

INTEGRATION OF BIOPHILIC DESIGN PRINCIPLES IN DRUG  
REHABILITATION CENTRES IN KANO, NIGERIA

BY

KANU, Benjamin Chiamaka  
MTech/SET/2017/7611

DEPARTMENT OF ARCHITECTURE  
FEDERAL UNIVERSITY OF TECHNOLOGY  
MINNA

JULY, 2021

**INTEGRATION OF BIOPHILIC DESIGN PRINCIPLES IN DRUG  
REHABILITATION CENTRES IN KANO, NIGERIA**

**BY**

**KANU, Benjamin Chiamaka  
MTech/SET/2017/7611**

**A THESIS SUBMITTED TO THE POSTGRADUATE SCHOOL, FEDERAL  
UNIVERSITY OF TECHNOLOGY, MINNA, NIGERIA IN PARTIAL FULFILMENT  
OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF MASTER OF  
TECHNOLOGY (MTech) IN ARCHITECTURE**

**JULY, 2021**

## **ABSTRACT**

Biophilic architecture is based on the assertion that humans have an innate connection with nature that should be expressed in their daily lives, especially in cities. This, which has not been a strong feature of architectural principles (even though there has been a long tradition of landscape architecture), yet potentially offers great rewards if the assertion is true. However, earlier and more recent studies have revealed that individuals who dwell among the splendours and mysteries of nature are never alone or weary of life thus, implying that there is something infinitely healing in the repeated refrains of nature. This research examined the principles of biophilic design while generating a framework for their applicability in the design of drug rehabilitation Centres in Nigeria. The choice of Kano is largely hinged on the affirmation that the area clutches the highest number of recorded drug addiction cases in Nigeria. The research adopted a descriptive research method, with the use of observation schedules, interviews and an in-depth review of existing literature. Five rehabilitation Centres in Nigeria were purposively selected for this research, with findings showing low attendant level of the application of biophilic design principles in the design of drug rehabilitation Centres within the study area. Furthermore, the research also established a design framework from the findings which features design elements that establishes direct and indirect contact with nature and also experience of place and space, upon which a design proposal of a drug rehabilitation Centre in Kano, Nigeria was developed. However the research concluded that Nigeria could be sitting on a treasure-trove in biophilic design principles. Therefore, these design considerations should be adopted as a design strategy for health and rehabilitation Institutions in Nigeria; which is a recommendation this research puts forward.

## TABLE OF CONTENTS

|            | <b>Content</b>                    | <b>Page</b> |
|------------|-----------------------------------|-------------|
|            | Title Page                        | i           |
|            | DECLARATION                       | ii          |
|            | CERTIFICATION                     | iii         |
|            | DEDICATION                        | iv          |
|            | ACKNOWLEDGEMENTS                  | v           |
|            | ABSTRACT                          | vi          |
|            | TABLE OF CONTENTS                 | vii         |
|            | LIST OF TABLES                    | xiv         |
|            | LIST OF FIGURES                   | xvi         |
|            | LIST OF PLATES                    | xvii        |
|            | LIST OF APPENDICES                | xviii       |
|            | <b>CHAPTER ONE</b>                | <b>1</b>    |
| <b>1.0</b> | <b>INTRODUCTION</b>               | <b>1</b>    |
| 1.1        | Background of Study               | 1           |
| 1.2        | Statement of the Research Problem | 3           |
| 1.3        | Aim of the Study                  | 4           |
| 1.4        | Objectives of the Study           | 4           |
| 1.5        | Justification of the Study        | 5           |

|            |  |          |
|------------|--|----------|
| 1.6        | Scope of the Study                               | 5        |
| 1.7        | Limitations of the Study                         | 6        |
| 1.8        | Contribution to Knowledge                        | 7        |
|            | <b>CHAPTER TWO</b>                               | <b>8</b> |
| <b>2.0</b> | <b>LITERATURE REVIEW</b>                         | <b>8</b> |
| 2.1        | Introduction                                     | 8        |
| 2.2        | Drug Addiction                                   | 8        |
| 2.3        | Treatment and Recovery                           | 10       |
| 2.4        | Drug De-addiction and Rehabilitation             | 11       |
| 2.5        | Rehabilitation Centres                           | 11       |
| 2.6        | Brief History of Biophilia                       | 12       |
| 2.7        | The Theory of Biophilia                          | 12       |
| 2.8        | The Evidence of Biophilia                        | 16       |
| 2.9        | Restoration and Attention                        | 17       |
| 2.9.1      | Recovery from stress or illness                  | 19       |
| 2.9.2      | Productivity within the work environment.        | 21       |
| 2.10       | The Implications for Design of Built Environment | 21       |
| 2.11       | Biophilic Design                                 | 22       |
| 2.12       | Dimensions of Biophilic Design                   | 23       |

|          |  |    |
|----------|--|----|
| 2.12.1   | Organic or naturalistic dimension of biophilic design.       | 23 |
| 2.12.1.1 | Direct connections to nature                                 | 23 |
| 2.12.1.2 | Indirect connection to nature                                | 24 |
| 2.12.1.3 | Symbolic connection to nature                                | 25 |
| 2.12.2   | Vernacular design relating to ecology of a place             | 26 |
| 2.12.2.1 | Vernacular design relating to culture and history of a place | 26 |
| 2.12.2.2 | Vernacular design fusing culture and ecology                 | 26 |
| 2.12.2.3 | Vernacular design avoiding placelessness                     | 27 |
| 2.13     | Elements of Biophilic Design.                                | 28 |
| 2.14     | Patterns of Biophilic Design                                 | 29 |
| 2.15     | Benefits of Biophilic Design to Patients' Health             | 31 |
| 2.16     | Application of Biophilic Design in Health Facilities.        | 32 |
| 2.16.1   | Direct contact with nature                                   | 32 |
| 2.16.1.1 | Natural features   | 33 |
| 2.16.1.2 | Views and vista  | 33 |
| 2.16.1.3 | Natural landscape and ecosystem                              | 34 |
| 2.16.1.4 | Façade greening  | 34 |
| 2.16.2   | Indirect contact with nature                                 | 37 |
| 2.16.2.1 | Natural materials  | 37 |

|          |  |     |
|----------|--|-----|
| 2.16.2.2 | Natural colours                              | 37  |
| 2.16.2.3 | Natural shapes, forms and patterns           | 38  |
| 2.16.2.4 | Images of nature                             | 38  |
| 2.16.3   | Experience of space and place                | 39  |
| 2.16.3.1 | Transitional spaces and bounded spaces       | 40  |
| 2.16.3.2 | Security and protection                      | 40  |
| 2.16.3.3 | Spatial harmony and spaciousness             | 40  |
| 2.16.3.4 | Attraction and beauty                        | 41  |
| 2.16.3.5 | Connection to place                          | 41  |
| 2.16.3.6 | Mobility and way finding                     | 425 |
| 2.17     | Design Considerations for Biophilic Design   | 42  |
| 2.17.1   | Identifying desired responses and outcome    | 43  |
| 2.17.2   | Diversity of design strategies               | 43  |
| 2.17.3   | Quality over quantity of attributes          | 44  |
| 2.17.4   | Duration of exposure and frequency of access | 44  |
| 2.17.5   | Scale and feasibility                        | 44  |
| 2.17.6   | Climatic factors                             | 45  |
| 2.17.7   | Wholeness of design                          | 45  |

|            |  |           |
|------------|--|-----------|
| 2.18       | Conceptual Framework for Biophilic Design in Drug Rehabilitation Centres                                       | 46        |
|            | <b>CHAPTER THREE</b>   | <b>45</b> |
| <b>3.0</b> | <b>RESEARCH METHODOLOGY</b>  | <b>46</b> |
| 3.1        | Introduction   | 46        |
| 3.2        | Data Types and Sources   | 47        |
| 3.2.1      | Primary data   | 47        |
| 3.2.2      | Secondary data   | 48        |
| 3.3        | Population of Study  | 48        |
| 3.4        | Sampling/ Case Study Selection Criteria  | 49        |
| 3.5        | Data Collection  | 50        |
| 3.5.1      | Case studies   | 50        |
| 3.6        | Instruments for Data Collection  | 50        |
| 3.7        | Procedure for Data Collection  | 52        |
| 3.8        | Data Analysis and Presentation   | 53        |
|            | <b>CHAPTER FOUR</b>  | <b>54</b> |
| <b>4.0</b> | <b>DATA PRESENTATION, ANALYSIS AND DISCUSSION</b>  | <b>54</b> |
| 4.1        | Data Analysis  | 54        |
| 4.1.1      | Biophilic design principles that can be adopted to provide healing environments in drug rehabilitation centres | 55        |



|         |  |    |
|---------|--|----|
| 4.1.2   | Attendant level of application of these biophilic design principles in drug rehabilitation centres in Nigeria. | 56 |
| 4.1.2.1 | Direct contact with nature   | 56 |
| 4.1.2.2 | Indirect contact with nature   | 63 |
| 4.1.2.3 | Experience of space and place  | 65 |
| 4.2     | Design Framework for Biophilic Design Principles in the Design of Drug Rehabilitation Centres in Nigeria       | 80 |
| 4.3     | Application of the Design Framework in the Design of a Proposed Drug Rehabilitation Centre in Kano State       | 81 |
| 4.3.1   | The site   | 81 |
| 4.3.2   | Site selection criteria  | 82 |
| 4.3.3   | Site selection justification   | 83 |
| 4.3.4   | Site planning, bye laws and regulations  | 84 |
| 4.3.5   | Site analysis  | 84 |
| 4.4     | Site Planning  | 85 |
| 4.5     | Design Report  | 86 |
| 4.5.1   | Design brief   | 86 |
| 4.5.2   | Design considerations and concept  | 87 |
| 4.5.3   | Structures provided in the proposed drug rehabilitation centre   | 89 |
| 4.5.5   | Construction   | 91 |

|            |                                       |            |
|------------|---------------------------------------|------------|
| 4.5.6      | Materials and finishes                | 92         |
| 4.5.7      | Patient furnishings                   | 93         |
| 4.5.8      | Landscape and external works          | 93         |
| 4.5.9      | Building services                     | 94         |
|            | <b>CHAPTER FIVE</b>                   | <b>97</b>  |
| <b>5.0</b> | <b>CONCLUSION AND RECOMMENDATIONS</b> | <b>97</b>  |
| 5.1        | Conclusion                            | 97         |
| 5.2        | Recommendations                       | 97         |
|            | <b>REFERENCES</b>                     | <b>99</b>  |
|            | <b>APPENDICES</b>                     | <b>103</b> |

## LIST OF TABLES

| <b>Table</b>  | <b>Page</b> |
|---|-------------|
| 2.1 Nine Values that Reflect Human Relationship with Nature   | 14          |
| 2.2 Conceptual Framework for Biophilic Design in Drug Rehabilitation Centres  | 45          |
| 4.1 Variables for Biophilic Designs in Drug Rehabilitation Centres  | 55          |
| 4.2 Assessment of Natural Feature (Ventilation and Day lighting) in the Sample Rehabilitation Centres   | 57          |
| 4.3 Assessment of Natural Features (Indoor Plants and Water Bodies) in the Sample Rehabilitation Centres  | 58          |
| 4.4 Assessment of Views and Vistas in the Sample Rehabilitation Centres   | 59          |
| 4.5 Assessment of Views and Vistas in the Sample Rehabilitation Centres   | 60          |
| 4.6 Assessment of Façade Greening in the Sample Rehabilitation Centres  | 62          |
| 4.7 Assessment of Natural Materials and Natural Colours in the Sample Rehabilitation Centres  | 63          |
| 4.8 Assessment of Natural Shapes, Forms, Patterns and Images of Nature in the Sample Rehabilitation Centres   | 65          |
| 4.9 Assessment of Key Biophilic Elements that reveal Experience of Place and Space (Translational and Bounded Spaces) in the Sample Rehabilitation Centres  | 66          |
| 4.10 Assessment of Key Biophilic Elements that reveal Experience of place and Space (Mobility and Way Finding) in the Sample Rehabilitation Centres         | 68          |
| 4.11 Assessment of Users' Perception of Security and Protection that reveal Experience of Place and Space in the Sample Rehabilitation Centres              | 69          |
| 4.12 Assessment of Users' Perception of Security and Protection that reveal Experience of Place and Space in the Sample Rehabilitation Centres              | 70          |
| 4.13 Assessment of Key biophilic elements that reveal Experience of Place and Space (Spatial Harmony and Spaciousness) in the Sample Rehabilitation Centres | 71          |

|      |   |    |
|------|---|----|
| 4.14 | Assessment of Users' Perception of Attraction and Beauty that reveal Experience of Place and Space in the Sample Rehabilitation Centres | 72 |
| 4.15 | Assessment of Users' Connection to Indigenous Habitat that reveal Experience of Place and Space in the Sample Rehabilitation Centres    | 74 |
| 4.16 | Structures Provided in the Proposed Drug Rehabilitation Centre  | 89 |

## LIST OF FIGURES

| Figure   | Page |
|--|------|
| 2.1 Elements and Attributes of Biophilic Design                                | 29   |
| 2.2 Patterns of Biophilic Design   | 30   |
| 2.3 Application of Biophilic design attributes (Direct Contact with Nature)    | 36   |
| 2.4 Application of Biophilic Design Attributes (Indirect contact with nature)  | 39   |
| 2.5 Application of Biophilic design attributes (Experience of space and place) | 42   |
| 4.1 Google Earth Site Location Map   | 89   |

## LIST OF PLATES

| Plate |   | Page |
|-------|---|------|
| I     | Picture of Natural Scene  | 20   |
| II    | Direct Connections to Nature by Natural Light and Vegetation in an Atrium                                     | 24   |
| III   | Natural materials offer indirect connections in Frank Lloyd Wright's Falling water.                           | 25   |
| IV    | Natural Features in the Built Environment at Henry Ford West Bloomfield Hospital                              | 34   |
| V     | Façade Greening at Haushan Hospital, Shanghai China   | 35   |
| VI    | Use of Natural Materials at St. Bernard Parish Hospital New Orleans, USA                                      | 37   |
| VII   | Natural patterns on facade at Airspace Tokyo, Japan   | 38   |
| VIII  | Spaciousness and Bounded Spaces at Mayo Clinic Hospital Minnesota, USA  | 41   |
| IX    | Images Showing Openings in Bauchi State Rehabilitation Centre Bauchi, Nigeria                                 | 58   |
| X     | Courtyard in Bauchi State Rehabilitation Centre Bauchi, Nigeria   | 60   |
| XI    | The Admin Block and Basic Education Block at Rehabilitation Centre for the Disabled Moniya, Ibadan, Oyo State | 61   |
| XII   | Building Façade at Plateau State rehabilitation Centre Jos, Nigeria   | 62   |
| XIII  | Showing the Mosque at the Rehabilitation Centre for the Disabled Moniya, Ibadan, Oyo State                    | 64   |
| XIV   | Walkway in Plateau State Rehabilitation Centre Jos, Nigeria   | 67   |
| XV    | Staircase leading to the Admin Block at Ekiti State Government Relief and Rehabilitation Centre, Ekiti.       | 69   |
| XVI   | Image of Building Façade in Bauchi State Rehabilitation Centre  | 73   |
| XVII  | Façade of Rehabilitation Centre for the Disabled Moniya, Ibadan, Oyo State                                    | 74   |

|       |   |    |
|-------|---|----|
| XVIII | Showing the Church Façade of the Rehabilitation Centre for the Disabled Moniya, Ibadan, Oyo State                           | 75 |
| XIX   | Environmental Features along Entrance in Bauchi State Rehabilitation Centre   | 76 |
| XX    | Showing Vegetation Covers and Notable Trees and Shrubs in Rehabilitation Centre for the Disabled, Moniya, Ibadan, Oyo State | 77 |
| XXI   | Green Surrounding Features in Ekiti State Government Rehabilitation Centre  | 77 |
| XXII  | Illustrated Patterns of the Pantanal of Brazil  | 88 |

## LIST OF APPENDICES

| <b>Appendix</b>  | <b>Page</b> |
|--|-------------|
| A     Site Plan  | 103         |
| B     Admin Floor Plan                                       | 103         |
| C     Blow-Out 1 of Admin Floor Plan                         | 104         |
| D     Blow-Out 2 of Admin Floor Plan                         | 104         |
| E     Front and Rear Admin Elevations                        | 105         |
| F     Side Admin Elevations                                  | 105         |
| G     Lecture Hall Floor Plan                                | 106         |
| H     Wards Floor Plan                                       | 106         |
| I     General Ward 2 Floor Plan                              | 107         |
| J     General Ward 1 Floor Plan                              | 107         |
| K     General Service Area Floor Plan                        | 108         |
| L     General Ward Elevations                                | 108         |
| M     Floor Plan of Skill Aquisition Centre/ Staff Chalets   | 109         |
| N     Staff Chalets Floor Plan                               | 109         |
| O     Floor Plan of Skill Aquisition Centre                  | 110         |
| P     Dinning Floor Plan                                     | 110         |
| Q     Elevation 1 of Skill Acquisition Centre /Staff Chalets | 111         |
| R     Elevation 2 of Skill Aquisition Centre /Staff Chalets  | 111         |
| S     Intensive Care Ward Floor Plan                         | 112         |
| T     Outdoor Recreation                                     | 112         |
| U     Section A-A  | 113         |



|   |   |     |
|---|---|-----|
| V | Section B-B                                 | 113 |
| W | Green Roof Details                          | 114 |
| X | Working Drawing of Skill Acquisition Centre | 114 |

## **CHAPTER ONE**

### **1.0**

## **INTRODUCTION**

### **1.1 Background of Study**

Humanity evolves in close relation to nature. And the quality of this relationship is reflected in the emotions, thoughts, culture and health that every individual or society expresses. In modern times however, the built space has been conceived and designed by giving nature a role that is not only marginal, but also irrelevant to the health and happiness of individuals (Kellert, 2012). Earlier studies (as early as the 1960's) have revealed that individuals who dwell among the splendours and mysteries of nature are never alone or weary of life thus, implying that there is something infinitely healing in the repeated refrains of nature (Downton *et al.*, 2017). This does not in any way suggest demonising the modern lifestyle or adopting the notion that it is essential to detach ourselves from cities, from built environments or from technological advancement. However, it is certainly imperative for urban buildings to have a design quality oriented to the physical and emotional reconnection with nature, its patterns and its processes. In other words, the compatibility of a building with the needs of the contemporary city is not limited to the design of the physical structure, but it also includes the functions and relationships that it produces and its ability to communicate with the surrounding environment with an exchange of value, in synergy with the individuals who enjoy it as a space dedicated to housing, work, leisure, but also healthcare.

It has been argued over the years that certain nature-based design approaches have overly focused on the 'respect of nature' which is a scheme to evade the hazardous impacts of the built

environment on the natural environment. Thereby, flopping in meeting the critical need of lessening the separation between humans and nature by improving the contact with processes related to the natural environment and building according to an approach that is culturally and ecologically channelled towards human health and well-being (Salingaros, 2015). As a result of this, there is a need for a paradigm aimed at reconstructing a harmonious relationship between humans and nature in the built environment. In line with this school of thought, biophilic design most likely represents the missing component in nature-based design, which is still tied to an idea of nature understood more as an ethical value, than as a biologically given condition.

The term biophilia was coined from two Greek words ‘bios’ which means life and ‘philia’ which is to love; suggesting a meaning of anything that is nature loving. The term biophilia which was used for the first time in the 1960s by Erich Fromm is the intrinsic human disposition to affiliate with nature (Kellert & Calabrese, 2015). Although biophilia is the phenomenon, biophilic design is internationally recognized as a process that offers a sustainable design approach aimed at relinking individuals with their natural environment (Downton *et al.*, 2017). It is note-worthy that architecture is not a treatment, but can most significantly become part of the healing process through the creation of spaces that foster and provide meaning to those activities utilized to achieve gradual rehabilitation through a therapeutic environment (Ryan *et al.*, 2014).

However, according to World Health organization, de-addiction is a process of reversing the state of someone physically or psychologically enslaved to a particular habit while rehabilitation is defined as a set of measures that assist individuals who experience or are likely to experience

disability or addictions to achieve and maintain optimum functioning in interaction with their environment (WHO, 2016).

## **1.2 Statement of the Research Problem**

The menace of drug abuse and addiction in Nigeria has reached a frightening proportion and has pervaded every fibre of the society, especially in the North-West. The issue of drug addiction over the years has become an issue for National concern in Nigeria and the National Drug Law Enforcement Agency (NDLEA) has continued to come up with measures to aid rehabilitation in a bid to minimally reduce drug addiction in the country.

In line with the Federal Republic of Nigeria's strategy to reduce the level of drug addiction in the country, the National Drug Law Enforcement Agency has outlined the urgent need to establish fully functional and effective drug rehabilitation centres in North-Western States in Nigeria (NDLEA, 2018). These states which were identified as the States with the highest number of victims of drug addiction require drug rehabilitation centres; as they are insufficient and in some areas, not even available at all. Kano which is the most populated of these States in the North West has been identified by the NDLEA as one of the States where these centres are most required. And these centres are expected to provide a therapeutic scenery which aids de-addiction and rehabilitation. (Ryan *et al.*, 2014).

Also, biophilic design principles have been suggested by previous research as great catalysts for aiding recovery are often inadequately considered in the design of health and medical Centres (Blair, 2014). Hence, the need to research into examining these biophilic design principles in

drug rehabilitation centres in Kano State. Therefore, this thesis focuses on examining biophilic design principles in drug rehabilitation centres in Kano State, Nigeria as this could provide architectural solutions for drug rehabilitation.

### **1.3 Aim of the Study**

This study is aimed at exploring the principles of biophilic design and generating a framework for their applicability in the design of drug rehabilitation centres.

### **1.4 Objectives of the Study**

The specific objectives are to:

- i. Study biophilic design principles that can be adopted to provide healing environments in drug rehabilitation Centres.
- ii. Investigate the attendant level of application of these biophilic design principles in drug rehabilitation Centres in Nigeria.
- iii. Propose a design framework for biophilic design principles in the design of drug rehabilitation centres in Nigeria.
- iv. Demonstrate the application of the design framework in the design of a drug rehabilitation Centre in Kano State that will facilitate rehabilitation.

### **1.5 Justification of the Study**

The Federal Government's policies against drug addiction necessitates the National Drug Law Enforcement Agency (NDLEA) to call for a need for the establishment of drug rehabilitation Centres in North-Western States in Nigeria; where these cases of drug addiction is at about 37.47% (NDLEA, 2018). Therefore, there is a serious need to establish drug rehabilitation Centres in those areas that incorporates indigenous biophilic design elements to aid rehabilitation process. This research will provide passive and sustainable architectural measures of reducing the menace of drug addiction through the use of natural features as well as traditional elements.

### **1.6 Scope of the Study**

The research hinges on the aspect of biophilic architecture which Kellert (2012) described as the core principles of biophilic design, hence the thesis emphasizes mainly the provision of a befitting environment which connect its users to the natural environment while promoting ecological conservation, positive health, and wellbeing. The rehabilitation centre will cater for both the male and female genders of different age ranges, as such; all design considerations and elements will be focused on the needs for improving healing process and recovery of the patients.

However, the research work did not propose deep details in the aspect of medications and medical treatment of the patients but provides spaces as deemed fit, through the use of natural shapes and forms, environmental features, light and space, evolved human-nature relationships,

and natural patterns and processes. Beyond this, issues of place-based relationships were also explored.

### **1.7 Limitations of the Study**

The following were the limitations encountered in the course of this research work:

- i. Restriction from obtaining data by observation in Wards and Patients-based areas within the studied rehabilitation Centres due to sensitive nature of those areas. As a result detailed observation could not be carried out in those areas, thereby limiting the extent of data obtained in those areas.
- ii. Photographs were not allowed to be taken in certain areas of the rehabilitation Centres for security reasons due to the sensitive Nature of those areas which limited the data obtained in those areas.
- iii. Due to security concerns, it was not possible to conduct interviews with the Patients of any level of rehabilitation, as data related to their perception of spaces and environment was obtained from staff members and this limited the depth of data obtained concerning experience of the Patients.

These above mentioned limitations encountered in the course of this research work implied that findings were based on data obtained from limited areas observed in all the sample rehabilitation Centres and from users and staff of those spaces.

## **1.8 Contribution to Knowledge**

This study contributes to the body of knowledge in the following ways:

- i. The study reveals how biophilic design principles can aid drug de-addiction and rehabilitation.
- ii. The study provides a guideline or module for incorporating biophilic design principles in the design of drug rehabilitation Centres.



## **CHAPTER TWO**

### **2.0**

### **LITERATURE REVIEW**

#### **2.1 Introduction**

This chapter seeks to establish clarity on the thesis title, deepening the focus of inquiry and seeking to evaluate already established knowledge on biophilic design principles and drug rehabilitation centres with the aim of establishing a theoretical background or framework by examination of relevant literature.

#### **2.2 Drug Addiction**

Drugs are chemicals that tap into the brain's communication system and disrupt the way nerve cells normally send, receive, and process information. There are at least two ways that drugs are able to do this: by imitating the brain's natural chemical messengers, and/or over stimulating the "reward circuit" of the brain according to the National Institute on Drug Abuse (2015). Some drugs, such as marijuana and heroin, have a similar structure to chemical messengers, called neurotransmitters, which are naturally produced by the brain. Because of this similarity, these drugs are able to "fool" the brain's receptors and activate nerve cells to send abnormal messages. other drugs, such as cocaine or methamphetamine, can cause the nerve cells to release abnormally large amounts of natural neurotransmitters that prevent the normal recycling of these brain chemicals, which is needed to shut off the signal between neurons. This disruption produces a greatly amplified message that ultimately disrupts normal communication patterns.

However, some people become addicted while others do not. And of course, phenomena like these happened but there is no single factor that predicts whether or not a person will become addicted to drugs. Risk for addiction is influenced by a person's biology, social environment, and age or stage of development.

Costeira (2014) outlined three (3) major factors that could lead to drug addiction and these are;

- a) Biology: The genes that people are born with in combination with environmental influences, account for about half of their addiction vulnerability. Additionally, gender, ethnicity, and the presence of other mental disorders may influence risk for drug abuse and addiction.
- b) Environment: A person's environment includes many different influences from family and friends to socioeconomic status and quality of life in general. Factors such as peer pressure, physical and sexual abuse, stress, and parental involvement can greatly influence the course of drug abuse and addiction in a person's life.
- c) Development: Genetic and environmental factors interact with critical developmental stages in a person's life to affect addiction vulnerability, and adolescents experience a double challenge. Although taking drugs at any age can lead to addiction, the earlier that drug use begins, the more likely it is to progress to more serious abuse. And because adolescents' brains are still developing in the areas that govern decision making, judgment, and self-control, they are especially prone to risk-taking behaviours, including trying drugs of abuse.

Drug addiction is a preventable disease. Research has shown that prevention programs that involve the family, schools, communities, and the media are effective in reducing drug abuse. Although many events and cultural factors affect drug abuse trends, when youths perceive drug abuse as harmful, they reduce their drug taking. It is necessary, therefore, to help youth and the general public to understand the risks of drug abuse and for teachers, parents, and health care professionals to keep sending the message that drug addiction can be prevented if a person never abuses drugs (Faloore, 2012).

### **2.3 Treatment and Recovery**

Addiction is a treatable disease. Discoveries in the science of addiction have led to advances in drug abuse treatment that help people stop abusing drugs and resume their productive lives. Addiction need not be a life sentence. Like other chronic diseases, addiction can be managed successfully. Treatment enables people to counteract addiction's powerful disruptive effects on brain and behaviour and regain control of their lives (Robinson *et al.*, 2014).

The chronic nature of the disease means that relapsing to drug abuse is not only possible, but likely. Relapse rates (how often symptoms recur) for drug addiction are similar to those for other well-characterized chronic medical illnesses such as diabetes, hypertension, and asthma, which also have both physiological and behavioural components. Treatment of chronic diseases involves changing deeply imbedded behaviours, and relapse does not mean treatment failure. For the addicted patient, lapses back to drug abuse indicate that treatment needs to be reinstated or adjusted, or that alternate treatment is needed. Research shows that combining a therapeutic

environment, treatment medications, where available, and behavioural therapy is the best way to ensure success for most patients (Dallimer *et al.*, 2012).

## **2.4 Drug De-addiction and Rehabilitation**

According to the World Health organization (WHO), drug de-addiction is a process of reversing the state of someone physically or psychologically enslaved to a particular habit of drug abuse or misuse while drug rehabilitation is defined as a set of measures that assist individuals who experience or are likely to experience obsessions with certain drugs to achieve and maintain optimum functioning in interaction with their environment (WHO, 2016).

## **2.5 Rehabilitation Centres**

Simply put, a rehabilitation centre is a location in which rehabilitation can occur. People get displaced from society for a variety of reasons. Some may experience an accident or illness that temporarily makes them unable to function the way they used to, while others may have an addiction that handicaps them. A rehabilitation centre provides a support system to help restore people to their place in society.

Rehabilitation centres serve people who have a physical disability, an intellectual disability (ID), a pervasive development disorder (PDD), an addiction problem (alcohol, drugs, gambling) or behavioural, psychosocial or family difficulties. Generally, rehabilitation centres offer adaptation, rehabilitation, social integration and accompaniment, as well as support services for family and friends. Their services may be provided on the centres' premises, in schools, at work or at home, as need be (Gamble *et al.*, 2014).

For the purpose of this study, drug rehabilitation centres will be the central focus. The function of this type of rehabilitation centres is to provide the means and space to help in the recovery process. This process varies depending on the rehabilitation that is needed. Rehabilitation centres use a combination of therapy, small groups, individual sessions and highly structured living. The function of a rehabilitation centre is to both increase the quality of life and to help the patient integrate back into the community (Green, 2012).

## **2.6 Brief History of Biophilia**

Biophilia is “the inherent human inclination to affiliate with nature” (Kellert & Calabrese, 2015). Wilson in 1984 popularised this term (that originated with Fromm) in exploring the need for nature premise as a hereditary human behavioural trait (Wilson & Kellert, 1993). The relationship between aesthetics and human comfort has been debated for millennia. It has been treated with guidelines, commentaries, codes and prescriptions that link one or another part of human wellbeing to visual and/or other stimuli. Exploration and elucidation of the connection between aesthetics and nature reaches back to the ancient Greeks and mysteries of sacred geometry and the divine proportion (Kellert, 2012). The concept of biophilia extends this philosophical enquiry about nature and aesthetics scaffolding scientific support for its validity.

## **2.7 The Theory of Biophilia**

The theory of biophilia was introduced in 1984 by socio-biologist Edward o. Wilson in his book of the same name (Kellert, 2012). However, the first time the notion of biophilia was mentioned was in the late 1900s by Erich Fromm, a German social psychologist. Fromm hypothesized that people have a passionate love of life and all that is alive; it is the wish to further growth, whether

in a person, a plant, an idea, or a social group (Fromm, 1973). Wilson takes Fromm's notion further and explains biophilia more completely. Wilson's theory of biophilia states that humans have an innate tendency to focus on life and lifelike processes. To elaborate, this theory purports humans have a need for nature beyond what nature provides them at a physical level, and encompasses the human craving for aesthetic, intellectual, cognitive, and even spiritual needs (Kellert & Callabrese, 2015).

Nature is essential to healthy human development in that it facilitates development of intellectual capacity, and immersion in nature satisfies human's desire for curiosity, discovery and imagination (Kellert, 2012). Specifically, biophilia is the inherent human inclination to affiliate with natural systems and processes, especially life and life-like features of the nonhuman environment. Wilson poetically summarizes biophilia thus: To explore and affiliate with life is a deep and complicated process in mental development. To an extent still undervalued, our existence depends on this propensity, our spirit is woven from it, and hope rises on its currents (Na-Umma, 2014).

Fromm emphasized a passionate love of life, whereas Wilson's biophilia goes much deeper than just the love of natural life. Biophilia encompasses our physical, emotional, and intellectual need for nature and lifelike processes. It is an important need in human development to affiliate with the diversity of nature. This biological need to connect with nature has an effect on human conditions such as intellectual capacity, emotional bonding, aesthetic attraction, creativity and imagination (Kellert *et al.*, 2008). In summary, Stephen Kellert has suggested that biophilia is:

- i. Inherent or biologically based
- ii. A part of human evolutionary development
- iii. Associated with human physical health
- iv. Likely to increase mental well-being and personal fulfilment
- v. A basis for the human conservation of nature

The need for nature is not only material or exploratory but is directly related to our emotions, aesthetic values, and cognitive functioning. The notion of biophilia asserts that human fulfilment is intimately dependent on our relationship with nature (Kellert, 2012). Stephen Kellert has developed nine fundamental values that reflect our relationship with nature. They are not instincts but rather a group of “learning rules” that affect human development. Each of these values indicates the human dependence on nature as basis for survival as well as physical and psychological well-being (See Table 2.1).

**Table 2.1 Nine Values that Reflect Human Relationship with Nature**

| VALUE               | DEFINITION             | FUNCTION              |
|---------------------|------------------------|-----------------------|
| <b>Utilitarian</b>  | Practical and material | Physical              |
|                     | exploitation of nature | sustenance/security   |
| <b>Naturalistic</b> | Direct experience and  | Curiosity, discovery, |
|                     | exploration of nature  | recreation            |

---

|                                 |  |  |
|---------------------------------|--|--|
| <b>Ecologicistic-Scientific</b> | Systematic study of structure, function            | Knowledge, understanding, observational skills         |
| <b>Aesthetic</b>                | Physical appeal and beauty of nature               | Inspiration, harmony, security                         |
| <b>Symbolic</b>                 | Use of nature for language and thought             | Communication, mental development                      |
| <b>Humanistic</b>               | Strong emotional attachment and "love              | Bonding, sharing, cooperation, companionship           |
| <b>Moralistic</b>               | Spiritual reverence and ethical concern for nature | order, meaning, kinship, altruism                      |
| <b>Dominionistic</b>            | Mastery, physical control, dominance of nature     | Mechanical skills, physical prowess, ability to subdue |
| <b>Negativistic</b>             | Fear, aversion, alienation from nature             | Security, protection, safety, awe                      |

---

**(Source: Kellert, 2008; Kellert, 2012; Ryan *et al.*, 2014)**

The nine values offer support of the biophilia hypothesis but do not constitute “proof” of biophilia. The values are meant to serve as basic connection in the relationship between human development and his dependence on nature. To this point the notion of biophilia has been



theoretical for the purpose of explaining the idea. However, there is a growing body of empirical evidence that supports biophilia and the human benefit from contact with nature (Kellert, 2012).

## **2.8 The Evidence of Biophilia**

A number of researches have confirmed the hypothesis that contact with nature can lead to increased mental health and psychological well-being (Kellert, 2012; Locklear, 2012; Ryan *et al.*, 2014). The contact is not limited to only a natural environment or landscape but could include the simple notion of nature. Examples of this are reading a book about nature, viewing art, or listening to a story. Each of these activities connects people to nature as long as they affect human emotion in some way. According to Kellert & Callabrese (2015), there are three types of contact we have with nature: direct, indirect and symbolic. Direct contact involves immediate experience with natural processes such as hiking through a forest, swimming in a stream or mountain climbing. Direct contact usually involves a person immediately within a natural environment (Montgomery, 2012).

Indirect contact involves some kind of human intervention or control such as mowing a lawn, viewing an aquarium or gardening. Symbolic contact does not require any physical contact with natural processes or organic life forms. It involves a symbolic or metaphoric encounter such as depictions of landscapes in art or photographs or the use of organic patterns and forms in either decoration or architecture. Whether we are affected directly, indirectly or symbolically, there is mounting evidence that each kind of contact affects us positively and contributes to human well-being (Hildago, 2014).

The following section will examine the current research available on the benefits of experience and contact with nature. The focus of the review will be on psychological restoration and attention, recovery from stress or illness and productivity.

## **2.9 Restoration and Attention**

The Attention Restoration Theory (ART) is an example of a stimulation theory, which helps to explain the responses of humans, in particular, to the sensory information contained in their environment. Since each environment – interior or exterior – can contain any number of stimuli to which any or all of our senses can react, understanding the role of environmental influences on human functioning and wellbeing is essential to the successful implementation of any design plan (Curie & Zilm, 2014). Environmental psychologists Costeira, (2014) opine that contact with the natural environment can have a psychologically restorative effect on people. They call these types of settings restorative environments. Restorative environments whether they are in the context of nature or the built environment, incorporate elements that function therapeutically by reducing cognitive fatigue and alleviating stress.

These environments provide opportunities for rest, recovery, contemplation, and isolation. Davidson (2013) stipulated that all stress is not created equal. They distinguished a difference between stress and mental fatigue. Stress involves preparation for a particular event that could be threatening or harmful such as preparing to have surgery. Mental or cognitive fatigue on the other hand, arises out of hard cognitive work such as long hours at work or studying. Excessive worrying can also cause cognitive fatigue. The worn-out feeling we get is usually not a physical effect but rather mental fatigue (Edward & Christopher, 2012).

AbdelMeguid (2014) hypothesized that a preferred environment is thus more likely to be a restorative environment. Since nature plays such a powerful role in what is preferred, in general terms there is a theoretical basis for expecting natural environments to be restorative. In order to better understand the qualities of restorative environments, Kaplan (2014) determined that, in order to be a restorative setting, the following components must exist:

- i. Fascination: Achieved through a part of or a whole setting that easily engages attention thereby allowing fatigued attention to rest.
- ii. Being away: Provided by a setting that is either physically or conceptually different from an individual's typical setting.
- iii. Extent: Provided by a setting that is complex enough to engage the mind and promote exploration.
- iv. Compatibility: Achieved when the design of a setting supports the intended use by the occupant.

In conclusion, the attention restoration theory provides a valuable framework to demonstrate how nature can play a role in creating a workspace that supports physical and psychological wellbeing, while encouraging the restoration of the directed attention needed for daily human functioning (Ratcliffe *et al.*, 2013).

### **2.9.1 Recovery from Stress or Illness**

The positive effects from contact with nature or natural views have proven to be greatest when people are experiencing high levels of stress or are confined to situations like hospitals, prisons and work environments. In these cases frequent direct, indirect or symbolic contact with nature continues to have a positive physical and psychological effect on human wellbeing (Kaplan, 2014). Several studies of patient groups have consistently shown that simply looking at environments dominated by greenery, flowers, or water as compared to a built environment that lacks natural elements is significantly more effective in promoting recovery from stress and illness. It has been found that simple objects such as aesthetically appealing greenery or flowers for hospital patients can have calming and healing effects. one study revealed that in-room vegetation and access to gardens within hospitals increased positive feelings such as pleasantness and calmness as well as reducing negative emotions such as fear and sadness (Ratcliffe *et al.*, 2013).

Although many studies involve direct contact with nature, there have been studies that prove indirect and symbolic contact can have positive effects as well. one of leading studies regarding recovery was conducted by environmental geographer and psychologist Roger Ulrich investigated 160 short term hospitals patients recovering from heart surgery and their reactions to wall art (MacKerron & Mourato, 2013). The patients were divided into two types of recovery rooms. one room contained a picture of a natural scene of water and trees, (Plate I), while the other room didn't feature any form of contact with nature. Patients in this room where seen to recover faster than those without any contact with nature.



**Plate I: Picture of Natural Scene**  
(Source: MacKerron & Mourato, 2013)

### **2.9.2 Productivity within the Work Environment.**

Recently, evidence has been built on the benefits of exposure to nature in the workplace. Studies have shown contact as indirect as a landscape picture or a decorative motif has been shown to enhance well-being and productivity within the work environment (Jackson *et al.*, 2013). Environmental psychologist Judith Heerwagen (2013) conducted a study with 168 office workers in two public agencies with a variety of locations were surveyed: those with no view to the outside, those with a view to the outside but not including any natural elements such as sky, trees, or green space, and those with an outdoor view containing natural elements.

Participants responded to a survey that sought feedback on issues such as perceived job stress, perceived success of restorative opportunities such as wellness programs, and overall life satisfaction (Kaplan, 2014). Results indicated that workers with a view of natural elements reported fewer health concerns than those without a view of nature. Those with a view of nature also reported a significantly higher overall job satisfaction than those without a view of nature.

## **2.10 The Implications for Design of Built Environment**

In Stephen Kellert's book *Building for Life: Designing and Understanding the Human Nature Connection* (2005) the author argues that the greatest mistake of our time is the assumption that the built environment can exist independent of the natural environment (Kellert & Callabrese, 2015). The result of this is the design of buildings and developments that abuse and degrade people's experiences of nature, fostering alienation and destructive environmental practices. As a result of this practice, there has been widespread land degradation, soil, water and Air pollution and depletion of natural resources. The current answer to this problem has been the implementation of 'sustainable design' practices or 'green design'. Sustainable design is design that has a low impact on the environment by pursuing energy efficiency, using renewable energy, reducing resource consumption, reusing and recycling products and materials, lessening waste pollution, employing non-toxic substances and materials, protecting indoor environmental air quality, and avoiding habitat destruction and loss of biodiversity (Kellert, 2012). This practice is also known as low environmental impact design.

Low environmental impact design has lessened the impact on the natural environment but has failed to foster a connection between people and nature in the built environment. He suggested that with today's technology and knowledge of the benefits of the connection with nature, we can minimize harm to the environment as well as enrich the mind, body and spirit by promoting experiences of nature within the built environment. He refers to this practice as restorative environmental design which incorporates sustainable design practices as well as reconciling and harmonizing the natural and human environments (Lee *et al.*, 2016).

Kellert (2012) has proposed that the implementation of restorative environmental design, low impact environmental design and the two dimensions of biophilic design, organic and vernacular design can;

- i. Sustain the natural habitat and systems on which our existence relies
- ii. Foster biophilia, our innate tendency for nature and
- iii. Connects people to place, a necessity for human well-being.

## **2.11 Biophilic Design**

Steven Kellert, a Professor of Social Ecology at Yale, has taken the biological theory of biophilia and applied it to the built environment, coining the term “biophilic design”. The goal of biophilic design is to translate an understanding of biophilia into the design of the built environment, resulting in beneficial contact between people and nature within modern buildings and landscapes (Kellert, 2012).

## **2.12 Dimensions of Biophilic Design**

Biophilic design contains two main dimensions: the “organic or naturalistic” dimension and the “place-based or vernacular” dimension (Gamble *et al.*, 2014).

### **2.12.1 Organic or naturalistic dimension of biophilic design.**

The organic dimension of biophilic design is shapes and forms in the built environment that directly, indirectly, or symbolically reflect the inherent human affinity for nature (Na-umma, 2014). Nature can be experienced directly, indirectly, and symbolically under this dimension of biophilic design.

#### **2.12.1.1 Direct connections to nature**

Direct connections to nature within the built environment are relatively unstructured contacts with self-sustaining features of the natural environment such as views of the exterior environment, daylight, natural ventilation, plants, animals, natural habitats, and ecosystems (Blair, 2014). Immediate views of nature out a window are also classified as direct connections to nature. Kellert (2012) emphasizes that the design quality of a direct experience with nature within the built environment affects the impact of the connection on users. For instance, a singular palm tree in a mall does not have a marked psychological effect on a person. However, a diverse atrium that incorporates a range of natural features such as natural light, vegetation, soil and water would constitute biophilic design that has the power to stimulate a person’s senses, emotions, and intellect as shown in Plate II below.





**Plate II: Direct Connections to Nature by Natural Light and Vegetation in an Atrium**  
(Source: Kellert, 2012)

#### **2.12.1.2 Indirect Connection to Nature**

Indirect connections to nature within the built environment are controlled or manipulated contact with the natural environment that requires ongoing human input to survive, such as a potted plant, a water fountain, natural materials, or an aquarium (Kellert, 2012). Classifying indirect experiences with nature within the built environment typically are not black and white and involve a degree of personal judgment. Usually elements of nature have been manipulated in some way, such as vegetation, animal life, light, air, water, materials (such as wood, stone, cotton, leather, and wool), and natural processes such as; aging, weather, and climate. Some examples of indirect experiences with nature include potted plants, fish in an aquarium, formally designed fountains, and stone walls as shown by the Plate III below.



**Plate III: Natural Materials offer Indirect Connections in Frank Lloyd Wright's Fallingwater.**  
 (Source: Na-Umma, 2014)

### **2.12.1.3 Symbolic connection to nature**

Symbolic connections to nature within the built environment involve no actual contact with real nature, but represent the natural environment through image, picture, ornamentation, video, metaphor, and other techniques (Kellert *et al.*, 2008). This connection to nature indicates nature can be symbolically experienced within the built environment in a variety of ways, such as decoration, ornamentation, pictorial expression, and shapes and forms that simulate and mimic nature. Moreover, these symbolic representations of nature can appear in a wide diversity of building features such as walls, doors, entryways, columns, trim, casements, fireplaces, furnishings, carpets, fabrics, art, and sometimes even an entire façade. The symbolic expression of nature within the built environment can be experienced in both obvious ways and subtle way.

### **2.12.2 Vernacular design relating to ecology of a place**

Vernacular design which connects to the ecology of place does so at a large scale, being sensitive to the building site, the surrounding ecosystems, and the watershed (Gillis & Gatersleben, 2015). Such a design requires intimate knowledge of the physical site characteristics (water flow, geology) and biological characteristics (species composition). Vernacular design which makes connections to the ecology of a place should even strive to restore or enrich ecological functions whenever possible (Green, 2012).

#### **2.12.2.1 Vernacular design relating to culture and history of a place**

Vernacular design can connect to the culture of a place by creating spaces which reflect the architecture of its geographic region. It can create social traditions relating to place by encouraging traditions and shared relationships within these spaces. The goal of creating vernacular connections within the built environment is to foster a sense of loyalty and commitment between people and the environments in which they live. Architect Tom Bender notes the value of creating spaces which reflect the culture and history of the people in that area: A building, like a person can help restore to our surroundings a sense of sacredness and honouring of people, place, and diverse traditions (Kellert, 2012).

#### **2.12.2.2 Vernacular design fusing culture and ecology**

Vernacular design which effectively connects culture and ecology recognizes the continual interaction between and interdependence of culture and nature. Vernacular design which fuses these two produces a space which reflects the specific culture and ecology of the specific local, which ideally form a respectful partnership. Rene Dubos expands on the interaction between

culture and nature: People always add something to nature, and thereby transform it, but their interventions are successful only to the extent that they respect the genius of the place (Groenewegen *et al.*, 2012).

#### **2.12.2.3 Vernacular design avoiding placelessness**

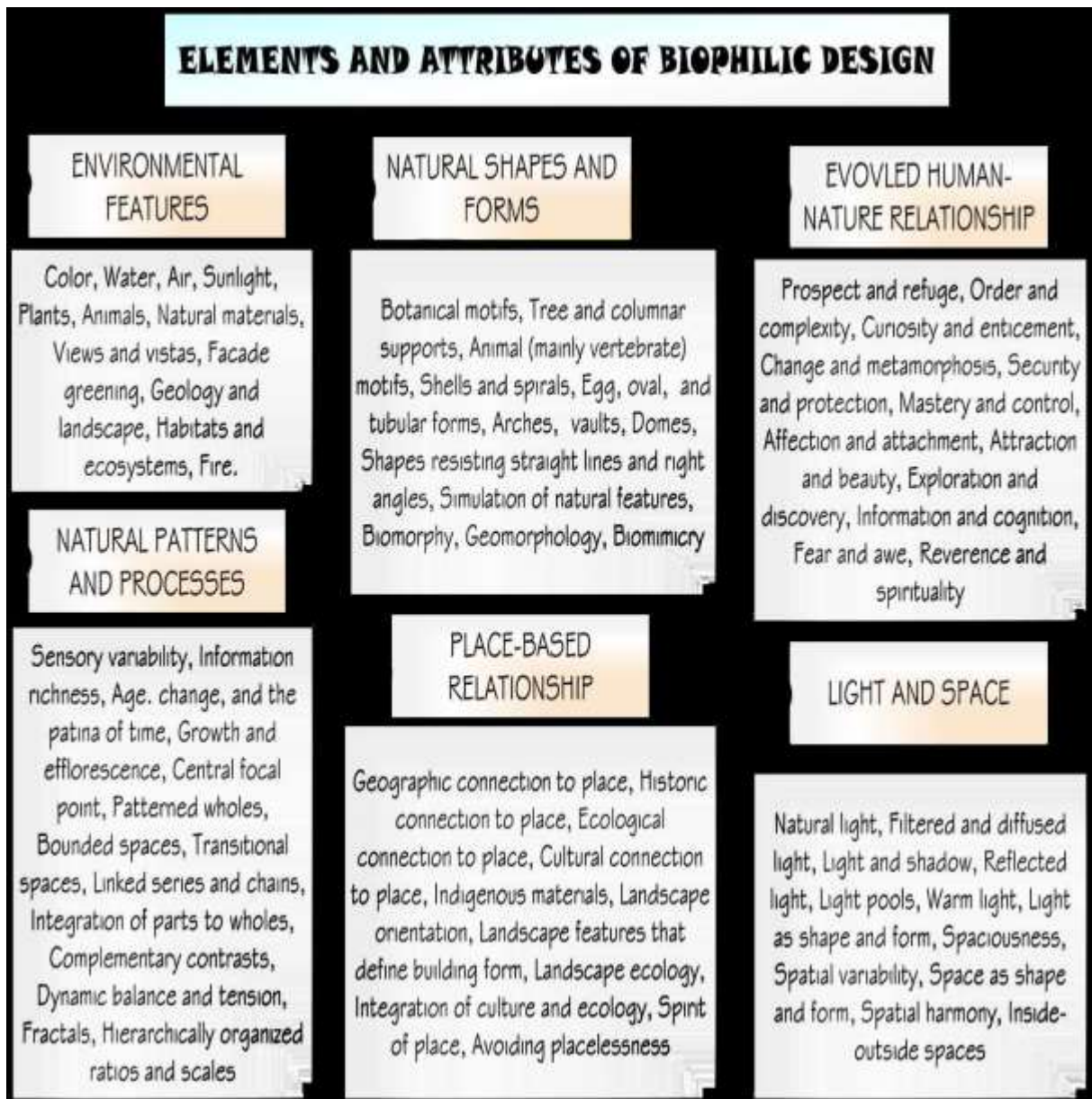
Placelessness is diminishing the distinctive local and regional identity and replacing it with uniformity and anonymity. Regrettably, the modern built environment too often embodies this characteristic. Conversely, designing the built environment to avoid placelessness involves connecting people to the various aspects of vernacular design previously discussed (ecology, culture and history) in order to foster a connection and attachment to the places people live and work (Kellert, 2012). one of the most successful and appropriate examples of vernacular design is Renzo Piano's design for The Tjibaou Cultural Centre in New Caledonia. Piano conducted exhaustive studies into the culture and traditions of the region and enlisted the help of anthropologists of South Pacific culture. Piano found that there was no vernacular architecture for the region as their structures were built from perishable materials. This absence of a vernacular architecture allowed Piano the opportunity to research the culture and develop the first vernacular style for the area (Molthrop, 2017).

The Centre, which lies on a narrow strip of land surrounded by water, features the ten cases or curved structures that soar from the ground all having different heights and functions. The cases are constructed of wooden joists and ribs that vibrate in the wind, and are meant to reflect the natural materials of the Melanesian huts. Piano's design is so successful because he did not

borrow from the past but merely researched the local culture and was able to design something completely new (Molthrop, 2017).

### **2.13 Elements of Biophilic Design.**

The two basic dimensions of Biophilic design can be related to six Biophilic design elements given as Environmental features, Natural shapes and forms, Natural patterns and processes, Light and space, Place-based relationships and Evolved human-nature relationships. These six elements are then revealed in more than seventy Biophilic design attributes (Kellert, 2008; Molthrop, 2017). These dimensions, elements and attributes can be used in different combinations to achieve successful designs for various targeted users as outlined in the Figure 2.1 below.



**Figure 2.1 Elements and Attributes of Biophilic Design**  
(Source: Ryan *et al.*, 2014).

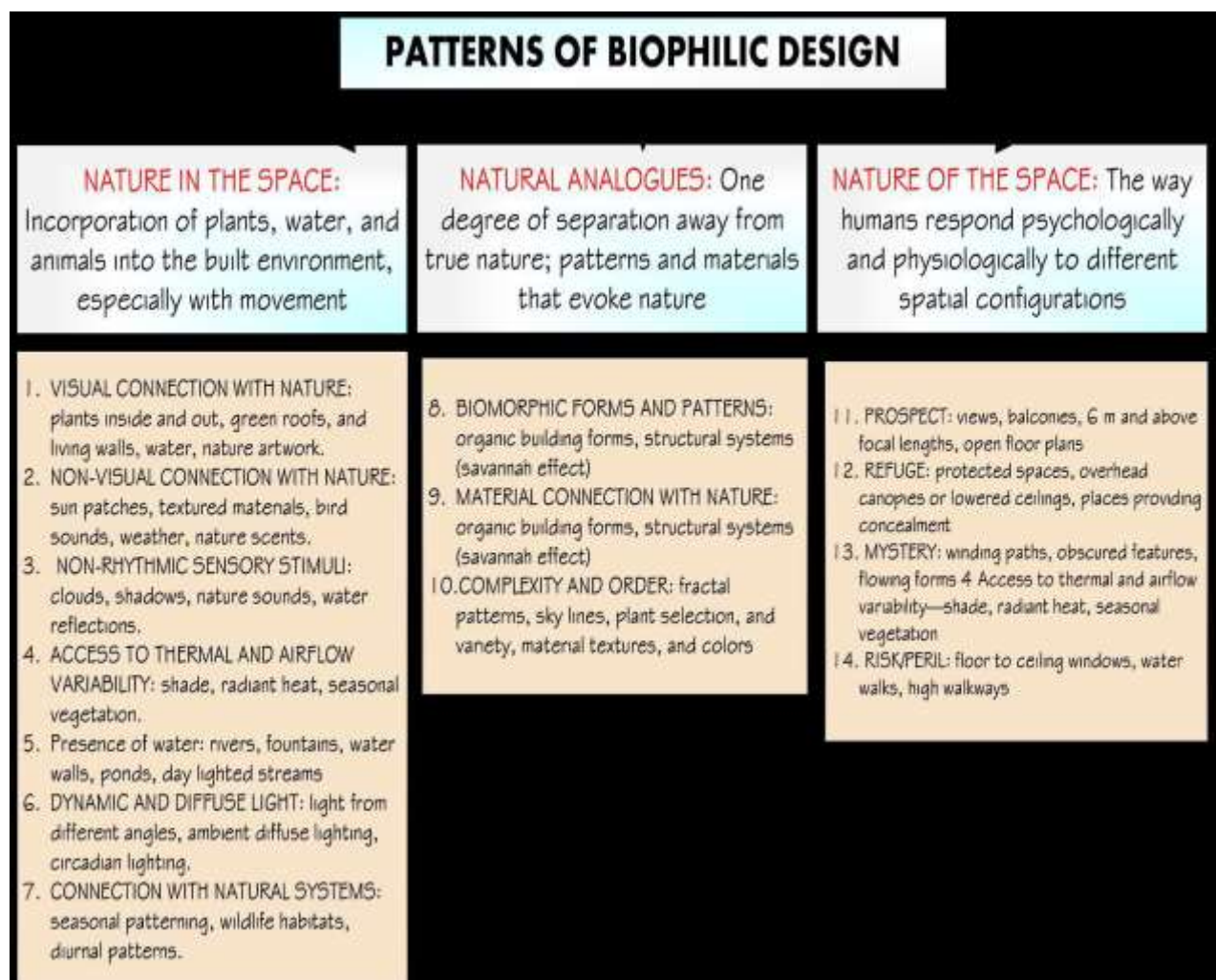
## 2.14 Patterns of Biophilic Design

Ryan *et al.* (2014) refined the six elements and seventy design attributes of Biophilic design with supportive qualitative and quantitative research in both the physiological and the psychological.



They recognized that previous design attribute lists were unwieldy and potentially confronting for designers, and then consolidated the design attributes to the following fourteen patterns within three categories as illustrated in Figure 2.2 below.

While informed by science, biophilic design patterns are not formulas; they are meant to inform, guide and assist in the design process and should be thought of as another tool in the designer's toolkit. The purpose of defining these patterns is to articulate connections between aspects of the built and natural environments and how people react to and benefit from them.



**Figure 2.2 Patterns of Biophilic Design**  
 (Source: Ryan *et al.*, 2014).

### **2.15 Benefits of Biophilic Design to Patients' Health**

Evidence from over three decades of research on the impact of nature on human health and wellbeing can justify the claim that Biophilic design is beneficial to patients' health (Gillis & Gatersleben, 2015). As a biological theory, Biophilia offers an evidence-based methodology for design which draws its techniques from nature. Nature functions in ways that alter the physical environment that people live in, thereby reducing health risks. For example, vegetation can filter pollutants from the air and buffer the urban heat island effect, potentially reducing the prevalence of respiratory infections or heat-related illnesses (Jackson et al. 2013). In addition to such direct effects, nature can also indirectly influence health by mitigating the risks associated with other areas of people's lives or by encouraging positive health behaviours.

Many individual-level studies have revealed relatively strong associations between exposure to nature and improved healing times, reduced allergies, enhanced social cohesion (Groenewegen *et al.*, 2015), reduced stress, improved cognitive ability, increased psychological (Ryan *et al.*, 2014), and enhanced happiness (MacKerron and Mourato, 2013). Exposure to nature also have restorative effects, potentially reducing the effects of stress in a person's life. Its basis is to lower stresses on the human body, helping its built-in defences to fight illness and to promote healing (Ratcliffe *et al.*, 2013). The most significant body of research to date has shown a strong positive correlation between exposure to nature and psychological well-being measured in a range of ways, including mental restoration, self-esteem, attachment, and anger (Barton and Pretty, 2014; Dallimer *et al.*, 2012), systolic and diastolic blood pressure and heart rate and recovery times.



Although the concept of Biophilic design is relatively new, the plethora of research on nature and restorative environments makes a strong case for the health and wellbeing potential of incorporating biophilic design attributes into the built environment. Given that the basic tenant of biophilic design is adoption of nature and nature like features into the built environment, the evaluation of its benefits to patients' health is highly dependent on the effect of nature on health.

In conclusion, evidence from scientific sources have shown that re-connecting humans with their surroundings by applying the special geometry of nature helps restore mental, social and physical health. Whether through immersion in nature, through frequent outdoor play or scenic window views, nature helps foster patients' ability to cope with stress, improve attention functioning, social well-being, and psychological health, reduce pain medications, increased patient mobility and independence, and potentially can improve various health outcomes.

## **2.16 Application of Biophilic Design in Health Facilities.**

The evolution of Biophilic design characteristics has led to the recently published document "The Practice of Biophilic Design" by Stephen Kellert and Elizabeth Calabrese (2015). There are three kinds of experience of nature that represent the basic categories of Biophilic design framework. These include the *direct experience of nature*, the *indirect experience of nature*, and the *experience of space and place* (Kellert & Calabrese, 2015).

### **2.16.1 Direct contact with nature**

The direct experience of nature refers to actual human contact with environmental features in the built environment. Figure 2.3 reveals the application of the following:

### **2.16.1.1 Natural features**

Water: Sound of water has the ability to create musical sounds comprehensible to humans. This itself is a highly Biophilic humanistic trait. Moving water has very strong Biophilic attractions as well as calming effects (AbdelMeguid, 2014).

Air (Natural Ventilation): People prefer natural ventilation over processed and stagnant air, as it is important to human comfort and productivity. The perception of and contact with weather in the built environment can be both satisfying and stimulating. (Kellert & Calabrese, 2015).

Sunlight (Daylight): The experience of natural light is fundamental to human health and wellbeing, enabling an orientation to the day, night and seasons in response to the sun's location and cycles. Bright daylight has medicinal properties, it entrains circadian rhythms, enhances mood, promotes neurological health, and affects alertness. (Heerwegen, 2013). An awareness of natural light can also facilitate movement and way finding, and contribute to comfort and satisfaction.

Vegetation (Plants): The presence of plants as shown in Figure 2.6 can reduce stress, contribute to physical health, improve comfort, and enhance performance and productivity (AbdelMeguid, 2014). Vegetation in design can be used to reduce air pollution, noise control, prevent spread of diseases, control movement and provide good views and vista as shown in Plate IV.

### **2.16.1.2 Views and vista**

People express a strong and consistent preference for exterior views, especially when the vistas contain natural features and vegetation. Views of natural elements positively provoke human

beings feeling and psychological state. Recovery and patient's wellbeing act upon the natural scenes that are conveyed from the outdoor natural environment (AbdelMeguid, 2014).

#### **2.16.1.3 Natural landscape and ecosystem**

When design is done considering the natural landscape and ecosystem, long-term sustainability is achieved. There is also a sense of comfort, security and predictability of weather by the users. Also, buildings and landscape designs that connect to the topography contribute a sense of place (Locklear, 2012).



**Plate IV: Nature Features in the Built Environment at Henry Ford West Bloomfield Hospital**  
(Source: Locklear, 2012)

#### **2.16.1.4 Façade Greening**

Harsh weather stress risk in the environment threatens human health and effective countermeasures are not clearly identified. Façade greening is a promising countermeasure to reduce urban heat, it helps reduce indoor noise, prevent heat penetration and improve indoor and outdoor air quality. It can be attached to a large area in cities and features several co benefits, such as insulating buildings. Façade greening reduces outdoor heat and has cooling effects on

building surfaces (Janicke *et al.*, 2015). The multiple benefits of facade greening systems could allow to a more sustainable urban design and to compensate the lack of green spaces inside dense cities for the wellbeing of the dwellers. Plate V below illustrates façade greening in a Hospital in China.



**Plate V: Façade Greening at Haushan Hospital, Shanghai China**  
(Source: Locklear, 2012)

| MODE OF EXPERIENCE          | BIOPHILIC DESIGN ATTRIBUTES   | POSSIBLE ADOPTION IN HEALTH FACILITY DESIGN   |
|-----------------------------|---|---|
| DIRECT EXPERIENCE OF NATURE | <b>NATURAL FEATURES</b> <ul style="list-style-type: none"> <li>Natural Ventilation</li> <li>Water</li> <li>Vegetation</li> <li>Sunlight</li> <li>Weather</li> </ul> | <ul style="list-style-type: none"> <li>Indoors or outdoor water fountains, fish tanks, stream.</li> <li>Windows that allow fresh air, show movement of sun and stars.</li> <li>Natural light can be incorporated by the use of top--light, skylights.</li> <li>Use of shading devices to avoid glare from sunlight and other incimate weather conditions.</li> <li>Windows should allow for cross ventilation, single sided ventilation or stack effect.</li> <li>Outdoor natural areas with rich vegetation and animals.</li> <li>Design should incorporate built in features for plants in the internal environment and gardens in the outdoor environment. e.g: • Planter boxes, Gardens, Green roof.</li> <li>Include design features that allow for sitting among plant material or flowers.</li> <li>Provide spaces that allow direct physical access to nature.</li> </ul> |
|                             | <b>VIEWS AND VISTA</b>  | <ul style="list-style-type: none"> <li>Windows should be carefully designed for the provision of views of natural, outdoor scenes.</li> <li>Carefully plan the sightlines and avoid external obstructions.</li> <li>If not a curtain wall then, windows should be in the following range ; 1 m &lt; Vision window height &lt; 2.2m.</li> <li>Many windows as possible should look out over natural features.</li> <li>Provide views from all treatment spaces, bereavement and consult rooms, public corridors, staff corridors, family and staff lounges.</li> <li>Provide operable windows where applicable.</li> </ul>   |
|                             | <b>NATURAL LANDSCAPE AND ECOSYSTEM</b>  | <ul style="list-style-type: none"> <li>Design should be done to fit into the natural landscape and ecosystem with minimal alterations.</li> <li>Provide terraces in mild climates and solarium in more extreme climates.</li> <li>Self-sustaining ecosystems achieved through design strategies as constructed wetlands, forest glades and grasslands; green roofs; simulated aquatic environments; and other means.</li> <li>Contact with natural systems can be fostered by views, observational platforms, direct interaction, and even active participation.</li> </ul>   |
|                             | <b>FAÇADE GREENING</b>  | <ul style="list-style-type: none"> <li>Vertical greening can achieved through use of traditional use of climbing plants against a façade from the ground or from planter boxes.</li> <li>They can be plants rooted into the ground or plants that are rooted in artificial substrate at grade with watering system.</li> <li>Green façades can be applied directly to the wall and also indirectly to the wall with a supporting structure such as net system or cable and wire net system.</li> <li>Roof gardens can also be incorporated in the design to provide facades at a higher level of access</li> </ul>  |

**Figure 2.3 Application of Biophilic Design Attributes (Direct Contact with Nature)**  
 (Source: Kellert, 2012; Green, 2012; Locklear, 2012; AbdelMeguid, 2014; Ryan *et al.*, 2014; Kellert & Calabrese, 2015).



### **2.16.2 Indirect contact with nature**

The indirect experience of nature refers to contact with the representation of nature, the transformation of nature from its original condition, or exposure to particular patterns and processes typical of the natural world. Figure 2.4 shows application of the concepts below.

#### **2.16.2.1 Natural materials**

Natural materials can be especially stimulating, reflecting the dynamic properties of organic matter in adaptive response to the stresses and challenges of survival over time. The transformation of materials from nature frequently elicits positive visual and tactile responses, which few artificial materials can duplicate as shown in Plate VI (Kellert & Calabrese, 2015).



**Plate VI: Use of Natural Materials at St. Bernard Parish Hospital New Orleans, USA  
(Source: Kellert, 2012)**

#### **2.16.2.2 Natural Colours**

Colour affect human behaviour, controls stress, affect the healing status of patients. Human beings emotional state is strongly affected by the colour of the room or environment they are in (AbdelMeguid, 2014). People are attracted to bright flowering colors, rainbows, beautiful sunsets, glistening water, blue skies, and other colorful features of the natural world.

### **2.16.2.3 Natural shapes, forms and patterns**

These naturalistic forms can be extraordinarily diverse from the leaf-like patterns found on columns, the shapes of plants on building facades, to animal facsimiles woven into fabrics and coverings. The occurrence of naturalistic shapes and forms can transform a static space into one that possesses the dynamic and ambient qualities of a living system (Kellert & Calabrese, 2015).

A space with good Biomorphic Patterns (such as shown in Plate VII) feels interesting and comfortable, possibly captivating, contemplative or even absorptive. The intent is to use biomorphic patterns in a way that creates a more visually preferred environment that enhances cognitive performance while helping reduce stress (Ryan *et al.*, 2014).



**Plate VII: Natural Patterns on Facade at Airspace Tokyo, Japan**  
(Source: Kellert, 2012)

### **2.16.2.4 Images of Nature**

The image and representation of nature in the built environment can be both emotionally and intellectually satisfying. A recent study by Gamble *et al.* (2014) concluded that brief viewing of nature pictures offers an inexpensive and enjoyable way to temporarily boost cognitive function in both young and older adults. Although it is not yet known how long this effect lasts, but

Lederbogen *et al.* (2015) study, suggests that more extended exposure to nature might have longer-term effects.

| MODE OF EXPERIENCE            | BIOPHILIC DESIGN ATTRIBUTES | POSSIBLE ADOPTION IN HEALTH FACILITY DESIGN   |
|-------------------------------|-----------------------------|---|
| INDIRECT EXPERIENCE OF NATURE | NATURAL MATERIALS           | <ul style="list-style-type: none"> <li>Prominent natural building and decorative materials include wood, stone, wool, cotton, and leather, used in a wide array of products, furnishings, fabrics, and other interior and exterior designs</li> </ul>   |
|                               | NATURAL COLOURS             | <ul style="list-style-type: none"> <li>Soft tone colours yellow, green or blue for walls, Light tones and warm colours white, cream and light grey for the flooring.</li> <li>Incorporate natural earth tone colors as appropriate keeping in mind that some colors can interfere with the nurses' assessments of patients' skin tones, agitate patients, visitors, and staff, and disorient certain patient populations.</li> <li>The use of bright colors should be cautiously applied, and emphasize such appealing environmental forms as flowers, sunsets and sunup's, rainbows, and certain plants and animals.</li> <li>The occurrence of highly artificial, contrasting, and "vibrating" colors should be avoided.</li> </ul> |
|                               | NATURAL SHAPES AND FORMS    | <ul style="list-style-type: none"> <li>Simulate natural forms through shapes, patterns, texture, details, and processes of nature.</li> <li>Consider plant, foliage, shell, spiral, or egg-like forms</li> <li>Reference geological systems and vernacular forms within the local or regional context.</li> <li>Think of columns like trees within the space and Introduce sinuous, flowing shapes</li> </ul>   |
|                               | NATURAL PATTERNS            | <ul style="list-style-type: none"> <li>Natural patterns include symmetries, trees, spirals, meanders, waves, foams, tessellations, cracks and stripes which could be applied on building facades, Arrangement of the structural system (e.g., columns shaped like trees), Fabrics, carpet, wallpaper designs or other materials.</li> <li>Provide orderly variation on a basic pattern and avoid the overuse of forms and patterns that may lead to visual toxicity</li> <li>Window details: trim and moldings, glass color, texture, mullion design, window reveal details, Furniture details, Woodwork, masonry</li> <li>Building form, Furniture form, Pathway and hallway form</li> </ul>   |
|                               | IMAGES OF NATURE            | <ul style="list-style-type: none"> <li>Consider introducing sensory artwork that simulates natural sounds, forms, or processes into public spaces.</li> <li>These images can occur through the use of photographs, paintings, sculpture, murals, video, computer simulations, and other representational means.</li> </ul>  |

**Figure 2.4 Application of Biophilic Design Attributes (Indirect Contact with Nature)**  
(Source: Kellert, 2012; Green, 2012; Locklear, 2012; AbdelMeguid, 2014; Ryan *et al.*, 2014; Kellert & Calabrese, 2015).



### **2.16.3 Experience of space and place**

The experience of space and place refers to spatial features characteristic of the natural environment that have advanced human health and wellbeing. Figure 2.5 gives possible adoption of the following concepts below in health facilities.

#### **2.16.3.1 Transitional spaces and bounded spaces**

Transitional spaces include hallways, thresholds, doorways, gateways, and areas that link the indoors and outdoors especially porches, patios, courtyards, colonnades, and more which when well-planned enhance easy use of building spaces (Kellert & Calabrese, 2015). Bounded spaces give patients a sense of privacy, security and territoriality.

#### **2.16.3.2 Security and protection**

A fundamental objective of the built environment is ensuring protection from threatening forces in nature. Security in the built environment must not excessively insulate or isolate people from the natural world.

#### **2.16.3.3 Spatial harmony and spaciousness**

The manipulation of space in the built environment tends to be most effective when it blends light, mass, and scale within a bounded context. This achievement evokes a sense of harmony, which fosters a sense of security and facilitates movement within diverse settings. People prefer feelings of openness in natural and built environments. Effective designs often include spacious settings in close alliance with smaller spaces as shown in Plate VIII below.



Plate VIII: Spaciousness and Bounded Spaces at Mayo Clinic Hospital Minnesota, USA  
*Source: Locklear (2012)*

#### **2.16.3.4 Attraction and beauty**

Attraction means beauty, or the way a design appeals to us. This helps in fostering the capacities for curiosity, imagination, creativity, exploration, and problem solving. Some of our most successful buildings and landscapes foster an aesthetic appreciation for natural process and form. Designs can appeal to these predispositions by emulating the sensory experience of nature.

#### **2.16.3.5 Connection to place**

Architecture of Place is about creating design that makes people feel empowered, important, and excited to be in the places they inhabit in their daily lives. Humans have an affinity for familiar places which can be enhanced by both cultural and ecological means. Culturally relevant designs promote a connection to place and the sense that a setting has a distinct human identity. Ecological connections to place can similarly foster an emotional attachment to an area, particularly an awareness of local landscapes, indigenous flora and fauna, and characteristic meteorological conditions (Kellert & Calabrese, 2015).

| MODE OF EXPERIENCE            | BIOPHILIC DESIGN ATTRIBUTES      | POSSIBLE ADOPTION IN HEALTH FACILITY DESIGN   |
|-------------------------------|----------------------------------|---|
| EXPERIENCE OF SPACE AND PLACE | TRANSITIONAL AND BOUNDED SPACES  | <ul style="list-style-type: none"> <li>Create spaces that are protected and private, consider privacy needs of adjacent rooms</li> <li>Provide visual privacy from the interior to exterior and vice versa</li> <li>Introduce screens or curtains to increase level of privacy (or perceived privacy)</li> <li>Create subspaces within the larger gathering space</li> <li>Provide varying ceiling heights.</li> <li>Lobbies, walkways, staircases, ramps and lifts should be adequate and spacious</li> </ul>  |
|                               | MOBILITY AND WAYFINDING          | <ul style="list-style-type: none"> <li>Situate circulation (vertical and horizontal) adjacent to courtyards for ease of way-finding and to allow for natural light to penetrate the interior environment.</li> <li>Provide access into the courtyard and terraces or windows from levels above</li> <li>Design a focal point of the courtyard to serve as an item that is recognizable whether in the space or moving around it</li> <li>Introduce pools of light to encourage movement into a space</li> <li>Use material color and texture to assist in way-finding</li> <li>Introduce regional elements of nature into signage</li> <li>Include culturally significant and nature themed colors into way-finding system</li> </ul> |
|                               | SPATIAL HARMONY AND SPACIOUSNESS | <ul style="list-style-type: none"> <li>Proper spatial analysis and provision of ample space for various hospital activities</li> <li>Spatial harmony- with light, mass, scale, rhythm etc.</li> <li>Design should evoke a feeling of openness in both natural and built environment.</li> <li>Related spaces should be placed at close proximity.</li> </ul>  |
|                               | ATTRACTION AND BEAUTY            | <ul style="list-style-type: none"> <li>Attraction and beauty can be achieved with the proper combination of some biophilic attributes.</li> <li>Presence of natural features, natural shapes and forms, indigenous material, spaciousness, images of nature all incorporated in the design in the right scale, balance, rhythm, emphasis and right places can bring out the beauty of the environment or building</li> </ul>  |
|                               | CONNECTION TO PLACE              | <ul style="list-style-type: none"> <li>Use of indigenous materials, sculptures or arts related to the place at strategic places.</li> <li>Building design to fit into the climate, topography, ecology of place i.e. design with such considerations.</li> <li>Culturally relevant and Ecological considerations such as particular awareness of local landscapes, indigenous flora and fauna, and characteristic meteorological conditions.</li> <li>Consider historically significant plants of the region or site</li> <li>Introduce native plant species where applicable.</li> <li>Reference local and indigenous materials whenever possible to increase the sense of place.</li> </ul>   |
|                               | SECURITY AND PROTECTION          | <ul style="list-style-type: none"> <li>Landscape features can be used to achieve security and protection by creating boundaries and perimeters.</li> <li>Proper planning and control of access and exits</li> <li>Strategic placing of hospital facilities to curb spread of germs or diseases i.e proper zoning of facilities</li> <li>Containment and disposal of infectious and other hazardous wastes.</li> <li>Applying the design and improving the availability of assistive devices to avert patient falls</li> <li>Isolation rooms for communicable diseases</li> </ul>  |

**Figure 2.5 Application of Biophilic Design Attributes (Experience of Space and Place)**  
 (Source: Kellert, 2012; Green, 2012; Locklear, 2012; AbdelMeguid, 2014; Ryan *et al.*, 2014; Kellert & Calabrese, 2015).

### **2.16.3.6 Mobility and way finding**

People's comfort and wellbeing often relies on freely moving between diverse and often complicated spaces. Clearly understood pathways and points of entry and egress are especially critical to fostering mobility and feelings of security, while the absence of these features often breeds confusion and anxiety (Kellert & Calabrese, 2015).

### **2.17 Design considerations for biophilic design**

Biophilic design in practice could be seen to involve the application of varying design strategies, which have been referred to as experiences and attributes by Stephen Kellert (2012), such as;

#### **2.17.1 Identifying desired responses and outcome**

Biophilic design in practice could be seen to involve the application of varying design strategies, which have been referred to as experiences and attributes by Stephen Kellert. The choice of which design applications to employ inevitably varies depending on a project's circumstances, constraints and performance need of targeted population (Kellert, 2012).

#### **2.17.2 Diversity of design strategies**

Biophilic design attributes are flexible and replicable which can be implemented under a range of circumstances. These attributes in combination tend to increase the likelihood of health benefits of a space. Incorporating a diverse range of design strategies can accommodate the needs of various user groups from differing cultures and demographics and create an environment that is psycho-physiologically and cognitively restorative.

### **2.17.3 Quality over quantity of attributes**

When planning for implementation, common questions recur, such as how much is enough and what makes a good design great. A high quality intervention may be defined by the richness of content, user accessibility and diversity of strategies. A single high quality intervention can be more effective and have greater restorative potential than several low quality interventions. Climate, cost and other variables may influence or limit feasibility of certain interventions, but should not be considered an obstacle to achieving a high quality application.

### **2.17.4 Duration of exposure and frequency of access**

The design should allow for maximum exposure of the principles adopted to the building users. The ideal exposure time is likely dependent upon the user and desired effect, but as a general guideline, empirical evidence shows that positive emotions and mental restoration and other benefits can occur in as little as 5 to 20 minutes of immersion in nature (Barton & Pretty, 2014).

### **2.17.5 Scale and feasibility**

The attributes of Biophilia to be adopted are to be scaled to fit into the surrounding environment and the predicted user population of the space. Each space presents different design challenge depending on the programming, user types and dynamics, climate, culture, and various physical parameters, as well as existing or needed infrastructure. Size and availability of space are two of the most common factors influencing feasibility of Biophilic design patterns.

### 2.17.6 Climatic factors

The strength of Biophilic architecture is that it blends buildings into various settings so that there is a natural harmony between climate, architecture and people. The main goal of climatic design, on a macro and micro level, is to reduce uncomfortable conditions created by extremes of cold, heat or dryness. In hot climate regions, Biophilic attributes should protect users from the intense radiation from the sun, ground, surrounding buildings, dust, sandstorms and insects.

### 2.17.7 Wholeness of design

Biophilic design should never occur in piecemeal or disconnected fashion, but rather in a manner whereby the diverse applications mutually reinforce and complement one another, resulting in an overall integrated ecological whole.

## 2.18 Conceptual Framework for Biophilic Design in Drug Rehabilitation Centres

**Table 2.2 Conceptual Framework for Biophilic Design in Drug Rehabilitation Centres**

| DIRECT CONTACT WITH NATURE   | INDIRECT CONTACT WITH NATURE       | EXPERIENCE OF SPACE AND PLACE  |
|--|------------------------------------|--|
| Natural Features (Water, Ventilation (Air), Daylight (Sunlight) & Vegetation | Natural Shapes, Forms and Patterns | Transitional Spaces and Bounded Spaces                                   |
| Views and Vistas   | Natural Materials                  | Security and Protection  |
| Natural Landscape and Ecosystem  | Images of Nature                   | Spatial Harmony and Spaciousness   |
| Façade Greening  | Natural Colours                    | Attraction and Beauty<br>Connection to Place<br>Mobility and Way Finding |

## CHAPTER THREE

### **3.0**

## **RESEARCH METHODOLOGY**

### **3.1 Introduction**

The purpose of this chapter is to introduce the research strategy and the empirical techniques applied in order to evaluate and reveal the influence of biophilic design principles on the design of a rehabilitation Centres for drug addicts. This study adopts the descriptive research method, which depicts a phenomenon as it is in a fairly accurate way to give a clear picture of the situation under study through the identification of variables to be observed or through the study of the relationships between two or more phenomena.

Descriptive survey can be done through observation, case study (in-depth study of an area or group) and by survey (brief interview or discussion with users about a specific topic or topics).

The case study as well as survey were employed in the conduct of this study.

In this research, case studies as well as survey were employed using a mixed approach to examine the reflection of biophilic design principles in the design of a rehabilitation Centres that possess such elements in their designs, also to provide a basis for its reflection in rehabilitation Centre design.

### **3.2 Data Types and Sources**

Data was collected from various sources ranging from field investigation to oral interviews and surveys to existing literature and research works. Essentially, two types of data were utilized for this research work. They are the primary and secondary data respectively.

#### **3.2.1 Primary data**

Primary data for this research was collected through physical observation and survey conducted by the researcher. A checklist of variables was developed by the researcher for the physical observation and interviews conducted, and this includes;

##### **A. Direct Contact with Nature**

- i. Natural Features: Water, Air (Natural Ventilation), Sunlight (Daylight) and Vegetation (Plants)
- ii. Views and Vista
- iii. Natural Landscape and Ecosystem
- iv. Façade Greening

##### **B. Indirect Contact with Nature**

- i. Natural materials
- ii. Natural Colours
- iii. Natural Shapes, Forms and Patterns
- iv. Images of Nature



### C. Experience of Space and Place

- i. Transitional spaces and Bounded spaces
- ii. Security and Protection
- iii. Spatial Harmony and Spaciousness
- iv. Attraction and Beauty
- v. Connection to Place
- vi. Mobility and Way finding

#### **3.2.2 Secondary data**

Secondary Data are generally obtained from already existent or published literature. This type of data unlike primary data, is not acquired by the researcher from field investigations, but rather from other previous researches and existing information. The secondary data realized in this study was sourced from books, journals, encyclopedia, magazines, the internet, government policy documents and reports and records from the National Drug Law Enforcement Agency (NDLEA) as well as the World Health organization (WHO). Recommendations from experts on biophilia were studied and included in the literature of the study.

#### **3.3 Population of Study**

Population is the aggregate of all the elements that share some common set of characteristics and that comprise the universe of the purpose of the research problem. Population in this study will include rehabilitation Centres within the northern part of Nigeria and some other rehabilitation Centres that have some elements of biophilic design principles reflected on their designs within Nigeria.

### **3.4 Sampling/ Case Study Selection Criteria**

A sample is a derivative of a population from which a certain study is to be carried out. Case study selection is comparable to sampling in a quantitative research and that those cases are usually purposively selected (Oluigbo, 2010). These cases were characterized for study due to their innate qualities which were in relatable to the phenomenon under examination.

The case studies selected for this study were sampled purposively on these bases;

- i. As rehabilitation center with adequate coverage in scope of facilities required to operate as a standard rehabilitation facility.
- ii. As a facility that possesses some Biophilic design principles.
- iii. Facilities in the Northern part of Nigeria with similar natural attributes with the intended proposed rehabilitation Centre as stated in of the objectives of the Study.

A sample size of (5) five rehabilitation Centres within Nigeria was drawn for this research. The selection was due to the availability of the facilities to be studied in those locations and context of the study area. These rehabilitation Centres include;

- 1. Quintessential Healthcare Centre, Jos, Plateau State.
- 2. Plateau State Rehabilitation Centre, Jos, Plateau State.
- 3. Bauchi State Rehabilitation Centre, Bauchi State.
- 4. Rehabilitation Centre for the Disabled, Moniya, Ibadan, Oyo State.
- 5. Ekiti State Government Relief and Rehabilitation Centre, Ekiti State.

### **3.5 Data Collection**

Relevant information was obtained using various methods of data collection. Case studies constitute the primary sources of data. While, secondary data was sourced from the internet, conference publications, journals, seminar papers, publications, magazines, and academic papers.

#### **3.5.1 Case Studies**

A case study may refer to both research method and unit of analysis, which involves the study of examples as case of being researched. Case study in architecture begins with a documentation of the physical characteristics of the case. This documentation was based on evaluation of design principles that allows incorporation of nature into the environment of a rehabilitation center to produce a therapeutic environment. Case studies allow one to present data collected from multiple methods (such as; surveys, interviews, document review, and observation) to provide a comprehensive record of the structures under consideration (oluigbo, 2010).

However, for the purpose of this study, data was collected by means of; observation, visual survey, interviews, and checklist of the level of application of Biophilic design principles on the cases studied.

### **3.6 Instruments for Data Collection**

Two instruments were used in order to obtain data for the purpose of this research activity. The instruments employed include interview guides and observation schedule or checklist. These were used because in order that a user oriented design is achieved, the design must be based on

a thorough understanding of the end users, their environments and the tasks they must perform in that facility (Norman, 2016).

Observation Schedule (Checklist) was employed in this Study for majorly accessing the variables of biophilic design that were featured in Direct Contact with Nature and Indirect Contact with Nature. Also the Checklist featured in the assessment of certain variables that had to do with Experience of Space and place.

While on the other hand, the interview guide chiefly aided both structured and unstructured interviews for obtaining data assessing variables relating to the Experience of Space and Place, which is a key feature in biophilic designs. This choice of research instrument used here was influenced by the fact that determining experience of a particular place or space has to be an exclusive reserve of the end-users of that place or space (Bozzoli *et al.*, 2016). Ten (10) users of the rehabilitation Centres were interviewed using an interview guide and an audio recorder was used to record interviews such that no information was lost.

For the purpose of this study, the collection and documentation of data was made possible through the use of Photographs, sketches, and notes. Photographs were taken of relevant physical elements of the case study to ascertain the extent or level of application of principles of Biophilic design applied in the design, planning, and construction. Sketches of some relevant part of the case study were necessary to further describe some features of spatial organization, or to enhance the quality of some details that are not too clear from the pictures taken during the field visit. As an instrument, notes were taken on the field work to outline the account and

extent of the independent variables on the case studies as they relate to the considerations and application of principles of Biophilic design.

### **3.7 Procedure for Data Collection**

The Procedure for data collection in the case study involved visits to the case study sites, and taking visual analysis of their architectural elements as they reflect these biophilic design principles. Buildings were then critically evaluated based on the outlined criteria of analysis. Where it was deemed fit, some professionals and senior staff members of any case study site were approached and interviewed for information regarding the aim and objectives of the study.

### **3.8 Data Analysis and Presentation**

Analysis of data collected on the visual survey and observation was based on the descriptive accounts as observed, and noted via the instruments of data collection. Brief introduction, account of independent variables, and checklist on the application of Biophilic design principles was used to capture a better perspective of the facilities for more effective evaluation.

The case study analysis focused on an illustrative qualitative method. The illustrative method will be used because it is descriptive and adds examples to the study. Data collected on each case study will be carefully analyzed and represented in different forms which include: -

- i. Diagrammatic representation- proper representation of data was made by the use of sketches and also where drawings/ sketches will not do or are not available was supported with pictures.

- ii. Figures- Data collected from the case studies was demonstrated in the form of drawings and figures.
- iii. Photographs- Pictures of the existing cases was taken and documented showing their facilities and the application of cultural identity and its principles where applied in the design, (if applied).
- iv. Tables- Data collected on this research from the case studies was documented and represented on assessment tables

## **CHAPTER FOUR**

### **4.0 DATA PRESENTATION, ANALYSIS AND DISCUSSION**

This chapter seeks to focus on the data gotten over the course of the study, provide clear analysis of the data and the results of the analysis are also offered, with their meanings elucidated.

#### **4.1 Data Analysis**

Analysis of obtained from the field through the use of the earlier stated research instruments is presented using tables, figures and plates. Discussion of findings gotten from the field work are also made to better understand the variable and conditions noticed during the field work.

The analysis of result for this study was done in line with the research objectives which are to;

- i. Study biophilic design principles that can be adopted to provide healing environments in drug rehabilitation Centres.
- ii. Investigate the attendant level of application of these biophilic design principles in drug rehabilitation Centres in Nigeria.
- iii. Propose a design framework for biophilic design principles in the design of drug rehabilitation centres in Nigeria.
- iv. Demonstrate the application of the design framework in the design of a drug rehabilitation Centre in Kano State that will facilitate rehabilitation.

#### 4.1.1 Biophilic design principles that can be adopted to provide healing environments in drug rehabilitation centres

This objective seeks to investigate the principles of biophilic design that are universally adopted to provide therapeutic environments in drug rehabilitation Centres. After an in-depth review of relevant Literature, it was discovered that the principles of biophilic design as applied in Health facilities find their core around *Direct Contact with Nature*, *Indirect Contact with Nature* and *Experience of Place and Space*. These variables although in a broad sense of description, have been broken into smaller units as determined by their applicability in Health facilities to offer a therapeutic effect, thereby creating enabling and functional spaces to foster rehabilitation as indicated earlier in **Table 2.2** and shown in **Table 4.1** below.

**Table 4.1 Variables for Biophilic Design in Drug Rehabilitation Centres**

| DIRECT CONTACT WITH NATURE   | INDIRECT CONTACT WITH NATURE       | EXPERIENCE OF SPACE AND PLACE          |
|--|------------------------------------|--|
| Natural Features (Water, Ventilation (Air), Daylight (Sunlight) & Vegetation | Natural Shapes, Forms and Patterns | Transitional Spaces and Bounded Spaces |
| Views and Vistas   | Natural Materials                  | Security and Protection                |
| Natural Landscape and Ecosystem  | Images of Nature                   | Spatial Harmony and Spaciousness       |
| Façade Greening  | Natural Colours                    | Attraction and Beauty                  |
|  |                                    | Connection to Place                    |
|  |                                    | Mobility and Way Finding               |

These variables in actual practice, must be applied with respect to certain design considerations which are; *Identifying Desired Responses and outcome*, *Diversity of Design Strategies*, *Quality*



*over Quantity of Attributes, Duration of Exposure and Frequency of Access, Scale and Feasibility, Climatic Factors and Wholeness of design.*

#### **4.1.2 Attendant level of application of these biophilic design principles in drug rehabilitation centres in Nigeria**

This objective takes a look at a sample of drug rehabilitation Centres within Nigeria to assess how the variables of biophilic design principles outlined earlier in objective 1 are applied in the design and construction of their buildings. To achieve this objective, data relating to Direct and Indirect Contact with Nature were obtained primarily by observation and the results are given below.

While Data relating to Experience of Space and Place was majorly gotten from interviews, with observation slightly featuring also where necessary. The variables that were used in the investigation were selected based on qualitatively measurable parameters derived from **Table 2.2** above, and **Figures 2.8, 2.11 and 2.13** in the Literature Review section.

##### **4.1.2.1 Direct contact with nature**

The following tables below show the results of data obtained from the checklist (observational) investigation of biophilic design parameters that revealed Direct Contact with Nature and they are explained and discussed below.

**Table 4. 2 Assessment of Natural Feature (Ventilation and Day lighting) in the Sample Rehabilitation Centres**

| S/No             | List of Rehabilitation Centres                    | Amount of openings | Sizes of openings | Skylight |
|------------------|---|--------------------|-------------------|----------|
| 1.               | Ekiti State Rehabilitation Centre                 | x                  | x                 | X        |
| 2.               | Plateau State Rehabilitation Centre               | x                  | x                 | X        |
| 3.               | Bauchi State Rehabilitation Centre                | x                  | ✓                 | X        |
| 4.               | Rehabilitation Centre, Moniya, Ibadan, Oyo State. | x                  | x                 | X        |
| 5.               | Quintessential Healthcare Centre                  | ✓                  | ✓                 | X        |
| <b>Total (%)</b> |   | <b>20</b>          | <b>40</b>         | <b>0</b> |
| ✓ – Adequate     |   | x –Inadequate      |                   |          |

(Source: Authors Fieldwork, 2018)

The results from **Table 4.2** above show that only 20% of the rehabilitation Centres have adequate amount of openings, while 40% have adequate sizes of openings. While none of the rehabilitation Centres featured skylight. These results revealed little exposure to sunlight/Daylight and natural ventilation is a common feature within interior spaces of the sample rehabilitation Centres. Also, due to inadequate amount and sizes of windows and other openings there is limited view of the natural environments and features at the surroundings.



**Plate IX: Images Showing Openings in Bauchi State Rehabilitation Centre, Bauchi, Nigeria**  
(Source: Authors Fieldwork, 2018)

**Table 4. 3 Assessment of Natural Features (Indoor Plants and Water Bodies) in the Sample Rehabilitation Centres**

| S/No          | List of Rehabilitation Centres                    | Indoor Plants  | Water Bodies |
|---------------|---|----------------|--------------|
| 1.            | Ekiti State Rehabilitation Centre                 | x              | X            |
| 2.            | Plateau State Rehabilitation Centre               | x              | X            |
| 3.            | Bauchi State Rehabilitation Centre                | ✓              | X            |
| 4.            | Rehabilitation Centre, Moniya, Ibadan, Oyo State. | x              | X            |
| 5.            | Quintessential Healthcare Centre                  | ✓              | ✓            |
|               | <b>Total (%)</b>                                  | <b>40</b>      | <b>20</b>    |
| ✓ – Available |   | x –Unavailable |              |

(Source: Authors Fieldwork, 2018)

Results from **Table 4.3** above reveal that only 20% of the rehabilitation Centres featured Water Bodies while 40% possessed Indoor Plants within their interior spaces.

From **Tables 4.2 and 4.3**, results from field observation reveal that Natural Features within interior spaces were minimally featured amongst the Sample rehabilitation Centres studied.

**Table 4. 4 Assessment of Views and Vistas in the Sample Rehabilitation Centres**

| S/No             | List of Rehabilitation Centres                    | Courtyards    | Vegetation in Courtyards | Atriums  | Sit-outs/Balconies |
|------------------|---|---------------|--------------------------|----------|--------------------|
| 1.               | Ekiti State Rehabilitation Centre                 | x             | -                        | X        | x                  |
| 2.               | Plateau State Rehabilitation Centre               | ✓             | x                        | X        | x                  |
| 3.               | Bauchi State Rehabilitation Centre                | ✓             | ✓                        | X        | ✓                  |
| 4.               | Rehabilitation Centre, Moniya, Ibadan, Oyo State. | x             | -                        | X        | ✓                  |
| 5.               | Quintessential Healthcare Centre                  | ✓             | X                        | X        | x                  |
| <b>Total (%)</b> |   | <b>60</b>     | <b>33</b>                | <b>0</b> | <b>40</b>          |
|                  |   | ✓ – Available | x –Unavailable           |          |                    |

(Source: Authors Fieldwork, 2018)

**Table 4.4** above give results that show that 60% of the rehabilitation Centres have courtyards, with only 33% of those courtyards having vegetation in them. Also, none of the rehabilitation Centres had Atriums and only 40% featured sit-outs/balconies. These results coupled with those from **Table 4.2** (that showed inadequate amount and sizes of openings) suggest that there is limited view to natural views and vistas in the surroundings.



**Plate X: Courtyard in Bauchi Rehabilitation Centre, Bauchi State**  
(Source: Authors Fieldwork, 2018)

**Table 4. 5 Assessment of Natural Landscapes and Ecosystem in the Sample Rehabilitation Centres**

| S/No             | List of Rehabilitation Centres                    | Amount of Trees /Positioning | Tree Cover | Shrubs    | Healing Gardens | Blend with Natural Habitat |
|------------------|---|------------------------------|------------|-----------|-----------------|----------------------------|
| 1.               | Ekiti State Rehabilitation Centre                 | ✓                            | x          | ✓         | X               | x                          |
| 2.               | Plateau State Rehabilitation Centre               | x                            | x          | x         | X               | x                          |
| 3.               | Bauchi State Rehabilitation Centre                | x                            | x          | ✓         | X               | x                          |
| 4.               | Rehabilitation Centre, Moniya, Ibadan, Oyo state. | ✓                            | ✓          | x         | X               | ✓                          |
| 5.               | Quintessential Healthcare Centre                  | ✓                            | ✓          | ✓         | X               | x                          |
| <b>Total (%)</b> |   | <b>60</b>                    | <b>40</b>  | <b>60</b> | <b>0</b>        | <b>20</b>                  |

✓ – Adequate

x –Inadequate

(Source: Authors Fieldwork, 2018)

**Table 4.5** indicates that 60% of the rehabilitation Centres have adequate amount of trees on site, and also 60% having adequate amount of shrubs on site, with just 40% having the adequate

amount of tree cover for sufficient sun shading, noise buffering, air filtration and micro temperature control. Also, healing (therapeutic) gardens was not a feature that was present on site in any of the studied rehabilitation Centres. But only 20% of the studied rehabilitation Centres were observed to have a blend with the natural habitat in the area. These results from the **Table 4.5** generally suggests little consideration of the natural landscape and ecosystem in the design and planning of the rehabilitation sites.



**Plate XI: The Admin Block and Basic Education Block at Rehabilitation Centre for the Disabled M0niya, Ibadan, Oyo State**  
(Source: Authors Fieldwork, 2018)

| <b>S/No</b>      | <b>List of Rehabilitation Centres</b>             | <b>Green Roof</b> | <b>Use of Climbers on Walls</b> | <b>Flower Pots/ Flower beds</b> |
|------------------|---|-------------------|---------------------------------|---------------------------------|
| 1.               | Ekiti State Rehabilitation Centre                 | x                 | x                               | x                               |
| 2.               | Plateau State Rehabilitation Centre               | x                 | x                               | x                               |
| 3.               | Bauchi State Rehabilitation Centre                | x                 | x                               | ✓                               |
| 4.               | Rehabilitation Centre, Moniya, Ibadan, Oyo State. | x                 | x                               | x                               |
| 5.               | Quintessential Healthcare Centre                  | x                 | x                               | ✓                               |
| <b>Total (%)</b> |   | <b>0</b>          | <b>0</b>                        | <b>40</b>                       |
| ✓ – Available    |   | x –Unavailable    |                                 |                                 |

(Source: Authors Fieldwork, 2018)

From **Table 4.6** above, none of the rehabilitation Centres had green roofs or wall climbers as a green feature on their building facades, while only 40% of the studied rehabilitation Centres possessed flower pots or flower beds as façade greening feature. These results generally reveal lack of adequate consideration of façade greening in the design and construction of these buildings.



**Plate XII: Building Façade at Plateau state rehabilitation Centre, Jos, Nigeria**  
(Source: Authors Fieldwork, 2018)

Ultimately, the results obtained from **Table 4.2 – Table 4.6** clearly reveal that users of the studied rehabilitation Centres (ranging from the members of staff to the patients) have restricted Direct Contact with Nature both within interior spaces as well as exteriors of the studied facilities.

#### 4.1.2.2 Indirect contact with nature

The following tables below show the results of data obtained from the investigation of biophilic design parameters that revealed Indirect Contact with Nature and they are explained and discussed below.

**Table 4. 7 Assessment of Natural Materials and Natural Colours in the Sample Rehabilitation Centres**

| Rehabilitation Centres |   |                                       |                         |                                      |
|------------------------|---|---------------------------------------|-------------------------|--------------------------------------|
| S/No                   | List of Rehabilitation Centres                    | Use of Natural Construction Materials | Use of Natural Finishes | Use of Natural Colours for Finishing |
| 1.                     | Ekiti State Rehabilitation Centre                 | x                                     | X                       | ✓                                    |
| 2.                     | Plateau State Rehabilitation Centre               | x                                     | X                       | x                                    |
| 3.                     | Bauchi State Rehabilitation Centre                | x                                     | X                       | x                                    |
| 4.                     | Rehabilitation Centre, Moniya, Ibadan, Oyo State. | ✓                                     | ✓                       | x                                    |
| 5.                     | Quintessential Healthcare Centre                  | x                                     | X                       | x                                    |
|                        | <b>Total (%)</b>                                  | <b>20</b>                             | <b>20</b>               | <b>20</b>                            |
| ✓ – Available          |   | x –Unavailable                        |                         |                                      |

(Source: Authors Fieldwork, 2018)



**Table 4.7** above, only 20% of the studied rehabilitation Centres were constructed using natural construction materials. Also, 20% of the rehabilitation Centres made use of natural finishes for interior and exterior spaces. And then 20% of the rehabilitation Centres featured natural colours within interior spaces. These results clearly show that there was low patronage (usage) of Natural Materials and Natural colours, thereby indicating low indirect contact with nature as a means of psychologically enhancing mental health and productivity.



**Plate XIII: Showing the Mosque at the Rehabilitation Centre for the Disabled Moniya, Ibadan, Oyo State**  
(Source: Authors Fieldwork, 2018)

From **Table 4.8** below shows that none of the studied rehabilitation Centres employed the use of Natural forms or Natural shapes and patterns, while only 20% integrated images of nature within their interiors which suggests low or inadequate indirect contact with nature.

**Table 4. 8 Assessment of Natural Shapes, Forms, Patterns and Images of Nature in the Sample Rehabilitation Centres**

| S/No          | List of Rehabilitation Centres                    | Use of Natural Building Forms | Use of Natural Shapes and Patterns | Use of Images of Nature in Interior Spaces |
|---------------|---|-------------------------------|------------------------------------|--|
| 1.            | Ekiti State Rehabilitation Centre                 | x                             | X                                  | x  |
| 2.            | Plateau State Rehabilitation Centre               | x                             | X                                  | x  |
| 3.            | Bauchi State Rehabilitation Centre                | x                             | X                                  | x  |
| 4.            | Rehabilitation Centre, Moniya, Ibadan, Oyo State. | x                             | X                                  | x  |
| 5.            | Quintessential Healthcare Centre                  | x                             | X                                  | ✓  |
|               | <b>Total (%)</b>                                  | <b>0</b>                      | <b>0</b>                           | <b>20</b>                                  |
| ✓ – Available |   | x –Unavailable                |                                    |  |

(Source: Authors Fieldwork, 2018)

**Table 4.7** and **Table 4.8** above show that Indirect Contact with Nature which is a key feature of biophilic designs is not adequately integrated in the studied rehabilitation Centres.

#### 4.1.2.3 Experience of space and place

The data used to measure Experience of Place and Space was obtained from both interviews as well as first hand field observation by the researcher. Variables such as; *Translational and Bounded Spaces, Mobility and Way-Finding as well as Spatial Harmony and Spaciousness* where examined using first-hand observation by the researcher by means of checklist as revealed by **Tables 4.9, 4.10 and 4.13** below and the results were discussed accordingly.

While other variables like *Security and Protection, Attraction and Beauty and Connection to Indigenous Habitat* were assessed by means of interviews conducted by the researcher. Interviews

were used for these variables because data concerning experience of place and space is adequately captured and obtained from the End-Users of these rehabilitation Centres. Hence, ten (10) staff members (that had worked in the facility for a minimum of two (2) years) were interviewed using an interview guide and the results of their responses were represented in **Tables 4.11, 4.12, 4.14 and 4.15**. Discussions of results from the tables were also given.

**Table 4.9 Assessment of Key Biophilic Elements that reveal Experience of Place and Space (Translational and Bounded Spaces) in the Sample Rehabilitation Centres**

| S/N   | List of Rehabilitation Centres                    | Staircases               |                 | Lobbies/Halls            |                 | Walkways                 |                 | Public Spaces |                      |
|---|---|--------------------------|-----------------|--------------------------|-----------------|--------------------------|-----------------|---------------|----------------------|
|   |   | Width $\geq 1.5\text{m}$ | Natural Feature | Width $\geq 2.0\text{m}$ | Natural Feature | Width $\geq 1.2\text{m}$ | Natural Feature | Spacious      | Connection to Nature |
| 1.  | Ekiti State Rehabilitation Centre                 | x                        | X               | X                        | X               | x                        | X               | x             | x                    |
| 2.  | Plateau State Rehabilitation Centre               | ✓                        | X               | X                        | X               | x                        | ✓               | x             | x                    |
| 3.  | Bauchi State Rehabilitation Centre                | ✓                        | X               | ✓                        | X               | x                        | X               | ✓             | x                    |
| 4.  | Rehabilitation Centre, Moniya, Ibadan, Oyo State. | x                        | x               | x                        | X               | ✓                        | ✓               | x             | x                    |
| 5.  | Quintessential Healthcare Centre                  | ✓                        | x               | ✓                        | X               | ✓                        | X               | ✓             | ✓                    |
| <b>Total (%)</b>  |   | <b>60</b>                | <b>0</b>        | <b>40</b>                | <b>0</b>        | <b>40</b>                | <b>40</b>       | <b>40</b>     | <b>20</b>            |
| <div> <div>✓ – Available</div> <div>x –Unavailable</div> </div> |   |                          |                 |                          |                 |                          |                 |               |                      |

(Source: Authors Fieldwork, 2018)

Furthermore, the result obtained in **Table 4.9** above shows that 60% of the rehabilitation centres have staircases with widths that are  $\geq 1.5\text{m}$  (which is regarded as adequate for staircases), none of which have natural features along staircases. Also, 40% possess lobbies/halls have widths

$\geq 2\text{m}$  (which gives an acceptable range of widths for lobbies/halls) and none of the rehabilitation centres have natural features along lobbies/halls. In addition, 40% of the rehabilitation centres have walkways with widths falling within the acceptable range  $\geq 1.2\text{m}$  and only 40% feature natural features along walkways. Further results reveal that only 40% of the rehabilitation centres possess well-spaced public spaces such as receptions and visiting areas and only 20% feature any form of connection to nature within those spaces. These results clearly reveal that the biophilic experience of Space and Place was inappropriately considered in Translational and Bounded Spaces in the studied rehabilitation Centres.



**Plate XIV: Walkway in Plateau State Rehabilitation Centre Jos, Nigeria**  
(Source: Authors Fieldwork, 2018)

**Table 4. 10 Assessment of Key Biophilic Elements that reveal Experience of Place and Space (Mobility and Way Finding) in the Sample Rehabilitation Centres**

| S/No             | List of Rehabilitation Centres                    | Circulation Spaces | Ease of locating Staircases, Elevators, Lobbies | Signage   |
|------------------|---|--------------------|---|-----------|
| 1.               | Ekiti State Rehabilitation Centre                 | x                  | ✓   | x         |
| 2.               | Plateau State Rehabilitation Centre               | x                  | X   | x         |
| 3.               | Bauchi State Rehabilitation Centre                | ✓                  | ✓   | x         |
| 4.               | Rehabilitation Centre, Moniya, Ibadan, Oyo State. | ✓                  | ✓   | x         |
| 5.               | Quintessential Healthcare Centre                  | ✓                  | ✓   | ✓         |
| <b>Total (%)</b> |   | <b>60</b>          | <b>80</b>                                       | <b>20</b> |
|                  |   | ✓ –Adequate        | x –Inadequate                                   |           |

(Source: Authors Fieldwork, 2018)

From **Table 4.10** above shows that 60% of the studied rehabilitation Centres had adequate circulation spaces, while only 20% featured adequate signage and 80% of the rehabilitation Centres featured relative ease in locating staircases and lobbies, as there were no elevators in the studied rehabilitation Centres. These results suggest there is a need for adequate mobility and way finding consideration in the studied rehabilitation Centres.



**Plate XV: Staircase Leading to the Admin Block at Ekiti State Government Relief and Rehabilitation Centre, Ekiti.**

(Source: Authors Fieldwork, 2018)

**Table 4. 11 Assessment of Users' Perception of Security and Protection that reveal**

| S/No                              | Experiences of Place and Space in the Sample Rehabilitation Centres | Casualties of Addicts in Wards | Occurrences of Fire in Wards | General Feeling of Insecurity |
|-----------------------------------|---|--------------------------------|------------------------------|-------------------------------|
| 1.                                | Ekiti State Rehabilitation Centre                                   | 60%                            | 40%                          | 30%                           |
| 2.                                | Plateau State Rehabilitation Centre                                 | 40%                            | 50%                          | 40%                           |
| 3.                                | Bauchi State Rehabilitation Centre                                  | 50%                            | 30%                          | 20%                           |
| 4.                                | Rehabilitation Centre, Moniya, Ibadan, Oyo State.                   | 30%                            | 30%                          | 30%                           |
| 5.                                | Quintessential Healthcare Centre                                    | 30%                            | 20%                          | 10%                           |
|                                   | <b>AVERAGE (%)</b>  | <b>42%</b>                     | <b>34%</b>                   | <b>26%</b>                    |
| <i>%- Percentage Availability</i> |   |                                |                              |                               |

(Source: Authors Fieldwork, 2018)

From the **Table 4.11** above, the results of the interviews conducted with the users of the studied rehabilitation Centres clearly show that an average of 42% of the End-Users gave claims to casualties of patients in wards, also averagely 34% of users attested to occurrences of fire outbreak in wards and an averagely of 26% sustained a general feeling of insecurity within the rehabilitation facility. These results gave rise to further interview of the users which birthed **Table 4.12** below.

**Table 4. 12 Assessment of Users' Perception of Security and Protection that reveal Experience of Place and Space in the Sample Rehabilitation Centres**

| S/No | List of Rehabilitation Centres                    | Use of Fixed Furniture/ Fixtures in Wards | Use of Padded Walls/ Floors | Use of Fire Proof Materials in Wards | Hidden Electrical Circuits in Wards | Protection of Balconies/ Terraces in Upper Floors |
|------|---|---|-----------------------------|--------------------------------------|-------------------------------------|---|
| 1.   | <del>Ekiti State</del><br>Rehabilitation Centre   | 0%  | 0%                          | 20%                                  | 10%                                 | 30%   |
| 2.   | Plateau State Rehabilitation Centre               | 10%                                       | 0%                          | 0%                                   | 0%                                  | -   |
| 3.   | Bauchi State Rehabilitation Centre                | 30%                                       | 0%                          | 10%                                  | 30%                                 | -   |
| 4.   | Rehabilitation Centre, Moniya, Ibadan, Oyo State. | 20%                                       | 0%                          | 30%                                  | 10%                                 | -   |
| 5.   | Quintessential Healthcare Centre                  | 30%                                       | 0%                          | 10%                                  | 40%                                 | -   |
|      | <b>AVERAGE (%)</b>                                | <b>18%</b>                                | <b>0%</b>                   | <b>14%</b>                           | <b>18%</b>                          | <b>30%</b>  |

*%- Percentage Availability*

**(Source: Authors Fieldwork, 2018)**

Results from the interview as shown in **Table 4.12** above reveals that it is clear that an average of 18% of the users agreed to the use of fixed furniture and fixtures in wards, while none (0%) of the users shared the view of padded walls and floors being used in the wards of the studied rehabilitation Centres. Howbeit, 14% averagely said fire proof materials were used within the wards, average 18% of the users shared the viewed that electrical circuits and switches were hidden in wards and finally, 30% of the users of Ekiti State rehabilitation Centre sustained the opinion that the balconies and stairways were protected and safe. These results (numbers) thereby suggests a concerning degree of insecurity within spaces in the study rehabilitation Centres.

**Table 4. 13 Assessment of Key Biophilic Elements that reveal Experience of Place and Space (Spatial Harmony and Spaciousness) in the Sample Rehabilitation Centres**

| S/No             | List of Rehabilitation Centres                    | Floor to Ceiling Height $\geq 3m$ | Office Floor Area $\geq 9m^2$ / 2 persons | Ward Floor Area $\geq 20m^2$ / 2 persons | Harmony of Interior Spaces |
|------------------|---|-----------------------------------|---|--|----------------------------|
| 1.               | Ekiti State Rehabilitation Centre                 | ✓                                 | x   | x  | x                          |
| 2.               | Plateau State Rehabilitation Centre               | ✓                                 | x   | x  | x                          |
| 3.               | Bauchi State Rehabilitation Centre                | ✓                                 | x   | ✓  | ✓                          |
| 4.               | Rehabilitation Centre, Moniya, Ibadan, Oyo State. | ✓                                 | ✓   | x  | x                          |
| 5.               | Quintessential Healthcare Centre                  | ✓                                 | ✓   | ✓  | ✓                          |
| <b>Total (%)</b> |   | <b>100</b>                        | <b>40</b>                                 | <b>40</b>                                | <b>40</b>                  |
|                  |   | ✓ –Available                      | x –Unavailable                            |  |                            |

(Source: Authors Fieldwork, 2018)



**Table 4.13** above shows the results obtained from observation of users' experience of spaces and it reveals that 100% of the studied rehabilitation Centres had ceiling heights that were equal to or greater than 3 metres ( $\geq 3\text{m}$ ) within interior spaces. 40% of the office spaces had floor areas that were equal to or greater than 9 metres square per 2 persons ( $\geq 9\text{m}^2/2\text{persons}$ ). 40% of the ward spaces had floor areas that were equal to or greater than 20 metres square per 2 persons ( $\geq 20\text{m}^2/2\text{persons}$ ) and finally, 40% of the rehabilitation Centres featured harmony of interior spaces. This goes to show that as far volumes and areas are concerned, the spaciousness of spaces within the studied rehabilitation was largely inadequate and harmony of spaces was not adequately sustained.

**Table 4. 14 Assessment of Users' Perception of Attraction and Beauty that reveal Experience of Place and Space in the Sample Rehabilitation Centres**

| S/No | List of Rehabilitation Centres                    | Satisfaction with Aesthetics of Building Façade | Satisfaction with Aesthetics of Interior Spaces | Use of Natural Decorative Features within Interior Spaces |
|------|---|---|---|---|
| 1.   | Ekiti State Rehabilitation Centre                 | 0%  | 10%   | 0%  |
| 2.   | Plateau State Rehabilitation Centre               | 10%   | 0%  | 10%   |
| 3.   | Bauchi State Rehabilitation Centre                | 10%   | 20%   | 20%   |
| 4.   | Rehabilitation Centre, Moniya, Ibadan, Oyo State. | 0%  | 0%  | 30%   |
| 5.   | Quintessential Healthcare Centre                  | 20%   | 30%   | 0%  |
|      | <b>AVERAGE (%)</b>                                | <b>8%</b>                                       | <b>12%</b>                                      | <b>12%</b>  |

(Source: Authors Fieldwork, 2018)

Results obtained from **Table 4.14** suggest that an average of 8% of the users of the studied rehabilitation Centres were satisfied with the aesthetics of the facades of the buildings on site, also an average of 12% of the end-users were satisfied with the aesthetics within interior spaces and averagely 12% of the users of the studied rehabilitation Centres sustained the view that natural decorative elements were used for aesthetics within interior spaces. This findings reveal a level of dissatisfaction of the aesthetics and beauty of the studied rehabilitation centres.



**Plate XVI: Image of Building Façade in Bauchi Rehabilitation Centre, Bauchi State**  
(Source: Authors Fieldwork, 2018)



**Plate XVII: Façade of Rehabilitation Centre for the Disabled, Moniya Ibadan, Oyo State**  
(Source: Authors Fieldwork, 2018)

**Table 4. 15 Assessment of Users' Connection to Indigenous Habitat that reveal Experience of Place and Space in the Sample Rehabilitation Centres**

| S/No | Rehabilitation Centres                            | Feeling of Being at Home | Materials/ Finishes in Patients' Areas | Use of Traditional Fixtures/ Fittings | Traditional Artefacts in Interior Spaces |
|------|---|--------------------------|--|---------------------------------------|--|
| 1.   | Ekiti State Rehabilitation Centre                 | 20%                      | 10%                                    | 10%                                   | 20%                                      |
| 2.   | Plateau State Rehabilitation Centre               | 30%                      | 10%                                    | 0%                                    | 0%                                       |
| 3.   | Bauchi State Rehabilitation Centre                | 10%                      | 20%                                    | 0%                                    | 0%                                       |
| 4.   | Rehabilitation Centre, Moniya, Ibadan, Oyo State. | 30%                      | 40%                                    | 20%                                   | 10%                                      |
| 5.   | Quintessential Healthcare Centre                  | 20%                      | 10%                                    | 0%                                    | 10%                                      |
|      | <b>AVERAGE (%)</b>                                | <b>22%</b>               | <b>18%</b>                             | <b>6%</b>                             | <b>8%</b>                                |

(Source: Authors Fieldwork, 2018)

The results from **Table 4.15** reveal that averagely 22% of the users of the studied rehabilitation Centres shared the opinion of feeling at home whenever they are in the facility, an average of 18% of the users consented to the use of indigenous materials and finishes in wards and other interiors, only about 6% in average agreed to the use of traditional fixtures or fittings and only 8% of the users attested to the use of traditional artefacts and elements within interior spaces. These results suggests a low level of connection of people to their indigenous habitat in the studied rehabilitation Centres.



**Plate XVIII: Showing the Church Façade of Rehabilitation Centre for the Disabled Moniya, Ibadan, Oyo State (Source: Authors Fieldwork, 2018)**



**Plate XIX: Environmental Features along Entrance in Bauchi state, Rehabilitation Centre**  
(Source: Authors Fieldwork, 2018)





**Plate XX: Showing Vegetation Covers and Notable Trees and Shrubs in Rehabilitation Centre for the Disabled Moniya, Ibadan, Oyo State**  
(Source: Authors Fieldwork, 2018)



**Plate XXI: Green Surrounding Feature in Ekiti State Government Rehabilitation Centre**  
(Source: Authors Fieldwork, 2018)

## **4.2 Design Framework for Biophilic Design Principles in the Design of Drug Rehabilitation Centres in Nigeria**

### **DIRECT CONTACT WITH NATURE**

- i. Results from the data analysis showed that ventilation and day lighting was inadequate within the studied rehabilitation Centres and this can be greatly improved by providing sufficient amount and sizes of openings and also providing means of sky-lighting; which will aid fenestration, day-lighting and enhance visual connection with users and the natural environment outside the buildings.
- ii. Also, it was observed that indoor plants were scarcely featured within interior spaces and also water bodies were not in any way featured both within and outside the studied rehabilitation Centres. An integration of water bodies and indoor plants will give the users a sense of connection to nature, help purify the air within interior spaces, help in mental and psychological rehabilitation and also improve productivity.
- iii. Adequate views and vistas of the natural environment were not captured in the studied rehabilitation Centres and this can be drastically enhanced by providing adequate amount of openings, introducing sufficient vegetation and other natural features in courtyards and atriums and also introducing sit-outs, verandas, balconies and terraces where views and vistas of the natural environment can be abundantly captured.
- iv. The Natural landscaping in the studied rehabilitation Centres was not appropriately considered with regards to the ecosystem. However, this can be addressed by planting the adequate amount of trees and tree cover, proper positioning of trees, adequate

planting of shrubs, provision of healing or therapeutic gardens and blending landscaping features with the natural habitat of the particular area and ecosystem in general. This will undoubtedly facilitate direct contact with nature which will foster rehabilitation.

- v. In addition, façade greening was an alien feature in the studied rehabilitation Centres and this can be incorporated into the design of rehabilitation Centres by using green features such as: green roofing, climbers on exterior walls, use of flower pots or flower beds and the use of wood and other natural materials.

#### INDIRECT CONTACT WITH NATURE

- vi. From the data analyzed in this study it is clear that users of the studied rehabilitation Centres were not sufficiently provided indirect contact with nature and this can be immensely introduced and improved by; using natural construction materials, using natural colours, using natural shapes, forms and patterns and also introducing pictures of nature in interior spaces.

#### EXPERIENCE OF SPACE AND PLACE

- vii. From the analysis of data it was observed that translational and bounded spaces were found to be designed without considering natural features along their paths. By ensuring that the standard widths and dimensions are used in designing translational and bounded spaces and also incorporating natural features (such as plants, natural materials, patterns and images of nature) along their paths, users can come into the experience of space and nature which can aid rehabilitation of patients and productivity of staff.



- viii. From the results, mobility and way-finding can be better enhanced by creating adequate circulation spaces as well as locating staircases and elevators along areas where they can be easily located and also improving signage in rehabilitation facilities.
- ix. Furthermore, findings show that the feeling of security and protection (which was at a concerning level) can be better enhanced by employing passive means of security such as; use of fixed furniture/fixtures in wards, use of padded walls/floors in wards, use of fire proof materials in wards and other parts of the facility, hiding electrical circuits and switches from patients in wards, using hand rails, balustrades, glass or other railings to protect balconies and terraces in upper floors and also compartmentalization of spaces within the facility.
- x. In addition, spatial harmony and spaciousness which was a far-fetched feature in the studied rehabilitation Centres can be improved by designing spaces with standard floor areas and volumes and also integrating features and patterns (natural) that will be consistent in interior spaces.
- xi. Also, the results suggest that the users were averagely dissatisfied with the Aesthetics of both interior spaces and building exteriors in the studied rehabilitation Centres. However, this can be tremendously improved by the use of natural features such as indoor plants, water bodies, natural materials, natural colours and images of nature within interior spaces while green Facading will greatly enhance the aesthetics of building exteriors.
- xii. Finally, most of the user sustained the opinion that connection to indigenous habitat was scarcely achieved within the studied rehabilitation Centres. This feature can be enhanced

by using indigenous or traditional building materials and finishes within interior spaces, use of traditional fittings and fixtures and also introducing popular traditional artefacts and symbols into interior spaces as decorative features. This will ultimately and greatly lead to the users of spaces having a sense of “feeling at Home”, and this will in turn improve mental relaxation, rehabilitation and productivity.

### **4.3 Application of the Design Framework in the Design of a proposed Drug Rehabilitation Centre in Kano State**

#### **4.3.1 The site**

The proposed site is located at Naibawa, Kano State Nigeria. The Site seats beyond ring road (bypass) just along Kano-Zaria road; which will serve as an access road to the Site. Landmark facilities close to it are; Naibawa Eastern Bypass Mosque and ALP oil. The area around the site is relatively undeveloped with vegetation predominant around it as shown in Figure **4.1** below.



**Figure 4.1 Google Earth Site Location Map**  
(Source: Authors Fieldwork, 2018)

#### **4.3.2 Site selection criteria**

The choice of site was majorly influenced by the National Drug Law Enforcement Agency's (NDLEA) recommendations in the Drug Report of 2018. In their report they clearly stated that drug rehabilitation Centres should be sited with the following considerations:

- i. The site must be situated at a location where the drug addicts are away from their homes and societies. This suggests that the rehabilitation Centre should be located at the outskirts of the Town (but not too far from the Town) or at secluded parts of the Town in order to separate the drug addicts from the environments they are used to.

- ii. The site must be located at a very serene and secluded environment that can enable mental rehabilitation. Suggesting that the site must be at a secluded environment that is quiet and has an atmosphere serene enough to foster rehabilitation.

on the basis of the above criteria, the following other criteria were introduced considering the objective of the study:

- iii. The site must contain natural occurring biophilic elements such as trees, shrubs, rocks and water bodies (if possible) that can create a serene and enabling environment that fosters rehabilitation.
- iv. The site must be situated at a location with limited access routes for security reasons.
- v. Sufficient Space and Possibility of Future Expansion: The site chosen has sufficient space for the building and to also accommodate the various traffic lines coming to the institution. It allows for future expansion, retains attractive grounds and obviate objectionable appearances of overcrowding.

#### **4.3.3 Site selection justification**

The site was selected on the auspices of regulatory land use which often categorizes it as a commercial zone and can therefore be used. Although, being classified under the commercial zones, it is note-worthy that these type of facilities must be situated at the fringes of Town, but not too far from Town so that visitation from friends, family and loved ones of the Patients will not be so much of a burden. The site was also selected by virtue of NDLEA's recommendations for locating drug rehabilitation Centres according to the Drug Report of 2018 as indicated earlier.

The site gives it a good connection for commuters, and features good proximity to power and water supply.

#### **4.3.4 Site planning, bye laws and regulations**

The location and site selection was carefully guided by the land use ordinances of the Kano Urban Planning and Development Authority (KNUPDA), Kano Geographic Information System (KANGIS) and the development control policies.

#### **4.3.5 Site analysis**

i. Landscape -There trees, shrubs and grasses currently growing of the propped site. This Trees, shrubs and grasses will be deliberately and intelligently incorporated in the overall land scape design of the site to help create a natural therapeutic environment to foster rehabilitation of the Users.

ii. Wind - The prevailing winds in Kano which covers the proposed site are North-East (NE) and South-West (SW) trade winds. The NE winds blows across the site between November and January and is usually characterized by its hazy and dusty nature. The SW winds blows from the Atlantic ocean and brings rain to the West African coast, including Nigeria from April to october. A proper understanding of the benefit of the properties of the winds would help provide a design that is energy efficient and comfortable for the users of the rehabilitation Centre.

iii. Sun Rise and Sun Set -The sun rises from the eastern region across the site and sets at the western region creating a spectrum of day light that can be used for proper office light in relation to building form and orientation for the reduction of the use of artificial energy for lighting with in the port facilities.

iv. Topography –The site is relatively flat, with gentle slopes seen featured in certain areas. This featured will be harnessed and duly appropriated in the design and site planning.

v. Noise –The major source of noise is the Kano-Zaria access road close to the site. Adequate noise buffer will be provided along the path of the access road using vegetation and other natural noise buffering elements during the site planning.

vi. Sun path analysis -The sun rise occurs between 6.00am and 10.00am at the east. Improves to be good to the occupants' morning activities and also for solar energy. This is the advantageous part of the building and the wards are to face this part. Mid-day sun occurs at noon. The rays are very hot and harsh on the skin. It stands above the building and can be harnessed as a source of solar energy. The sunset occurs between 4.00pm to 6.00pm in the west. It brings about glare and might hinder vision but also proves to be a beautiful view. Shading devices can be used to avoid glare at this part of the building

#### **4.4 Site Planning**

The site planning of the site was done in such a way that it will provide patients with serious mental health needs with a functional and aesthetic environment that provides them with the greatest chance of achieving recovery. An Administrative block, wards for inpatients, Medical facilities, Lecture halls, skill acquisition Centres and Staff quarters were featured on the

proposed site. The activities of maintenance personnel, supportive service providers, emergency crews and utility workers were accommodated on site in such a manner that are as unobtrusive as possible for the patients, visitors and clinical staff using the facility.

The completed site will feature: *landscaped features, setbacks and buffers, adequate parking for staff and visitors, safe, attractive circulation for pedestrians from the parking areas and public transportation stops, access for emergency vehicles, utility and service access, covered entry and signage-wayfinding.*

## **4.5 Design Report**

### **4.5.1 Design brief**

The menace of Drug abuse and addiction which is at a frightening scale, is one that has pervaded every fibre of our society in Nigeria. In line with the Federal Republic of Nigeria's strategy to reduce the level of drug addiction in the country, the National Drug Law Enforcement Agency has outlined the urgent need to establish fully functional and effective drug rehabilitation centres in North-Western States in Nigeria (NDLEA, 2018). These states which were identified as the States with the highest number of victims of drug addiction require drug rehabilitation centres as they are insufficient and, in some areas, not even available at all. Kano which is the most populated of these States in the North West have been identified by the NDLEA as one of the States where these centres are required. In view of this, the proposed design should incorporate the natural environment, habitat and culture of the people of that area, such that these parameters can be used to foster rehabilitation of drug addicts in addition to other active measures of de-addiction and rehabilitation. The proposal must cater for issues such as sustainability, bio-

climate and energy-efficiency in their designs with all the necessary facilities and spaces of a fully functional drug rehabilitation Centre.

#### **4.5.2 Design considerations and concept**

For the purpose of this design careful considerations were given to the following in order to achieve a suitable biophilic design;

- i. Landscape elements were carefully implemented to give users of the facility a sense of direct contact with nature in order to create a therapeutic scenery and environment to aid rehabilitation and even productivity of staff.
- ii. Safety of the occupants was a very important design consideration in the design of this drug rehabilitation Centre. Therefore various passive means of security were employed to ensure safety of the Patients.
- iii. Interaction between patients in the recovery or rehabilitation process is very important. However the interaction was controlled and checked in the design, so as to avoid sneaking in of drugs and other addictive substances and also to ensure that each patient is protected from potentially violent patients,
- iv. Circulation, mobility and way-finding is also adequately important as a design consideration in drug rehabilitation Centres. Vehicular and pedestrian movements (routes) were clearly defined and controlled. Also alternative routes were created to cater for contingencies and emergencies.



- v. Ambient Environment (noise/lighting/ventilation): The noise, air and light features. Design consideration include provision for natural daylight, control of glare, proper room orientation, use of high level windows, use of noise absorbing materials, functional zoning, different room types.
- vi. Functional Zoning: The basic principle in hospital zoning is controlled movement. Patients, staff, visitors and materials should move throughout hospitals according to certain criteria.

This design adopts a biophilic design approach for its concept which suggests a design approach that makes interior and exterior spaces eco-friendly and nature loving. The 14 patterns of biophilia as established by Ryan *et al* (2014) formed the pillars of the design. However, the forms and shapes of the buildings on site and arrangement was influenced by the *Pantanal of Brazil*; which is a natural occurring healing swampy vegetative area. The curvy and circular repeated shapes and forms observed from the aerial view of the Pantanal was adopted on the site, and the design also featured an interplay of water and vegetation in order to replicate the same healing environment throughout the entire site.



Plate XXII: Illustrated Patterns of the Pantanal of Brazil  
*Source: Google (2018)*

### 4.5.3 Structures provided in the proposed drug rehabilitation centre

**Table 4.16 Structures provided in the Proposed Drug Rehabilitation Centre**

| S/No | Structure            | Description/Function  | Qty |
|------|----------------------|---|-----|
| 1.   | General Ward A       | This 2 storey building with about 30 rooms was specially designed for patients at the last stages of their rehabilitation process. It can contain a maximum of 4 people in a room. And each room has a closet and a bathroom.                 | 1   |
| 2.   | General Ward B       | This 2 storey building with about 24 rooms was specially designed for patients at the beginning and middle stages of their rehabilitation process. It can contain a maximum of 3 people in a room. And each room has a closet and a bathroom. | 1   |
| 3.   | Administrative Block | This bungalow with an atrium at the reception was designed for Administrative Staff in the rehabilitation Centre. And it contains offices, rest rooms, a cafeteria, and a board room.   | 1   |
| 4.   | Medical Block        | The Medical Block which is also a bungalow was designed to cater for the medical team. It contains offices, consultation rooms, laboratories, theatres and rest rooms.  | 1   |

---

|                              |  |   |
|------------------------------|--|---|
| 5. Intensive Care Ward       | This bungalow with 10 rooms was specially designed for addiction cases that need thorough attention. It was designed to contain just 1 person per room, with a closet and bathroom. Rooms for medical personnel and security are also included within the block. | 1 |
| 6. Service/ Maintenance Unit | This building also is just a single floor and contains service and maintenance spaces like stores, water control, power controls and other services.   | 1 |
| 7. Therapeutic Core          | This 5m tall structure with steel trusses and glazed covering is a distinctive feature in the proposed site. It's a meditation as well as natural relaxation and rehabilitation area that affords addicts direct as well as indirect contact with nature.        | 1 |
| 8. Meeting/Meditation Area   | This area is specially designed for the meeting with visitors, as well as patient-patient interactions and meditation. It's an outdoor roofed facility.  | 1 |
| 9. Utility Building          | The Utility building is a one storey structure that features general dining halls, television spaces, a gym, rest rooms, first aid rooms and control rooms.  | 1 |
| 10 Lecture Hall              | This multi-purpose hall was primarily designed for lectures and other activities primarily for out-patients. The building has 2 floors.  | 1 |

---

---

|   |                               |  |   |
|---|-------------------------------|--|---|
| 1 | Skill Acquisition Centre      | This building features lecture rooms, rest rooms and stores for keeping learning equipment.  | 4 |
| 1 | Staff Chalet                  | These are residential buildings for staff that will leave within the facility.   | 8 |
| 1 | outdoor Recreational Facility | An outdoor recreational facility is provided on site. Comprises of various sports facilities. This is in order to help with physiotherapy of the patients. | 1 |
| 1 | Religious Buildings           | Religious buildings also feature on Site. There is a Mosque.   | 2 |

---

#### **4.5.5 Construction**

Structural frame system was adopted for the construction of the buildings in the rehabilitation Centres as prefabrication also plays a vital role in the construction of the buildings. Single footing foundations were employed in the construction of buildings in the proposed design. The foundation of the buildings will be constructed by first digging the trench and creating a concrete base upon which the buoyant foundation sits in. The foundation itself is made from reinforced concrete in filled with extruded polystyrene (for water-proofing) and Styrofoam which is reinforced to give it the required strength to carry the loads to be placed on it. Steel I-section columns were used in certain areas while, square concrete columns were used in other areas. I-section beams were used in certain places, while concrete beams were also used in other areas for construction. Walls were constructed with sandcrete blocks and concretes while in certain areas, prefabricated glazing was used as walling in certain areas that required a good view of

the external environment. Certain parts of the roof was constructed with concrete slabs, while green roof was predominantly used with sky-lighting been featured also as roofing in certain areas. Wooden horizontal fins were also featured over glazing and walling as serving both as burglary proof and also provided frames upon which climbers were grown and this helps to purify indoor air and aid ventilation as well as reduce glare.

#### **4.5.6 Materials and finishes**

The selection and choice of materials was based on *sustainability, durability, degree of space flexibility offered by materials, weight of the materials and the suitability to achieve a sense of natural scenery*. The main materials for construction are:

- i. Concrete
- ii. Steel
- iii. Wood

While, finishing on the other hand was majorly done in so a way that it gives either direct, indirect or a feel of nature. Interior finishes were selected according to; *aesthetic value, therapeutic attributes, maintainability, durability, affordability, infection control, sustainability, safety/security and flammability/flame spread compliance*. Finishes used as;

- i. Floor finishes –Resilient flooring (such as rubber flooring, sheet vinyl or linoleum) or padded carpets in wards and patients-based areas and ceramic tiles for general spaces and offices.

ii. Wall finishes –Paints (using natural colours), padded vinyl wall covering, solid surface panels (for bathrooms) and corner guards in wards and patients-based areas. Wooden horizontal fins and climbers, with stone cladding were used for external walls.

iii. Ceiling finishes – Acoustic tiles were used in wards, Plaster of Paris (PoP) were used for public areas and certain areas were skylight glass and rubber materials.

#### **4.5.7 Patient furnishings**

Patient furniture, especially in-patient furniture for this design are durable, easily maintained and abuse resistant with tamper proof fasteners. Furniture do not have sharp edges or surfaces that could be used as an anchor point. Chairs used in in-patient dining areas and in-patient rooms are heavy enough and fastened to the ground to minimize the threat of the chair being through or otherwise used as a weapon. Same goes to beds and other furniture.

#### **4.5.8 Landscape and external works**

Landscape features provide a major aesthetic benefit to any site. In all but the most urban settings, the landscape provides the first impression of the facility. With regards to Mental Health, landscaping is especially important and is a significant part the overall goal of providing treatment in a therapeutic, residential-like setting. Moreover, visual access to natural elements will be used to promote healing in patients. Existing natural features will be preserved whenever possible and the portion of the site disrupted would be limited to minimal areas outside the building footprint, roadways, parking, walks and utility trenches. While planning for the

landscaping of the site, indigenous vegetation, whether introduced or replaced because of the project, will be strongly featured to reduce the need for irrigation and pesticides.

The soft landscaping features were majorly constituted by vegetation (trees and shrubs) and water bodies, while hard landscape will feature interlocked walkways, driveways, rocks, pollards, concrete flower beds and concrete water fountain base. Courtyards and atriums will feature adequate landscaping.

#### **4.5.9 Building services**

##### **i. Electricity**

The electrical services in this port shall be transmitted and provided by the Kano Electricity Distribution Company (KEDC) into the site, the distribution of power at a suitable voltage to the various units of the ports will help various systems such as including the telecommunication systems and installation of fire alarm systems function at full capacity. Standby generators together with solar cells would also be installed and used in cases of power outage or emergency as the case may be. The capacity of the generators to be used as standby generator shall be equal to the anticipated load for the various sections of the rehabilitation Centre.

##### **ii. Water Supply.**

Water is critical to most human endeavours, the proposed rehabilitation Centre will require constant water supply as well. Water needed on the proposed facility will be sourced directly from the water board Authority and this direct source will be supplemented indirectly with boreholes sunk to ensure constant water supply at all times.

### iii. Drainage

Run-off water from the buildings and surfaces such as car parks and paved areas within the proposed facility shall be adequately drained off into the drainage system. The construction of the drainage system will be such that all the channels empty its content into the State's central drainage system.

### iv. Sewage and Refuse Disposal

For the sewage within the facility, septic tanks and soak away pits will be provided to ensure adequate attention is given to it. These will be strategically located on site for easy access and maintenance. Refuse Disposal Provision will be made for refuse collection from various points on the site the maintenance department for collecting refuse from bins and tipping same to dumps provided near a central package incinerator plant. Provision would also be made for collection of recyclable objects to be collected and further transported off-site to where they can be recycled.

### v. Fire Security

Fire incidents are a common occurrence in buildings either due to man made errors caused by human negligence or electrical sparks. Fire precaution aims at safe guarding lives and properties and this is achieved by reducing fire incidences, controlling fire propagation and spread, providing adequate means of escape to the building occupants and adhering strictly to fire safety



measures. The proposed rehabilitation Centre shall adopt the following measures to check fire incidents:

- a. The use of fire stop assembly to protect penetrations through fire walls such as cables and pipes to prevent the spread of fire in the design.
- b. The walls and ceilings are made of fire proof materials to reduce fire spread (such as Plaster of Paris P.O.P, vinyl wallings).
- c. The cables are coated with fire retardants to reduce flame spread and smoke development of combustible cables.
- d. Compartmentalization of the entire building by use of fire resistant rated walls and floors.
- e. Installation of fire sprinkler systems to reliable water source, smoke and fire detectors connected to electric wiring and installed in stairways, corridors and sensitive areas.

#### vi. Maintenance

The choice of materials satisfies low maintenance cost, however periodic checking and tests will ensure good maintenance culture. Maintenance is any work undertaken in order to keep restore or improve every part of the building to ensure acceptable standard of utility and value of such facility. The maintenance department of this proposed rehabilitation Centre will be responsible for preparing the scheduled preventive maintenance work on all the building within the entire and render minor repairs on plumbing, structural, lighting and electrical.

## **CHAPTER FIVE**

### **5.0 CONCLUSION AND RECOMMENDATIONS**

#### **5.1 Conclusion**

The contemporary demand for sustainability in virtually every sphere of our world today being expressed in the minutest proposition for carbon emission is changing the way architects design buildings; thus influencing a wide range of solutions. These solutions seek to integrate tradition and modernity, highlighting interventions that avoid conflicts between man and nature. Biophilic Architecture shares the love for nature and the love for life in the planet; therefore, it is most likely to influence contemporary Architecture.

Biophilic design principles which offer sustainable solutions to improve mental health and well-being is a treasure-trove which Nigeria as a country should harness in drug rehabilitation Centres. Knowing fully that the implementation of these biophilic design principles provides a wide range of indigenous (localized), sustainable, as well as cost effective strategies to foster rehabilitation of drug addicts in drug rehabilitation Centres across the Nation.

#### **5.2 Recommendations**

From the study, these recommendations can be applied to improve the design and operation of rehabilitation Centres in Nigeria:

- i. Biophilic design framework as proposed by the study should be adopted as a design strategy for the design of health and rehabilitation Institutions in Nigeria.

- ii. Indigenous natural elements, traditional materials and cultural features should be incorporated in the development of rehabilitation Centres around Nigeria, as this will make for better direct, indirect and experiential connection between people and their traditional habitat which in turn will enhance rehabilitation and recovery.

## REFERENCES

- AbdelMeguid, S. (2014). *Biophilic design: Strategies for hospitals retrofit*. University of Stuttgart, Germany. Retrieved July 24, 2017 from <https://iusd.asu.edu.eg>.
- Barton, J., Pretty, J. (2014). What is the best dose of nature and green exercise for improving mental health; A Multi-study Analysis. *Environmental Science and Technology*, 44:3947–3955.
- Blair, M. T. (2014). *Enhancing human health and recovery through biophilic design*. University of Massachusetts Amherst. Retrieved July, 24 2017 from [scholarworks.umass.edu/theses/870](http://scholarworks.umass.edu/theses/870).
- Bozzoli, C. (2016). Self-Employment and Conflict in Columbia. *Journal of Conflict Resolution*. <http://journals.sagepub.com/doi/abs/10.1177/0022002712464849>.
- Costeira, M. E. (2014). *Healthcare architecture: History, evolution and new visions*. Centre for Urban State of Rio de Janeiro. Retrieved April 27, 2018 from <http://www.epublicacoes.uerj.br/index.php/sustinere> Jul/Dec.
- Currie, J. & Zilm, F. (2014). History of Health Care Architecture. Retrieved April 25, 2018 from <http://healtharchitecture.wikifoundry.com/page/History+of+Health+Care+Architecture>
- Dallimer, M., Irvine, N., Skinner, J., Davies, G., Rouquette, R., & Maltby, L. (2012). Biodiversity and the feel good factor: Understanding associations between self-reported human well-being and species richness. *Bioscience*, 62: 47–55.
- Davidson, D. (2013). *Integrating Biophilic Principles and Therapeutic Design Elements in outdoor Spaces for Children at Tucson Medical Center*. College of Architecture, Planning & Landscape Architecture, the University of Arizona.
- Downton, P., David, J., Zeunert, J., & Roös, P. (2017) Biophilic design applications: putting theory and patterns into built environment practice. *The International conference on design and technology, KEG*, 59–65. <https://doi.org/10.18502/keg.v2i2.596>.
- Edward, C., & Christopher, F. C. (2012). Biophilic design: Strategies to generate wellness and productivity. *The American Institute of Architects, and the Association of Collegiate Schools of Architecture*. Retrieved July 24, 2017 from [www.aia.org/DesignHealth](http://www.aia.org/DesignHealth).
- Faloore, O. (2012) Drug Addiction and Rehabilitation in Nigeria: *Insights from Sociological Theories*.
- Fromm, E. (1973). *The anatomy of human destructiveness*. (30) 350-390. Frankfurt, Germany: Frankfurt School of Critical Theory Press.

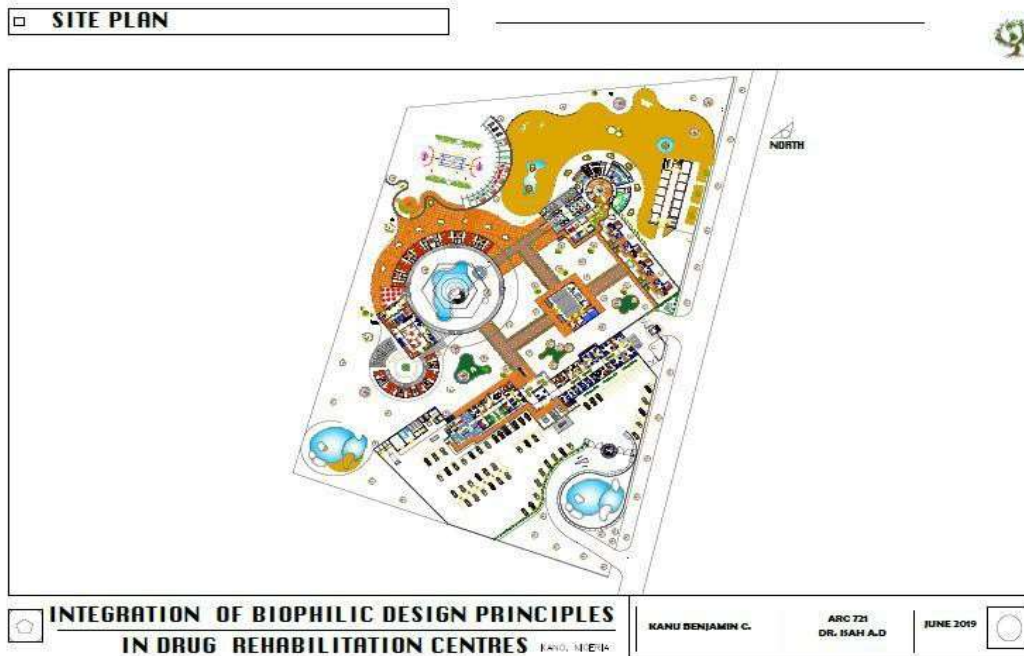
- Gamble, K., Howard, J., & Howard, D. (2014). Not just scenery: Viewing nature pictures improves executive attention in older adults. *Experimental Aging Research*, 40(5), 513–530. <http://doi.org/10.1080/0361073X.2014.956618>.
- Gillis, A., Gatersleben, B. (2015). A Review of Psychological Literature on the Health and Wellbeing Benefits of Biophilic Design. *Buildings* 5(3), 948-963; doi/10.3390/buildings5030948. <https://conservancy.umn.edu>.
- Green J, (2012). *Back to nature for good: Using biophilic design and attention restoration theory to improve well-being and focus in the workplace*. Retrieved March 12, 2017 from: <https://conservancy.umn.edu>.
- Groenewegen, P., Van den Berg, A., Maas, J., Verheij, R., & Vries, S. (2012). Is a green residential environment better for health? If so, why?. *Annals of the Association of American Geographers*, 102: 996–1003.
- Heerwagen, J. (2013). *Psychosocial value of space*. Retrieved from [http://www.wbdg.org/resources/psychspace\\_value.php](http://www.wbdg.org/resources/psychspace_value.php).
- Hildago, A. (2014). Biophilic Design, Restorative Environment and Well-Being. *Research gate*. Retrieved July 24, 2017 from <https://www.researchgate.net/publication/275961124>.
- Jackson, E., Daniel, J., McCorkle, B., Sears, A., & Bush, F., (2013). Linking ecosystem services and human health: The Eco-Health Relationship Browser. *International Journal of Public Health*, 58: 747–755.
- Janicke, B., Meier, F., Hoelscher, M. & Scherer, D. (2015). Evaluating the Effects of Façade Greening on Human Bioclimate in a Complex Urban Environment. *Advances in Meteorology*. Retrieved July 24, 2017 from <https://www.hindawi.com/journals/amete/2015/747259/>.
- Kaplan R., (2014). “The Nature of the View from Home: Psychological Benefits”. *Environmental Behavior*, 33(4), 507-542. doi:10.1177/00139160121973115
- Kellert, S., Heerwagen, J., & Mador, M. (2008). *Biophilic Design: The Theory, Science & Practice of Bringing Buildings to Life*. Hoboken, New Jersey, U.S.A: John Wiley & Sons.
- Kellert, S. (2012). *Notes on the synthesis of form*. Cambridge, Massachusetts: Harvard University Press.
- Kellert S. (2012). *Birthright. People and nature in the modern world*. London, England: Yale University Press.

- Kellert, S., Calabrese, E. (2015). *The Practice of Biophilic Design*. Retrieved from [www.biophilic-design.com](http://www.biophilic-design.com).
- Lederbogen, F., Kirsch, P., Haddad, L., Streit, F., Tost, H., Schuch, P., et al. (2015). City living and urban upbringing affect neural social stress processing in humans. *Nature*. 474: 498–501.
- Lee, J., Park, J., Tsunetsugu, Y., Ohira, T., Kagawa, T., & Miyazaki, Y. (2016). Effect of forest bathing on physiological and psychological responses in young Japanese male subjects. *Public Health*, 125: 93–100.
- Locklear, K. (2012). *Guidelines and Considerations for Biophilic Interior Design in Healthcare Environments*. Austin, TX: The University of Texas.
- MacKerron, G., & Mourato, S. (2013). Happiness is greater in natural environments. *Global Environmental Change–Human and Policy Dimensions*, 23: 992–1000.
- Molthrop, E. (2017). *Biophilic Design: A review of principle and practice*. Retrieved July 24, 2017 from <http://dujs.dartmouth.edu/wp-content/uploads>.
- Montgomery, M. (2012). Benefits of biophilic design explored through human ecology. *Undergraduate Research Community Journal*, 14. Retrieved July 24, 2017 from [http://www.kon.org/urc/urc\\_research\\_journal14.html](http://www.kon.org/urc/urc_research_journal14.html).
- National Drug Law Enforcement Agency (2018). Drug Use Survey. *Drug Use in Nigeria*. <https://ndlea.gov.ng/annual-reports>.
- National Institute on Drug Abuse (2015). *The Science of Drug Abuse and Addition* 39(3), 461–492.
- Na-umma, U. (2014). *Application of biophilic design features in the design of vesico-vagina fistulae (V.V.F.) centre in Gusau, Zamfara state*. Department of Architecture, Ahmadu Bello University, Zaria.
- Norman, D.A. (2016). *User oriented Design Analysis Methods*. Retrieved from <http://genemol.org/biomolespa/PCR/PCR.pdf> on 5/7/2016.
- Oluigbo, S.N. (2010). *Context and Application of Case Studies in Architectural Research*. Department of Architecture, Ahmadu Bello University, Zaria-Kaduna.
- Ratcliffe, E., Gatersleben, B., & Sowden, T., (2013). Bird sounds and their contributions to perceived attention restoration and stress recovery. *Journal of Environmental Psychology*, 36: 221–228.

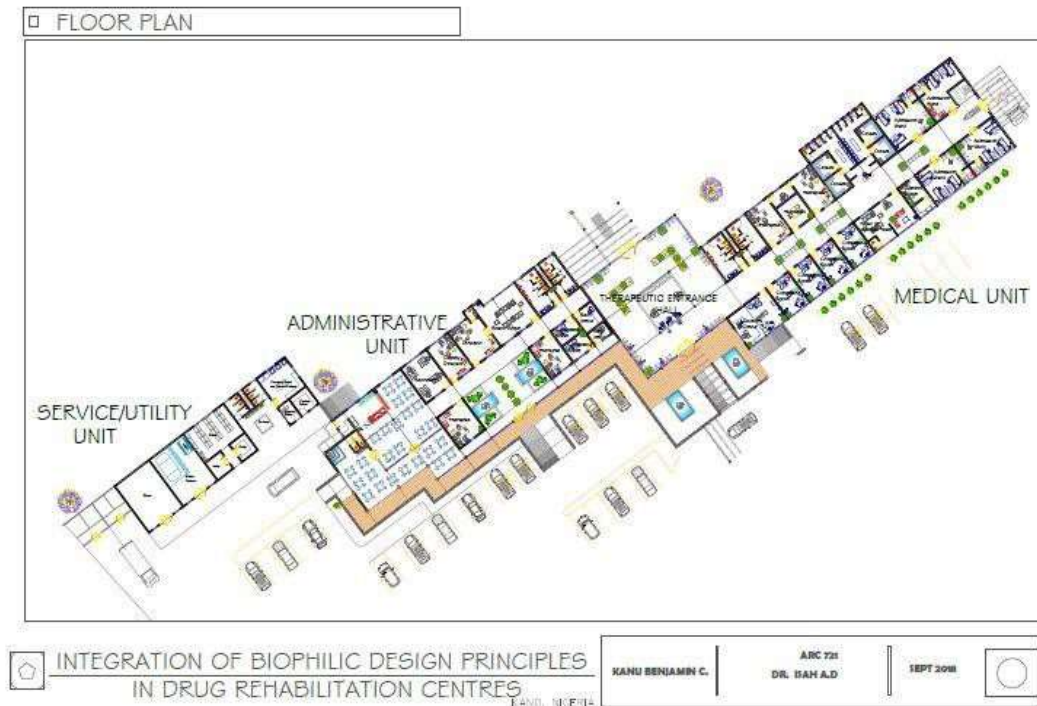
- Robinson, L., Smith, M. & Saisan, J. (2014). [Web page] *Drug abuse and addiction* [Ref. May 2014]. Available at: <http://www.helpguide.org/articles/addiction/drug-abuse-and-addiction.htm>.
- Ryan, C., William, B., & Joseph, C. (2014). *Patterns of biophilic design: Improving health & well-being in the built environment*. New York, U.S.A: Terrapin Bright Green LLC.
- Ryan, C., Browning W., Clancy, J., Andrews L., & Kallianpurkar, N. (2014). Biophilic Design Patterns Emerging Nature-Based Parameters for Health and Well-Being in the Built Environment. *Archnet-IJAR, International Journal of Architectural Research. Archnet-IJAR*, 8(2), 62-76.
- Salinas, N.A. (2015). *Biophilia and healing environments: Healthy principles for designing the built world*. New York, NY: Terrapin Bright Green, LLC. Retrieved from April 24, 2017 from [www.TerrapinBrightGreen.com/publications](http://www.TerrapinBrightGreen.com/publications).
- Wilson, E., Kellert, S. (1993). *The Biophilia Hypothesis*. Washington DC: Island Press.
- World Health Organization (2016). *World Drug Report*. Vienna: United Nations office on Drugs and Crime.

## APPENDICES

### Appendix A: Site Plan

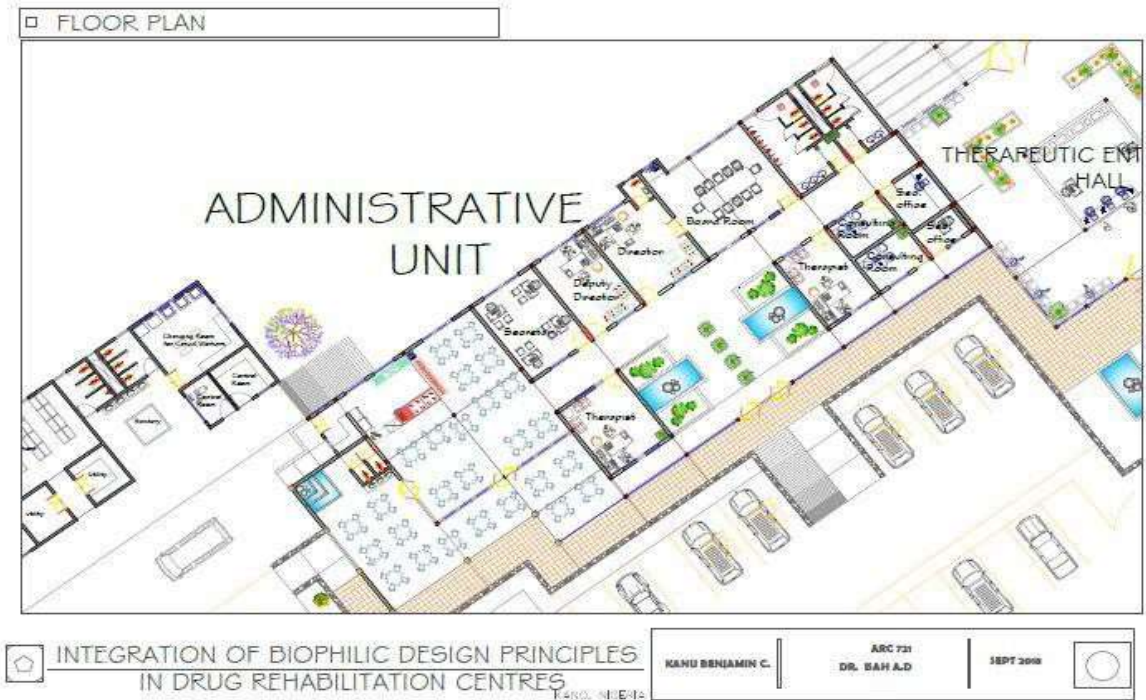


### Appendix B: Admin Floor Plan

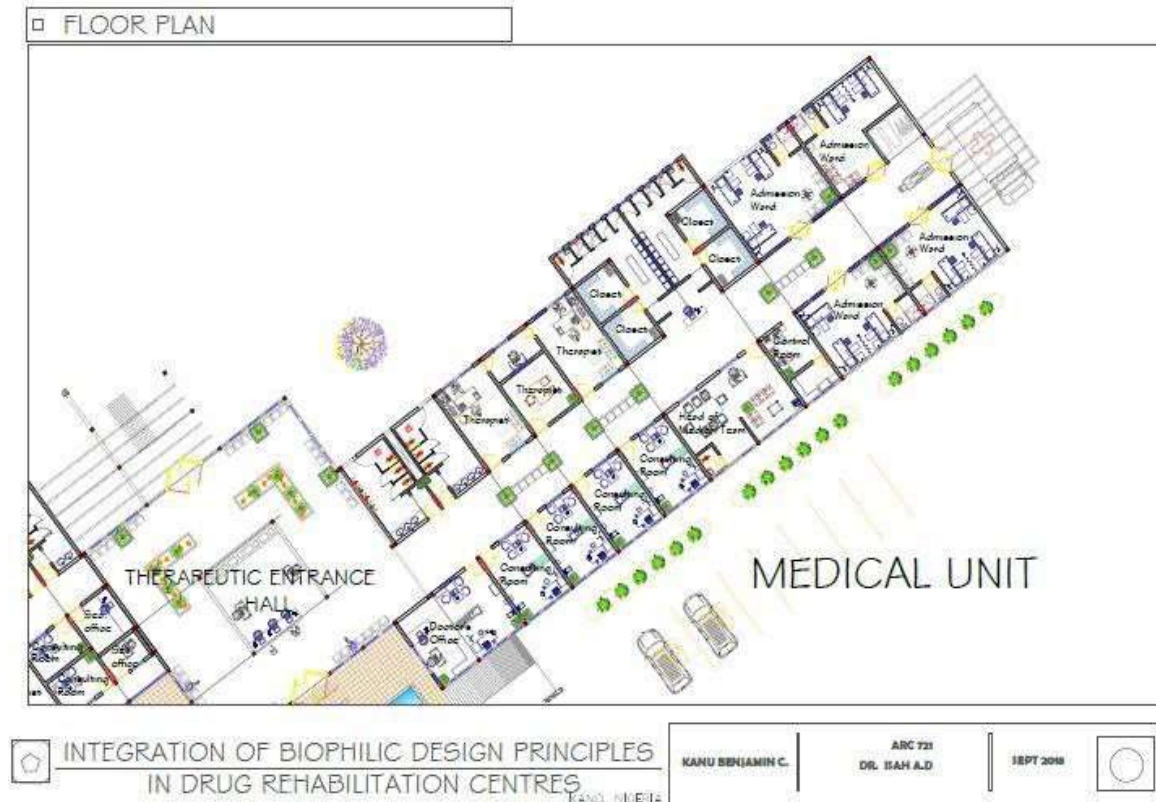




## Appendix C: Blow-Out 1 of Admin Floor Plan



## Appendix D: Blow-Out 2 of Admin Floor Plan



## Appendix E: Front and Rear Admin Elevations

### ELEVATION



### ADMINISTRATIVE BUILDING



INTEGRATION OF BIOPHILIC DESIGN PRINCIPLES IN DRUG  
DE-ADDICTION AND REHABILITATION CENTRES

KANU BENJAMIN O.

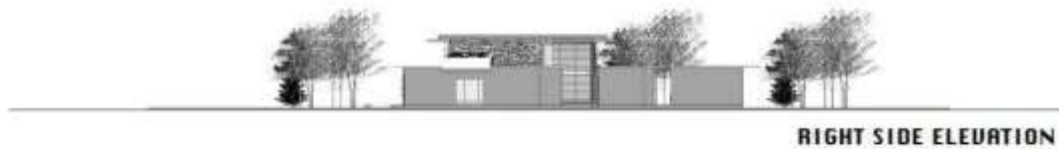
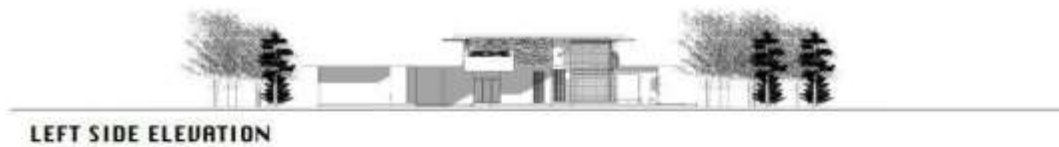
ARC 721  
DR. HAH A.D  
1:200

FEB 2018



## Appendix F: Side Admin Elevations

### ELEVATION



### ADMINISTRATIVE BUILDING



INTEGRATION OF BIOPHILIC DESIGN PRINCIPLES IN DRUG  
DE-ADDICTION AND REHABILITATION CENTRES

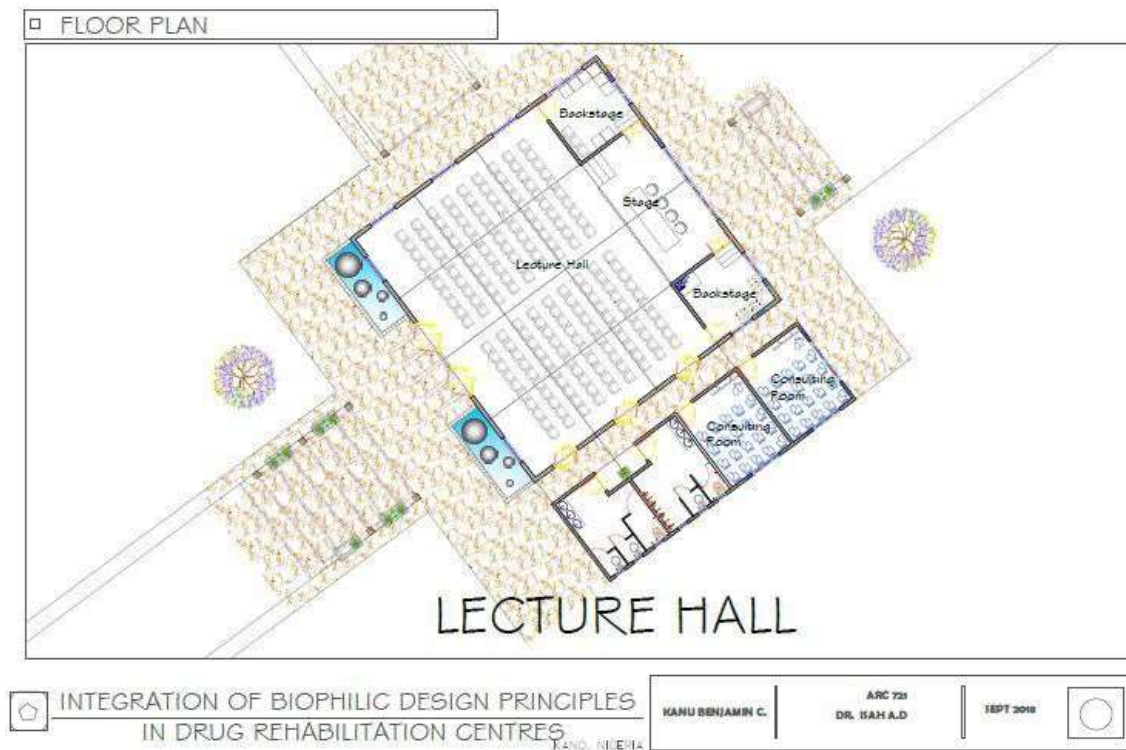
KANU BENJAMIN O.

ARC 721  
DR. HAH A.D  
1:200

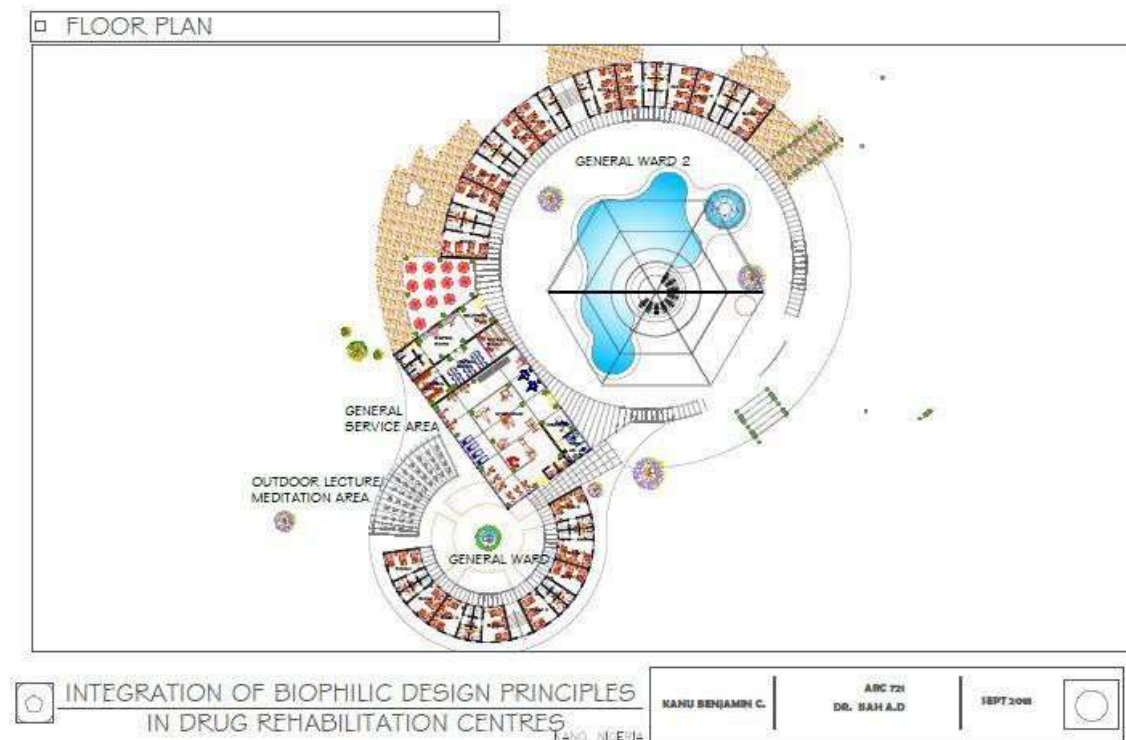
FEB 2018



## Appendix G: Lecture Hall Floor Plan

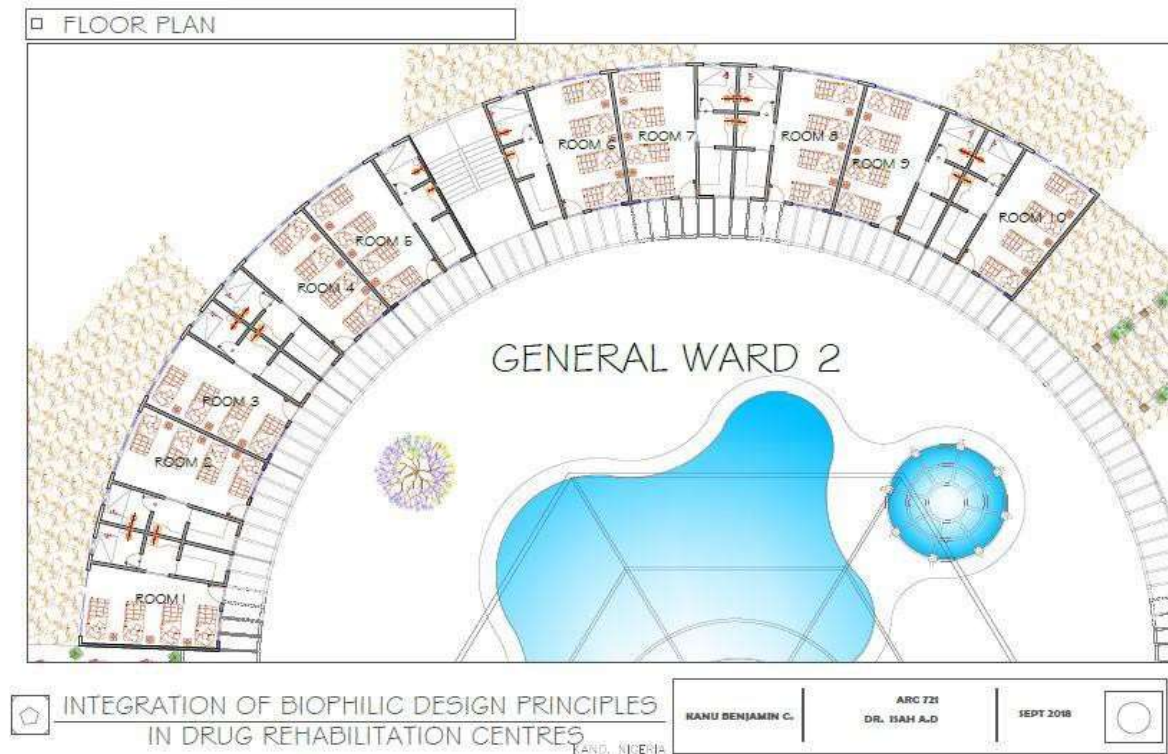


## Appendix H: Wards Floor Plan

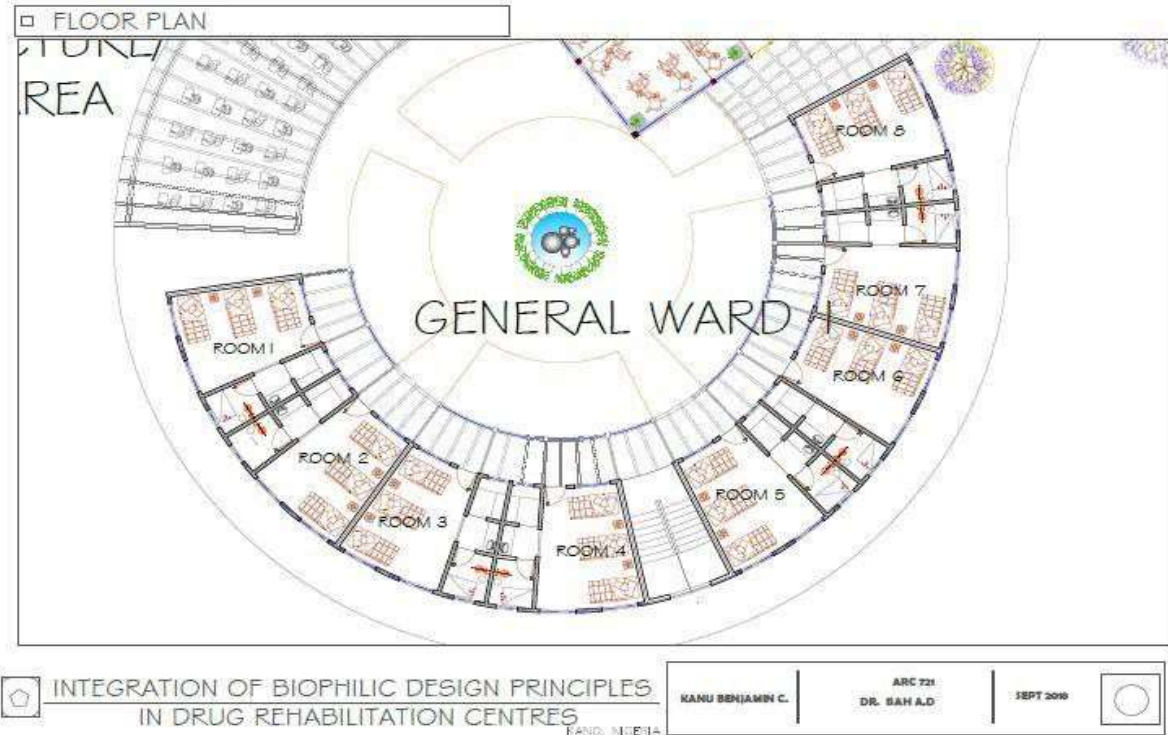




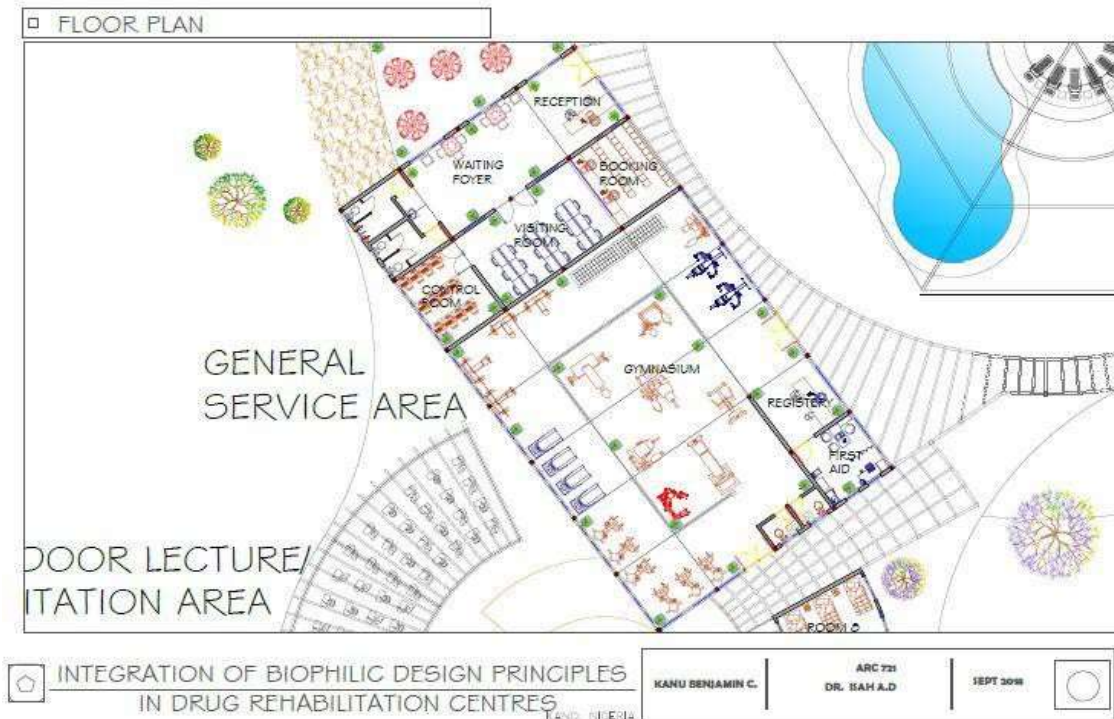
## Appendix I: General Ward 2 Floor Plan



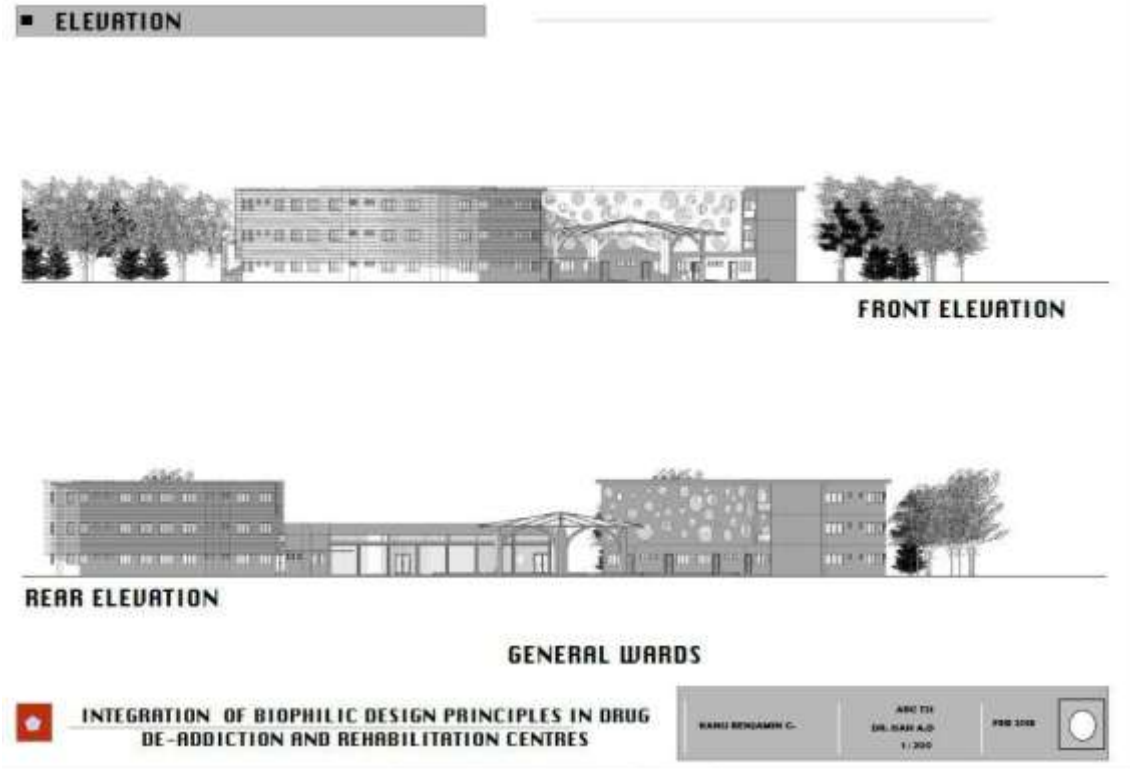
## Appendix J: General Ward 1 Floor Plan



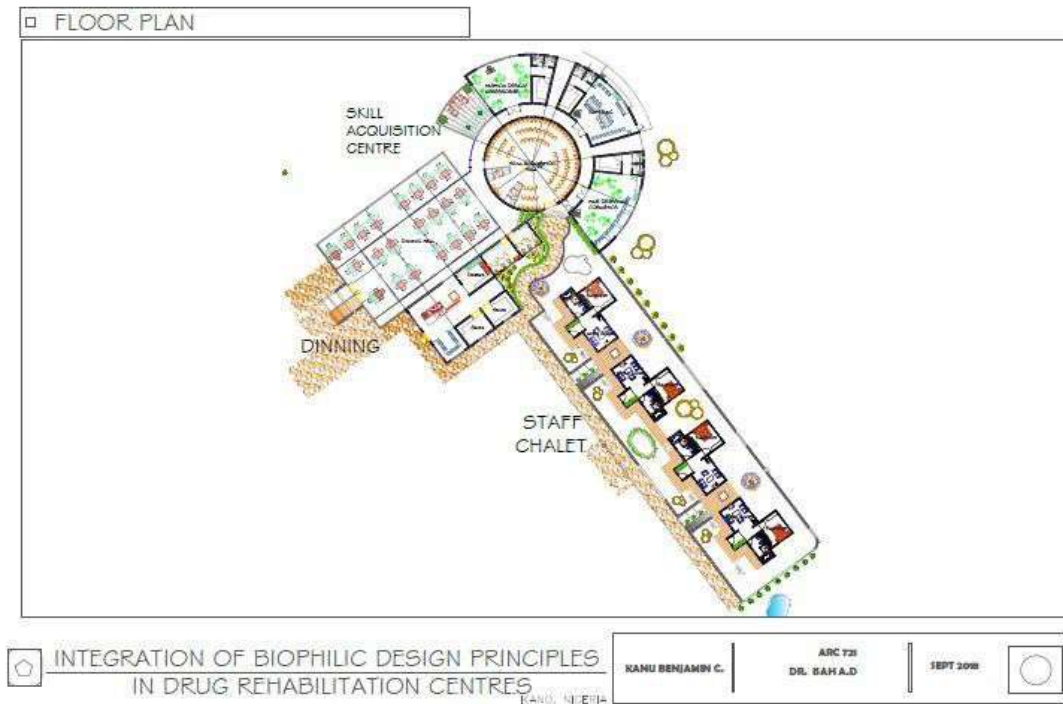
## Appendix K: General Service Area Floor Plan



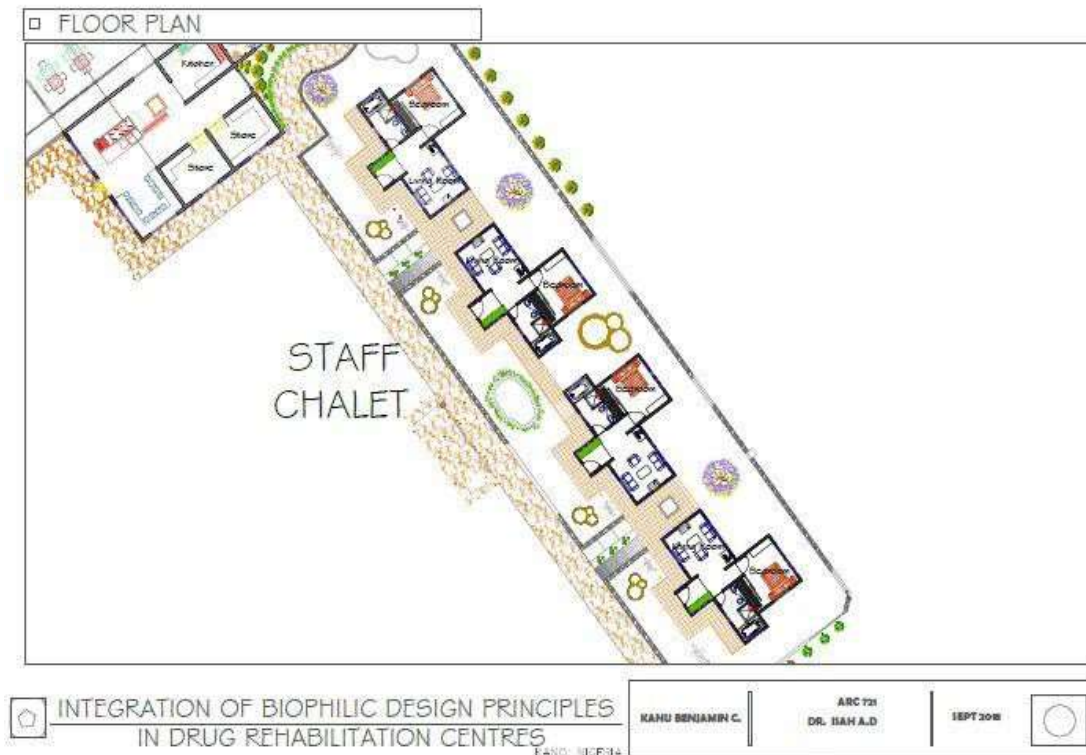
## Appendix L: General Ward Elevations



## Appendix M: Floor Plan of Skill Acquisition Centre/ Staff Chalets

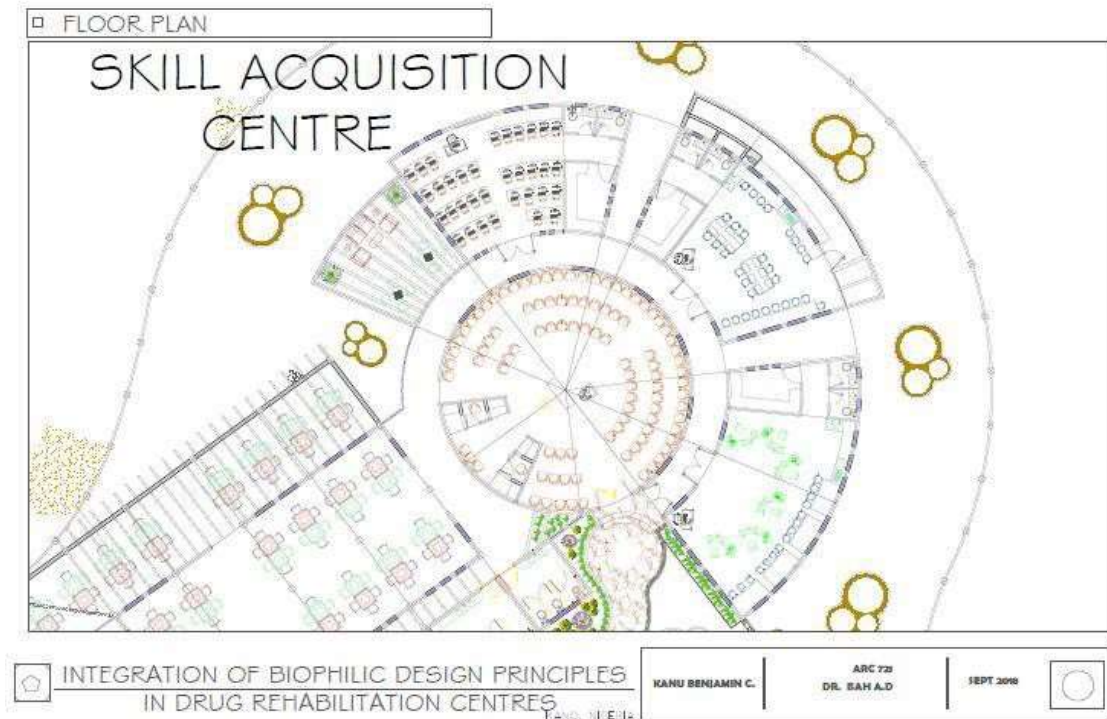


## Appendix N: Staff Chalets Floor Plan

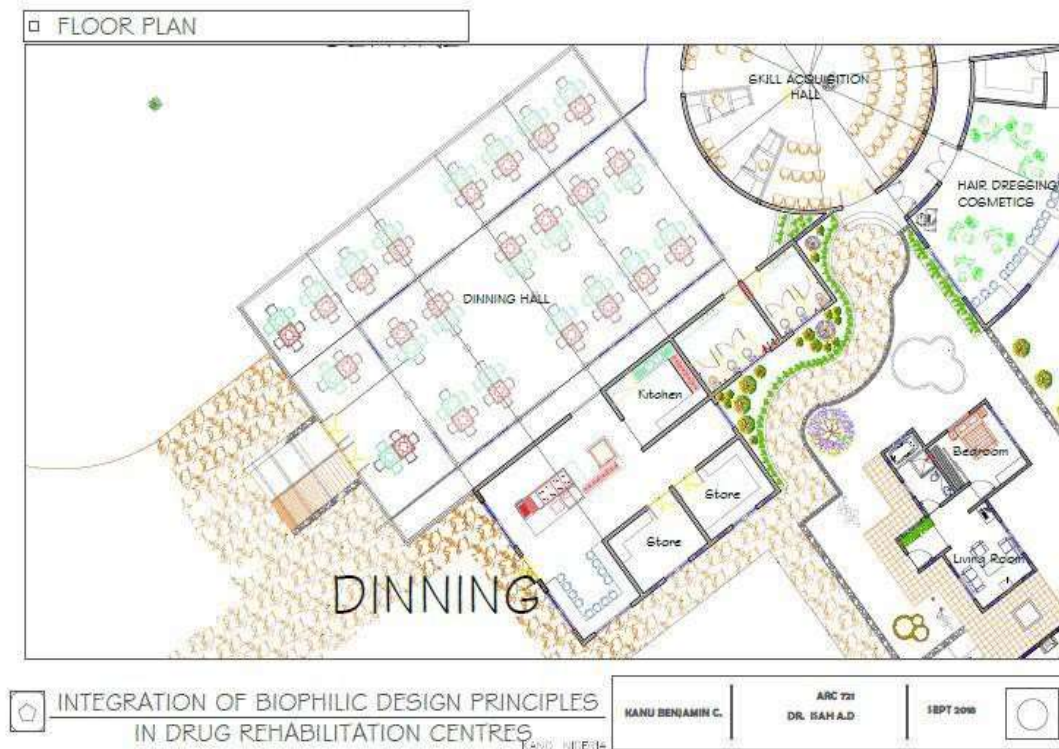




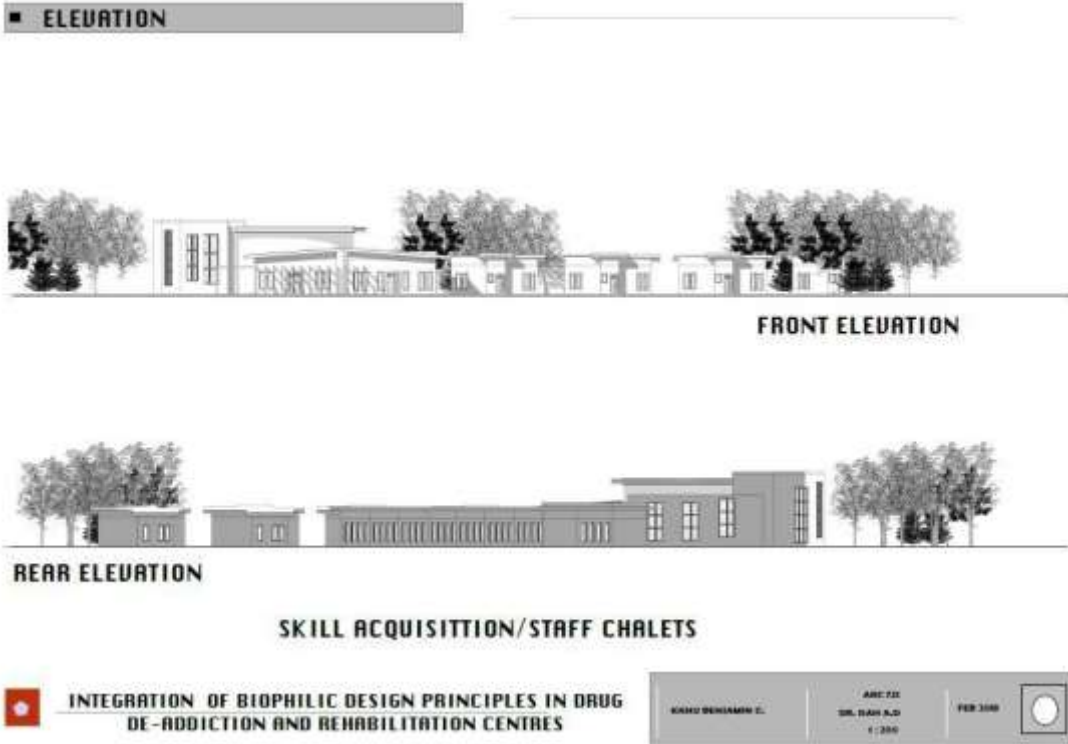
## Appendix O: Floor Plan of Skill Acquisition Centre



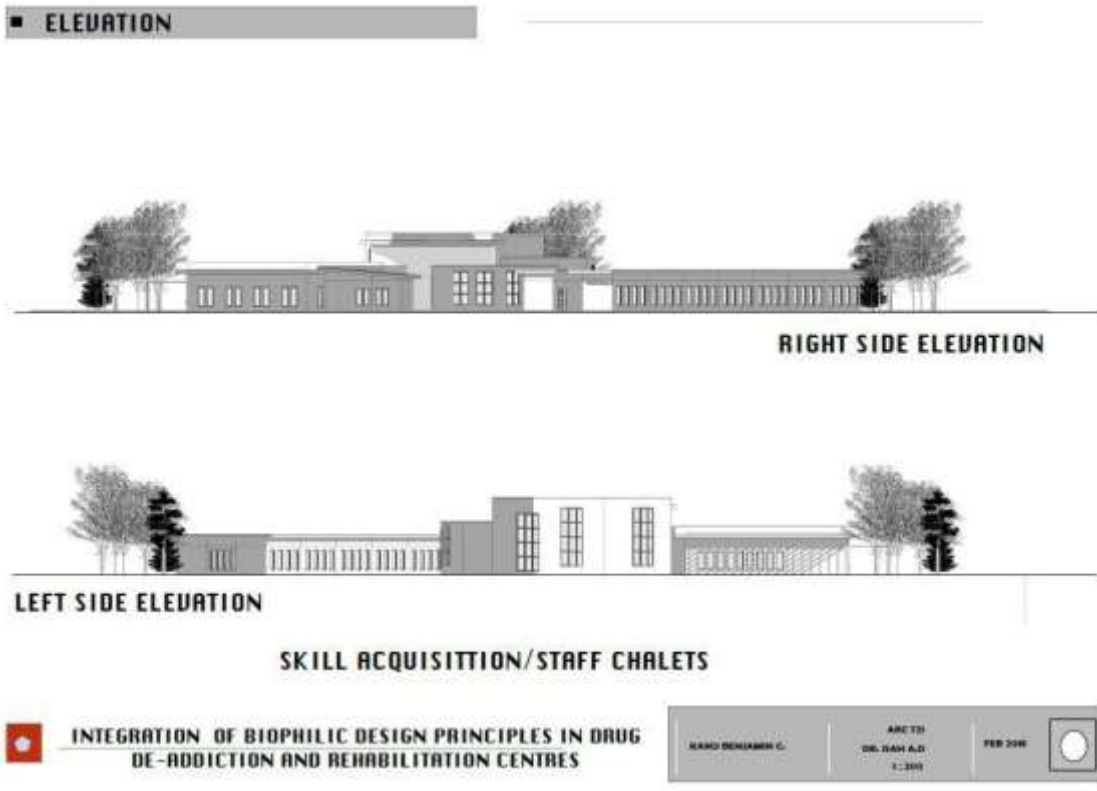
## Appendix P: Dinning Floor Plan



## Appendix Q: Elevation 1 of Skill Acquisition Centre /Staff Chalets

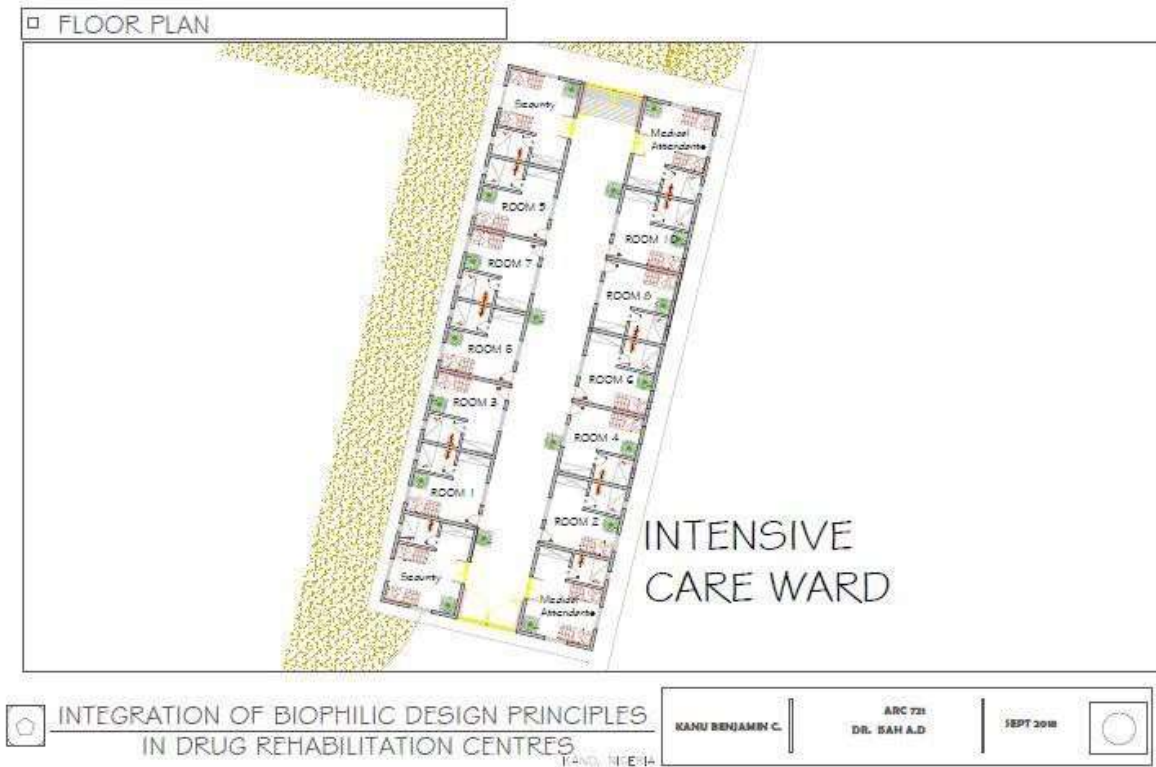


## Appendix R: Elevation 2 of Skill Acquisition Centre /Staff Chalets

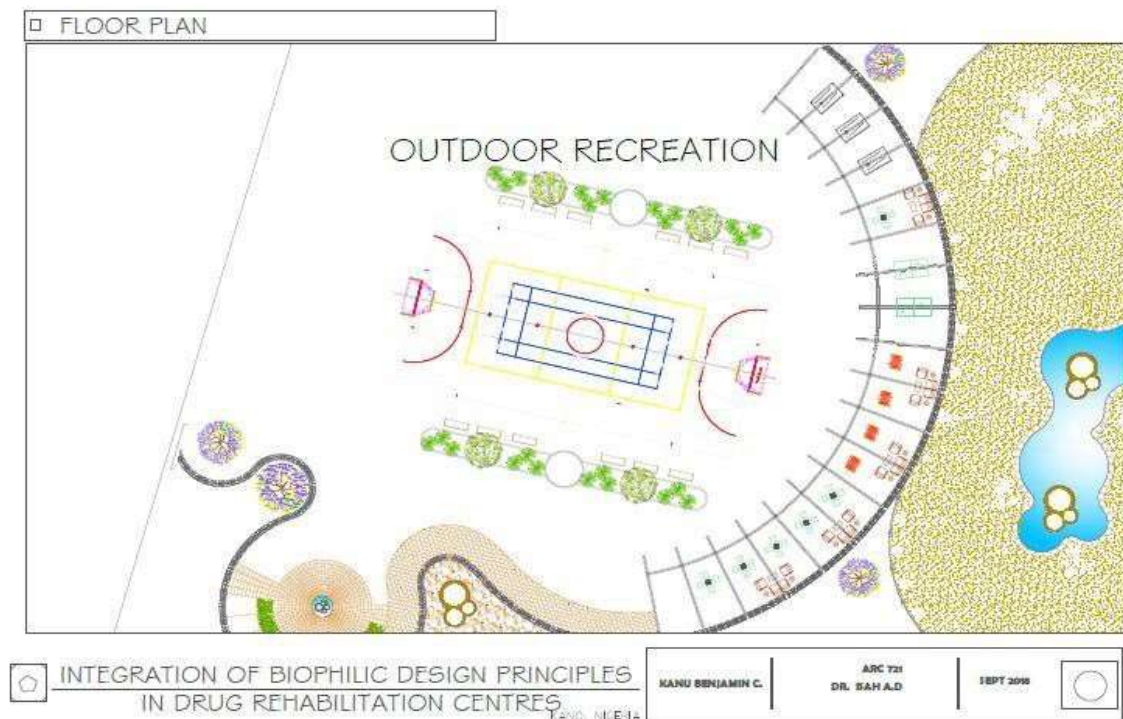




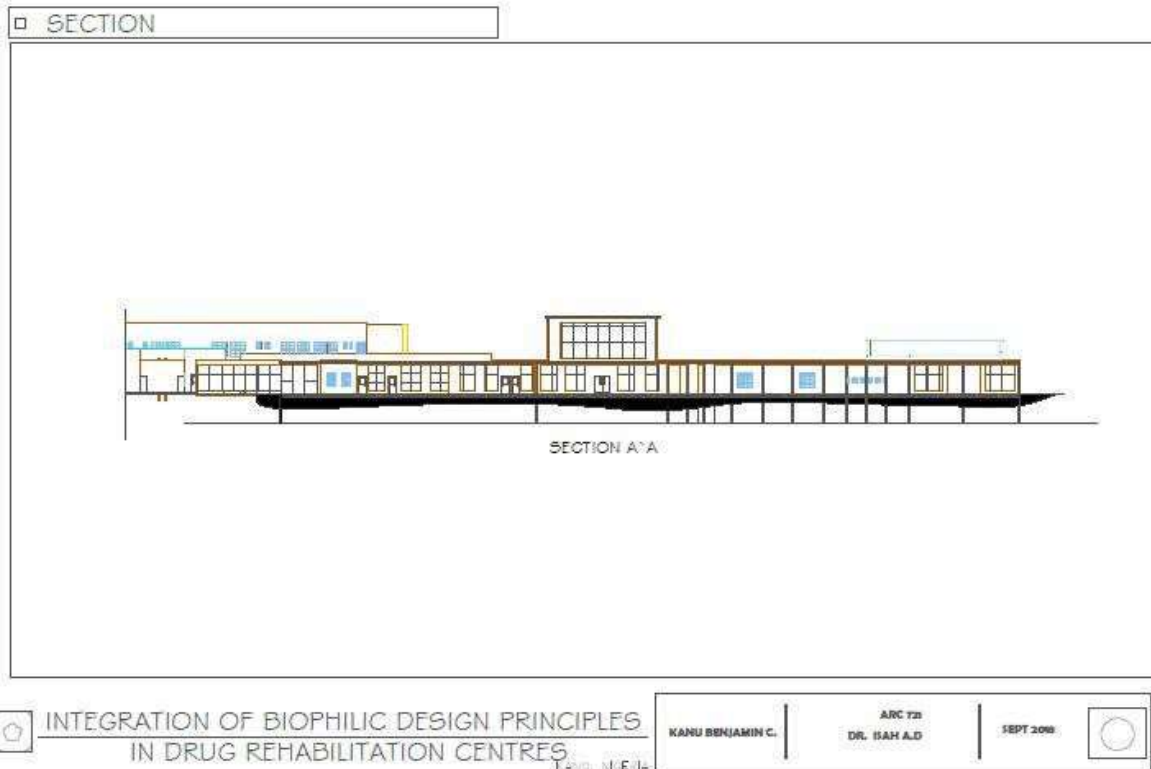
## Appendix S: Intensive Care Ward Floor Plan



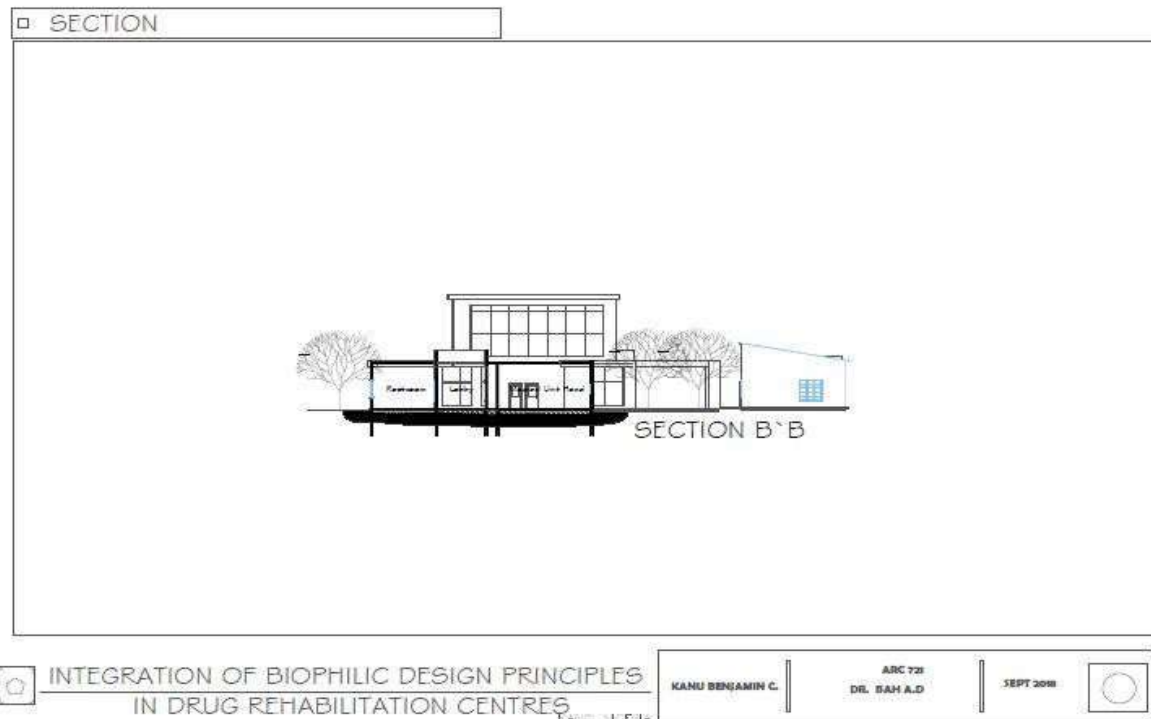
## Appendix T: Outdoor Recreation



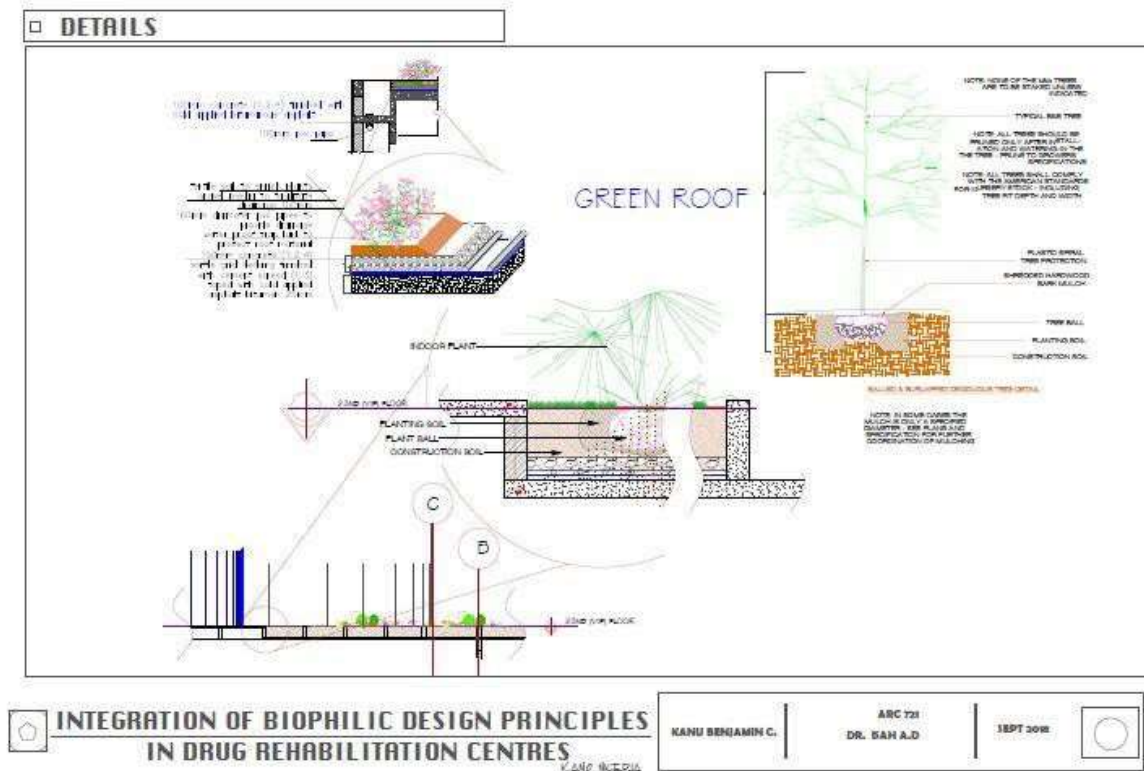
## Appendix U: Section A-A



## Appendix V: Section B-B



## Appendix W: Green Roof Details



## Appendix X: Working Drawing of Skill Acquisition Centre

