



UNIVERSITY OF NAIROBI

RUKWARO, IGNATIUS WAMBUGU

B51/34483/2019

**The research project submitted in partial fulfillment for the degree of
Master of Arts in Design of the University of Nairobi**

**INCORPORATING BIOPHILIC DESIGN IN MODERN APARTMENTS
SPACES IN KILELESHWA.**

SUPERVISOR 1: DR. SAMUEL MAINA

SUPERVISOR 2: JOYCE AKACH

Faculty of the Built Environment and Design

Department of Art and Design

University of Nairobi

August 2021

DECLARATION

The research project is my original work and has not been presented for a degree or any other award in any other University.

Author Rukwaro, Ignatius Wambugu

Signature.......... Date...2/9/2021.....

This research project has been submitted in partial fulfilment of the examination requirements with our approval as the University of Nairobi supervisors.

Supervisor 1: Dr. Samuel Maina

Signature.......... Date 2/9/2021.....

Supervisor 2: Joyce Akach

Signature.......... Date 2/9/2021.....

Director, Dr. Lilac Osanjó

Signature.......... Date 2/9/2021.....

DEDICATION

I dedicate this research to my son Adric Rukwaro, wife Elizabeth Wambugu, my parents Robert and Margaret Rukwaro, my siblings Mary Nyakiambi and Ruth Wangui, for their unrivalled support, encouragement for their comments and continuous encouragement, prayers and having faith in me throughout my studies.

ACKNOWLEDGEMENT

Above all else, I give thanks to God for blessing me with the ability and resources to pursue my course. I would want to give my earnest thanks to every individual who added the acknowledgement of this project.

I owe my sincere gratitude to my two Supervisors, Dr. Samuel Maina and Ms. Joyce Akach and teaching staff and Ph.D. students of the school of the Arts and Design for their advanced insightful help, kindness, and giving guided direction towards the realization of this research study. All the time they availed themselves when I required help. Their productive views and remarks formed the detailing of this research study.

Unique appreciation goes to my lecturers Dr. Lilac Osanjo, Collins Makunda, Dr. Michael Munene, Dr. Francesca Odundo, Dr. Betty Mwiti and Dr. Lorraine Amollo for their insightful comments, guidance and constructive criticism. Their comments believed in the fruition of this study. They gave me guidance, confidence and significant influences on this work. To all of you, your astute and informative remarks and proposals on my draft propelled and supported an enormous aspect of my last corrections and commendably improved the standard of this research project. I also extend my gratitude to all my classmates and friends who were helpful in the success of this study.

I also thank all the respondents' during the pilot and the main fieldwork study who were mainly the occupants of different Kileleshwa apartments, various design professionals for allowing me time off their busy schedules and furnishing me with all the fundamental data that empowered me complete my hands-on work quickly. Regardless of the insights and backing of the above-named people, any error(s) of omission as well as oversight remain exclusively my duty. I finally thank all those who assisted me in my study but I have not recognized them.

TABLES OF CONTENTS

1. CHAPTER: INTRODUCTION.....	16
1.1. OVERVIEW.....	16
1.2. BACKGROUND OF THE STUDY.....	16
1.3. PROBLEM STATEMENT.....	19
1.4. RESEARCH OBJECTIVES	20
1.5. RESEARCH QUESTIONS	20
1.6. JUSTIFICATION OF THE STUDY	20
1.7. SIGNIFICANCE OF THE STUDY	21
1.8. ASSUMPTIONS.....	22
1.9. SCOPE AND LIMITATIONS OF THE STUDY.....	22
1.10. DEFINITION OF TERMS.....	23
1.11. ORGANIZATION OF THE STUDY.....	24
2. CHAPTER: LITERATURE REVIEW	25
2.1. HISTORY AND ORIGINS.....	25
2.1.1. RESTORATIVE ENVIRONMENTAL DESIGN	28
2.2. PRINCIPLES OF BIOPHILIC DESIGN.....	29
2.3. SICK BUILDING SYNDROME	30
2.4. BIOPHILIC DESIGN ELEMENTS	31
2.4.1. NATURE IN THE SPACE	33
2.4.2. NATURE ANALOGUES	33
2.4.3. NATURE OF THE SPACE	34
2.5. BENEFITS OF BIOPHILIC DESIGN	35
2.5.1. KONO DESIGNS	40
2.6. USE OF BIOPHILIC DESIGN FOR MODERN APARTMENTS.....	41
2.6.1. BOSCO VERTICALE APARTMENTS.....	41
2.6.2. BOSCO VERTICALE STRUCTURAL SYSTEM.....	48
2.6.3. FREEBOOTER APARTMENTS DESIGN	52
2.6.4. 2.6.3 HALONG VILLA HANOI-VIETNAM	55
2.7. BIOPHILIC DESIGN AND POLICY	58
2.8. CONCEPTUAL FRAMEWORK.....	59
3. CHAPTER: RESEARCH METHODS.....	62
3.1. INTRODUCTION.....	62
3.2. RESEARCH DESIGN	62
3.2.1. CASE STUDY APPROACH	62

3.3. DESCRIPTION OF THE CASE STUDY	63
3.3.1. LOCATION OF STUDY.....	64
3.4. UNIT OF ANALYSIS	65
3.5. DATA SOURCES	65
3.6. SAMPLING.....	65
3.6.1. SNOW BALL SAMPLING	65
3.7. DATA COLLECTION INSTRUMENTS AND TECHNIQUES.....	67
3.7.1. QUESTIONNAIRE.....	67
3.7.2. OBSERVATIONS	68
3.7.3. PILOT STUDY	68
3.7.4. ADMINISTRATION OF THE RESEARCH	68
3.8. DATA ANALYSIS AND PRESENTATION TECHNIQUES	69
3.8.1. SYNTHESIS.....	69
3.8.2. PRESENTATION.....	69
3.9. ETHICAL CONSIDERATIONS.....	69
<u>4. CHAPTER RESULTS</u>	<u>70</u>
4.1. 4.1 OVERVIEW.....	70
4.2. 4.2 INTRODUCTION PROFESSIONALS, OCCUPANTS AND OBSERVATIONS	70
4.3. NATURE OF THE BIOPHILIC DESIGN ATTRIBUTES.....	73
4.3.1. COLOR	73
4.3.2. WATER.....	76
4.3.3. SPACE	78
4.3.4. SUNLIGHT	83
4.3.5. AIR.....	88
4.3.6. MATERIALS	90
4.3.7. LANDSCAPE	93
4.3.8. VIEWS AND VISTAS.....	105
4.4. BIOPHILIC DESIGN STRATEGIES	108
4.5. WAYS OF RESTORING THE NATURAL ENVIRONMENT.....	112
<u>5. CHAPTER: SYNTHESIS AND INTERPRETATION OF THE FINDINGS.....</u>	<u>114</u>
5.1. OVERVIEW.....	114
5.2. COLOR.....	114
5.3. WATER	114
5.4. SPACE.....	115
5.5. SUNLIGHT.....	115
5.6. LANDSCAPE.....	115
5.7. MATERIALS.....	116
5.8. AIR	116
5.9. VIEWS AND VISTAS.....	117
5.10. BIOPHILIC DESIGN STRATEGIES	117

5.11. RESTORATION118

6. CHAPTER: CONCLUSION AND RECOMMENDATIONS 119

6.1. OVERVIEW.....119

6.2. CONCLUSIONS119

6.2.1. THE NATURE OF BIOPHILIC DESIGN IN THE INTERIOR AND EXTERIOR SPACES OF MODERN APARTMENTS IN KILELESHWA WARD.119

6.2.2. BIOPHILIC DESIGN STRATEGIES THAT INFORMED IN THE APARTMENTS DESIGN IN KILELESHWA WARD FOR THE WELLBEING OF THE OCCUPANTS.....120

6.2.3 WAYS OF RESTORATION OF THE NATURAL ENVIRONMENT IN THE DESIGN OF APARTMENT’S IN KILELESHWA.....122

6.3. RECOMMENDATIONS.....123

6.3.1. COLOR123

6.3.2. WATER.....123

6.3.3. SPACE123

6.3.4. SUNLIGHT124

6.3.5. LANDSCAPE124

6.3.6. MATERIALS124

6.4. FURTHER AREAS OF RESEARCH125

7. CITED REFERENCES..... 126

8. APPENDICES 131

LIST OF TABLES

Table 4.1: Professional Respondents and Names of their Firms.....	71
Table 4.2: Occupation Respondents in different apartments in Kileleshwa Ward	72
Table 10.1: Environmental Features and their Attributes.....	132

LIST OF FIGURES

Figure 1.1: View of Apartments in Kileleshwa Ward	18
Figure 2.1: Outcomes of Mental Health in Different Environmental Settings	31
Figure 2.2: Living Wall at Hazel Wolf K-8, Seattle WA - NAC Architecture.....	36
Figure 2.3: Massachusetts General Hospital Lunder Building - NBBJ.....	36
Figure 2.4: Twitter Offices in Seattle	37
Figure 2.5: National Museum of Qatar Gift Shop.....	38
Figure 2.6: Planted Pergola – Tokyo, Japan	39
Figure 2.7: Pasona Urban Farm Office.....	41
Figure 2.8: Bosco Verticale Apartments.....	42
Figure 2.9: View of the Bosco Verticale apartments from the Porta Nuova Gardens	43
Figure 2.10: View of the Bosco Verticale complex	43
Figure 2.11: Bosco Verticale under construction.....	44
Figure 2.12: Floor plan of the Bosco Verticale apartment Tower.....	45
Figure 2.13: Detailed Chart of the Bosco Verticale façade vegetation’s features and characteristics	46
Figure 2.14: Vegetation Cover on the Bosco Verticale towers.....	46
Figure 2.15: Vegetation placement and the plant irrigation system of the western tower; and vegetation response on daylighting and ventilation in the interior spaces of the tower.	47
Figure 2.16: Sectional Detail-drawings of Bosco Verticale’s interior and outdoor spaces.....	47
Figure 2.17: Water Supply and Irrigation System for Bosco Verticale’s towers.....	48
Figure 2.18: Bosco Verticale’s detailed section showing cantilevered terraces	49
Figure 2.19: Bosco Verticale’s temporary bind	50
Figure 2.20 : Bosco Verticale’s basic bind	50
Figure 2.21: Bosco Verticale’s redundant bind.....	50
Figure 2.22: Bosco Verticale’s plant container layer membrane and plant container’s drainage system	51
Figure 2.23: Freebooter Apartments Conceptualization.....	53
Figure 2.24: Freebooter Apartments elevations and section drawings.....	54
Figure 2.25: Freebooter Apartments design.....	55
Figure 2.26: Hanoi Vietnam.....	56
Figure 2.27: Hanoi Vietnam.....	56
Figure 2.28: Ha Long Villa – Ha Long, Vietnam	57
Figure 2.29: Ha Long Villa – Ha Long, Vietnam	57
Figure 2.30: Ha Long Villa – Ha Long, Vietnam	58
Figure 2.31: Biophilic Design Conceptual Framework.....	60
Figure 2.32: Biophilic Design Conceptual Framework.....	61
Figure 3.1: Logical Framework used in the study used.....	63
Figure 3.2: Map of Kileleshwa Ward	64
Figure 3.3: Likert Response Scale.....	67
Figure 4.1: Occupant Respondents and Storey heights	72
Figure 4.2: Psychological perceptions of color on the built environment by Professionals.....	73
Figure 4.3: Relationship with the Professionals.....	74
Figure 4.4: Ramis Court apartment design	74
Figure 4.5: Peers Peak apartment design	74

Figure 4.6: Sunny Hill apartment design	75
Figure 4.7: Viraj Gardens apartment design	75
Figure 4.8: Bellway Court apartment design	75
Figure 4.9: Kaisa Gardens apartment design	75
Figure 4.10: Water Features that have been used by the professionals	76
Figure 4.11: Peers Park apartment empty swimming pool	77
Figure 4.12: Bell Crest Gardens apartment swimming pool.....	77
Figure 4.13: Ramis Court apartment swimming pool and vegetation.....	77
Figure 4.14: Ramis Court apartment swimming pool and vegetation top view.....	77
Figure 4.15: Sunny Hill apartment swimming pool space.....	77
Figure 4.16: Sunny Hill apartment swimming pool space.....	77
Figure 4.17: Transitional Space Characteristics.....	78
Figure 4.18: Reasons for lack of transitional spaces given by professionals.....	79
Figure 4.19: Types of Transitional Spaces	79
Figure 4.20: Different Biophilic design attributes.....	80
Figure 4.21: Transitional Spaces designed by the professional respondents.....	80
Figure 4.22: Elements of exterior spaces.....	81
Figure 4.23: Elements of Interior spaces	81
Figure 4.24: Ramis Court apartment lounge space	82
Figure 4.25: Viraj Gardens apartment lounge space	82
Figure 4.26: Viraj Gardens apartment lounge space	82
Figure 4.27: Ramis Court apartment decorative walls and screens	82
Figure 4.28: Kaisa Garden lounge space	82
Figure 4.29: Bellway Court apartment lounge space	82
Figure 4.30: Light Inclusivity results by professional respondents.....	83
Figure 4.31: Occupants Respondents on Internal Spaces	83
Figure 4.32: Responses on Occupants’ satisfaction on lighting of internal spaces.....	84
Figure 4.33: Occupants’ Respondents on lighting of Internal Spaces.....	84
Figure 4.34: Reasons for inadequate lighting in interior spaces reported by occupants	85
Figure 4.35: Kaisa Garden small windows	85
Figure 4.36: Kaisa Garden Bedroom Interior Space	85
Figure 4.37: BellCrest Garden staircase space.....	86
Figure 4.38: Sunny Hill apartment lounge.....	86
Figure 4.39: Bellway Court apartment corridor space.....	86
Figure 4.40: Ramis Court apartment corridor space.....	86
Figure 4.41: Bellway Court apartment staircase space.....	86
Figure 4.42: Bellway Court apartment staircase space.....	86
Figure 4.43: Ramis Court apartment interior	87
Figure 4.44: Viraj apartment interior space	87
Figure 4.45: Bell Way Court apartment space	87
Figure 4.46: Peers Peak apartment staircase space	87
Figure 4.47: Ramis Court apartment staircase space.....	87
Figure 4.48: Bellway Court apartment staircase space.....	87
Figure 4.49: Occupants responses on air quality satisfaction in internal spaces	88

Figure 4.50: Occupants responses on influence of outdoor vegetation on air quality in internal spaces	88
Figure 4.51: Occupants responses on ventilation of internal spaces	89
Figure 4.52: Reasons for inadequate ventilation in interior spaces reported by occupants.....	89
Figure 4.53: Ramis Court washroom ventilation	90
Figure 4.54: Ramis Court washroom ventilation occurring through the laundry	90
Figure 4.55: Professional response on use of indigenous material	91
Figure 4.56: Professional response on use of natural material.....	91
Figure 4.57: Kaisa Garden apartment finish	92
Figure 4.58: Ramis Court apartment interior finish	92
Figure 4.59: Sunning Hill apartment finish	92
Figure 4.60: Sunning Hill apartment finish	92
Figure 4.61: Viraj Gardens apartment finish.....	92
Figure 4.62: Bellway Court apartment finish.....	92
Figure 4.63: Lack of Consideration of the Natural Environment Results by the professional respondents.....	93
Figure 4.64: Reasons of Lack of Green Walls Results by the professional respondents	94
Figure 4.65: Occupants Response on landscape elements in the apartment space	94
Figure 4.66: Occupants Respondents awareness of landscaping elements within the apartment.....	95
Figure 4.67: Occupants Respondents awareness of landscaping elements outside the apartment	95
Figure 4.68: Occupants response on the use of landscaped spaces	96
Figure 4.69: Occupants response on satisfaction of landscaped spaces	96
Figure 4.70: Occupants Response on landscape elements in the apartment.....	97
Figure 4.71: Occupants' satisfaction of the vegetation within the apartment compound	97
Figure 4.72: Occupants' response effect of planting on their well-being.....	98
Figure 4.73: Occupants' Respondents on Internal Spaces.....	98
Figure 4.74: Ramis Court apartment landscape	99
Figure 4.75: Bellway Court apartment landscape	99
Figure 4.76: Kaisa Garden landscape	99
Figure 4.77: Peers Park apartment landscape	99
Figure 4.78: Sunning Hill apartment landscape	99
Figure 4.79: Viraj Garden apartment landscape.....	99
Figure 4.80: Peers Park apartment landscape	99
Figure 4.81: The river and forest adjacent Kaisa garden apartment.....	99
Figure 4.82: Viraj Garden apartment masonry finish.....	100
Figure 4.83: Bellway Court apartment masonry finish	100
Figure 4.84: Sunning Hill apartment hedges and concrete pathway	100
Figure 4.85: Peers Peak concrete pathway.....	100
Figure 4.86: Sunning Hill apartment Brick screens	101
Figure 4.87: Sunning Hill apartment concrete pathway	101
Figure 4.88: Sunning Hill apartment mazeras hard surface.....	101
Figure 4.89: Kaisa Garden apartment tile hard surface	101
Figure 4.90: Kaisa Garden apartment outdoor furniture.....	102
Figure 4.91: Viraj Garden apartment.....	102
Figure 4.92: Sunning Hill apartment outdoor furniture.....	102
Figure 4.93: Sunning Hill apartment swimming pool	102

Figure 4.94: Ramis Court apartment swimming pool	102
Figure 4.95: Peers Park apartment swimming pool.....	102
Figure 4.96: Bellcrest apartment swimming pool	103
Figure 4.97: Kaisa Garden children playground	103
Figure 4.98: Bellcrest apartment children playground	103
Figure 4.99: Viraj Garden apartment children playground.....	103
Figure 4.100: Ramis Court apartment children playground	103
Figure 4.101: Peers Peak apartment children playground	103
Figure 4.102: Ramis Court apartment landscape lights.....	104
Figure 4.103: Peers Peak apartment landscape lights.....	104
Figure 4.104: Sunning Hill apartment landscape lights.....	104
Figure 4.105: Peers Peak apartment drying lines	104
Figure 4.106: Bellway Court apartment drying lines	104
Figure 4.107: Sunning Hill apartment drying lines	104
Figure 4.108: Occupants’ response on the importance of vistas.....	105
Figure 4.109: Occupants’ response on the relationship between internal spaces and vistas	105
Figure 4.110: The pleasant views as reported by occupants.....	106
Figure 4.111: Bell Crest Garden apartment balcony views and vistas	106
Figure 4.112: Viraj Garden apartment views and vistas.....	106
Figure 4.113: Ramis Court apartment views and vistas	107
Figure 4.114: Ramis Court apartment views and vistas	107
Figure 4.115: Ramis Court apartment views and vistas	107
Figure 4.116: Kaisa Garden apartment views and vistas.....	107
Figure 4.117: Bell Way Court apartment views and vistas	107
Figure 4.118: Sunny Hill views and vistas	107
Figure 4.119: Occupants’ response on harmony and nature.....	108
Figure 4.120: Viraj Garden outdoor space.....	109
Figure 4.121: Bellcrest Garden swimming pool space.....	109
Figure 4.122: Ramis Court indoor outdoor.....	109
Figure 4.123: Ramis Court landscape.....	109
Figure 4.124: Ramis Court occupants in the natural environment.....	110
Figure 4.125: Ramis Court occupants in the natural environment.....	110
Figure 4.126: Ramis Court occupants in the natural environment.....	111
Figure 4.127: Ramis Court occupants in the natural environment.....	111
Figure 4.128: Ramis Court swimming pool integrated with the natural environment	111
Figure 4.129: Sunning Hills swimming pool integrated with natural material finish and vegetation.....	111
Figure 4.130: Biophilic design elements considered in restoration of natural environment for apartment design	113
Figure 6.1: Biophilic Design Model	125

APPENDICES

Appendices 8.1: Map of Kileleshwa ward in Nairobi County	131
Appendices 8.2: Biophilic Design attributes.....	132
Appendices 8.3: Questionnaire Occupants	133
Appendices 8.4 Questionnaire Professionals	141

ABBREVIATIONS

- I. **LEED**-Leadership in Energy and Environmental Design
- II. **BORAQS**- Board of Registration of Architects and Quantity Surveyors Kenya
- III. **AAK**- Architectural Association of Kenya
- IV. **BREEAM**- Building Research Establishment Environmental Assessment Method
- V. **IDAK**- Interior Design Association of Kenya
- VI. **COVID-19** -Coronavirus disease 2019
- VII. **WHO**-World Health Organization
- VIII. **SBS**- Sick Building Syndrome
- IX. **VTN**: - Vo Trong Nghia
- X. **UN**- United Nations
- XI. **UNESCO**- United Nations Educational, Scientific and Cultural Organization
- XII. **USGBC**- United States Green Building Council

Abstract

Urbanization in Kenya is growing at an extraordinary rate. Construction has become two-fold and Nairobi has expanded to additional counties as a metropolitan city. Exclusive estates like Kileleshwa, Kilimani, Lavington and Riverside have seen a construction boom in apartments. The demand for these estates is due to their proximity to the Central Business District. This is also after the deregulation of the zoning laws in 2004 and 2012 by the Nairobi County Government to allow apartments with more floors from pressure by developers. Townhouses that existed before in these areas were demolished for tall apartments to cater to the market demand for housing and the new emerging middle class in Nairobi. This massive construction boom has led to a congestion of structures in these once prestigious estates. Increased floors and apartments that take up small spaces has become the norm. Developers have tried enticing homeowners with modern designs, well-furnished modern materials and finishes but the apartments still fall short in terms of catering to the occupant's wellbeing. The apartments have small spaces are congested lacking privacy and there is an alienation from the natural environment. The objectives of the research were to examine whether biophilic design was considered in the design process for the apartment spaces in Kileleshwa ward and if not, how the existing spaces affect the wellbeing of its occupants. The researcher came up with a logical framework for the study. This would act as a guideline for collection of data and analyzing the data using knowledge of proponents of Biophilic design. A Case study research design was employed and research was mainly a qualitative study. Data was obtained through survey method by using online questionnaires, photographs and desktop review study. The location under study was Kileleshwa ward where apartment's data was gotten from the apartments, occupants and design professionals. The results of the study revealed that designers and developers had to consider new ways of integrating natural environments in the existing apartments in Kileleshwa ward, maintenance of the natural features and considerations of the wellbeing of the occupants should always be at the center front of the design of an apartment space. The research also established the developers had to create new marketing and business strategies in terms of what they were offering occupants by having a selling point of the occupant's welfare in mind and using the features of the natural environment. The findings established that biophilic design was partially used in some of the apartments while in some spaces and it was non-existent due to inadequate space to execute, lack of funds, design restrictions by the client and a conservative design approach by the designers. The biophilic attributes needed maintenance and occupants complained of noise and dust pollution, small spaces, lack of privacy, poor external views and lack of proper natural day lighting entering their interior spaces. The study findings noted that the poorly maintained external spaces were rarely in use and a majority of the occupants noted that the natural environment was decreasing around their neighborhoods. The findings from the professions revealed that knowledge of biophilic design was inadequately informed to different players. These were clients, developers and other professionals. The study recommended designers to take responsibility and make bigger positive impact by designing buildings incorporating the natural environment, for a healthier fulfilling life for the occupants. There should be an awareness on biophilic design knowledge and its positive environmental impact on the well-being of housing occupants. Green spaces, water features and indoor landscaping should be well maintained by apartment owners during the restoration of the natural environment.

1.Chapter: Introduction

1.1. Overview

This chapter looks at the background information of the study. The researcher formulates the problem statement, the main and specific objectives and the main specific research questions. The researcher also looks at the justification and significance of this study to its surrounding community. Lastly, the researcher identifies the scope and limitations of the study and definition of terms for the study.

1.2. Background of the study

The World meter (2020), forecasts that 6.6 billion, 68% of the world population, will be in urban spaces in 2050. Kellert (2005) reveals for the last 50 years, the world has experienced the biggest urbanization shift with hundreds of millions of people moving to urban areas especially in developing and developed countries. This has led in the extraction of vast resources for urban areas to cater for the infrastructure growth in the production of raw materials. Large environments and habitats have been converted to cater urban settings for this infrastructure growth. Kellert (2005) establishes that presently metropolitan environments in their current state are destructive to the natural environment and have adverse destructive effects. Kellert observes that urban spaces are responsible for releasing up to 33% of water, noise and air pollution and majority of the non-biodegradable waste. He adds these urban centers exhaust almost 40% of energy resources and close to 50% of the natural resources from the natural world reserves. This is inclusive of fresh water. Kellert notes that the precarious condition we have put ourselves in is due to our disregard for the natural environment and upholding a negative mentality of associating nature with illiteracy, ignorance and unsophistication. Kellert challenges our notion of infrastructure development and technological progress by challenging our idea of modern civilization. Kellert believes the feats we have achieved lead to forfeiting considerable amount of the natural environment and its resources for raw materials to fuel our technological advancement and sustaining urban development. This has led to diminishing natural resource reserves, generating vast amount of harmful non-biodegradable waste that harm our ecosystem biodiversity natural habitats and endanger species and our future existence as well. This should not be the case. Kellert (2015) believes current societies are misled in the understanding of civilization and urbanization as exploitation of the natural environments and ecosystems is synonymous to advancement and human progress. Human beings have struggled to maintain the link to their natural environment especially after modernization and migration to urban settings creating a vacuum between human beings and nature. Our connection to the natural world is likely to

diminish if we do not interact with nature repeatedly as we must engage with nature repeatedly in order to continue to enhance it. This is evidently so especially in developing countries in East Africa, Kenya.

According to Fengler (2010) Africa as a whole is growing and developing at a fast pace. The World Bank Development Report for 2009 “Reshaping Economic Geography” discovered that almost all African states were experiencing progressive growth. The report noted that by 2050 Africa’s population would surpass 1 billion people to 2 billion people and continue experiencing progressive growth. These results draw parallels to high urbanization that is high rural to urban migration and high urban densities around Africa’s major cities, which was visibly similar in developed countries. Fengler notes that this was considered a positive observation as urban centers led to an increase in job creations by young people and an increase in innovation and exchange of ideas in urban centers due to people interacting. (Fengler, 2010).

In Kenya by 2050, the population will have grown to 91 million people and 48% of the population will be in urban spaces. As it is right now 14 million Kenyans, 27% of the total population stay in urban spaces (Worldometer, 2020). The World meter website (2020) projects that the Kenyan population would increase by 1 million people every year with recording an increase of 3000 people daily for the next four decades. The United Nations projections indicate that in half a century (year 2050) Kenya’s population will have grown to 85 million people. The basis of this population growth is determined to be an increase in fertility rates among the Kenyan population due to an increase in families and higher life expectancy due to improvements in the standard of living and healthcare. The life expectancy was projected to improve from 54 years to 68 years in the next half of the century. The dependency ratio was also projected to have a positive trajectory as the proportion of the employed-age population would increase at an exponential rate than the dependents portion of the population, this being the young and the elderly. (Fengler, 2010).

This economic development is in sharp contrast to the present state of the natural world. There has been migration and construction of flats and apartments in and around Nairobi environs to cater to the yet developed house security in the city. The Kenyan government has also come up with the Affordable housing plan, which is in its Big Four Agenda of housing, manufacturing food security and health care. The Kenyan government’s plan is to be able to provide cheap and affordable housing to low-income Kenyans in urban populations. This is on track with global developments as majority of urban areas around the world increase due to massive rural to urban migration. According to the Kenya Vision 2030 Website (2021) in 2008, the Kenyan Government launched the inception of Kenya Vision 2030. This was a development plan spanning the next 22 years, which its foremost

objectives were; to transform Kenya into an industrial and manufacturing hub with modernized infrastructure systems, a comprehensive technologically advanced affordable health care system, modern expansive affordable housing infrastructure and food security. This is to be regarded as the “Big Four” Agenda. The government believes these changes would translate to positive impact to the country’s economy, uplift the country middle class and improve the overall standard of living. The vision was established through studying, observing, analyzing and reviewing the Kenyan population and consultations from key stakeholders from all over the country (Vision2030, 2021).

Nairobi County is the capital of Kenya. It acts as a metropolitan hub. Presently there has been an increase in development in Nairobi Kileleshwa ward. This is due to an increase in population of middle level earning income households looking for residential spaces near the city. This has resulted in developers taking advantage of this creating a construction boom in these areas mainly; Kileleshwa, Lavington and Kilimani. Increase in urban population translates into destruction of the natural environment to allow more land for urban centers. This makes urban settings lack any features of the natural environment conducive for our wellbeing and creates a stark difference between the natural world and urban centers. The interior and exterior spaces in some of these apartments have little to any contact with natural elements and if they are present, it is only the bare minimum that is achieved. This also extends to interior spaces in these apartments. The designers do not take in consideration the natural environment and fail to merge the natural ecosystems into their designs to create spaces that still maintain the natural systems of the environment for the wellbeing for the user. Tenants are exposed to bare masonry walls and unpleasant sites of walls and columns distancing the users of these spaces from nature. This has made also people living in urban spaces isolated from natural elements as they are absent in their surroundings (**Figure 1**).



Figure 1.1: View of Apartments in Kileleshwa Ward
Source: (Rotich, 2020)

1.3. Problem statement

The natural environments are good for the wellbeing and mental development for human beings. Successful Biophilic design facilitate the much-needed connection between individuals and the natural environment creating healthier human beings with a sense of community who have satisfying relationships. However, design of the modern apartments in Kileleshwa ward, reveals a rampant culture of designing and building spaces that lack any contact what so ever with the natural environment and its features and processes. Most of this modern apartment designs lack sufficient natural light and ventilation, natural materials, scenic natural vistas, natural environment inspired shapes and forms, and other features of the natural world. Additionally, the lack of an imaginative interchange of natural lighting, spaciousness, plants, and water leads to a cold non-stimulating habitable space that dot enhance our affinity for the natural environment and do not satisfy our mental wellbeing. The natural environments are decreasing due to urbanization and exploitation of natural resources. This has led to loss of the natural indigenous habitats to create room for urban spaces. These outcomes are evident in the vast amounts of pollution in the air and water, destroyed natural surroundings, destruction of natural habitats and natural resource being diminished. Further, most of these urban high-rise buildings lack greenery spaces and interiors that accommodate them. The occupants within these apartments have to struggle because their interior spaces are surrounded by masonry and concrete walls and are cluttered. The apartment's interior and exterior spaces within urban areas lack an integration with the local natural environments. This is evident in a design perspective of the buildings and the spaces within. The fabricated environments which are made of concrete, have brought many conveniences but at a cost of mental health and wellbeing. This inclination to manmade environment has also caused adverse effects on our emotional, intellectual, and moral advancement. This is especially widespread in urban areas. biophilic design success is determined by the proper implementation and abiding to its fundamental principles. Thus, this study investigates how the concept of biophilia and re-establishing how nature and the built environment can be integrated to serve human beings in their environment by implementing the principles correctly.

1.4. Research objectives

The main objective of this study focuses on how biophilic design integrates into the urban apartment's interior and exterior spaces. The objectives of the study are;

- i. To examine the nature of biophilic design in the interior and exterior spaces of modern apartments in Kileleshwa ward.
- ii. To determine the biophilic design strategies that informed in the apartments design in Kileleshwa ward for the wellbeing of the occupants.
- iii. To propose ways of restoring the natural environment in the design of apartments in Kileleshwa ward.

1.5. Research questions

- i. How has biophilic design been integrated into the urban apartment's interior and exterior spaces? The research questions that have guided the study are;
- ii. What is the nature of biophilic design in the interior and exterior spaces of modern apartments in Kileleshwa ward?
- iii. What are the biophilic design strategies that informed in the apartments design in Kileleshwa ward for the wellbeing of the occupants?
- iv. What are the ways of restoring the natural environment in the design of apartments in Kileleshwa ward?

1.6. Justification of the study

As the world continues to urbanize vast amounts of pollution land exploitation and environmental damage continues to escalate. 70% of the world's emissions are from urban spaces towns and cities. This is due modern forms of plastic products, transports, cars, air travel, and high concentration of fine particles due to construction of infrastructure. Large natural habitats near cities have also been converted to dwelling spaces for urbanites as their population grows. (Gonçalves, 2018). There is growing concern in environmental degradation in urban spaces. Numerous efforts by scholars and professionals in the built environment have promoted the use of biophilic design in the built environment in a way to integrate natural systems with the built environment (Frost, 2020).

Biophilic design not only helps in countering environmental degradation but also reconnects urban dwellers with nature as it was in the early times. It helps in integrating urban environments with the natural ecosystem forming a symbiotic relationship between the built environment and nature. This promotes sustainable development in

urban spaces while still countering global warming and pollution and the unhealthy living standards of urban spaces. This is also due to the positive impact the natural environment has on our mental state and wellbeing that have been empirically proven (Wolfs, 2015). The biophilia concept by Kellert, 2005 establishes that it is in human beings' genetic tendencies to value nature, which affects our human physical, material, emotional, intellectual, and moral well-being. Due to this, it is in human beings' deep connection with nature to conserve it and find ways to collaborate with natural environment for our future is dependent on it.

1.7. Significance of the study

Biophilic design and its proponents state that its effects are greater than green design. Its ability to solve pollution problems by reducing the carbon foot print and, in particular, are great at reducing air pollutants. Frost (2020) notes that biophilic design can reduce noise and air pollution caused by traffic jams in urban spaces. Frost adds that psychological and mental wellbeing of human beings are catered for when using biophilic design in interior spaces for hospitals and homes for the elderly. This is significant for global health as these spaces facilitate in diminishing probability of life-style diseases, stress and other avoidable health complications. Almusaed (2006) establishes the importance of vegetation elements in our urban environment. They enrich our air by minimizing air pollution through filtering of dust particles, retain rainwater, and help in regulating temperatures areas by cooling spaces and acting as a buffer in shading spaces for the harsh sun.

The content of this study is based on many disciplines encompassing; interior design, landscape architecture, biology, evolutionary biology and psychologists, eco psychology, environmental psychology, cognitive archeology, physiology, neuroscience and general field of medicine, urban planning and architecture. Leading built environment consultants have taken to collaborating with psychologists, meteorologists, engineers, material scientists and biologists in expanding their scientific knowledge in biophilic design. This results in a greater understanding of the natural systems and higher levels of sustainability in our built environment. This integration of different scientific areas of knowledge will allow designers to be able to understand our natural environment. The study shows us how to form better symbiotic relationships with them with the buildings and urban spaces that we build helping us solve the modern ecological issues.

1.8. Assumptions

The assumption of the study is that designers place the clients' needs in the design of these interior spaces when designing them. Additionally, the designers are aware of biophilic design and its importance to the wellbeing of the user. Lastly is that architects, interior designers and urban planners in their designs are motivated in developing better built environments for their users which are sustainable and environmentally friendly and have a high positive impact for the natural environment. Another assumption is that availability of biophilic design principles or lack thereof have an effect on the tenants' wellbeing in the apartments under the study.

1.9. Scope and limitations of the study

The scope of the case study is within Kileleshwa ward. The limitations of the study include; time, finances, COVID-19 pandemic, privacy concerns by apartment occupants in the area of study, availability of literature review material, accessibility to data of apartments and integrity of the research subjects. In order to be able to undertake the study the limitations will be overcome through different ways. Proper planning and budgeting in terms of finances and conducting of pilot study to assess the variables being studied. The COVID-19 protocols set by Kenya's Ministry of Health shall be followed during the undertaking of principal researcher and assistant researchers. The researcher also has invested installation of an internet network to have access on vast online sources of literature and data. Lastly, the researcher will acquire an introduction letter from the School of the Arts and Design to show credibility of and ethical practices in the study.

1.10. Definition of terms

Biophilic Design: This is a design that aspires to rekindle and enhance the link human beings have with the natural environment by integrating features and processes of the natural world into an urban setting.

Urbanization: This is the gradual observed movement of people from a rural setting to an urban setting

Apartments: This is a housing space or property with all the necessary domestic amenities serving its occupant that occupies a building's floor level as an individual unit.

Interior Landscaping: This is the skill of setting up and maintaining outdoor spaces in both urban and natural environments using natural occurring and synthetic elements to create conducive functional aesthetically pleasing environmentally friendly outdoor spaces.

Wellbeing: This is a pleasant feeling felt by human beings indicating ones mental, emotional, psychological stability and one is satisfied with his or her life and looks forward to a purposeful future.

Sustainability: This is the prevention of diminishing the world's natural resources with the aim of achieving equilibrium in the environment to guarantee safety for the natural habitats and ecosystems.

Natural Environments: This are the spaces occupied by; organisms, different animal and plant species, innate non-living things, human beings and human made surroundings and their experiences and processes as they exist on planet Earth.

Built Environments: The built environment is a terminology used to refers to the environment made by human beings to serve as a functional space where they can partake in their day-to-day activities e.g., roads, schools, office buildings and shopping centers

1.11. Organization of the Study

The study is organized into six chapters. Chapter 1 is the Introduction of the study. The chapter identifies the background of the study and problem statement. The chapter formulates the research questions and objectives, justification and significance of the study, assumptions, scopes and limitations and definitions of terms. Chapter 2 describes the general literature and formulates conceptual framework. Chapter 3 is the research methods. This chapter outlines the methodology of this study, the research design that was used by the researcher to investigate the problem in the field. Chapter 4 outlines the results obtained in the fieldwork of the study. Chapter 5 synthesis and interprets the results of the findings. Chapter 6 establishes the conclusion of the study and formulates recommendations of the study. Lastly, there are references and appendices. The appendices contain the questionnaires, maps of case study, and additional information on biophilic design attributes inform of tables.

2. Chapter: Literature Review

The literature is reviewed closely following the following thematic areas;

- i. History and origins of biophilic design
- ii. The principles of biophilic design/ positive restorative environments
- iii. Sick Building Syndrome
- iv. Biophilic design elements
- v. Use of biophilic design for modern apartments
- vi. Biophilic design and policy

2.1. History and Origins

According to Kellert, Heerwagen, & Mador, (2013) “biophilia” is derived from two Greek words “bio” and “philia” which mean life and affinity respectively. The practice of biophilic design has its beginnings from ancient time where inspirations of designs were borrowed from nature. The design philosophy tries to bridge our urban environments with nature by using natural elements in our construction and finishes and taking advantage of natural resources as sunlight in terms of lighting (Koruarchitects, 2021). American social psychologist born in Germany, Erich Fromm was the first author to coin the term “Biophilia” in one of his many authored books, *The Heart of Man* (1964). In the book he states; “I believe that the man choosing progress can find a new unity through the development of all his human forces, which are produced in three orientations. These can be presented separately or together: biophilia, love for humanity and nature, and independence and freedom.” (Kellert et al. 2015).

(Wilson, 1984) was a proponent of biophilia. He described “biophilia” as a predisposed natural condition of human beings to be attracted to the processes and phenomenon occurring in nature that is inherent in us due to our adaptation and evolutionary processes that had an effect on the hominids, our descendants while in nature. He was of the view that the connection human beings had acquired because of evolution, adaptation in the natural environment was solely for survival, and we adapted to have an affinity to our surrounding environments. These evolutionary traits were passed along our species making as with time be linked to the natural environment unknowingly. Kellert (2015) credits our need of affiliation to the natural environment contributes to our physical mental health fitness and wellbeing. This is expected as we as human beings have spent 99%, the better part of our documented history adapting and evolving to the natural environment and have only recently started

inhabiting built environments recently. This phenomenon resulted in us being accustomed to the natural world. Nature has become part of us our social systems, socialization, expressions, interpretation of our day-to-day lives.

Ulrich (1991) supports this theory and adds that due to our invested connection with nature as part of our evolutionary process, this has led to us having an overwhelming positive response when human beings are exposed to different attributes of the natural environment. This is also emphasized by Ulrich (1977) as the reason for our positive response is that we identify more with the natural world due to our continuous experiences and interactions with it during our evolutionary process identifying what is useful safe due to our ability to predict different natural patterns and processes present, which intrigue us. Kellert and Finnegan reveal that our physical health, mental development and emotions have developed while having adapted to the natural environment (Kellert and Finnegan 2011). Maggio (2020) point out that biophilic design aims at harmonizing the natural world with the architectural designed environment in order to forge better healthy living spaces, which have a positive influence to the wellbeing of our lives. (Nota, Marian, Callegari, Berto, & Barbiero, 2017) Theorize that due to the adaptive process, we have experienced as human beings in the natural world, our psychological physiological wellbeing is overwhelmingly dictated by the presence of a natural environment, as we perceive the natural world as full of growth and continuous change. Not only does the natural environment give us a feeling of well-being and but also supports it. Nota, Marian, Callegari, Berto, & Barbiero accentuate that for biophilic design to be initiated a connection should be established between a person and the environment natural they are presently in or near them. Biophilic design takes advantage of this connection we have with the natural world and is creatively applied to the spaces we spend majority of our lives in where we earn a living, grow, socialize, interact and commune.

This similar to Kellert and Calabrese (2015) definition of the biophilic design framework. They posit that our love and predisposed need is to interact with the natural world is dictated by genetics and adaption of the natural environment. As a result, we have come to perceive the natural environment has a beneficial influence to our health and well-being. Kellert and Calabrese underscore that the biophilic design framework should act as a road map in outlining the most sustainable and non-destructive way to creatively design for the built environment spaces while still considering the surrounding natural environment. Vivian Loftens in an Interview with Nicolas Kemper (2018) believes that Biophilic design has three important functionalities. She outlines them as; sustainability, regenerative and resiliency. The design should be a sustainable design not depleting the earth of natural materials. It should be a regenerative design able to regenerate the forested areas we have used up. Lastly,

it should be a resilient design able to offer resiliency protecting human beings from the damages of climate change and rising sea levels (Kemper, 2018).

Kellert and Calabrese illustrate that biophilic design occurs in two levels; the macro and micro-level. The macro level focuses on large-scale urban designs e.g.; cities townships and community estates. The macro level is achieved by integrating the surrounding natural environment in the urban plan while the micro level focuses on the spaces enclosures where individuals reside. At the micro level, a duality has to occur between the interior spaces and the surrounding natural environment to facilitate the connection with the user of the space. Kellert and Calabrese further illustrate add that the micro levels serve to the psychological hurdles present in the urban setting. They alleviate the stresses and issues of the hustle and bustle of urban living lifestyle by expediting our predisposed innate desire for connection with nature. This is achieved by creating a conducive interior space that are integrated into the natural environment to offer rejuvenation and positive influence on the psychological health and wellbeing of an individual. Integrating the natural environment features into these urban living spaces rather than using artificial means to create these favorable environments for the user of the space cut the costs and enhancing the outcomes within the built environment (Kahveci & Goker, 2020).

Kellert (2005) laments that this connection is deteriorating at unprecedented rate. He further adds that we are destroying the natural environment with our urban sprawl expansions. This in turn has led to devastating ecological damage of our natural environment including; cataclysmic events due to global warming, mass extinction of species and endangered animals, food shortages, desertification of regions in the world due to deforestation, destruction of world catchment areas and forests; Amazon and the Congo Forest through illegal logging and resources exploitation. Kellert warns that when the connection to the natural environment is severed with time, we lose meaning of it and become indifferent towards the natural world. He reveals that due to our conditioning of living in the built environment in urban spaces and disregard of the natural environment a majority of us are losing its value. This has also led to a raise in poor mental health among urban dwellers from isolation from sunlight, noise, water and air pollution, congestion, depressive working and living conditions. We only see the natural world as a resource to exploit. Kellert stresses that at childhood is when human beings have an essential experience of nature for human physical and mental maturation. He emphasizes that children should interact with nature constantly in order to understand its value to human beings and also for better developmental growth in all facets of our well-being; intellectually, emotionally, spiritually, psychologically and mentally.

2.1.1. Restorative environmental design

Kellert (2005) believes designers have not made major efforts to facilitate the connection we have with natural environments in the built environment. He acknowledges that the adoption of green design is impactful but not as impactful as adopting biophilic design. He is of the view that that green design is a half measure only meant to protect various ecosystems and habitats to endure our exploitation. The green design objectives include; use of passive energy design systems, implementation of renewable energy in designs, regulating resources mining, recycling and reusing non-biodegradable manufactured products, reducing waste and all house pollution, using of non –toxic materials and maintaining natural indoor environmental quality habitats and reducing reduction of biodiversity. Kellert defines these objectives as low environmental impact design. Kellert challenges green design and believes that in as much as it tries to mitigate the catastrophic environmental damage, we have brought on ourselves it still does not bring us close to the natural environment which we are inherently connected to.

Kellert endorses restorative environmental design and believes it to be our salvation. He considers that positive environmental impact; the interaction between individuals and the natural world in the built environment can only be achieved by restorative environmental design, which he refers to biophilic design. According to Kellert, restorative environmental design not only protects the natural environment in its purpose but also considers human health by creating a positive environment for the psychological well-being of human beings.

Kellert describes the main purpose of biophilic design is facilitating the connection between human beings and nature occurs in the built environment. He describes restorative environmental design as a healing tool for our wellbeing and the already damaged natural environment. Restorative environmental design advances progressive interactions and experiences of nature in the built environment. Kellert demonstrates that biophilic design occurs in two dimensions namely organic/ naturalistic/ design and vernacular/ place-based design. These dimensions describe the different occurrences that natural systems interact with human beings.

1.1.1.1. Organic design

Kellert (2005) defines organic design is the application of natural shapes and forms in the built environment. These natural shapes and forms can be of architecture, interior spaces, works of art and landscapes. The design can use these shapes and forms directly or indirectly. When indirectly used, symbols borrowed from the natural world are incorporated in the design. Organic design effect is usually achieved by using different organic shapes and elements derived from the natural environment. Examples are; animal print patterns, shapes and shapes and forms of shells. When organic design has been accomplished, the design makes human beings to be connected to it due to our predisposed connection to the natural world.

Kellert (2008) defines direct experience of nature translates to the unarranged contact with self-sustaining features of the natural environment. They include; light, air, water, plants, animals, natural landscapes, ecosystems and weather. The indirect experience of nature requires humans' maintenance to exist. They are part of humans' designs and take up forms like symbols, art forms, video recordings and any medium we use to represent our interpretation of the natural world.

1.1.1.2. Vernacular design

Kellert (2005) describes vernacular design as the connection of an individual to space or building different perspectives e.g., cultural context, historical context, geographical context or ecological context. Kellert further adds that vernacular design brings out a sense of fondness to a place or space with the connection to the design mainly being of culture/ history ecology within a community in a specific region. This brings out the individual's identity and caters to his well-being. An example of such a design can be historical monuments.

2.2. Principles of Biophilic Design

Kellert (2015) outlines nine inferred principles of biophilic design. They include; connect adaptive, innate need, integrate, complementary, connected, contact, interconnected and context. Kellert emphasizes that these principles are the core ethos of biophilic design and are mandatory in its implementation for it to occur successfully. The main function of biophilic design is to satisfy our inherent need to connect with the natural environment. It gives urban dwellers the opportunity to interact and experience nature in an urban environment. Its main goal is to facilitate a connection that encompasses human beings, existing organisms in the natural world, the ecology to interact, interconnect and integrate together as one ecosystem. The rate at which biophilic design succeeds and has a positive influence in our spaces is influenced by these principles and how they are implemented in a space. These principles should not be applied in isolation but should rather be viewed and used while taking into consideration the overall environment and its functionality. Additionally, an individual should be in contact with the natural environment repeatedly. This repetitive engagement reinforces the value of the natural world to the individual and has a positive effect to our wellbeing. Kellert (2015) insists that for effective biophilic design to occur the natural environment features should not occur in isolation rather should be used together and integrated in the environment whole system. The feature should achieve connectedness, complementary characteristics to the space and environment, integration in the overall environment and design.

Vivian believes that as urban dwellers as a community should be exposed to the varied natural world and its elements repeatedly. The contact to her needs to be visual and on a daily basis (Kemper, 2018). Kellert (2015)

alludes that success in implementation of biophilic design results in a strong bond between an individual and his or her natural environment. It creates a positive impact on an individual's health and better mental health and lastly a sense of community arises among individuals experiencing successful biophilic design making them have a sense of membership in their community, which they regard as significant.

2.3. Sick Building Syndrome

According to Modi and Parmar (2020), a majority of our modern lives are spent indoors, working and socializing in the modern world. In 1970s, tenants who lived in newly constructed spaces were said to experience some form of sickness-varied symptoms where they lived or worked. Symptoms included psychological distress, uneasiness, illnesses, stress and physical distress, which were coined as office illnesses. Later on, in 1984 World Health Organization (WHO) was the first to use this term Sick Building Syndrome (SBS) to describe the illness as manifesting in about 30% of buildings, the occupants experienced different health complications. Sick Building Syndrome was defined as an individual's poor physical and psychological state of health due to the environments they inhabit. Hidalgo (2014) asserts that modern working environments have led to mental fatigue resulting in anxiety and depression, which in turn can contribute to aggression and violence. She further adds that the conditions and working environments of modern life inhibits individuals' abilities to keep focused on daily routine activities. This also resulted to poor focus in working environment and unproductive workers. Kellert (2015) reveals that as we continue to modernize, we have adopted a mantra of disregarding any connection with the natural environment. He demonstrates this by giving examples of the spaces designed for us e.g., schools, hospitals, office buildings that lack any semblance of the natural environment. These buildings spaces do not have adequate natural sun and ventilation, lack use of natural material décor, lack views of plants and inspired environmental shapes and forms in them. These cold spaces give rise to mental fatigue, symptoms of illnesses and poor work performance.

Modi and Parmar describe the conditions of SBS occur when individuals who live in airtight buildings which have low presence of the natural environment. The causes have been identified ranging from biological air contaminants, poor ventilation, electromagnetic radiation and psychological factors. Mental fatigue can also be a contributing factor, which leads to violence and depression. Hidalgo advocates for greenery to be integrated around interior spaces primarily helps to curb this. She suggests that the built environment can stimulate psychological health and well-being through community living. Kellert (2015) encourages designers to design spaces that allow natural lighting and ventilation, incorporate the natural environment shapes and forms, have outdoor views of the natural environment and vegetation and allow transitional access to outdoor spaces in order

to enhance the health and productivity of individuals in urban spaces. Social living can help reduce mental fatigue through taking part in community projects like rooftop gardening in high-rises. Sullivan & Chang (2011) endorse community living. Designers should foster community and social interactions in urban spaces. They should also reduce contact with modern phenomenon like over-crowding of people and heavy traffic jams that may induce depression when exposed to urban dwellers (Figure 2.1).

FAVORABLE SETTINGS TO MENTAL HEALTH		
<ul style="list-style-type: none"> - legible places - attractive, well-maintained, safe places - contact with green space - with privacy - appropriate contact with other people 	Can produce	<ul style="list-style-type: none"> - well-being - life satisfaction - quality of life - social support - ability to concentrate - creative play in children - less mental fatigue
UNFAVORABLE SETTINGS		
<ul style="list-style-type: none"> - crowded places - noisy places - dangerous places 	Can produce	<ul style="list-style-type: none"> - social withdrawal - reduced social ties among neighbors - smaller social networks - diminished social and motor skills in children - distress - anxiety - irritability

Figure 2.1: Outcomes of Mental Health in Different Environmental Settings
Source: (Hidalgo, 2014)

2.4. Biophilic Design Elements

The two dimensions of biophilic design branch out to form the six-biophilic design elements, which they connect to. These elements are; environmental features, natural shapes and forms, natural patterns and processes, light and space, place-based relationships and evolved human-nature relationships

Kellert (2008) describes environmental features elements as the features found in the natural environment used in the built environment designs. These include color, water, air, sunlight, plants, animals, natural materials, views and vistas, façade greening, geology and landscape, habitats and ecosystems and fire.

Kellert (2008) describes natural shapes and forms elements as the shapes and forms that we use in our modern designs that are visible to us in our surrounding natural environment. The biophilic design attributes for this design element are; botanical motifs, tree and columnar supports, animal (mainly vertebrate motifs), shells and spirals, egg, oval and tubular forms, arches, vaults, domes, shapes resisting straight lines and right angles, simulation of natural features, biomorphy, geomorphology and biomimicry.

Kellert (2008) describes natural patterns and processes elements incorporate natural properties in modern designs of the built environment. These properties visible to us are character traits of nature. Sensory variability, information richness, age, change and the patina of time, growth and efflorescence, central focal point, patterned wholes, bounded spaces transitional spaces, linked series and chains, integration of parts to wholes, complementary contrasts, dynamic balance and tension, fractals and hierarchically organized ratios and scales.

Kellert (2008) describes light and space elements focus on natural lights character traits and occurrences in the natural surroundings we inhabit. The biophilic design attributes for this design element are; natural light, filtered and diffused light, light and shadow, reflected light, light pools, warm lights, light as shape and form, spaciousness, spatial variability, space harmony and inside outside space.

Kellert (2008) describes place-based relationship elements as the relationships we have imbued to places or spaces due to repeated interactions with them under different contexts e.g., social, cultural geographical making them of great significance to us. The connections we form to surroundings indicates our need as human beings to define territories and assert dominance over them for safety and security reasons due to our evolutionary traits. As human beings, we are certain of spaces we are familiar with and have strong connections with them. The attributes are; geographic connection to place, historic connection to place, ecological connection to place, cultural connection to place, indigenous materials, landscape orientation, landscape features that define building form, landscape ecology, integration of culture and ecology, spirit of place and avoiding place-lessness

Evolved Human-Nature Relationships are elements that focus on the inherent human relationship with nature. These attributes are characterized by; emotional beliefs and metaphorical meaning in the context of human culture. The biophilic design attributes for this design element are; prospect and refuge, order and complexity, curiosity and enticement, change and metamorphosis, security and protection, mastery and control, affection and attachment, attraction and beauty, exploration and discovery, information and cognition, fear and awe, reverence and spirituality.

These attributes are important for understanding biophilic design for interior and exterior design in urban spaces. Apart from the contribution of Kellert (2008) in biophilic design as quoted by Maggio (2020) in (Browning, Ryan, & Clancy, 2014) has stressed that such designs have clear pattern strategies, which aim at making biophilia a

tangible experience within the context of the architectural design of buildings. These patterns are organized in three categories namely; nature in the space, nature analogues and nature of the space.

2.4.1. Nature in the Space

Maggio (2020) asserts that nature in space looks at the approaches, which facilitate an instant link with the natural environment by having physical manifestations of natural features in a given interior or exterior space. This approach entails implementing the environment features' attributes in a space; examples being pot plants, fountains, green facades and rooftop gardens. Browning, Ryan, & Clancy, (2014) quoted by Smartcity (2020) has stated the conceptual definitions of the attributes of Nature of space in biophilic design. Below are the definitions;

Visual connection with nature – Improvement in mental engagement, mood and emotions.

Non-visual connection with nature – Stimulating the sense of hearing, smelling, tasting and touch in reference to nature, living systems and natural processes.

Non-rhythmic sensory stimuli – Exposure to natural sounds and fragrances for physiological restoration.

Thermal & airflow variability – Bringing air temperature, relative humidity, and surface temperatures that imitate natural environments.

Presence of water – Enhancing the experience of space through seeing, hearing or touching the water.

Dynamic and diffuse light – Benefiting from ranging intensities of light and shadow that change over time to create conditions that happen in nature.

Connection with natural systems – Focusing on seasonal and temporal changes indicative of a healthy ecosystem.

2.4.2. Nature Analogues

Maggio (2020) describes nature analogues as establishing indirect natural elements in our modern designs through impressions and recreations of the natural world. This can be achieved through imitating organisms' shells, natural habitats, plant variable traits, patterns and colors occurring in nature. These attributes can be realized in furniture pieces, body ornaments, designed fabrics and art forms. Maggio further adds in the built environment, nature analogue can be integrated through buildings taking up organic forms, cladding of beams and columns with designed motifs inspired by features of the natural environment e.g., flower patterns. Browning, Ryan & Clancy (2014) quoted by Smart city (2020) has stated the conceptual definitions of the attributes of Nature Analogues in biophilic design. Below are the definitions;

Biomorphic forms and patterns – Representing patterned, textured and numerical arrangement that we see in nature.

Material connection with nature – Using natural elements and material that reflect the local ecology or geology.

Complexity and order – Implementing rich sensory information that adheres to a spatial hierarchy similar to those found in nature.

2.4.3. Nature of the space

According to Maggio (2020) nature of the space focuses on intentionally incorporating designs that mimic nature's processes with the intention of making the design as the focal point of a space in order to initiate feelings of fear and awe to the user of the space. These are similar attributes as outlined by (Kellert, 2008). According to Abbas (2017), Humans create from primitive connection with nature in order to sustain welfare. In terms of prospect and refuge, human beings feel safe in a place of refuge and have a window to the life itself. This reflects the inborn conservative need to survey for dangers from a safe place. Browning, Ryan & Clancy (2014) quoted by Smart city (2020) has stated the conceptual definitions of the attributes of Nature of the space in biophilic design. Below are the definitions;

Prospect – Providing unrestrained view over a distance for surveillance and planning.

Refuge – Creating a place for withdrawal from environmental conditions.

Mystery – Designing obscured views that excite a person to travel deeper into the built environment.

Risk – Identifying threat and combining it with a reliable defense system.

Espinosa (2021) has noted that biophilic interiors harness Maggio's (2020) strategies patterns in order to create natural environments for human beings to live, work and learn. Further Espinosa (2021) identifies that when in contact with direct presence of nature, biophilic design develops a multi-sensory interaction, which creates restorative spaces for humans whilst decreasing air, and visual pollution levels in the city. Design that connects human beings to nature is proven to inspire, boost productivity and contribute to a stronger sense of well-being.

Nota, Marian, Callegari, Berto, & Barbiero (2017) quoting (Kaplan & Kaplan, 1989) have presented spatial biophilic factors which include; fascination, being-away, extent and compatibility for considering during residential design. Each of the factors is discussed below.

1.1.1.3. Fascination

A building should be designed to allow fascinating stimuli such as the presence of water, trees, animals and suggestive elements such as sunsets, light reflections, windy leaves. These features stimulate the use of

involuntary attention by regenerating direct attention and ensuring good cognitive functioning (Nota, Marian, Callegari, Berto, & Barbiero, 2017).

1.1.1.4. Being Away

A building should allow individuals to physically and/or mentally move away from their daily routine (e.g., work, everyday worries), that is, from all those situations that require the use of direct attention and which are a cause of mental fatigue as well as environmental stress (noise, crowding, air pollution, traffic); (Nota, Marian, Callegari, Berto, & Barbiero, 2017).

1.1.1.5. Extent

A building should be coherent and legible, characterized by a space-time extension, large enough to be explored and have new experiences where the individual feels "immersed". Immersion is favored in the environments with coherence, where each part is in harmony with the whole. Natural environments are intrinsically endowed with space-time extension; (Nota, Marian, Callegari, Berto, & Barbiero, 2017).

1.1.1.6. Compatibility

A natural environment should offer the opportunity to indulge the interests or achieve the purposes of the individual. There is a compatibility or match between the individual's inclinations and the opportunities offered by the environment itself. (Nota, Marian, Callegari, Berto, & Barbiero, 2017). These four biophilic design factors capture the considerations to be undertaken when designing building structures in natural environments in order to achieve a rich ecosystem for human beings. This ecosystem should be able to achieve the principles of biophilic design (integration, adaptation, interconnectedness) while still engendering positive mental health and wellbeing of human beings and countering pollution issues.

2.5. Benefits of Biophilic Design

According to Wolf (2015), the benefits of biophilic design include; accelerated healing for patients who underwent surgery. Students who were in classroom environments which had integrated the natural environment e.g., natural lighting open outdoor spaces indoor use of natural materials were more active and attentive in class, had higher grades and were less absent. Majority of the most celebrated architectural marvels have their concepts borrowed from nature; this includes biomorphy and biomimicry wolf (**Figure 2.2**) (2015).



Figure 2.2: Living Wall at Hazel Wolf K-8, Seattle WA - NAC Architecture
Source: (Kazmierczak. 2021)

Browning et.al (2012) suggests that biophilic design has made property to be more attractive, have a higher value in the real estate market. Office workers who work in environments with successful integration of biophilic design have an increase in the productivity levels, lack mental fatigue and potentially reduced violence and crime. Ulrich, (1983) has highlighted those recuperating patients whom views of the natural environment near the hospital have had a smooth recovery compared to those whose views were obstructed by distance external walls. This study indicates a positive improvement in public health and overall wellbeing. General health has also improved among health care facilities integrated with biophilic design (**Figure 2.3**). Chan, (2015) establishes that offices spaces with vegetation alleviate distress and mental fatigue and increase positive moods by more than 60%. Chan observes that greenery in an office space can diminish anxiety, depressive moods, violence, and exhaustion increasing work stamina, bringing joy, better mental health and increasing the workers productivity.



Figure 2.3: Massachusetts General Hospital Lunder Building - NBBJ
Source: (Kazmierczak. 2021)

Healthy air is vital for the well-being of occupants and their overall well-being. Plants purify the chemical contaminants and carbon (iv) oxide in the air by photosynthesis releasing off oxygen as a byproduct of the process. Plants also perform a purification process through oxygenation; they perform temperature moderation, execute dust anchoring mitigating air pollution and water pollutants absorption. When using indoor plants, the green plants appearances reflect the natural world supporting human physiology, mental health and wellness (Modi & Parmar, 2020).

Espinosa, (2021) has revealed that many companies are investing in the employees' wellbeing by integrating and adapting biophilic design in their offices. Examples of such companies are; Adidas and Google, which are known for actively boosting their employees. Lohr, Pearson-Mims and Goodwin, (1995) observed that workers in windowless environment had low productivity than those exposed to introduced plants within their windowless environment. The benefit accrued from biophilic design directly improves the wellbeing the human beings in their day-to-day spaces. In the Twitter office (**Figure 2.4**), have patterns with shapes that have a naturally occurring arrangement. Natural inspired patterns with the floor arrangement having an organic like inspiration. The textiles have texture applied to them, custom patterning, and floor plans that are more organic with reduced number of perpendicular lines (interior architects, 2015). Indirect biophilic design elements have the following features; they should have color tones inspired by nature tones. Nature inspired shapes and organic natural forms paintings and art forms of nature. These could be plants, animals; wildlife, which intrigues human beings and evokes curiosity-imitating nature using materials, symbols natural forms of nature. (Hyde, 2018).

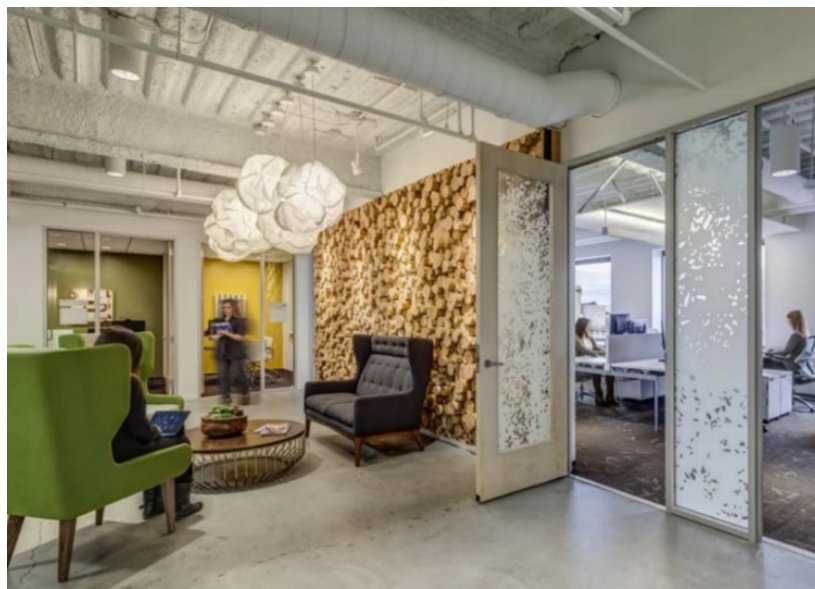


Figure 2.4: Twitter Offices in Seattle
Source: (interior architects, 2015)

Vorbild, (2020) encourages use of natural materials in furniture making while incorporating biomorphic forms in them. These is through curvilinear forms on furniture e.g., curved desk, taking advantage of asymmetrical shapes of natural features e.g., flowers, plants and intentionally taking advantage of randomness and complexity occurrences in nature e.g., Spread of leaves on a tree pattern are imitated on furnishing fabrics. Vorblid further adds that interior walls should be painted in greens, blues and other shades as they the hues found in nature. Kellert and Finnegan (2011) advocates that restrained or indirect biophilic design can be possible. They describe this by suggesting exploiting the forms and patterns visible in the natural world into buildings' interiors. Examples include use of ornamentation resembling vines climbing tree-like columns that supports the ceiling just as witnessed in nature's creepers and climbers. Additionally use of natural bare materials like masonry and plants on building facades can lead to successfully realizing biophilic effects (**Figure 2.6**). (Kellert & Finnegan, 2011).



Figure 2.5: National Museum of Qatar Gift Shop
Source: (mindtheinterior, 2020)

Lucia (2021) suggests that organic shapes and curves can be used in biophilic design are these are elements present in nature. The curves and organic forms can take up symbolic motif or be a basic form part of a conceptual design. The curves would capture the attention of the users of the space and spark a connection with them evoking pleasant feelings. Doshi (2020) illustrates an example of this in the Planted Pergola in Tokyo Japan designed by Thomas Alexander Heatherwick of Heatherwick Studio. Doshi suggests the building gives a geographical context to Tokyo city making the residents of Toranomon-Azabudai district have an invested connection with the attraction it resulting to vernacular design at play. The building functions as mixed development complex having a curvilinear structure resembling the undulating forms found in nature of ocean waves and the characteristics of water (**Figure 2.6**) (Doshi, 2020).



Figure 2.6: Planted Pergola – Tokyo, Japan
Source: (Doshi, 2020)

According to Lucia, (2021) natural light can be integrated into spaces via translucent walls, purposefully placed windows, skylights, perforated screens and other creatively designed fenestrations. Lucia adds that interplay of natural light with shadows is advisable as it conjures a feeling reminiscent of the natural world. This is phenomenon is visible in the natural environment as natural light is obstructed by different objects e.g., leaves, trees, stones etc. Lucia advocates in designs with negative carvings to create vibrant pattern forms that have an interplay of light and shadow. This fully captures the features of natural light in the natural environment context in urban spaces.

Hyde (2018) is of the opinion that for successful incorporation of biophilic design in urban properties direct and indirect natural elements should be integrated in these spaces to give the occupants and opportunity to experience, interact and connect with nature. Hyde advocates maximizing use of natural light and natural ventilation, incorporating natural vegetation and water elements in property spaces and lastly a developer should consider the property is surrounding environment and strategically incorporate them to the interior spaces through strategically placed opening and outdoor spaces. Scenic views of nearby rivers, parks, and vegetation and land mass forms can create pleasant feelings and cater to mental wellbeing to the occupants of the property (Hyde, 2018). Indirect design elements include; color tones similar to colors found in the natural world e.g., blue skies oceans as suggested by Lucia (2021), patterns, shapes and forms found in nature including artwork paintings and decorative flowers, plants and animals (Hyde, 2018).

Hyde notes that another aspect of biophilic design is sensory experience. Hyde describes examples which can be achieved by incorporating natural experiences through our physical senses; this includes, taste sound and touch in urban spaces. Taste includes having natural vegetation fruits, berries that are edible in the urban space Sound can be experienced through natural occurring sounds, the flow of rivers and water bodies, and outdoor vegetation attracts birds chirping. Wind blowing gently rustling trees. Smell can be portrayed through ornamental plants and flowers, which have rich varied scents. Touch sensors can be implemented by contrasting organic smooth and rough textures and patterns that stimulate us imparting us with pleasant feelings of relief and tranquility (Hyde, 2018).

2.5.1. Kono Designs

Lucia (2021) suggests that vegetation in urban spaces can be implemented in different ways. These includes; interior gardens in atriums, green roofs and green walls. Interiors can be connected to the natural vegetation by creatively incorporating vistas and scenic views and taking advantage of deliberately placed windows, skylights and translucent openings. Andrews (2013) establishes that Kono design in the year 2010 incorporated the biophilic design concept in their design of the Pasona urban farm office. The driving concept of the design was for the ability of the workers to grow their own vegetables in their office spaces.

Andrews describes the building spaces had been around for 50 years. The priority spaces which were incorporated in the redesigning included office spaces, auditorium spaces, cafeteria spaces, rooftop gardens and urban farming facilities and spaces. 3995m² of the building surface area were revised to be occupied greenery elements. The vegetation used included; plants, fruits vegetables and rice. The green features included green walls, facades, and pot plant vegetation. Drainage pipes and ventilation mechanism systems were positioned at the perimeter of the building to achieve maximum indoor heights to facilitate for better climate control systems. The systems were calibrated by complex sophisticated automatic systems monitoring all indoor climate phenomenon to create safe natural environments for both employees and the integrated natural vegetation. Plants were situated in meeting rooms, vertical cages, wooden boxes, installed structures, balcony installations and facades. These plants included fruits, vines, vegetables, vase-boxed plants. The office building green façade consisted of a dual two-layered structured green facade, which supported the growth of flowers while on the buildings balcony orange trees were visible. **(Figure 2.7)** (Andrews, 2013).

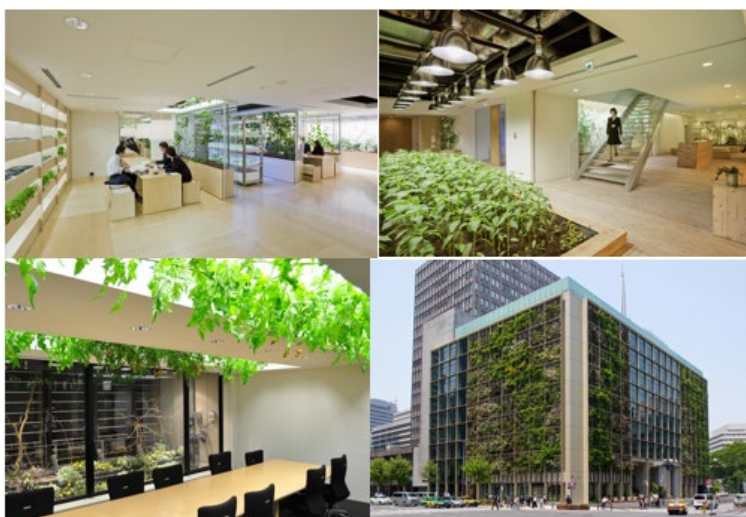


Figure 2.7: Pasona Urban Farm Office
Source: (Andrews, 2013)

2.6. Use of biophilic design for modern apartments

Kenya is currently undergoing a surge of urbanization leading to high-density housing construction. This includes the design of modern flats in different urban centers to shelter high rural-urban immigration. In Nairobi, it is evident development of modern apartments in the different wards. The review of the literature is to bring out the best practices that should inform use of biophilic design for modern apartments.

2.6.1. Bosco Verticale Apartments

Lubell (2020) describes Bosco verticale as two residential towers located in the district of Porta Nuova, Milan district in Italy. They consist of two residential towers with plants and trees incorporated to their designs. The vegetation integrated into the two buildings is similar to 10,000m² (1hectare) of forest (**Figure 2.8**). Lubell notes the project design for the two residential towers has garnered a variety of awards for its concept and is considered as an exemplar prototype for residential cities of the future and the future of sustainable urbanization. Lubell reveals the buildings plants are supported by inbuilt automated cabling structures, modern customized support structures and sustained by systemized irrigation apparatus. The plants are grown on cantilevered balconies out of design specific containers. The towers' plants provide the greenery for the occupants' wellbeing, filter the air by absorbing CO₂, reduce the heat island effect, and insulate and regulate the building energy. The towers plants act as a home for numerous plants and animals' species. The two residential towers rejuvenated the urban areas of Porta Nuova since it was a dead town with unused railway tracks and abandoned industrial buildings (Lubell, 2020).



Figure 2.8: Bosco Verticale Apartments
Source: (Designcurial, 2019)

1.1.1.7. Challenges

Giacomello (2015) notes the major challenges met when executing the project was involving numerous varied inter-disciplinary outlooks and requirements. The challenge was visible when linking all the professionals together to make the vertical forests possible. Another challenge was the maintenance activities required to ensure the buildings vegetation lived longer and healthier preventing hazardous occurrences on the occupants of the towers while following the original concept. Lastly whether the Bosco Verticale would be sustainable venture due to its high maintenance costs and predicting whether it would be of value to its occupants in the end (Giacomello, 2015).

1.1.1.8. Conceptualization

According to Ardiani, Prawata, & Sholihin (2020) the architects involved in this project were the Boeri Studio located in Milan Italy. Bianchini (2021) states the two towers stood at a height of 110metres and 76metres high respectively. The project was completed in 2014. Ardiani, Prawata, & Sholihin describe the concept implemented involved using building materials like polychrome, reinforced concrete to support the screen vegetation and for the walls and vegetation screens. The vegetation on the building created its own microclimate, reduced extreme sunlight restoring the indigenous natural environment into the city to promote urban ecosystems for different species of birds and insects. The architects desired a natural method of temperature regulation and ventilation for the occupants and were against using any artificial ventilation systems. The architects focused on the needs and wants of the urban dwellers. The project was to be the first of its kind in sustainability metropolitan reforestation and rekindle urban bio diversity in tight spaces constraints of spaces (Figure 2.9) (Ardiani, Prawata, & Sholihin, 2020). Bianchini (2021) reveals the architects aimed was to realize a project for an urban setting reforestation facilitating to the regrowth of the lost natural environment and urban biodiversity while taking into consideration the usage of space (Figure 2.10). The vertical forests on the tower total surface area corresponded to an urban area setting of approximately to 50,000m². (Bianchini, 2021).



Figure 2.9: View of the Bosco Verticale apartments from the Porta Nuova Gardens
Source: (Bianchini, 2021)



Figure 2.10: View of the Bosco Verticale complex
Source: (Lubell, 2020)

1.1.1.9. How Vertical Forest is made

Bianchini (2021) notes the concrete structures were used for support and reinforcement together with the floor slabs which had a thickness of 280mm. The buildings facades were finished off with dark grey porcelain tiles with large cantilevered balconies extending at 3350mm depth. The building complex had a floor area of 40000m² between the two towers (**Figure 2.11**). The southern tower is known as Torre de castilla while the western tower is known as torre confalonteri. Bianchini further adds that large balconies create terraces that occupy different species of plants. The vegetation comprised of 800 different species of trees with a ranging height of 3000mm to 9000mm high, 15000 different types of plants and flowers and 4500 different types of shrubs (Bianchini 2021).



Figure 2.11: Bosco Verticale under construction
Source: (Burrows, 2021)

According to Bianchini (2021) the Positions of the plant species were preselected and arranged with regards to the façade. Clarification on aesthetics required sun-shading amount to be allowed for each residential unit. Plant holders were prefabricated concrete materials depending on the sizes and plant. Plant holders were prefabricated contingent to whether they were to be used by plants, trees or shrubs. The variability in their dimensions were as follows; trees containers were planted in 1000mm deep thick soil layer and shrubs were planted in 500mm deep thick soil layer. Bianchini noted that plant holders contained water and root-resistant membrane around internally. Drainage systems fitted were root resistant and consisted of polyethylene/ geotextiles fabric layers for prevention of water leakage. Static load management of the vegetation was used to deal with load trees dynamic and load swaying of trees due to wind and other weather phenomenon. The static load management was investigated through simulations done in a wind tunnel to sort out such issues. Technical elements like special steel anchorage structures, cabling enhancements were implemented for retaining trees and avoid branches falling from the tower (**Figures 2.12,2.13, 2.14, 2.15, 2.16 and 2.17**) (Bianchini, 2021).



Figure 2.12: Floor plan of the Bosco Verticale apartment Tower
Source: (Bianchini, 2021)



Figure 2.13: Detailed Chart of the Bosco Verticale façade vegetation's features and characteristics
Source: (Bianchini, 2021)



Figure 2.14: Vegetation Cover on the Bosco Verticale towers
Source: (Bianchini, 2021)

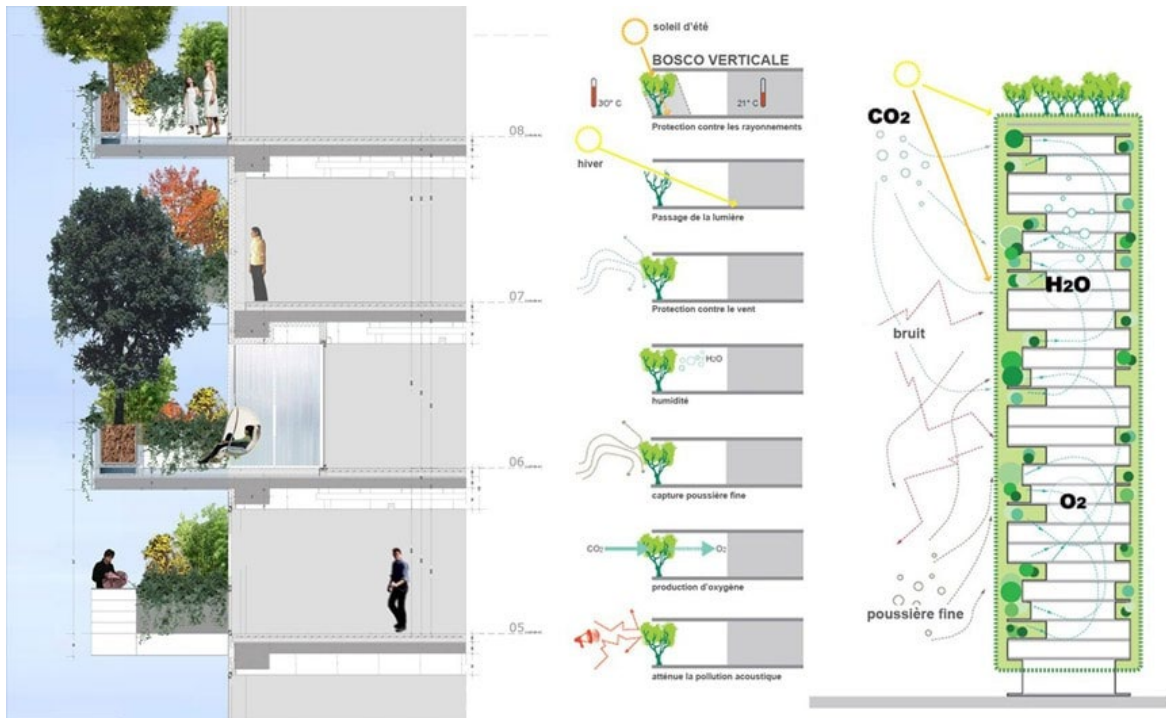


Figure 2.15: Vegetation placement and the plant irrigation system of the western tower; and vegetation response on daylighting and ventilation in the interior spaces of the tower
Source: (Bianchini, 2021)



Figure 2.16: Sectional Detail-drawings of Bosco Verticale's interior and outdoor spaces
Source: (Bianchini, 2021)

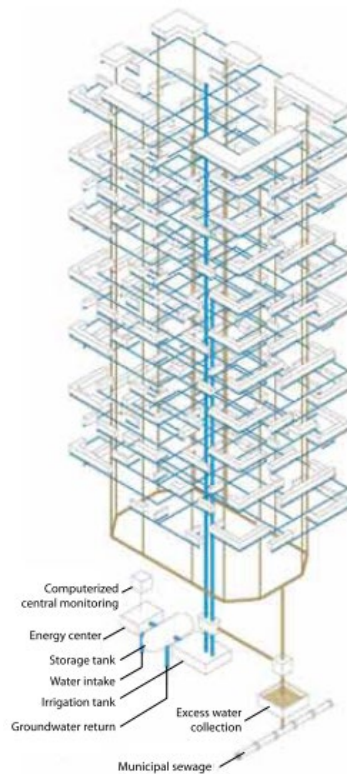


Figure 2.17: Water Supply and Irrigation System for Bosco Verticale’s towers
Source: (Giacomello, 2015)

2.6.2. Bosco Verticale Structural System

Giacomello (2015) establishes that the structural integrity of the building had to be proven to make sure the vertical concept would be feasible. The Structure was fabricated from concrete with the columns being made from reinforced concrete and the floor being made from post-tensioned reinforced concrete. Precise calibration was done for the structural elements due to this factor; Load gravity for the trees and soil, 3.3metres cantilever terraces, the unsupported corners spanning 7mettres and the dynamic loads on wind effects on trees its stability and security (Figure 2.18). Giacomello notes that to achieve this a scale model testing of a full-scale model testing was done and on real trees in the field. Other factors taken into consideration to the fullest extent were geometrical, dimensional and plants properties. This included; botanical analysis of center of gravity of the trees, height of the trunk, surface area center of gravity of the canopy and air permeability of each species. For this reason, untried testing was executed in wind tunnels with an objective of defining the local wind phenomenon around vertical forest. A scale model of the two towers was fabricated at scale 1:100. Pressure sensors were mounted onto the scale model to evaluate balance, forces moments and the aerodynamic coefficients of the building. Tree restraining devices needed to be studied to deepen the knowledge that facilitated the design for safe and efficient solutions in botanical, structural and architectural equipment (Giacomello, 2015).



Figure 2.18: Bosco Verticale’s detailed section showing cantilevered terraces
Source: (Giacomello, 2015)

2.6.2.1.1. Restraint system

According to Giacomello (2015) the structural design restraint system provided three protections against falling trees. These systems were the temporary bind, basic bind and redundant bind (Figure 2.19, 2.20 and 2.21). The temporary comprised of a stabilizing -root ball for the tree fixed to the plant holder through textile harness belt. The temporary bind was implemented in the initial life of the trees until when the roots were natured and took hold. The rudimentary bind- trees were safe guarded with several elastic belts held together by steel cables, secured on to the thick reinforced concrete cantilevered foundation and acted as the main-fail arrest harness for grown trees. The redundant bind consisted of a secured steel cage mounted to the root ball of the plant containers. These binds stabilized trees positioned on the gustiest higher levels of the tower (Giacomello, 2015).



Figure 2.19: Bosco Verticale's temporary bind
Source: (Giacomello, 2015)

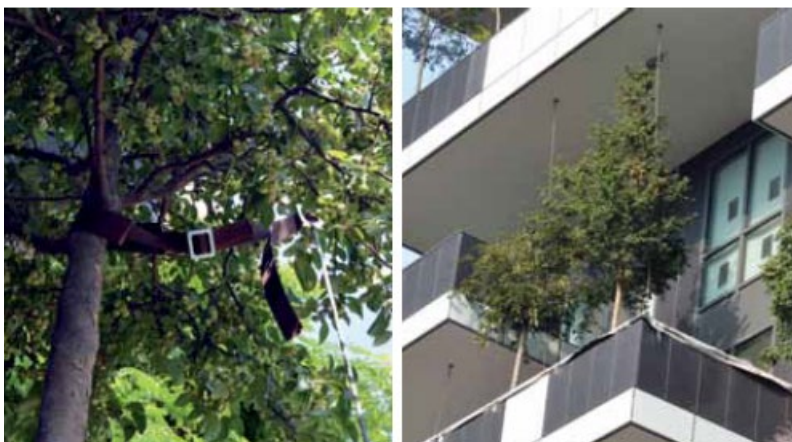


Figure 2.20 : Bosco Verticale's basic bind
Source: (Giacomello, 2015)



Figure 2.21: Bosco Verticale's redundant bind
Source: (Giacomello, 2015)

2.6.2.1.2. Plants Containers

Giacomello (2015) notes that the plant containers were located to the extreme end of the terraces of the cantilevered balcony. The dimensions of the plant holders varied with the type of plant size, height and root depth to allow the different plant's roots to acclimate to the artificial plant holders they were located in. Tree containers had 1.1 meters depth and a similar width and length. The dimensions for shrubs were 0.5 meters depth and a similar length and width. The container structure was water resistant by applying a bituminous water proofing membrane. A protective sheeting was also installed to protect the containers form roots penetration (Giacomello, 2015).

Giacomello (2015) describes the plant containers comprised of different interior layers in them. They included a division layer and fostering drainage and filaments with three-dimensional core characteristics fabricated from synthetic non-woven filters. To facilitate peak drainage of out-flowing water in the layers, these layers exhibited high drainage pressure potential. These layers also deterred root infiltration, circumventing air movement and protecting the porous nature of the filters serving also as a protective measure. The Substrate layer of soil in the container contained of different mixed grains of volcanic lapilli. This was a volcanic inorganic material that allowed water permeability and optimal water retention. The substrate also had green compost and top soil. The immediate layer is the steel welded net structure that holds on to the root ball steel structure for the trees. The layers are divided by the vegetation course which holds the tree and the layers firmly together (Figure 2.22) (Giacomello, 2015).



Figure 2.22: Bosco Verticale's plant container layer membrane and plant container's drainage system
Source: (Giacomello, 2015)

1.1.1.10. The Cooling Effect of Bosco Verticale

According to CIBSE (2020) The external façade of the towers adjusts with the seasons. The two towers external appearance and colors alters as the leaves from the façade vegetation change with the time of the year. The plants provide much needed natural temperature regulation all around the year cutting costs on artificial indoor temperature regulation systems. In the period of winter, the deciduous trees on the building's façade do not have any leaves as they are shed off and are bear with branches permitting the sun to heat up the cold apartment interiors while during summer the trees leaves act as a shading to the interiors cooling them down preventing them from overheating. Water cooling and heating is undertaken to attain an equilibrium use of ground heat pumps which helps reduce energy usage. The water pumps work best in autumn and spring when the towers apartment units' temperature can be regulated (CIBSE, 2020).

1.1.1.11. Maintenance

Bianchini (2021) describes the maintenance to be above average cost and the elite purchase price makes the towers apartments only be accessible to wealthy tenants' clientele. Bianchini further adds that maintenance is overseen by the tower's employed administration. Maintenance involves keeping track of the vegetation and the vegetation compatibility to the conceived environmental conditions of the towers. The towers fauna receive water through the assistance of a sophisticated sub divided water irrigation system. The system takes advantage of complex drip irrigation reusing grey water and recycling ground water from the geothermal heat pumps system. The vegetation is conserved by the towers employed in-house gardeners who utilize mounted cranes at the top of the towers, which assist them in reaching difficult points of the building facades to inspect the plants and their harnesses. The high cost of maintenance is offset by the reduction in energy consumption and the positive impact the restorative environment has on the inhabitants of the tower and the surrounding urban environment (Bianchini 2021).

2.6.3. Freebooter Apartments design

Jewell (2019) describes Freebooter apartments as a four-storey apartment in Amsterdam Netherlands designed by the GG loop a Dutch architectural firm. She states that the architects incorporated biophilic design principles in its design that facilitated in rekindling the residential connection to nature. This was achieved through vernacular design. The apartment concept design paid homage to the town's traditions of ship assembling. The overall form of the apartment borrowed the curvilinear form found in ships. Ship building materials inspired the major finish materials used in the interior and exterior design of the apartment. These were mainly; different types of timber (red cedar, pine and wood planks), glass and steel structures. The outer façade of the apartment consisted of light filtering/ sun shading screen made of processed laminated timber. Jewell notes that the apartment blocks

were all prefabricated structures. The fabrications were conducted offsite. This construction method was implemented to offset costs and reduce construction time making the project duration last 6 months (Jewell, 2019).

Jewell observes that the biophilic design implementation focused on natural features of natural light and natural materials. The architects observed and analyzed the sun movements all year around. The findings determined the placement and angular positioning of the timber louvers screens to properly create diffuse natural light for the interior units. The apartment interiors were open plan with the living spaces for recreation located at the ground floor and the bedrooms private space located at the second floor. Interiors spaces had a minimalist design. They consisted of pine-clad walls, full height windows and curvilinear walls in the stairways and corridors. Jewell determines that these interior features were derived from the interiors of a ship cabin. The large windows linked the interior spaces to the outdoor patios and permitted natural lighting into the interior spaces of the apartment. This made it possible for the occupants of the apartment to connect with the natural environment (**Figures 2.23, 2.24, 2.25**) (Jewell, 2019).

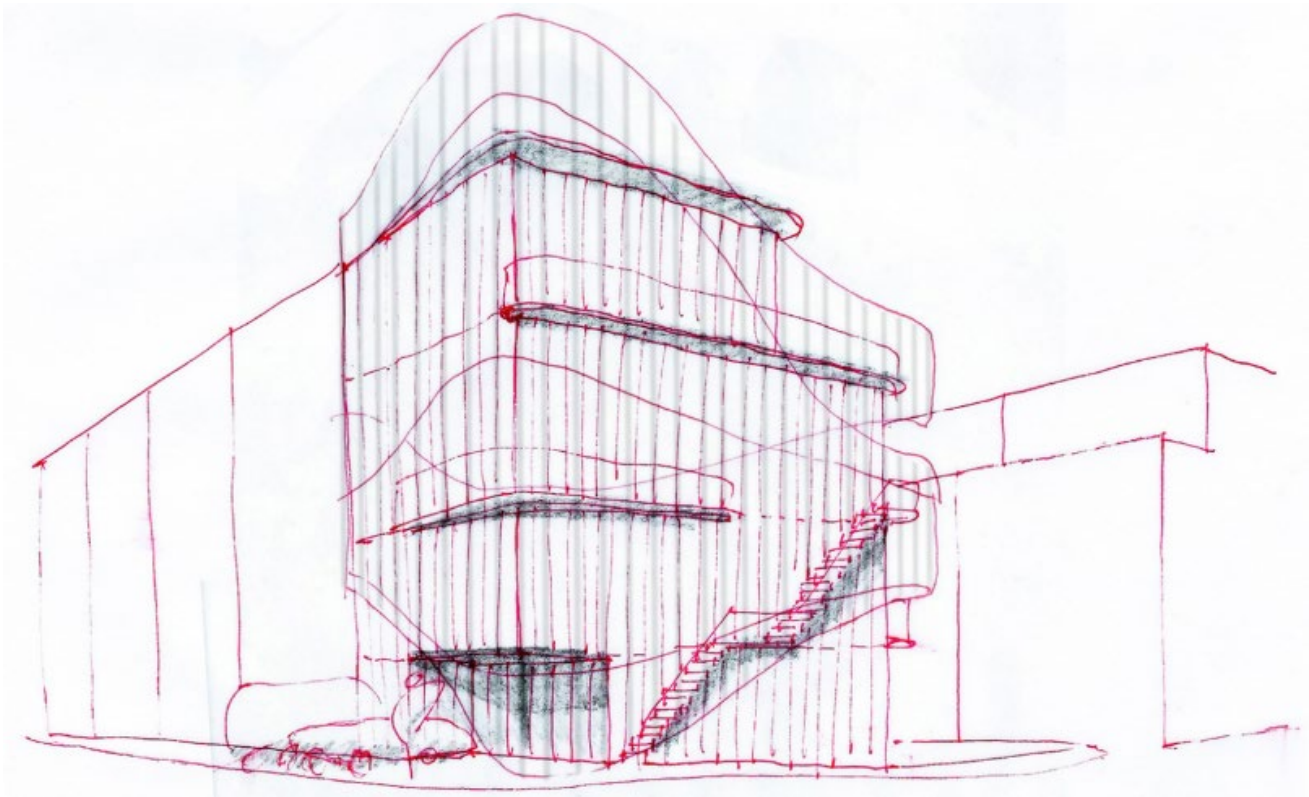


Figure 2.23: Freebooter Apartments Conceptualization
Source: (Pintos, 2019)

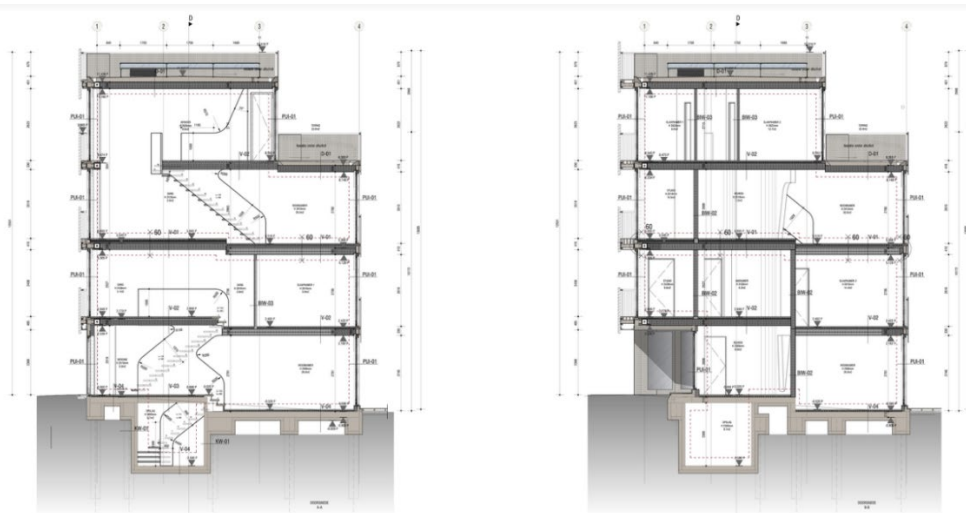
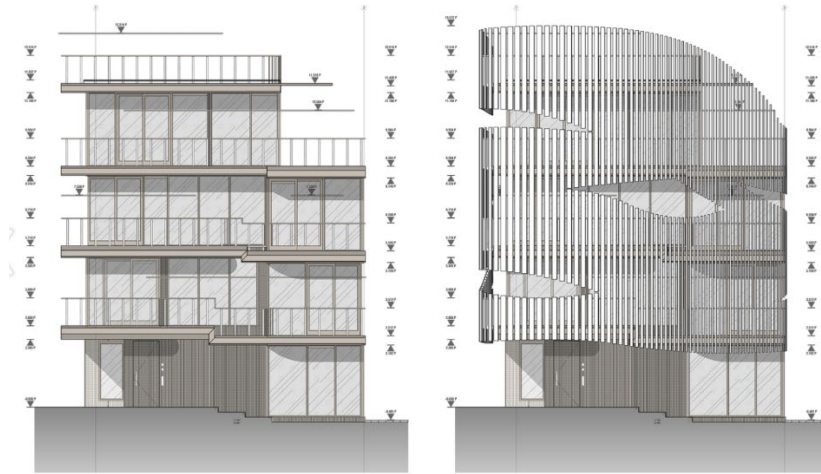


Figure 2.24: Freebooter Apartments elevations and section drawings
Source: (Pintos, 2019)



Figure 2.25: Freebooter Apartments design
Source: (Jewell, 2019)

2.6.4. 2.6.3 Halong Villa Hanoi-Vietnam

According to VTN Architects website (2020) Vietnam over the years had experienced rapid economic growth and standard of living among its inhabitants. This was mainly driven by the tourism industry. The rapid development unfortunately translated to clearing up much of the untouched natural environment in Hanoi. The architects understood that to challenge this situation they were to come up with a space that was able to rejuvenate the fleeting connection the locals had with nature in the urban town of Hanoi.

VTN Architects state that Halong villas are located in northern Vietnam in the city of Hanoi Vietnam. The town is approximately 160km northeast of Hanoi. Hanoi is a renowned UNESCO world heritage site due to the Ha long Bay. The villas were designed by VTN Architects. The Architects intended the Villa designs to incorporate aspects of sustainability, harmony with the natural environment and integrate with the surrounding landscape. The principal motivating concept in the design was the creation of an urban home that facilitated the experience of living in nature thus the name “house for trees”. The design was to have the following design properties; simplicity, modular, functional and allow for replication in any tropical climate region in the world. To achieve these concepts, the VTN Architects designed the villa using biophilic design principles (**Figure 2.26 and Figure 2.27**) (VTNArchitects, 2020).



Figure 2.26: Hanoi Vietnam
Source: (VTNArchitects, 2020)



Figure 2.27: Hanoi Vietnam
Source: (VTNArchitects, 2020)

The main spaces of the villa were in two layers; interior and semi-interior layers. The space concept design consisted of an enclosed pentagon within a pentagon. Each of these space layers had a variety of plants and vegetation. The spatial layers acted as noise and hot climate buffers regulating the hot outdoor climate by cooling the interior spaces and reducing noise pollution. These layer spaces were connected through transitional spaces with each of their entrances leading to the main spiral staircase. The villa had enormous window facades giving the occupants the ability to take in the natural vegetation and vistas at different angles and an opportunity to connect with the natural environment. The large windows also connected the occupants of the villa with the neighborhood as they opened the spaces to the view of the neighbors making their day-to-day activities visible to the neighborhood (**Figure 2.28**) (VTNArchitects, 2020).



Figure 2.28: Ha Long Villa – Ha Long, Vietnam
Source: (VTNArchitects, 2020)

The Semi exterior space acted as a transitional space connecting the interior space with the outdoor garden at the central portion of the villa. The indoor garden fostered different human activities as it acted as a multi-purpose space for the occupants. It was used for; sightseeing, outdoor recreation space, it could be converted to an outdoor dining space giving the occupants a chance to connect with nature as they interacted and feasted together and lastly the garden acted as a focal point connecting all the other interior spaces (**Figure 2.29**) (VTNArchitects, 2020).



Figure 2.29: Ha Long Villa – Ha Long, Vietnam
Source: (VTNArchitects, 2020)

The exterior walls were left unfinished exposing the grey concrete to embody the bare rocks present in HA Long Bay. There were trees planted all around the villa as well as presence of a rooftop garden. The villa overall façade generated a contrast effect between the soft scape of trees, shrubs and plants and the hard scape of the exterior grey concrete walls. The vegetation casted shadows on the exterior wall surfaces illustrating the contrast between light and shadow in nature, the passage of time as process in nature and the variable properties of natural light as viewed in nature (**Figure 2.30**) (VTNArchitects, 2020).



Figure 2.30: Ha Long Villa – Ha Long, Vietnam
Source: (VTNArchitects, 2020)

2.7. Biophilic Design and Policy

International accreditation bodies like LEED, BREEAM and WELL have recognized the importance of Biophilic design. They have come up with new credits and accreditation for designs, which follow the Biophilic design framework. In WELL certification if a design integrates vegetation through urban farming framework and eatable gardens in the design, higher certification levels are awarded. BREEAM NL awards certification and points for designs, which have implemented 3-5 biophilic design patterns in their designs. (Maggio, 2020). According to Vangelatos (2020) the elements observed are biophilic design approach of nature analogues that consist of bio mimicry, implementation of patterns, shapes and motifs derived from the natural environment. Other factors they consider are the air quality, access to daylight, artificial light that mimic daylight, natural color palettes, passive lighting, window positioning in an interior space and whether they have scenery of nature (Vangelatos, 2020). United States Green Building Council (USGBC) a green building rating system in the United States advocates the integration of natural environment features through elements like; installation of green facades, protection of natural habitats and ecological systems, heat island reduction, biophilic design, and rainwater conservation (Lubell, 2020).

Lubell (2020) portrays the steps the Singapore government has put in place to enforce biophilic design policy. The Singapore government enacted in its building code making it mandatory for all new urban spaces to incorporate vegetation, roof gardens, green facades and greenery terraces. To support this policy the Singapore government has incentivized developers to implement these biophilic design elements in their designs by assisting in covering 50% of the vegetation installation costs in upcoming and existing constructions. Lubell further adds that Singapore insists on new constructions to achieve the countries Green Mark Green certification program standards that will assist the government intentions of planting a million nature trees by 2030.

According to the IDAK website, IDAK (2021) the Interior Designers Association of Kenya (IDAK) is a certified association of Kenyan interior designers enumerated under the Societies Act. The association's role is to unify, disseminate and conserve the interior design professional standards in Kenya. IDAK collaborates with various industry stakeholders to uphold the significance of the interior design profession. The Society facilitates in training its members, equipping them with skills and knowledge to adapt to the growing interior design profession to be at par with international standards. This is done through career development and mentorship programs (IDAK, 2021).

According to the AAK website, AAK (2021) the Architectural Association of Kenya was founded in 1967. The Association is listed under the Societies Act and unifies all existing Kenyan professionals. It comprises of Kenya's leading professionals in the field of the built and natural environment. They include; architects, quantity surveyors, town planners, engineers, landscape architects, environmental design consultants and construction project managers. The Association functions as the connection between the association's listed professionals and the local stakeholders in the Kenyan construction scene. These stakeholders include; policy makers. The manufacturing industry, real estate, developers and financial institutions (AAK, 2021).

2.8. Conceptual Framework

Kellert (2008) and Wolfs (2015) have presented definitions of biophilic design which emphasis integrations of measure into the built environment in order to create connections between humans and the environment. They stress that the built and Natural environments should always coexist. This study takes that position of these proponents of biophilic design where there is need for greater collaboration between humans and nature. The works of Kellert and Calabrese (2015) on biophilic design has generated design principles, which are indicated in the conceptual framework. Further Kellert (2008) developed the biophilic dimensions, design elements and

attributes. This study borrows heavily from the works of Kellert as shown in the conceptual framework. This study defines biophilic design dimensions as context in which contact to nature occurs with human beings. The biophilic design elements are described as how human beings connect to nature. The biophilic design attributes are the recognized characteristics of the biophilic design elements. The relationships of the biophilic design principles, dimensions, elements and attributes are shown in the conceptual framework below in **(Figure 2.31)**.

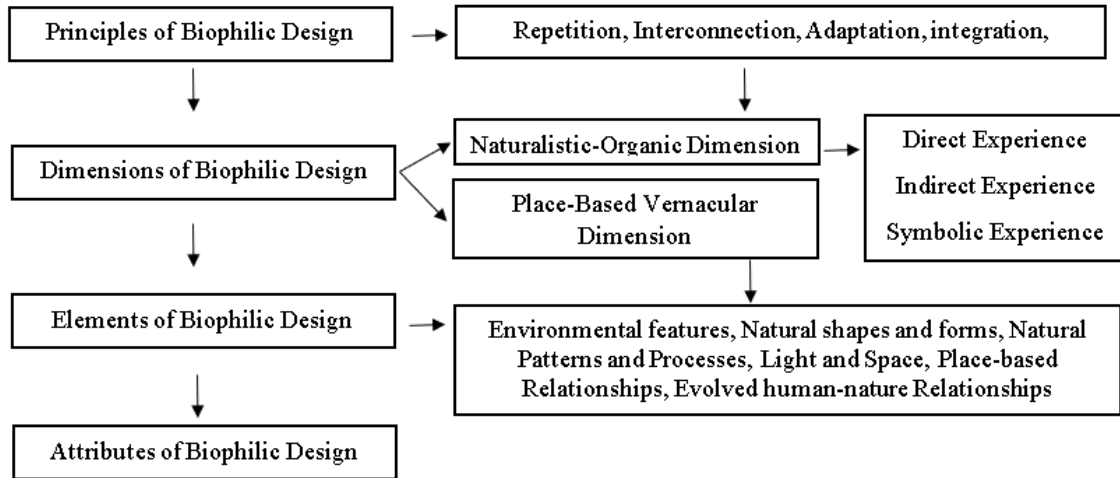


Figure 2.31: Biophilic Design Conceptual Framework
Source: Author 2021

The principle used in this study are holistic in bringing together nature man and the built environment in an orderly manner. The naturalistic and vernacular dimensions when either is selected or organized by the adapted biophilic design principle by the designer. The different dimensions use the same biophilic design elements to achieve the desired setting that shows connection between man and nature. Finally, the attributes are the tools that a designer uses to implement biophilic design in the built environment. These attributes will be used as the variables for this research. The conceptual and operational definitions for each of them are presented as in the tables shown in the appendix section. The biophilic design strategies act as the independent variables while the biophilic design attributes are affected by these strategies thus they are the dependent variable. The study regards the principles of biophilic design as they the biophilic strategies are they dictate the success of biophilic design as suggested earlier by Kellert (2015). All this is interpreted within the apartment environment. How the designer applies the biophilic design strategies on the biophilic design attributes will determine whether the occupant’s wellbeing will be achieved **(Figure 2.32)**.

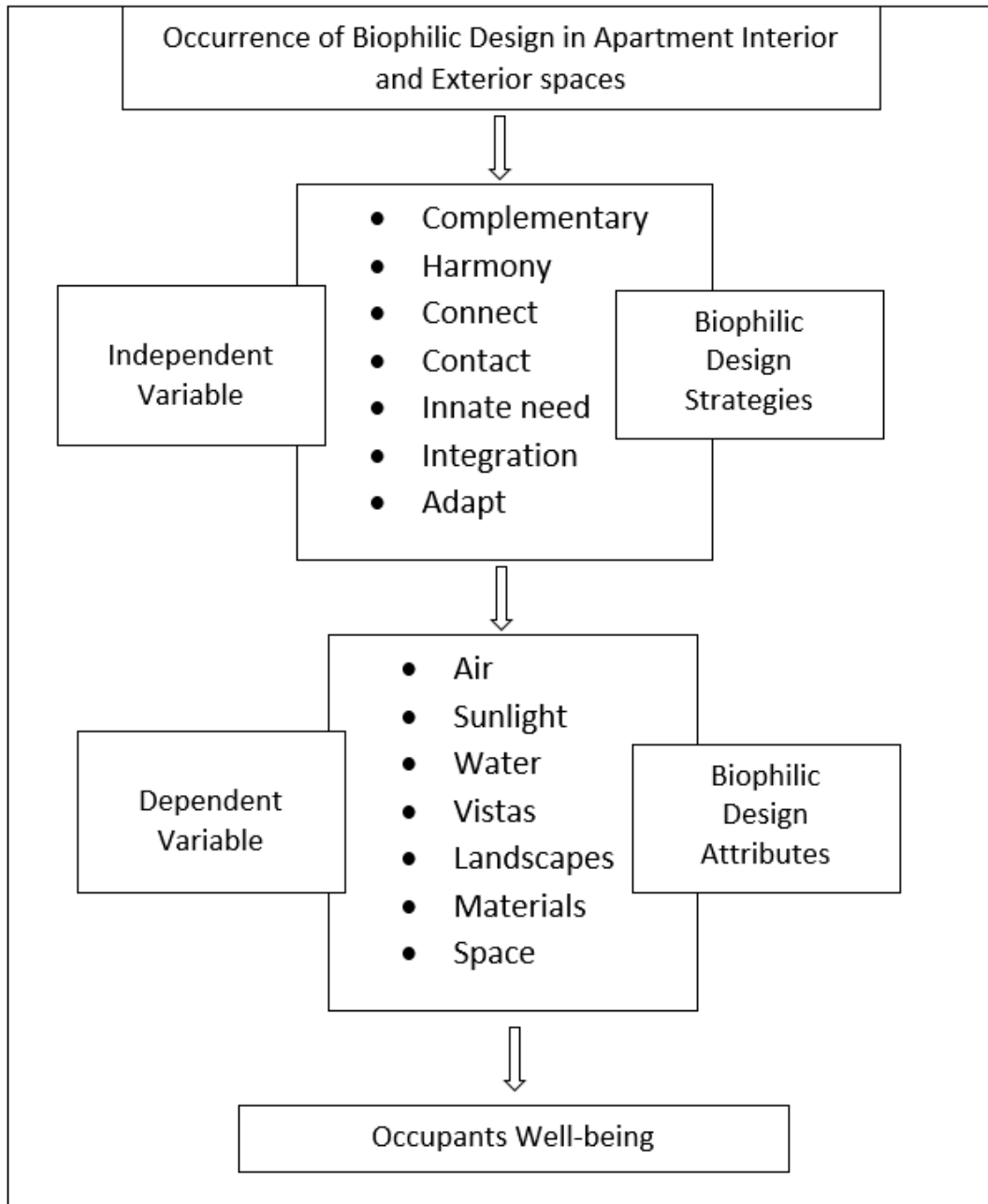


Figure 2.32: Biophilic Design Conceptual Framework
Source: Author 2021

3. Chapter: Research Methods

3.1. Introduction

Sileyew (2019) defines research methodology as the blueprint undertaken to execute research with the assistance of the researcher's objectives and problems during when undertaking the study. This chapter detailed extensively the research methods implemented by the author while taking into consideration the objectives of the study. The author delineated the research design, research methodology, the study area, data sources such as primary data sources and secondary data and population considerations. A qualitative research method was undertaken, as it was suitable for the objectives of the study. The data collection methods included; questionnaires photographs and desk review.

3.2. Research Design

Libguides (2021) outlines a case study as a thorough examination of phenomena of interest with the aim of specifically focusing on researchable exemplar. The research design used was a case-study design. This would give the researcher the opportunity to conduct a thorough in-depth study of the phenomenon undertaken in real-life context. (Crowe, et al., 2011).

3.2.1. Case Study Approach

A qualitative case study, specifically a single case approach was implemented with the aim of establishing the context in which biophilic design exists in Kileleshwa Ward and to test whether the biophilic design attributes in Kileleshwa work. A qualitative case study, specifically a single case would also aid in having an in-depth knowledge and different views of the phenomenon under study while taking advantage of the variability in data sources as illustrated by (Baxter and Jack 2008). As stated earlier a variety of data sources were executed to ensure credibility of the study. This is in agreement with (Patton, 1990) who postulate that variability of data information in the field enhances the findings as they result to a further understanding of the case study (Baxter & Jack, 2008).

The study used a logical framework in order to plan how the research design would be undertaken (**Figure 3.1**). Log framer, 2012 advocates for a logical framework in a study. This framework functions as a tool to aid the researcher in planning for the objectives, activities and resources and research design implemented in the study and above all strategy to be undertaken by the researcher in identifying the objectives, activities and resources of

the research and any unexpected external elements that may affect the research. These external elements are to be considered as the assumptions of the study.

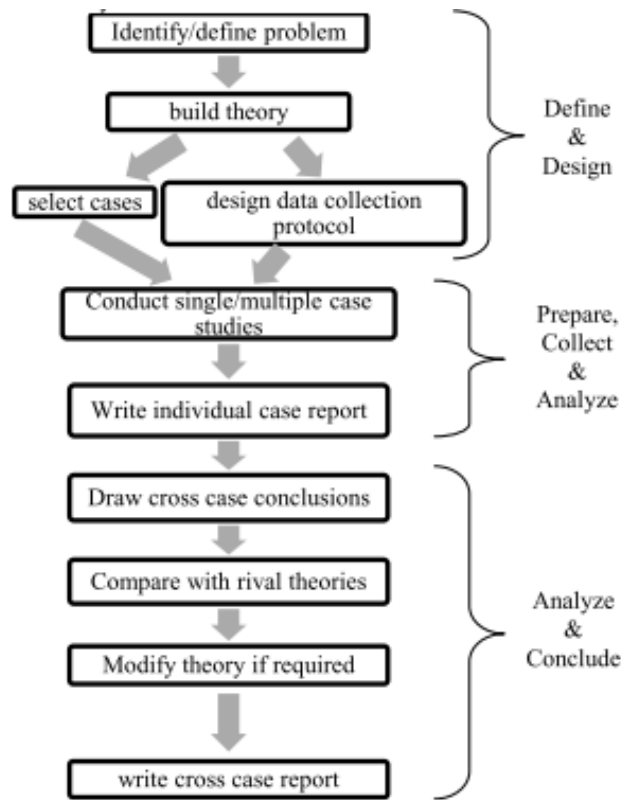


Figure 3.1: Logical Framework used in the study used
Source: (Teegavarapu, Summers, & Mocko, 2008)

3.3. Description of the Case study

According to Dagoretti North CDF, 2019 Kileleshwa as one of the electoral wards that constitutes of Dagoretti North constituency which is located in Nairobi County. The Kenya census carried out in 2019 indicated that the ward had a population of 27,202 inhabitants with a majority of homes residing being of high class and middle-class status of the Nairobi metropolitan population. The ward covers an approximately 9km². There is presence of established shopping centers such as the Hurlingham and Yaya center. Outdoor spaces include the Arboretum recreational park which is a major park in Nairobi. The Park splits Kileleshwa from the Nairobi Central Business district. Majority of the residence reside in duplex, town houses and apartments (DagorettiNorthCDF, 2019).The **(Figure 3.2)**. Appendix 4 shows a map of Kileleshwa ward.

3.3.1. Location of study

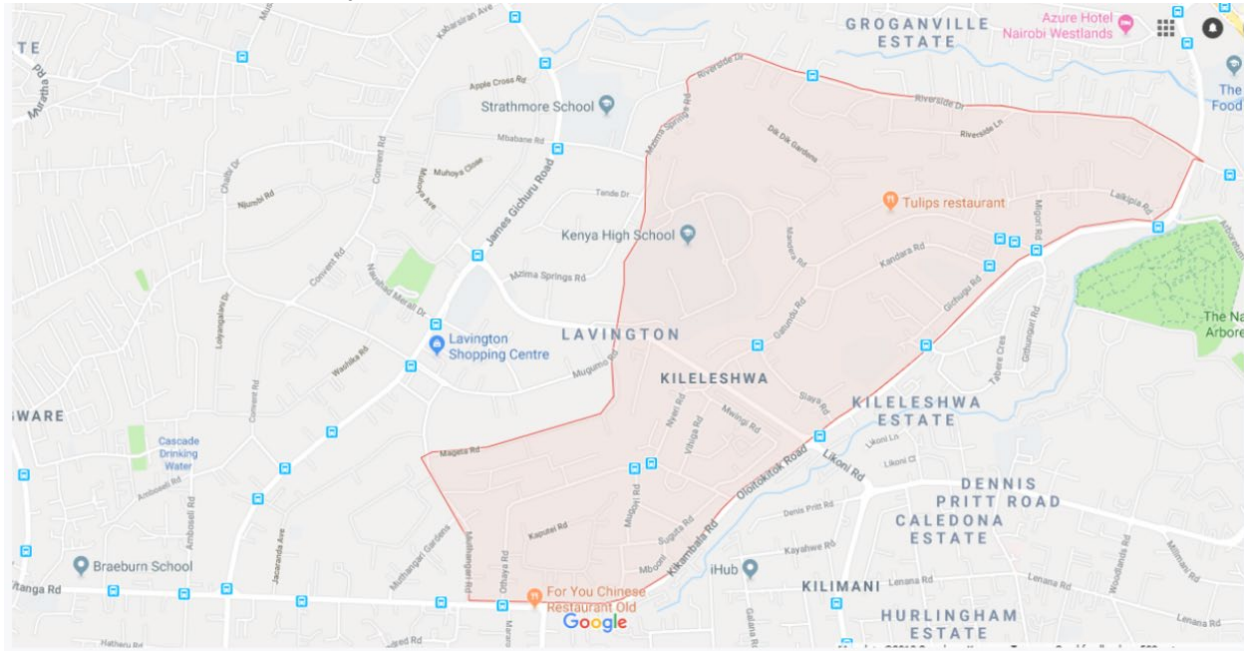


Figure 3.2: Map of Kileleshwa Ward
Source: (Mbithe, 2018)

The study was carried out in Nairobi City County. The intention of selecting Nairobi City County was due to its proximity to the researcher and knowledge about the county. Lastly, the main intension was Nairobi County’s status as one of the most vibrant developing counties in Kenya. The researcher saw an opportunity to study the ongoing developments and urban sprawl. The study intended to investigate whether these new urban spaces in Nairobi County, Kileleshwa Ward catered to the occupants’ well-being and considered the surrounding natural environment. The ward is located near the urban Centre of Nairobi and undertaking urban apartment developments. This makes Nairobi City County a hub of development activities. The study focused on Kileleshwa ward within Nairobi County because it had a concentration of upcoming middle class gated community apartments. There was presence of features of the natural environment which were maintained e.g., the Arboretum Park, Wasonga and Kirichwa rivers. A majority of apartments in Kileleshwa ward had landscaping features integrated into the property. These interior and landscape spaces were studied to find out if they met the biophilic design requirements (Mbithe, 2018).

3.4. Unit of Analysis

Mugenda and Mugenda (1999) define the unit of analysis as the element whose data is aggregated and analyzed in the study to make conclusions, decisions or inferences. The unit of analysis was informed by the research questions. It was therefore crucial to determine the unit of analysis before undertaking the sampling process because, the units constituted measured variables that formed the analyzed data (Babbie, 2001). The unit of analysis in this study was the plots, occupants, architects, landscape architects, and interior designers.

3.5. Data Sources

Primary and secondary data were the main sources of data applied in the study. These sources of data revealed the research problems in line with the formulated objectives of the study. The researcher carried out both structured and close-ended questionnaires. Secondary sources were attained through desktop study review, which was a cyclic process of the study as refinement and accuracy coincided simultaneously. Secondary research was carried out from the existing published works, books, scholar journals, reports, conference proceedings and online articles from the internet in view of sourcing the data on;

- i. Definition of biophilic design
- ii. principles for biophilic design
- iii. Elements of biophilic design
- iv. The benefits of biophilic design
- v. Use of biophilic design for modern apartments

3.6. Sampling

3.6.1. Snow Ball Sampling

Question pro (2021) outlines that snowball sampling or also referred to as chain-referral sampling is defined as a non-possibility sampling technique where by the attributes of the samples are a challenge to acquire or interview due to certain unavoidable restrictions. Question pro (2021) further adds that for this sampling method to be implemented a primary data source selects other possible data sources that are to take part in the study. Snowball sampling method relies heavily on referrals. This method assisted the researcher in creating a sufficient sample size that made it possible to obtain comprehensive results from the analysis of the study. The researcher used known tenants of Kileleshwa apartments and used them to recruit additional tenants in order to meet the researchers sample target. This sampling method was utilized due to the restrictions and difficulties experienced

by the researcher when conducting the pilot study to obtain data from occupants and professionals. A majority of Occupants were hesitant to share their information due to privacy issues even after informing them confidentiality would be upheld by the researcher while other occupants were uncooperative. This sampling technique was also used for professionals as consultants for different firms were used to pass questionnaires to their counterparts in their respective firms to obtain a favorable threshold sample size for proper analysis of the study.

1.1.1.12. Population

Frankel and Warren define population as the comprehensive count of people, commodities, phenomenon and events that have similar characteristics and properties, which have drawn the attention of the researcher. The population under study was the plots with apartments in Kileleshwa ward. Completed flats within 3 to 10 fell under the population. Google maps was used to trace the apartment's population. The total population acquired was 150 apartments.

1.1.1.13. Population frame

Mugenda and Mugenda (2012) outline the population frame as an extensive catalogue of the entities existing in the target population from which the sample is designated. The target population was made of architects and registered under the Board of Architects and Quantity surveyors. Interior designers registered under IDAK Interior design association of Kenya and landscape Architects registered under AAK Architectural Association of Kenya. The target population for the plots was established through observation method and Google maps. The researcher established the key informants from the listing of the following; architects, interior designers and landscape architects.

1.1.1.14. Sampling size and method

Mugenda and Mugenda (2003) states that a sample size needs to be not less than 30 persons. Further, according to (Warren, 2002) for qualitative research to be publicized, it needs not less than 30 samples. This study focused to fulfill this threshold. The researcher had a maximum of 23 plots used as the case study. The key informants' sample was as follows; 14 practicing architectural firms, 6 interior design firms, 2 landscape architects and 3 urban designers. The key informants chosen were used due to their conversant knowledge in the area of study.

The sample size established was established by observational listing of all the apartments between three to ten stories. Purposeful and chain referral sampling was conducted to select 23 samples from the listed target

population. The reason for this sampling method. The sample of 23 was established to be adequate for analysis and generalization of the findings by (Warren, 2002) and Mugenda and Mugenda (2003). The decision for the sample size was also made due to convenience, time constraints and budgetary limitations.

3.7. Data collection Instruments and techniques

In this study, emphasis was laid on the use of in-depth key informant’s structured questionnaires and observations. Semi-structured questionnaires were used for data collection from key informants. The use of various tools and approaches facilitated the acquisition of detailed and comprehensive data ensuring that there were no obvious gaps in the study results.

3.7.1. Questionnaire

The questions in the questionnaire were close ended multiple-choice format as well as short answer questions especially where the study needed to seek more information on the sampled respondents on the biophilic design variables for ease of analysis and interpretation. The structured questions were rated using a 5-point Likert scale with different assigned responses with varying degree of each response along the scale (**Figure 3.3**). In some instances, specifically Yes or No responses was sought. Responses from the Likert scale were easy to synthesis as it would be able to indicate clearly the respondents’ stance on the phenomenon.

Response Set	1	2	3	4	5
Frequency	Never	Rarely	Sometimes	Often	Always
Quality	Very poor	Poor	Fair	Good	Excellent
Intensity	None	Very mild	Mild	Moderate	Severe
Agreement	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
Approval	Strongly disapprove	Disapprove	Neutral	Approve	Strongly approve
Awareness	Not at all aware	Slightly aware	Moderately aware	Very aware	Extremely aware
Importance	Not at all important	Slightly important	Moderately important	Very important	Extremely important
Familiarity	Not at all familiar	Slightly familiar	Moderately familiar	Very familiar	Extremely familiar
Satisfaction	Not at all satisfied	Slightly satisfied	Moderately satisfied	Very satisfied	Completely satisfied
Performance	Far below standards	Below standards	Meets standards	Above standards	Far above standards

Figure 3.3: Likert Response Scale
Source: (Mbithe, 2018)

The researcher formulated two questionnaires. One for the design professional consultants and the occupants. The professionals' questionnaire contained questions from 6 thematic areas of the biophilic design attributes and strategies. These were; air, materials, sunlight, views and vistas, landscape and space, The biophilic design strategies were complementary, connect adapt, innate need, integration harmony and contact; There questionnaire consisted of three parts; knowledge of biophilic design, application of biophilic design attributes in external and internal spaces of apartments and lastly rating the attributes using the Likert scale. The questionnaires were posted online using the Google forms application for easy access for the respondents. The occupants' questionnaire dwelt on the perceptions of the internal and external apartment spaces based on the properties of biophilic design. The questionnaire's aim was to determine the user's satisfaction in view of those attributes of biophilic design from the different occupants of apartments in Kileleshwa ward.

3.7.2. Observations

The observation techniques applied were photography. This technique collected the information on the quality and character of indoor and outdoor spaces of the apartments. The researcher used sensory experiential mapping of different environments within the target population plot and buildings. This aided the researcher in having a firsthand experience on the biophilic design attributes established in the literature review in the sampled apartments in Kileleshwa ward.

3.7.3. Pilot Study

A pilot study has been defined as a study prior the larger study with a focus to test and validate the study procedures as documented, questionnaires, selection of respondents and the study methods towards preparing for the main field data collection (Stewart, n.d). The researcher took three identified samples among the 23 and carried out a pilot study to enable refining of the research tools and familiarize with the cases, the type of respondents and to identify any challenges that would likely occur during the fieldwork with the research tools. The researcher documented the experiences of the pilot study and how it would improve the final study.

3.7.4. Administration of the research

The researcher used the letter provided by the school of the arts and design to introduce himself to the respondents. The researcher organized with the respondents when they could be available for interview, dropping and collecting questionnaires and finally when the researcher could visit to take photographs and do observations of the apartments.

3.8. Data Analysis and Presentation Techniques

3.8.1. Synthesis

The researcher synthesized the primary data of the study using a descriptive thematic method.

3.8.2. Presentation

The analyzed data was displayed using tables, charts. Distribution tables of frequencies and percentages. Diagrams like bar charts and pie charts were utilized as they had the ability to show correlations, comparisons, different relationships and contrast between different variables in the field. Tables were used as they were suitable for comparison of the data. Charts were used as they were able to represent comprehensive large data.

3.9. Ethical Considerations

The researcher acquired ethical clearance and authorized letters from the Department of the Arts and design, University of Nairobi. To all the informants being interviewed, the intentions of the study were expounded on. The researcher made sure that the subjects under study were in full knowledge that any and all information gathered from them was considered confidential and their identities were not to be revealed to any other party without their consent. Organization related to the sampled apartments were informed of the study and consent was acquired to conduct the study in their apartments.

4. Chapter Results

4.1. 4.1 Overview

This chapter presents the results obtained from the field as per the objectives of the study. Thematic areas were developed from the objectives that governed the presentation of the respondent's feedback. The analysis of the Kileleshwa apartment occupants' and professionals' questionnaires and the observations are presented below.

4.2. 4.2 Introduction Professionals, Occupants and Observations

There were 22 professional respondents. Two of the respondents were landscape architects, 14 were architects, six were interior designers and three were urban designers (**Table 4.1**). All of the respondents came from local practicing Kenyan firms. The average year of practice for all professionals was approximately seven years. 86% of the professionals had designed apartments before while the others had not. Most of the apartment developments were done in Nairobi County with some being as far as Mombasa, Lamu, Eldoret, Kitui, Kiambu, Kajiado, Kabarak and Nyeri. Seven of the respondents had designed apartments in Nairobi County Kileleshwa ward.

22 occupant respondents answered the questionnaire (**Table 4.2**). The occupants lived in different storey heights (Figure 4.1). Majority of the occupants lived in 4 storey apartments.

The findings of observations made of the following apartments; Bellway apartments, Sunny Hill apartments, Kaisa Gardens apartments, Ramis Court apartments, BellCrest apartments, Pear Peaks apartments and Viraj Gardens apartments. These apartments were observed and analyzed on these biophilic design attributes namely; Materials, color. Complementary contrast, light, plant features, landscapes features, water features, views and vistas.

Table 4.1: Professional Respondents and Names of their Firms

Professional Respondent	Name of Firm
Architect 1	Waaki Associates
Architect 2	Building Design Consortium
Architect 3	DLR Group Africa
Architect 4	No firm
Architect 5	Eco Build Africa
Architect 6	Bowman Associates
Architect 7	Baobab Kenya
Architect 8	No firm
Architect 9	No firm
Architect 10	BuildX Studio
Architect 11	Edon Consultants International
Architect 12	Edon Consultants International
Architect 13	No firm
Architect 14	Ministry of Defense
Interior Designer 1	No firm
Interior Designer 2	Gerry born Ventures Ltd
Interior Designer 3	No firm
Interior Designer 4	Step sign Interiors Ltd
Interior Designer 5	University of Nairobi/Colmak Design Studio
Interior Designer 6	Urban Eleven Ltd. + The East Afrikan Master Craftsmen Ltd
Landscape Architect 1	Landtek Consult
Landscape Architect 2	Ecla designs
Urban Designer 1	University of Nairobi/Colmak Design Studio
Urban Designer 2	Landtek Consult
Urban Designer 3	Urban Eleven Ltd. + The East Afrikan Master Craftsmen Ltd

Source: Author 2021

Table 4.2: Occupation Respondents in different apartments in Kileleshwa Ward

Name of Apartment	Number of Respondents
Ramis Court Apartments	2
Bellway Court Apartments	3
Serene Court Apartments	1
Peers Park Apartments	1
Viraj Gardens Apartments	1
Bellcrest Gardens Apartments	2
Regents Court Apartments	4
Kaisa Garden Apartments	3
Socian Villas Apartments	1
Sunning Hills Apartment	2
Lalucia Court Apartments	1
Casa Acacia Apartments	1
Greenvale Apartments	1
Total	23

Source: Author 2021

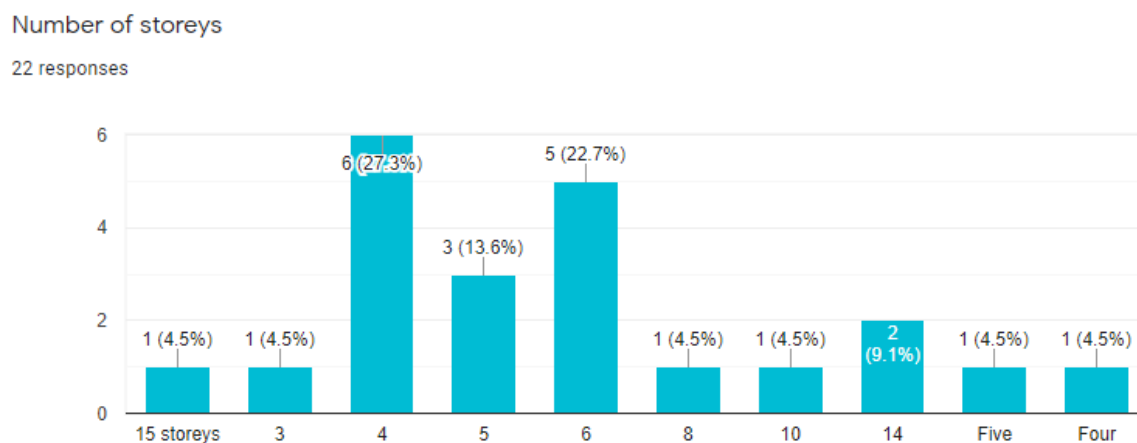


Figure 4.1: Occupant Respondents and Storey heights

Source: Author 2021

4.3. Nature of the Biophilic Design Attributes

The findings for biophilic design attributes reported by professionals, occupants and observations are report below.

4.3.1. Color

12 (58%) of the professional respondents strongly agreed that color had a physiological effect to the user’s spaces while 3 (14%) of the professional respondents strongly disagreed (Figure 4.2). All the respondents preferred color tones inspired by nature. These were the tones they proposed to clients when designing apartments for the internal and external designs. One professional stated that the colors used may be inspired from abstraction and the built environment due to the brief and imagination expected by the client. When asked if they preferred color inspired from abstraction and built environment half of the respondents said they did not. A majority of respondents agreed that color created a pleasant feeling to the occupants (Figure 4.3). The other reasons given by professionals to why colors inspired by the natural environment were suitable to clients’ apartments were; these color tones tended to connect with the natural environment, they brought in balance, harmony and a longevity of the idea being relied by the design. 17 (81 %) of professionals used the plant color when designing landscapes for apartments.

Do you agree color has a psychological effect to the users of the spaces you designed them for ?

21 responses

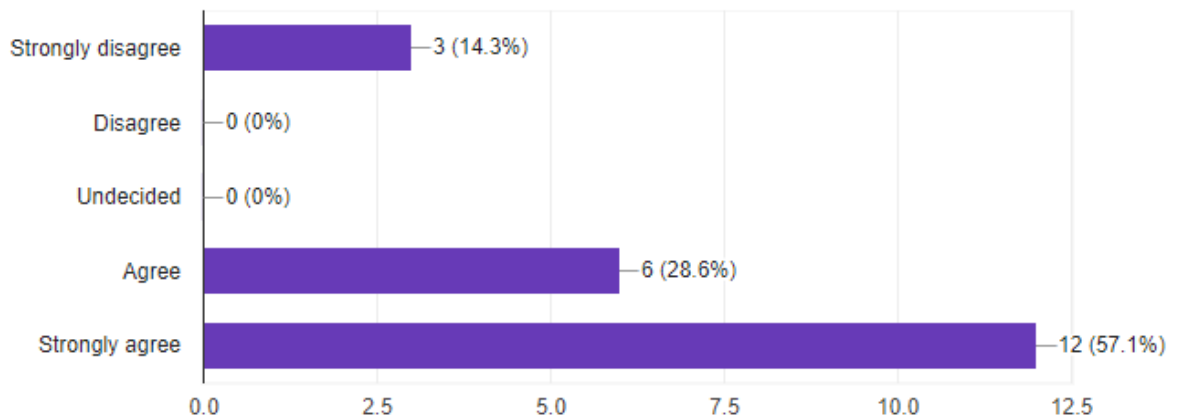


Figure 4.2: Psychological perceptions of color on the built environment by Professionals
Source: Author 2021

Why do you think natural environment inspired tones would work better in client's apartment design ?

22 responses

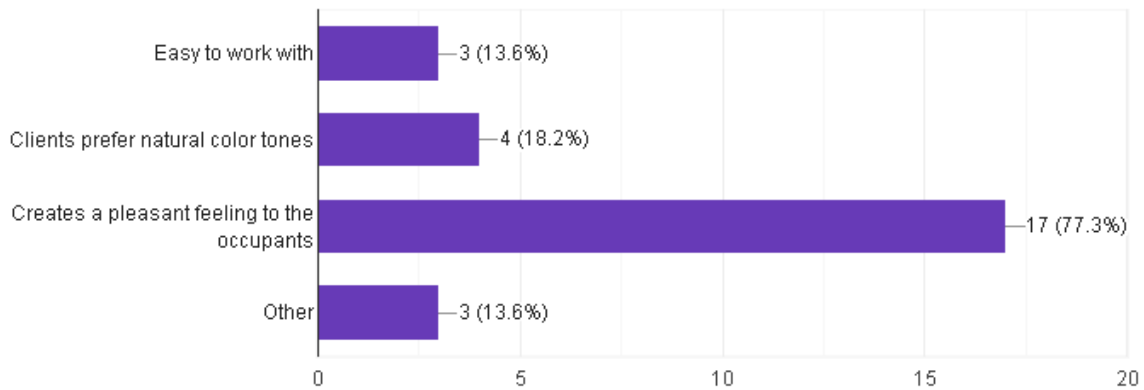


Figure 4.3: Relationship with the Professionals
Source: Author 2021

The observations on color were made from the built forms and the landscaped elements of the studied apartments. The Ramis court apartment had curved colored windows and balconies as its rear façade. It was painted white and surrounded by the trees, boundary hedges, shrubs and the swimming pool giving an integrated natural environment (**Figure 4.4**). Peers' Peak apartment had light orange color tones complementing with white tones in the balconies. The landscaped vegetation had a variety of green color tones and the roofing tiles had a dark brown color tone (**Figure 4.5**).



Figure 4.4: Ramis Court apartment design
Source: Author 2021



Figure 4.5: Peers Peak apartment design
Source: Author 2021

Sunny Hill apartment had big balconies, distinct pitched roofs and landscaped trees on one side of the parking space (Figure 4.6). The apartments had brick cladding which was balanced out by the light paint tones and was similar to the roof tiles of the apartment. Viraj gardens and Bellway Court apartments had grey masonry finish on their overall finish. The landscape of Viraj apartment looked barren but there was presence of indigenous trees (Figure 4.7) while Bellway court had a lawn and shrubs (Figures 4.8).



Figure 4.6: Sunny Hill apartment design
Source: Author 2021



Figure 4.7: Viraj Gardens apartment design
Source: Author 2021

Kaisa Garden apartments are tall structures of 14 storeys with a vibrant orange color and a small lawn with palm trees planted in concrete pots at the Centre with a seating area and children’s playing area that acts as the focal point of the space. The building has geometrical façade with modern look and feel (Figure 4.9).



Figure 4.8: Bellway Court apartment design
Source: Author 2021



Figure 4.9: Kaisa Gardens apartment design
Source: Author 2021

4.3.2. Water

Majority (83 %) of professionals used swimming pools as water features in an apartment while six percent used spas (Figure 4.10). One respondent stated that limited space did not allow having water feature as a design in the apartment space.

Have you ever used any of these water features in the designs of apartment ?

18 responses

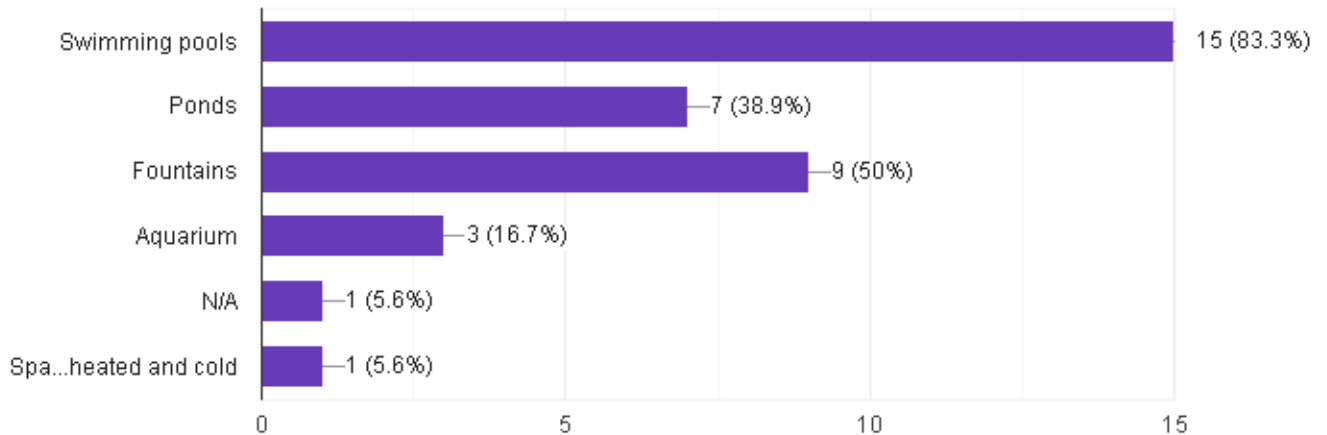


Figure 4.10: Water Features that have been used by the professionals

Source: Author 2021

Only 7 (32%) of the occupant respondents stated that they had water features present within their apartment compound. 9 (64%) approved of having water features in their apartment compounds. The water features reported by the occupants were swimming pools (60 %) and rivers (40 %). The rivers were neighboring the apartment compound. One of the occupants reported an empty pool.

Observation findings indicated that Peers Park apartments had a neglected swimming pool which was empty and misused for hanging carpets (Figure 4.11). Bellcrest apartments had a swimming pool where shadows were cast on it as there is not enough sunlight due to tall buildings surrounding it and a lack of privacy (Figure 4.12). Ramis court had a secure swimming pool surrounded by a hedges and variety of trees which provided privacy (Figures 4.13 and 4.14). Sunny hill apartments had a swimming pool space as well surrounded by trees and hedges (Figures 4.15 and 4.16).



Figure 4.11: Peers Park apartment empty swimming pool
Source: Author 2021



Figure 4.12: Bell Crest Gardens apartment swimming pool
Source: Author 2021



Figure 4.13: Ramis Court apartment swimming pool and vegetation
Source: Author 2021



Figure 4.14: Ramis Court apartment swimming pool and vegetation top view
Source: Author 2021



Figure 4.15: Sunny Hill apartment swimming pool space
Source: Author 2021



Figure 4.16: Sunny Hill apartment swimming pool space
Source: Author 2021

4.3.3. Space

8 (36%) of the professional respondents stated they would maximize apartment occupancy space to the disadvantage of external landscaping elements. The main reason given for maximizing the apartment on the plot was to increase the interior space and number of flats for maximum rental income. The professionals stated that developers ignored development guidelines in order to maximize apartment occupancy. The professionals stated that outdoor space played a big role in the balance between the building and its surrounding environment. 11(50 %) of the professionals' respondents strongly agreed that transitional spaces were important in the design of interior and exterior apartment spaces. One of the respondents stated that having transitional spaces would depend on the client's brief. The majority transitional spaces designed by professionals had the following characteristics; spacious, functional, had access to natural light and fresh air. These spaces allowed maximum connection between different spaces and had diffused light and created privacy (Figure 4.17).

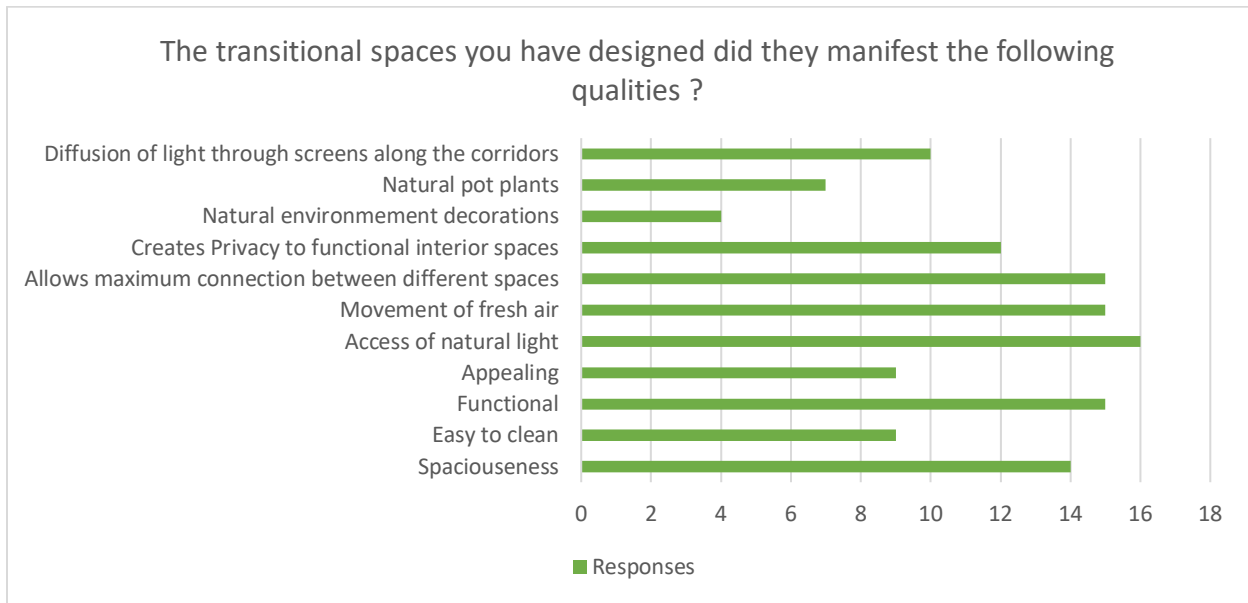


Figure 4.17: Transitional Space Characteristics
Source: Author 2021

A majority of professional respondents designed transitional spaces such as; porches, atriums, courtyards and lobbies. The professionals stated why they were not designing transitional spaces. Among the reasons were; client's restriction to the proposed design, lack of knowledge by designers to design them, expensive undertaking. The other reasons stated were lack of space, insecurity and lack of appreciation of transitional spaces by the client (Figure 4.18).

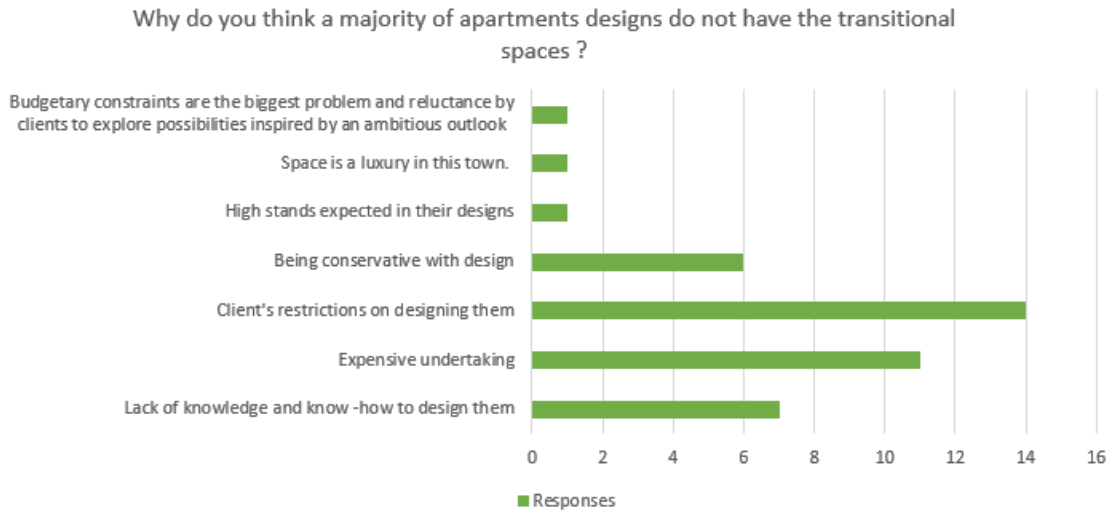


Figure 4.18: Reasons for lack of transitional spaces given by professionals
Source: Author 2021

The professionals designed outdoor and indoor leisure spaces in apartments. These spaces included; gardens, lounges, wide corridors, family rooms, balconies, gazebos, vertical gardens, terraces, patios, roof top gardens, interior plants, water features, atriums and courtyards (**Figure 4. 19**). Color, line, shape, proportion and acoustical elements were some of the design elements the professionals stated they used to integrate spaces to achieve biophilic design.

Which Ones ? colonnades, aisles, courtyards, water bodies, openings like doorways, pathways, grounds, patios, gardens, trellis, pergolas, foyers, lobbies,
 19 responses

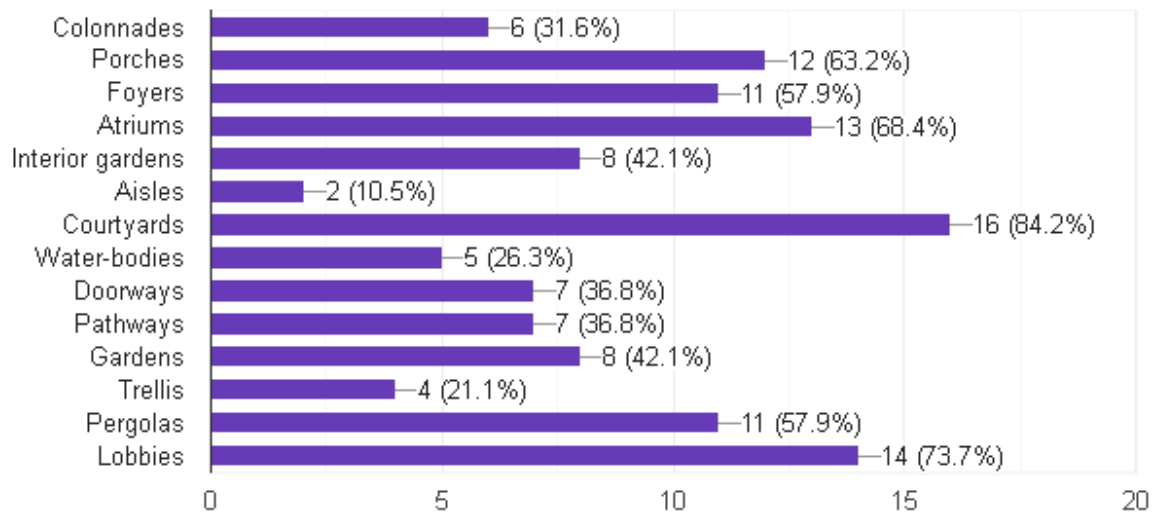


Figure 4.19: Types of Transitional Spaces
Source: Author 2021

The professionals reported that the common conducive biophilic design attributes they incorporated in the apartment designed included; botanical motifs, organic shapes and forms, façade greening, transitional spaces, natural materials, natural colors, vistas, spaciousness and natural lighting (Figure 4.20).

What are the common design and built form features do you incorporate for conducive occupation for an an apartment ?

21 responses

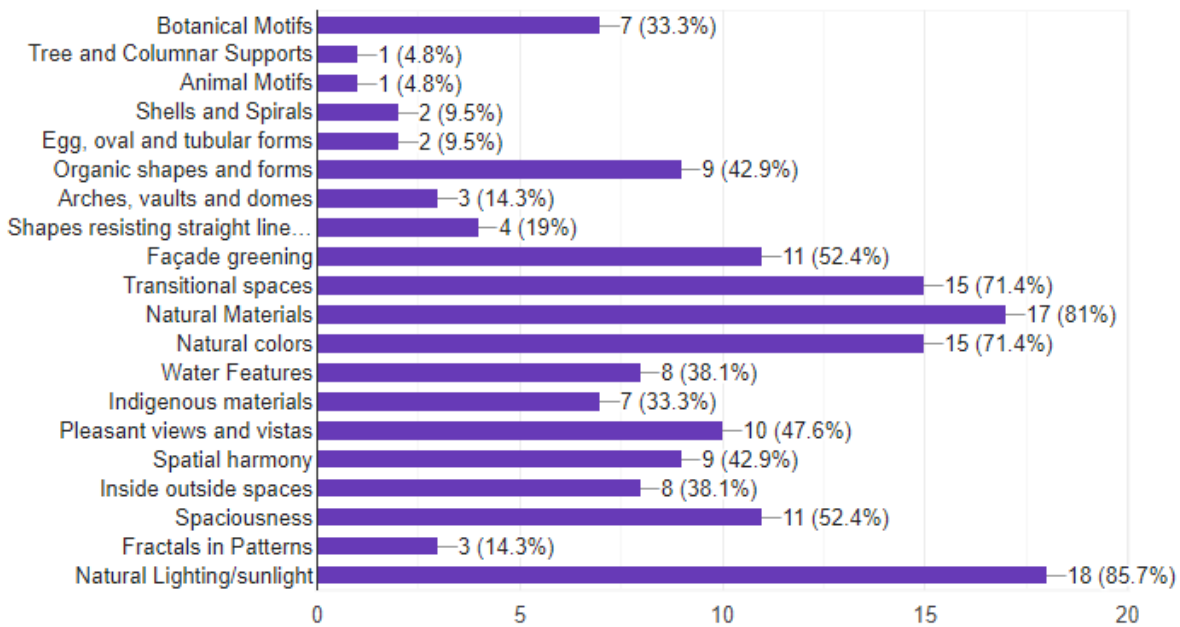


Figure 4.20: Different Biophilic design attributes
Source: Author 2021

21 (95%) of professionals identified hearing of natural features and animals as the sensory experience captured natural environment while taste was the least used sensory experience (Figure 4.21).

How would you bring out this sensory experiences using the natural environment in an apartment space?

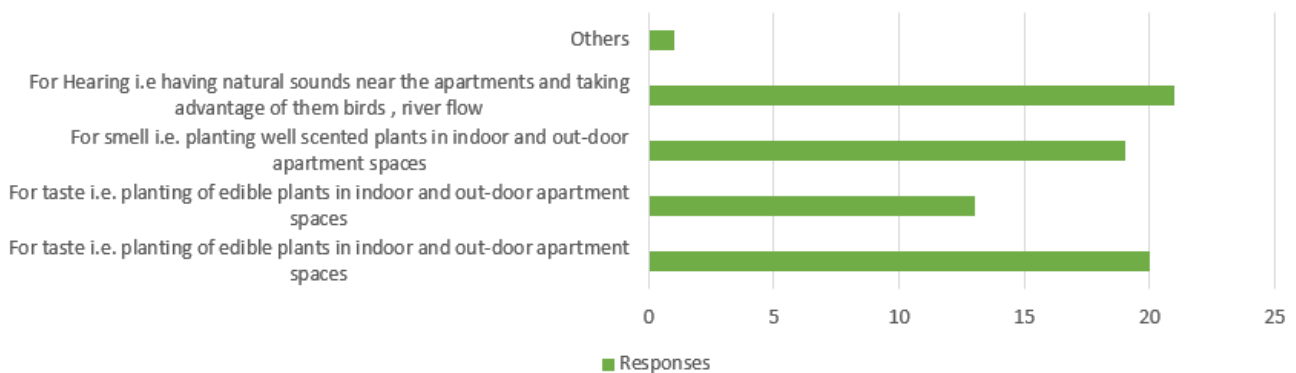


Figure 4.21: Transitional Spaces designed by the professional respondents
Source: Author 2021

20 (91%) of the occupant respondents considered the internal and external of the apartment they were staying in beautiful. The reasons given by majority of respondents were parking spaces while the least were balconies for external spaces (Figure 4.22). Similarly, the elements for the internal spaces that scored the highest were large windows and well-ventilated rooms while the least scoring elements were curvilinear spaces, indoor gardens, and high timber ceiling (Figure 4.23).

ii. If yes, what are the aesthetic elements for the exterior space of the apartments?

21 responses

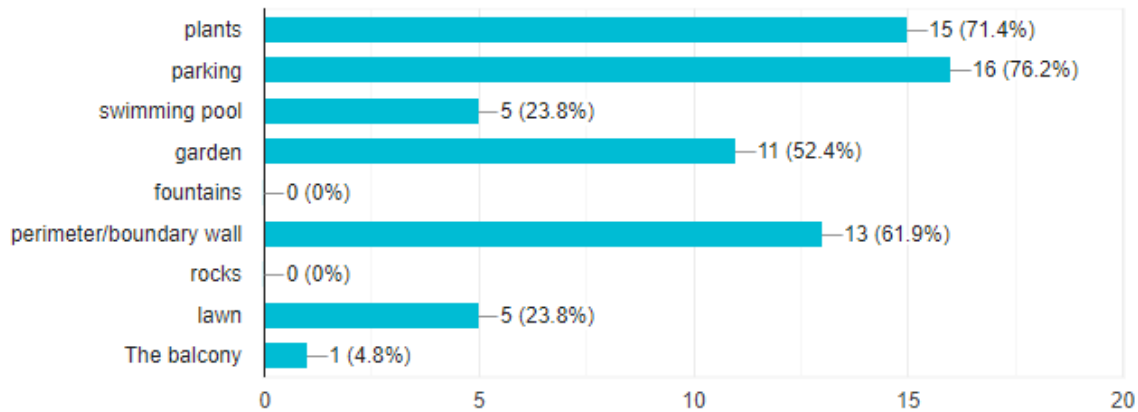


Figure 4.22: Elements of exterior spaces

Source: Author 2021

If yes, what are the aesthetic elements for the internal spaces of the apartments?

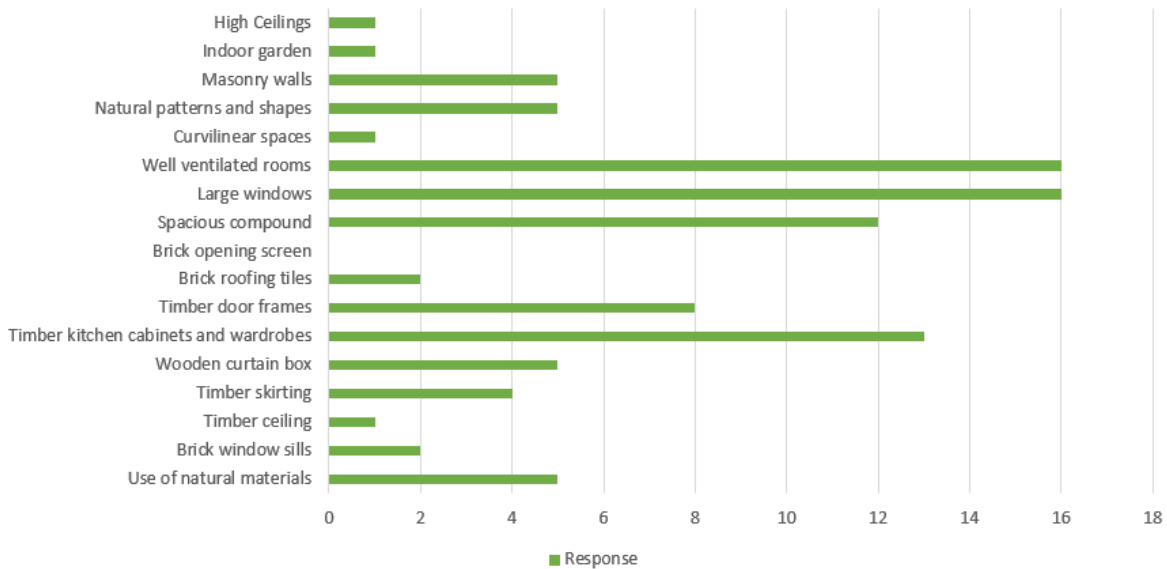


Figure 4.23: Elements of Interior spaces

Source: Author 2021

Ramis court, Viraj garden and Sunning Hills apartments had spacious lounges (**Figure 4.24, 4.25 and 4.26**). In Ramis Court apartments the common spaces had screens which allowed the diffusing of light. There were decorations present along the walls in the walkways of palm trees painted along the walls. The screens were made of adobe baked bricks and there was presence of indoor pot plants along the walk ways (**Figure 4.27**). Kaisa Garden and Bellway apartments had small lounge spaces. The spaces lacked ornamentation of any kind (**Figure 4.28 and 4.29**).



Figure 4.24: Ramis Court apartment lounge space
Source: Author 2021



Figure 4.25: Viraj Gardens apartment lounge space
Source: Author 2021



Figure 4.26: Viraj Gardens apartment lounge space
Source: Author 2021



Figure 4.27: Ramis Court apartment decorative walls and screens
Source: Author 2021



Figure 4.28: Kaisa Garden lounge space
Source: Author 2021



Figure 4.29: Bellway Court apartment lounge space
Source: Author 2021

4.3.4. Sunlight

11 (50 %) of the professionals had the highest considerations for large windows to facilitate in natural ventilation and lighting in apartment spaces while only 1 professional had a moderate consideration of large windows. 11(50%) of the respondents also stated that it was extremely important to take advantage of the buildings orientation towards sunlight to regulate internal temperatures of the apartment space. The professional expressed different ways they would make natural light inclusive in the internal spaces of apartments (Figure 4.30).

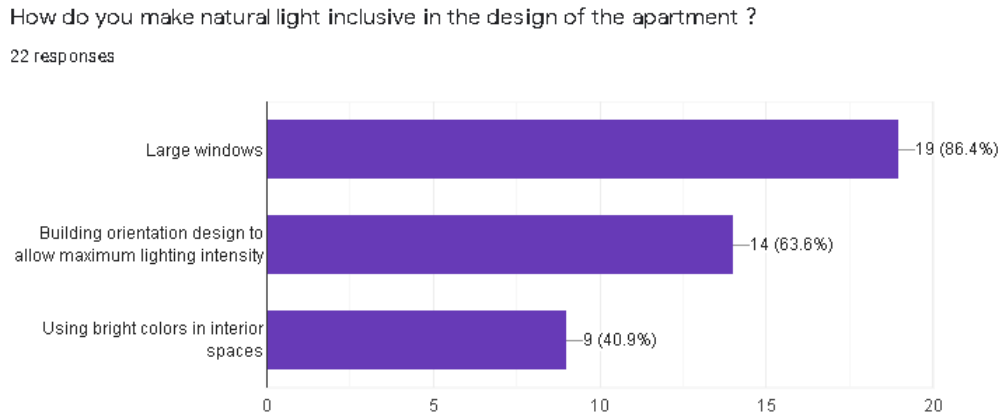


Figure 4.30: Light Inclusivity results by professional respondents
Source: Author 2021

21 (91%) of occupants' respondent stated they received adequate sunlight in their apartment spaces. The main reason given for inadequate lighting in were; spaces being blocked by surrounding buildings and having small windows. Eight (34 %) of the occupants stated that they had excellent quality of sunlight in their apartment spaces while four (17%) reported having poor sunlight quality (Figure 4.31).

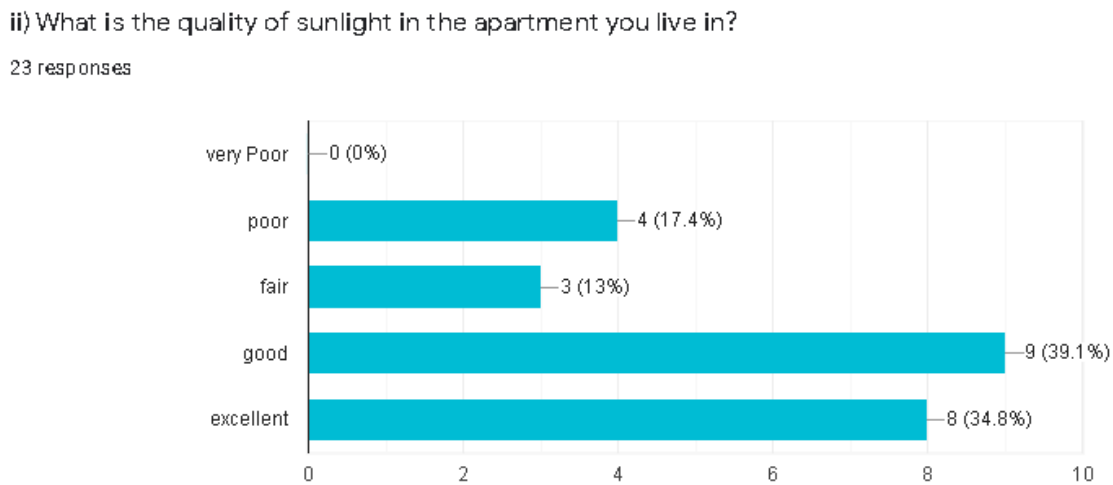


Figure 4.31: Occupants Respondents on Internal Spaces
Source: Author 2021

11(47.8%) of occupants were satisfied with the lighting in their apartment spaces while 1(4%) was not satisfied (Figure 4.32).

v) Are you satisfied with the amount of sunlight you receive in your apartment?

23 responses

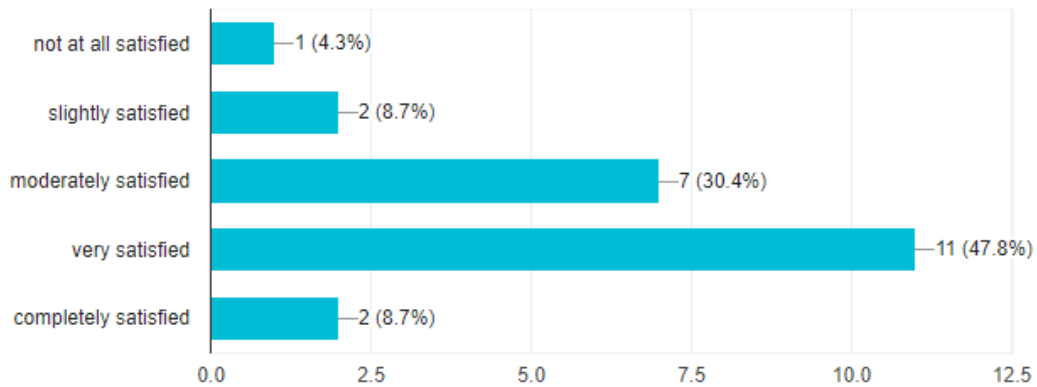


Figure 4.32: Responses on Occupants' satisfaction on lighting of internal spaces
Source: Author 2021

18 (78 %) of occupants stated that there were spaces in their apartments that were inadequately lit. These spaces included; the kitchen, toilet, laundry and corridors among others (Figure 4.33).

Name those spaces;

19 responses

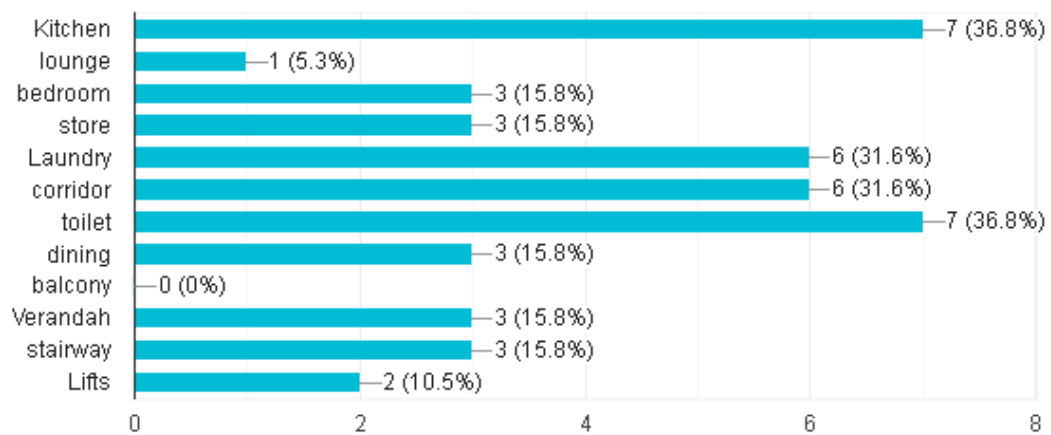


Figure 4.33: Occupants' Respondents on lighting of Internal Spaces
Source: Author 2021

Majority of the occupants stated that inadequate lighting in spaces was caused by lighting through other spaces while the least reported reason was artificial lighting and lack of windows (Figure 4.34).

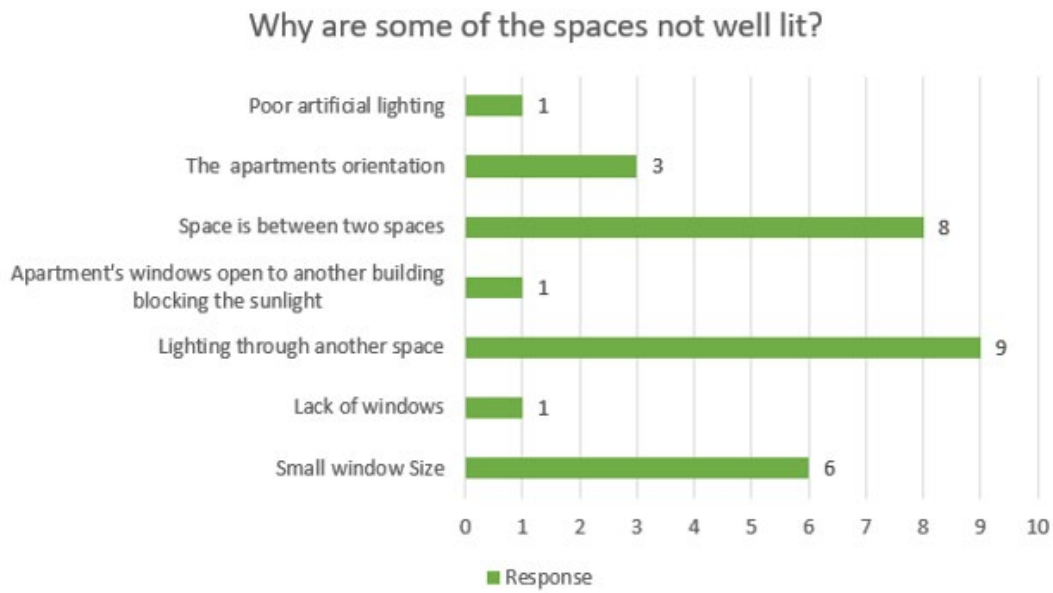


Figure 4.34: Reasons for inadequate lighting in interior spaces reported by occupants
Source: Author 2021

The observation findings established that Bellcrest Gardens, Kaisa Gardens and Sunning Hill apartments had different poorly lit spaces. Kaisa garden apartment had small windows in their bedrooms which were covered natural lighting source at the roof level. Some of the windows in Kaisa garden apartments were obstructed by neighboring buildings (Figure 4.35 and 4.36). Bellcrest Garden apartment had small windows in its staircase space (Figure 4.37). Sunning Hill apartment was below the ground level and the lounge window was blocked by embankment (Figure 4.38).



Figure 4.35: Kaisa Garden small windows
Source: Author 2021



Figure 4.36: Kaisa Garden Bedroom Interior Space
Source: Author 2021



Figure 4.37: BellCrest Garden staircase space
Source: Author 2021



Figure 4.38: Sunny Hill apartment lounge
Source: Author 2021

The corridor spaces for Bellway Court and Ramis court apartment were not well lit and got their day light source indirectly from other spaces (**Figure 4.39 and Figure 4.40**). A majority of Bellway Court Apartment staircase spaces were not well lit (**Figure 4.41 and 4.42**).

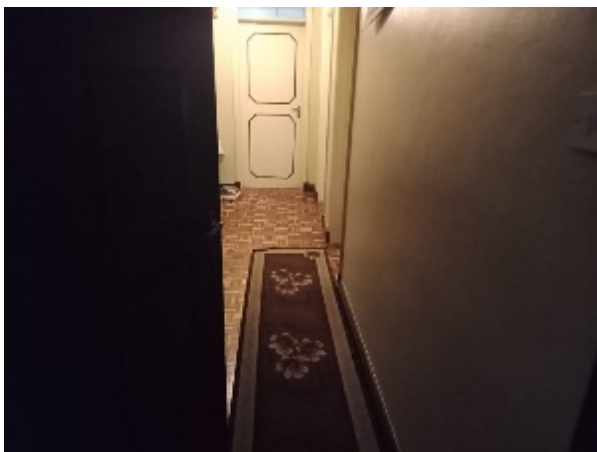


Figure 4.39: Bellway Court apartment corridor space
Source: Author 2021

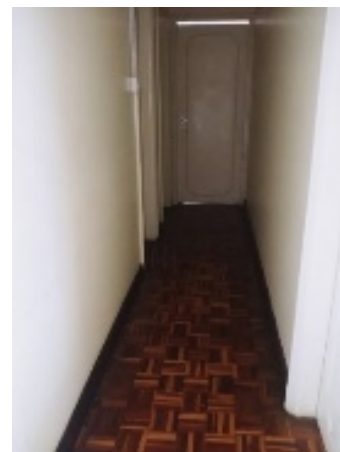


Figure 4.40: Ramis Court apartment corridor space
Source: Author 2021



Figure 4.41: Bellway Court apartment staircase space
Source: Author 2021

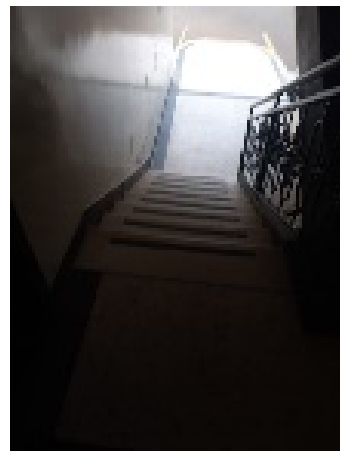


Figure 4.42: Bellway Court apartment staircase space
Source: Author 2021

Ramis court, Viraj Gardens and Bellway Court apartments had different well-lit and ventilated spaces (**Figure 4.43, 4.44 and 4.45**). Ramis Court and Peers Peak apartments had well-lit staircase spaces by taking advantage of screens and large windows in these spaces. Bellway Court apartment had some staircase spaces well lit (**Figure 4.46, 4.47 and 4.48**).



Figure 4.43: Ramis Court apartment interior
Source: Author 2021



Figure 4.44: Viraj apartment interior space
Source: Author 2021



Figure 4.45: Bell Way Court apartment space
Source: Author 2021



Figure 4.46: Peers Peak apartment staircase space
Source: Author 2021



Figure 4.47: Ramis Court apartment staircase space
Source: Author 2021



Figure 4.48: Bellway Court apartment staircase space
Source: Author 2021

4.3.5. Air

All of the professional respondents stated that use of the natural environment to regulate ventilation was important. They also all agreed that it was important to have proper window sizes for natural lighting and ventilation in internal spaces. 19 (86%) of professionals stated that they would use well scented plants in indoor and outdoor of the apartments to bring out sensory variability (Figure 4.21). 15(72%) of professionals reported that they had designed transitional spaces that manifested movement of fresh air as one of its qualities (Figure 4.17).

All of the occupant respondents stated that the quality of air in their apartment was adequate with 10(46%) of the occupants stating the quality of air was excellent while six (26%) stating it was fair. The main reason given for poor quality of air was dusty roads. 14 (61%) of occupants were satisfied with the quality of air in their apartment while one (4%) occupant was not satisfied (Figure 4.49).

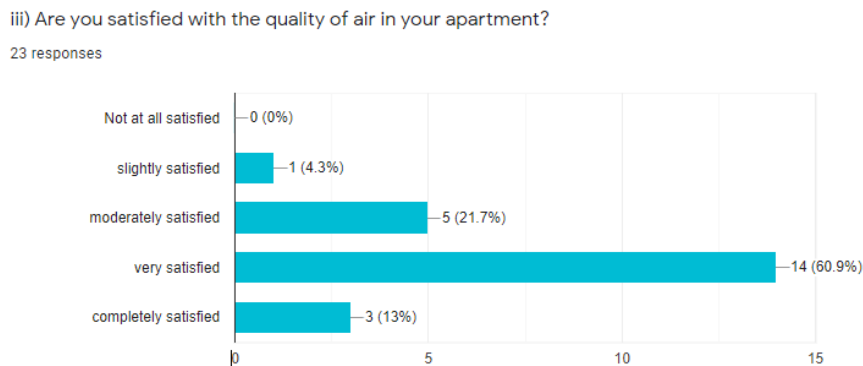


Figure 4.49: Occupants responses on air quality satisfaction in internal spaces
Source: Author 2021

12 (52.2%) of the occupants strongly agreed that the outdoor vegetation had a positive influence in quality of air in their apartments while one (4%) occupant strongly disagreed (Figure 4.50).

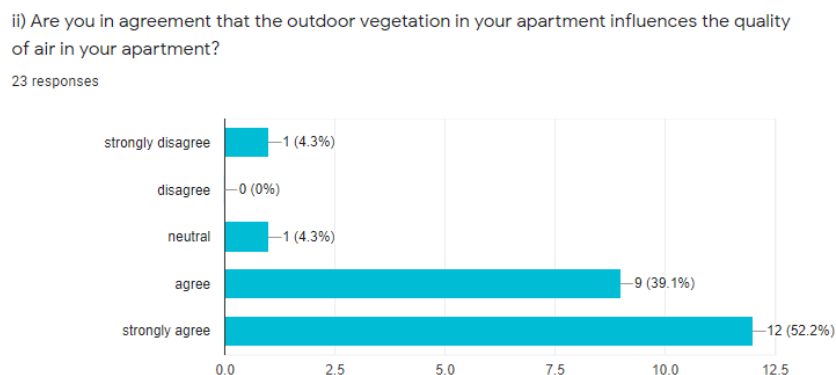


Figure 4.50: Occupants responses on influence of outdoor vegetation on air quality in internal spaces
Source: Author 2021

Nine (39%) of occupants reported that there was inadequate ventilation in different internal spaces in their apartments. These spaces included toilets and corridors (**Figure 4.51**).

Name those spaces:

10 responses

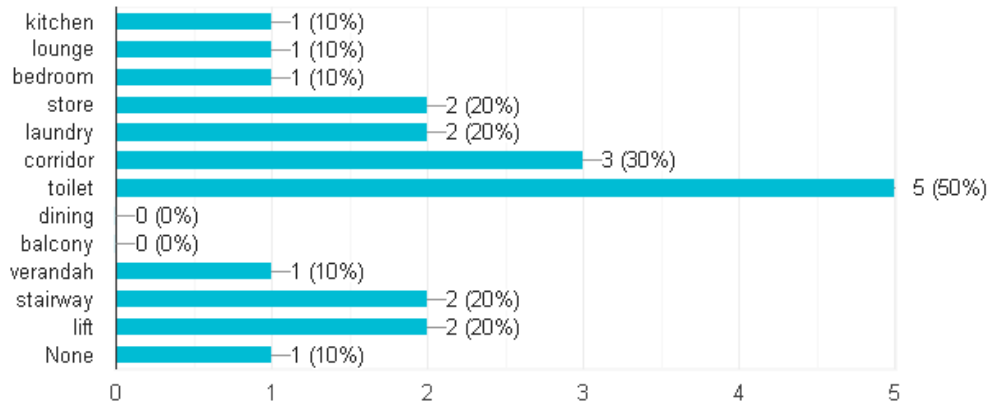


Figure 4.51: Occupants responses on ventilation of internal spaces

Source: Author 2021

Majority of occupants stated the reason for poor ventilation in their internal spaces was due to apartment windows opening to another building hindering proper ventilation while the least reported reasons were lack of vents on the windows and ventilating through other spaces (**Figure 4.52**).

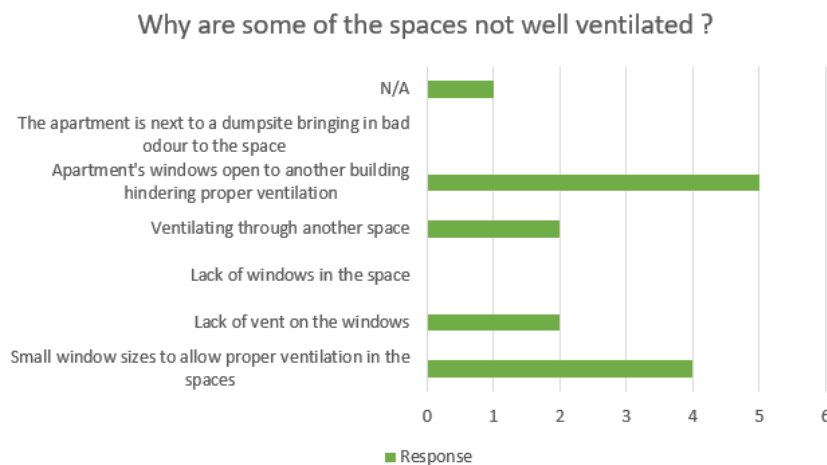


Figure 4.52: Reasons for inadequate ventilation in interior spaces reported by occupants

Source: Author 2021

The observation findings established that in Ramis Court apartment washroom space was ventilated through the laundry space (**Figure 4.53 and 4.54**). Sunny Hill apartment lounge space ventilation was obstructed by the embankment (**Figure 4.38**) while buildings (**Figure 4.35**) obstructed some of the spaces in Kaisa Garden apartment's ventilation.

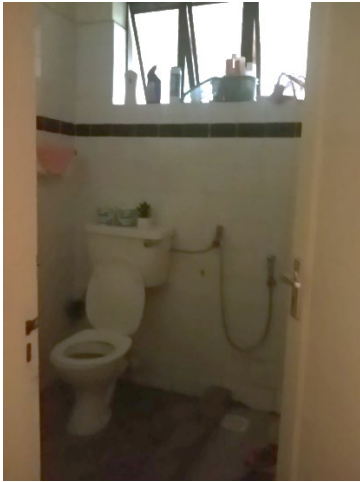


Figure 4.53: Ramis Court washroom ventilation
Source: Author 2021



Figure 4.54: Ramis Court washroom ventilation occurring through the laundry
Source: Author 2021

4.3.6. Materials

13(59%) of professional respondents agreed that indigenous materials should be used in the design of apartments while three (14%) disagreed to this (**Figure 4.55**). 10 (46%) of professionals strongly agreed that it was better to use finishes from natural materials than using synthetic imitation materials while three (14%) of the professionals strongly disagreed to this (**Figure 4.56**). The main reason was that natural materials were exhaustible and design should take advantage of technologies and look into composite materials. Professionals stated that masonry could be interpreted by the natural environment in different ways. These included; by painting natural color tones, molding it to give it different tactile feel, exposing the natural finish, cladding it with natural stone, molding texture and patterns and motif on it, planting creepers and other similar plants on it to create contrast.

Five (25%) of the building occupants reported that use of natural materials including; timber, stone and bricks. Timber was used to make; ceiling, skirting, kitchen cabinets, wardrobes and door frames while bricks made window sills and roofing tiles. Stone was used to make masonry walls. The occupants liked these natural materials because of their aesthetical qualities (**Figure 4.23**).

Are you in agreement that indigenous materials should be used in the design of apartments ?

22 responses

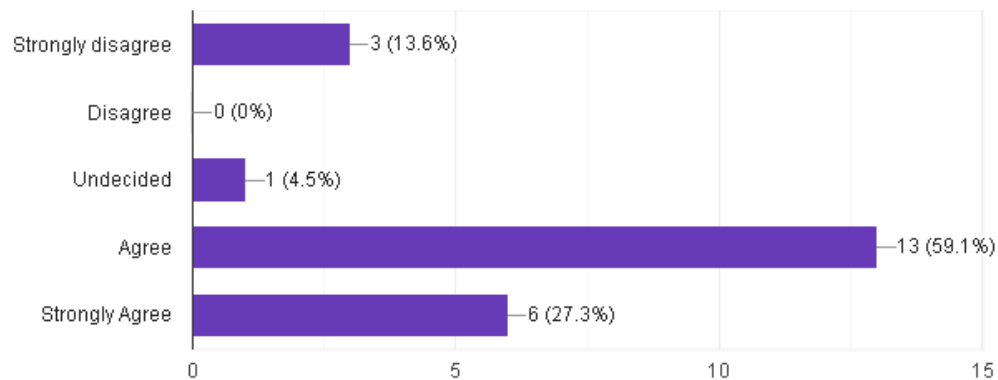


Figure 4.55: Professional response on use of indigenous material
Source: Author 2021

As a designer do you agree that natural materials are better to use as finishing than synthetic imitations of these materials ?

22 responses

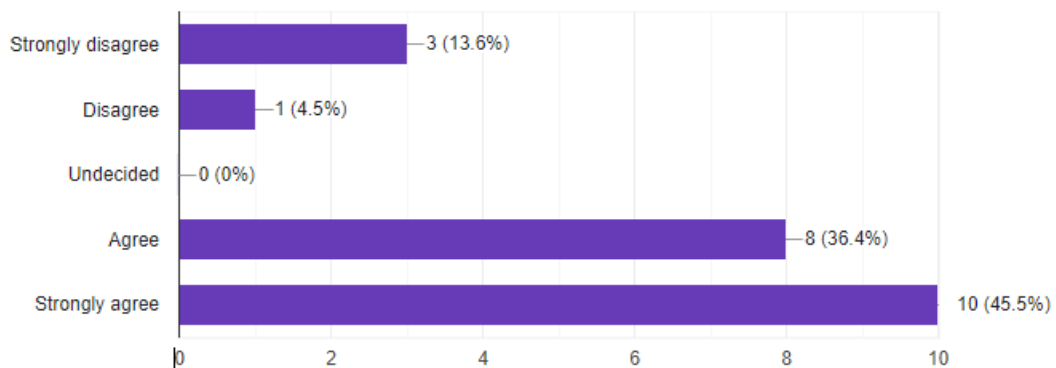


Figure 4.56: Professional response on use of natural material
Source: Author 2021

The observation findings establish that Kaisa Garden apartment had used floor tiles and paint on the plastered walls (**Figure 4.57**). Ramis Court had parquet floor, T&G ceiling, timber pelmet and skirting (**Figure 4.58**). In all apartment spaces the external doors were made of painted mild steel. Sunning hill apartment only had both wooden and tile floor finish (**Figure 4.59 and 4.60**). There are no decorations in the any of the spaces. Viraj garden had a floor finished with plastic PVC which was an imitation of natural wood (**Figure 4.61**). Bellway apartment had used carpet on a wooden parquet floor (**Figure 4.62**).



Figure 4.57: Kaisa Garden apartment finish
Source: Author 2021



Figure 4.58: Ramis Court apartment interior finish
Source: Author 2021



Figure 4.59: Sunning Hill apartment finish
Source: Author 2021

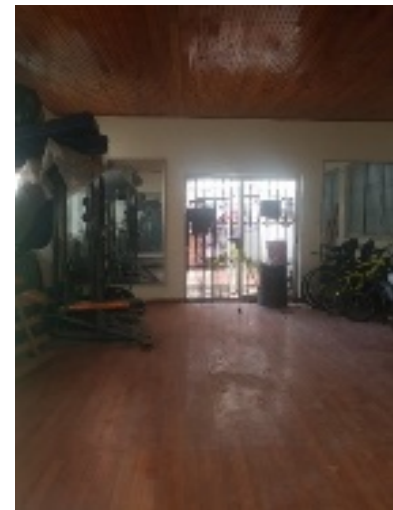


Figure 4.60: Sunning Hill apartment finish
Source: Author 2021

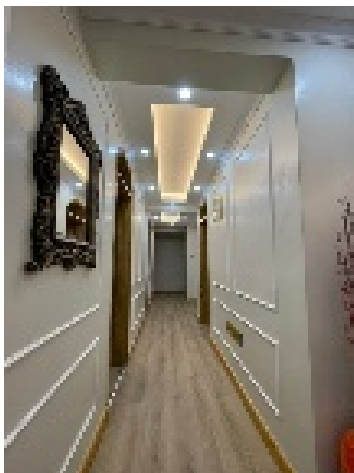


Figure 4.61: Viraj Gardens apartment finish
Source: Author 2021



Figure 4.62: Bellway Court apartment finish
Source: Author 2021

4.3.7. Landscape

19 (86%) of the professional respondents agreed that it was important to maintain the natural ecosystem and habitats within the apartment compound. 16 (73%) of the professionals stated that the main factor leading to least consideration of natural environment in the apartment design was client maximizing on plot coverage while the least consideration highlighted by four (18%) of the professionals was lack of considering biophilic design principles (**Figure 4.63**). One professional reported that considering the natural environment in the design of apartments was perceived not to add value on the sell or rent of the apartments. All the professionals noted that taking into account of the natural environment in the design of apartments had a positive effect on the wellbeing of the occupant.

16(73%) of the professionals stated that the main reason apartments did not have green walls or roofs gardens was due to the venture being an expensive undertaking while one (5%) of the professionals reported there was lack of incentive to incorporate green walls and roof gardens (**Figure 4.64**). 18 (82%) of the professionals reported using images of nature like paintings when decorating the interiors of apartments while 16(72%) of the professionals stated that they had used murals of the natural environment to decorate the outdoor spaces of apartments. Some of the professionals stated they did not use murals to decorate outdoor spaces due to restrictions by the client and having a prudence to geometric forms in their mural designs.

What factors lead to least consideration of natural environment elements in the design of an apartment ?

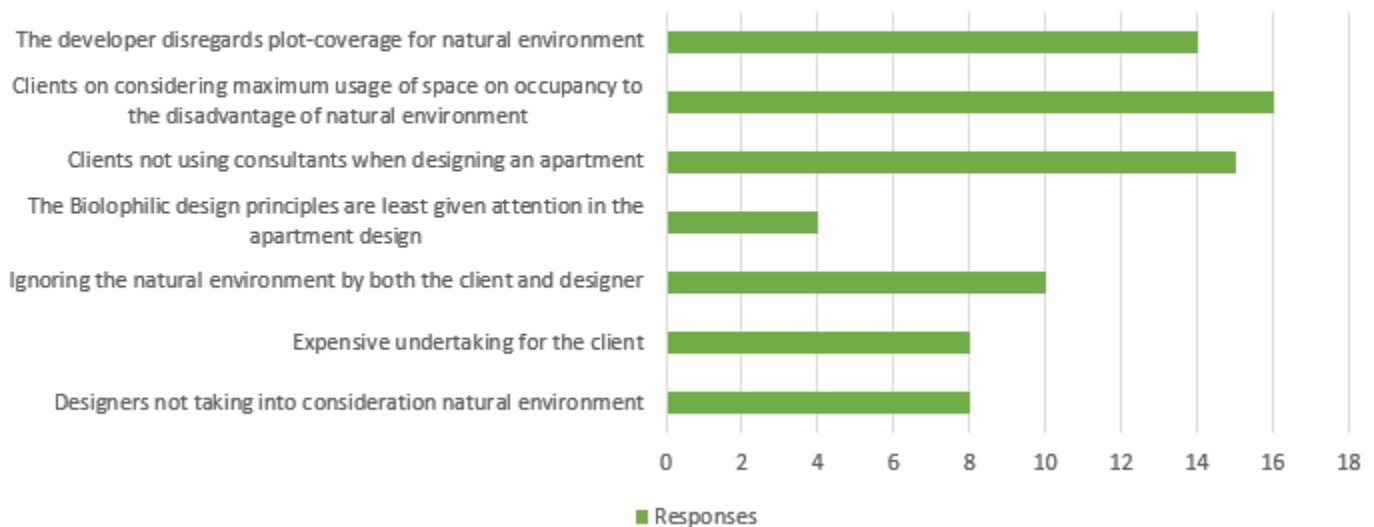


Figure 4.63: Lack of Consideration of the Natural Environment Results by the professional respondents
Source: Author 2021

As a professional consultant, why do you think many apartments do not have green walls and roof gardens ?



Figure 4.64: Reasons of Lack of Green Walls Results by the professional respondents
Source: Author 2021

22 (96%) of the occupant respondents stated that there were landscaping elements in their apartment spaces. Majority, 15(68%) of the occupants reported that flower pots were the main landscaping elements while the least were rocks, moulds, landscape photographs, aquariums, patio and fountains identified by one (5%) occupant for each case (Figure 4.65).

ii) Name those landscaping elements;

22 responses

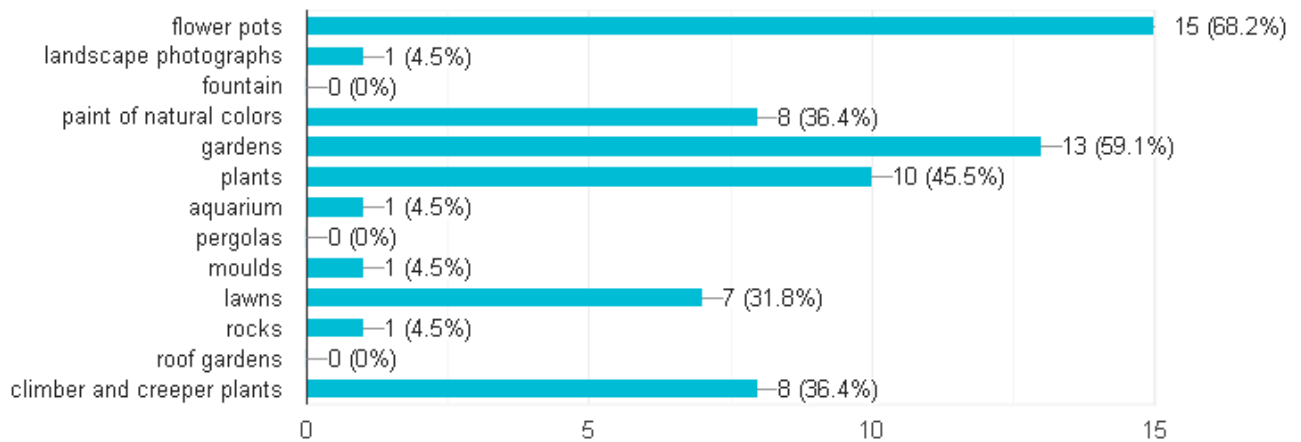


Figure 4.65: Occupants Response on landscape elements in the apartment space
Source: Author 2021

Majority, 9 (39%) of occupants were aware of the internal landscaping within the interior spaces of their apartments (Figure 4.66) while 3(13%) were not aware for the same. 9(41%) of occupants were also aware of the external landscaping within their apartment compound while one (5%) was not aware (Figure 4.67). Majority of the occupants were not using the landscaped spaces (Figure 4.68) because they were not satisfied with them (Figure 4.69).

iii) Are you aware of the landscaping within the interiors of your apartments?

23 responses

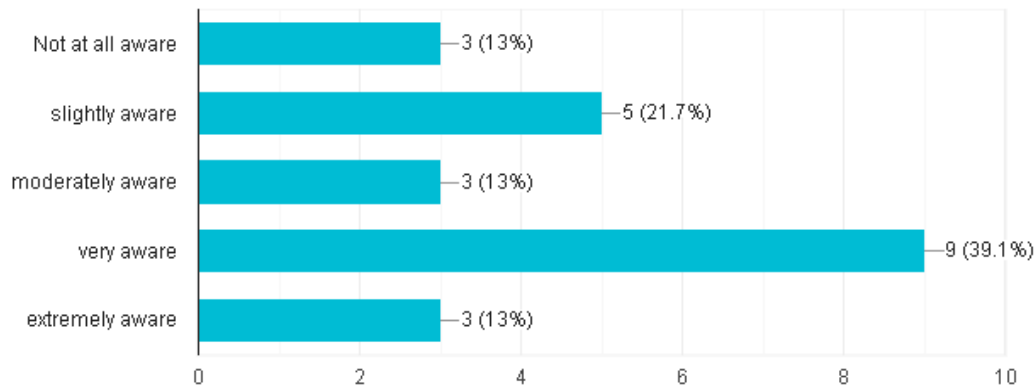


Figure 4.66: Occupants Respondents awareness of landscaping elements within the apartment
Source: Author 2021

iv) Are you aware of the landscaping within your apartment compound?

22 responses

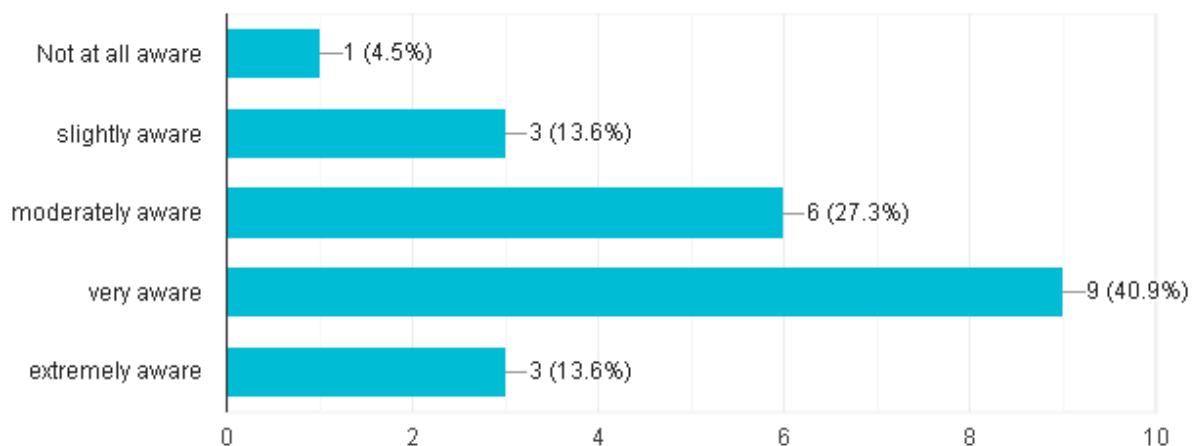


Figure 4.67: Occupants Respondents awareness of landscaping elements outside the apartment
Source: Author 2021

v) How frequent do you use the landscaped spaces at your apartments?

22 responses

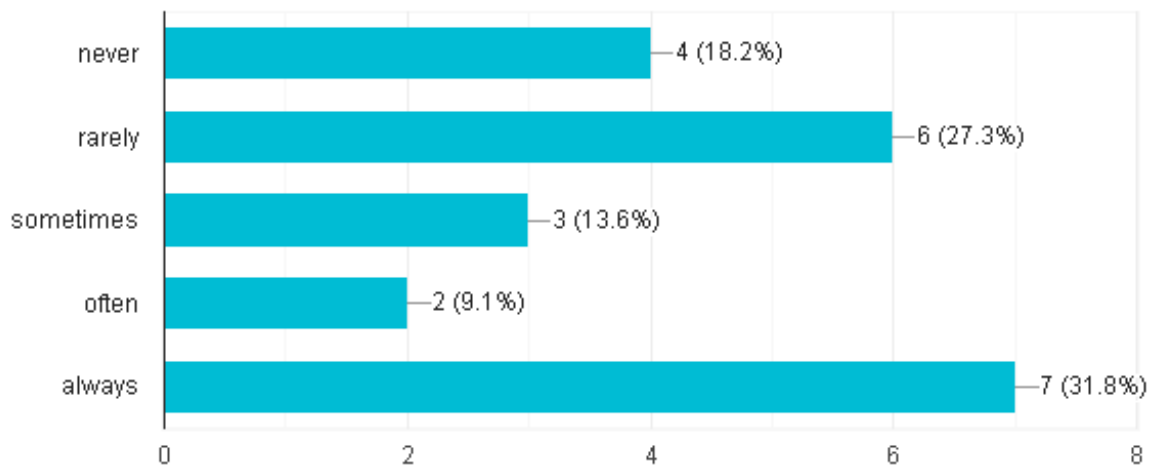


Figure 4.68: Occupants response on the use of landscaped spaces

Source: Author 2021

vi) Are you satisfied with the landscaping in your apartments?

22 responses

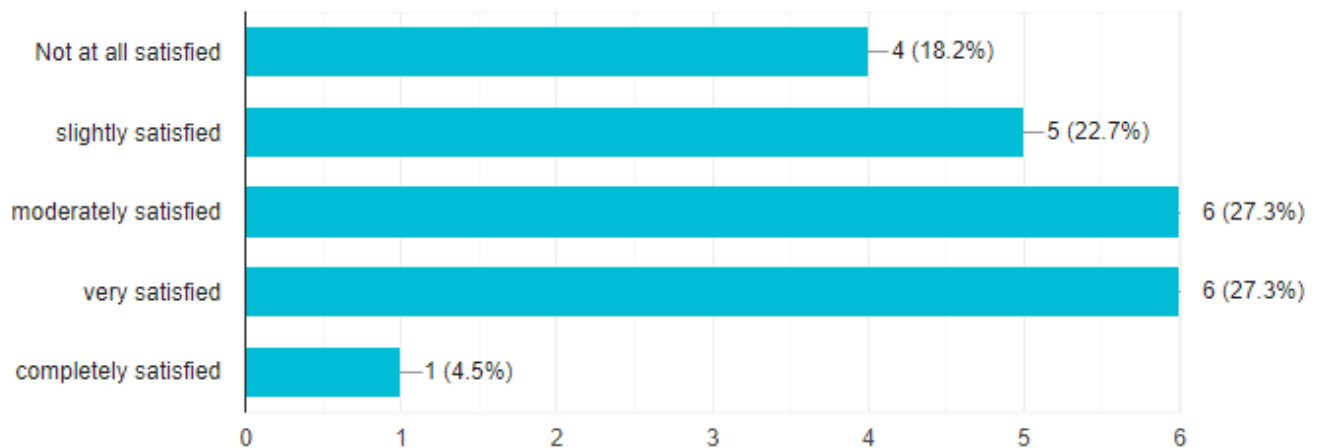


Figure 4.69: Occupants response on satisfaction of landscaped spaces

Source: Author 2021

14 (70%) of the occupants stated that landscaping elements were in the apartment compound while the lifts area, toilet, laundry, pool area and bedrooms were reported to by the least number of occupants as having landscaped elements. The dining, store and corridor were not reported to have any landscaping elements by the occupants **(Figure 4.70)**.

vii) What spaces in your apartment have landscaping elements?

20 responses

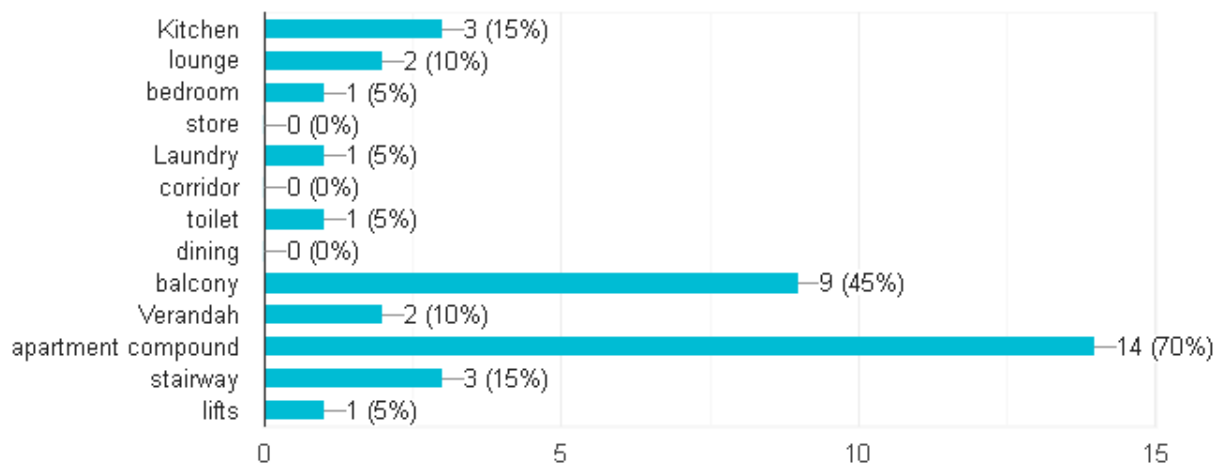


Figure 4.70: Occupants Response on landscape elements in the apartment

Source: Author 2021

8 (36%) of occupants were satisfied with the plants, trees and shrubs within the apartment compound (**Figure 4.71**). 59% of the occupants stated that the plants, trees and shrubs had a positive effect on their well-being and mental state of health (**Figure 4.72**). The most frequently reported spaces that related to the view of plants were; the lounge reported by 9 (41%) of the occupants, the bedroom reported by 13 (60%) of the occupants and the balcony reported by 14 (64%) of the occupants (**Figure 4.73**).

ii) Are you satisfied with the plants, trees and shrubs present within the compound of your apartment?

22 responses

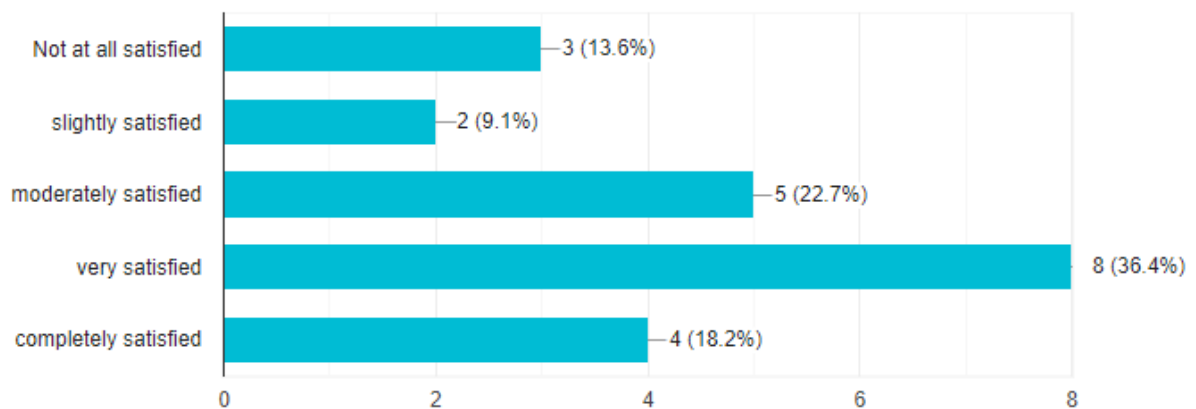


Figure 4.71: Occupants' satisfaction of the vegetation within the apartment compound

Source: Author 2021

iv) Do these plants, trees and shrubs have a positive effect on your well-being and mental state?

22 responses

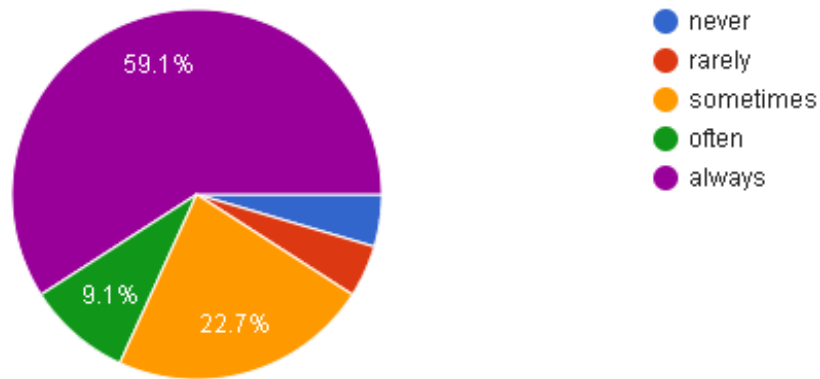


Figure 4.72: Occupants’ response effect of planting on their well-being
Source: Author 2021

v) Which spaces in your apartment relates strongly with view of the plants?

22 responses

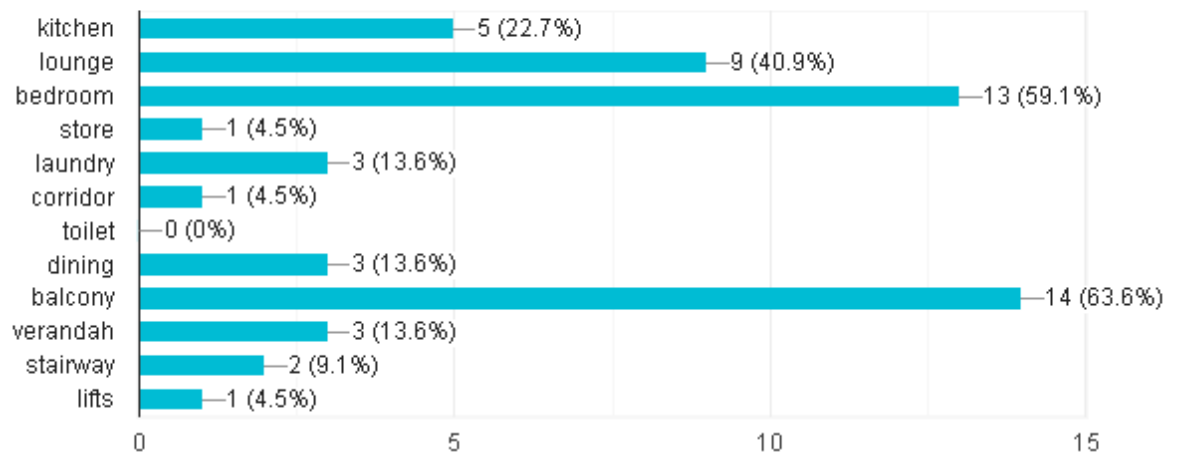


Figure 4.73: Occupants’ Respondents on Internal Spaces
Source: Author 2021

The observation findings indicate that Ramis Court, Bellway Court, Kaisa Garden, Peers Park and Sunning Hill apartments had a variety of vegetation; lawns, shrubs, trees, hedges and potted plants. Ramis Court, Viraj Garden, Bellway Court and Sunning Hill apartments had indigenous trees in their landscapes. Green walls were visible at Peers Park apartments. Kaisa Garden apartment was adjacent to a river and forest (**Figure 4.74, 4.75, 4.76, 4.77, 4.78, 4.79, 4.80 and 4.81**).



Figure 4.74: Ramis Court apartment landscape
Source: Author 2021



Figure 4.75: Bellway Court apartment landscape
Source: Author 2021



Figure 4.76: Kaisa Garden landscape
Source: Author 2021



Figure 4.77: Peers Park apartment landscape
Source: Author 2021



Figure 4.78: Sunning Hill apartment landscape
Source: Author 2021



Figure 4.79: Viraj Garden apartment landscape
Source: Author 2021



Figure 4.80: Peers Park apartment landscape
Source: Author 2021

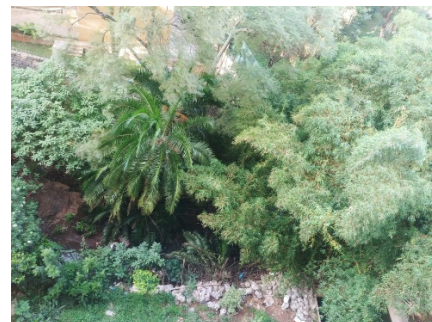


Figure 4.81: The river and forest adjacent Kaisa garden apartment.
Source: Author 2021

Viraj Gardens and Bellway Court apartment had masonry wall finish while the others were painted. All the apartment spaces had parking which had used cabro finish. Sunning Hill and Peers Park apartment had hedges along the concrete pathways. Ramis Court and Sunning Hill apartments had some of the windows made of brick screens. Sunning Hill also had some areas of hard surface made of mazeras stone. Kaisa had tile flooring finish on the outdoor seating and recreational space. All apartments had masonry boundary walls with electrical laser wires installed for security (Figure 4.82, 4.83, 4.84, 4.85, 4.86 and 4.87).



Figure 4.82: Viraj Garden apartment masonry finish
Source: Author 2021



Figure 4.83: Bellway Court apartment masonry finish
Source: Author 2021



Figure 4.84: Sunning Hill apartment hedges and concrete pathway
Source: Author 2021



Figure 4.85: Peers Peak concrete pathway
Source: Author 2021



Figure 4.86: Sunning Hill apartment Brick screens
Source: Author 2021



Figure 4.87: Sunning Hill apartment concrete pathway
Source: Author 2021



Figure 4.88: Sunning Hill apartment mazeras hard surface
Source: Author 2021



Figure 4.89: Kaisa Garden apartment tile hard surface
Source: Author 2021

Seating areas were found at Kaisa Garden, Viraj Gardens and Sunning Hill apartments. Swimming pools were found at Sunning Hills, Ramis Court, Peers Park and Bellcrest apartments. All apartments had parking with proper covered drainage channels. Children play areas were found in; Kaisa Garden, Bellway Court, Viraj Garden, Ramis Court and Peers Park apartments. There was garden lighting in Ramis Court, Peers Park and Sunning Hill apartments. At the rear of the apartment buildings there were drying lines security (**Figure 4.90, 4.91, 4.92, 4.93, 4.94, 4.95, 4.96, 4.97, 4.98, 4.99, 4.100, 4.101, 4.102, 4.103, 4.104, 4.105, 4.106 and 4.107**).



Figure 4.90: Kaisa Garden apartment outdoor furniture
Source: Author 2021



Figure 4.91: Viraj Garden apartment outdoor furniture
Source: Author 2021



Figure 4.92: Sunning Hill apartment outdoor furniture
Source: Author 2021



Figure 4.93: Sunning Hill apartment swimming pool
Source: Author 2021

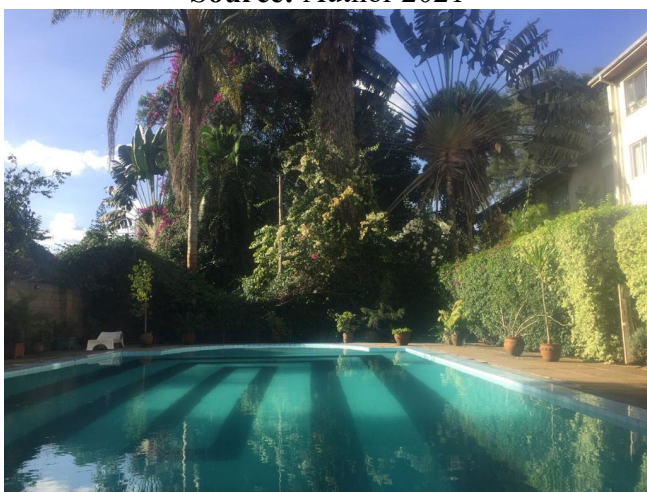


Figure 4.94: Ramis Court apartment swimming pool
Source: Author 2021

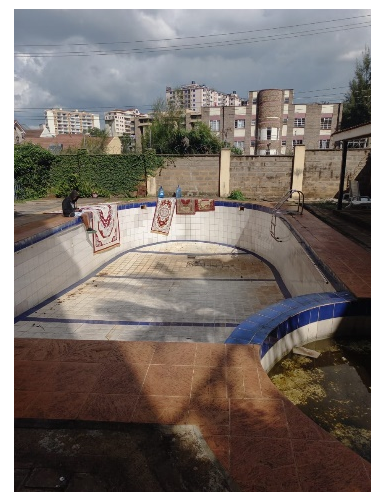


Figure 4.95: Peers Park apartment swimming pool
Source: Author 2021



Figure 4.96: Bellcrest apartment swimming pool
Source: Author 2021



Figure 4.97: Kaisa Garden children playground
Source: Author 2021



Figure 4.98: Bellcrest apartment children playground
Source: Author 2021



Figure 4.99: Viraj Garden apartment children playground
Source: Author 2021



Figure 4.100: Ramis Court apartment children playground
Source: Author 2021



Figure 4.101: Peers Peak apartment children playground
Source: Author 2021



Figure 4.102: Ramis Court apartment landscape lights
Source: Author 2021



Figure 4.103: Peers Peak apartment landscape lights
Source: Author 2021



Figure 4.104: Sunning Hill apartment landscape lights
Source: Author 2021



Figure 4.105: Peers Peak apartment drying lines
Source: Author 2021



Figure 4.106: Bellway Court apartment drying lines
Source: Author 2021



Figure 4.107: Sunning Hill apartment drying lines
Source: Author 2021

4.3.8. Views and Vistas

14 (64%) of professional respondents stated that views and vistas were important to occupants’ wellbeing in an apartment space. All of the occupant reported they had vistas from their apartment windows. 12 (54%) of the occupants noted that the vistas from their apartments were very important to them (Figure 4.108). 20 (91%) of occupants stated that these vistas gave them a peaceful state of mind. The occupants’ interior spaces that strongly related with the pleasant views were; balconies, bedrooms and lounges. The spaces that had minimal relations with these spaces were toilets. The lift area, store and the laundry had no relationship with the vistas (Figure: 4.109). For the majority of the occupants’ vistas were; vegetation, forests and distant buildings. 21(96%) of occupants reported that they had vistas of pot plants at the balconies, trees and shrubs from their apartment windows (Figure 4.110). 18 (82%) of occupants reported that the vistas of vegetation were within their compound while 11 (50%) were in neighboring compounds.

iv) Are these views important to you?

22 responses

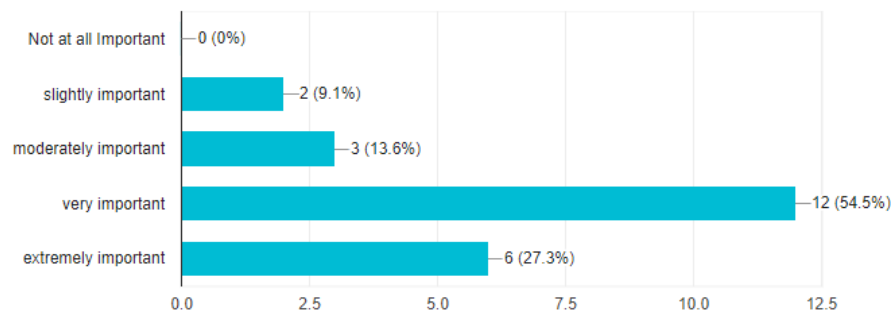


Figure 4.108: Occupants’ response on the importance of vistas
Source: Author 2021

Which spaces in your apartment relates strongly with the views and pleasant vistas?

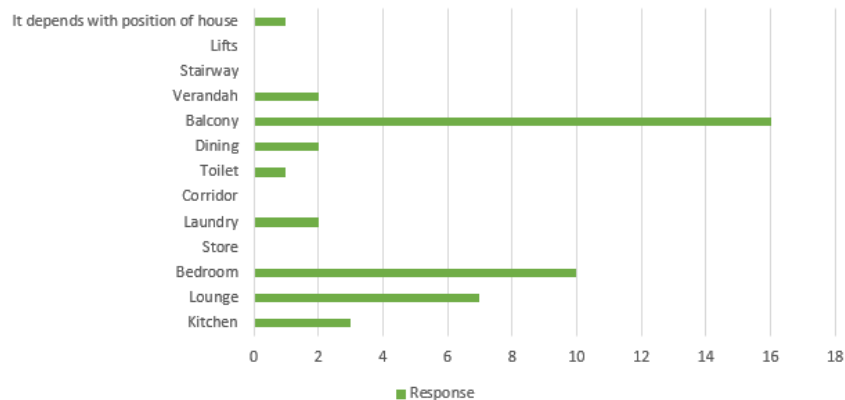


Figure 4.109: Occupants’ response on the relationship between internal spaces and vistas
Source: Author 2021

viii) Name those views and pleasant vistas;

22 responses

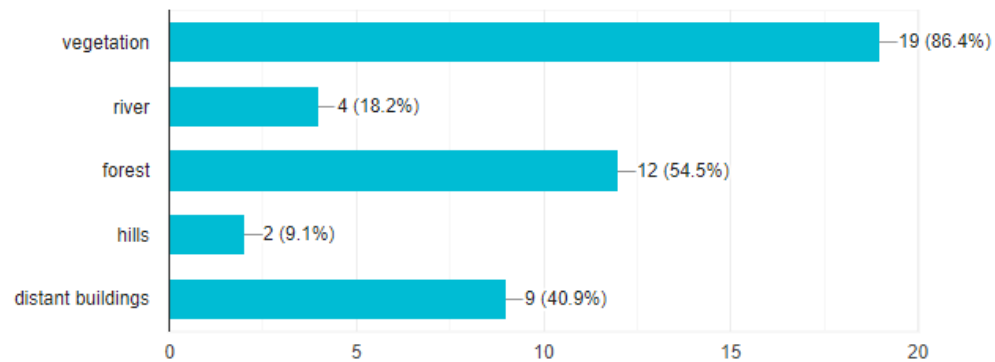


Figure 4.110: The pleasant views as reported by occupants
Source: Author 2021

The observation findings noted Bellcrest apartments had views of town houses, apartment walls and distant trees (**Figure 4.111**). The views were from the balcony. Viraj Garden apartment had a balcony view of the apartment compound trees and parking area (**Figure 4.112**). Ramis Court had vistas of the outdoor vegetation from the lounge window and the apartment landscaped backyard and swimming pool from the balconies and bedrooms (**Figure 4.113, 4.114 and 4.115**). Kaisa Garden apartments did not have a balcony but had a large window in the lounge space with views of trees, the main road and neighboring apartments (**Figure 4.116**). Bellway Court had views of the parking space with existing trees and shrubs (**Figure 4.117**). Sunning Hill apartments had minimal vegetation views. This was due to its ground level position and obstruction by the embankment (**Figure 4.118**).



Figure 4.111: Bell Crest Garden apartment balcony views and vistas
Source: Author 2021



Figure 4.112: Viraj Garden apartment views and vistas
Source: Author 2021



Figure 4.113: Ramis Court apartment views and vistas
Source: Author 2021



Figure 4.114: Ramis Court apartment views and vistas
Source: Author 2021



Figure 4.115: Ramis Court apartment views and vistas
Source: Author 2021



Figure 4.116: Kaisa Garden apartment views and vistas
Source: Author 2021



Figure 4.117: Bell Way Court apartment views and vistas
Source: Author 2021



Figure 4.118: Sunny Hill views and vistas
Source: Author 2021

4.4. Biophilic Design Strategies

The findings from the professionals, occupants and observations on the biophilic design strategies that informed the design of the apartment are presented below. The strategies included; connection and harmony, integration, adaptive, complementary, contact and innate need.

Harmony; 91% of the occupants felt that they were in harmony with nature. The main reason they were in harmony with nature was due to a lot of greenery at the apartment compound (**Figure 4.119**).

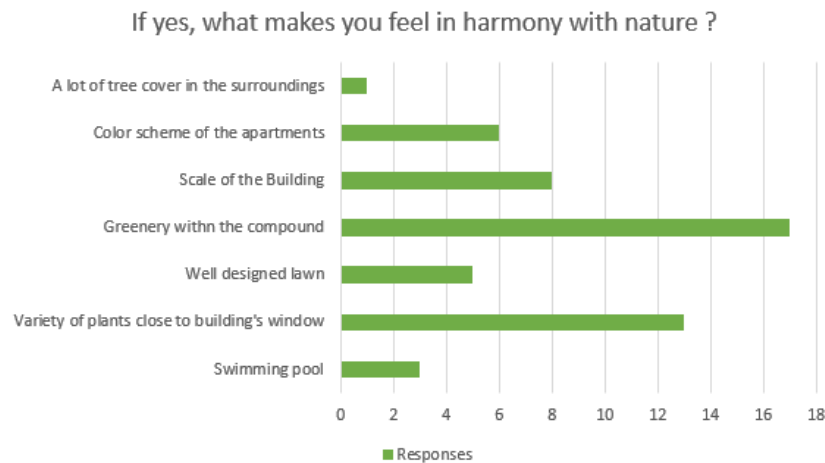


Figure 4.119: Occupants' response on harmony and nature
Source: Author 2021

Connection: 74% of the occupants reported that connection to nature was important in regards to the apartment they stayed in. The occupants said they felt connected to nature through natural vegetation, vistas, scale of the building and the use of natural materials.

Integration; 54% of the occupants stated that the landscaping within their compound created buffer zones to prevent noise and dust pollution from the road. The apartment compound was not well integrated due to; stalled building construction, waste construction material and debris and unkempt landscapes. 73% of the occupants felt that there was a loss of natural habitat within their neighborhood because of lack of preservation of natural environment as the apartments were being developed.

Adaptive: The observation findings of external landscape in Viraj Gardens apartment showed lack of soft landscaping, thus, making it difficult to use for relaxing and playing. The Bellcrest Gardens swimming pool was not in use because of its location was the view from the apartment thus there was lack of privacy (**Figures 4.120 and 4.121**).



Figure 4.120: Viraj Garden outdoor space
Source: Author 2021



Figure 4.121: Bellcrest Garden swimming pool space
Source: Author 2021

Complementary: Ramis court has big windows which provide direct view of the natural vegetation hence complementing the natural environment views with the internal spaces. The complementary strategy was also observed in Ramis Court apartment where water vegetation and the built form complemented each other in integrating of parts to a whole (**Figures 4.122 and 4.123**).



Figure 4.122: Ramis Court indoor outdoor complementary
Source: Author 2021



Figure 4.123: Ramis Court landscape complementary
Source: Author 2021

Innate needs: 82 % of the occupants reported that natural vegetation was important to their wellbeing and mental state of health. 55% of occupants were satisfied with the natural vegetation within their compound. observation finding from Ramis Court and Peers Park apartments show close association of occupants and the natural environment (**Figure 4.124 and Figure 4.125**).



Figure 4.124: Ramis Court occupants in the natural environment
Source: Author 2021



Figure 4.125: Ramis Court occupants in the natural environment
Source: Author 2021

Contact: Bellcrest Garden and Peers Park apartments had swimming pools that lacked human contact. This was due to a lack of maintenance and inappropriate location that did not provide privacy. The swimming spaces also lacked proper integration with the natural environment. Contact has been successfully achieved as a biophilic strategy in Ramis Court and Sunning Hill apartment swimming pool spaces (**Figures 4.126, 4.127, 4.128 and 4.129**).

Where biophilic design strategies were well applied the environment attracted human activities while where they were poorly applied the spaces were rarely used and occupants were unaware of them. Spaces with natural environment had a positive effect on the occupants' wellbeing and mental health.



Figure 4.126: Ramis Court occupants in the natural environment
Source: Author 2021



Figure 4.127: Ramis Court occupants in the natural environment
Source: Author 2021



Figure 4.128: Ramis Court swimming pool integrated with the natural environment
Source: Author 2021



Figure 4.129: Sunning Hills swimming pool integrated with natural material finish and vegetation
Source: Author 2021

4.5. Ways of Restoring the Natural Environment

Ways of restoring the natural environment in apartment design in Kileleshwa ward as per the Figure 20 (95%) of the professionals emphasized to the client on the need of incorporating the natural environment in the apartment design as a way of improving the apartment design. 17 (77%) of the professionals felt that the client should be in the for-front advocating for integration of the natural environment in his/her brief to the professionals. Professionals should demonstrate the value of the natural environment in their early conceptual stages of their design of apartments to the client. 21(96%) of the respondents stated that the occupant, client, designer, contractor and developer had a role to play in maintaining the natural environment. To sustain the natural environment within the apartment compound, the professionals proposed the following actions; use of renewable materials, by integrating designs that respond to the natural site characteristics, through conservation effort, incorporating the natural environment into building designs to respond to the day to day life of the occupant, proper selection of plant materials that work in the specific natural environment, integration of drip irrigation in landscape design, proposing designs of edible landscape and urban farming, recycling and reusing of waste and soil water. Implementing a robust maintenance program of the natural environment and having a design attitude that acknowledges nature.

The professionals stated the ways of integrating the natural ecosystems and habitats into the design of apartments included; use plants for soft landscaping , water features, natural local materials, natural colors, connecting between indoor and outdoor spaces, creating spacious spaces, using large windows, orienting opening to scenic vistas and sun movement, allowing natural ventilation and lighting to the interiors, introducing indoor landscaping, creating large balconies with planters, incorporate animals and live plants in within the apartment landscape, include atriums and courtyards where appropriate, create tactile designs, apply passive design strategies, ensure design responds to social cultural balances, optimize preservation of natural habitat in the design of apartments, create green walls, roof gardens, include transitional spaces and infuse nature in the indoor and outdoor spaces through views (**Figure 4.130**).

Which of the following elements do you think should be considered in designing interior and exterior spaces for apartments ?

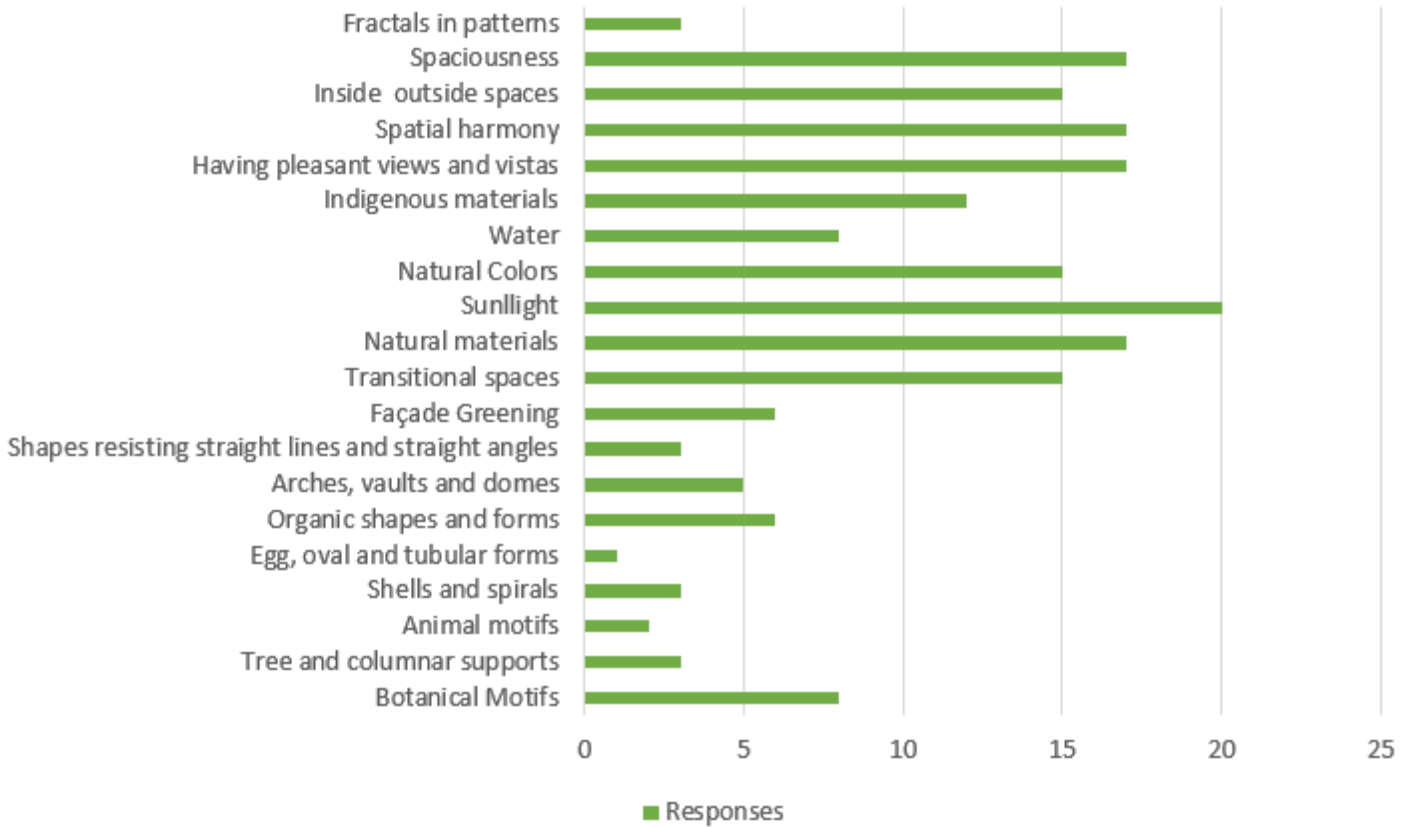


Figure 4.130: Biophilic design elements considered in restoration of natural environment for apartment design
Source: Author 2021

Other ways restoring the natural environment within apartment compound as stated by professionals include; limiting the ground coverage and plot coverage of zoning regulations, sensitizing the client on the importance of the natural environment and its benefits, involving landscape architects and interior designers in apartment designs

5. Chapter: Synthesis and interpretation of the findings

5.1. Overview

This chapter is a synthesis of the findings in light of what was established in the literature review.

5.2. Color

Design professionals stated that they use color from nature. This tied with only a few of the observed studied apartments, mainly Viraj and Bellway. The two apartments had integrated well with the natural environment. Ramis Court apartments had a natural outside environment but had not integrated well with due white painted walls. Use of natural colors aligns with views suggested by Hyde (2018) who stated that design elements should include natural resembling colors, patterns, natural shapes and forms. Further Lucia (2021) stresses that colors which evoke natural setting give a natural feel to design. Color can thus, be used to simulate natural features and as a decorative element in the different spaces. This can arouse feelings of the natural environment, natural processes and functional features.

5.3. Water

Different flats had used different means to achieve the water attribute including swimming pools, spar, fountains and rivers. Many residents did not have water features though they indicated they would like to have them. The main reason why water features were missing was lack of space for them. Bellcrest and Peers Park had a swimming pool that were not in use by the occupants. Ramis Court was the only apartment that had a secure and private swimming pool and thus, was functional. Where water features were properly used, for example, at Ramis Court, it brought nature into space. Maggio (2020) stated that presence of water in a space enhances the experience of space through seeing, hearing or touching. Hence, water gives a complementary effect causing feelings of awe and admiration of nature when well-integrated in the apartment design. Hyde (2018) established that water could be used as a sensory element in property spaces through fountains and the flowing sound of rivers, which could initiate pleasant feelings for the occupants when they experienced these sounds.

5.4. Space

Most of the studied apartments had maximized on the space available leaving minimal outdoor space to the extent of violating the building by-laws. Professionals' design functional transition spaces where possible as sometimes they are limited by client restrictions in the design brief. Occupants related the available internal/external spaces of the apartments with beauty based on how they were satisfied with the spaces. This was confirmed through observation where some apartments like Bellcrest, Kaisa and Sunning Hill did not have proper light spaces. Ramis Court apartments were considered beautiful with well-ventilated spaces though there was a problem of lighting the bathroom space from the laundry space and the long corridors were lit indirectly from other spaces. VTN Architects (2020) in their design of Halong Villa Hanoi they used the biophilic design where spaces were interconnected with nature. Well organized and interconnected spaces foster emotional and intellectual stimulation hence designers should endeavor to achieve this.

5.5. Sunlight

Bellcrest Gardens, Kaisa Garden, Ramis Court, Sunning Hills and Bellway Court apartment all had some spaces that were not well light. Such spaces included the kitchens, corridors, toilets and stores. This was due to use of small windows, obstruction by neighboring buildings and lighting indirectly from other spaces. This did not conform to biophilic design as advocated for by Jewell (2019), Hyde (2018) and Lucia (2021) who all emphasized use of natural lighting and proper orientation of the building to receive natural light. Well-lit spaces simulate feelings of connection with the natural environment.

5.6. Landscape

Ramis Court, Sunning Hill and Bellway Court apartments had used a variety of landscape elements. Viraj Gardens, Bellcrest Garden and Peers Park apartments had poorly maintained landscaped spaces. The professionals noted that the design of landscape was limited in the design of flats because of the need to maximize on the plot coverage, using of incompetent designers and they also noted that a majority of clients felt that landscaping did not add value in the rental returns. However, the occupants were of the view that landscaped spaces were important to their wellbeing and mental health. The apartment landscaped spaces did not conform to Bianchini (2021) analysis Of Bosco Verticale use of natural vegetation, space and green walls. Bosco Vericale concept of landscaping demonstrates that space a hindrance to achieving a proper landscaped building. In addition, Giacomello (2015) stressed that multi-disciplinary approach and proper maintenance are necessary to achieve biophilic design in landscaping of urban apartments. Limitations of landscaping space can be solved by vertical

greening of the apartments. Landscaped spaces are important in the design of apartments for the wellbeing of the occupants.

5.7. Materials

Viraj Gardens and Bellway court apartments used natural material for their external finishes. Ramis Court, Sunning Hill and Bellway Courts apartments used a variety of natural materials finishes for their internal spaces. A majority of occupant respondents admired the use of natural materials in the interior spaces of their apartments. The professionals agreed on the use of indigenous natural materials. However, some of them noted that natural materials were exhaustible and fabrication of composite materials was necessary as a substitute. This is in line with Jewell (2019) who reported that the prefabrication process of materials used in the Freebooter apartment design reduced the cost, environmental footprint and construction time. Kellert and Finnegan (2011) advocate on using natural materials by leaving them bare in order bring out their physical traits as seen in nature. However, Kellert (2008) insists on the use of actual natural materials. Indigenous materials create positive relation and effect to the user of apartment.

5.8. Air

Majority of the apartments had well ventilated rooms. A few of the apartments had poorly ventilated spaces that included the laundry, kitchen, stores and corridor. Majority of occupants stated the reason for poor ventilation in their internal spaces was due to apartment windows opening to another building hindering proper ventilation and ventilating through other spaces.

The quality of air was generally good because of the vegetation within the apartment compound. Only 4% of the occupants were not satisfied with the air quality in their apartments due to dusty roads. This is in line with Bianchini (2021) analysis of the Bosco Verticale building where he stated that trees and shrubs on the cantilevered balconies aided in purifying the air in the building for the occupants' wellbeing.

All of the professional respondents stated that use of the natural environment to regulate ventilation was important. This ties with Kellert (2005) who states that air is an affinity innate need, thus, the reasons for ventilation. Fresh air in a building brings a stimulating feeling and enhances the wellbeing of the occupants.

5.9. Views and Vistas

Professional that views and vistas were important to occupants' wellbeing in an apartment space while the occupant stated that they had vistas from their apartment windows. The occupants' interior spaces that strongly related with the pleasant views were; balconies, bedrooms and lounges. The spaces that had minimal relations with these spaces were toilets. For the majority of the occupants' vistas were; vegetation, forests and distant buildings. Similarly, VTN Architects (2020) designed the Halong Villa Hanoi which had presence of a large window and plenty of greenery to feel the rich natural landscape and city view from different angles regions. Views and Vistas are an integral aspect of unifying the natural environment with the interior spaces for the wellbeing of the occupants. Hyde (2018) advocates for developer to take advantage of the surrounding property views by strategically placing window openings towards them in order for occupants to fully experience and interact with the scenic environment thus fulfilling their affinity to nature.

5.10. Biophilic Design Strategies

Analysis of the attributes, the synthesis of the attributes has touched on all the biophilic design strategies. These biophilic design strategies are; contact, connect, adapt, complementary, innate needs, integration and harmony. Where they have been applied well the study has shown the quality of space has attracted high number of occupants and are of value to them. Where the strategies were poorly applied, the attributes were not functional and occupants were unable to take advantage of them. Most occupants reported that they were in harmony and connected with nature in their apartments due to greenery and use of natural materials. Integration strategy was not well applied in apartment developments due to lack of preservation of the natural environment. The adaptive strategy was also not well applied as the attributes used were not well adapted to their uses thus, they were not functional. The complementary strategy was well applied in some of the apartments. Ramis court apartment had a variety of vegetation used together with water features. Contact and innate need strategies were only achieved in Ramis Court and occupants were observed to use the outdoor spaces frequently. Maintenance of the landscaped space played a major role in the success of the strategies used. These strategies are supported by different proponents of biophilic design, for example, Kellert (2008), Espinosa (2021), Maggio (2020), Bianchini (2021), Jewell (2019) and VTN Architects, (2020) as discussed under the different biophilic design attributes. From this synthesis it is apparent that biophilic design attributes cannot work in isolation. Appropriate strategies are necessary for biophilic design to be achieved. Where proper biophilic design strategies have been implemented in the apartment design, the well maintained biophilic design attributes cater for the occupant's wellbeing, thus, the occupants recognize the spaces being of value to them.

5.11. Restoration

Professionals, occupants and observations identified several ways of restoring the natural environment. All the parties emphasized on using varied biophilic design attributes to restore the natural environment. The professionals also advocated raising awareness of the importance of the natural environment and ensuring regulatory compliance in apartment designs. Kellert (2005) stated that green design was not enough in restoring the natural environment in urban spaces. He proposed for restorative environmental design whereby there was reestablishing of a positive connection between nature and humanity in the built environment resulting positive environmental impact also called biophilic design. The study concurs with Kellert in bringing back the nature in the design of urban apartments. As the developers construct apartments there should be a conscious effort not to compromise the preservation of the natural environment.

6. Chapter: Conclusion and Recommendations

6.1. Overview

This chapter highlights the conclusions of the study and establishes recommendations for designers inferred from the in-depth synthesis and analysis of the study. It is organized using the objectives and the thematic areas of the study.

6.2. Conclusions

6.2.1. The nature of biophilic design in the interior and exterior spaces of modern apartments in Kileleshwa ward.

The findings established that biophilic design attributes were present in a varied extent in the interior and exterior spaces of apartments in Kileleshwa. These biophilic design attributes are summarized below.

Color; Professionals and occupants agreed on natural inspired color tones. Observations on the Kileleshwa apartments noted that color of natural tones were not regarded much in the design of apartment interior and exterior spaces.

Air; Professionals and occupants agreed that all spaces in the apartment should be ventilated naturally.

Water; Observations indicated that water features were present in some apartments but were not well maintained and in some were nonexistent. There were not integrated well with the landscape design.

Space; A majority of the occupants complained of small spaces and this was also evident in the observation findings. Majority of the space were small and had poor day-lighting and ventilation. This was mainly common in-service areas and lobbies. Majority of the spaces lacked any natural inspired decorations.

Landscaping; Majority of interior spaces of apartments lacked greenery and where they were found they were not well integrated with the spatial organization of the spaces. Majority of landscaped external areas were not in harmony with the built form of the apartment. The interior of the apartment was not well integrated with outdoor landscaped spaces.

Sunlight and Ventilation; Majority of the occupants complained of some interior spaces like the service areas such as corridors, kitchens, laundry and lounge did not receive adequate lighting and ventilation due to the poor building orientation. Small windows and obstruction of apartment windows by neighboring buildings.

6.2.2. Biophilic Design Strategies that informed in the Apartments Design in Kileleshwa Ward for the Wellbeing of the Occupants

The study has established that biophilic design defines how apartment occupants interact with their indoor and outdoor spaces and how this influences human behavior. This was demonstrated that residents drew pleasant feelings in certain apartment spaces because of how the biophilic design attributes were appropriately organized through the biophilic design strategies. This study concludes that varied behavior occurred within certain spaces depending on how these strategies were executed in the context of the existing natural environment. The strategies that informed the design of the apartment included; connection and harmony, integration, adaptive, complementary, contact and innate need. The discussion below shows how each of the design strategies expressed in organizing the design attributes in Kileleshwa apartment design;

Connection and Harmony of apartment to nature; Majority of the occupants felt connected and in harmony with nature because of the variety of natural vegetation and the scale of the building. A few of the occupants felt they could not connect to nature due to poorly located balconies and congestion of buildings. Some occupants' apartments had views oriented to roofs and masonry walls of neighboring buildings thus these occupants did not experience the connection with nature.

Integration with natural landscape; the neighborhood was not well integrated with the landscape due to numerous negative impacts revealed by the occupants. These were waste generation, fumes and noise pollution by cars. It was observed presences of unpleasant man-made sites within apartment neighborhood. This included stalled building construction, waste construction material and debris and unkempt landscaped areas.

Although most of the compound had vegetation its design did not create proper buffer zones to prevent fumes and noise pollution.

Adaptive: Majority of external landscaped spaces were not adaptive to for occupant use. The observation showed lack of proper designs of outdoor spaces, lack of furniture for outdoor spaces for resting and were poorly maintained. This was also supported by a majority of occupants not being aware of their outdoor spaces.

Complementary: Most of the indoor and outdoor spaces in Kileleshwa apartment were not complementary. Most of the front of the apartments had conflicting uses; parking, children play areas and pedestrian walk ways. There were chances of car accidents when children were playing and pedestrian moving, children damaging cars when they were playing and disruption of children's play as cars pass-by. Most of the backyard were not easily accessible, some were used as hanging line spaces and were very small, and others lacked any landscaping elements and were neglected. Most of the outdoor spaces that closely linked with the building were hard surfaces of cabro finishes missing out natural vegetation which is emphasized in biophilic design. The balconies had conflicting uses while they were supposed to be for relaxing them had hanging lines for drying clothe and in some instances were used for storage. This made the occupants have less admiration for this apartment. Some facilities like swimming pools were located in view of apartments hence lacked privacy for occupants who wanted to use them.

Innate needs: The occupants were concerned with the rate at which the destruction of the natural environment was occurring within their neighborhood during the construction of apartments. The occupants wished that the apartment design would consider retaining as much as possible the natural environment as possible which was not the case. Professionals revealed that why designers were not considering biophilic design elements in the design of apartments were due to; clients not using the proper professionals, client maximizing plot coverage and plot ratios and the developer disregards plot ratios and coverage of the natural environment and designers, client and developer ignoring the considerations of biophilic designs. This has led to lack of response innate needs being well served in apartment designs.

Contact: The occupants were easily accessing the natural features designed for due to poorly maintained facilities e.g., swimming pools, lawns, lack of proper maintained lawns, landscaping elements like furniture and children play areas, hard surface finishes, access to close natural features like rivers, unsecured risk facilities e.g., empty swimming pools. Majority of outdoor spaces were inaccessible by the elderly, children and disabled persons due to lack of ramps which would aid movement for them.

6.2.3 Ways of Restoration of the Natural environment in the design of apartment's in Kileleshwa

The professionals noted to restore the natural environment for the wellbeing of the occupant in design of apartments, the following were proposed; use of natural materials, having transitional spaces, having spaciousness, taking advantage of sunlight in lighting spaces, having pleasant views and vistas, using of indigenous materials, having spatial harmony, use of natural colors, The other attributes present that the professionals recommended were interior plants locating apartments away from sources of noise pollution. Having organic shapes and forms in your external and internal spaces should also be considered. In Addition, the professionals stated that external recreational facilities and proper window sizes to allow light were important to the wellbeing of the occupant. The professionals emphasized that balconies to be orientated in the proper direction of pleasant views. The professional emphasized inclusion of furniture in landscaped spaces, use of water features, green walls, vertical landscaping, indoor and outdoor connections through openings, creation of universal design for the disabled persons in the interior and exterior spaces of the apartment. The professionals stated that the biophilic design strategies should be applied for proper spatial organization of the design attributes for the restoration of the natural environment to succeed. The study shown that the more the space is biophilic the more it creates human fulfillment and pleasure.

The occupants revealed that for their satisfaction of their wellbeing they stated that the apartment design should have; spaciousness, private well ventilated and lit spaces, place that have large windows orientated toward scenic sites sunshine and uses of natural materials in building finishes cladding motifs of natural features on building services, use plants, strong connection of indoor and outdoor spaces, introducing air filters by having vegetation buffer near building opening. The occupants felt that all these aspects of biophilic design would create a pleasant, comfortable lifestyle and health indoor environment for them.

6.3. Recommendations

The study recommends the following to be taken by occupants and professionals in restoring biophilic design in apartments in Kileleshwa for the occupant's wellbeing. The recommendations are presented as per the thematic Biophilic attributes analyzed in the study.

6.3.1. Color

1. Designers should use colors with tones borrowed from the natural environment in their designs to help create connectedness and an indirect experience to nature.

6.3.2. Water

1. Designers should adopt different water features and take advantage of existing ones near the built form e.g., rivers or ponds through sensory variability and open access spaces near them.
2. Artificial water features like swimming pools ponds and streams should be well maintained regularly cleaned.
3. Water feature spaces should be enjoyable for users. There should be presence of outdoor furniture preferably organic furniture to blende with the natural environment or made from natural material and should also be different vegetation to complement with the water feature.

6.3.3. Space

1. Apartment spaces should be spacious, multi-functional, well ventilated and receive proper natural sunlight for day-lighting.
2. Transitional spaces should be well designed, functional, with proper natural lighting and integrated with natural environment e.g., pot-plants.
3. Spaces should flow easily to allow for ease of circulation indoors and outdoors spaces with the integration natural environment. This is through vistas of outdoor spaces, having large open windows that connects to the outdoor environment.
4. Balconies should be located to enable pleasant views, and should be spacious enough to allow for functionality.
5. Indoor and outdoor spaces should connect through semi enclosed areas that allow spillover of activates and should adapt and connect to the natural environment.

6.3.4. Sunlight

1. Proper day-lighting should be achieved. Designers should incorporate large windows with proper orientation of the sun.
2. Designers should avoid lighting spaces through intermediary spaces.
3. Designers adapt screen walling in service areas to allowing lighting and ventilation,

6.3.5. Landscape

1. Designers should provide functional landscape spaces integrated with the built environment.
2. Designers should use the natural vegetation as a buffer to reduce noise and air pollution.
3. Designers should be creative in their execution of the landscape and how they integrate plants in apartment landscapes and interior scape; Designers should borrow concepts from communal gardens, rooftop gardens, vertical gardens, façade greening, cantilever balcony gardens.
4. Designers should take advantage of different plants to show sensory variability in apartments, smell of flowers, contrasting colors of flower plants trees and rocks, the flowing sound of rivers, the contrast dynamism and balance of hard surfaces and soft cape of plants shrubs and bushes.
5. Designers should view the landscape and built environment as one whole ecosystem and thus should take advantage of the landscapes form blending it with the apartment without altering much of the natural environment. This is by preserving indigenous trees, plants preserving the terrain form as much as possible, having outdoor patios to allow integration to the apartment and planting of similar vegetation indoors. The landscape environment should be well maintained.

6.3.6. Materials

1. Natural materials should be used in both indoor and outdoor spaces
2. Designers should take advantage of indigenous materials
3. Designers should use the materials creatively achieving attributes like complementary contrast, sensory variability, natural occurring patterns and progressive aging to show a passing of time.

This study recommends a model that should be used to guide designers in restoring of natural environment in apartment developments using biophilic design strategies (Figure 6.1). The model shows how the biophilic design strategies applied by the designer on the biophilic design attributes determine the wellbeing of the occupants.

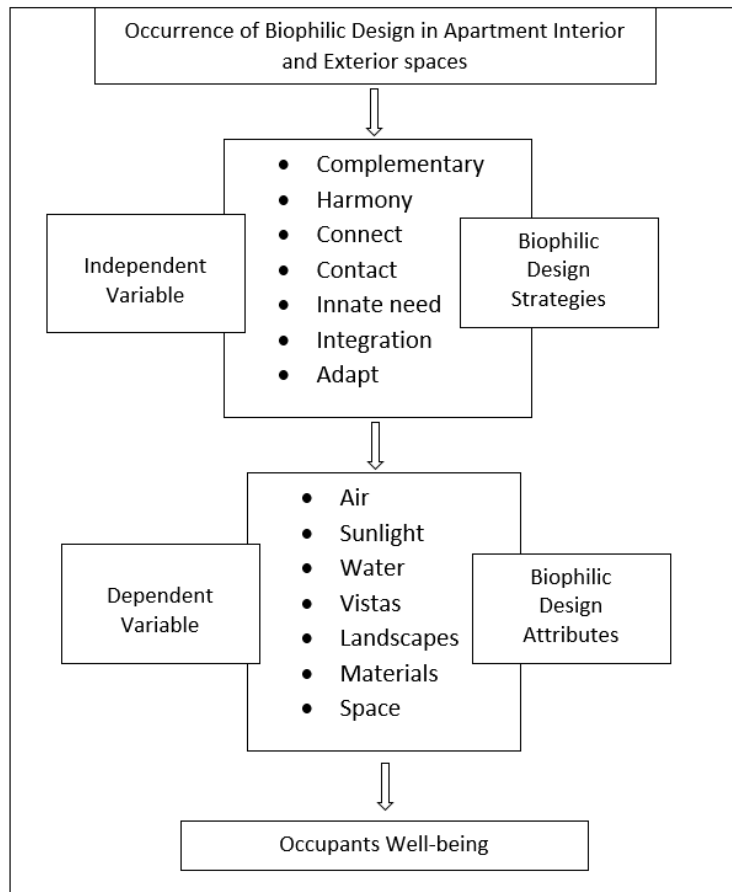


Figure 6.1: Biophilic Design Model
Source: Author 2021

6.4. Further Areas of Research

The further areas of research are;

1. Understanding the natural environment in view of incorporating a symbiotic relationship with it and the urbanizing society.
2. Regulatory framework that guide in the implementation of biophilic design.
3. Establishing new ways of implementing biophilic design in congested urban areas.
4. Studies should be extended to other building typologies e.g., offices, schools, hospitals and other institutions.

7.Cited References

- AAK. (2021). *Objectives of AAK*. Retrieved from aak.or.ke: <https://aak.or.ke/objectives-of-aak/>
- Abbas, Z. J. (2017). Biophilia and Built Environment: An Implication for Healthcare Facilities. *International Journal on Emerging Technologies* 8(1):, 628-634.
- Almusaed, D. A. (2006). Biophilic Architecture: Towards a New Potential of Healthy Architecture. *Rethinking Sustainable Construction, 12th Rinker International Conference, Next Generation Green Buildings*. Sarasota.
- Andrews, K. (2013, September 12). *Pasona Urban Farm by Kono Designs*. Retrieved from dezeen: <https://www.dezeen.com/2013/09/12/pasona-urban-farm-by-kono-designs/>
- Ardiani, Y. M., Prawata, A. G., & Sholihin, A. (2020). Application of biophilic architecture in apartment design. *IOP Conference Series: Earth and Environmental Science; The 3rd International Conference on Eco Engineering Development* (pp. 1-9). Jakarta: IOP Publishing. Retrieved from Application of biophilic architecture in apartment design
- Babbie, E. R. (2001). *The practice of social research*. Belmont: Wadsworth Thomson Learning.
- Baxter, P., & Jack, S. (2008). Qualitative Case Study Methodology: Study Design and Implementation for Novice Researchers . *The Qualitative Report Volume 13 Number 4*, 544-559 .
- Bianchini, R. (2021, March 15th). *The Vertical Forest towers in Milan by Boeri. Phenomenon or archetype?* Retrieved from inexhibit: <https://www.inexhibit.com/case-studies/the-vertical-forest-towers-in-milan-by-boeri-phenomenon-or-archetype/>
- Browning, B., Garvin, C., Ryan, C., Kallianpurkar, N., Labruto, L., Watson, S., & Knop, T. (2012). *The Economics of Biophilia Why designing with nature in mind makes financial sense*. New York: Terrapin Bright Green LLC.
- Browning, W., Ryan, C., & Clancy, J. (2014). *14 Patterns of Biophilic Design; Improving Health and Well-Being in the Built Environment*. New York: Terrapin Bright Green LLC.
- Burrows, V. K. (2021). *It's not that easy being green*. Retrieved from worldgbc: <https://www.worldgbc.org/news-media/bosco-verticale-not-easy-being-green>
- Chan, D. W.-t. (2015). Urban farming in Hong Kong. *Springer Open Journal*, 4.
- CIBSE. (2020, November 20th). *CIBSE Case study: Bosco Verticale*. Retrieved from designingbuildings: https://www.designingbuildings.co.uk/wiki/CIBSE_Case_Study:_Bosco_Verticale
- Crowe, S., Cresswell, K., Robertson, A., Huby, G., Avery, A., & Sheikh, A. (2011). The case study approach. *BMC Medical Research Methodology Vol 11*, 1-7.
- DagorettiNorthCDF. (2019). *Dagoretti North CDF*. Retrieved from Dagoretti North CDF: <https://dagorettinorthngcdf.go.ke/kileleshwa/>

- Designcurial. (2019, February). *Biophilic Design and Architecture-10 of the best Biophilic Buildings*. Retrieved from Designcurial: <http://www.designcurial.com/news/biophilic-design-and-architecture---10-of-the-best-biophilic-buildings-4527750/7>
- Doshi, A. (2020, January). *Biophilic design in architecture: Nature meets concrete*. Retrieved from designwanted: <https://designwanted.com/architecture/biophilic-architecture/>
- Espinosa, A. (2021). *Biophilia | Bringing Nature Indoors*. Retrieved from luxiders: <https://luxiders.com/biophilia/>
- Fengler, W. (2010, April 28th). *Demographic Transition and Growth in Kenya*. Retrieved from Worldbank: <https://www.worldbank.org/en/news/opinion/2010/04/28/demographic-transition-growth-kenya>
- Frost, R. (2020, December 8). *How do you make cities healthier, cleaner and cooler? By making them green, scientist say?* Retrieved from euronews: <https://www.euronews.com/living/2020/08/12/greener-cities-could-help-you-to-live-longer>
- Giacomello, E. (2015). A New Urban Forest Rises in Milan. *Council on Tall Buildings and Urban Habitat*, 12-18.
- Gonçalves, A. (2018, December 12). *A Ranking Of The Most Sustainable Cities In The World*. Retrieved from youmatter: <https://youmatter.world/en/the-worlds-greenest-cities-in-2018-what-ecological-lessons-can-learn-from-them/>
- Hidalgo, A. K. (2014). Biophilic Design, Restorative Environments and Well-Being. *Conference: Colors of Care: The 9th International Conference on Design & Emotion* (pp. 535- 544). Bogota: Universidad de los Andes.
- Hyde, F. (2018, October 18). *Design strategies that promote health and wellness and elevate the guest experience*. Retrieved from hhendy: <https://hhendy.com/design-strategies-that-promote-health-and-wellness-and-elevate-the-guest-experience/>
- IDAK. (2021). *Objectives*. Retrieved from idak: <https://idak.org/membership/>
- interiorarchitects. (2015, April). *Did you know there are 14 patterns of Biophilic design?* Retrieved from interiorarchitects: <https://interiorarchitects.com/did-you-know-there-are-14-phases-of-biophilic-design/>
- Interiorarchitects. (2021). *PROJECT FILES: IROBOT HEADQUARTERS, BEDFORD, MA*. Retrieved from interiorarchitects: <https://interiorarchitects.com/project-files-irobot-headquarters-bedford-ma/>
- Jewell, N. (2019, May 24th). *An apartment complex in Amsterdam follows biophilic design principals*. Retrieved from inhabitat: <https://inhabitat.com/an-apartment-complex-in-amsterdam-follows-biophilic-design-principals/>
- Kahveci, H., & Goker, P. (2020). Evaluation of Biophilic Approach in the Design of Residential Sites; Case of Sinpaş Altınoran, Ankara / Turkey. *Online Journal of Art and Design Volume 8, Issue 3*, 127- 150.
- Kaplan, R., & Kaplan, S. (1989). *The experience of nature: A psychological perspective*. Cambridge, UK: Cambridge University Press.

- Kazmierczak, L. (2021). *For the Love of Nature! Introducing Biophilia in the K-12 Learning Environment*. Retrieved from nacarchitecture: <https://www.nacarchitecture.com/naclab/biophilia.aspx>
- Kazmierczak, L. (2021). *Nature's Cure: Using Biophilic Design to Enhance Healing*. Retrieved from nacarchitetur: <https://www.nacarchitecture.com/naclab/naturescure.aspx>
- Kellert, S. R. (2005). Building for Life: Designing and Understanding the Human Connection. *Renewable Resources Journal*, 8-24.
- Kellert, S. R. (2015, October 26th). *What Is and Is Not Biophilic Design?* Retrieved from metropolismag: <https://www.metropolismag.com/architecture/what-is-and-is-not-biophilic-design/>
- Kellert, S. R., & Calabrese, E. F. (2015). *The Practice of Biophilic Design*. Newyork: www.biophilic-design.com.
- Kellert, S. R., & Finnegan, B. (2011). *Biophilic Design; The Architecture of Life Viewing Guide*. Retrieved from biophilicdesign: <http://www.biophilicdesign.net>
- Kellert, S. R., Heerwagen, J., & Mador, M. (2013). *Biophilic Design: The Theory, Science and Practice of Bringing Buildings to Life*. Hoboken, New Jersey, United States: Wiley & Sons 1st edition.
- Kemper, N. (2018, April 19th). *Vivian Loftness on Biophilia and Why We Must Design Buildings Connected to Nature*. Retrieved from commonedge: <https://commonedge.org/vivian-loftness-on-biophilia-and-why-we-must-design-buildings-connected-to-nature/>
- Koruarchitects. (2021). *How to boost office productivity with biophilic design*. Retrieved from koruarchitects: <http://www.koruarchitects.co.uk/office-productivity-biophilic-design/>
- L.M.Wolfs, E. (2015). Biophilic Design and Bio-Collaboration: Applications and Implications in the field of Industrial Design. *Archives of Design Research, Vol 28*, 71-89.
- Libguides. (2021). *Research Guides*. Retrieved from libguides: <https://libguides.usc.edu/writingguide/researchdesigns>
- Liu, S. (2016). Research on Green Space Reconstruction in Interior Design and Application. *2nd International Conference on Education Technology, Management and Humanities Science* (pp. 774-782). Shijiazhuang Hebei: Atlantis Press.
- Logframer. (2012, April 19th). *What is a logical framework*. Retrieved from Logframer: <https://logframer.eu/content/what-logical-framework>
- Lohr, V. I., H, C., Pearson-Mims, & Goodwin, G. K. (1995). Interior Plants May Improve Worker Productivity and Reduce Stress in a Windowless Environment. *Plants for People*, 1-10.
- Lubell, S. (2020, November 3rd). *How Milan's Bosco Verticale Has Changed the Way Designers Think About Sustainable Design*. Retrieved from architecturaldigest: <https://www.architecturaldigest.com/story/how-milans-bosco-verticale-has-changed-the-way-designers-think-about-sustainable-design>
- Lucia. (2021). *Using Biophilic Design to Improve Habitability*. Retrieved from modlar: <https://www.modlar.com/news/216/using-biophilic-design-to-improve-habitability/>

- Maggio, M. S. (2020, July 21). *How can biophilic design be integrated into architecture?* Retrieved from abt: <https://www.abt.eu/en/blog/how-can-biophilic-design-be-integrated-into-architecture.aspx>
- Mbithe, M. (2018, September 18). *Kileleshwa Neighbourhood Guide*. Retrieved from buyrentkenya: <https://www.buyrentkenya.com/discover/kileleshwa-neighbourhood-guide>
- Mindtheinterior. (2019, September 20th). *Wellness Focused Interior Design – designing interiors for health and well-being*. Retrieved from mindtheinterior: <https://mindtheinterior.com/wellness-focused-interior-design-designing-interiors-for-health-and-well-being/>
- Mindtheinterior. (2020, September 25th). *Biophilic Interiors-spaces that reconnect us with nature*. Retrieved from mindtheinterior: <https://mindtheinterior.com/biophilic-interiors-designing-spaces-that-reconnect-us-with-nature/>
- Modi, K., & Parmar, S. (2020). Understanding Biophilia and its integration with Architecture. *International Journal of Scientific & Engineering Research, Volume 11, Issue 5*, 1-16.
- Mugenda, O. M., & Mugenda, A. G. (1999). *Research Methods: Quantitative and Qualitative Approaches*. Nairobi: African Centre for Technology Studies.
- Mugenda, O. M., & Mugenda, A. G. (2003). *Research methods: Quantitative and qualitative approaches*. Nairobi: Acts Press.
- Mugenda, O. M., & Mugenda, A. G. (2012). *Applied Research & Training Service*. Nairobi: Act Press.
- Nota, G., Marian, R. G., Callegari, G., Berto, R., & Barbiero, G. (2017). When Biophilic Design Meets Restorative Architecture: the Strambinello Project. *Visions for Sustainability Vol 8*, 46-58.
- Orman, P. (2017). Understanding the Biophilia Hypothesis through a Comparative Analysis of Residential Typologies in Phoenix, São Paulo, and Tokyo. Arizona State Univeristy, Arizona.
- Othman, A. R., & Sahidin, N. (2016). Vertical Greening Wall as Sustainable Approach. *Asian Journal of Quality of Life*,, 39-51.
- Patton, M. Q. (1990). *Qualitative evaluation and research methods*. Newbury Park: Sage Publications.
- Pintos, P. (2019). *Freebooter Housing / GG-loop*. Retrieved from archdaily: <https://www.archdaily.com/915782/freebooter-housing-gg-loop>
- Questionpro. (2021). *Snowball Sampling: Definition, Method, Advantages and Disadvantages*. Retrieved from questionpro: <https://www.questionpro.com/blog/snowball-sampling/>
- Robert, K. S. (2005). Building for Life: Designing and Understanding the Human-Nature Connection. *Renewable Resources Journal*, 8-24.
- Rotich, K. (2020, Novemeber 13). *Kileleshwa, Loresho house prices drop*. Retrieved from businessdailyafrica: <https://www.businessdailyafrica.com/bd/markets/capital-markets/kileleshwa-loresho-house-prices-drop-3019828>
- Sileyew, K. J. (2019, August 7th). *Research Design and Methodology*. Retrieved from intechopen: <https://www.intechopen.com/books/cyberspace/research-design-and-methodology>

- Smartcity. (2020, May 19). *What Are Biophilic Buildings? A Lesson From Vietnam*. Retrieved from smartcity: <https://www.smartcity.press/biophilic-buildings-in-smart-cities/>
- Sulliva, W. C., & Chang, C.-Y. (2011). Mental Health and the Built Environment. *Making Healthy Places*, 106-116.
- Teegavarapu, S., Summers, J. D., & Mocko, G. M. (2008). Case Study Method for Design Research: A Justification. *ASME 2008 International Design Engineering Technical Conferences & Computers and Information in Engineering Conference* (pp. 1-9). New York city: ASME Publishers.
- Terramai. (2021). *Biophilia and Interior design: Creating a Multi Sensorial Experience*. Retrieved from terramai: <https://www.terramai.com/blog/biophilia-interior-design-create-multi-sensorial-experience/>
- Ulrich, R. S. (1977). Aesthetic and Affective Response to Natural Environment. *Behavior and the Natural Environment*, 85-125.
- Ulrich, R. S. (1983). Aesthetic and affective response to natural environment. *Human Behavior and Environment, Vol.6: Behavior and Natural Environment*, 85- 125.
- Ulrich, R. S. (1991). Effects of Healthcare Environmental Design on Medical Outcomes. *Journal of Healthcare Interior Design*, 97-109.
- Vangelatos, G. (2020). *Wellness Architecture Design Goes Beyond Residential Spaces*. Retrieved from hmcarchitects.: <https://hmcarchitects.com/news/wellness-architecture-design-goes-beyond-residential-spaces-2019-07-10/>
- Vision2030. (2021). *vision2030*. Retrieved from vision2030: <https://vision2030.go.ke/towards-2030/>
- Vorbild. (2020). *Biophilic Interior Design*. Retrieved from vorbild: <https://vorbild.co.uk/biophilic-interior-design/#:~:text=Biophilic%20interior%20design%20is%20the,design%20in%20interiors%20and%20architecture.&text=A%20space%20with%20a%20good,other%20senses%20need%20to%20too.>
- VTNArchitects. (2020). *Ha long Vila*. Retrieved from vtnarchitect: <https://www.vtnarchitects.net/>
- Warren, J. R. (2002). Reconsidering the Relationship Between Student Employment and Academic Outcomes: A New Theory and Better Data. *British Journal of Mngement Volume 13, Issue 3*, 209-219.
- Wilson, E. O. (1984). *Biophilia*. Cambridge: Harvard University Press.
- Worldometer. (2020). *Kenya Population*. Retrieved from Worldometer: <https://www.worldometers.info/world-population/kenya-population/>

Appendices 8.2: Biophilic Design attributes

Element: Environmental Features		
Attribute	Conceptual Definition	Operational Definition
Color	This is the perception of light under the wavelength of light	These are color that relate to natural phenomenon within natural environment
Water	This a liquid state substance made of hydrogen and oxygen	The association of water features in the natural environment. Characteristics of water features, movement, clarity, flow, quantity.
Air	Gaseous state of particles in the environment atmosphere	This is the association of air its features in the natural environment. Breeze, movement, flow simulation of other senses.
Sunlight	The wave length of energy that comes from the sun	This are the benefits of sunlight in the natural environment. Used as a source of light, warmth, health, comfort and wellbeing.
Plants	Plants are mainly multicellular organisms, predominantly photosynthetic eukaryotes of the kingdom Plantae	The benefits of plants to human beings' source of food and beneficial to our wellbeing in our presence.
Natural Materials	These are the materials that compose of naturally occurring compounds and elements gotten from the natural environment directly.	This is the evidence of decay or the natural process of aging of materials over a period of time which evokes natural process.
Views and Vistas	This what is seen from a distance of a geographical location or from a distance.	These are geographical features, vegetation visible from the interior during the human experience. The features should be propionate unrestricted and not too confined.
Natural Light	The light from the sun	Effects of the day-lighting inclusion of the full color spectrum of natural light
Landscape ecology	All the visible features of an area of land, often considered in terms of their aesthetic appeal the branch of biology that deals with the relations of organisms to one another and to their physical surroundings.	Landscapes that consider landscape structure pattern and process such as ecological connectivity, biological corridor resource flow.

Source: Author 2021

Appendices 8.3: Questionnaire Occupants

Occupants & Professional Consultants (Landscape Architects, Architects and Interior Designers) Questionnaire

Study title: INCORPORATING BIOPHILIC DESIGN IN MODERN APARTMENTS SPACES IN KILELESHWA

Below are important definitions applied to this research

Biophilic Design: This type of design encourages the integration of nature into the built environment as a strategy to re-establish a strong connection between humans and their natural environment as well as it improves human health and well-being.

Natural Environments: The term 'natural environment' refers to the non-human-made surroundings and conditions in which all living and non-living things exist on Earth. It is characterized by presence of air, landscape, sunlight, plants and water. This concept of the natural environment encompasses an ecological system of a place.

Wellbeing: Well-being is the experience of health, happiness, and prosperity. It includes having good mental health, high life satisfaction, a sense of meaning or purpose, and ability to manage stress.

Key objective of the study

To foster connections between people and their natural environment, enhancing feelings of relationship, and a sense of membership in a meaningful community through effective biophilic design.

Notes

Confidentiality will be observed in this research and collected data will only be used for the purpose of this research

Occupants Questionnaire

Section A: Respondent information

Respondent code name.....

Location (street name)

Name of the Apartments.....

Number of storeys.....

Storey living in.....

State period of stay.....

Tenant (Yes.... No...) Or Home-owners (Yes No....)

Section B: Perceptions of relationship of occupants to their built environment and nature

i. Would you consider the apartments you are staying in aesthetically pleasing and beautiful?

Yes No

If not, why.....

If yes, what makes the environment aesthetically pleasing?
.....

ii. Do you feel you are in harmony with nature in the apartments you are staying?

Yes No

If not, why.....

If yes, what makes about your setting makes you feel in harmony with nature?
.....

iii. What is your connection to the apartments you stay in?

none very weak weak strong very strong

iv. Is connection to nature important to you in regards to the apartments you stay in?

not at all important slightly important moderately important very important extremely important

v. To what frequency do you feel a connection to nature in the apartments you stay in?

never rarely sometimes often always

- vi. To what degree do you feel a sense of admiration when you look at your apartments?
 never rarely sometimes often always
- vii. What is the quality of security in the apartments you stay in?
 very poor poor fair good excellent
- viii. Do you agree the interior apartments you stay in are spacious to your liking?
 strongly agree agree undecided disagree strongly disagree

Section C: Integration of natural elements with Apartment environment to create conducive habitable place

A. Sunlight

- i) Do you receive sunlight inside your apartment space? Yes No
 If not, why.....
- ii) What is the quality of sunlight in the apartment you live in?
 very Poor poor fair good excellent
- iii) How is the intensity of sunlight in the apartments you live in?
 none very low low high very high
- iv) Is this sunlight important to you?
 not at all important slightly important moderately important very important
 extremely important
- v) Are you satisfied with the amount of sunlight you receive in your apartment?
 not at all satisfied slightly satisfied moderately satisfied very satisfied completely satisfied
- vi) Are there spaces in your apartment that are not lit from a window direct to the sunlight?
 Yes No

Name those space;

Kitchen (Yes No) lounge (Yes No) bedroom (Yes No) store (Yes No)
 Laundry (Yes No) corridor (Yes No) toilet (Yes No)
 dining (Yes No) balcony (Yes No)
 Verandah (Yes No)

B. Air

i) What is the quality of air in the apartment you live in?
 very Poor poor fair good excellent

If the air is of poor quality, why is this the case

.....

ii) Are you in agreement that the outdoor vegetation in your apartment influences the quality air in your apartment? strongly disagree disagree neutral agree strongly agree

iii) Are you satisfied with the quality of air in your apartment?
 Not at all satisfied slightly satisfied moderately satisfied very satisfied completely satisfied

iv) Are there spaces in your apartment that are not well ventilated with a window directly to the air outside? Yes No

Name those space;

Kitchen (Yes No) lounge (Yes No) bedroom (Yes No) store (Yes No)
 Laundry (Yes No) corridor (Yes No) toilet (Yes No)
 dining (Yes No) balcony (Yes No)
 Verandah (Yes No)

C. Landscape

i) Are there landscaping elements in your apartments? Yes No

If not why are there no landscaping elements in your apartments?

.....

ii) Name those landscaping elements;

Flower pot (Yes No) , landscape photographs (Yes No) , fountain (Yes No) ,
paint of natural colors (Yes No) , gardens (Yes No) , plants (Yes No) , aquarium
(Yes No) pergolas (Yes No) moulds (Yes No) lawns (Yes No)
rocks (Yes No) roof gardens (Yes No) , others
.....

iii) Are you aware of the landscaping within your apartments?

Not at all aware slightly aware moderately aware very aware extremely aware

iv) Are you aware of the landscaping within your apartment compound?

Not at all aware slightly aware moderately aware very aware extremely aware

v) How frequent do you use the landscaped spaces at your apartments?

never rarely sometimes often always

vi) Are you satisfied with the landscaping in your apartments?

Not at all satisfied slightly satisfied moderately satisfied very satisfied completely
satisfied

vii) What spaces in your apartment have landscaping elements? Yes No

Kitchen (Yes No) lounge (Yes No) bedroom (Yes No) store (Yes
No) Laundry (Yes No) corridor (Yes No) toilet (Yes No) dining
(Yes No) balcony (Yes No)
Verandah (Yes No)

D. Plants

i) Are there pot plants, trees, shrubs or visible plants from your windows in your apartments?

Yes No

If not, why

Where are these plants, trees and shrubs?

(a) within your compound (Yes No);

(b) neighboring plots (Yes No)

ii) Are you satisfied with the plants, trees and shrubs present within the compound of your apartments?
Not at all satisfied slightly satisfied moderately satisfied very satisfied completely satisfied

iii) Are these plants, trees and shrubs important to your wellbeing and mental state of health?
Not at all Important slightly Important moderately important very important extremely important

iv) Do these plants, trees and shrubs have a positive effect on your well-being and mental state?
never rarely sometimes often always

v) Which spaces in your apartment relates strongly with view of the plants?
Kitchen (Yes No) lounge (Yes No) bedroom (Yes No) store (Yes No)
Laundry (Yes No) corridor (Yes No) toilet (Yes No)
dining (Yes No) balcony (Yes No)
Verandah (Yes No)

E. Views and Vistas

i) Do you have any views and pleasant vistas (pleasing views) of natural vegetation from your windows in the apartments you stay in? Yes No

If not, why

ii) Do the views and pleasant vistas give you a peace of mind? Yes No

iii) What is the quality of the views?
very Poor poor fair good excellent

iv) Are these views important to you?
Not at all Important slightly important moderately important very important extremely important

v) When you look at the views from your apartment are you in awe of what you see of the natural environment.

never rarely sometimes often always

vi) Which spaces in your apartment relates strongly the views and pleasant vistas?

Kitchen (Yes No) lounge (Yes No) bedroom (Yes No) store (Yes No)
Laundry (Yes No) corridor (Yes No) toilet (Yes No)
dining (Yes No) balcony (Yes No)
Verandah (Yes No)

vii) Are these views and pleasant vistas within your compound Yes No);
or neighboring plots (Yes No)

viii) Name those views and pleasant vistas? Vegetation (Yes No), river (Yes No), forest (Yes No), hills (Yes No), distant buildings (Yes No) others.....

F. Water Features

i) Are there any water features present within your apartment compound? (These are Fountains, swimming pools or ponds) Yes No

If not, why

ii) Do you approve of these water features?

Strongly disapprove disapprove neutral approve strongly approve

If not, why

iii) Are these water features Important to you?

iv) Which spaces in apartment relates strongly the water feature?

Kitchen (Yes No) lounge (Yes No) bedroom (Yes No) store (Yes No)
 Laundry (Yes No) corridor (Yes No) toilet (Yes No)
 dining (Yes No) balcony (Yes No)
 Verandah (Yes No)

- v) Are these water features within your compound (Yes No);
 or neighboring plots (Yes No)
- vi) Name those features? Fountains (Yes No) , swimming pools (Yes No) or ponds
 (Yes No) river (Yes No) , others

G. Pollution

- i) Do you feel that there has been loss of natural habitat within your neighborhood?
 (Yes No)
- ii) Identify the type of negative impacts of the natural habitat among the following (i.e., cutting of trees (Yes No) waste generation (Yes No) , pollution by car fumes (Yes No) , noise by cars (Yes No) , water pollution (Yes No) , and chemical byproduct contamination in the air and water (Yes No)?)
- iii) To what degree do you feel there has been a loss of natural habitat within your neighborhood?
 none very mild mild moderate severe
- iv) Does the landscape in your apartment compound help in preventing the noise pollution (i.e., trees at the boundary of the compound to prevent noise pollution (buffer zone)) Yes No
- v) Are there any unpleasant man-made sites in your apartment compound or neighborhood?
 Stalled building construction (Yes No) , waste construction material or debris (Yes No) , unkempt landscapes (Yes No)
 Others

Professional Consultants (Landscape Architects, Architects and Interior Designers) Questionnaire

Section A: Respondent information

i) Tick the name of occupation you belong

Landscape Architect Architect Interior Designer

Other.....

ii) Name of firm.....

iii) How long have you been practicing.....

iii) Have you ever designed an apartment Yes No

If yes name at least three locations of the apartment development

Section B: Perceptions of relationship of consultants to their built environment designs and the natural environment

i) Have you ever used Biophilic Design to design apartments/the interiors of an apartment/landscaping of an apartment?

Yes No

If not, why.....

ii) How important is color to you in your area of design when designing apartments?

Not at all important slightly important moderately important very important extremely important

iii) Do you agree color has a psychological effect to the users of the spaces you design?

strongly agree agree undecided disagree strongly disagree

iv) Do you prefer colors from natural materials or synthetic man-made materials?

Yes No

If not, why.....

v) Have you ever proposed colors from natural colors to a client for an apartment internal and external space design?

Yes, I have No, I have not

If not, why.....

vi) Why do you think natural tones would work better in client's apartment design?

They are easy to work with

A majority of clients prefer natural colors

Really help in wellbeing of the occupant

Other.....

vii) As a landscape architect, interior designer or architect, how have you used color in landscapes for apartments?

Yes, I have No, I have not

If not, why.....

viii) As a landscape architect, interior designer or architect, do you use color of plants in your design of the landscape?

Yes, I have No, I have not

If not, why.....

ix) Have you ever used any of these water features in the designs of apartment?

Swimming pools

Ponds

Fountains

If not, why.....

x) How would you use water as a design element for apartments?.....

Swimming pools Ponds Fountains

Other.....

xi) Do you feel it is important for water features to be present in apartments?

Not at all Important slightly Important moderately important very important extremely important

xii) Would you recommend maximizing of apartment space to the disadvantage of landscaping elements? Yes

No

If not, why.....

xiii) Does your profession mitigate destruction of the natural environment within apartment development? Yes

No

If not, why.....

xiv) As an interior designer, landscape architect or architect, what do you think should be done in integrating natural environments with apartment compounds?.....

xv) As an architect, interior designer or landscape architect, would you recommend for spaces that have sensory experience from natural environment?

Yes No

If not, why.....

xvi) Do you agree with the designs of apartments with roof gardens and facade greening/ green walls?

strongly agree agree undecided disagree strongly disagree

xvii) As a professional consultant, why do you think many apartments do not have green walls and roof gardens?

- Lack of knowledge and know -how to build them
- Expensive undertaking
- Lack of Knowledge about them from designers
- Clients' restriction on building them
- Being conservative with design and not taking risks from designers
- Complex requirements by regulatory bodies or lack thereof
- Lack of the proper modern equipment to build them
- Other.....

xviii) What factors lead to least consideration of natural environment in the design of an apartment?

- Designers not taking into consideration natural environment
- Expensive undertaking for the client
- Ignoring the natural environment by both the client and designer
- Lack of space for the natural environment
- Relying on simple designs which do not cater to the natural environment
- Clients not using consultants when building apartments
- Clients on considering maximum usage of space on occupancy to maximize on profit
- Other.....

xix) To what degree do you consider the natural environment has an effect on the apartments' users' wellbeing?

never rarely sometimes often always

xx) To what extent do you consider large windows facilitate natural ventilation and lighting for apartment space?

None very mild mild moderate severe

xxi) How do you integrate the natural eco-system and habitats into the design of apartments?
.....

xxii) As an interior designer, landscape architect or architect, do you agree it is important to maintain natural ecosystem and habitats?

strongly agree agree undecided disagree strongly disagree

xxiii) Are you in agreement that indigenous materials should be used in the design of apartments regardless of cost?

strongly agree agree undecided disagree strongly disagree

If no, why not?.....

xxiv) Do you agree that transitional spaces are important in the interior design of apartments?

strongly agree agree undecided disagree strongly disagree

xxv) As a professional consultant which of the following elements have you used in designing apartments?

Botanical motifs Tree and columnar supports Animal motifs shells and spirals egg, oval and tubular forms organic forms arches, vaults and domes shapes resisting straight lines and right angles Façade greening Transitional spaces Natural materials sunlight natural

colors water indigenous materials having pleasant views and vistas spatial harmony
inside outside spaces spaciousness Fractals in patterns

Other.....

xxvi) Which of these elements do you think have not been considered by designers when designing apartments?

Botanical motifs Tree and columnar supports Animal motifs shells and spirals egg, oval and tubular forms organic forms arches, vaults and domes shapes resisting straight lines and right angles Façade greening Transitional spaces Natural materials sunlight natural colors water indigenous materials having pleasant views and vistas spatial harmony
inside outside spaces spaciousness Fractals in patterns

Other.....

xxvii) As an interior designer, landscape architect or architect, do you use images of nature when decorating the interiors?

Yes No

If no, why.....

xxviii) As an interior designer, landscape architect or architect, do you agree that natural materials are better to use as finishing than synthetic imitations of these materials?

strongly agree agree undecided disagree strongly disagree

If you disagree, why?.....

xxix) Why do apartment designs lack biomimicry influences?

- Lack of knowledge and know -how to build them
- Expensive undertaking
- Lack of Knowledge about them from designers
- Clients' restriction on building them
- Being conservative with design and not taking risks from designers

Complex requirements by regulatory bodies or lack thereof

Lack of the proper modern equipment to build them

Other.....

xxx) As a professional consultant do you believe transitional spaces in apartments are important?

Yes No

If not, why.....

xxxi) Which of the following elements do you think are important to an occupant's wellbeing in an apartment space?

Proper sized windows to let in sunlight

Built in Air-conditioning system to control temperature

A fire place

Views of distant buildings, vegetation from the occupant's main window

Proper artificial lighting but poor outdoor lighting

Installation of wallpaper with organic form patterns

Spacious rooms

Use of synthetic imitation materials

Use of artificial plants

Presence of transitional spaces

Open Kitchen

Additional recreational facilities like gyms Patios, gardens and swimming pools

Availability of parking space

xxxii) Have you ever designed transitional spaces in apartments?

Yes No

Which ones?

Colonnades

Porches

Foyers

Atriums

Interior gardens

xxxiii) To what degree do you agree the transitional spaces are important to the wellbeing of the user?

strongly agree agree undecided disagree strongly disagree

xxxiv) Why do you think a majority of apartments designs do not have the transitional spaces?

Lack of knowledge and know -how to build them

Expensive undertaking

Lack of Knowledge about them from designers

Clients' restriction on building them

Being conservative with design and not taking risks from designers

Complex requirements by regulatory bodies or lack thereof

Lack of the proper modern equipment to build them

Other.....

xxxv)Have you ever advised a client to consider the natural elements to better the apartment's design?

Yes No

If no, why.....

xxxvi)To what extent do clients influence integration of natural elements into the design of apartments?

strongly agree agree undecided disagree strongly disagree

xxxvii) Which of the following elements do you think should be considered in designing landscape apartments?

Botanical motifs , Tree and columnar supports , Animal motifs , shells and spirals , egg, oval and tubular forms , organic forms , arches, vaults and domes , shapes resisting straight lines and right angles , Façade greening , Transitional spaces , Natural materials , sunlight , natural colors , water , indigenous materials , having pleasant views and vistas , spatial harmony , inside outside spaces , spaciousness , Fractals in patterns

Other.....

xxxviii) Are natural shapes and forms important in your designs of apartments?

Not at all important slightly important moderately important very important extremely important

If not important, why.....

xxxix) Do you use nature or nature inspired features in your designs of apartment?

Yes No

If no, why.....

xl) Do you allocate natural spaces for leisure in the designs of the apartments?

Yes No

If not, why.....

xli) How do you make natural light inclusive in the design of the apartment?

Large windows
Building orientation design to allow for maximum light
Using bright colors

Other.....

xlii) What consideration do you take to reduce alteration of the natural environment when designing the apartments?

Not destroying the indigenous trees
Maintaining any natural features

Introduction landscapes trees shrubs and plants

Other.....

xliii) Are there natural environmental elements that should be used to reduce noise, dust and air pollution in the design apartments?

Yes No

Which ones are they?.....

Do you see them currently being used?

Yes No

xliv) Do you agree that observations of these elements are important for designing apartments?

Emphasize on the landscape features

Not at all Important slightly Important moderately important very important extremely important

Taking advantage of biometrical conditions; correct sunlight orientation, air and wind direction

Not at all Important slightly Important moderately important very important extremely important

Use of indigenous materials

Not at all Important slightly Important moderately important very important extremely important

Integrating apartment with a natural feature e.g., hill, river slope

Not at all Important slightly Important moderately important very important extremely important

Having outdoor spaces for apartments patios gardens roof gardens and pot plants and vegetation

Not at all Important slightly Important moderately important very important extremely important

Proper window sizes for natural lighting and ventilation for occupants

Not at all Important slightly Important moderately important very important extremely important

Use of the natural environment for ventilation regulation of temperature in apartments

Not at all Important slightly Important moderately important very important extremely important

Presence of well-maintained natural vegetation in the apartment compound?

Not at all Important slightly Important moderately important very important extremely important

Proper spacing out of apartment buildings to allow sunlight and proper ventilation for occupants

Not at all Important slightly Important moderately important very important extremely important

Spacious interior and exterior spaces for occupants in apartments

Not at all Important slightly Important moderately important very important extremely important

Proper waste management in apartments and proper upkeep of natural environment

Not at all Important slightly Important moderately important very important extremely important

Presence of leisure amenities lawns swimming pools patios etc. and additional spaces for parking

Not at all Important slightly Important moderately important very important extremely important

Proper artificial lighting

Not at all Important slightly Important moderately important very important extremely important

What other elements do you believe are important?.....



UNIVERSITY OF NAIROBI
FACULTY OF BUILT ENVIRONMENT & DESIGN
Department of Art and Design

P.O.Box 30197, GPO 00100 Nairobi, Kenya
Tel.0204913505, Email:stad@uonbi.ac.ke

REF: UON/FBED/DAD/6/7

DATE: September 01, 2021

To: Dean
Faculty of Built Environment and Design

RE: CERTIFICATE OF CORRECTION

I hereby certify that Rukwaro Ignatius Wambugu has made the required corrections to his thesis which was examined on June 23, 2021 for the award of M.A. in Design. The corrections have been appropriately and satisfactorily carried out. The Title is “INCORPORATING BIOPHILIC DESIGN IN MODERN APARTMENTS SPACES IN KILELESHWA”

A handwritten signature in black ink, appearing to read 'S. Maina', with a long horizontal line extending to the right.

Dr. Samuel M. Maina
Supervisor

INCORPORATING BIOPHILIC DESIGN IN MODERN APARTMENTS SPACES IN KILELESHWA.

ORIGINALITY REPORT

7%

SIMILARITY INDEX

7%

INTERNET SOURCES

2%

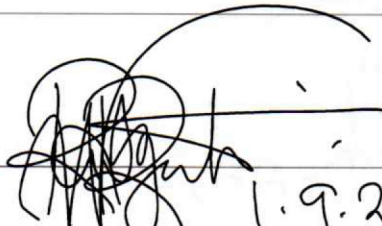
PUBLICATIONS


4%

STUDENT PAPERS

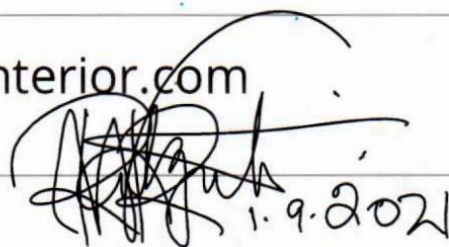
PRIMARY SOURCES

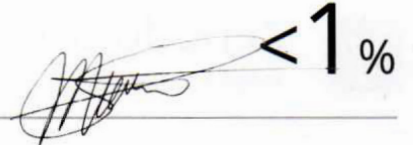
1	scholarspace.manoa.hawaii.edu Internet Source	1%
2	www.ojs.unito.it Internet Source	1%
3	www.researchgate.net Internet Source	<1%
4	hdl.handle.net Internet Source	<1%
5	ir-library.ku.ac.ke Internet Source	<1%
6	erepository.uonbi.ac.ke Internet Source	<1%
7	researchonline.jcu.edu.au Internet Source	<1%
8	www.vkmaheshwari.com Internet Source	<1%
9	zenodo.org Internet Source	<1%


1.9.2021

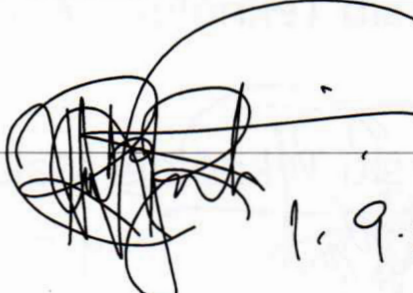

 <1%

10	repository.up.ac.za Internet Source	<1 %
11	pdfs.semanticscholar.org Internet Source	<1 %
12	Submitted to University of San Carlos Student Paper	<1 %
13	Submitted to Curtin University of Technology Student Paper	<1 %
14	Submitted to University of Nairobi Student Paper	<1 %
15	Submitted to Brenau University Student Paper	<1 %
16	issuu.com Internet Source	<1 %
17	www.citefactor.org Internet Source	<1 %
18	Submitted to RMIT University Student Paper	<1 %
19	University of Tennessee, Knoxville Publication	<1 %
20	ir.msu.ac.zw:8080 Internet Source	<1 %
21	mindtheinterior.com Internet Source	<1 %



1.9.2021



22	aodr.org Internet Source	<1 %
23	harrisfieldsss.eq.edu.au Internet Source	<1 %
24	eprints.glos.ac.uk Internet Source	<1 %
25	assessment.dasa.ncsu.edu Internet Source	<1 %
26	www.cak.go.ke Internet Source	<1 %
27	Submitted to The Scientific & Technological Research Council of Turkey (TUBITAK) Student Paper	<1 %
28	Submitted to The Technical University of Kenya Student Paper	<1 %
29	repository.out.ac.tz Internet Source	<1 %
30	www.intechopen.com Internet Source	<1 %
31	Submitted to Somerville House Student Paper	<1 %
32	csumb.edu Internet Source	<1 %

 1.9.2021 

- 33 Submitted to London Metropolitan University <1 %
Student Paper
-
- 34 www.inexhibit.com <1 %
Internet Source
-
- 35 Submitted to Mount Kenya University <1 %
Student Paper
-
- 36 Submitted to University of Derby <1 %
Student Paper
-
- 37 erepository.uonbi.ac.ke:8080 <1 %
Internet Source
-
- 38 Submitted to University of Hong Kong <1 %
Student Paper
-
- 39 www.abt.eu <1 %
Internet Source
-
- 40 etd.lib.metu.edu.tr <1 %
Internet Source
-
- 41 metropolismag.com <1 %
Internet Source
-
- 42 Submitted to Laureate Higher Education <1 %
Group
Student Paper
-
- 43 Submitted to Universiti Teknologi MARA <1 %
Student Paper
-
- 44 Submitted to Universiti Teknologi Malaysia

 1.9.21



Student Paper

<1 %

45 Submitted to University of Newcastle
Student Paper <1 %

46 www.worldbank.org
Internet Source <1 %

47 Submitted to British University in Egypt
Student Paper <1 %

48 Submitted to Kenyatta University
Student Paper <1 %

49 Submitted to University of Technology,
Sydney
Student Paper <1 %

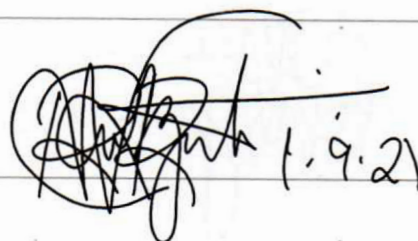
50 "Proceedings of 3rd International Sustainable
Buildings Symposium (ISBS 2017)", Springer
Science and Business Media LLC, 2018
Publication <1 %

51 Submitted to Stamford College
Student Paper <1 %

52 Submitted to University of Hull
Student Paper <1 %

53 en.wikipedia.org
Internet Source <1 %

54 ufh.netd.ac.za
Internet Source <1 %

 1.9.21



55 Submitted to Higher Education Commission Pakistan <1 %
Student Paper

56 Submitted to National University of Ireland, Galway <1 %
Student Paper

57 Submitted to Nottingham Trent University <1 %
Student Paper

58 Submitted to Kwame Nkrumah University of Science and Technology <1 %
Student Paper

59 Submitted to Scotland's Rural College <1 %
Student Paper

60 built-environment.uonbi.ac.ke <1 %
Internet Source



61 eap.uonbi.ac.ke <1 %
Internet Source

62 mafiadoc.com <1 %
Internet Source

63 www.irbnet.de <1 %
Internet Source

64 www.njcponline.com <1 %
Internet Source

65 www.wrdsb.ca <1 %
Internet Source

 1.9.21 

66 hhendy.com <1 %
Internet Source

67 kola.opus.hbz-nrw.de <1 %
Internet Source

68 www.ijsrp.org <1 %
Internet Source

69 www.interestjournals.org <1 %
Internet Source

70 Integrated Circuit Defect-Sensitivity Theory
and Computational Models, 1993. <1 %
Publication

71 bsu.edu <1 %
Internet Source

72 digitalcommons.wayne.edu <1 %
Internet Source

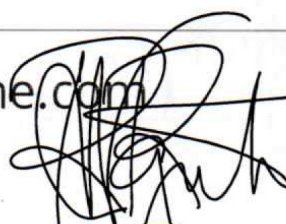
73 ijcir.mak.ac.ug <1 %
Internet Source


74 lib.dr.iastate.edu <1 %
Internet Source

75 openscholar.dut.ac.za <1 %
Internet Source

76 vvmdocumentation.femern.com <1 %
Internet Source

77 www.tandfonline.com


1-9-21



Internet Source

<1 %

78

gssrr.org
Internet Source

<1 %

79

interiorarchitects.com
Internet Source

<1 %

80

libres.uncg.edu
Internet Source

<1 %

81

ndl.ethernet.edu.et
Internet Source

<1 %

82

supportessays.com
Internet Source

<1 %

83

vietnamnet.vn
Internet Source

<1 %

84

wlv.openrepository.com
Internet Source

<1 %

85

www.biophilicdesign.net
Internet Source

<1 %

86

www.dezeen.com
Internet Source

<1 %

87

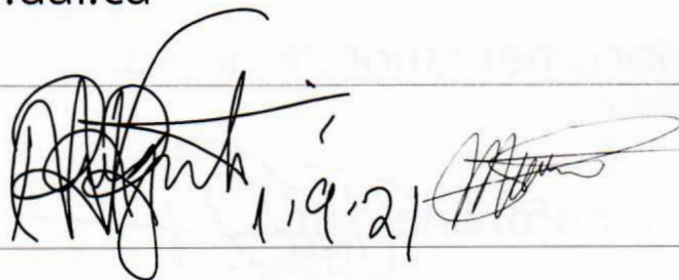
DalSpace.library.dal.ca
Internet Source

<1 %

88

apps.dtic.mil
Internet Source

<1 %

A handwritten signature in black ink, followed by the date '11.9.21' and another signature.

89	cityterritoryarchitecture.springeropen.com Internet Source	<1 %
90	dergipark.org.tr Internet Source	<1 %
91	dspace.mak.ac.ug Internet Source	<1 %
92	eprints.usm.my Internet Source	<1 %
93	erepository.uoeld.ac.ke Internet Source	<1 %
94	getd.libs.uga.edu Internet Source	<1 %
95	ihned.cz Internet Source	<1 %
96	library.state.or.us Internet Source	<1 %
97	mSPACE.lib.umanitoba.ca Internet Source	<1 %
98	scholarship.claremont.edu Internet Source	<1 %
99	www.edra.org Internet Source	<1 %
100	www.frontiersin.org Internet Source	<1 %

[Handwritten signature]
i-9-21

101

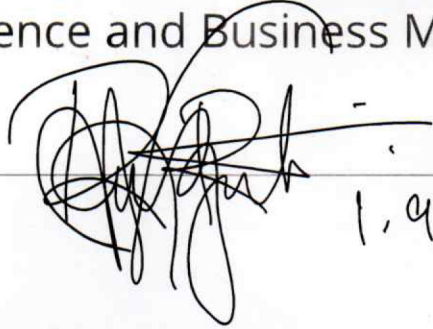
www.ijeat.org
Internet Source

<1 %


102

"Green Buildings and Renewable Energy",
Springer Science and Business Media LLC,
2020
Publication

<1 %



1.9.21



Exclude quotes On

Exclude matches < 5 words

Exclude bibliography On

UNIVERSITY OF NAIROBI

Declaration of Originality Form

This form must be completed and signed for all works submitted to the University examination.

Name of Student IGNATIUS WAMBUKU RUKWARO

Registration Number B51/34483/2019

College _____

Faculty/School/Institute FACULTY OF THE BUILT ENVIRONMENT AND DESIGN

Department DEPARTMENT OF ART AND DESIGN

Course Name MASTER OF ARTS IN DESIGN

Title of the work

INCORPORATING BIOPHILIC DESIGN IN MODERN APARTMENTS SPACES IN KILELESHWA

DECLARATION

1. I understand what Plagiarism is and I am aware of the University's policy in this regard
2. I declare that this _____ (Thesis, project, essay, assignment, paper, etc) is my original work and has not been submitted elsewhere for examination, award degree or publication. Where other people's work, or my own work has been used, it has properly been acknowledged and referenced in accordance with the University of Nairobi requirements.
3. I have not sought or used the services of any professional agencies to produce this work
4. I have not allowed, and shall not allow anyone to copy my work with the intention of presenting it off as his/her own work
5. I understand that any false claim in respect of this work shall result in disciplinary action in accordance with University Plagiarism Policy.

Signature 

Date 02/09/2021

UNIVERSITY OF NAIROBI DIGITAL REPOSITORY

DEPOSIT AGREEMENT

To efficiently administer the University of Nairobi Digital Repository and preserve its content for long-term use, the University requires certain permissions and warrants from a depositor/copyright owner. By accepting this agreement, a copyright owner still retains copyright in their work and does not give up the right to submit the work to publishers or other repositories. If the depositor is not a copyright owner, they represent that the copyright owner has given them permission to deposit the work.

By accepting this agreement, a depositor/copyright owner grants to the University an exclusive right to reproduce, translate and distribute the submission, including the digital content, metadata and abstract, in any format or medium worldwide and royalties, including, but not limited to, publication over the internet except as provided for by an addendum to this agreement.

By depositing my/our work in the University of Nairobi Digital Repository, I/we warrant the following:

- (i) This submission does not, to the best of my/our knowledge, infringe on a copyright or other intellectual property rights.
- (ii) If the submission contains material for which I/we do not hold copyright and that is not fair use, I/we have obtained the unrestricted permission of the copyright owner to deposit the submission with the University the rights required by this agreement and that such third-party material is clearly identified and acknowledged within the text or content of the submission.
- (iii) The submitted material does not contain any confidential information, proprietary information of others or export controlled information.
- (iv) There are no restrictions or required publication delays on the distribution of the submitted material by the University.
- (v) Once the submission is deposited in the repository, it remains there in perpetuity.
- (vi) The information I/we provide about the submitted material is accurate.
- (vii) That if copyright terms for, or ownership of, the submitted material changes, it is my/our responsibility to notify the University of these changes.

I/we understand that the University of Nairobi Digital Repository:

- (i) May make copies of the submitted work available world-wide, in electronic format or print medium for the lifetime of the repository, or as negotiated with the repository administrator, for the purpose of open access
- (ii) May electronically store, translate, copy or re-arrange the submitted works to ensure future preservation and accessibility within the lifetime of the repository unless notified by the depositor that specific restrictions apply
- (iii) May incorporate metadata or documentation into public access catalogues for the submitted works. A citation/s to the work will always remain visible in the repository during its lifetime
- (iv) Shall not be under any obligation to take legal action on behalf of the depositor or other rights holders in the event of breach of intellectual property rights or any other right in the material deposited
- (v) Shall not be under any obligation to reproduce, transmit, broadcast, or display the submitted works in the same format or software as that in which it was originally created
- (vi) May share usage statistics giving details of numbers of downloads and other statistics with University of Nairobi staff

While every care will be taken to preserve the submitted work, the University of Nairobi is not liable for loss or damage to the work(s) or associated data while it is stored within the digital repository.

Work(s) to be deposited:

Title:INCORPORATING.....BIOPHILIC DESIGN.....IN.....MODERN.....
.....APARTMENTS.....SPACES.....IN.....KILELESHWA.....

Author:IGNATIUS.....WAMBUGU.....RUKWARO.....

Depositor's Declaration

I/weIGNATIUS.....WAMBUGU.....RUKWARO..... hereby declare
to the University of Nairobi Digital Repository, a non-exclusive license on the terms outlined above.

Name.....IGNATIUS.....WAMBUGU.....RUKWARO.....

College.....FACULTY OF THE BUILT ENVIRONMENT.....
DEPARTMENT OF THE ARTS AND DESIGN.....



University of Nairobi

A world-class university committed to scholarly excellence

[Portal Home](#)

[Student Fees](#)

[Timetables](#)

[Course Registration](#)

[Reservations](#) [Inquiries](#)

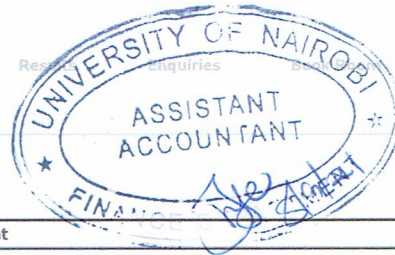
[Logout](#)

[Fee Statement](#)

[Detailed Fee Statement](#)

[Pay Fees Online](#)

[Click here for college accounts](#)



B51/34483/2019 IGNATIUS WAMBUGU RUKWARO (Regular/Integrated)

Detailed Fees Statement						
Academic Year : 2019/2020						
Transaction Id	Date	Description	Debits DR	Credits CR	Balance	Cur.Rate
2180423728	2019-09-10	FEES PAYMENTS	0.00	21,500.00	-21,500.00	KES=1
2180481790	2020-02-25	FEES PAYMENTS	0.00	600.00	-22,100.00	KES=1
2180482342	2020-02-26	FEES PAYMENTS	0.00	2,000.00	-24,100.00	KES=1
B51/34483/2019-2019/2020-239/TUIT	2019-09-30	TUIT WAIVER	0.00	145,000.00	-169,100.00	KES=1
B51/34483/2019-2019/2020-SEM1	2020-02-26	FEES PAYABLE FOR SEM1 DETAILS				
		BDS501	12,000.00	0.00	-157,100.00	KES=1
		EXAMINATION FEES	6,000.00	0.00	-151,100.00	KES=1
		BDS503	12,000.00	0.00	-139,100.00	KES=1
		BDS505	12,000.00	0.00	-127,100.00	KES=1
		BDS507	12,000.00	0.00	-115,100.00	KES=1
		BDS509	12,000.00	0.00	-103,100.00	KES=1
		BDS511	12,000.00	0.00	-91,100.00	KES=1
		CAUTION MONEY	5,000.00	0.00	-86,100.00	KES=1
		ACTIVITY FEES	2,000.00	0.00	-84,100.00	KES=1
		COMPUTER LAB FEES	5,000.00	0.00	-79,100.00	KES=1
		FIELD WORK FEES	2,000.00	0.00	-77,100.00	KES=1
		ID CARD FEES	1,000.00	0.00	-76,100.00	KES=1
		LIBRARY FEES	3,000.00	0.00	-73,100.00	KES=1
		MEDICAL FEES	5,000.00	0.00	-68,100.00	KES=1
		REGISTRATION FEES	2,000.00	0.00	-66,100.00	KES=1
		FEES PAYABLE FOR SEM1 (Grand Total)	103,000.00			
B51/34483/2019-2019/2020-SEM2	2020-02-26	FEES PAYABLE FOR SEM2 DETAILS				
		BDS518	12,000.00	0.00	-54,100.00	KES=1
		EXAMINATION FEES	0.00	0.00	-54,100.00	KES=1
		BDS520	12,000.00	0.00	-42,100.00	KES=1
		BDS524	12,000.00	0.00	-30,100.00	KES=1
		BDS542	12,000.00	0.00	-18,100.00	KES=1
		BDS522	12,000.00	0.00	-6,100.00	KES=1
		FEES PAYABLE FOR SEM2 (Grand Total)	65,000.00			
Academic Year Totals :			168,000.00	169,100.00	-6,100.00	
Closing Balance : -6,100.00						
Academic Year : 2020/2021						
Opening Balance			0.00	6,100.00	-6,100.00	
2200003454	2021-02-02	FEES PAYMENTS	0.00	24,000.00	-30,100.00	KES=1
2200060279	2021-08-21	FEES PAYMENTS	0.00	17,900.00	-48,000.00	KES=1
B51/34483/2019-2020/2021-239/TUIT	2021-02-23	TUIT WAIVER	0.00	145,000.00	-193,000.00	KES=1
B51/34483/2019-2020/2021-SEM1	2021-08-18	FEES PAYABLE FOR SEM1 DETAILS				
		BDS603	12,000.00	0.00	-181,000.00	KES=1
		BDS601	12,000.00	0.00	-169,000.00	KES=1
		EXAMINATION FEES	2,000.00	0.00	-167,000.00	KES=1
		CAUTION MONEY	5,000.00	0.00	-162,000.00	KES=1
		ACTIVITY FEES	2,000.00	0.00	-160,000.00	KES=1
		FIELD WORK FEES	2,000.00	0.00	-158,000.00	KES=1
		ICT SERVICES	5,000.00	0.00	-153,000.00	KES=1
		ID CARD FEES	1,000.00	0.00	-152,000.00	KES=1
		LIBRARY FEES	3,000.00	0.00	-149,000.00	KES=1
		MEDICAL FEES	5,000.00	0.00	-144,000.00	KES=1
		REGISTRATION FEES	2,000.00	0.00	-142,000.00	KES=1
		FEES PAYABLE FOR SEM1 (Grand Total)	51,000.00			
B51/34483/2019-2020/2021-SEM2	2021-03-01	FEES PAYABLE FOR SEM4 DETAILS				
		BDS602	58,500.00	0.00	-83,500.00	KES=1

BDS604	58,500.00	0.00	-25,000.00	KES=1
ACTIVITY FEES	2,000.00	0.00	-23,000.00	KES=1
LIBRARY FEES	3,000.00	0.00	-20,000.00	KES=1
REGISTRATION FEES	2,000.00	0.00	-18,000.00	KES=1
MEDICAL FEES	5,000.00	0.00	-13,000.00	KES=1
COMPUTER LAB FEES	5,000.00	0.00	-8,000.00	KES=1
FIELD WORK FEES	2,000.00	0.00	-6,000.00	KES=1
ID CARD FEES	1,000.00	0.00	-5,000.00	KES=1
FEES PAYABLE FOR SEM4 (Grand Total)	137,000.00			
Academic Year Totals :	188,000.00	193,000.00	-5,000.00	KES=1
GRAND TOTALS :	356,000.00	356,000.00	-5,000.00	KES=1
Closing Balance : -5,000.00				

[About Us](#)

© 2013 University of Nairobi . Design: by ICT Centre

GOVERNMENT-SPONSORED (MODULE I) STUDENTS PAYMENT INSTRUCTIONS

1. Cash Deposits, EFT or RTGS transfer to UON MODULE I Collection Account No. 2032770838 at ABSA Bank, Plaza Branch

SELF-SPONSORED PROGRAMMES (MODULE II) PAYMENT INSTRUCTIONS / OPTIONS

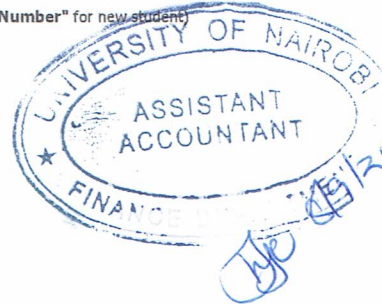
1. Bank Account

- => Cash Deposits, EFT or RTGS transfer to UON MODULE II Collection Account No. 2032771362 at ABSA Bank, Plaza Branch
- => Cash Deposits, EFT or RTGS transfer to UON US\$ Dollar Account No. 2032770625 at ABSA Bank, Plaza Branch

2. M-Pesa Pay Bill

- => The Business Number is 300059
- => The Account Number is your "Student Registration Number" (or "Admission Ref Number" for new student)

NOTE: CASH, AGENCY BANKING AND ATM DEPOSITS ARE NOT ALLOWED



UNIVERSITY OF NAIROBI

Towards World Class Excellence



P.O. BOX 30197-00100 NAIROBI TEL. 318262

Website: www.uonbi.ac.ke



POSTGRADUATE STUDENT ID CARD

RUKWARO IGNATIUS WAMBUGU

Reg. No: B51/34483/2019

ID/PP NO: 20407689

MASTER OF ARTS IN DESIGN

SCHOOL OF THE ARTS & DESIGN



Holder's Sign

Director Graduate School Sign



This ID/Card is valid up to 08-DEC-2020

ISO 9001:2008 Certified