gold, clothes, salt, kolanut, slaves, and henna. Certainly, trade influenced religion. By the 14th century, Islam was becoming widespread in Hausa as Wangara scholars, scholars, and traders from Mali, scholars, and traders from the maghrib brought the religion with them. Predominantly, Hausa-speaking communities are scattered throughout West Africa and on the traditional Hajj route north and east, traversing Sahara with an essentially large population around Agadez. Also, Hausa's have also moved to large coastal cities in the region, such as Libya, over the last 5000 years. Most Hausa society is spatially organized into a hierarchy of settlement

varying from the 9 most rural hamlet to the most urban city for a settlement the Hausa usually select a place which is near a rock out crop, a butte (dutse) or an inselberg (fa) that have religious significant as home of spirits (iskoki). There also serve as the last lines of defence. However, no settlement is established on such a feature because it is believed that such natural formations are the prepared habitation of spirit. Settlement like Kano, Katsina, and Zaria later grew into cities that were all founded not very far from such formation.

The Hausas architecture is perhaps one of the least known but most beautiful of the medieval ages. Many of their early mosques and palaces are bright and colorful, including intricate engraving or elaborate symbols design into façade and courtyards. This architectural style is known as 'tubali', which means architecture in the Hausa language.

The traditional architecture of Hausa land is an area that has not been receiving much attention since the proliferation of modern architectural designs in Hausa land. During the colonial period and even centuries before the colonis era, there has been considerable arrangements of hausa social structure in the cities of zaria kano and gumel, which is often described as heirrarchical ranging from base that include blacksmith, crafts men, musicians, traders, farmers and labourers to royalty at the top [7].

In northern Nigeria, the traditional royal palaces built by skillful Hausa master builders represents one of the most outstanding examples of mud architecture in sub Saharan Africa [8] unfortunately this skill is now been lost due to the replacement of indigenous building materials with modern ones such as concrete and corrugated iron roofing sheets.

The design and plan of Hausa royal houses represent the rich cultural heritage of the region [9]. However, even the palaces themselves are undergoing major transformations toward modernism without bearing in mind that these palaces are the only remaining heritages in society showcasing the region's indigenous architecture. Taking a look at the emir's palace kano and the hadejia emirs palace, dutse emirs

palace in jigawa state as references, modern architect in Nigeria have failed to allow the majority of the palaces to be overshadowed by modernism to a large extent. This effect happens overtime during the pre-colonial, colonial, and post-colonial era (mostly when the palaces are undergoing major retrofitting).



Figure 5.2a & 5.2b: Exterior facades of Hadejia palace [4]



Figure 5.3a & 5.3b: Interior façade of katsina palace [4]



Figure 5.4(a) & 5.4(b): Façade of emirs' palace Kano [10]

Retrofitting a traditional building is however, a complex task because of many confounding variables. Energy retrofits can reduce building energy consumption and carbon emissions but face particular challenges when implemented in historic and traditionally constructed buildings. Retrofitting these buildings is a complex balancing act, in which many criteria are balanced against one another to achieve continued, long-term use of the building. Retrofitting in general means an upgrade to an existing building [11]. According to EPPR [12], retrofitting is any change to an existing structure to reduce or eliminate the possibility of damage. While retrofitting a traditional building, consider the retrofit principle (Figure 5.5)



Figure 5.5: Retrofit Principle [13]

Retrofit is the process of improving buildings' energy and environmental performance through technical interventions, albeit that to achieve benefits, this process often needs to encompass occupants' lifestyle changes and involves an ongoing program of repairs and maintenance [13].

All work on buildings requires an approach that is specific to their context. However, there are some general qualities of traditional buildings that are worth defining compared to modern buildings, which consequently require different understanding, skills, and material solutions. Traditional buildings are constructed from different materials and in different structural forms compared with modern buildings and therefore, they perform differently. They usually heat up and cool down more slowly. Moreover, they deal with moisture differently, allowing rain, groundwater and internal moisture (from washing, cooking, and breathing) to move in a controlled way into and through their semi-permeable fabric. They also rely on sunshine, wind, heating, and adequate internal ventilation through windows, chimneys, and draughts to keep dry. In good condition and with regular maintenance, the system stays in balance. Changes to fabric

performance, heating, and ventilation, if not correctly undertaken, can change this balance and lead to problems of overheating, moulds, and ill health. Culturally, traditional buildings provide local character and a very tangible connection to the past, with aesthetic and community benefits. All buildings do this, but traditional buildings reach further into the past and have greater links to locality and history, which cannot be easily replaced (Figure 5.6).

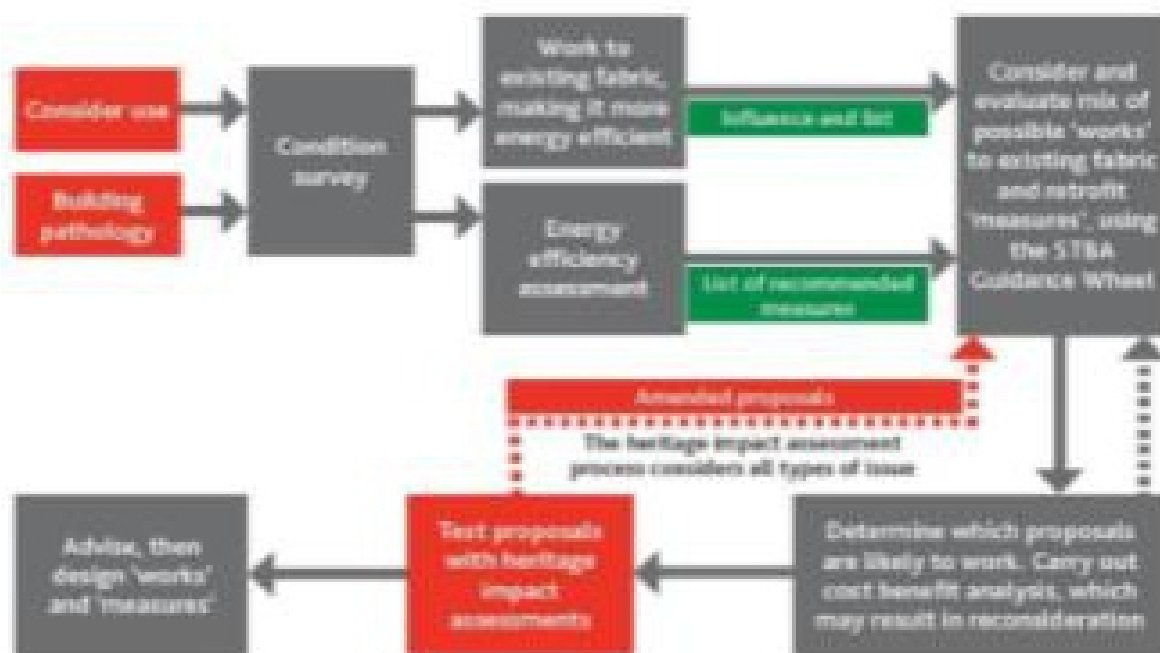


Figure 5.6: Holistic retrofit process following BS 7913: 2013

5.3 METHODOLOGY

The methodology adopted for this research is an extensive and critical literature review on the traditional architecture of palaces and the review of the impact of modernism on traditional architecture, particularly palaces which happens to be the focus of any traditional architecture. As such, the building block of this paper is secondary sources of data. A reconnaissance survey and personal observation of the existing palaces in their real context.

5.4 DISCUSSION

Hausa traditional architecture is drastically affected and transformed by the external forces of modernism and westernization that crept its way primarily through colonialism in the 20th century. The trend is that palaces are the only aspect of our architectural heritage remaining. However, the palaces themselves are beginning to become the victims of such influence in an attempt to retrofit. Urgent addressing is needed to control the trend or transition. Otherwise, there will be no remain of our rich cultural heritage. Godwin and Kyratzis [14] opined that heritage and historical buildings are local treasures and human heritage and international property.

The Hausa traditional palaces have the highest expression and concentration of Hausa architecture in design, construction, ornamentation, and decorations. Modern architecture emphasizes retaining our cultural heritages to upgrade these facilities, the effort of the tradition should not be left in vain. Conversely, with the evolution of industrialization and technological advancement, the touches of modernism in the 21st century era cannot be totally rejected. Still, rather strategies need to be enhanced and implemented to retrofit the Hausa traditional palaces.

Since retrofitting of a traditional or heritage building entails two contrasting phenomenon, which makes it retrofitting entirely different from a normal contemporary building, it must strike a unique balance between an upgrade to meet the modern day requirement and at the same time retain its dignity in terms of cultural and heritage protection. However, while retrofitting Hausa traditional palaces, attention must be paid to at least the following;

i. Conservation

“Conservation” means all the processes of looking after a place to retain it’s historical and architectural and aesthetic and cultural significance and includes maintenance, preservation, restoration, reconstruction, and adoption or a combination of more than one of these [15].

To conserve (*conservare*) means to keep, to preserve. Thus the basic attitude of preservation comes most purely to conservation: to conserve is the supreme preservation principle. Together with stabilization and safeguarding measures, conservation work that protects the fabric of a monument and prevents further loss should have absolute priority over all other measures. Unfortunately, this principle cannot be taken for granted because parts of a monument are often renovated or even reconstructed at great cost while other components of the same building continue to deteriorate without urgently necessary conservation work.

ii. Preservation

“Preservation” means and includes maintaining the fabric of a place in its existing state and retarding deterioration [15]

iii. Restoration

“Restoration” means and includes returning the existing fabric of a place to a known earlier state by removing accretions or by reassembling existing components without introducing new materials [15]. However, restoration in its full richness may not suffice for the preservation of the traditional palaces; this is due to the relativity of the material used; they may not be able to withstand continuing harsh effect of the environmental exposure

iv. Repair

The repair objective is to reduce the long-term deterioration of a building’s fabric by remedying the cause of any defects [16]. This, in turn, sustains the building’s significance, but to achieve this, there needs to be sufficient information to understand the impact of the proposed repairs. Sustainability requirement:

The sustainability requirement for retrofitting a traditional building is mostly carried out in terms of energy efficiency. Responsible retrofit should deliver sustained net reductions in energy use, at minimal environmental impact, while maintaining or improving the traditional built environment and making a positive contribution to human health [13].

Energy retrofits can reduce building energy consumption and carbon emissions but face particular challenges when implemented in historic and traditionally constructed buildings. A successful retrofitted traditional building should achieve:

v. Energy savings/Environmental improvement

Real reductions in energy use reduce costs and CO₂ emissions and ultimately improve everyone's fuel security [11]. Long-term savings are best achieved through simple and robust technical measures which are easy to use and maintain.

vi. Heritage protection and enhancement

Most traditional buildings, including those listed, can be upgraded with at least some retrofit measures (to fabric or services). With appropriate care and user engagement, it is possible to achieve sustained energy use reductions without damage to buildings or to streetscapes [13]. Where buildings have fallen into disrepair, they can be enhanced by sympathetic renovation and proper maintenance, which prolongs their life and contributes to reductions in energy use.

vii. Healthy buildings

Retrofit is an opportunity to improve energy use and improve comfort and health for a building's occupants. Discomfort and ill health in buildings are often connected with moisture problems due to poor maintenance, inappropriate repairs, and alterations or inadequate [13]. All these omissions also affect the health of the building fabric Balance.

Achieving responsible retrofit often requires compromises between different values. It also requires a Whole Building Approach whereby there is an integration of the fabric measures (such as insulation, new windows, draught-proofing), and services (particularly ventilation, heating, controls, and renewables) along with proper consideration of how people live and use the building [13].

5.5 DEVisING A RETROFITTING STRATEGY

Palaces are cultural treasures, so their retrofitting is entirely different from a typical contemporary building, and of course the:

- i. A thorough historical context of any palace should be overviewed before beginning any action/alteration
- ii. Identify those palaces in their full richness and authenticity
- iii. Explore the probable cause of damage or decay that makes it necessary for retrofitting
- iv. Identify the various retrofitting techniques that will cause less harm to the building fabric or the building itself
- v. The choice of material used in the initial construction is recommended, and where this is unavailable, a substitute of the former could be adopted
- vi. While making substitution to building materials, a sustainable approach should be explored as the overall goal of retrofitting is to increase the efficiency of the palaces and meet the modern-day requirement
- vii. Identify the options that meet the objective of repair, restoration, conservation, and preservation
- viii. The option of reversibility
- ix. Modern architects in northern Nigeria, while retrofitting a palace, should consider all the above-listed strategies not to compromise the standard

5.6 CONCLUSION

Modernism could be said to have indeed crept its way into the traditional architecture of Hausa land structures, edifices, and even monuments leaving no area of building in touch; of course, it will remain stagnant with no room for avoidance. Palaces, in general, are the fulcrum of a state's political, economic, and spiritual activities. Art and artistic symbolism are integral aspects of communicating power and

royal distinction. It is in this context that palace art and ornamentation can be appreciated.

Unfortunately, Hausa land palaces are becoming part of the calamities of modern influence to what is known as an upgrade. An extensive literature on these palaces' current situation reveals the injury the cause by modern trend. The research, however, draws attention to careful consideration on how to retrofit them. Otherwise, the sustainable approach deployed nowadays, when viewed from conservation and preservation will be no longer sustainable because it comprises future generations meeting their architectural heritage. The research, however, succeeded in exploring strategies and measures to approach retrofitting of Hausa traditional palaces.

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