Fundamentals of Architecture

Book 1 Volume 2

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National Universities Commission

Core Curriculum and Minimum Academic Standards CCMAS)

CCMAS Book Series

Fundamentals of Architecture

Book 1 Volume 2

Landscape architecture, Interior Architecture and Design, Furniture Design

General Editor: **Abubakar Adamu Rasheed**
MNI, MFR, FNAL, HLR

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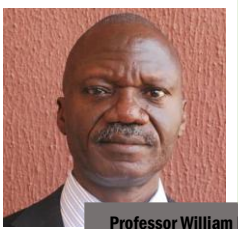

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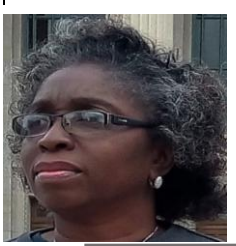

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Core Curriculum and Minimum Academic Standards (CCMAS)

Architecture

Fundamentals of Architecture Book 1 Volume 2

LANDSCAPE ARCHITECTURE, INTERIOR ARCHITECTURE AND DESIGN, AND FURNITURE DESIGN

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Foreword

The National Universities Commission is empowered by the Education (National Minimum Standards and Establishment of Institutions) Act, CAP E3, Laws of the Federation of Nigeria, 2004, to lay down minimum academic standards in Nigerian Universities and to accredit the degrees therefrom. According to this and in its sustained commitment to the revitalisation of the Nigerian University System, the Commission launched the "Core Curriculum and Minimum Academic Standards (CCMAS)", in December, 2022. The document has been adjudged by both internationally and locally revered scholars, as a standard and fit-for- purpose, designed to meet the demands of the 21st Century.

To ensure the efficient delivery of the CCMAS, it has become fitting and necessary to develop a reference document that would contain innovative and simple topics for all disciplines/programmes to serve as a guide for students and lecturers. This novel idea informs the development of the CCMAS Book Series, which presents to Nigerian universities the fundamentals of each discipline, aimed at deepening the understanding of the CCMAS, for the overall improvement in teaching and learning, and ultimately, for the production of nationally relevant and globally competitive graduates from the System.

The excitement and wide acceptance of the Book Series stems from the fact that several scholars in their respective disciplines sent in their contributions, which are rated topnotch in all ramifications. There is no gainsaying that the Book Series is a welcome masterpiece as it expounds what the CCMAS offers and the many lessons and motivations to draw from its optimal implementation, for the overall good of society.

The effort of the National Universities Commission in the development of the CCMAS and following up with associated innovative initiatives like the CCMAS book series is commendable. Consequently, I congratulate the Executive Secretary, National Universities Commission, Professor

Abubakar Adamu Rasheed *mni, MFR, FNAL* for adding another feather to his feather-filled cap within his reltively short period in NUC. Kudos must be given to the Distinguished Emeritus Professor Okebukola led NUC Strategy and Advisory Committee (STRADVCOM) and staff of the National Universities Commission for driving this process to fruition. There is no way this initiative can become a reality without the contributions of the scholars who developed the texual materials. Consequently, I laud the erudite scholars of Nigerian universities, who have demonstrated their love for academic excellence in sharing their knowledge with humanity through the instrumentality of this project.

I commend the CCMAS Book Series to staff and students of Nigerian universities and indeed to scholars all over the globe as the contribution of the Nigerian University System to academic development and excellence.

Happy reading.

Malam Adamu Adamu
Honourable Minister of Education

Preface

In keeping with its mandate of making university education in Nigeria more responsive to the needs of the society, the National Universities Commission commenced the journey to restructure the BMAS in 2018, introducing in its place, the Core Curriculum and Minimum Academic Standards (CCMAS), to reflect the 21st Century realities, in the existing and new disciplines and programmes in the Nigerian University System. The arduous process, which was birthed through continued stakeholder interactions over the course of four years, produced seventeen documents to cater for each of the disciplines in the Nigerian University System. A key feature of the CCMAS document is the unique structure that provides for 70% of core courses for each programme, while allowing universities to utilise the remaining 30% for other innovative courses in their peculiar areas of focus.

Following the conclusion of the development and review process as well as a series of editing, the CCMAS documents were lau nched in a grand ceremony on the 5th of December 2022. With the launch, the job of the Commission was far from over as this was only the beginning of a three-phase process in the development/review and implementation of the CCMAS document. Having completed phase one, which is the launching of the CCMAS, NUC proceeded to phase two, which involves the development of the 30% CCMAS by the universities. At the same time, the plan for capacity building for effective implementation of the CCMAS as well as the development of textual materials to support the implementation of the CCMAS were taken on board.

The need to have customised (bespoke) texts to support the implementation of the CCMAS was pointed out by an erudite Professor (President of the Nigerian academy of Education) during one of the General Assemblies and was processed through the NUC Strategy and Advisory Committee (STRADVCOM). Emeritus Professor Nimi Briggs was unanimously nominated as the Project Coordinator. The series of

textual materials are called the *CCMAS Book Series* and titled *Fundamentals Series* in the first project.

The contributors across the 17 disciplines have been drawn from the six geopolitical zones and proprietorship of universities such that there is collective ownership. The major denominator for selection was scholarship in the discipline, which was reflected in the narrative of each book. The various chapters showcase and give examples from local published research so that visibility can be given to ideas from Nigeria and Africa on the topics. While definitions and models from "western" scholars are mentioned, these are de-emphasised as much as possible. The time is ripe to show the world, through this book, that Nigerian scholars, over the last 70 years at least, have been in the frontline of research in the published topics and now able to provide generic and contextual definitions, models and examples in the respective disciplines for scholarly work the world over.

The contents target the compulsory courses in the CCMAS and will be published in a series. As much as possible, the books attempt to sync with the levels of delivery of the curriculum that is 100 level; 200 level and so on. The books are written in very simple English, well-illustrated and rendered in the typical course-material format of objectives, content to be learned, summary, evaluation, exercises and references.

The Commission is optimistic that these series will serve as a guide to support the implementation of the CCMAS documents in the Nigerian University System and beyond and adequately equip the trainers and students in making university education more responsive to the needs of society.

Professor Abubakar Adamu Rasheed, *mni, MFR, FNAL, HLR*
Executive Secretary

Message from the Project Coordinator

Emeritus Professor Nimi Briggs (RIP)

With the launching of the 17 documents of the new Core Curriculum and Minimum Academic Standards (CCMAS) on Monday 5th December 2022 by Vice- President Professor Yemi Osinbajo, *GCON,* Nigeria's National Universities Commission (NUC) accomplished a major feat in its quest to rapidly revitalise the nation's university system.[1] In this regard, the Commission working through its *Strategy Advisory Committee (STRADVCOM),* had, in 2019, identified 10 priority areas that needed urgent attention, one of which is, the introduction of a reengineered curriculum that addresses 21st century challenges. Such a curriculum, it was envisaged, should lay emphasis on skills acquisition and learning outcomes and should be able to stand side by side with those from the World's best universities in the quality of its content as well as being relevant on issues affecting the local communities in which individual universities are located. Thus, CCMAS documents were developed to provide 70% of the contextual materials and compulsory credit units required for graduation at the bachelor's level across the entire chain of degree courses offered by all universities in the country.

That done, attention shifted towards enabling individual universities to develop the additional 30% of the curriculum from issues that are peculiar and relevant to their core mission and local circumstances, as approved by Senates of their individual universities, capacity building and training of staff on the delivery of the CCMAS and the production of books that would cover the contextual materials of the CCMAS.

It is expected that utilisation of the CCMAS series in the Nigerian Universities System will commence in the 2023/2024 academic session. Stringent efforts were therefore made to conclude the production of the series of books, the first in the series, well in advance of that period.

Nimi D. Briggs

February 2023

Note: Sadly, Emeritus Professor Nimi Briggs passed on April 10, 2023. He is resting in the realisation that this project is "safely delivered", he being a globally renowned scholar in obstetrics and gynecology.

Editors' Note

The Book Fundamentals of Architecture is presented in two volumes. Volume 2 contains materials from three of the programmes in the Faculty of Architecture which are: Landscape Architecture, Interior Architecture and Design, Furniture Design. The book has 12 chapters which are sequentially arranged according to programme.

Book 1 covers the contents of the compulsory courses for 100-level students with some stretch to 200 level courses. It is a book that has benefitted from multiple authorship by seasoned Professors who have taught the topics in their chapters for at least five years. Contributors are also drawn from public and private universities in all the six geopolitical zones in Nigeria. This is to give a rich flavour of examples and case studies from across the country on the various topics. Each chapter has a main author, who is responsible for coordinating materials from co-authors and acts as a sub - editor for the chapter.

Editorial work has been done in using the American Psychological association style.

The development of the book went through a 12-step process. These are:

Sequence	Activity
Step 1	• Set up Editorial Committee • Layout of Chapters
Step 2	• Call for Expression of Interest (EoI) with the chapter layout advertised from which potential authors will select.
Step 3	• Selection of contributors based on geographical spread and expertise in having taught the top for at least five years. As much as possible, each chapter should be co authored by scholars from different universities.

	• Submission of signed Acceptance Form
Step 4	• Development of first draft (Version 1.0)
Step 5	• Collation of first draft by Editorial Team
Step 6	• Plagiarism check
Step 7	Three-way review by • Scholars external to the writing team • Internal to the writing team: exchange of chapters for review among the contributors • Final-year students selected across universities in the Nigerian university system
Step 8	• Revision of Version 1.0 based on feedback from the three clusters of reviewers. Product is Version 2.0
Step 9	• Check by Editorial Technical Team for compliance with suggestions for improvement made by the three clusters of reviewers. This can be done at plenary with all contributors present.
Step 10	• Second revision by authors based on the feedback at plenary/by the editorial technical team review of Version 2.0. Product is version 3.0
Step 11	• Professional editing/copy editing of Version 3.0. Product is Version 4.0.
Step 12	• Printing/publication of Version 4.0.

Professor William B. Qurix OFR, FNIA, FCIMC, MNIM
Professor Oludolapo O. Amole MNIA
Editors

Message from the Association of African Universities

(Endorsement of the CCMAS Book- *Fundamentals of Architecture Book 1 Volume 2*)

It gives me great pleasure on behalf of the Association of African Universities; an umbrella organization representing higher education in Africa, to endorse the innovative development of the Core Curriculum and Minimum Academic Standards (CCMAS) and its accompanying CCMAS Book series, by the National Universities Commission of Nigeria.

The Association of African Universities commends the National Universities Commission for embarking on this innovative revolution of reviewing the curricula of universities in Nigeria. This project is coming at a time when there is an urgent need to ensure that graduates of African universities possess the necessary skills that will promote the development of Africa. The development of the CCMAS has provided national guidance on the quality of learning for graduates in our universities and has also given room to each university to reflect their unique vision and mission in their own contributions through the courses that are developed by their faculty members. Faculty members are being empowered to undertake their normal teaching activities to achieve the laid down learning outcomes for each course and program.

The Book series will not only ensure that quality learning takes place but will also give room for the learners to learn in their own time and space. The Book series are aimed at ensuring that learners in Nigeria can develop the skills and competencies necessary for personal and national development, including critical thinking, decision-making, mental agility, creativity, innovation, problem-solving, and logical thinking, among others. This will help the graduates of our institutions to be competitive in a world where the ability to generate, use and

disseminate knowledge, coupled with the ability to develop new ideas about how to do things better and faster, is now the deciding factor in the growth of people and nations.

The Association of African Universities fully commends the National Universities Commission of Nigeria for this revolution in curriculum engineering. The process of developing the book series has followed world best practices with appropriate peer review activities that involve the learners. This initiative is therefore commended to all African Universities as we embark on the continental program of decolonizing the curricula of African universities to build the Africa that we want and need. We hope that other countries in Africa will be able to learn from this revolution in teaching and learning being promoted through this book series.

Prof. Olusola Oyewole
Secretary-General
Association of African Universities, Accra, Ghana

Dedication

Dedicated to

Professor Abubakar Adamu Rasheed *mni, MFR, FNAL, HLR*

who offered exceptional service as the Executive Secretary of the National Universities Commission (NUC) from 2016 to 2023.

Courses covered in Fundamentals of Architecture Book 1 Volume 2

LANDSCAPE ARCHITECTURE

LAA 101 The Role of Landscape Architects in the Building Industry

LAA 222 Communication Media in Landscape Architecture

LAA 201 Technical Drawing for Landscape Architects

LAA 202 Drawing Materials and Tools for Landscape Design

LAA 104 Interface of Human Systems, Environmental Harmony and the Ecosystem

LAA 203 Basic Elements of Map Reading, Analysis and Generation in Landscape Planning

LAA 205 Gardens in the History of Landscape Design

LAA 206 History of Traditional Architecture and Open Spaces Planning in Nigeria

LAA 210 Conceptual Attitudes Behind the use of Visual Character, Ecological Values, Plant Heritage and Ecosystem Restoration

LAA 237 Planting Design, Orientation, Arrangement and Human Needs

LAA 208 Plant Materials, Classification and Uses in Landscape Design

LAA 235 Street Furniture and Their Role in Enhancing Urban Legibility

INTERIOR ARCHITECTURE AND DESIGN

IAD 103 Interior Architecture as a Discipline

IAD 203 Interior Architecture as A Profession

IAD 207 Materials and Elements Used in Interior Architecture and Design

IAD 204 Principles and Elements of Colour

FURNITURE DESIGN

FUD 101 Introduction to Furniture Design

FUD 102 Anthropometrics Measurements for Furniture Design

FUD 212 Understanding Material Properties and Types of Furniture

FUD 201 Universal Design Considerations in Furniture Design

FUD 107 Principles Of Sketching Human Figures and Furniture

FUD 215 Drawing and Concept Development Techniques in Furniture Design

FUD 222 Fundamentals of Human Physiology

FUD 201 Common Workplace Posture and Motions

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Associate Professor	**AMINU**	**Yakubu Dodo**	**Najran University**	**Author**
Professor	**Adelaiye**	**Alexander**	**Bingham University**	**Author**

Table of Contents

Foreword vii

Preface ix

Message from the Project Coordinator xi

Editors' Note xiii

Message from the Association of African Universities xv

Dedication xvii

Courses covered in Fundamentals of Architecture Book 1 Volume 2 xix

List of Authors and Co-authors xxii

Table of Contents xxv

CHAPTER ONE: INTRODUCTION TO LANDSCAPE ARCHITECTURE 1

Community Planning and Design 1

Adejumo Tunji, *University of Lagos, Lagos.*& Emenike Augusta Ifeoma, *Enugu State University of Science and Technology, Enugu*

The Role of Landscape Architects in the Building Industry 12

Ayeni, Dorcas A. *Federal University of Technology,* Akure and Uduma-Olugu N. *University of Lagos*

Communication Media in Landscape Architecture 28

Joseph Adeniran Adedeji (PhD), *Federal University of Technology, Akure*

Technical Drawing for Landscape Architects 41

Olugbenga Adewolu *Bells University of Technology, Ota*

Drawing Materials and Tools for Landscape Design 57

Ayeni, Dorcas A., *Federal University of Technology, Akure*

CHAPTER TWO: INTERFACE OF HUMAN ECOSYSTEMS AND ECOLOGY 74

Interface of Human Systems, Environmental Harmony and the Ecosystem 74

Prof Akunnaya Pearl Opoko, *Bells University of Technology*, Prof Tunji Adejumo, *University of Lagos* & Dr Anifowose

Ecosystems, Space, Place, Culture and Landscape 83

Joseph A. Adedeji, *Federal University of Technology, Akure*

CHAPTER THREE: MAP READING AND AERIAL PHOTO INTERPRETATION 95

Basic Elements of Map Reading, Analysis and Generation in Landscape Planning 95

Prof. Tunji Adejumo, *University of Lagos* Israel O. Taiwo *Afe Babalola University, Ado-Ekiti* and Oluwagbenga M. Oso

CHAPTER FOUR: HISTORY OF LANDSCAPE ARCHITECTURE 107

Gardens in the History of Landscape Design 107

Uduma-Olugu N. *University of Lagos* and Nenchi D. W. *Bingham University, Karu*.

History of Traditional Architecture and Open Spaces Planning in Nigeria 136

Emenike, Augusta Ifeoma (PhD), *Enugu State University of Science and Technology, Enugu.*

CHAPTER FIVE: PLANT MATERIALS AND DESIGN 151

Conceptual Attitudes Behind the use of Visual Character, Ecological Values, Plant Heritage and Ecosystem Restoration 151

Prof. Akunnaya Pearl Opoko, *Bells University of Technology Ota* Titilayo Anifowose

Planting Design, Orientation, Arrangement and Human Needs 160

Ayeni, Dorcas A., *Federal University of Technology, Akure*

Plant Materials, Classification and Uses in Landscape Design 182
Obiefuna, Jerry N. *Godfrey Okoye University, Enugu*. Nenchi Deborah. W. *Bingham University, Karu* and Atumye Amos A. *Bingham University, Karu*
CHAPTER SIX: LANDSCAPE COMPONENTS AND METHODS 201
Street Furniture and Their Role in Enhancing Urban Legibility 201
Emenike, Augusta Ifeoma (PhD), *Enugu State University of Science and Technology, Enugu.*, Nenchi, Deborah, *Bingham University, Karu*
CHAPTER SEVEN: INTRODUCTION TO INTERIOR ARCHITECTURE AND DESIGN 213
Interior Architecture as A Discipline 213
Prof E. B. Jaiyeoba, *OAU. Ile-Ife* Associate Professor E. O. Ola-Adisa, University of Jos
Interior Architecture as A Profession 227
Prof E. B. Jaiyeoba, *OAU. Ile-Ife* Dr E. O. Ola-Adisa, *University of Jos*
Materials and Elements Used in Interior Architecture and Design 242
Associate Professor Faizah Mohammed Bashir, *University of Hail*
CHAPTER EIGHT: COLOUR THEORY AND PSYCHOLOGY OF INTERIOR SPACES 262
Principles and Elements of Colour 262
Emenike, Augusta Ifeoma (PhD), *Enugu State University of Science and Technology, Enugu.*
CHAPTER NINE: INTRODUCTION TO FURNITURE DESIGN 274
Introduction to Furniture Design 274
Prof. Musa Lawal Sagada, *ABU Zaria*
CHAPTER TEN: SPATIAL DYNAMICS OF ERGONOMICS AND ANTHROPOMETRICS IN INTERIOR SPACES 284
Anthropometrics Measurements for Furniture Design – Beginners Course 284
Olugbenga Adewolu *Bells University of Technology, Ota*
Understanding Material Properties and Types of Furniture 302
Asst. Prof. Yakubu Aminu Dodo Ph.D., *Najran University*
Universal Design Considerations in Furniture Design 316
Asst. Prof. Yakubu Aminu Dodo Ph.D., *Najran University*
CHAPTER ELEVEN: FREE HAND DRAWING 322
Principles of Sketching Human Figures and Furniture 322
Olugbenga Adewolu *Bells University of Technology, Ota*
Drawing and Concept Development Techniques in Furniture Design 337
Asst. Prof. Yakubu Aminu Dodo Ph.D., *Najran University*
CHAPTER TWELVE: INTRODUCTION TO BODY PHYSIOLOGY 342
Fundamentals of Human Physiology 342
Prof. Alexander Adelaiye, *Bingham University, Karu*
Common Workplace Posture and Motions 354
Prof Alexander Adelaiye, *Bingham University, Karu*

CHAPTER ONE: INTRODUCTION TO LANDSCAPE ARCHITECTURE

Community Planning and Design

Adejumo Tunji, *University of Lagos, Lagos*.**& Emenike Augusta Ifeoma,** *Enugu State University of Science and Technology, Enugu*

Overview

Community planning is a form of physical planning which is the arrangement of urban and rural land uses for the purposes of creating functionally, efficient and aesthetically pleasing environments for living, working, circulation and recreation, (Ogbazi, 1992). Community planning involves the formulation of long-range visions, goals, policies and strategies for achieving social, economic and environmental sustainability of a community. It guides the future development of the community. It combines a form of public participation and interactive form of town or neighbourhood planning.

This text discusses community planning and design is all part of the planning process. Also it is based on planning theory, which is a body of scientific concepts, definitions and assumptions used in planning our cities and communities. As planning it strives for an open, orderly approach to determine community needs, set goals and priorities for future development of the community which ends in the design.

Objectives

The objectives are to:

1. define planning theory;
2. Explain the types of planning theory;
3. discus community planning;
4. explain community design;
5. discuss community planning process; and
6. identify the benefits of community planning.

Planning Theory

It is embedded in urban planning which is a technical and political process focused on the development and design of land use and the built environment. It is technical because of the various things (land, air, water, infrastructure, etc) that have to be considered, and political because a lot of politics go into bringing all the stakeholders together to agree and when this agreement is finalised, lobbying the government officials for the implementation of the plan as laid out. Most times a very good plan has been worked out, but the political will to carry it out might be lacking. Then these plans are confined

to the shelves. Most times it is a top-down approach because it follows, it comes from the authorities deciding on what is best for the town, (Taylor, 1998). Planning theory is the body of scientific concepts, definitions, behavioural relationships and assumptions that define the body of knowledge in urban planning.

Types of Planning Theory

There are many planning theories that are the principal pillars of urban planning today such as; rational-comprehensive, incremental, transactive, communicative, advocacy, equity, radical, humanistic and phenomenological, (Whittmore, 2015). These will be taken individually.

Rational-comprehensive theory- it takes the whole community, its structure, economic activity, social structure into account in any planning event. It comprises several systematic steps depending on the scale, complexity and precision needed. It starts with data collection, data analysis, formulation of goals and objectives, generation of alternative concepts, elaboration on the concepts, evaluation of alternative solutions and translation of the chosen option into policy and plans for implementation. This was the oldest planning theory which followed a top-down formula.

Incremental theory- is still almost like comprehensive only that, its plans and policies are done incrementally on what was. A long-range policy is worked out with short range plans within the policy framework for immediate intervention.

Transactive theory- was developed as a response to the inapplicability of the rational-comprehensive theory in post-industrial society. It was based on the premise that any fundamental change in the society must be from below (the grassroots), (Ogbazi, 2002).

Advocacy theory- was developed because of the need to accommodate various views in the planning process. It was modelled upon the legal profession where plural views and special interests of various groups are accommodated. An advocate prepares the plan for the group, community or town, presents and defends it in the political arena. Advocacy is sensitive to ethics, history and philosophy of the society.

Radical theory - based on socialist ideology whereby the existing social processes are sort to be understood before making any complex plans. In fact, this arose out of defiance to comprehensive theory.

The early 19th century saw a lot of people coming up with models of how to tackle the problems of unsanitary conditions and squalor as prevalent in those days. Ebenezer Howard came up with a new set of conceptual models, all in the bid to make the city cleaner (sanitation) and bring nature back into living spaces.

He propounded the Garden city theory, followed by Concentric Circle model by Burgess Ernest, Radburn Superblock by Clarence Stein, the Sector Model by Homer Hoyt and the

Multiple Nuclei by Chauncy Harris and Edward Ulman while the Neighbourhood concept by Clarence Perry (Mohd, 2017).

The Garden city- propounded by Ebenezer Howard was for a city of 6,000 acres to accommodate 32,000 population. It should have a central area of 1,000 acres, individual plots of 20 ft by 130 ft and a gross density of 32 persons per acre. The roads were to radiate from the centre dividing it into 6 wards. There should be several garden cities making a cluster with a central city of about 50,000 people, e.g. Letchworth.

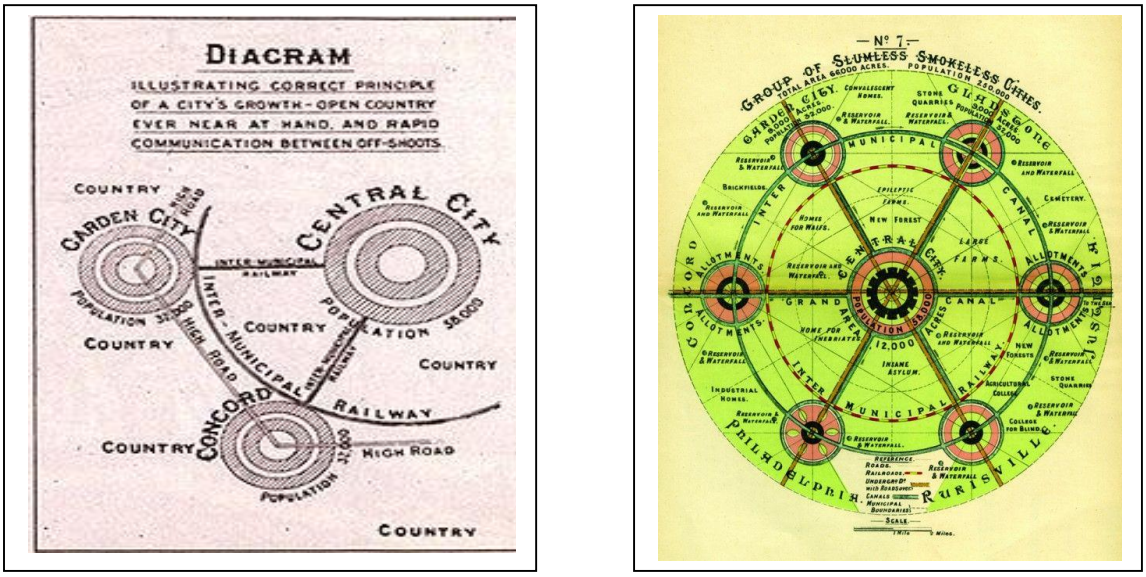

Figure 1. *The Garden City.* *Source*: claysant.blogspot.com

The Neighbourhood Concept- proposed by Clarence Perry. This was a neighbourhood unit providing a residential area with ideal size of population for services and identity. The guiding principle is neighbourhood size related to the catchment area of an elementary school and 10 mins walking distance from every house within a ½ mile radius. The neighbourhood should have no thorough traffic, a neighbourhood centre with school and services, parks and play areas, etc. This will be bounded by arterial streets and district shops.

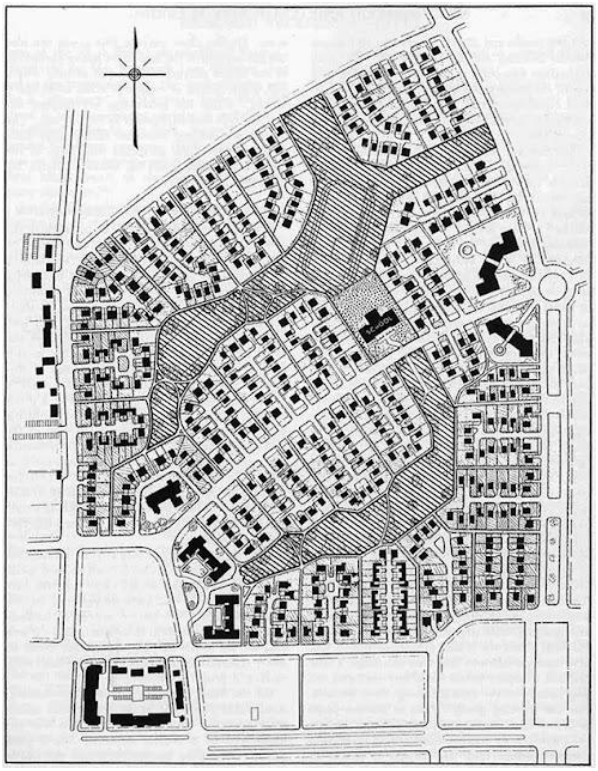

Figure 2. *Neighbourhood Concept.*

Radburn Superblock- proposed by Clarence Stein, followed closely the tenets of the neighbourhood model but instead of the small lots, they were merged to form superblocks, thereby freeing areas of greens in the neighbourhood.

Concentric Circles- propounded by Ernest Burgess, he identified and used five zones of land use Central Business District (CBD), Zones of Transition (Mixed Commercial and Industrial), Low Income Housing Zone, Middle Income Housing Zone, Out-lying Zone (Suburban) with growth (Population and Transportation) each ring tended to invade the Outer adjacent zone, thereby changing the structure of the city eventually.

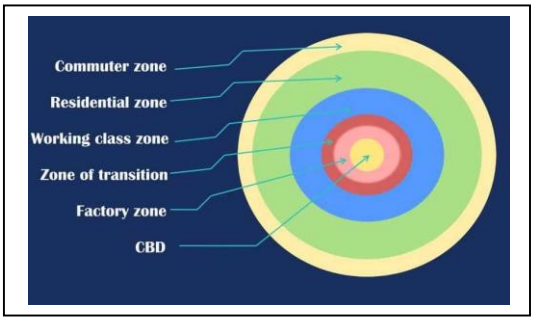

Figure. 3 *Concentric Circles model*

Sector Model- propounded by Homer Hoyt, he believes that cities do not grow in strict concentric circles but in sectors or similar development especially housing. This model complements concentric models.

Multiple Nuclei- propounded by Chauncy Harris and Edward Ulman. They proposed that land use patterns develop in a series of nuclei with different functions. It was also articulated that as a city grows, existing nuclei can be absorbed and newer ones created, due to specialisation.

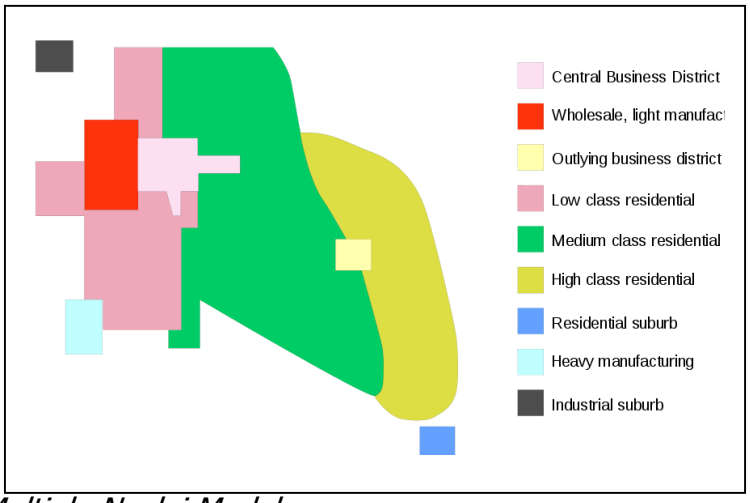

Figure. 5 *Multiple Nuclei Model*

What is Community Planning?

It involves the formulation of long-range visions, goals, policies and strategies used in achieving economic, social and environmental sustainability in communities, (Wheeler, 2004). It can also be called long range planning or comprehensive planning used in guiding the community's future developments.

It strives to create an open orderly approach to find out the community needs, set out attainable goals and priorities. It has a unique feature of involving everyone in a participatory mode thereby harnessing the untold potential inherent in different individuals, from the bottom up.

What is Community Design?

It is the art of making sustainable living spaces that tries to adapt people's needs for shelter, livelihood, commerce, recreation and social order. Community design is intentional, not haphazard following closely with community planning, (Ashley, 2023). In fact community design is the outcome of a community planning exercise shown in maps, comprehensive plans, zoning ordinances, etc.

The major building blocks of community design are; paths, edges, districts, nodes and landmarks as seen in the image of the city. Paths are the walkways, streets, railways, etc

that connect activities and different land uses. They are the main lifelines of the city. Edges are boundaries between two kinds of districts used in organising a community e.g. open spaces, landscaped boulevards, etc. Districts are areas treated in ways distinct from the others, having things in common within themselves. Nodes are areas or points that have some value and serve as core which could be intersections of paths. Landmarks are similar to nodes but refer to a particular element (structural or natural), (Ashley, 2023). In most Nigerian towns; a church, mosque, post office, big supermarket, school, etc could serve as landmarks. Even the chief's (king's) house or a big shrine could serve as landmarks in villages.

The Community Planning Process

Community planning is like any physical planning activity that strives for an open, orderly approach to determine community needs, set goals and priorities. It includes people of every level (Public Participation) to determine the future social, economic and physical development of their community, (Lefevre, Kolsteren, Devval, Byekwaso & Beghin, 2000). Community planning is a logical bottom-up evolution and works in a process format. It is depicted in the chart as shown in fig.6.

Figure. 6 *Community Planning Process*

Source: University of Wisconsin-Madison, Steps in a planning process, land use training and resources.

The Community Planning Process can be divided into three stages as follows: Pre-Planning Stage (preparing to plan) is for data collection, liaising with the people, generally preparing the ground. The second is the Planning Stage where with data from stage 1, proposals are made, evaluated against all seen and unseen circumstances, so as to be fool proof. And then the final being the Post-Planning Stage which is implementation of whatever plan that has been developed. It is detailed as shown below.

Stage 1: Pre-Planning is divided into two

1) Community diagnosis: base data is collected on the existing situations of the community by;

1. Determine purpose, capacity and readiness for planning. This has to come from the people, see what their problems are and be willing to tackle them one-on-one.
2. Take Inventory of existing plans, studies and tools that is if there has been any plans made before, whether implemented or not has to be brought forward.
3. Explore preliminary issues and concerns, that is where the education comes in, people are briefed on the best things and encouraged to come out, to air their views and participate.
4. Identify potential planning participants and stakeholders.
5. Build capacity for planning by providing education to local officials and residents.

2) Process Design:

1. Establish a budget for planning; they have to work within a budget.
2. Determine who will prepare the plan.
3. Issue a request for proposals if you will be working with a consultant.
4. Establish roles, responsibilities and membership of groups involved in planning.
5. Identity preferred steps in the planning process and the desired end products.
6. Incorporate opportunities for public participation and education.

Stage 2: Planning consists of five steps:

Data Collection Analysis: assess the communication data and inform needs (technical, spatial data, public opinion data), analyse and interpret data, make projections, show patterns and trends for discussion.

Issue Identification:

1. Identify key communication issues, challenges, opportunities and desires.
2. Use local data and analyses to support/identify issues
3. Prioritise issues to be addressed.
4. Identify a vision for the future development.

Goal and Objectives Formulation

1. Develop goals and measurable objectives.
2. Develop indicators to monitor progress.

Strategy Formulation.

1. Identify potential plan implementation strategies to satisfy goals/objectives.
2. Evaluate impact of alternative strategies and select preferred options.
3. Recommend specific plan implementation policies, programs actions and tools.
4. Describe timelines and parties responsible for plan implementation.

Review plan and Approval:

1. Present plan to commission.

2. Make changes arising from review.
3. Adopt a plan.

Stage 3: Post Planning: In this stage.

Plan Implementation:

1. Adopt a specific course of action to implement.
2. Develop or amend local policies, programs and tools.

Monitoring and Assessment:

1. Monitor progress
2. Review and revise Plan

In another instance the Community Planning Process can also be summarised into these four steps as follows:

1. Analysing: In this step the community articulates their problems; where is our community now? How did we get here?
2. Envisioning: Having articulated their problems, they make proposals on what to aim for; where do we want to be?
3. Planning: in this stage, there are predictions on what is expected to be done; how do we get there?
4. Evaluating: there will always be taking stock of what has happened, how it is happening and what is expected to happen; what progress have we made towards reaching our goals?

Benefits of Community Planning

One very good benefit of community planning is the bottom-up process, whereby the whole community is involved. It gives everyone a chance to voice out and contribute to the planning of their community. Here the people are educated on the issues at hand and promptly follow the process as it enfolds. It creates vibrant urban and rural places that are attractive, convenient, functional and safe. Community planning conserves natural, historic and cultural landscapes especially for wildlife habitat, storage of flood water, enhances groundwater recharge and so on. With the above it promotes economic development and efficient use of local services and infrastructures, (Hall, 2014). Above all it predicts future development and protects private property rights.

Summary

Community planning and design is basically the physical planning and design of towns. It takes on all the land uses and the base structure for efficient and effective running of the towns so planned.

In this course, the student acquires knowledge of all planning theories, the planning process and synthesises them into a good workable plan (design). This makes the course to comprise theoretical as well as practical aspects to it, so the student is expected to

know the theories and the practical aspect of planning and design of the community properly.

Exercises

1. In a study of your university town, trace and relate if any planning theory has been used in its initial plan.
2. Design a neighbourhood of about 2000 people using the garden city concept.
3. Describe one benefit of community planning and relate it to what happens in any town of your choice.

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The Role of Landscape Architects in the Building Industry

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Overview

Landscape architects create functional, sustainable, and aesthetically pleasing outdoor spaces for the building industry. Residential, commercial, and public projects like parks, gardens, and plazas are their specialties. Analysing site conditions, developing design concepts, preparing construction documents, and overseeing the final design are their duties. To ensure the landscape design is seamlessly integrated into the project, they work with architects, engineers, contractors, and other building professionals.

This text discusses how sustainable outdoor spaces depend on landscape architects and especially how design landscapes support local ecosystems, reduce water use, and improve air quality using ecology and plant science. It also focuses on how landscape architects also work with communities to ensure their designs meet the needs and preferences of those who will use and enjoy the space. Stakeholder feedback from public meetings and workshops may be used to improve their designs.

Objectives

The objectives of the text on the role of landscape architects in the building industry are to:

1. discuss the landscape architects' role in sustainable and functional building design;
2. examine how landscape architects in the building industry balance environmental considerations with customer preferences, budget restraints, and project schedules;
3. examine how landscape architecture improves building aesthetics, property values, and outdoor area use; and
4. enlighten about the collaboration between landscape architects, architects, engineers, and other building industry experts to maximise project success.

Introduction

The Landscape Architect plays many roles in the building industry. Most important of which is their primary role as the custodian of the earth's resources, ensuring that the resources are used in a very judicious manner that enables sustainability for the same resources for future generations. Beyond the most commonly known role of designing parks and gardens, the landscape architect is tasked with being the nexus between the architect and the urban designer. In this guise, the landscape architect is the fabric that ensures the smooth running of the city especially as concerning the green infrastructure and the linkages across the urban and rural and indeed regional and global land management and planning. Their functions range from small garden spaces/scales, to

streetscapes, to neighbourhood, theme and regional parks to landfill planning, to highway design and urban/drone agriculture to forest conservation to tourism planning of nature reserves, etc.

In a similar manner that architecture shows each group of people's culture, that is the same way that the landscape architect's design on land reveals the people's culture and philosophies. Beyond being a "Plant whisperer", knowing every relationship of plants used in design, The landscape architect's full understanding for topography, hydrology and structures in general prepares them to play the most important role of tying the building firmly to its environment and ensuring a generously harmonious relationship between man and nature. This understanding stems from the balancing of the ecosystem in the built environment. This task is beyond beautification, decoration or even mere design – it is tied to climate change and sustainability as a keyword in dealing with the rest of the building industry.

Before establishing landscape architects' functions in the building industry, explaining the different perceptions and who a landscape architect is, is essential. People often get confused and sometimes assume the terms landscape, landscaping, landscape design, and landscape architecture to mean the same thing. Nevertheless, these terms do not mean the same thing in any way, and their meanings are wholly distinct.

Different Perceptions of Landscape

Although they are all related to creating and modifying the built and natural environment, the phrases landscape, landscape architecture, landscape design, and landscaping have diverse meanings and applications.

The term **"landscape"** refers to the physical characteristics of an area of land, which can include both natural (terrain, water bodies, and flora) and man-made elements (buildings, roads, and other forms of infrastructure). The way people perceive landscapes differ from person to person. But the European Landscape Convention (ELC) defines Landscape as

"An area, as perceived by people, whose character is the result of the action and interaction of natural and or human factors."

Meaning that Landscape arises from the interaction of people with their environment. Landscape can therefore be defined based on the above as *'scenery of natural and man-made features within the built and natural environment defined by man's interaction and activities within his surroundings*.

The field of study known as **landscape architecture** focuses on designing and planning outdoor areas to produce surroundings that are not only functional and visually beautiful but also sustainable and responsible for the environment. The American Society of Landscape Architecture (ASLA), Defines landscape architecture as:

'The art of design, planning or management of the land, arrangement of natural and man-made elements thereon through the application of cultural and scientific knowledge, with concern for resource conservation and stewardship to the end that the resultant environment serves a valuable and enjoyable purpose.

The definition implies that the profession applies artistic and scientific principles to the research, planning, design and management of both natural and the built environment.

The process of generating plans and designs for outdoor spaces is known as **landscape design**. When producing these plans and designs, the emphasis is typically placed on aesthetics, utility, the space's particular requirements and the people who will be using it. Landscape design focuses more on the artistic merits of the design, while landscape architecture encompasses artistic design and management.

So, *landscape design is the art of arranging or modifying the features of a landscape for aesthetic or practical purposes.*

Its primary concern is the creation of attractive outdoor environments and the selection of design components, materials and plants. A landscape designer is different from a landscape architect primarily because of a variation in training and differing vocational tendencies; a landscape architect is literally an architect of Landscape who brings together the natural balance between man's needs and ecology.

Landscape architects make use of their knowledge in design, engineering, and horticulture to produce outdoor areas that are not only practical but also aesthetically pleasing. Landscape architects can work on a wide variety of projects, from intimate private gardens to expansive urban parks and other public areas.

The term **"landscaping"** refers to the art of modifying and beautifying outdoor terrain by planting trees, flowers, and shrubs, grading and creating structures such as patios and retaining walls, and adding components such as water features or lighting.

Although these terms are sometimes confused and frequently used in conjunction with one another, it is essential to understand the differences between them. Creating functional, environmentally friendly, and aesthetically pleasing outdoor environments is the focus of the work of landscape architects and designers. Landscaping, on the other hand, refers to the physical labour involved in putting such designs into action. When working with professionals in landscape design and architecture, it can be helpful to understand these distinctions so that you can more effectively explain your wants and goals to those professionals.

So, who is a Landscape Architect?

A professionally trained and licenced to design and plan outdoor spaces, such as parks, gardens, urban plazas, residential properties, and other outdoor places, is known as a landscape architect. This kind of specialist is responsible for the design and planning of outdoor areas. Landscape architects use their understanding of design, engineering, and horticulture to create landscapes that are not only practical and aesthetically beautiful but also sustainable and responsible for the environment. Landscape architects may work for private clients, government agencies, or architectural companies. They are typically involved in the planning, designing, and managing of outdoor areas throughout the project's lifetime.

Creativity, problem-solving ability, attention to detail, and good communication skills are essential for a career in landscape architecture. Other critical skills include the ability to analyse and interpret data. Many professionals in this industry receive their licences by registering with Landscape Architects' professional bodies such as the Society of Landscape Architects of Nigeria, abbreviated as SLAN, the American Society of Landscape Architects, abbreviated as ASLA, and The International Federation of Landscape Architects (IFLA), in addition to earning a bachelor's or master's degree in landscape architecture.

SLAN is a trade group for landscape architects in Nigeria. Its acronym stands for the group's full name. Through advocacy, education, and professional skills development, the organisation contributes to the growth of the landscape architectural profession in Nigeria. The mission of ASLA is to improve the profession of landscape architecture and raise awareness about the significance of environmentally responsible design, planning, and management of both the built and natural environments. The International Federation of Landscape Architects (IFLA) is a global organisation that represents landscape architects from all over the world and has the mission to increase awareness of the landscape architecture profession and to advocate for the significance of environmentally responsible design and planning in the process of sculpting the built and natural environments. In addition, the IFLA serves as a forum for international cooperation and the dissemination of information among landscape architects worldwide.

The Role of The Landscape Architect in the Building Industry.

The design and management of outdoor areas that are functional, aesthetically pleasing, and environmentally sustainable is the responsibility of landscape architects, who play an essential role in the building industry because they are responsible for designing and managing such areas. In the construction sector, landscape architects have a variety of essential jobs and a variety of essential responsibilities, including the following:

1. Site Analysis and Planning: One of the most critical processes in landscape architecture is site analysis and planning. A comprehensive analysis of the site's physical,

environmental, and social characteristics is required to develop a comprehension of its potential and the limitations it suffers. The ultimate goal is to develop a site plan that makes the most of the site's potential while also satisfying the demands and goals of the client. The first step in site analysis is to carry out a detailed site inventory. The inventory involves collecting data about the site's topography, soil conditions, climate, flora, hydrology, wildlife, cultural and historical elements, and other relevant aspects. The information collected assists the landscape architect in understanding the site's strengths, flaws, and potential.

Once the site inventory is complete, the second step is to conduct a site analysis. The landscape architect examines the site data to identify site constraints, which may include places prone to flooding, steep slopes, poor soil conditions, and other problems that may affect the development of the site. The investigation additionally uncovers chances to improve the site's natural features and a feeling of identity within the neighbourhood.

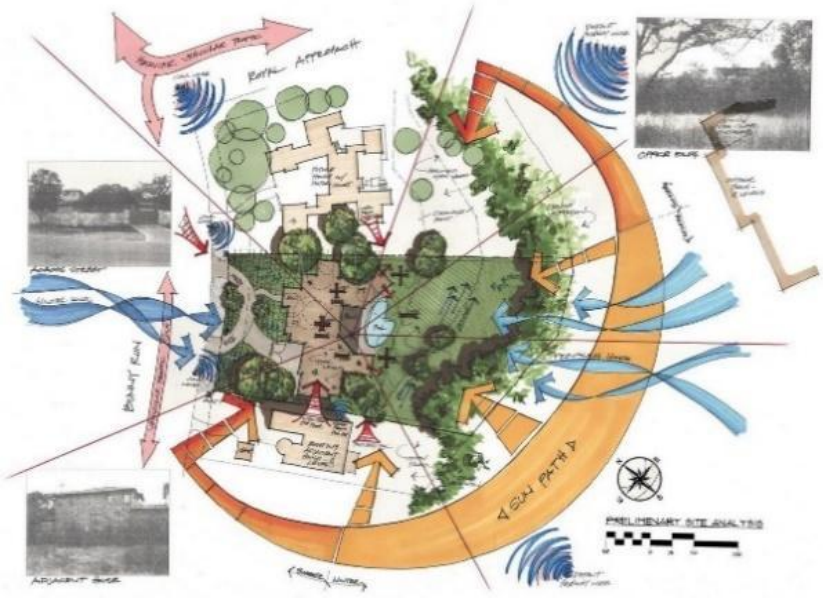

Figure 1. *A sketch of a preliminary site analysis of a landscape project* (Rethinking the future, 2022)

The landscape architect creates a site plan after they have completed an inventory and analysis of the site. The plan illustrates the intended design and layout of the outside space, which includes walkways, planting beds, hardscape components, water features, and other elements such as lighting. In addition, concerns about drainage, erosion control, and access to the site are tackled by the plan.

Figure2. https://www.google.com/search?q=landscape+site+planning&client=firefox-b-d&source=lnms&tbm=isch&sa=X&ved=2ahUKEwi8y46jsrH9AhUGBMAKHSPvAXAQ_AUoAXoECAEQAw&biw=1536&bih=739&dpr=1.25#imgrc=wshLHcr-zKSOjM

Landscape architects work collaboratively with other built environment professionals, such as architects and engineers, during the planning phase of a project to ensure that the outside areas and the constructed environment are harmoniously combined. This collaboration ensures that the site plan is appropriately coordinated with the building design and construction, ultimately providing a seamless and undetectable transition between the inside and outdoor spaces. In a nutshell, site analysis and planning are two of the most critical steps in the landscape design process.

Design and Development:

Design and development are essential components of landscape architecture. Landscape architects are in charge of planning, designing, and constructing outdoor areas that are practical, environmentally friendly, and visually beautiful. They cultivate intimate relationships with clients and communities to understand their requirements, preferences, and goals for the area. In addition to this, they consider the location's environmental aspects, such as the climate, the soil, and the topography.

Landscape architects put their expertise to use by relying on their knowledge of plant species, hardscape materials, and building techniques while developing their designs. They take great care in selecting plant species that are ideally suited to the characteristics

of the location and that will flourish in the region's climate. When selecting plants, they take several other considerations into account, including the need for maintenance, the patterns of growth, and the aesthetic aspects of the plants. In addition to plants, landscape architects utilise various hardscape materials, such as stone, brick, and concrete, to build pathways, walls, and other structures in the Landscape. These materials are referred to collectively as hardscape materials. They take great care in selecting materials that are long-lasting, environmentally friendly, and aesthetically pleasing.

In addition to this, landscape architects make use of computer-aided design (CAD) tools in order to generate three-dimensional models and visual representations of their designs. Clients and community members can view the finished space and provide feedback on the design courtesy of this feature. In addition, it enables landscape architects to conduct correct calculations and measurements, ensuring that the ideas they create are accurate and can be implemented.

In general, it is the responsibility of landscape architects to design outdoor areas that are useful and improve the health and quality of life of both people and the environment. They work hard to come up with attractive, robust, and environmentally friendly ideas while catering to their customers and the community's requirements.

Sustainable Design

Sustainable design is an essential element that must be included in landscape architecture. Landscape architects work hard to design outdoor areas that not only fulfil the requirements of their clients and the community as a whole but also minimise the adverse effects of construction projects on the surrounding environment and foster the growth of a more environmentally friendly society. In the field of landscape architecture, sustainable design is an essential component. Landscape architects are responsible for designing outdoor areas that suit the demands of their clients and the community and reduce the environmental impact of development projects. This responsibility includes meeting the needs of their clients and the community. It involves using environmentally friendly materials, implementing steps to conserve water, and designing areas that encourage the use of environmentally friendly transportation methods.

Using recycled materials is one way that landscape architects promote sustainable landscape design. They take great care in selecting materials that are less harmful to the environment and have a smaller carbon footprint than conventional materials. This can involve the use of reclaimed wood, concrete, and other building materials, as well as the use of resources that are sourced locally to reduce the number of emissions caused by the transportation of these products. Another way that landscape architects support sustainable practices is by putting into action various water conservation practices. This can include the use of drought-resistant plant species that demand less water, the design of areas that capture and reuse rainwater, and the installation of irrigation systems that use efficient water usage technology. Landscape architects contribute to preserving this

precious resource and lessen the negative effect of construction projects on the ecosystems they are located in by finding ways to use less water.

Landscape architects also design green infrastructure systems, such as green roofs and rain gardens, which help manage stormwater runoff and lessen the heat island effect in urban areas. These systems can be found in many cities. Rain gardens are designed to collect and filter rainfall before it is released into storm drains. In contrast, green roofs are covered with vegetation that absorbs rainwater and provides insulation. These green infrastructure systems assist in minimising the amount of stormwater runoff that enters local waterways, which in turn can help prevent flooding and reduce erosion.

Last but not least, landscape architects design areas that promote eco-friendly modes of mobility. This can include the construction of paths that are suitable to pedestrians and cyclists, the creation of locations that are easily accessible by public transportation, and the encouragement of the use of electric automobiles. Landscape architects contribute to the reduction of greenhouse gas emissions and the promotion of healthier, more sustainable societies through the promotion of sustainable transportation.

Project Management

Project management is an essential component of landscape architecture. Landscape architects play an important role in ensuring that the finished product satisfies the required quality, durability, and usability criteria by effectively managing the construction process.

The administration of projects is an integral part of landscape design, and landscape architects are frequently the ones who are tasked with overseeing the construction phase of a given landscape project. They collaborate with the contractors and other specialists necessary to guarantee that the design is carried out accurately and that the end product satisfies the requirements set forth.

In order to be able to manage a project efficiently, landscape architects need to have a comprehensive understanding of the design, materials, and construction methods that are involved. They must also have good leadership and communication skills to effectively coordinate the project team's efforts, including contractors, subcontractors, and other experts. Managing a project's finances, timelines, and contracts is the responsibility of landscape architects. They are obligated to keep a close eye on the project's costs to ensure that it stays within its allotted budget, and they must make necessary adjustments to the project timeline to ensure that it is finished on time.

They also manage contracts with contractors and subcontractors, ensuring that all parties fulfil their obligations and that the project is completed to the desired standards. This ensures that the contracts are managed effectively. Throughout the construction process, landscape architects are tasked with supervising the project team's work. This is done to guarantee that the design is carried out accurately and that the result is in accordance

with the outlined initial requirements. In addition, they are responsible for managing any issues that come up during the construction phase, whether they be unanticipated site conditions or design changes, to keep the project on schedule. In addition to managing the construction process, landscape architects are tasked with ensuring that the project satisfies the required quality, durability, and functionality criteria. They are obligated to conduct a thorough review of the completed project and make any necessary modifications to align it with the requirements outlined earlier.

Community Engagement

Community engagement is an essential component of landscape architecture. This is because it enables landscape architects to create designs that are sensitive to the requirements and preferences of the communities they serve. Landscape architects can produce designs that contribute to a community's general well-being and quality of life when they work with community members to develop such designs. These designs can reflect the distinctive personality and culture of the community.

Landscape design relies heavily on community participation since it requires close collaboration with local communities to comprehend their requirements, inclinations, and priorities fully. Landscape architects can produce designs adapted to the community's specific demands and represent the town's distinctive character and culture when they engage with the community and solicit feedback from residents.

Landscape architects must have excellent relationships with community leaders, stakeholders, and citizens to engage with the communities they work with effectively. They must also be able to speak clearly and actively listen to comprehend the community's concerns, priorities, and goals. They will be able to get vital insights into the community's history, culture, and traditions, which can inform the design process if they do this.

Once landscape architects have a grasp of the community's requirements and preferences, they can put this knowledge to use by designing landscapes that meet the requirements and preferences of the community. For instance, they could plan the layout of a park so that it is accessible to people of all ages and abilities; alternatively, they could design public areas that encourage socialisation and the formation of communities, such as a communal garden or a plaza that is open to the general public and serves as a meeting place.

When developing designs, landscape architects consider the community's functional requirements and the social and cultural environment in which the community exists. For instance, they might incorporate cultural elements into the design, such as art installations or sculptures that reflect the community's history and traditions. This could be done in several different ways. They could also design locations conducive to social

engagement and community building, such as dining areas, public art exhibitions, or interactive play structures, for example.

Maintenance and Management

Maintenance and management are essential components of landscape architecture that must be present to keep outdoor areas in good health and assure their continued viability. Landscape architects play a crucial role in ensuring that outdoor areas will continue to be safe, functional, and aesthetically pleasing in the years to come. They do this by devising efficient maintenance plans, working closely with maintenance staff, and managing how people use and enjoy outdoor areas.

Maintenance and management are essential to landscape architecture because they guarantee that outdoor areas will remain usable, secure, and aesthetically pleasing. Landscape architects play an essential part in the ongoing management and maintenance of outdoor spaces. They collaborate closely with park officers, maintenance staff, and other professionals to develop and implement maintenance plans that ensure outdoor spaces' long-term health and viability. Landscape architects are essential to the process.

Creating maintenance plans that detail the procedures that must be followed to keep outdoor areas in good shape is one of the fundamental responsibilities of landscape architects responsible for their upkeep and administration. These plans include watering, pruning, and fertilising plant materials, as well as repairing and replacing hardscape features such as benches, walks, and signage; also, the plant materials will be pruned and trimmed as necessary. In addition, timelines and budgets for carrying out these operations are included in the maintenance plans, as are procedures for dealing with unexpected events such as damage caused by a storm or vandalism.

In addition, landscape architects collaborate closely with park workers and other maintenance staff members to ensure that outdoor areas are kept tidy, risk-free, and in good condition. This entails doing routine inspections and monitoring of outdoor areas to identify problem spots and then taking the necessary corrective actions to resolve problems such as excessive growth, erosion, or potential safety hazards. Guidelines and procedures for using fertilisers and pesticides, as well as protocols for managing stormwater runoff, are examples of the types of things that landscape architects design for the maintenance staff to follow.

In addition to developing plans for maintenance and working with maintenance staff, landscape architects play a role in controlling the overall use of outdoor areas, and the enjoyment people get from using them. This may involve setting laws and standards for public places, such as rules for dog owners or regulations that control the usage of picnic spots. Another possibility is that this may involve the use of public spaces. Landscape architects may also collaborate with community groups and other stakeholders to establish programmes and activities that increase the use of outdoor areas. Some

examples of these programmes and activities include outdoor exercise courses and community gardening programmes.

Conservation Planning

Landscape architects play an essential part in the process of environmental conservation by carrying out planning for conservation. They can help reduce the influence of landscape design on the environment while supporting the sustainable and effective use of resources by providing advice on the conservation of natural resources such as water, soil, and energy. Landscape architects play an essential part in the conservation planning process, which is crucial for the preservation of the environment. They offer advice on preserving natural resources such as water, soil, and energy, and they also design landscapes that make the most of these assets while consuming as little of them as possible.

For Water Conservation, Landscape architects design landscapes that use as little water as possible by combining water-efficient irrigation systems, drought-resistant plants, and other water-saving measures into the design of outdoor spaces. In addition, they offer guidance on the use of recycled water and rainfall collection devices to lessen the requirement for drinkable water. In soil Conservation, Landscape architects advise their clients regarding soil conservation through erosion control measures, strategies for soil stability, and the incorporation of native plants that assist in preserving soil moisture and preventing erosion.

Also, for Energy Conservation, Landscape architects construct landscapes that promote energy efficiency by including shade trees, green roofs, and reflective surfaces that lessen the influence of the urban heat island. This can be accomplished by incorporating these elements into the Landscape. In addition, they offer guidance on using renewable energy sources such as solar and wind power for outdoor power lighting and other landscape features.

For Eco-Friendly materials, Landscape architects often guide their clients regarding using environmentally friendly materials in the design of outdoor spaces. They encourage using materials that have been recycled or recovered, as well as products that have a low impact on the environment.

Landscape architects also use Life Cycle Analysis to examine landscape design's influence on the surrounding environment and to locate areas in which landscape design could be enhanced. They evaluate the environmental impact of the materials, construction procedures, and maintenance practices and recommend modifications that can lessen the environmental impact.

Landscape architects also work to restore damaged or degraded ecosystems by designing landscapes that provide habitat for native species and promote biodiversity. Habitat restoration is an essential role of landscape architects in environmental conservation. By

designing landscapes that provide habitat for native species and promote biodiversity, they can help restore damaged or degraded ecosystems and support the health and resilience of local ecosystems.

Landscape architects play an essential role in environmental protection by engaging with communities, providing workshops and training sessions, and presenting before the public. They also create materials for outreach, such as brochures, posters, and educational resources, and offer specialised counsel and technical assistance to help decision-making and advance environmentally friendly practices. They can raise awareness about the significance of safeguarding natural resources and promoting the conservation of our planet's ecological systems if they engage with local people, provide education and training, and advocate for sustainable practices.

Produce Contracts and Estimated Costs

It is the job of landscape architects to develop contracts and cost estimates when it comes to the process of designing landscapes. They perform tasks such as investigating the site, developing the design, estimating the costs, preparing the contract, managing the project, developing a timetable, communicating with contractors and subcontractors and supervising the construction process to ensure the project is completed within the client's budget. Landscape architects may significantly contribute to the success of landscape design projects by ensuring that the projects they design are financially sustainable and by adhering to the budget set for the project throughout its course.

Report writing

Report writing is crucial to a landscape architect's job since it helps them document their work, explain their thoughts and recommendations to clients, and give a basis for decision-making. Reports on a variety of topics, including environmental impact assessments, feasibility studies, design ideas, and project evaluations, may be expected of landscape architects if they are to fulfil their job responsibilities. Report writing entails several significant areas, including research and analysis, report writing, review and editing, presentation, follow-up and monitoring, and report writing. Landscape architects can assist in promoting sustainable practices and protecting natural resources by documenting their work, conveying their thoughts and recommendations, and giving a basis for decision-making.

Work Closely with Other Professionals

Landscape architects collaborate closely with members of several other professions to ensure that the planning and execution of projects are carried out in a successful and efficient manner. Specialists must work together to accomplish the intended result and ensure the project is finished on time and without exceeding its budget. In order to develop an all-encompassing design that satisfies the requirements of all parties involved, including site analysis, planning, compliance, coordination, and construction, landscape

architects collaborate with surveyors, civil engineers, town planners, and civil engineers. This process results in a comprehensive design. The combined knowledge and experience of these professionals guarantee that the project's design will be ideal for the neighbourhood, the environment, and the site itself.

The Landscape architect and urban design

Landscape architects are also involved in urban renewal. They deal with street design and streetscaping. Working in tandem with the urban planner the landscape architect is involved with both street and highway designs, bringing aesthetics to engineering projects that contribute to a city's identity and ambience and sense of place. Waterfront design, recreation and other reclamation /renewal projects give the landscape architect an opportunity to tie the city to its residents and produce places of enjoyment for both users and tourists. The planning of tourism destinations, estates, campuses and such like projects are in the purview of landscape architects, as they are trained in a variety of professions to complement others in the building industry.

Summary

The designing and planning of outdoor spaces, such as parks, gardens, campuses, and public areas, falls within the purview of landscape architects, who play an important part in the construction industry. Their work entails combining natural elements into the design, such as trees and water, and creating spaces that are not only environmentally friendly but also functional for people to use and enjoy.

Landscape architects collaborate closely with other building industry professionals, such as architects and engineers, to ensure that the constructed environment and the outdoor spaces flow together effortlessly. This is one of the primary responsibilities of landscape architects. As they design something, they take into account a variety of issues, including environmental sustainability, accessibility, as well as the social and cultural context of the site. In general, landscape architects play a significant role in the creation of aesthetically pleasing, practically useful, and environmentally responsible outdoor settings in the built environment.

Exercise

1. What are some of the challenges that landscape architects face when working on building projects, and how do they overcome them?
2. What are some of the most important factors for landscape architects when developing outdoor spaces for buildings, such as parks, plazas, and courtyards?
3. How can landscape architects ensure that their designs are sustainable and environmentally responsible?
4. How do landscape architects collaborate with other building designers, such as architects and engineers, to design a building?

Students are expected to go for case studies within their vicinity for more real-world examples and trends

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Dr Dorcas Ayeni, an Associate Professor in the Department of Architecture at the Federal University of Technology Akure (FUTA). is an accomplished architect and academic specialising in Landscape Architecture and Sustainable Tourism. She holds a Bachelor of Science in Architecture and a Master of Science in Architecture from Ahmadu Bello University, Zaria. She obtained her PhD in Architecture and Sustainable Tourism from De Montfort University, Leicester, in the United Kingdom.

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She has significantly established collaborative partnerships between FUTA and international universities, including London South Bank University and De Montfort University

Communication Media in Landscape Architecture

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Overview

Communication is an important aspect of design professions generally. Landscape architecture is one of the design professions where landscape designs are communicated by the landscape architect to the client for understanding, appreciation and acceptance and to the landscape contractor for execution. The designer first communicates the ideas to himself/herself effectively during the design process before being able to communicate with others. This is normally done by developing design ideas and concepts through simple line diagrams. Like in all communication processes, three points are distinguishable in a continuum: origin, medium, receiver. The success of communication lies in a thorough flow of information from the origin, through the medium, to the receiver.

This text focuses on communication media; especially its concepts; its uses and the various types of media. This is based on the fact that the designer doubles as the originator and receiver in communication during the design process when design decisions are made. It explains how in the case of the client and contractor, they are largely receivers of communications of landscape designs, while the client could be the originator when communicating the design brief to the landscape architect. In different participatory-design models, communications of designs and feed-backs are effected between design and user groups. Therefore, communication media are critical tools throughout the process of delivering landscapes – pre-design, design, and post-design stages. These stages also overlap or have points of confluence with the three conventional stages in landscape contracts – pre-contract, contract, and post-contract.

Objectives

The objectives of the text are to:

1. define the basic concepts in relation to communication;
2. categorise and outline the communication media in landscape architecture;
3. describe the uses of the communication media for different purposes;
4. examine the influence of information and communication technologies on the communication strategies in landscape architecture; and
5. identify guidelines for personal development in the use of communication media in landscape architecture.

Introduction

Communication media remain central to the practice of landscape architecture from time immemorial. A sketch of this historical development (for example Nijhuis, 2013) reveals that northern Italy had maps of villages carved on rocks as far back as 2000 BC while early Egypt and China had floor plans and models that were older.

The 14th Century marked a turning point in the importance of visual communication in landscape architecture with the advancements in measurement methods. This came with model making, drawing of plans, invention of drawing instruments, and a culmination of the entire process to the use of the term landscape architect for the first time by Morel in 1804.

This text offers an outline discussion on these communication techniques in landscape architecture with a view to introduce, inspire, and provide means of developing these strategies in individual students in the early period of their training to gain effectiveness and mastery.

Basic Concepts

Communication

Communication implies an act and process of transmitting design information from the designer to the audience. In landscape architecture, landscape designs are transmitted as feasible visual solutions to specific design problems. The goal could be to meet specific needs in the use of outdoor spaces, solving ecological problems, reclaiming misused/damaged/lost spaces, enhancing the quality of spaces for optimum human benefits through place-making, etc.

Sender

This is the person or group of people who possess visual communication skills and expertise through professional training in landscape architecture. The sender could communicate his/her design ideas personally or to other members of a design group during the design process or to juror(s) or client(s) or landscape contractor(s).

Message

This is a very important aspect of landscape communication and the essence of the entire endeavour. The message could involve a combination of tangible and intangible design issues. Tangible messages to be communicated could include environmental issues related to spaces, hydrology, chemicals, geology, topography, antiquities, access, neighbourhood, vegetation, and climate. Intangible design messages could be environmental issues that are social, legal, cognitive, psychological, and historical. The goal of the message is to show how landscape spaces are to be implemented, how they would function and how such functions have been framed by the tangible and intangible design considerations.

Medium

Medium is the mode of explicitly and implicitly transferring the landscape design message. The communication medium should be carefully selected to achieve the best understanding of the message by the receiver. For this reason, there is the need for an

optimum blend of expertise, exactitude, and appropriateness in choice of medium. The medium could be visual or non-visual. However, a tradition of visual communication media has been long entrenched in the profession and practice of landscape architecture.

Receiver

The receiver in landscape architecture communication is the person or group of persons for whom the message is intended. This depends on the goal of the message. At the designer's level when articulating design ideas, and therefore communicating to him/herself or others within the design group, the goal could be as simple as exploring, explaining, or formulating design ideas with single line sketches. When the client is the receiver, the overall goal is to sell the design idea and therefore should be non-technical and as pictorial and fascinating as possible. When the landscape constructor/contractor is the receiver, the overall goal is to be explicit and detailed to ensure that all specifications are clearly drawn and written to arrive at their cost implications.

Senses

Communications in all areas of human (and nonhuman) endeavours are based on senses. These include sight, sound, touch, smell, and taste. Depending on the medium of communication, they are all important for the receiver to understand the message. At the designer's level, there could be a need to engage a combination of different senses in delivering a specific landscape design message. For instance, the effect may be created in a visual medium. Impairment of one sense or the other in a landscape user or user group (receiver) may be augmented with another sense by the landscape designer (sender). A common example is to augment sight impairment of prospective users or user groups with touch, sound, or smell, or different combinations in the design of auditory landscapes for hearing-impaired users .

Communication media

Visual media

This is a group of communication media in landscape architecture where design messages are transmitted visually. Communications are achieved basically by the sense of sight/visualisation. They include drawings, texts, models, paintings, photographs, maps, toolkits, and simulations, of various categories.

Non-visual media

This is a group of communication media in landscape architecture where design messages are transmitted non-visually. In this group, communications are achieved with non-visual senses - touch, sound, smell. They are largely used for landscape designs that predominantly have visually-impaired persons or groups of persons as end-users.

Drawings

Drawings are the basic and common media of communication in landscape architecture. They are composed of lines and dots to convey specific ideas based on conventional signs and symbols. Drawings could be one-dimensional conveying only a sense of length, two-dimensional showing both length and breadth, or three-dimensional to convey length, breadth and depth. They are essentially composed of lines used during the design process to articulate design thoughts, organise spaces, and formulate design solutions.

Drawings range from sketches, presentation drawings, to working/production drawings. Communication of landscape ideas and designs could be drawing on surfaces like paper, clothing materials, and wood of various types and sizes. Landscape drawings are made up of the elements of landscape design – line, form, texture, shade, colour.

A line is a moving point. It could be straight or curved to communicate landscape elements like vegetation (creepers, shrubs, trees). Different types of lines could be combined to communicate different design ideas.

Form is the shape of a landscape element communicated through drawing. The form could be formal or informal. Formal form includes shapes like rectangle, triangle, square, cone. Informal forms have non-rigidly defined shapes found in nature like amoeboid, leafy, and generally relaxing forms.

Texture is the surface appearance of a landscape element usually communicated with dots, which could be rough or smooth. Visual communication of roughness or smoothness has to do with arrangement and density of dots. These could create psychological perception of the intended texture through cognitive mental imaginations.

Shade is an element of drawing produced for communicating depth of parts of landscape elements in a drawing through pointillism, blurring, or hashing, of different types.

Colour is almost a *sine qua non* for visual communication in landscape architecture. Different hues are used to communicate physical, emotional, psychological, chemical, etc., aspects of landscape designs. There are warm and cold colours.

Except sketch drawings, drawings are normally produced to scale to show different landscape components. Drawings have advantages and disadvantages as communication media in landscape architecture. A major advantage of drawings is that they are generally acceptable as the means of communicating landscape designs. However, drawings require more time, expertise, and drawing material resources to prepare. In particular, explicit three-dimensional drawings of landscapes require a great deal of effort.

Texts

Textual contents are essential components of visual communications in landscape architecture. They are generally inscribed as parts of drawings to give further

explanations that cannot be fully depicted in graphical terms. This is usually necessitated because of the abstract nature of spaces that are a dominant part of landscape design and narratives.

Texts could be in the form of space annotations, spatial relationships, indication of directions/orientations (e.g. a North inscription written on a N-arrow), indicating place names and geographical locations, materials and methods specifications, temporal descriptions, or activity sequences.

Texts are generally expected to be scanty on drawings except Specification documents that are largely textual.

Texts are advantageous as they are the most viable means of communicating landscape designs to non-experts as they do not require any symbolism nor technical details to understand. However, excessive use of texts, except for landscape specification writing, makes communication of landscape designs unprofessional.

Models

Models are materialistic miniaturisation of landscapes. They are normally produced to scales with synthetic materials to mimic landscape elements found in nature and to communicate buildable structural components of landscapes.

In preparation of models, different appropriate materials are used to represent the land, grass, shrubs, trees, paving, outdoor furniture, automobiles, landscape electrification and artificial lighting system, enrichment items (signage, outdoor arts and sculptures, focal point elements), human activities, and general biodiversity elements that make landscape models look 'real'.

Models of landscapes could range from plot size to neighbourhood, sub-region, region, national, continental, and global scales with opportunities to emphasise or overlay different aspects of landscapes. Focus could be on vegetation, topography, motorised and non-motorized landscape facilities, etc., or overlay all these depending on the aim of producing the landscape model.

The art of landscape model making requires expertise, material resources, time, imaginations, and painstakingly. Models allow vivid communication of realities. These realities include colour in nature, scale of elements, space relationships, and functionalities of landscapes.

Models are the most 'real' medium of communications in landscape architecture but also the most expensive in terms of cost of production.

Paintings

Landscape painting is a critical medium of communication in landscape architecture. It is also referred to as landscape art, with a longtime history starting from around 1500 BC,

through Medieval, Renaissance, to the Modern and postModern era of the 21st Century. In actual fact, the word *landscape* originated from and was first seen in painting before observing it in real life.

The literature is replete with rigorous arguments on the exact origin of the word *landscape* in relation to *painting*. However, there appears to be a large consensus that "the term landscape originated as a verbal artefact of European landscape painting, and it was initially used in German, Dutch and English (as l*andschaft*, *landskip* and *landscape*) to describe the visual environment depicted by artists" (Jakle, 1987, p. xii).

Landscape painting deals with the creation of three-dimensional illusions of realities on two-dimensional surfaces, for geographical, poetic, religious, and philosophical goals in addition to communicating landscape designs.

Landscape paintings are generally sensuous and afford perception, appreciation, and understanding of natural environments for their aesthetic qualities and vistas.

Scenic views of landscapes remain central to nature appreciation and are markers of environmental beauties. Landscape paintings evoke these feelings through a complex mode of cognitive processes.

All the elements of elements of landscape design – line, form, texture, shade, colour – are equally applicable to landscape painting. There are different painting surfaces and material media that are suitable for different goals of landscape communication. They include oil-based paints, acrylic paints, and water-colour. Paintings could be done on paper, wooden, clothing, or concrete surfaces depending on the material media and goal.

There are three categories of landscape paintings in Romantic landscape art. These are Pastoral, Picturesque, and Sublime. Pastoral landscape paintings explore natural sceneries untouched by humans. Picturesque landscape paintings communicate human influence on the natural world. Sublime landscape paintings have a common goal of frightening with the supreme power of the natural world and that humans are finite compared with the wrath of God in nature.

Experience of landscapes could be more intense through paintings than tangible realities. Landscape communication through painting requires a great deal of time, passion, and expertise. Landscape paintings may not be handy compared with drawings since they require framing or are totally immovable when inscribed on surfaces of building elements like walls, ceilings, and structural members like beams and columns.

Photographs

Photography is an essential communication media for evoking emotions in landscape architecture design and post-design processes.

Photographs deal largely with time and motion in landscape communication. They are used during the design stage for documenting observations during landscape exploration, site analyses, and case studies. They could be singly presented or as a collage.

Photographs are ideal for documenting and communicating progressive changes in landscapes in the construction/contract stage from inception to occupancy levels, including management of landscapes in use. A series of photographs are ideal for documenting and communicating specific stages in the establishment of designed landscapes, including before site clearing, site clearing, layout of spaces, installation of landscape elements, and completion.

Landscape photography is a powerful communication medium in the post-contract stage for landscape post-occupancy studies.

Landscape photography is essential in conservation works to preserve heritage landscapes for environmental awareness and educational purposes.

The quality of landscape photographs is determined by the sophistication of the camera used and the level of expertise of the landscape photographer.

Experience of nature could be achieved through landscape photographs. With the power of colour, these are surrogates of nature, and they have the capacity to evoke and inspire all types of emotions – therapeutic, pleasant, restorative, tranquil, calm, restful, serene. The landscape photograph of some portions of Agodi Gardens, Ibadan in Nigeria shown in Plate 1 is an example.

Plate 1 showing the landscape photograph of some sections of Agodi Gardens, Ibadan in Nigeria. Source: Joseph A. Adedeji

Photography is a readily available medium of landscape communication that is amenable to all scales of landscapes but could be expensive.

Maps

Maps are one of the earliest communication mediums in landscape architecture, dating back a long time. Mapping of landscape spaces is a highly technical endeavour that is situated at the intersection of physical measurements (manual or digital), practices in geographic information systems, and highly complex space syntax methods.

Landscape maps are two-dimensional medium for communicating technical information about space coverage, configuration, topographical heights, vegetation, and geological features of existing or proposed landscapes for analysis, design, assessment, and management.

Digital mapping of landscapes is a modern time-saving method that could describe landscape features into the finest grain.

Landscape maps remain a vital communication tool in landscape architecture and have the capacity to transform the entire process of spatial-visual activities on land, water, and air spaces for exploring human perception and utilisation of nature.

Toolkits

Design toolkits are media for communicating design thoughts and ideas during the design process They are intellectual and conceptual frameworks that are evidence-based for the identification, quantification, and juxtapositions of landscape design requirements.

Toolkits are often formulated in sets to account for different spatial grains of landscapes, their design concerns and considerations, and overall design goals for achieving maximum efficiency of landscape spaces (Adedeji, Fadamiro and Odeyale, 2020).

They integrate users' requirements, characteristics, and aspirations with supportive site conditions to explore sustainable design solutions to environmental problems through human-scale landscape resources. They are generally user-centric as feedback and feed-forward communication of landscape performance and efficiency.

Landscape design toolkits communicate results of post-occupancy evaluations of landscapes taking cognizance of landscape elements (plants, structures, and enrichment items) through a visualisation method that combines drawings and texts.

They are produced from real-life situations by combining research with human perception, psychology, and theoretical praxis that have been confirmed to be supportive of human comfort and dignity.

Landscape design toolkits are simple to understand, apply, and test in different landscape design, establishment, and management pursuits.

Simulations

Even though simulation appears to be a recent communication medium in landscape architecture to many professionals, Zube and Simcox argue as far back as 1993 that it was not entirely true. This exemption was argued to be based on the premise that "the concept of simulation is old, the use of the term is relatively new" (Zube and Simcox , 1993, p. 253).

The duos opine that "plans, perspectives, and models are all simulations but were rarely called that and probably aren't by most designers and planners" (ibid, p. 253). This position is affirmed in this text.

For the purpose of this text, simulation is a landscape communication medium implying "more sophisticated techniques that are used for graphic analysis and communication of design, planning and management ideas and images" (ibid, p. 253).

Therefore, simulation is the "interactive 3D visualisation as the most effective way of facilitating the discussion among participants and improving the ability of the public to understand, analyse, and criticise the content" (Moural, Nordh, and Hassan, 2018, p. 2).

However, landscape simulation relies heavily on expensive technologies, is the most intangible visual communication medium, and susceptible to loss due to computer viral attacks on its virtual storage file.

Uses of the Communication Media in Landscape Architecture

The highlighted communication media serve many purposes in landscape architecture. They are used for exploration, examination, assessment, appreciation, design, establishment, and design of landscapes.

Landscape design cannot be functionally carried out without understanding and communicating the current character of the landscape site.

Landscape architects rely on the communication media throughout the process of design to show spatial thoughts, relationships, materials, compositions, and influence of climatic factors on all these towards analysing landscape design problems, taking design decisions, documenting and communicating these decisions to stakeholders, and ensuring compliance during implementation.

Landscape communication media are crucial components in landscape research with the goal of deriving strategies and suggesting approaches to landscape management policy formulations.

These are mostly through landscape character assessment, landscape evaluation, and landscape characterization.

Influence of Information and Communication Technologies (ICT)

There is no gainsaying that ICT has transformed the whole realm of communication in landscape technology. This transformation has skyrocketed the speed, scale, quality, and overall efficiency of the communication strategies in landscape architecture. Plates 2 shows the submission of a student in response to a landscape architecture assignment at the Federal University of Technology, Akure, Nigeria using ICT.

Plate 2: Undergraduate Landscape design submission produced with ICT at Federal University of Technology, Akure, Nigeria. Source: John Taiwo & Dorcas Ayeni

The current developments in ICT with the speed of innovations in robotics suggests that visual communication in landscape architecture would see a zenith where communication would be overtaken by implementation of landscape designs with minimal human involvement.

Guidelines for Personal Developments in Landscape Architecture Communication

The use of communication media in landscape architecture is a journey and not a destination. Begin the journey from an inception stage with simple line drawings that are one-dimensional. At this stage, identifying and mastering personal preferences and developing them into customised personal landscape communication styles with free-hand sketching are crucial.

Proceed to the two-dimensional drawings stage by focusing more on the means of drawing free-hand to scale. This is best achieved by using graded drawing sheets that are amenable to many scales.

Perception of three-dimensional landscape spaces through cognitive indexes like coherence, legibility, complexity, and mystery would lead to communicating landscape

thoughts and decisions during a design process using three-dimensional drawings. These indexes are also core to developing requisite skills in landscape simulation using the computer.

It is important to take note that expertise in preparation of drawings is fundamental in landscape architecture communication. Proper mastery of drawings would almost automatically reflect in and feed into other media like models and paintings.

Drawing is the only medium that distinguishes non landscape architects from landscape architects as anyone can easily communicate landscapes with photographs.

Summary

This text has emphasised the centrality and significance of communication media to landscape architecture by identifying and discussing the media, their uses, advantages, and disadvantages. The text overlays the different layers of concerns in landscape architecture communication by juxtaposing spatial, psychological (psychosomatic), temporal, material, professional, technological, and methodological requirements in landscape design communication media. With the skyrocketing growth in ICT, there is the danger of not understanding the basics of communication media in landscape architecture by jettisoning analog media that are not only fundamental to expertise in the increasingly modernising ICT communication but define who is really a Landscape Architect. In a nutshell, a person to bear this title should be an all-round expert in the efficient analysis, conceptualization, design, and communication of the significance and use of all types of outdoor spaces and their auxiliary indoor spaces.

Exercises

1. List and explain visual and non-visual communication media in landscape architecture.
2. What are the various nodes and their roles in landscape architecture communication media?
3. To what extent and in what ways can human senses influence and impact the efficiency of communication media in landscape architecture?
4. How would you strike a balance of expertise between analog and digital communication media in landscape architecture?

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Technical Drawing for Landscape Architects

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Overview

Technical Drawing is an essential skill for landscape architects, as it enables them to communicate their design ideas and concepts to clients, contractors, and other professionals involved in the design process. This course will cover various types of drawings used in landscape architecture, including site plans, elevations, sections, and details. Students will learn how to use different drawing tools and software, as well as how to create accurate scale drawings and incorporate important details such as dimensions, annotations, and symbols.

In addition, the course will cover important concepts such as line weight, scale, proportion, and perspective, as well as the use of colour and shading in technical drawings. Throughout the course, students will have the opportunity to practise their skills by creating a range of different types of drawings, both by hand and using digital software.

By the end of the course, students will have a solid foundation in technical drawing principles and techniques and will be able to create professional-quality drawings that effectively communicate their design ideas and concepts.

Objectives

1. identify and differentiate between various types of technical drawings used in landscape architecture, including site plans, elevations, sections, and details.
2. Demonstrate proficiency in using different drawing tools and software commonly utilised in landscape architecture to create accurate scale drawings.
3. Apply important technical drawing concepts, such as line weight, scale, proportion, and perspective, to effectively communicate design ideas and concepts.
4. Incorporate essential details, such as dimensions, annotations, and symbols, into technical drawings to enhance clarity and precision in conveying design information.
5. Practice creating a variety of technical drawings, both manually and using digital software, to develop the ability to produce professional-quality drawings suitable for communication with clients, contractors, and other professionals in the landscape architecture industry.

The Importance Of Technical Drawing In Landscape Architecture

Technical Drawing is crucial in landscape architecture because it is the primary means of communicating design ideas and concepts to clients, contractors, and other professionals

involved in the design process. Technical drawings provide precise and accurate information about a design, including the layout of the site, the placement of various elements, and the materials and dimensions required (Miller, 2023).

Some of the key reasons why technical drawing is important in landscape architecture include:

Communication: Technical drawings are the primary means of communicating design ideas and concepts between different stakeholders involved in the design process, including clients, contractors, and other professionals.

Accuracy: Technical drawings provide precise and accurate information about the design, ensuring that all elements are properly placed and that the design is feasible and practical.

Cost savings: Technical drawings can help to reduce costs by identifying potential design issues before construction begins, reducing the likelihood of costly mistakes and rework.

Materials And Tools Needed For Technical Drawing

The materials and tools needed for technical drawing in landscape architecture depend on the type of drawing being created, the preferred drawing method (by hand or using digital software), and personal preferences (Mozaffari, 2023). However, some common materials and tools include:

Paper: High-quality, acid-free paper is essential for technical drawing as it provides a smooth surface and prevents smudging and fading.

Pencils: A range of graphite pencils in different hardness levels (e.g., 2H, HB, 2B, 4B) are needed for creating precise lines of different weights and shading.

Erasers: High-quality erasers (e.g., kneaded erasers or vinyl erasers) are essential for removing unwanted lines and correcting mistakes.

Scale Rulers: Scale rulers are used to measure and draw precise lines and shapes to scale.

Triangles: Triangles are used to draw straight lines and angles accurately.

Compass: Compasses are used to draw circles and arcs of precise sizes.

T-squares: T-squares are used to draw straight lines parallel to the edge of the drawing board.

Computer and Software: A computer with appropriate software (such as AutoCAD or SketchUp) is necessary for digital drawings.

Graphics Tablet and Stylus: For creating digital drawings by hand, a graphics tablet and stylus can be used to create precise lines and shapes.

Printer: A high-quality printer is essential for printing final copies of digital drawings.

Overall, the materials and tools needed for technical drawing in landscape architecture require careful consideration to ensure that they are of high quality, appropriate for the type of drawing being created, and meet personal preferences.

Basic Drawing Techniques

Overview Of Basic Drawing Techniques

There are several basic drawing techniques used in technical drawing for landscape architecture. These techniques are used to create accurate, clear, and detailed drawings that communicate design ideas and concepts effectively (Northern Architecture, 2023). Some of the most common basic drawing techniques include:

Scale: Scale refers to the relationship between the size of the drawing and the actual size of the design. Drawing to scale is essential for an accurate representation of the design, and it allows the viewer to understand the size and proportions of the different elements.

Proportion: Proportion is the relationship between the size and position of different elements in a drawing. Maintaining proper proportion is essential for creating a balanced and harmonious design.

Perspective: Perspective is the technique of creating the illusion of three-dimensional space on a two-dimensional surface. This technique is used to create realistic and convincing drawings.

Shading: Shading is the technique of adding depth and dimension to a drawing by using different shades of pencil or ink. It is used to create the illusion of light and shadow and to add texture and detail to a drawing.

Drawing Lines, Shapes, and Curves

Drawing lines, shapes, and curves is an essential part of technical drawing in landscape architecture. These elements are used to create accurate and precise representations of the design and to communicate ideas and concepts effectively (Designing Buildings, 2022).

Understanding Scale and Proportion

Scale and proportion are important concepts in technical drawing for landscape architecture. These concepts help to create accurate, realistic, and aesthetically pleasing designs. Here is an overview of these two concepts:

Scale: Scale refers to the ratio of the size of an object in the drawing to the actual size of the object. For example, a drawing of a tree may be drawn to a scale of 1:10, which means that one unit of measurement on the drawing represents ten units of measurement in the real world. Scales are used to create drawings that are proportional to the actual size of the design, and they allow the viewer to understand the size and proportions of different elements in the design. Different scales are used for different types of drawings, such as site plans, elevations, and sections.

Proportion:

In Technical Drawing for landscape architects, proportions are essential for creating accurate and effective designs. Designers must carefully consider the proportion of

different elements in the design to create a cohesive and visually appealing final product (Your Art Path, 2023).

Lettering and Calligraphy

Understanding the Importance of Lettering and Calligraphy in Technical Drawing

Lettering and calligraphy are important elements in technical drawing for landscape architecture. Here are some reasons why lettering and calligraphy are important in the technical drawing:

Clarity: Clear and legible lettering is essential for communicating information in technical drawings. Designers use lettering to label different elements of the design, such as plants, trees, and hardscaping features. The lettering must be clear and easy to read to ensure that the viewer can understand the information presented in the drawing.

Professionalism: Lettering and calligraphy can add a professional and polished look to technical drawings.

Different Styles of Lettering and Calligraphy

There are different styles of lettering and calligraphy that can be used in technical drawing for landscape architecture. Here are some common styles: Block Letters, Script, Gothic, Italic, Calligraphy, and Hand-Drawn

In technical drawing for landscape architecture, the style of lettering and calligraphy used will depend on the preferences of the designer and the requirements of the project. It is important to choose a style that is appropriate for the design and that effectively communicates the ideas and concepts of the project (Northern Architecture, 2023).

Techniques for Consistent and Accurate Lettering

Consistent and accurate lettering is essential for creating professional and effective technical drawings for landscape architecture. Here are some techniques for achieving consistent and accurate lettering:

Use Guidelines: Guidelines can help to ensure that the lettering is consistent in size and spacing. Use a straightedge or ruler to create horizontal and vertical lines to guide the placement of the letters.

Practice Stroke Order: Each letter has a specific stroke order that should be followed for accurate and consistent lettering. Practice the stroke order for each letter until it becomes second nature.

Orthographic Projection

Understanding Orthographic Projection

Orthographic projection is a method used in technical drawing to represent three-dimensional objects in two dimensions. This method involves creating multiple views of the object from different angles, and then projecting these views onto a flat surface (Study.com, 2022).

There are three main types of views used in orthographic projection: front view, top view, and side view. These views are created by placing the object in a specific orientation and then projecting the view onto a flat surface.

Creating Plan, Elevation, and Section Drawings

Plan, elevation, and section drawings are three types of orthographic projections used in technical drawing for landscape architecture. These drawings are important for representing the design in a clear and accurate manner.

A PLAN drawing is a top-down view of a design that shows the layout of different elements in the design. This drawing is typically used to show the relationship between different elements in the design, such as the placement of trees, plants, and hardscaping features. Plan drawings are often accompanied by a legend that explains the symbols used in the drawing.

AN ELEVATION drawing is a side view of a design that shows the vertical relationship between different elements in the design. This drawing is typically used to show the height and depth of different elements, such as walls, stairs, and other vertical elements. Elevation drawings are often accompanied by notes that explain the dimensions and features of the elements shown in the drawing.

A SECTION drawing is a cutaway view of a design that shows the internal structure of different elements in the design. This drawing is typically used to show the relationship between different elements within a structure, such as the foundation, walls, and roof. Section drawings are often accompanied by notes that explain the dimensions and features of the elements shown in the drawing.

To create these types of drawings, designers must be proficient in orthographic projection techniques and have a good understanding of the elements they are representing. They must also be able to use appropriate lettering, symbols, and notations to accurately and effectively communicate their designs.

Creating Scale Drawings

Scale drawings are an essential component of technical drawing in landscape architecture. They allow designers to create accurate and proportionate representations of designs, which can be used for planning, presentation, and construction purposes.

To create a scale drawing, designers must first determine the scale to be used. The scale is the ratio of the size of the drawing to the size of the actual object or space being

represented. For example, a scale of 1:50 means that every unit of measurement on the drawing represents 50 units of measurement in the actual space or object.

Once the scale has been determined, designers can begin creating the drawing. They must carefully measure and proportion each element of the design, and ensure that they are accurately represented on the drawing. This may involve using different types of lines, symbols, and shading to distinguish different elements and features (Joshua Nava Arts, 2023).

To ensure that the drawing is accurate, designers must also carefully measure and mark the dimensions of each element. They may use tools such as rulers, protractors, and compasses to ensure that angles, curves, and other features are accurately represented.

In addition to creating accurate and proportionate representations of designs, scale drawings can also be used to show the relationship between different elements in the design. For example, they can show the placement of trees, plants, and other features in relation to each other, as well as their relationship to the surrounding environment.

Isometric and Perspective Drawing

Overview of Isometric and Perspective Drawing

Isometric and perspective drawings are two types of three-dimensional drawings used in technical drawing for landscape architecture. These drawings are used to create a more realistic and accurate representation of a design and to help designers visualize how different elements will interact with each other in three-dimensional space.

Isometric drawing is a method of creating a three-dimensional drawing in which all lines are drawn parallel to each other. This method creates a distorted image that appears to be three-dimensional, even though it is drawn on a two-dimensional surface. Isometric drawings are often used to show the layout of different elements in a design, such as the placement of plants, trees, and other hardscaping features.

Perspective drawing is a method of creating a three-dimensional drawing that accurately represents how objects appear in three-dimensional space. This method involves creating a vanishing point, which is a point in the drawing where all parallel lines appear to converge. This creates the illusion of depth and distance in the drawing, making it appear more realistic and accurate. Perspective drawings are often used to show the relationship between different elements in a design and to help designers visualize how the design will look in three-dimensional space (Student Art Guide, 2021).

Both isometric and perspective drawing are important skills for landscape architects, as they allow designers to create more accurate and detailed representations of their designs. By using these techniques, designers can effectively communicate their ideas and concepts, and create designs that are functional, attractive, and meet the needs of their clients.

Creating 3D Drawings and Renderings

Creating 3D drawings and renderings is an important aspect of technical drawing in landscape architecture. These types of drawings are used to create a more detailed and realistic representation of a design, which can be useful for planning, presentation, and marketing purposes.

To create 3D drawings and renderings, designers use specialized software such as AutoCAD, SketchUp, or Revit. These programs allow designers to create three-dimensional models of their designs, which can then be rendered in different ways to create a variety of visual effects.

One common technique used in 3D rendering is the use of lighting and shading effects. They can also use shading effects to create depth and dimensionality in the drawing (CGI Furniture, 2023).

Overall, creating 3D drawings and renderings requires specialized software and a good understanding of design principles and techniques.

Understanding Depth, Scale, and Perspective

Depth, scale, and perspective are important concepts in technical drawing in landscape architecture. Understanding these concepts is essential for creating accurate and realistic representations of designs.

Depth refers to the perceived distance between objects or elements in a drawing. In technical drawing, depth is often created using perspective techniques, such as vanishing points or horizon lines. By using these techniques, designers can create the illusion of depth and distance in a two-dimensional drawing.

Scale refers to the relative size of different elements in a drawing. In technical drawing, scale is often represented using a ratio or proportion, such as 1:50 or 1/8 inch equals 1 foot. By using a consistent scale, designers can ensure that all elements in the drawing are accurately proportioned and scaled.

Perspective refers to the way in which objects or elements appear to the viewer in a drawing. In technical drawing, perspective is often created using techniques such as vanishing points, horizon lines, and foreshortening. By using these techniques, designers can create a more realistic and accurate representation of the design, and help viewers visualize how different elements will appear in three-dimensional space.

Drawing Trees And Plants

Understanding How To Draw Trees And Plants

Drawing trees and plants is an important skill for landscape architects, as it allows designers to create accurate and realistic representations of vegetation in their designs. Here is a tip for drawing trees and plants:

Observe Real Trees and Plants: Before you start drawing, it is important to observe real trees and plants in their natural environment. Look at the shape and structure of different plants, and pay attention to how they grow and interact with their environment.

Techniques For Drawing Plant Materials, Including Shading And Texture

Drawing plant materials, such as leaves, flowers, and foliage, requires attention to detail and a good understanding of shading and texture techniques.

In summary, drawing plant materials requires attention to detail, a good understanding of shading and texture techniques, and a lot of practice. By using these techniques effectively, designers can create accurate and realistic representations of plant materials in their designs (University of Florida, 2018).

Using Plant Symbols In Technical Drawing

Here are some tips for using plant symbols in the technical drawing:

Use Standardized Symbols: There are a variety of standardized symbols that are used in landscape architecture to represent different types of vegetation.

Label Your Symbols: When using plant symbols, it is important to include labels that identify the type of vegetation being represented. This can be done using a key or legend on the drawing.

Use Different Symbols For Different Plants: It is important to use different symbols for different types of plants, such as trees, shrubs, and groundcovers. This helps to clearly communicate the types of vegetation that will be used in a design.

Use Different Symbols For Different Sizes: When using plant symbols, it is important to use different symbols for different sizes of plants. For example, a small shrub might be represented by a different symbol than a large tree.

Hardscape Elements

Understanding How to Draw Hardscape Elements, Including Paving, Walls, and Structures

Drawing hardscape elements, such as paving, walls, and structures, requires attention to detail and an understanding of technical drawing techniques. Here are some tips for drawing hardscape elements:

Use Accurate Measurements: When drawing hardscape elements, it is important to use accurate measurements and dimensions. This ensures that the elements will fit properly within the design and meet any relevant building codes.

Use a Ruler and Compass: To create accurate shapes and lines for hardscape elements, it can be helpful to use a ruler and compass. This allows you to create straight lines, angles, and curves with precision.

7.1.3 Pay Attention to Texture and Material: When drawing hardscape elements, it is important to pay attention to the texture and material of the element. This can be achieved using shading and texture techniques to create the appearance of brick, stone, or other materials.

Techniques for Shading and Rendering Hardscape Materials

Shading and rendering hardscape materials is an important aspect of technical drawing in landscape architecture, as it helps to create a realistic and visually appealing representation of the design. Here are some techniques for shading and rendering hardscape materials: Use A Variety Of Shading Techniques, Pay Attention To Light And Shadow, Use Different Shades And Colors, Use Reference Images, Experiment With Different Tools,

Using Hardscape Symbols in Technical Drawing

Using hardscape symbols is a common practice in technical drawing for landscape architecture. These symbols allow designers to create an easily understood representation of hardscape elements, such as paving, walls, and structures (Basic Elements of Landscape Architectural Design, 2023).

Water Features

Understanding How to Draw Water Features, Including Fountains, Ponds, and Streams

Drawing water features, such as fountains, ponds, and streams, is an important aspect of technical drawing for landscape architecture. Here are some tips for drawing water features in your landscape design:

Understand The Physics of Water: Before you start drawing water features, it is important to have a basic understanding of the physics of water. This will help you create accurate representations of water in your drawings. For example, water always seeks the lowest point, so if you are drawing a stream, it should flow downhill.

Use Reference Images: When drawing water features, it can be helpful to use reference images of real water features or to observe water in nature. This will help you create accurate representations of water in your drawings.

Use Shading And Texture: Shading and texture are important techniques to use when drawing water features. Shading can help create depth and dimensionality, while texture can help create the appearance of movement in the water.

Use Appropriate Symbols: There are a number of standard symbols used in technical drawing to represent water features, such as wavy lines to represent a stream or a circle to represent a fountain. Using these symbols can help communicate your design effectively.

Techniques for Creating Water Effects, Including Shading and Reflection

Creating water effects in technical drawings can add a lot of realism and visual interest to a landscape design. Here are some techniques for creating water effects, including shading and reflection:

Shading: Shading is a technique that can be used to create the appearance of depth and movement in the water. Typically, the darkest areas of the water are the deepest and the lightest areas are the shallowest. To create shading, use a combination of short, quick strokes and longer strokes to create a sense of flow and movement.

Reflection: Reflection is another important aspect of drawing water, particularly when drawing still water. To create a reflection, draw a mirror image of the object or landscape feature that is being reflected in the water. The reflection should be slightly lighter in colour than the original object or feature and should be softened or blurred slightly to create a sense of movement and depth.

Texture: Texture is an important aspect of creating realistic water effects. Consider the texture of the water's surface, which can vary from calm and smooth to choppy and rough. Use short, quick strokes to create a sense of movement and add texture to the water's surface.

Colour: Colour is also an important aspect of creating water effects. Consider the colour of the water in different lighting conditions, and adjust the colour of the water to reflect this. Additionally, consider the colour of the surrounding landscape and how it might reflect onto the surface of the water.

Using Water Feature Symbols in Technical Drawing

Using water feature symbols in technical drawings can help to quickly and accurately represent different water features in a landscape design. Here are some common water feature symbols used in a technical drawing:

Fountain Symbol: A fountain symbol is typically represented by a circle with short lines radiating outwards from the centre. The circle represents the basin or pool, while the lines represent the water jets or sprays.

Pond Symbol: A pond symbol is typically represented by an irregular shape with rounded edges. The shape represents the outline of the pond while shading and texture can be used to represent the water.

Stream Symbol: A stream symbol is typically represented by a series of short, wavy lines with arrows indicating the direction of flow. The lines represent the path of the stream while shading and texture can be used to represent the water.

Waterfall Symbol: A waterfall symbol is typically represented by a series of short, vertical lines with shading and texture to represent the water cascading over rocks.

SUMMARY

Understanding How To Use Technical Drawing To Analyze A Site

Technical Drawing can be a useful tool for analyzing a site during the landscape architecture design process. Here are some ways to use technical drawing to analyze a site:

Site Plan: Creating a site plan is the first step in analyzing a site. A site plan is a bird's eye view of the site, showing the location of buildings, roads, vegetation, and other features.

Topographic Map: A topographic map is a detailed representation of the site's elevation and contours

Section Drawings: Section drawings show a vertical slice through the site, allowing landscape architects to analyse the site's elevation and slope.

Detail Drawings: Detail drawings show specific elements of the site in more detail, such as a retaining wall or a paving pattern. By creating detailed drawings, landscape architects can analyse the materials and construction techniques that will be required for different site elements.

Techniques For Creating Site Analysis Drawings, Including Grading, Drainage, And Soil Analysis

Creating site analysis drawings is an important step in the landscape architecture design process. Here are some techniques for creating site analysis drawings for grading, drainage, and soil analysis:

Grading Plan: A grading plan shows the existing and proposed elevations of the site. This plan can be used to analyse the site's topography and to determine the location and extent of grading necessary to accommodate the design.

Drainage Plan: A drainage plan shows the location of existing and proposed drainage features, such as gutters, catch basins, and underground drainage pipes. This plan can be used to analyse the site's drainage patterns and to identify areas where additional drainage features may be necessary.

Soil Analysis Plan: A soil analysis plan shows the type and characteristics of the soil at different locations on the site. This plan can be used to analyse the site's soil conditions and to identify areas where soil amendments may be necessary.

Cross-Section Drawings: Cross-section drawings show a vertical slice through the site, allowing designers to analyse the site's elevation and slope. Cross-section drawings can also be used to analyse the relationship between different site elements, such as a building and a retaining wall.

Using Site Analysis Symbols In Technical Drawing

Site analysis symbols are graphic elements that represent specific features or conditions on a site. Here are some examples of site analysis symbols that can be used in technical drawings:

Contour Lines: Contour lines are used to represent the elevation of the site. These lines are typically drawn at a constant interval, such as 1 foot or 5 meters, and can be used to create a topographic map of the site.

Drainage Features: Symbols can be used to represent different types of drainage features, such as gutters, catch basins, and underground drainage pipes.

Soil Types: Different soil types can be represented using symbols or patterns. For example, sandy soil could be represented by a symbol with small dots, while clay soil could be represented by a symbol with larger dots.

EXERCISES

Choose a site for your project, such as a public park, community garden, or residential backyard. Make sure to select a site that has interesting features and challenges to design around.

Use the techniques learned in the course to conduct a thorough site analysis. Gather information about the site's topography, soil conditions, drainage patterns, and existing vegetation. This information will help you create an accurate and effective design.

Use your site analysis to develop a concept for your design. Think about how the site's features and challenges can be turned into opportunities for creating an attractive and functional landscape.

Use the principles learned in the course to create a design plan for your project. Start with a base plan that includes existing features and vegetation, and then add your design

elements, such as paths, patios, and planting beds. Use scale drawings and symbols to create a clear and concise design plan.

Once you have your design plan in place, add detail and texture to your drawings. Use shading and rendering techniques to add depth and dimension to your design. Pay attention to the details, such as the texture of paving materials, the shape of plant leaves, and the reflection of light on water surfaces.

Once you are satisfied with your design, finalise your drawings. Make sure they are accurate, clear, and easy to read. Add labels and annotations to explain important features and design elements.

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Dr. ADEOYE OLUGBENGA ADEWOLU is an esteemed senior lecturer in Architecture with an illustrious career spanning over 30 years in the university system. As a highly respected and experienced educator, Dr. ADEWOLU has made significant contributions to the field of architecture through teaching, research, and related works. Having obtained a Ph.D. degree in Architecture, Dr. ADEOYE ADEWOLU possesses a deep understanding of the subject matter and has developed strong expertise in various aspects of architectural theory and practice. Their extensive knowledge and passion for the discipline have been instrumental in shaping the minds of countless students who have had the privilege of being taught by them. Dr. ADEWOLU's teaching philosophy centres around fostering critical thinking, encouraging creativity, and nurturing a deep appreciation for the art and science of architecture. He is known for his engaging teaching style, employing innovative pedagogical techniques to ensure students receive a comprehensive education that combines theoretical concepts with practical applications. In addition to his teaching responsibilities, Dr. ADE ADEWOLU has actively pursued research endeavours throughout his career. Their scholarly work focuses on exploring emerging trends in architecture, sustainable design practices, and the integration of technology in the field. By staying at the forefront of advancements in the architectural domain, Dr. ADE ADEWOLU continually seeks to inspire students and fellow professionals alike, encouraging them to push boundaries and envision new possibilities.

Dr. ADEWOLU's contributions extend beyond the confines of the classroom and research lab. He has actively participated in academic committees, served as a mentor to aspiring architects, and collaborated with industry professionals to bridge the gap between academia and practice. His efforts to promote interdisciplinary collaboration and knowledge exchange have played a pivotal role in enhancing the architectural community within Nigeria and beyond.

Recognised for his expertise, Dr. ADE ADEWOLU has been invited to present at national and international conferences, delivering thought-provoking talks on topics such as sustainable design, urban planning, and the role of architecture in shaping societies. Their research findings have been published in reputable journals, further contributing to the body of knowledge in the architectural field.

With a career spanning three decades, Dr. ADEOYE OLUGBENGA ADEWOLU continues to be an influential figure in the realm of architecture education. Their commitment to excellence, dedication to their students, and unwavering passion for the subject have solidified their position as a respected authority in the field. As an author, their insights and expertise will undoubtedly enlighten readers and inspire future generations of architects and designers.

Drawing Materials and Tools for Landscape Design

Ayeni, Dorcas A., *Federal University of Technology, Akure*

Overview

Drawing is an important ability for landscape architects to have in order *to* properly express their design ideas to clients. Landscape architects have access to a wide variety of drawing materials and tools, each of which has its own set of distinctive qualities and applications. When it comes to drawing, the materials and tools that are employed can range from straightforward implements like pencils and paper to more intricate tools like tablets and styluses. Landscape architects are able to effectively communicate their design ideas and create magnificent, detailed drawings if they are proficient in the tools and techniques described herein.

This text focuses on drawing materials used in landscape drawing. It is also aimed at introducing the students to the tools and techniques and how to apply them in producing landscape drawings.

Objectives

The objectives of studying drawing materials and tools for landscape architects are to:

1. identify the various types of drawing materials and tools commonly used by landscape architects;
2. develop skills to create high-quality landscape designs that express design thoughts and ideas;
3. Identify the drawing materials essential for creating distinct landscape effects;
4. apply different drawing techniques, to create depth, texture, and shading in landscape drawings; and
5. explain the use of digital drawing tools and software, such as CAD programs, in landscape architecture.

Introduction

In order to conceptualise and explain original design concepts, landscape architects need access to a wide array of drawing materials and equipment. The use of these elements and tools is important to the accomplishment of successful landscape architecture projects.

The ability to visualise, communicate, be precise, be creative, be flexible, and document one's work are all reasons why drawing materials and tools are crucial for landscape architects. The materials consist of pens, pencils, and other writing instruments, as well as erasers, scale rulers**,** T-squares, compasses, drawing boards, and computer-aided design (CAD) software.

The Different Types of Drawing Materials and Tools

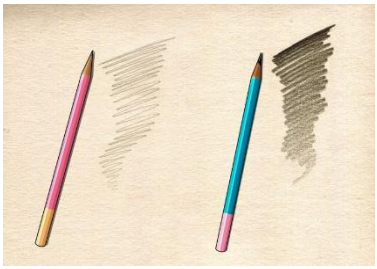
Pencils

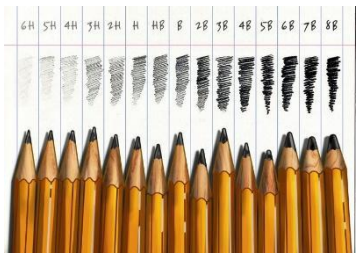
Pencils are an essential tool in a landscape architect's toolkit. They have a wide application because of their adaptability, low cost, and easy operation. A mix of letters and numbers, such as 9H, HB, and 9B, identifies the various kinds of leads found in pencils. The hardness of lead can range from the most difficult to the most gentle, with H standing for "hard" and B standing for "blackness." Pencils with a higher hardness grade, such as those with an H rating, have a lighter line weight and are the finest choice for drawing lines and details that are precise and clear. They are very helpful when it comes to drafting and making technical drawings. Due to the fact that they can be readily erased or refined, H pencils are also useful for quickly drawing out first ideas and concepts. Landscape architects frequently use H pencils when outlining plans, elevations, and sections.

Pencils with a softer lead, such as those with a rating of B, provide a darker line weight and are typically utilised for shading and tone work. B pencils are your best bet when it comes to giving drawings depth, contrast, and substance. The higher the B rating, the darker the line generated, and the softer the lead that was formed. When designing landscapes, architects often use B pencils to create shading and add depth to their designs. When it comes to creating shadows and gradients, which may lend a sense of realism and depth to a drawing, soft pencils are very beneficial tools.

Not only do pencils have a range of lead hardness options, but they also come in a variety of forms and sizes. For instance, landscape architects might use a mechanical pencil, which enables them to draw exact lines and requires significantly less sharpening than a standard pencil. They could also use a clutch pencil, which has a bigger lead capacity and is better suited for shading and drawing broad lines. In addition to their versatility, pencils are long-lasting sketching tools that can endure the deterioration caused by repeated usage. In contrast to other drawing tools such as markers or watercolours, Pencils do not smear or bleed, making them an excellent choice for creating precise drawings with a high level of detail.

In essence, pencils are the most fundamental sketching instrument that landscape architects utilise, and they are available in a wide variety of lead hardness levels. When drawing exact lines and details, use a harder lead, but you should use a softer lead for shading and toning. Several kinds of pencils, such as mechanical and clutch pencils, are used by landscape architects because each drawing calls for a unique set of specifications to be fulfilled.





What the letters "H" and "B" on pencils mean (5-Minutes Crafts 2022)

Erasers

Erasers are a vital tool for landscape architects and other artists because they enable them to easily remove undesirable lines, smudges, and marks from the drawing paper without destroying the surface. In addition, erasers are inexpensive and can be found at almost any office supply store. There are many different kinds of erasers available, such as gum erasers, plastic erasers, and kneaded erasers, to name a few.

Kneaded erasers, also known as silicone erasers, are a popular choice among landscape architects because they are malleable and can be shaped and moulded to fit into tiny areas. They are formed from a material that is both flexible and malleable, often consisting of a combination of gum and rubber, and are, therefore, very easy to mould into a point or a wedge-shaped tip. This enables landscape architects to erase undesirable marks and lines precisely and controllably from their drawings.

One of the many benefits of using kneaded erasers is that, unlike standard erasers, they do not leave any residue or crumbs behind when used. Because of this, they are perfect for use on fragile paper surfaces, such as tracing paper or vellum, where even the smallest smudge or scratch can completely ruin the drawing. Kneaded erasers are reusable and can be cleaned and reshaped as needed, making them a decision that is economical and kind to the environment. However, it is essential to note that while kneaded erasers are fantastic for removing graphite and charcoal, they may need to be more successful for erasing ink or other media. This is something that should be kept in mind. Because of this, landscape architects may require various erasers to employ, depending on the kind of drawing they are producing and the materials they are working with.

Fine Art Tutorials (2023)

Pens

Regarding the drawing process, landscape architects rely heavily on pens as one of the most important tools. They are available in various styles and dimensions; each well-suited for a distinct set of sketching methods and effects.

Fine-tip pens are normally available in diameters ranging from 0.05 mm up to 0.3 mm, and they are utilised for drawing fine lines and lettering. They are ideal for including minute particulars, such as outlining the margins of trees and plants, drawing hatching lines to create texture, and labelling design elements, and they come in a wide variety of shapes and sizes. Technical drawings, such as site plans and elevations, can also be accomplished using pens with fine tips.

On the other hand, pens with more comprehensive tips are preferred when shading and filling huge areas. These pens, which generally come in sizes ranging from 0.5 mm to 1.0 mm, produce bolder lines that are ideal for creating shadows, filling in huge spaces, and creating depth, and their standard diameters range from 0.5 mm to 1.0 mm. Landscape architects utilise pens with thicker tips to give contrast and dimension to their designs, such as producing shadowing on a hill or filling in a pond. Some examples of this may be found below.

One must understand that pens can include a variety of inks, some water-based, others oil-based, and others pigment-based. Oil-based pens are more smudge-resistant and produce bolder lines than their water-based counterparts. Water-based pens are superior for generating rapid sketches because of their ease of blending. Pigment-based pens are well-known for the exceptional quality of the ink they produce, which is resistant to fading and can create crisp lines. Some pens are designed to achieve particular effects, such as a calligraphy pen, which may make lines and curves that appear graceful and flowing. The use of these pens can lend a drawing a more decorative air, and they are frequently put to work producing titles or other ornamental motifs.

When creating drawings in landscape architecture using pens, it is essential to select a pen suited to the specific kind of drawing that will be made. Pens with broader tips are

more suited for adding shade and texture, while fine-tip pens are perfect for producing intricate blueprints and designs because of their ability to fit into tight spaces. Because this can affect the drawing's clarity and durability, selecting a pen with high-quality ink that will not smear or fade over time is another consideration that should be considered.

Drawing Pens (Cole, 2021)

Markers

Markers are a common and widely used drawing tool that landscape architects employ in order to give colour and texture to their drawings. They are available in many different varieties, such as water-based, alcohol-based, and solvent-based markers. Landscape architects can employ the distinctive qualities of each different kind of marker to generate various effects.

Because they are simple to blend and produce a transparent effect, landscape architects frequently go with watercolour markers as their medium of choice. They perform admirably on paper intended to be used with watercolour techniques, such as mixed media or watercolour paper. Because they are available in such a wide variety of hues and shades, they may be utilised in a wide variety of ways to produce genuine colour gradients and shading.

Another popular option for landscape architects is the use of markers that are based on alcohol. They dry quickly and provide colours that are intense and vivid. Because they come in such a wide variety of hues and tones, they can be utilised in the production of designs that are both elaborate and detailed. Marker paper and Bristol board are two examples of smooth paper surfaces that perform well for their application.

Landscape architects use markers based on solvents less frequently, despite these markers having unique qualities that can be advantageous for specific design reasons. Due to the fact that they are both permanent and weatherproof, they are ideal for use in

outdoor design projects. They are also perfect for drawing on non-porous surfaces, such as glass or plastic, as their ink does not absorb into the surface.

While using markers, it is essential to think about their characteristics and how they will behave when combined with the drawing paper. For instance, watercolour markers are most effective when used on paper specifically for watercolour techniques, but alcohol-based markers are most effective when used on smooth paper surfaces. In addition, landscape architects need to think about the level of transparency or opacity they want to create with their markers, as well as the particular colour palette they want to employ to get the intended effect.

Craft Thinking **(2021)**

Papers

When creating drawing, landscape architects must have access to paper as an essential medium. There are many different kinds of paper that can be used, and the one that is chosen will depend on the stage of the design process as well as the effect that is intended. The following is a list of some of the most frequent varieties of paper utilised by landscape architects:

Tracing paper is a type of translucent paper that enables landscape architects to generate various overlays and modifications of their designs. Landscape architects commonly use this type of paper. At the early stages of the design process, when numerous design options are being explored and changes are made to the drawing, it is usual to practise using this tool. Tracing paper can also come in handy when it comes to making rapid sketches and rough draughts.

Vellum paper: Vellum paper is a high-quality paper that has a smooth surface and is frequently used for more intricate drawings because of these characteristics. It is resilient and can tolerate erasures and changes in the original text. While generating a polished

and detailed drawing in the later phases of the design process, vellum paper is frequently employed as a common medium to work on.

Sketch paper is a thin, lightweight type of paper typically utilised to create preliminary sketches and ideas. It is simple to dispose of or recycle, which makes it popular for use in rapid drawings, and it may also be used again. In comparison to tracing paper and vellum paper, the durability of sketch paper is lower; nonetheless, it is more cost-effective and simpler to work with.

Watercolour paper: Paper for watercolour paintings and renderings often consists of watercolour paper, a special kind of paper that is both thick and absorbent. It is frequently used by landscape architects to generate representations of their plans that are accurate and precise, and it is one of the reasons why. A wide variety of watercolour paper is available, each offering a distinct feel and surface quality that can be tailored to achieve a particular effect.

Graph paper is a specific variety of paper that has been printed with a grid on its surface. Graph paper is also known as dot paper. It is widely used for the creation of precise and accurate drawings, including site plans and technical drawings, amongst other types of drawings. There is a wide range of grid sizes to choose from when purchasing graph paper; this allows users to accommodate their needs for varying degrees of precision.

The stage of the design process as well as the effect that is desired to be achieved, are both factors that dictate the type of paper that is used. Landscape architects must carefully consider the kind of paper that should be used for each design they develop. This is because the kind of paper used may significantly impact how the drawing turns out in the end**.**

Utrecht (2023)

Scale Rulers

In landscape architecture, scale rulers are essential because they enable designers to precisely represent the size and proportions of various elements in their designs. Scales Rulers are commonly fabricated from plastic or metal, and their surfaces are engraved

with markings and measurements specific to the scale being utilised. The scales 1:50, 1:100, and 1:200 are used most frequently in the field of landscape architecture. These scales illustrate the proportional relationship between the object's size in the drawing and the object's size in real life. For instance, if the scale is 1:50, the drawing is one millimetre to every fifty millimetres in the real world. To use a scale ruler, choose the appropriate scale for the drawing you are working on, and then measure distances on the drawing using the markings on the scale ruler. If a designer is working on a drawing at a scale of 1:100 and wants to represent a distance of 10 metres, they would measure 10 centimetres on the drawing using the ruler designed for the 1:100 size.

Scale rulers can be used to precisely represent the size of objects and elements in a drawing and their utility in measuring distances. Scale rulers are often made of metal. For instance, if a designer is working on a plan view of a garden and wants to represent the size of a tree, they can use the scale ruler to ensure that the tree is represented at the correct size relative to the other elements in the drawing. This can be accomplished by ensuring the tree is represented at the correct size relative to the other elements in the drawing.

In landscape architecture, scale rulers are essential because they ensure that plans are appropriately represented and help minimise problems that might result from erroneous scaling. They are a crucial tool for communicating designs to clients, contractors, and other stakeholders, and they are a fundamental component of the toolkit of a landscape architect.

Artnews (2020)

T-Squares

T-squares are a form of drawing tool utilised to produce straight lines, mainly when drawing plans, elevations, and other technical drawings. They comprised a long blade or edge positioned horizontally and referred to as the "head" and a blade or edge positioned vertically and referred to as the "shaft." The T-head square is often crafted from either wood or plastic, while the shaft can be built from either metal or plastic.

The head of the T-square should be positioned to align with either the top or bottom edge of the paper when it is put against the edge of the drawing board. The vertical shaft is then utilised as a guide to producing straight lines perpendicular to the margin of the paper. Landscape architects can eliminate the necessity for freehand line drawing by using a T-square, which enables them to verify that lines are straight, even, and exact.

Several variants of the T-square can be purchased, such as those that are adjustable and fixed. Adjustable T-squares feature a sliding head that can be rotated to various angles, making them the ideal tool for drawing diagonal lines or slanted lines due to the head's versatility. Fixed T-squares have a head that is secured in place and can be used to draw straight lines in either the horizontal or vertical plane.

In the field of landscape architecture, T-squares are an indispensable tool since they enable the creation of accurate and precise drawings that are straightforward to read and comprehend. When it comes to the drafting process, landscape architects can save time and effort by making use of a T-square, which allows them to easily and quickly make straight lines on their drawings.

Mau Art and Design (2023).

Compasses

Compasses are an essential drafting tool that landscape architects use to make circles and arcs of specific sizes with high precision and accuracy. They are made up of two arms that are attached to one another by a hinge, and at the end of each arm is a pointy tip that can be manipulated to form circles and arcs of varying diameters. A tip is at the end of one of the arms, while the other has a pencil or pen attached to it. The user can make circles of varying sizes by manipulating the distance between the sharp tip and the pencil, which in turn controls the circle's diameter. The ability to precisely design circular forms, such as tree canopies, roundabouts, and water features, makes compasses essential for landscape architects. In addition, you may form accurate arcs with them for garden walks, retaining walls, and other curved structures. Using a compass helps guarantee that the

circles and arcs are symmetrical and have even proportions, which is an important step in developing an aesthetically acceptable design.

When using a compass, the user must first adjust the arms so that they have the desired diameter. After that, they position the pointed end of the compass at the point in the middle of the circle or arc they want to create, and then they draw the form using the pencil or pen linked to the other arm of the compass. The compass can be turned about its central point to produce either a complete circle or an arc, depending on the kind of form that needs to be made.

Compasses are available in various shapes, sizes, materials, and designs; some compasses have extra functions, including angle adjustments and rulers. Some compasses also feature a magnetic component, which enables them to be utilised on magnetic surfaces like whiteboards. When selecting a compass, landscape architects should consider the project's size and the desired precision level. They should also examine the compass's material and how long it will last.

Cantu (2021)

Drawing Boards

Drawing boards are an indispensable piece of equipment for artists, designers, and architects of all stripes, including landscape designers. When used for sketching, painting, or drafting, they are intended to supply a flat and stable surface, which helps to ensure that the resulting lines and forms are correct and constant. A wide range of drawing boards are available on the market, each made of a different material, ranging from wood to plastic to metal.

Drawing boards made of wood are quite popular among professionals because of their longevity, sturdiness, and the fact that they provide a flat, stable surface. In order to cater to a wide range of preferences, they are offered a selection of different finishes, such as smooth, textured, or unfinished. Unfortunately, wooden boards are notorious for being cumbersome and pricey, making them less than ideal for individuals on a tight budget and students. Plastic drawing boards are both lightweight and portable, making

them a good option for those who need to work while on the move, such as students, hobbyists, or people who need to work in several locations.

They come in various colours, sizes, and forms, and some may even be purchased with stands that let the user alter the angle at which they are functioning. Drawing boards made of metal are less widespread, but they are known for their exceptional durability and sturdiness. They are built to resist heavy use and have a long lifespan due to their sturdy construction. They can also include extra features that help with precise measurements and lines, such as parallel rulers or angle guides. These features can be purchased separately or packaged together.

Drawing boards are also available in various configurations, including tabletop and portable models. Tabletop drawing boards are often larger than standard drawing boards and are designed to be placed on a desk or worktable. They offer a firm basis for the completion of larger projects. Portable drawing boards were initially developed for artists and designers who needed to work while on the move. As a result, they are an excellent choice for landscape architects who need to sketch while in the field. Drawing boards cater to a wide range of requirements and inclinations, they are a flexible and helpful instrument that any designer or artist can utilise.

Drawing Boards Source: Spectrum (2021).

Computer-Aided Design (CAD) Software

Computer-Aided Design (CAD) software is a type of programme that landscape architects utilise to produce accurate and detailed drawings. These drawings can be 2D plans, 3D models, or renderings. Landscape architects can develop complicated designs quickly and efficiently using CAD software, granting them the flexibility to modify their work rapidly.

The computer-aided design (CAD) programme provides various tools and functions developed expressly for landscape architecture. They include specialist plant libraries,

terrain modelling tools, and environmental analysis tools. Landscape architects can use these tools to produce precise and detailed designs, taking into consideration elements such as the sun's angle, the direction of the wind, and the drainage of water.

Landscape architects also can work with other professionals involved in a project, such as contractors, engineers, and architects, thanks to the capabilities of CAD software. Designs may be easily shared and modified, eliminating the need for protracted back-and-forth communication and significantly reducing the number of errors and misunderstandings that might occur. The capacity to build three-dimensional models and renderings of the design is another advantage offered by CAD software. Because of this, customers can form a more accurate mental image of the completed project, which can help eliminate misconceptions and ensure that the end result lives up to their expectations.

Computer-aided design (CAD) software is becoming an increasingly crucial instrument for landscape architects since it enables the creation of exact and comprehensive drawings quickly and efficiently and provides the capability to adapt and modify existing designs readily. It also makes it possible for landscape architects to cooperate with other professions effectively and develop client visualisations that accurately represent the finished project.

Sketch Pad

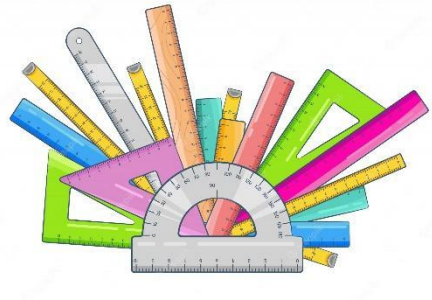
Sketch Pads are an important tool for landscape architects as they enable quick, spontaneous brainstorming and the investigation of design ideas. They are a multipurpose tool that can be used in a range of situations, such as on-site visits, in the midst of meetings, or even while travelling. They are also a helpful technique to build one's own unique style and maintain a record of one's evolving design ideas.

Sketch Pad

Source: Komtrak (2022)

Measuring tools:

Tape measures, rulers, and protractors are essential tools for landscape architecture, allowing designers to accurately measure and record distances, angles, and measurements of a site or design. They can be fabricated from metal, plastic, or cloth and are available in various lengths. They also help to decrease errors and inaccuracies, resulting in a more efficient and productive design process.



Measuring tools

Source: Freepik (2023)

Geographic Information System (GIS)

Landscape architects use geographic Information System (GIS) software to analyse and interpret geographic data, such as topography, slope, and aspect. It can also be used to evaluate and simulate vegetation data, such as tree canopies' coverage, species distribution, and growth rates. This information can be used to build planting plans customised to the site's characteristics and support local ecosystems. GIS software enables landscape architects to make more precise and well-informed decisions based on facts from the natural environment.

Summary

The importance of drawing materials and tools cannot be overstated in the field of landscape architecture. In order to develop and express their design concepts, landscape architects make use of a wide range of materials and instruments, ranging from the more conventional pencils and pens to the most cutting-edge CAD software. These tools make it possible for landscape architects to produce drawings that are precise and thorough, allowing them to successfully express their ideas to customers and other stakeholders. Landscape architects are able to craft aesthetically pleasing and practically useful outdoor areas with the assistance of these tools. These spaces can contribute to the enhancement of the natural environment and offer years of enjoyment. Hence, in order to produce projects that are successful, it is essential for landscape architects to have a comprehensive awareness of these technologies and the ways in which they can be utilised effectively. By mastering these tools and materials, landscape architects can

create clear and professional designs that communicate their vision to clients, stakeholders, and contractors.

Exercises

1. Why should you make sure that the paper you use for your landscape drawings is of a high quality?
2. In a drawing of a landscape, why is it essential to make use of a range of different line weights?
3. How do coloured pencils and markers bring depth and character to a landscape drawing?
4. Why is it necessary to make sure that the paper you use for your landscape drawings is of a high quality?
5. How can the use of computer software such as AutoCAD make the process of drawing landscapes more effective?

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BIODATA OF ASSOCIATE PROFESSOR DORCAS AYENI

Dr Dorcas Ayeni, an Associate Professor in the Department of Architecture at the Federal University of Technology Akure (FUTA). is an accomplished architect and academic specialising in Landscape Architecture and Sustainable Tourism. She holds a Bachelor of Science in Architecture and a Master of Science in Architecture from Ahmadu Bello University, Zaria. She obtained her PhD in Architecture and Sustainable Tourism from De Montfort University, Leicester, in the United Kingdom.

With a passion for research and education, Dr Ayeni has received grants and awards throughout her career. She has published over 80 papers in esteemed local and international journals and has served as a reviewer for reputable academic journals. Additionally, she has supervised several Master and doctoral students.

Dr Ayeni is a registered architect and a member of several professional organisations, including the Nigeria Institute of Architects, Architects Registration Council of Nigeria, Society of Landscape Architects of Nigeria, Nigerian Institute of Chartered Arbitrators, Architectural Educators in Nigeria, International Council on Monuments and Sites Nigeria (ICOMOS). She has held leadership positions within the Nigerian Institute of Architects Ondo State Chapter.

Dr Ayeni is an Associate Professor in the Department of Architecture at the Federal University of Technology Akure (FUTA). She teaches various architecture, landscape design, tourism, and heritage conservation courses. Her research interests include Architectural Tourism, Sustainable Tourism Development, Heritage Studies, Landscape Architecture, Urban Design Studies, and Architectural Education.

Beyond her academic and professional achievements, Dr Ayeni is actively involved in philanthropic work. She founded the Widows and Widowers Window of Hope, a non-profit organisation that supports widows, orphans, and "seniors.". She also enjoys travelling, has visited over 22 countries globally, and is keenly interested in collecting flags.

She has significantly established collaborative partnerships between FUTA and international universities, including London South Bank University and De Montfort University

CHAPTER TWO: INTERFACE OF HUMAN ECOSYSTEMS AND ECOLOGY

Interface of Human Systems, Environmental Harmony and the Ecosystem

Prof Akunnaya Pearl Opoko, *Bells University of Technology*, **Prof Tunji Adejumo,** *University of Lagos* **& Dr Anifowose**

Overview

The ecosystem comprises a variety of living and non living things co-existing in harmony and dependent on one another. It is the life support for human beings and all other living things. It is, however, subject to natural and man-made disturbances which sometimes alter its composition and stability. Whether or not the ecosystem recovers from these disturbances depends on the severity of the disturbance and the resilience capacity of the ecosystem.

This chapter discusses the ecosystem and its relationship with the human species. It is divided into the following sections. Section one comprises the overview and objectives of the chapter. Section two describes the ecosystem and the various services it provides especially for human beings. It also provides insight into the human ecosystem, explaining the relationship between human beings and the environment. It further highlights the need for harmony within the ecosystem as well as ways of achieving it. At the end of the chapter, some exercises are provided in order to test the understanding of the chapter by the students.

Objectives

The objectives of this chapter are to:

1. explain the meaning and the constitutes the ecosystem;
2. highlight the services provided by the ecosystem;
3. explain the relationship between human beings and the ecosystem;
4. explain the relationship between harmony between human beings and the ecosystem; and
5. identify ways of maintaining harmony between human beings and the ecosystem.

The Ecosystem

Brief description

Ecosystem is a generic term which refers to the interactions between one or more organisms within the context of their environment or habitat. An ecosystem is a physically

defined unit. Ecosystems may differ in compositions, geographical location, size and hierarchy. An ecosystem consists of two components namely the biotope (abiotic) and the biocenosis (biotic). The biotope is the physical setting which is made up of physical characteristics of the environment. These include, for instance, organic compounds, carbon dioxide, the soil including its moisture, concentration of nutrients and pH, the climate characterised by solar radiation,temperature, weather patterns, humidity, and the amount of precipitation. The biocenosis or biotic are the living components of the ecosystem. These consist of the flora and fauna. The flora consists of the various species of plants (Opoko, 2004) while the fauna include human beings, other animals, aquatic life and micro-organisms which are interdependent and constantly interact within the same environment. Within this environment, the species are able to meet their needs for food, habitation, recreation and survival.

Classifications of Ecosystems

Ecosystems are classified in different ways. A common classification is based on where they exist whether on land (terrestrial) or in water (aquatic). Terrestrial ecosystems include temperate forest, tropical rainforest, desert, taiga or boreal, tundra, shrubland and grassland ecosystems. Aquatic ecosystems include coral reef, oceanic, lentic, littoral and lotic ecosystems. Ecosystems can also be classified as either natural or artificial. Natural ecosystems exist in nature. They include deserts, forests and oceans. Artificial ecosystems are man-made. They include aquarium, farms and greenhouses.

Ecosystem Services

The ecosystem is the life support network for human beings. Without the ecosystem, the human species cannot survive. Ecosystem services thus provide the social, cultural, economic, political, health and well-being needs of people. Unfortunately, some of these are really appreciated and therefore not accounted for via conventional economic indicators. Human beings derive several benefits from the ecosystem. These are referred to as Ecosystem services (ESVs). The Millennium Ecosystem Assessment: Ecosystems and Human Well-being document broadly classified these services into four categories. These are:

Provisioning Services through which basic human needs for food, clean water, fuel, fibre and genetic resources are met. Ecosystems help to distribute nutrients to species within the system.

Regulating services help to manage and control ecosystem processes. These include water purification, waste management, floods and erosion control, air quality maintenance, drought mitigation, land degradation, climate regulation as well as regulation of human, animal and plant diseases.

Supporting services are services that are required for the production of other ecosystems. They provide a support network that helps to replenish the ecosystem via activities like primary production, production of oxygen, soil formation and nutrient cycling.

Cultural services provide non material benefits like inspiration and reflection opportunities, education and cognitive development, neighbourhood attachment, social capital formation, recreational, tourism, religious and spiritual enrichment.

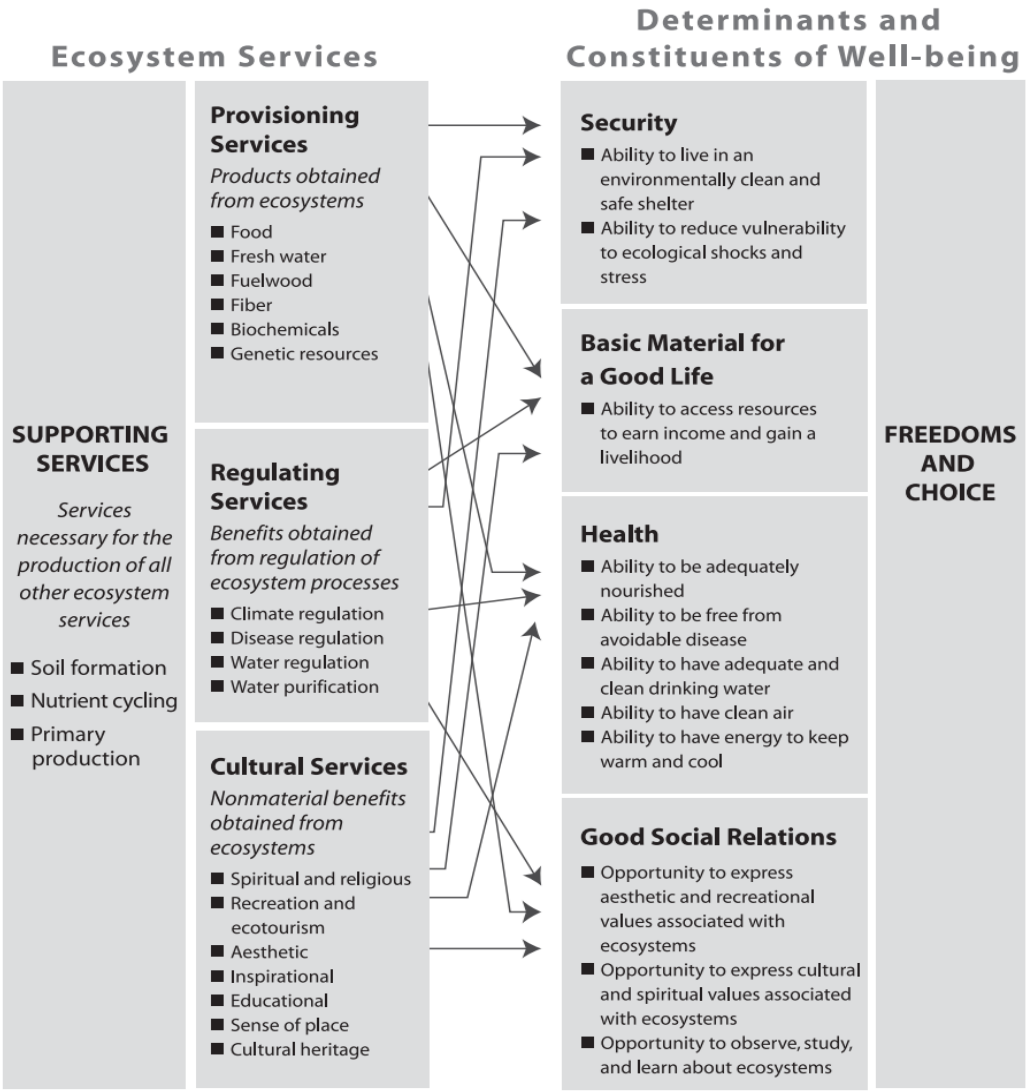

Figure 1: The Interrelationships Between Ecosystem Services and Human Well-being

Source: MA, (2005).

Human Ecosystems

The concept of human ecosystem is multidisciplinary based, drawing from various disciplines ranging from anthropology and sociology to ecology, philosophy and psychology. As implied, a human ecosystem is human-dominated. It explores the complex ways human beings relate to one another and their physical environment. These interactions occur at different nested hierarchical levels and contexts. Human ecosystems range from households to communities, nations, continents and the world operating within economic, sociopolitical, psychological, religious and cultural contexts. The human ecosystem comprises two systems, namely the resource and human social systems. While the resource system comprises the ecosystem, cultural and socioeconomic contexts, the human social system comprises social institutions, social cycles and social order. Cadenasso *et al.*(2006) has conceptualised the human ecosystem in their *The Human Ecosystem Framework* presented in figure 2. While the resources sustain the human ecosystem, their usage is moderated by the social system, which regulates human behaviour. The human ecosystem is not static. It is dynamic because it is subject to changes.

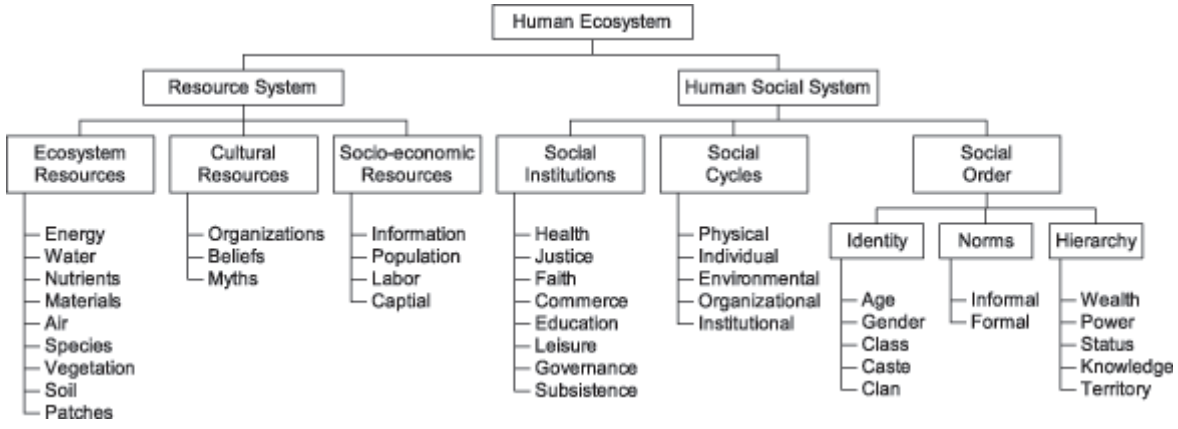

Figure. 2. *The Human Ecosystem Framework*

Source: Cadenasso *et al.* (2006)

The problem posed by the growing demand for ecosystem services is compounded by increasingly serious degradation in the capability of ecosystems to provide these services. Human actions are diminishing the capability of many ecosystems to meet these demands. In many parts of the world, this degradation of ecosystem services is worsened by lack of knowledge and understanding exhibited by local communities in their exploitation and management of the ecosystem.

Environmental Harmony

The ecosystem is made up of a mix of components of living things and non-living things. These interact intricately as a functional unit. They coexist symbiotically in a manner that each member is nourished and sustained. Therefore, any disturbance to any element within the system affects the entire ecosystem. When all elements of the ecosystem are in balance with each other and their environment, a state of equilibrium is said to exist. Ideally, natural ecosystems are seen as stable and "balanced" systems. In reality, this is not exactly the case. They are constantly changing with time due to the dynamics of natural occurrences from both internal and external forces. The natural forces include climatic variations, epidemics, drought, wildfires, volcanoes and tsunamis. Ageing and the activities of predators are some of these factors. The evolution could be slow or rapid depending on the forces and interacting elements. Ecosystems can, however, resist changes or adapt to them without any serious disruptions to their functioning. How fast an ecosystem recovers from these disturbances determines its resilience.

In addition to natural forces, human activities also alter and shape ecosystems. These include:

Agricultural activities which result in destruction of wildlife, global warming and climate change, destruction of critical freshwater aquifer recharge areas and aquatic resources degradation

Deforestation for resource mining or urbanisation leads to loss of biodiversity and trees, displacement and extinction of species, desertification, wildfires, aridity and erosion, increased emission of greenhouse gases and global warming and displacement of indigenous peoples.

Overpopulation results in undue exploitation and consumption of ecological resources which degrade the environment, destroy natural reserves and breeding areas, reduce biodiversity, engender extinction of species and affect food chains.

Pollution arising from runoffs, combustion of fossil fuels and poor disposal of chemical substances and products including plastics result in emission of carbon dioxide and other greenhouse gases, rise in sea-level and extreme weather which affect food chains, biodiversity, intensify desertification and erode the health and well-being of both human beings and wildlife.

Production of Black Carbon via diesel car exhausts, burning of trees and use of solid animal fuels and firewood for cooking contribute to melting of the glaciers, changing weather patterns including reduced rainfall, increased global temperatures and global warming.

Genetic Modifications in order to meet growing demand alter natural ways of predation, soil microbial populations and transfer of unsolicited genetic materials to other native populations.

Invasive/Introduced species: imported non-native species into an ecosystem may need to suppress and extinction of native species.

Ways to Maintain Ecological Balance

When the ecosystem is damaged or impaired, it can no longer function optimally and will need remedial action to recover and attain balance. Unfortunately, not every damaged ecosystem can be reversed. The extent of damage reversal will depend on how resilient the ecosystem is. The following are some ways to restore and maintain balance within the ecosystem.

Population Control

Catering for the needs of the global growing population is a major cause of the imbalance experienced in the ecosystem. Improved healthcare and technological advancement have improved human longevity with the resultant increase in the demand for ecosystem resources and services. It is therefore necessary to consciously control population at the individual and government levels. This is however, a sensitive issue with emotional, cultural and religious undertones.

Sustainable Management of Natural Resources

The human population is not only increasing rapidly but consuming huge amounts of resources in an unsustainable manner (Opoko, 2022). It is this unsustainable consumption pattern that has destabilised the ecosystem. Sustainable consumption patterns and management of natural resources are needed to help ecosystems recover and stabilise. Sustainability will ensure reduction in consumption and generation of wastes.

Ecological Conservation Practice

Conservation activities serve to protect elements of the ecosystem, especially those considered as endangered species from extinction. These include various species and their habitats. Conservation helps to preserve biodiversity. Conservation protocols and policies are often enacted at the national, and international levels though action must also be at the local level for successful implementation and outcomes.

Protect the Water

Water is a major element in the ecosystem that produces several ecosystem services. However, it is prone to contamination from several human activities like manufacturing, mining and agricultural activities. Contaminated water threatens ecosystem balance

especially with regard to soil marine life and species. Protecting water sources will help to restore and sustain ecological balance.

Recycle and Reuse

Some ecosystem resources are non-renewable while others can be renewed. This means that non-renewable resources are finite and therefore can be exhausted. Some of these resources like plastic, are also non-degradable when disposed of. Recycling of such resources reduces over-harvesting of natural resources and pollution. Recycling should also be extended to wastes especially industrial and agricultural wastes. Consumption should also give preference to renewable resources, like solar, hydro and wind energy.

Minimization of pollution levels

High pollution levels degrade the environment. Choice of consumption patterns and processes should give preference to alternatives which are less polluting and damaging to the ecosystem. For instance, fossil fuel consumption is known to produce high levels of high polluting carbon dioxide and other greenhouse gases.

Summary

This chapter has provided in a concise manner the basic information students need in order to understand the fragile but vital relationship between the ecosystem and human beings. It identified the services provided by the ecosystem, the human activities that constrain provision of these and the need for harmony within the ecosystem. It also identifies ways that such harmony can be achieved.

Exercises

Identify the two main components of the ecosystem and give three examples of each.

1. In what ways can the ecosystem be classified?
2. Briefly discuss the ecosystem services.
3. How do human activities affect the ecosystem?
4. Discuss 5 ways ecosystem balance can be restored.

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Ecosystems, Space, Place, Culture and Landscape

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Overview

Ecosystems appear to be the mainstay of landscape architecture, and much valued than built landscapes. Their significance stems from their all-round inclusivity as human and non-human components of nature. Ecosystems are also central to ecology, the study of the interactions of living organisms with their environments. In particular, landscape architecture sits at the interface of human and environmental ecologies with focus on place-making, place identity, spirit of place (what Christian Norberg-Schulz calls *genus loci*), and benefits humans derive from ecosystems, termed ecosystem services.

This text discusses the significance of non-human ecosystems to place production in landscape architecture with focus on the cultural ecosystem services. This is through a perceptual lens in landscape ecology with a view to designing places of ecological significance at landscape scale for human ecosystems.

Objectives

The text has the following objectives to:

1. examine the concepts of space and place in landscape architecture;
2. compare human ecology with landscape ecology;
3. discuss cultural ecosystem services of landscapes;
4. identify the roles of ecology in landscape architecture designs; and
5. explain the fuzzy boundaries among culture, nature, and landscapes as elements of place.

Introduction

Ecosystems are composed of ecological components of nature, both human and non-human, that are biotic. The living 'nature' of ecosystems makes them central to the ecological-environmental discourse. As communities of living organisms that coexist and co-dependent on one another at the intra-ecosystem level, members of a particular ecosystem contribute to the survival and sustainability of each other and to the ecosystem itself.

At the inter-ecosystems level, each ecosystem has roles to play that ensure sustainable balance of the earth as the master ecosystem of nature. These are through processes of 'give and take' that are symbiotic or parasitic. Landscape comes into this environmental discourse as the habitat of the earth's ecosystem and consists of spaces that frame them. The habitat of ecosystems could be terrestrial, aquatic, or arboreal. These spaces are

manipulated for the maximum comfort of the human ecosystems on earth to produce places that have characters and identities inscribed on them. These places could be recreation parks, urban botanical gardens, aquariums, conservation areas, and zoological gardens.

Basic concepts

Space

1. Space is a two or three-dimensional geographical entity located on any plain of the earth/globe. It could be on land, in water, or in the air. From an ecological perspective, a space should have capacity to support human and non-human life, and therefore be biotic.
2. As a two-dimensional element, a space could be vertical or horizontal or occur in any geometrical form. As a three-dimensional form, a space occurs as the enclosure of three planes and therefore a volume.
3. As a two-dimensional surface, space is a closure of lines that occur in different directions, lines being 'moving points'. For this reason, space and surface are analogous to two sides of the same coin that are intricately connected.
4. From a philosophical perspective, space is an abstraction, a temporal reality (Fadamiro and Adedeji, 2016), a symbol of 'being', and a materiality of all existences.

Place

1. Place is a transformed space through human actions. Place is a space with identity inscribed on it and distinguishes it from other spaces. Place is an embodied space.
2. The role of landscape architecture is to transform spaces to places imbued with characteristics that support life through the art of place-making.
3. The biotic quality of places makes them ecosystems of human and non-human nature with multiple ecosystem services.
4. The geographies and narratives of place in landscape ecology include place formation, place transformations, place identity, place-marking, and place-making.
5. The history of place in this ecology is soaked with encoded meanings, semiotics, symbolisms, events, actions, and actors, the understandings of which contribute to the art of place-making.

Landscapes

1. Since architecture is the art and science of designing spaces and places, landscape architecture is the art and science of designing open spaces and open places for human use and comfort.
2. These open spaces and open places are areas on land or water, green or grey, that are not covered with buildings, at all spatial (plot, block, neighbourhood, city, sub-region, region, national, sub-continental, continental) and temporal scales.
3. Invariably, a large percentage of concerns in landscape architecture deals with the science of designing space and place.

4. This science is embodied in ecology, because of the biotic content of landscapes and landscape architecture, landscapes being "integrative and visible socio-ecological systems of natural, physical, cultural, social, and aesthetic properties across different spatial-temporal scales" (Landscape Europe, 2015, p. 16).
5. Therefore, the rule of nature in landscapes makes their ecosystems paramount to human wellbeing, especially their cultural ecosystem services.
6. It is for these reasons that aesthetic appreciation of nature through perceptual human cognition of landscapes foregrounds human ecosystems and ecology. This is due to the social (dis) organisation in landscapes as complex socio-ecological systems and their foundations in "capitalism, neoliberalism, authoritarianism, class differentiation, socio-spatial segregation, and socio-ecological disorganisation" (Adedeji, 2021, p. 39).

Human ecology and landscape ecology

Human ecology (Steiner and Steiner, 2002) is concerned with the interaction of human societies with their physical and natural environments. It is a specialised field that understands and analyses human societies as organised socio-ecological systems, by borrowing principles from ecology to examine human-environment relationships. It deals with the impact of human population dynamics as ecological communities on environmental quality and the impact of environmental quality, especially green areas, on human quality of life (Adedeji and Fadamiro, 2018). Viewing the communities of humans as human ecosystems brings human ecology into synergy with landscape ecology and its human-nature contexts in urban (Gandy, 2022) and non-urban settings.

Landscape ecology deals with the non-human biotic aspects of the physical environment by situating them within the paradigm of environmentalism. In this context, the biotic non-humans are conceptualised as highly organised non-human communities of flora and fauna. The organisational details about the population dynamics, group sizes, families, species, food systems, and life cycles of the flora and fauna are of key interests in landscape ecology. It deals with the magnitude and pattern of processes (e.g. energy flows, food web) within and among ecosystems at different spatial scales. Human and landscape ecologies intersect at a confluence as environmentalism.

Environmentalism (Argyrou, 2022) is an environmental movement that focuses on environmental stewardship in human-environment relationships. It has gained traction as a growing field that has developed into political ecology with rural and urban dimensions producing blurring of boundaries between nature and culture. The tenets of environmentalism sit at the intersection of ecology, biodiversity, biophilic ideologies, nature conservation, and environmental ethics. In this nature-culture dilemma, culture is essentialized to understand nature, but still eco-centric. The eco-centricity of culture makes it amenable to examine ecosystem services from a cultural perspective.

Cultural ecosystem services of landscapes

Landscape places could be re-imagined as ecosystems. These systems provide non-material benefits to humans through perceptual modes. These modes are human senses in the categories of vision, smell, taste, touch, and hearing. They could be underpinned by religious or non-religious practices or other forms of non-religious spiritualities.

Human perception is a complex cognitively-laden process that produces non-material benefits and psychosomatic wellbeing. Such benefits that humans derive from ecosystems are generally called cultural ecosystem services (Millennium Ecosystem Assessment, 2005) Services.

Ecosystems in this sense are aggregated as forests, wildernesses, conservation areas, green spaces, rivers, streams, lagoons, oceans, green recreation parks, botanical gardens, urban green belts, agricultural fields, and home gardens. They are composed of trees, shrubs, climbers, ground covers, green shrines, and water. The cultural ecosystem services of these landscapes that make them to be places in different contexts through inscription of meanings include the following with examples:

Ecotourism

1. Ecotourism is a major cultural ecosystem service for the tour of ecological sites of nature. The sites are nature reserves of pristine ecosystems that afford connection of human beings' with nature.
2. Ecotourism is a form of spiritual devotion to nature. Plate 1 shows an exploration of nature at Lekki Conservation Centre, Lagos, Nigeria.

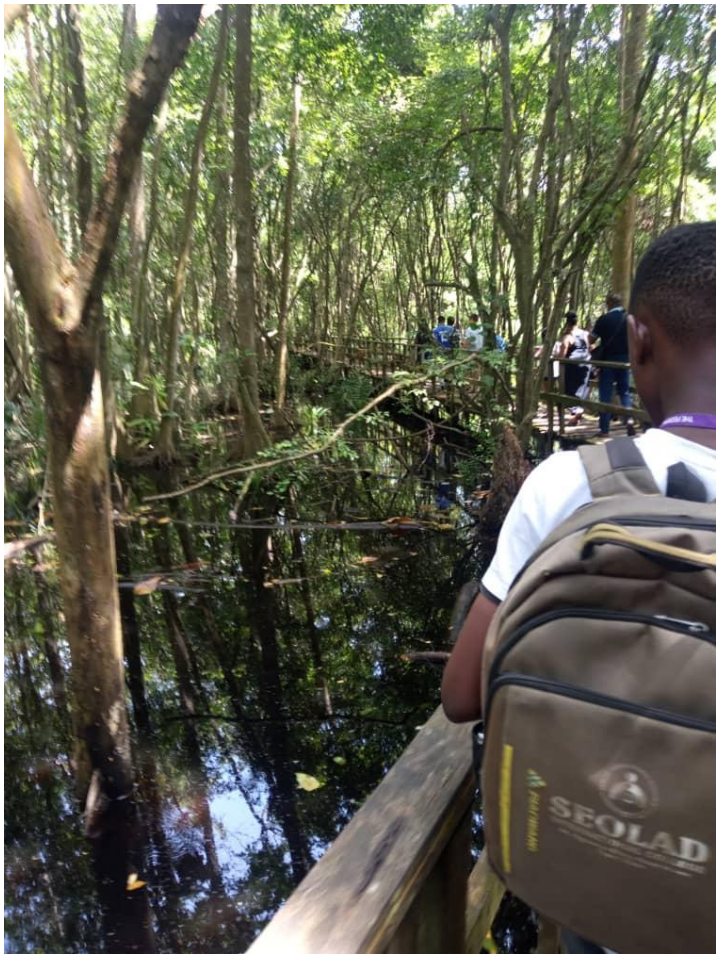

Plate 1: An exploration of nature at Lekki Conservation Centre, Lagos, Nigeria.

Source: Joseph A. Adedeji

3. Therefore, ecotourism is a form of spirituality where a reconnection with the supernatural God is afforded. Frank Lloyd Wright, architect of the landscape and foremost architect of the 20th Century, once described this act of human connection with nature as a form of deep religiosity.
4. Frank Lloyd Wright fittingly concluded that "Nature should be spelled with a capital 'N', not because Nature is God but because all that we can learn of God we will learn from the body of God, which we call Nature" (Spirn, 1997, p. 249).
5. He considered himself to be extremely religious and when asked for a proof of his religious claim: "Do you go to any specific church?" Wright responded, "My church [pause], I put a capital 'N' on Nature and go there" (Spirn, 1997, p. 250).

6. Formal and informal education about nature and natural processes in the environment are essential cultural ecosystem services of parks, gardens, and groves. University green infrastructures like zoological and botanical gardens are outdoor learning spaces for students in these fields and those of pharmacology for learning about flora and fauna.

7. These gardens are normally established primarily for research in these fields and other allied disciplines. Students' excursions to zoological and botanical/biological gardens are learning schemes out of classrooms to allow for practical comprehension of classroom teachings. An example of Osoun Grove is shown in Plate 2.

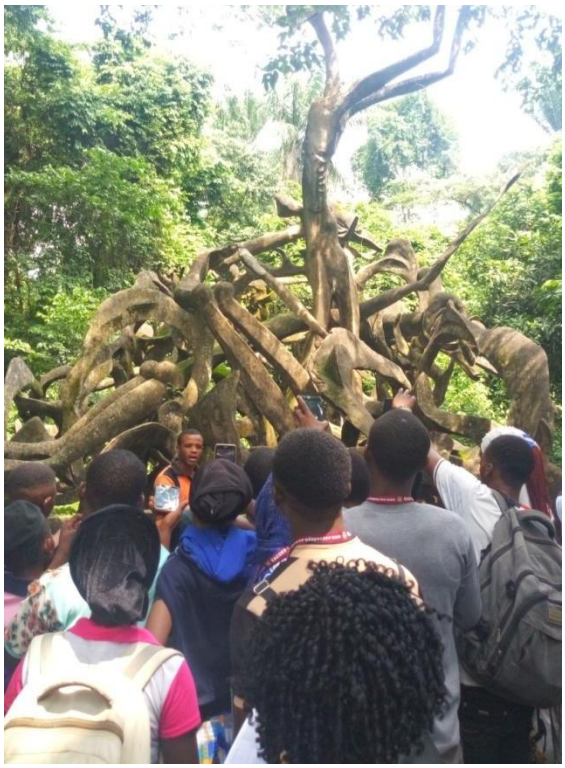

Plate 2: Landscape Architecture students on out of classroom learning at Osun Osogbo UNESCO World Heritage site, Osogbo, Nigeria. Source: Joseph A. Adedeji

8. Traditional green spaces like groves and sacralized sites are learning spaces about theology and religious practices.
9. As spaces of reflection about nature, they offer opportunities for informal education about nature, natural processes, and human-nature connections.
10. Cultural landscapes and their ecosystems continue to be significant in the traditional religions in the Global South. The sacralization of these ecosystems signifies their use as identities of cultural groups (Adedeji, 2023b, in press). They are emblems of 'spiritualisation of nature' and serve as traditional conservation of flora and fauna.
11. For instance, the gods in Yoruba cosmology are believed to be situated in urban groves where they are venerated and worshipped in their shrines. These gods are believed to be invisible spirits or ancestral spirits in the Yoruba pantheon.
12. Plate 3 is an example of cultural ecosystem service of traditional religious worship at Opa Oranmiyan Grove and Shrine at Ile-Ife, Nigeria.

Plate 3: Cultural ecosystem service of traditional religious worship at Opa Oranmiyan Grove and Shrine at Ile-Ife, Nigeria.

Source: Joseph A. Adedeji

Psychosomatics

1. Ecosystems of flora plant materials supply important cultural services as sites of meditation, idealisation, recuperation, therapeutic, creative thinking, mental health and wellbeing, and tranquillity for humans. The environmental sensory qualities of ecosystems provide connections between human minds and nature to trigger mechanisms for the relief of obnoxious mental loads, physical exhaustion, mental fatigue, and vagaries of life.
2. Psychosomatic cultural ecosystem services make human beings spend time in nature reserves and general green infrastructure by hiking long distances.
3. The mental mechanisms in psychosomatic cultural ecosystem services are explored for the design of healing gardens and landscape designs of healthcare grounds to afford maximum visual contact of green spaces by in-patients and out-patients.
4. This requires careful selection and specification of floral materials that have heavy qualities of psychosomatic loads in terms of their vegetative properties, especially colour, flower, and foliage system.

Passive recreation

1. Passive recreation is an important cultural ecosystem service of urban landscapes that are recreation sites. The sites provide opportunities for strolling, relaxation, walking, nature observation, and passive social interaction.
2. Examples of such urban landscapes are recreation parks and gardens. Their urban locations make them accessible to urban dwellers who visit the sites to escape from the characteristic hullabaloos of the city centres where green ecosystems have been 'designed out' to give room to building constructions due to exacerbating land use pressures consequent upon unprecedented urbanisation.
3. Agodi Gardens in Ibadan, and other recreation parks in Nigeria are examples of urban recreation gardens with various sections imbued with affordances for passive recreation. Plate 4a, 4b, and 4c show sections of Agodi Gardens, Ibadan; Lekki Conservation Centre, Lagos; and University of Lagos Lagoon Fronts, respectively, providing passive recreation cultural ecosystem service.

Plate 4: Cultural ecosystem service of passive recreation at some sections of urban recreation parks in Nigeria: Top – a: Agodi Gardens, Ibadan; Bottom, left - b: Lekki Conservation Centre, Lagos; Bottom, right – c: University of Lagos Lagoon Fronts. Source: Joseph A. Adedeji

Roles of ecology in landscape architecture designs

Ecology is an important component of designs in landscape architecture. Its role in landscape architecture designs is not only central but deterministic. It is for this reason that Ian McHarg argues that ecology is a command, where ecosystems shape landscape designs through critical analysis of natural site conditions (Spirn, 1998). This rule of nature signals naturalism as a guiding philosophy in landscape architecture that the universe is regulated by its own laws and processes.
Therefore, landscape designs that are environmentally sustainable, therapeutic in functional quality, sound to human perception, communicative of memories, and aesthetically pleasing are ecological. These ecological designs are produced in response to the command of ecology thereby fostering inalienable relationships between human and non-human nature (both biotic and abiotic).

Ecology, as a science and a command, has both direct and indirect roles in landscape architecture designs as agents of transforming spaces to places. The direct roles include guidance on plant specification and planting design based on knowledge of vegetative properties of in-situ and ex-situ, native and exotic species, and general plant sciences. The biotic-abiotic interactions in ecosystems are key determinations of energy flows and metabolic processes that guide sustainability targets in landscape designs.

Indirect application of ecology in place-making has to do largely with borrowing of ideas from nature and natural processes, including shapes and forms, through biomimicry and biophilic ideologies in guiding design decisions and formulating landscape design concepts. On the whole, landscape spaces and places are efficiently produced through ecological principles and knowledge of cultural ecosystem services leading to blurring of boundaries among culture, nature, and landscapes.

Culture, nature, and landscapes

The age-long philosophical debates about the understanding of culture and nature as binaries or non-binaries and the implications of either position on landscapes subsist. Despite the debates, evidence suggests that place production from two- or three-dimensional spaces through the art and science of place-making in landscape architecture requires essentializing culture to demystify nature (Adedeji, 2023a). This process is underpinned by ecology, ecosystems, and cultural ecosystem services.

Summary

There is an intricate connection among ecosystems, human ecology, space, place, and landscapes. In particular, there is a cultural domain in ecology that is essentially human and produces non-material ecosystem services, termed cultural ecosystem services. This text has outlined these services with illustrations on how

landscapes are implicated in place and space discourses. The text emphasises that ecology, both human (represented by culture) and non-human, is a command for landscape architecture for drawing inspirations to produce designs that are natural and therefore sustainable.

Exercise

(1) List and explain cultural ecosystem services.
(2) Discuss the roles of ecology in landscape architecture.
(3) What are the relationships among human ecology, landscape ecology, cultural ecosystem services, space, place, and landscapes?

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CHAPTER THREE: MAP READING AND AERIAL PHOTO INTERPRETATION

Basic Elements of Map Reading, Analysis and Generation in Landscape Planning

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Overview

Map reading is the ability to understand and interpret different types of maps, such as topographic maps, thematic maps, and site plans. This includes understanding symbols, scale, and key elements such as contour lines and elevation. The ability to read and interpret maps is crucial for architects, urban planners and other professionals in the built environment to be able to navigate complex urban environments, understand the topography of a site, and plan buildings and infrastructure accordingly. Map analysis involves the use of spatial data to analyse and understand relationships between various features of a landscape, such as land use patterns, natural resources, and infrastructure. This can involve overlay analysis, spatial statistics, and other techniques to identify patterns and trends. Map generation involves the creation of new maps, including base maps, site analysis maps, and other types of maps used in landscape planning. This can involve the use of survey data, field measurements, aerial photography, and GIS software.

The text discusses the processes of map reading, analysis, and generation in landscape planning which allow landscape planners to make informed decisions about the development and use of land. By understanding the topography and features of a site, landscape planners can develop plans that are environmentally sensitive, socially equitable, and economically sustainable. The use of maps and spatial data is also essential for effective communication with stakeholders, including community members, policymakers, and other professionals involved in the planning process.

Objectives

The objectives of this chapter, are to:

1. explain the elements of a Map;
2. describe the basics of map analysis;
3. appraise how maps are generated; and
4. explain how maps are applied in landscape planning.

Elements of a Map

Understanding key elements of a map and how to use them to navigate and interpret information about a particular area is fundamental to map reading, analysis and generation. Fig 1 is a sample street guide map showing some annotated map elements with black oval shapes.

Map elements include:

1. Map Scale: The scale of a map shows the ratio of distance on the map to the actual distance on the ground. It is usually presented as a ratio or as a bar scale.
2. Map Legend: A map legend is a key that explains the symbols and colours used on the map.
3. Compass Rose: A compass rose shows the direction of the North on the map, which is important for navigation.

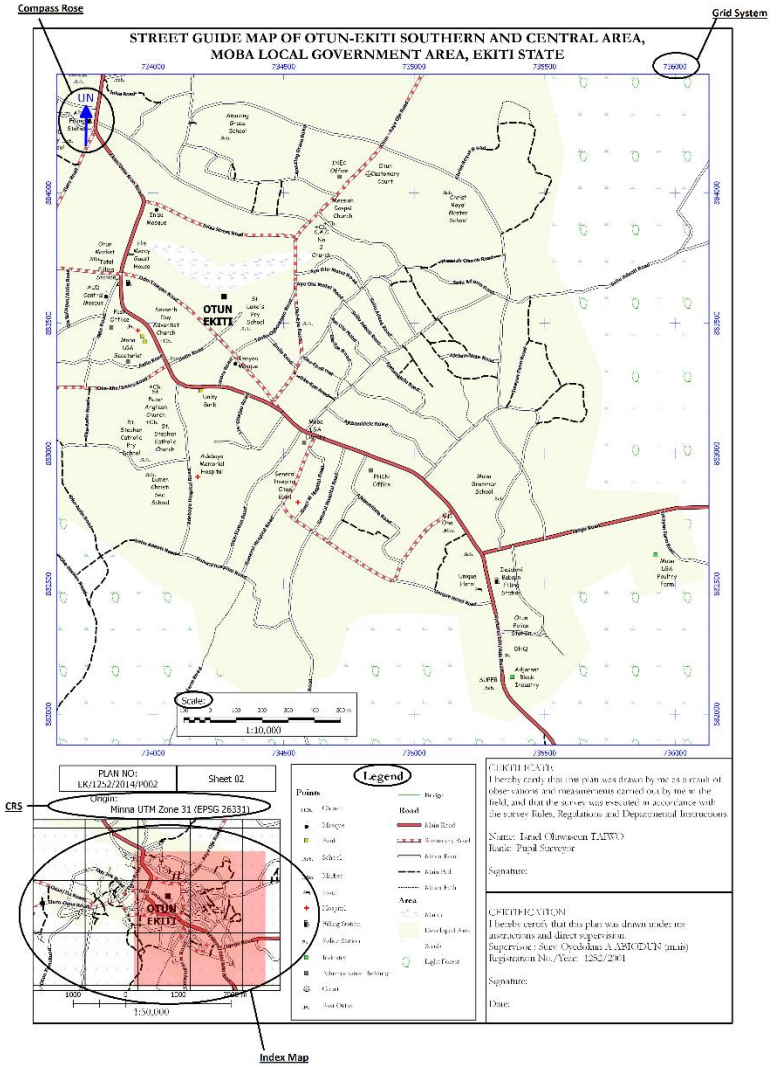

Figure 1: Sample Map with Annotated Map Elements

4. Contour Lines: Contour lines show the elevation and shape of the land on the map. They are used to identify hills, valleys, and other features of the landscape.
5. Grid System: A grid system is a series of horizontal and vertical lines that divide the map into smaller sections. It is used to identify specific locations on the map.
6. Inset Map: An inset map is a smaller map that shows the location of the main map in relation to a larger area.
7. Coordinate Reference System: A map projection is the method used to transfer the three-dimensional shape of the Earth onto a two-dimensional map.

Understanding these basic map elements help to interpret and navigate maps with greater ease and accuracy. Map reading skills are essential for a wide range of activities, including hiking, driving, and outdoor exploration, as well as for professional applications in fields such as cartography, geography, and urban planning.

Types of maps and their uses in landscape planning

There are various types of maps that are used in landscape planning, each serving a specific purpose. These different types of maps are essential tools for landscape planners to understand the physical features and patterns of a landscape, identify potential development sites, and plan projects that are in line with the needs and desires of the community. Below are some of the most common types of maps and their uses:

1. Topographic maps: Topographic maps show the physical features of a landscape, including elevation, relief, and land-forms. These maps are used to analyse the topography of a site, identify potential drainage issues, and assess the suitability of a site for development.
2. Land-use maps: Land-use maps show the different ways that land is utilised in a given area, such as residential, commercial, or agricultural. These maps are used to identify areas of existing development, plan new development projects, and understand the patterns of land use in a community.
3. Zoning maps: Zoning maps show the different zoning districts in a community, including residential, commercial, and industrial zones. These maps are used to regulate land use and ensure that development is compatible with the surrounding environment and the needs of the community.
4. Aerial photographs: Aerial photographs provide a detailed view of a landscape from above. They are used to identify land use patterns, assess the impact of development on the surrounding environment, and analyse the topography of a site.
5. Soil maps: Soil maps show the different types of soil present in a landscape, including their texture, structure, and drainage. These maps are used to assess the suitability of a site for various types of development, including agriculture, landscaping, and construction.
6. Transportation maps: Transportation maps show the location and extent of roads, highways, and other transportation infrastructure. These maps are used to plan transportation projects, analyse traffic patterns, and identify potential locations for new development.

7. Natural resource maps: Natural resource maps show the location and extent of natural resources such as forests, wetlands, and water resources. These maps are used to assess the impact of development on the environment and plan for the conservation and management of natural resources.

Understanding map symbols and legends

Maps symbols are visual representations of real-world features, such as roads, buildings, and natural resources. These symbols are used to convey information about the features of a landscape in a way that is easy to understand. Symbols are usually depicted as simple, graphic representations that are easily recognizable. Maps symbols can vary between different types of maps and different map-makers, so it is important to check the map legend for specific information about each symbol used.

Maps legends, also known as keys, are tables or charts that explain the symbols used on a map. These legends typically include a list of symbols used on the map and their corresponding meanings. Legends may also include information about scale, orientation, and other important elements of the map. The legend is usually located in a corner of the map and is usually indicated by a symbol or text that says "legend" or "key".

Maps symbols and legends are important tools for understanding and interpreting maps. To understand map symbols and legends, it is important to first locate the legend on the map. Once you have found the legend, look for the specific symbols you are interested in and read the corresponding description. This will help you understand what each symbol represents and how it relates to the landscape being depicted on the map.

Map scales and distances

Map scale is the relationship between the distance on a map and the actual distance on the ground. Map scale is usually represented in one of three ways:

1. Ratio or fractional scale: This is represented as a ratio of the distance on the map to the actual distance on the ground. For example, a map with a scale of 1:10,000 means that one unit on the map represents 10,000 units on the ground.
2. Bar scale: This is a graphical representation of the relationship between the distance on the map and the actual distance on the ground. A bar scale typically shows a line that is divided into segments that correspond to specific distances on the ground.
3. Verbal scale: This is a written description of the relationship between the distance on the map and the actual distance on the ground. For example, a map might have a verbal scale of "one inch equals one mile".

Distances on a map can be measured using the map scale. To measure a distance on a map, first determine the scale of the map. Then, measure the distance on the map using a ruler or other measuring tool. Finally, multiply the distance on the map by the scale to determine the actual distance on the ground.

It is important to note that map scale can have a significant impact on the level of detail and accuracy of a map. Large-scale maps (e.g. 1:10,000) show more detail and are useful for analysing small areas, while small-scale maps (e.g. 1:1,000,000) show less detail and are better suited for analysing larger areas. It is important to choose the appropriate scale for the task at hand to ensure accurate analysis and interpretation of the map.

Reading contour lines and elevation

Contour lines are lines on a map that connect points of equal elevation. They provide important information about the shape and topography of the land being represented

Figure SEQ "Figure" * ARABIC 2: *Sample topographical survey showing contour lines*

on the map. Figure 2 is a sample topographical survey plan of a wetland in Ekiti State University, showing contour lines in brown lines and spot heights in black.

The following steps can be used in reading contour lines and elevation on a map:

1. Look for the contour interval: This is the vertical distance between adjacent contour lines on the map. The contour interval is sometimes indicated in the map legend.
2. Determine the elevation of the first contour line: The elevation of the first contour line is indicated on the map, usually in the legend. This is the elevation at which the first contour line starts.
3. Determine the elevation of other contour lines: Each contour line on the map represents a specific elevation. To determine the elevation of a contour line, start at the first contour line and add the contour interval for each subsequent line.
4. Interpret the contour lines: Contour lines that are close together indicate steep terrain, while contour lines that are far apart indicate gentle terrain. When contour lines are evenly spaced, the terrain is relatively uniform. When contour lines are irregularly spaced, it indicates changes in the terrain such as cliffs, valleys, and ridges.
5. Use contour lines to visualise 3D terrain: By visualising the terrain represented by contour lines, you can get a better understanding of the shape and features of the land. For example, a "V"-shaped contour line indicates a valley or stream, while a "U"-shaped contour line indicates a ridge.

In addition to contour lines, maps may also include spot elevations, which are points on the map that indicate the exact elevation at that point. Spot elevations are usually represented by a small dot with an elevation number next to it.

Understanding how to read contour lines and elevation on a map is important for a variety of tasks, such as analysing terrain, planning hiking or biking routes, and determining the best location for construction projects.

Coordinate systems and map projections

Coordinate systems and map projections are essential components of cartography that enable maps to accurately represent the earth's surface. A coordinate system is a grid of horizontal and vertical lines that is used to define locations on the earth's surface.

The two most common coordinate systems used in mapping are latitude/longitude (also known as geographic coordinates) and UTM (Universal Transverse Mercator) coordinates. UTM coordinates is a form of the Cartesian coordinate system. Latitude and longitude coordinates are expressed as degrees, minutes, and seconds, with latitude measured north or south of the equator, and longitude measured east or west of the Prime Meridian. UTM coordinates use a metric grid system, with eastings and northings measured in metres, and the earth's surface divided into 60 north-south zones, each 6 degrees wide.

Map Analysis Techniques

Map analysis techniques are used to extract and interpret information from maps for various purposes, such as planning, decision-making, and research. Below are some commonly used techniques:

1. Overlay analysis: Overlay analysis involves overlaying multiple maps or layers of data to identify patterns and relationships between different features (Longley et al., 2015; Taiwo et al., 2020). For example, overlaying a map of land use with a map of transportation networks can reveal areas that are poorly served by public transportation.
2. Spatial analysis: Spatial analysis involves analysing geographic data to identify spatial patterns and relationships (Longley et al., 2015). Techniques such as spatial autocorrelation and hotspot analysis can be used to identify clusters of similar features, such as areas with high crime rates.
3. Network analysis: Network analysis involves analysing transportation networks, such as roads or rail lines, to identify the most efficient routes or locations for new infrastructure. Techniques such as shortest path analysis and service area analysis can be used to identify optimal routes or service areas.
4. Terrain analysis: Terrain analysis involves analysing the topography and physical features of a landscape to identify areas that may be prone to natural hazards such as flooding or landslides. Techniques such as slope analysis and aspect analysis can be used to identify areas with particular characteristics.
5. Statistical analysis: Statistical analysis involves analysing geographic data using statistical techniques to identify patterns and relationships. Techniques such as regression analysis and cluster analysis can be used to identify correlations and patterns in geographic data.

Generating Maps for Landscape Planning

Generating maps for landscape planning involves creating maps that accurately represent the physical and environmental characteristics of an area, as well as its cultural and social features. Maps can be generated for landscape planning from field survey measurements, digitising existing maps and converting paper maps to digital format, or by using GIS software for map generation. A typical process of generating maps for landscape designing using GIS is shown below:

1. Identify the purpose of the map: Before creating a map, it is important to identify its purpose and the specific information that needs to be represented. This will help determine the appropriate scale, data sources, and level of detail needed.
2. Collect data: Data sources for landscape planning maps may include aerial photographs, satellite imagery, topographic maps, soil surveys, vegetation surveys, and cultural data such as land use and zoning.
3. Choose a map projection and coordinate system: The map projection and coordinate system chosen will depend on the geographic area being mapped and

the intended use of the map. It is important to choose a projection and coordinate system that accurately represents the features being mapped.
4. Create a base map: A base map provides a framework for adding additional layers of data. A topographic map or aerial photograph can be used as a base map.
5. Add layers of data: Additional layers of data can be added to the base map to represent features such as land use, vegetation, soil types, water features, and cultural features.
6. Symbolise the map: Map symbols are used to represent different features and data types. It is important to choose symbols that are easily recognizable and clearly represent the features being mapped.
7. Label the map: Labels are used to identify features on the map, such as roads, landmarks, and water bodies. It is important to choose clear and readable fonts and to place labels in a way that does not interfere with the map's legibility.
8. Publish and distribute the map: Once the map is complete, it can be published and distributed to stakeholders and the public. This can be done in print or digital formats, such as PDFs or interactive web maps.

Creating accurate and informative maps is a critical component of landscape planning. By following these steps, maps that effectively represent the physical and cultural characteristics of an area and aid in decision-making and planning can be generated.

Application of Map Reading, Analysis, and Generation in Landscape Planning

Map reading, analysis, and generation are essential tools for landscape planning. They allow planners to understand the physical, social, and cultural characteristics of an area and to make informed decisions about land use, development, and conservation. Below are some specific applications of map reading, analysis, and generation in landscape planning:

1. Identifying natural features: Maps can be used to identify natural features such as water bodies, forests, wetlands, and wildlife habitat. This information can be used to develop plans for conservation and recreation.
2. Analysing land use patterns: Maps can be used to analyse land use patterns and trends, such as the location and density of residential, commercial, and industrial development. This information can be used to identify areas for growth and to plan infrastructure development.
3. Assessing environmental risks: Maps can be used to assess environmental risks such as flooding, landslides, and wildfire. This information can be used to develop plans for risk mitigation and emergency response.
4. Planning transportation networks: Maps can be used to plan transportation networks such as roads, transit lines, and bike lanes. This information can be used to identify optimal routes, improve traffic flow, and promote sustainable transportation options.
5. Developing green infrastructure: Maps can be used to identify areas for green infrastructure such as parks, greenways, and stormwater management systems. This information can be used to improve public health and well-being and to

promote environmental sustainability.

6. Managing cultural resources: Maps can be used to identify and manage cultural resources such as historic sites, archaeological sites, and cultural landscapes. This information can be used to protect and preserve cultural heritage and to promote cultural tourism.

Overall, map reading, analysis, and generation are critical tools for landscape planners. They provide a visual representation of the landscape and allow planners to make informed decisions that balance environmental, social, and economic considerations.

Summary

Recap of key concepts and techniques

The basic elements of map reading, analysis, and generation in landscape planning include map scale, map legend, compass rose, contour lines, grid system, index map, and map projection. Understanding these elements is important for interpreting and navigating maps with accuracy. Map analysis techniques can be used to identify land use patterns and spatial relationships, which are important for landscape planning. Maps can also be generated using various tools and techniques, including Geographic Information Systems (GIS), which allow for the integration of multiple layers of data.

Future trends and emerging technologies in map reading, analysis, and generation in landscape planning.

There are several future trends and emerging technologies in map reading, analysis, and generation in landscape planning:

1. Remote Sensing: Remote sensing technology is increasingly being used as a source for map generation and interpretation. Remote sensing techniques can provide high-resolution imagery and data on land cover, land use, vegetation, and other environmental factors. This data can be used to create more accurate maps and inform land use planning and management decisions.
2. 3D Mapping and Creation of Digital Twins: 3D mapping technologies are becoming more advanced and accessible, allowing for the creation of highly accurate and detailed 3D models of landscapes. These models can be used to analyze and visualize terrain features, drainage patterns, and other spatial data. This can improve the accuracy and effectiveness of landscape planning and management.
3. Big Data and Analytics: Big data analytics is becoming increasingly important in landscape planning. Large datasets can be used to analyze patterns and trends in land use, vegetation, and other environmental factors. This can inform decision-making and support more sustainable land use practices.
4. Mobile Mapping: Mobile mapping technology is becoming more widely used, allowing for the collection of geospatial data using mobile devices. This can improve the efficiency and accuracy of data collection, allowing for more frequent and up-to-date maps and analyses.
5. Augmented Reality: Augmented reality technology can be used to overlay maps

and other spatial data onto real-world landscapes. This can provide a more immersive and interactive way to explore and analyse landscapes, and can support more effective decision-making.

Overall, these emerging technologies have the potential to transform the way that maps are read, analysed and generated in landscape planning. They can improve the accuracy and accessibility of data, allowing for more informed decision-making and more sustainable development practices.

Exercises

1. Itemise and explain the basic elements in a map.
2. What are the three types of maps and how are they used in landscape planning?
3. Draw some symbols used in a map and describe what they mean.
4. Discuss at least four ways by which maps are analysed.

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CHAPTER FOUR: HISTORY OF LANDSCAPE ARCHITECTURE

Gardens in the History of Landscape Design

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Overview

It is important to study the history of gardens beginning from early civilization till contemporary times. As Norman Newton posited, over the years, the way man has impacted their lands show their culture and ultimately their philosophy, which is why he defined landscape as design on land. Human activities through the various civilization eras literally created three types of landscape; Natural landscape, Humanised as in man made landscape and Designed landscape. Natural landscape refers to the landscape that naturally occurs as a result of nature, ecology and its forces acting on the land, untouched by man. Humanised landscape being the one that results from man's intervention on the land, mostly for functional purposes such as mining, and agriculture. Designed landscape is one that is resulting from man intentionally affecting the land for mostly aesthetic and design purposes, for recreation, beauty, and such. Garden history discusses this last type of landscape.

This text focuses on the history of gardens in the context of landscape planning. It describes different settlement patterns; the origin of gardens; the concepts used in the design of gardens historically; the features which distinguish these gardens and the contributions of these gardens to landscape architecture.

Objectives

The objectives of this chapter are to:

1. explain the links between settlement and garden culture;
2. identify planning principles applicable to cities from prehistoric to contemporary times;
3. describe the different types of settlement patterns;
4. discuss the origin of garden design over the years;
5. explain the philosophy of the various ages that guided their impact on land, resulting in garden design;
6. describe how the worldviews of both the Eastern and Western worlds influenced their gardens;
7. compare the various garden features in different ages; and
8. discuss the contribution of garden culture of different cultures to landscape architecture.

History of Prehistoric Settlements and the Transition to Today's Settlement

"The human settlement is a place where people live. It refers to the totality of the human community with all the social, material, organisational, spiritual, and cultural elements that sustain it" (Islam, 2021). Human settlements are further unevenly distributed due to disparity in topography and climatic differences making them differ one from one another.

Prehistoric settlements dominated by Neolithic man were the hunter-gatherer society that preceded populated settlements anywhere in the world and was nomadic in nature consisting of few family units. They had a very simple and basic structure and were isolated. For instance, shelter was in isolated caves from archeological findings. Fear was a major encumbrance to the domination of the world around; the preoccupation was on how to find food, and security and not for leisure or art. Taming his environment was further inhibited by his level of sophistication. Archeological pieces of evidence through excavation on Niah, in a study by (Higham, 2013), confirmed that there was no evidence of skillful tools found other than pieces of stone flakes probably used for making things or used for treating bamboo. This is a clear indication that prehistoric man did not use sophisticated tools to impact their environment significantly nor did they have a garden culture.

The culture of hunter-gathers, which characterises isolated settlements with no permanent habitation, was a non-sustainable culture. The discovery of agriculture and sustained improvement in food production is often what is attributed to having made settlements to grow. Corroborated this (Bar-Yosef, 2001), in a study referred to intentional cultivation as what encouraged plant and animal domestication bringing about a transition of the way of life, appropriation of tasks, and aggregation of food including establishing a sound footing for societal and ownership on private bases and territorial control enforcement.

The emerging permanent settlements replaced the dispersed settlements. This occurred about 10,000 years ago when agriculture encouraged stable food supplies and hunter-gathers built permanent settlements that grew into composite cities around the world (Islam, 2021). The transition by Neolithic man from dispersed settlement to permanent settlement at this stage in human civilization provided the right impetus for gardening. The deliberate planning and arrangement of land for the cultivation of crops as a preoccupation associated with early civilization as it was in China, Egypt, and the Middle East are a precursor to gardens.

The stability provided by permanent settlements opened up society to the freedom to pursue activities such as trade and commerce, socio-political relevance (administration of city security), philosophy, religion, art and leisure. These activities and engagements further provided the inclination for gardening in a more sophisticated manner in different cultures around the world as we have it today. Laurie Michael 1975 opined that the role

that man's need plays and the role of tradition and culture are determinants of the ultimate outlook of our created and modified landscapes.

The first cities were said to have appeared in fertile, and rich agricultural valleys of Rivers Euphrates & Tigris in Mesopotamia (present day Iraq) and also in Hindus & Ganges valley in India, and the Yellow River of China. Over time, isolated settlements began to cluster together and transformed in structure from hamlets to villages, then from towns to cities and today we have merging cities as in conurbation (Figures 1 and 2).

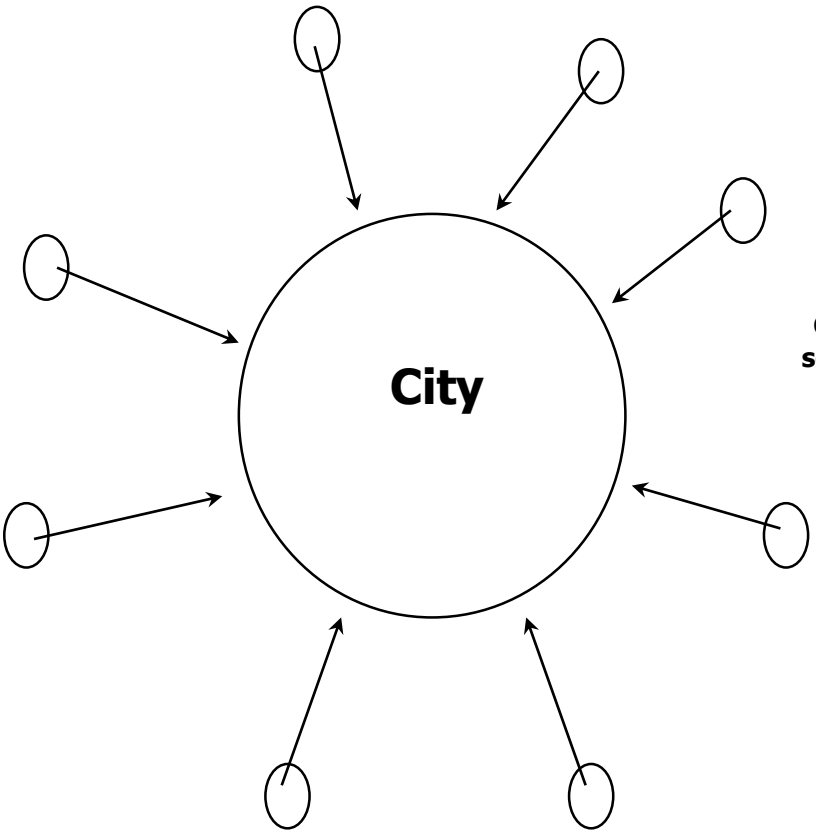

Figure 1. *Diagrammatic illustration showing how settlements cluster to form a city*

Sketch by: Nenchi D. W

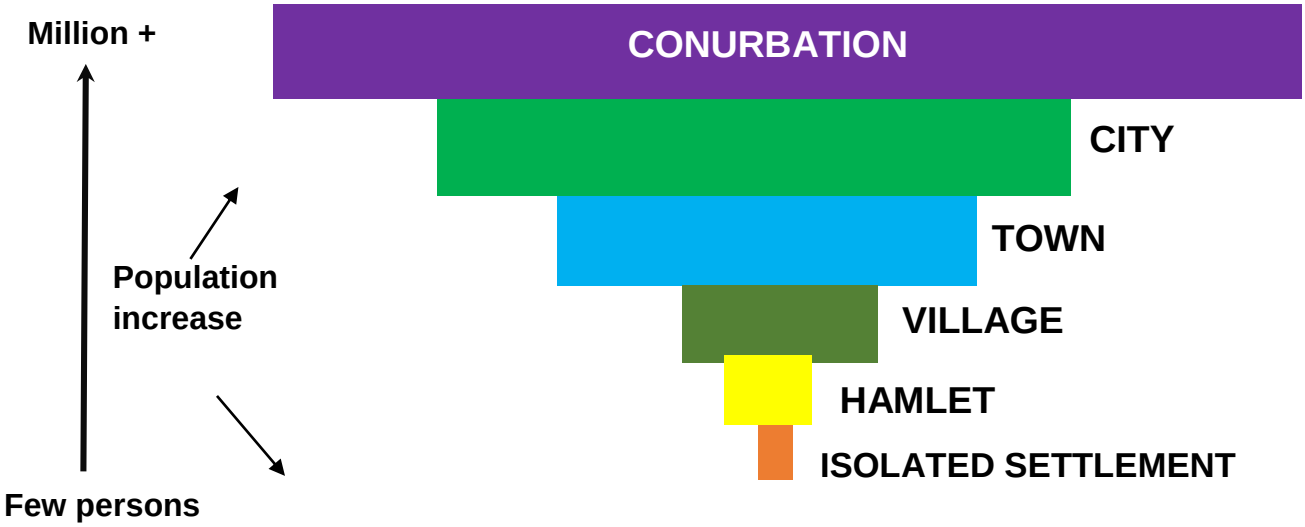

Figure 2. *A diagrammatic illustration showing how city growth starts off from isolated settlement and growing into conurbation*.

Sketch by: Nenchi D. W

Western World and Oriental Nations Planning Precedents.

The planning of cities commenced with the first settlements. Ancient planning principles have provided the bases for today's planning of urban areas around the world alongside the many contemporary concepts as applied today.

For a good understanding, the different planning periods in history will be discussed starting from the pre-Classical period through to Contemporary time. The Pre -Classical and Contemporary periods discuss both the Eastern and Oriental worlds, while the Graeco- Roman, Medieval, Renaissance and Baroque, Enlightenment Europe, Modern periods are about the Western world. Lastly the Indian and Chinese are singled out as examples of oriental planning in history for their peculiar contributions.

Pre-classical period 1500 BC- 250 CE

The first noticeable planning features of pre- classical cities in history was associated with the deliberate planning of housing and streets with considerations for orientation to sun and wind. Some basic town planning principles that characterised this period according to Dani & Thapar, 1996 include straight alignment of the houses along the streets. Public drains that empty from the residents aligned along the edge of the streets and in the direction of the wind. Windows of the houses are made to open onto the streets and are positioned in wind direction for its obvious advantages.

The earliest cities flourished aided by the Indus civilization around the plains of the Indus valley extending to the sea coast of Arabia (Dani & Thapar, 1996). Here the Harappan

civilization made a significant impact on art, culture, trade, and city form and a good example of such a city was Rahma Dher. Another major civilization of this period was the Maya Civilization in Mesoamerica known for its architectural masterpieces such as temple-pyramids, house mounds, and palaces that are surrounded by courtyards or broad plazas. An Example of a city of this period in Mesoamerica was Nakbe.

Graeco-Roman Period 332 BCE- 642 CE

The Graeco-Roman civilization refers to the Greeks and Romans, and other culturally related entities in the region. This cultural affinity led to the sharing of many cultural values and other positive strides that make up for progress across the divide. City planning was one of such and it spanned a period of more than 12 centuries. The concept of zoning, gridiron street planning with houses aligned to take in sunshine was the innovation of the Greek coming as early as the 9th Century BC. The Etruscan also made contributions in the science of hydraulics imbibed by the Romans. Later on, changes in the Mediterranean world encouraged the removal of city walls by the Pax Roman and also improvement in water supply over a considerable distance (Cilliers, 2015). (The Etruscan were an ancient people of Etruria in Italy whose planning culture was assimilated by the Romans).

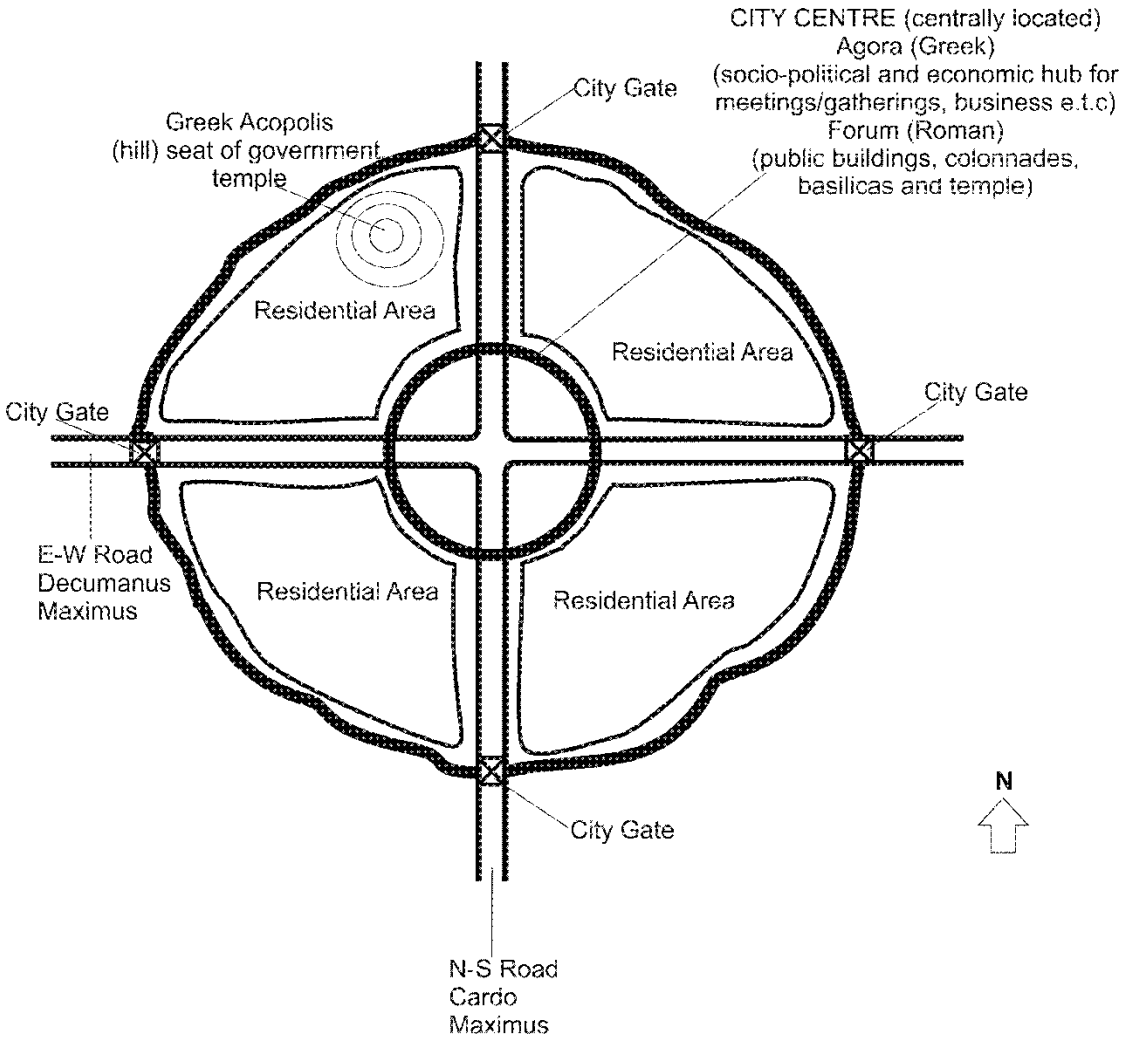

Figure 3. *Schematic drawing of a typical Graeco-Roman city*

Sketch by: Nenchi D. W

A typical Grecian ancient city had a city wall or polis, the raised ground or hill top called the acropolis is where the set of government, and the religious centre or temple was located. The amphitheatre and public spaces called the agora is located at the city centre or sometimes near a harbour. These were the prominent open spaces that were used for recreation and meetings. The agora is built of beautifully decorated colonnades in long rows arrangement, framed by free standing walls called stoa with walkways as illustration in figure 3 above.

Roman cities were more densely packed and centralised than the Greek cities having more decorative and colossal buildings, better water and waste disposal, and paved roads the result of better building technology and knowledge in hydraulics (Cilliers, 2015) citing (Barnish 1996). Roman cultural influence extended through North Africa and to Europe.

Some major features of the Roman town planning that makes the early cities stand out is the gridiron pattern which was borrowed from the Greeks. An alignment of roads constructed in stone from north to south known as the cardo maximus and from east to west known as the decumanus maximus and with a hierarchy of primary and secondary roads. Their intersection served as the "Forum" replacing the Greek Agora. The Forum was a major open space located in the city centre where the religious, political/ administrative, and commercial buildings are located. It consisted of an open courtyard surrounded by colonnades similar to the Greek Agora. Buildings such as temples, administrative headquarters buildings, markets and stores are found here as shown in figure 3 above.

Medieval Europe 476 BCE- 1450 CE 476 1400

With the waning influence of the Roman Empire came the mediaeval period in Europe. The feudal system of land control was a major feature of this period. Land was under the control of a feudal lord who held them on behalf of the king. The feudal system created a class. Land was given out to sub tenants who in turn give out smaller portions for profit. People who found freedom from this migrated to urban areas in search of a better life and quickly grew the population in those cities.

Mediaeval cities had diverse origins and hence their town planning statues. To corroborate this, (Platt et al., 1978) categorised planned European cities into those that derived their origins from the Greco-Romans, as well as those that were influenced to develop by related circumstances during the mediaeval time. A city can be founded on an empty land by a king or baron having its houses aligned along both sides of the streets with burgage plots. It could have streets intersecting at right angles. It may be compact, or in scattered fashion. Agriculture could have been the deciding locational factor and for security reasons the choice was for a compact form surrounded by a wall.

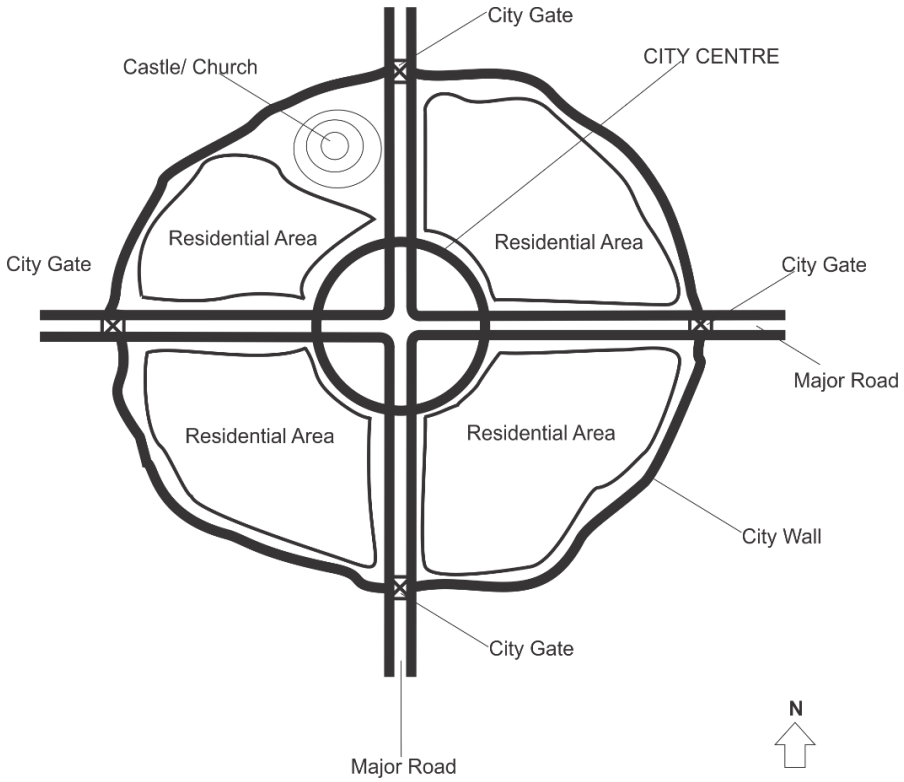

Figure 4. *A Schematic Layout Plan of a Typical Medieval Europe city.*

Sketch by Nenchi D. W

Cities typically had the castle located on a high ground, the Church and other town buildings were close by. (see figure 4 showing a schematic plan of a Mediaeval city above).

The Church building was characterised by the architecture of that time, pre- Romanesque, Romanesque and Gothic styles were the most common with elaborate decorations. The Church played a role in city planning by their elaborate and detailed designs, contributing to societal stability alongside the monarchs. London is an example of a city that grew during the mediaeval period.

Squares and open spaces were peculiar to mediaeval cities and were prominently located in front of public buildings and Churches. Often, the spaces do not have a regular geometric shape and were popularly used for festivals, recreation, parades and for civic events. Gardens of this time were enclosed using simple wattle material; trellis and arbours for display plants, and raised bed and meadow planted with wildflowers. Bifurcate gardens were also common.

Renaissance and Baroque Europe 1400- 1800

This period allowed for more idealistic planning of cities due to the renaissance awakening in different spheres of art, philosophy, and the characteristic dramatic art forms of the

baroque. Planning became more constructive and developed along already set out concepts that transcended through Europe. With stability, the city walls were let down and city planning was allowed to flow into its surroundings depending on what physical form it was designed to take as shown in Figure 5 below.

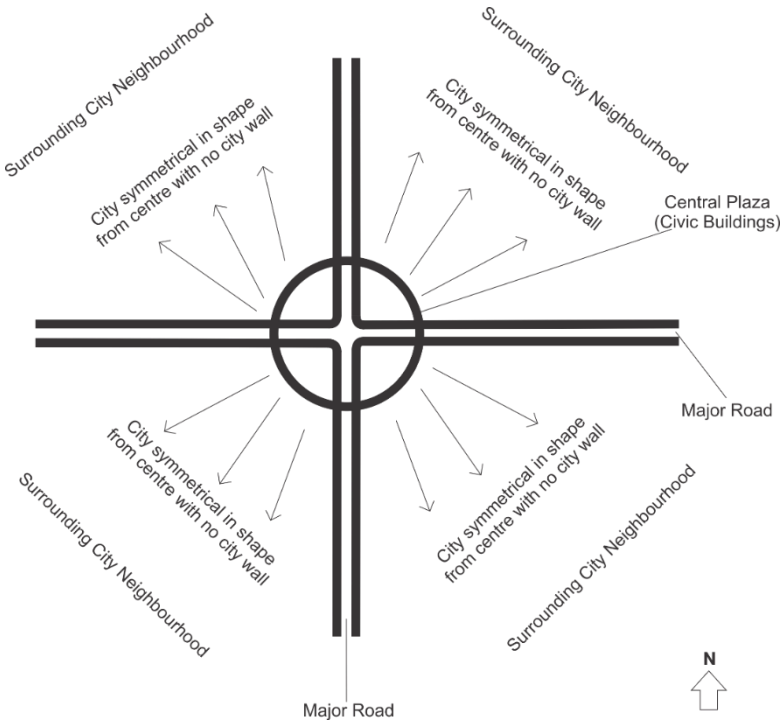

Figure 5. *A Schematic Layout Plan of a Typical Renaissance and Baroque City*

Sketch by Nenchi D. W

The French renaissance gardens at this time were characterised by symmetry and the creation of geometrical planting beds as in parterre, and the use of fountains, labyrinths and grottoes. An example of this type of garden is the garden of Versailles by Andre Notre. This was also the start of the "Romantic Movement" in France, and in Britain with the romantic gardens were characterised by the use of fragrance, colourful plants, winding paths, and sweeping meadows and places for rest and contemplation It was the era of parks, and gardens attached to a villa, palace or residence of the high class in the society. Being the period of science and inventions, and classical arts, the construction of the Eiffel Tower in Paris that was built in steel was made possible.

The Enlightenment Europe and America 1700- 1800

This period coincided with the "Industrial Revolution" in Europe that was noted for philosophical and critical thinking in virtually all of the human endeavour. The industrial revolution encouraged city growth, a process that changed the urban structure of cities bringing along social calamity and economic decline. Congestion and housing problems and the emergence of slums, pollution problems, and an increase in the occurrence of

diseases were some of the major issues of that time. With this, cities had of necessity to find lasting strategies to address the decay in the urban structure, in order to revamp them (Mehdipour & Rashdi, 2016).

These were in the form of urban planning reforms to remove impoverished housing by building better ones, construction of roads, better sanitary conditions for the disposal of sewage, and open spaces for the improvement of life of the people. Some cities in Europe that saw this type of improvement in infrastructure are Liverpool, London, Paris, Berlin. A contributor to urban planning at this period was Lancelot ``Capability" Brown (1716-1783) an English gardener and landscape architect of "Gardenesque Style" emphasising nature as a piece of artwork. He created over 170 gardens and one of them is Chatsworth gardens, in England.

Modern planning 1800- onwards

This was the era of industrial expansion when cities had a huge influx of people into cities both in Europe and in America. The age of the automobile, traffic lock jams, and pollution. The growth of slums intensified leading to a deficiency in infrastructure to meet the needs of the growing population. In Paris, Georges- Eugene Haussmann transformed mediaeval streets in Paris involving buildings, parks, squares and wide boulevards. Several theorists and some reformist later contributed to better cities using philosophical concepts such "Utopian city", "Garden city" by Ebenezer Howard in 1898 as in Welwyn England, the "Radburn" in New Jersey the United State of America and others such as "Modernism" and "New Town" Concept.

This was also the era of the "Park Movement" in Europe. A landscape designer Humphry Repton (1752- 1818) contributed numerous garden designs such as Ashton court in England of the "Picturesque Style" so also was John Nash 1752- 1835 an architect who re- designed Regent Street and then St James' Park London. Many gardens initially owned by the wealthy which hitherto were private were opened up to the public as a response to them giving back to the society. These public parks were meant to ameliorate the problems of congestion by providing for the recreational needs of the lower class, and to reduce air pollution by serving as "lungs" to the city.

Across the continent in America the influence of garden designers in Europe inspired the "Park Movement" in America following the industrial revolution. Fredrick Law Olmstead was one of the pioneers of the Park Movement in America who designed well over 100 parks and university campuses. This includes New York Central Park, Prospect Park in Brooklyn and Emerald Necklace in Boston. His designs were in keeping nature at its best whether by the use of vegetation, topography or scenery. He is referred to as the father of landscape architecture.

Contemporary Urban Planning 1960 onwards

Contemporary Urban Planning is concerned with political, social, economic, health and environmental problems of cities. This ranges from transportation, crime, housing, highway infrastructure, safe drinking water, waste water disposal, refuse disposal, and sewage that will make cities livable. The United Nations Sustainable Development Goal No11 on Sustainable Cities and Communities on Transforming our World: The 2030 Agenda for Sustainable Development pg. 26 adopted by all nations in 2015.

There are multi- dimensional issues facing today's cities which have assumed critical discussion topics at international, national and sub- national levels. According to the 2018 Revision of World Urbanization Prospects by the Population Division of United Nations Department of Economic and Social Affairs (UN UDESA) estimate that 65 % of the world population currently live in urban areas this is projected to increase to 68% by 2050. Urbanisation and population growth is projected to add another 2.5 billion people to urban areas by the year 2025, 90% of the increase is taking place in Asia and Africa. Jointly, China, India and Nigeria will account for 35% of the world urban population between 2018 and 2050. This means that planning for cities must be taken as a priority by all concerned to match population growth and avoid unpleasant situations that poor planning can bring about.

Many urban planning concepts have evolved over time to make cities more responsive, resilient, sustainable and functional and in consonance with the Sustainable Development Plan Goal Number 11. Such concepts include "Sustainable Cities", "Green Urbanism", "Green cities", "Smart Cities", as strategies to solve planning problems. These concepts propose functionality, aesthetics, sustainable environmental resource stewardship, social equity and economic growth as ways to foster livability in cities. "Nature Base Solutions" are proposed for the future of cities by the United Nations according (Panning, 2022) pg. xxi a report by the United Nation- Habitat, World Cities Report 2022: Urban Planning for the Future Cities.

Different countries approach their urban planning needs by adopting different concepts that suit their peculiarities. For instance, the Green City as used in Singapore and Smart City which leverages technology in solving urban planning issues as in London and Amsterdam. However, many countries particularly in Africa, Latin America and Asia are still behind in adopting these contemporary concepts. In Nigeria, inconsistency in planning policy formulation and the funds for implementation is the biggest encumbrance to effective physical planning. This explains why most of our cities are yet to fully benefit from improved standard of living unlike in the developed economies.

The collusion of our traditional with the colonial, and later the post- colonial planning strategies adopted at various times have eroded the traditional city planning. Open spaces such as village/ town square, and designated forests, home gardens and other forms of gardens have not been adequate replacement in most cities. The Master planning

adopted for big cities is not adequately managed for implementation and rightly scheduled for review at the appropriate time, giving room for piece meal planning and its attendant disadvantages.

Urban renewal is now being used by many state governments to upgrade city infrastructure, for instance in Lagos State. The changes usually are focused on grey infrastructure such as road and housing and not so much on green infrastructure and greenspace development for our open spaces. The Garden City Concept was pursued in Port Harcourt City, but this cannot be said to be a total success due to changes that are already mentioned that are associated with our planning policies. The "Green City", "Green Urbanism," "Smart City" are concepts that are very slow in taking hold in most cities in Nigeria.

Abuja, the Federal Capital City of Nigeria can be said to have done better in Master Plan implementation that is based on a Green City concept when compared with other cities in Nigeria. On land use provision for different categories of open space development such as parks and gardens, Abuja has fared better in achieving this. The city has parks in hierarchy of small pockets, to neighbourhood, district, city, and a regional park, as well as other forms of green areas.

Today's contemporary urban planning is under the statutory purview of the sub- national and sometimes national governments. Findings by (Planning, 2022) pg. xvii a report by the United Nation- Habitat, World Cities Report 2022: Urban Planning for the Future Cities is that urban and territorial planning that delivers on plan is essential for warding off negative social, economic, and environmental issues related to future city growth. In view of this, concerted efforts are needed in low come countries ahead of growth in the planning and infrastructural investment by applying effective policies to guide the investments for a realistic outcome.

Prehistoric planning precedents of Oriental Nations.

Examples of planning concepts that have helped to shape city form in the oriental world from prehistoric times are discussed as follows:

The Indian Example (6000 – 3000 BCE)

The Hindu religious beliefs, one of the ancient religions in the world practised in India played a very important role in history in understanding why and how early cities derived their form in that part of the world. This is based on the religious observation referred to as "Vaastu Shaastra" an 8000 years old philosophy centred on the worship of Amida Buddha in Buddhism and its application to urban planning. According to (Patra, 2014) citing (Saini 1994) this philosophy is an ancient science based on time-tested scriptures and guidelines working on the premise that appropriate placement of all kinds of exertions in the rightful area and place under the control of the universe is what brings about

satisfaction, success, and peacefulness. This philosophy prescribes planning and architectural specifications for residential homes, industry, and commercial areas.

The planning of architectural components in cities such as temples, palaces, houses, including gardens are done using direct interpretations of Vaastu Shaastra for centuries in India. It is the significant determinant factor influencing the planning of cities in close and beneficial relationships with nature (Pusalkar, 2022). This philosophy has provided the basis for the architectural design and the planning of urban areas in India up to the present time (Toraskar et al., 2017).

The Vaastu Shaastra pre proposes the following shapes for towns (1). Chandura (square), (2). Agatara (rectangle), (3). Vrtta (circle), (4). Krtta Vrtta (elliptical), and (5). Golo Vrttra (full circle). A city with Vajra- suci (diamond or octagonal) is considered not appropriate (Patra, 2014) citing (Dwivedi 1988).This means that only certain shapes that are acceptable are to be contemplated.

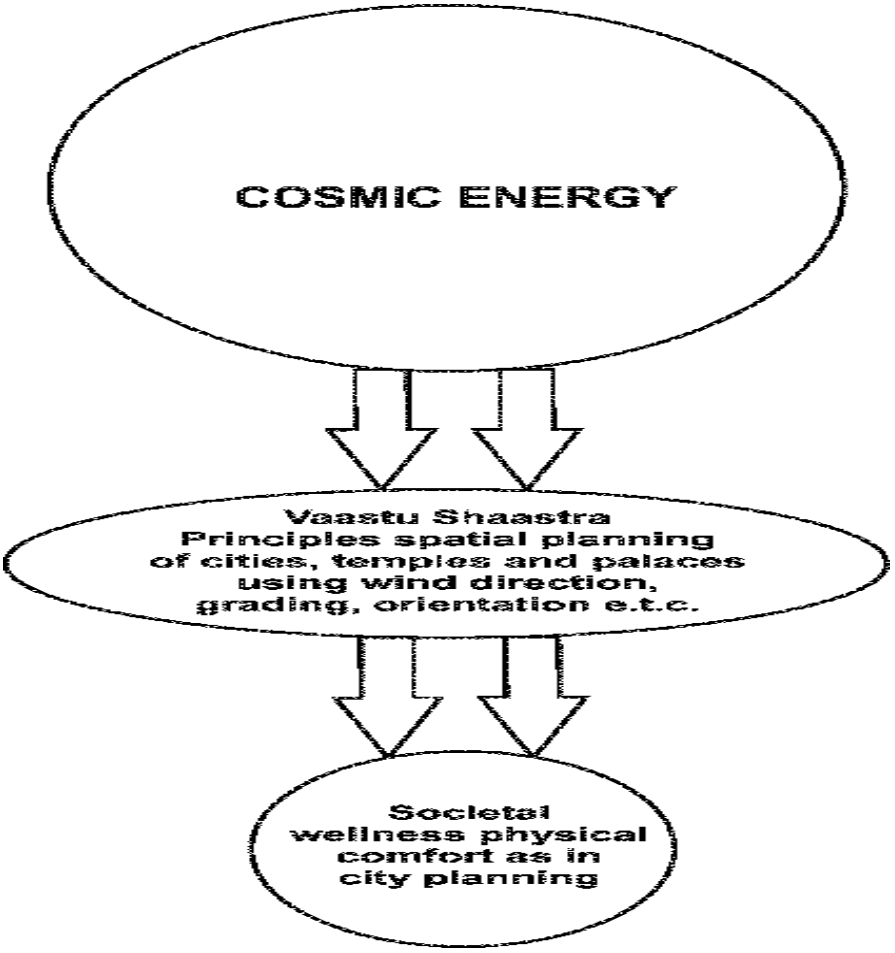

Figure 6. *Conceptual Representation of Indian Vaastu Shaastra Concept in City Planning.*

Sketch by Nenchi D, W

The overall individual and societal wellness is what this planning concept embodies in garden mythology. Management of energy from the cosmic order to determine orientation, location, wind direction contributes to physical comfort which in the cultural belief is positive energy or vibration in harmony with the natural environment. Its emphasis is on harmony and balancing with the natural environment as a sustainable planning strategy. The Vaastu Shaastra concept is illustrated in figure 6 above. A well-planned building done by the use of proper site planning considering wind direction, sun orientation, appropriate grading as is now applied in modern planning principles must have come from this knowledge.

Principles prescribed for special organisation/ planning and architecture include: site location where sea shore, coast or river is prescribed for a town, ground preparation/ site selection, site planning and space arrangement, layout geometry, orientation of a site specifications and dimensions etc. The product is a spatial organised plan with an aesthetic appeal. An example of a city planned with these principles is the walled city of Jaipur.

The Chinese Example (960 BCE)

The traditional religion in China, Taoism with the influence of Buddhism religion from India prescribes ethical guidelines on different aspects of life with the inclusion of the planning of cities, siting and construction of buildings, tomb, grottoes, temples including gardens are guided by "Feng Shui", a Chinese geomancy. Feng Shui is the fundamental belief that these 2 elements, water and wind are essential to harmonious life for the living and even the dead, with nature and the cosmic order. In planning a city, a wrong location will attract negative forces or energy, and such conflicts should not be pursued rather the appropriate location should be found to ensure wellness of life. The Feng Shu being a traditional religious way of life is still observed in the siting of buildings and tombs in China.

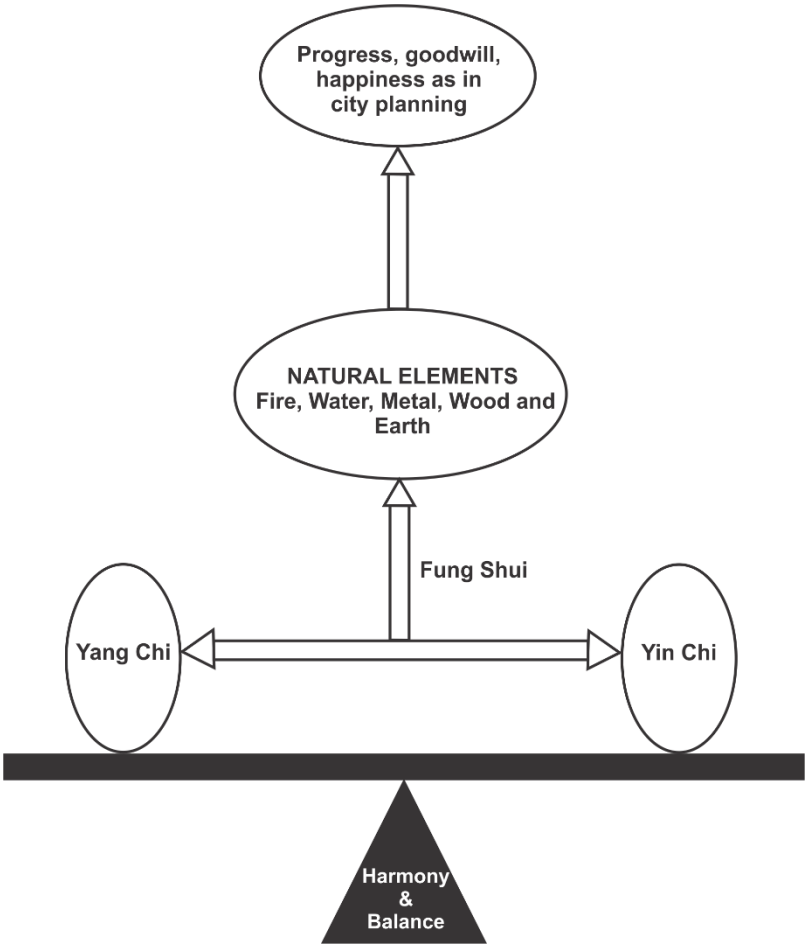

Figure 7. *Conceptual Representation of The Chinese Fung Shui concept in City Planning*

Sketch by Nenchi. D. W

The Feng Shui concept is about living in harmony with natural elements. There are 5 elements that involve fire, water, metal, water, wood and earth. They have the capacity for positive or negative energy referred to as "yang chi" and "yin chi". While "yang" is associated with life, activity, movement and growth, "yin" is associated with silence, quietness, and death. The balance between yang and yin and these elements water, metal, wood, fire and earth brings with it progress, goodwill and happiness.(Koranteng et al., 2011).The religious principle is also applied in garden design where nature elements are sort after, and laid out in a delicately arrangement to express harmony. The "Feng Shui" concept is illustrated by the conceptual sketch design in figure 7 above.

The Early Prehistoric Gardens Examples

Sometimes referred to as Edenology, the evolution of the myths around the Garden of Eden/Paradise in both eastern and western culture certainly affected the development and man's perception of what a garden should be like. Referred in the Bible as a most beautiful garden created by God with beautiful flowers and plants, fruit-bearing and ornamental trees and shrubs, The Garden of Eden was meant to be a most desirous place to be, although man's sin had him driven away from it, the garden was thought to be located somewhere in Persia. There is an Islamic equivalent of this - called Paradise, and in each case, some rivers were associated with it, giving nutrition and contributing to its beauty and ambience/ allure. The four rivers of life described in this garden were highly strategic in the development of the later Islamic gardens of both Spain and Persia.

Hanging Gardens of Babylon 605- 561 BCE

The Hanging Gardens of Babylon are among the early prehistoric examples of gardens. It is assumed to be one of the 'seven wonders of the world". Located near the royal palace in Babylon, Mesopotamia, the Hanging Gardens of Babylon is one of the famous gardens of all time. Said to be very beautiful, they are popularly thought to be the work of King Nebuchadnezzar II (reigned c. 605 - 561 BCE), who built them to console his Median wife, because she missed the mountains and greenery of her homeland. This certainly influenced the description of the gardens as being on high stone terraces which imitated mountains and were planted with many types of large trees and flowers. The terraces would have created an aesthetic effect of hanging vegetation, as well. Such description allows us to imagine that the irrigation would have been easy, resulting in the lushness of the vegetation.

There are different suggestions on how it must have looked. Some researchers supposed that they were rooftop gardens, others suggested that the gardens were built within the walls of the royal palace and did not actually "hang" but were instead "up in the air". Even in those times, it was a major attraction as people travelled from far distances to come and see the hanging gardens of Babylon.

Gardens of Ancient Egypt 2035- 1668 BCE

The ancient Egyptians were far advanced in a lot of ways. More notable among their landscapes were the Pyramids and Tombs for their Pharaohs. Due to their belief in life after death for the Pharaohs, they created monumental structures to allow the Pharaohs transit into gods after death. One of the most notable ones was the memorial for Queen Hatshepsut near the Nile River. Being one of the female pharaohs at that time, the tomb was a grand memorial, colossal and intimidating and fit for a god. The gardens began as simple fruit orchards and vegetable gardens, irrigated with water from the Nile. It then evolved into pleasure gardens as the country gradually became richer. The earliest

gardens were composed of planting beds divided into squares by earthen walls, so the water could soak into the soil rather than be lost.

Palace gardens first appeared before the Middle Empire (2035 - 1668). They were very large in scale and were laid out in geometric patterns with enormous and numerous ponds. Pleasure gardens became a common feature of luxury residences during the time of the New Kingdom. The standard design included a pond, usually rectangular in the centre, filled with colourful fish and lotus blossoms in the water, with flowers around the edges.

Ponds and pools were a common feature of residential gardens of the wealthy and powerful of ancient Egypt. There were successive rows of trees around the pond and the edges of water basins were sloping with a stairway down one side to allow gardeners collect water for irrigation. The ponds were often surrounded by walls or columns supporting grapevines which were decorated with colourful paintings of people, animals and plants.

The belief in life after death played a major role in the design of the ancient Egyptian gardens. Irrigation and the connection to the Nile River as a life-giving force was another strong factor in their gardens. Ancient Egyptians also had funeral gardens which were tiny versions of house gardens placed in tombs. They usually had a small square house or pavilion with wooden columns, surrounded by a wall. Within the wall, a basin is surrounded by a row of trees, and it was expected that the dead would enjoy the garden in the afterlife.

Persian Gardens 4000 BCE

They may have originated as early as 4000 BCE, but this tradition began with the Achaemenid dynasty around the 6th BCE. The gardens were quite structural in design, made with a lean palette of materials, working with specific textures and shapes, harnessing light from the sun and water for irrigation. Known mostly as pleasure gardens, the Persian gardens were made for recreation and enjoyment of nature. Therefore, both the trees and water were used in very interesting forms to bring maximum pleasure, creating the necessary ambience for the creation of outdoor rooms. The Persian style integrated indoors with outdoors through the connection of a surrounding garden with an inner courtyard. Architectural elements such as vaulted arches between the outer and interior areas were used to open up the divide between them.

The thinking behind the Persian gardens was that of pleasure and simulating the heavenly paradise on earth. For this purpose, a lot of water was used to create fountains of various kinds and the lush vegetation subtly employed to create an aromatic sensual planting which also helped to modulate the heat in the microclimate. Trees were used as biotic shades; and pavilions and walls were structurally prominent for blocking the sun due to the dry heat. Irrigation required was provided through a form of a tunnel, which

transported water from a local aquifer. Trees were often planted in a ditch, which prevented water evaporation and allowed the water quick access to the tree roots. The result was a garden of splendour, usually for the emperor and his family alone.

Gardens in Medieval Europe 500 B- 1500 CE

Gardens during the mediaeval times were found mostly in Monasteries and Nunneries, The Middle Ages was a time where people were cloistered together and mostly not open to the rest of the world, Monasteries were places of learning and literacy centres of botanical knowledge, agricultural and gardening expertise. The Monasteries had different kinds of gardens – these were medicinal, utility, herbal and culinary gardens. The mediaeval gardens were not for recreation or pleasure, they were rather for retreat and regular procession of the Monks.

Gardening was an essential part of the monks' daily duties. The specification at that time was that the gardens have to be within the walled safety of the monasteries. The monks were very literate and had a good knowledge of ancient Greek and Roman Classical culture therefore, the gardens were designed with a lot of symmetry and geometry. The mediaeval garden layout was strictly geometrical. Paths and alleys crossed at right angles, and flower and vegetable beds were laid between them in measured, symmetrical patterns.

Symmetry was not only an expression of beauty, but also of order, discipline, tranquillity and seclusion. Monasteries were places of prayer and meditation, and so harmony and calm were essential for life in the monastery. The result was that the mediaeval gardens were orderly places where beauty coexisted with utility.

A typical monastery had a cloister garden within its walled enclosure. Beyond this, was also a herb garden and a tree garden. The cloister garden was usually dominated by a large lawn, some symbolic plants, an evergreen tree, a rose garden and a fountain. Mediaeval gardens existed in mediaeval farmsteads as small fenced-in gardens before monastery gardens started.

Spanish Gardens 8th- 15th CE

In Southern Spain, the garden design style had a formal arrangement and incorporated principles and elements of design from ancient Persian gardens, Roman gardens, Islamic gardens and the great Moorish gardens of the Al-Andalus era on the Iberian Peninsula. This is because most of the Spanish gardens were designed and used by the Moors. The Moors were highly educated and well versed in engineering and thus they made different fountains and achieved several feats with water in the gardens. The paradise garden is interpreted with a central cross axis, in the four cardinal directions, with long ponds or water channels where water reflects and flows, all in a walled courtyard. This is because they usually fought many wars and came back to the walled forts to rest before embarking

on another jihad. They also brought the Roman and Greek cultures from conquered lands to bear on their garden design.

These gardens were characterised by simplicity, geometry, symmetry, and the use of water in sublime ways. Patterned after the four rivers of life in Islam, a depiction of paradise on earth, these gardens were designed for peace and tranquillity for the users. There was also a high level of interplay between indoors and outdoors. The choice of materials for the garden was simple – water, trees, play of indoor/outdoor, shade and light too.

The use of trees provided sensory experiences that gave feelings of coolness, humidity, sounds, greenery and fragrance which were vital considering the hot climate of the environment. Shade was provided with the use of arcades, pergolas, trellis and garden pavilions. Ceramic elements and tiles were often used in water features, as paving, and in pottery.

Other parts of Spain with public parks and large gardens were influenced by the Italian gardens, the French formal gardens and the English landscape gardens.

Gardens of the French Renaissance 13th CE

The gardens of the French renaissance were initially inspired by the Italian renaissance gardens through King Charles VIII in the 13th century, and later evolved into the grander and more formal French gardens during the reign of Louis XVI, by the middle of the 17th century. They were designed to illustrate the renaissance ideals of measure and proportion, and to remind viewers of the virtues of Ancient Rome. The gardens were characterised by symmetrical and geometric planting beds or parterres, plants in pots, paths of gravel and sand, terraces, stairways and ramps, moving water in the form of canals, cascades and monumental fountains, and extensive use of artificial grottoes, and statues of mythological figures.

The French formal gardens were famous for their grandiose scale and their firm grip on the geometry on extensive swathes of land. In some cases, rivers were diverted from far distances to create fountains and water displays in the French gardens. Trees were manicured into topiary and allies were created with parterres as venues for the famous grandiose parties by the French royalty.

The philosophy behind the French formal garden was the superiority of man over nature, necessitating the subjugation of land into the strict geometry and using plants as tools in the gardens to form outdoor playrooms. Another key determinant of the French gardens was that they received inspiration from Italian gardens but had to change many things due to the difference in climate and topography of France.

Early Prehistoric Oriental Gardens

The psychology behind oriental gardens is the belief that man, nature and cosmology coexist in harmony and balance. Oriental gardens are highly spiritual, based on the Eastern religion. The gardens were often an abstraction or imitation of nature.

Chinese Gardens 1600- 1046 BCE

The Chinese landscape garden style evolved for over three thousand years and includes vast gardens built for pleasure and to impress, as well as more intimate gardens for reflection and escape from the outside world. It expresses harmony between man and nature. A typical garden is enclosed by walls and includes one or more ponds, rock works, trees, flowers, and an assortment of halls and pavilions within the garden connected by winding paths and zig-zag galleries.

The garden was not meant to be seen all at once. The plan of a typical Chinese garden presented the visitor with a series of perfectly composed and framed glimpses of scenery. The Chinese Garden is famously described as "a series of scenes threaded on a pathway". There are four essential elements of a classical garden: Architecture (which consists of different structures, courtyards, galleries, and bridges), Water, Rocks, and Flowers/ Trees. The scenery, although appearing natural, took a lot of planning to achieve. The ambience is that of beauty and serenity.

The origin of Chinese gardens is traced to the dynasties of Shang and Zhou which developed further during the Ming 1368- 1644 BCE dynasty and later in the Qing 1644-1912 BCE dynasty. There are three types of gardens that were prominent during the Ming and Qing dynasties, they are the royal gardens, temple gardens, and the private gardens developing around the south, north, and south of the ridges (Han, 2022).

Religion had a very strong influence on created forms in ancient landscape architecture of China. Nature, and the belief in its relation between the cosmos and man. While Buddhism emphasised the natural world (Uduma-Olugu, 2018).

These three religious philosophies obviously flow through the design of Chinese gardens. Feng shui concept puts its emphasis on the relationship between man, nature and cosmology. Feng sui is featured in Chinese architecture in buildings (temples and pavilions), garden design, as in the use of rocks, water, winding paths, concept of concealment, using objects of contemplation, borrowed views or framing up views, use of symbols for instance the use of rocks for mountains etc, the use of specific plant such as pines, lotus flower, chrysanthemum etc., and balancing of Yin and Yang.

Ying and Yang meaning shade and light, for moon and sun that represents two different opposites which created heaven and the earth. It is when the two unite by intersecting with the Yin and Yang that life comes to all things and a detachment from each brings catastrophe. As a result, there must always be a balancing between Yin and Yang (Zhang,

2021). The Chinese Garden culture was to later influence the garden culture of Japan in many ways.

Example of a Classic Chinese Garden

Temple of Heaven, Beijing

This is a religious worship garden in Beijing, China. It was in use during the Ming and Qing dynasties where the emperors worshipped. The layout of the garden is in a regular geometrical way, an influence derived from Confucius as opposed to the usual irregular forms of Chinese gardens. The grandeur of the garden is in the temple consisting of three buildings, that are masterpieces of Chinese architecture on a 273-acre well landscaped grounds with path ways preserved since prehistory. The most intriguing building is the conical roofed imperial vault of Heaven dominating the sky- line. It is a world heritage site as classified by United Nations Educational, Scientific, and Cultural Organization UNESCO.

Japanese Gardens 6th- 7th CE

Early traditional Japanese gardens in history have deep roots in Japanese traditional culture (Aji, 2008). Also alluding to it, Japanese garden design principles are entrenched in its buoyant traditions and charming natural environment (Habib et al., 2013). Just like their Chinese counterpart, the Japanese garden design is strongly tied to the Eastern religion of Shinto, Buddhism and Taoism.

Japanese gardens are composed of a simple minimalist natural setting to inspire reflection and meditation. Components include the abstraction of various natural features like, level ground, hills, streams, ponds, valleys, mountains, moors, forests and dewy ground.

The gardens are characterised by the waterfall, the lake, hills, islands, bridges and natural guardian stones. One of the prime considerations in the garden design is the selection and effective distribution of the natural stones. Characteristic garden furnishings include: wells, stone water basins, stone lanterns and figures, pagodas, arbours, summer houses, and sleeve fences.

There are many types of Japanese Gardens, but two key types stand out – the Stroll Garden and the Meditation Garden. The stroll garden is often an abstraction of nature with several features representing water bodies, hills and valleys, rivers, rocks, bridges, etc. All these are arranged carefully to simulate a natural landscape with plants strategically placed to hide and reveal views of different beautiful, splendid scenes. The meditation or Zen Garden is usually a dry garden consisting of symbolic stone/rocks, strategically placed in a well raked quartz bed. This type of garden does not have plants except some moss, also they are usually passive landscapes to be observed and enjoyed from the house and not experienced within the garden itself.

The perfection of nature is attained by tranquillity, balance, harmony, and power, at the highest level. This is what is recreated in the elements and materials used in the design of gardens. The garden itself symbolises a life cycle of birth, life, and death. Empty spaces are a common feature meant for contemplation. They are where the spirit meets the soul of nature.

Nature can offer inspiration to gardeners as they carefully observe and experience it firsthand while paying careful attention. This is the case when a stream running downhill in its natural environment inspires the design of a stream in a garden. A stream flowing in an unnatural way will be seen as out of place destroying the real essence of the garden composition (Aji, 2008). The observance of nature and its processes are used in a careful way without losing the scale to recreate miniatures of nature as seen in these gardens. Japanese gardens are guided by design principles such as:

Replication of nature in its components

Nature components such as trees, shrubs, and ponds are left to go through their natural cycle as in life and death. For instance, seasonal changes in plants are emphasised to show the lack of permanence in life. Trees rather than flowers are used since green is the bold colour of nature to express naturalness as in fading leaf and leaf fall, also by using bonsai trees.

Mimicking nature

The intention of imitating nature is achieved when the elements of a Japanese garden are under the control of humans for the desired form and shape as in shrubs and pines (Wishnu Aji, 2012). In mimicking or imitating nature, nature is infused through the deliberate selection of the best materials as a replica of a scaled-down nature in the design of the garden components. The use of lowland for plains, rocks boulders for mountains, pools for lakes, gravel for water, and sand to represent waves, and bonsai trees for fully grown trees. These elements and materials, when put together, are then crafted carefully and delicately to form the garden.

Enclosure

These are included to break views and create privacy at different levels. They are a strong element in the design concept. Stones, bamboo and shrubs are often used, with modernization other materials such concrete are also used.

Inclusion of borrowed scenery

Most Japanese gardens are always walled, additional views are let into the gardens by creating vistas. Distant views are brought closer by framing trees and mountains to increase the views in the garden. This is embodied in the philosophy of having nature brought as close as possible to be experienced.

Asymmetry

The asymmetrical balance is used to achieve the natural look of Japanese gardens. This is on the premise that nature does not exist in fine lines but in curves. To achieve this, stones or plants are placed in odd number groupings to depict the real world. Religious beliefs such as not walking in a straight line on a footpath are combined to achieve this effect. A stepping stone is deliberately placed out of line while an additional stepping stone is provided as an odd one.

Other concepts are:

An allusion whereby objects are made to appear bigger than they actually are. Not only that, but an element of surprises is also often placed to arouse astonishment. However, the tranquillity that nature brings is carefully preserved in the process.

Use of ornaments like stone lanterns are used to adorn pathways leading to the tea garden where religious activities take place, water basins, bamboo wind chimes, bells, peacock and Japanese warrior ornaments etc.

Example of a Classic Japanese Garden

Ryoan- ji in Tokyo, Japan

This is a typical example of Zen Garden that is a garden made of natural elements such as rocks, stones, gravel, sand, or wood. Planting is minimally used and water is excluded in this part of the garden. The attraction of Ryoan- ji garden is the rock garden. The stones are not just placed in a disorderly manner but rather in a skillfully calculated arrangement to display harmony Uduma- Olugu N.(2018) University of Lagos Press & Book shop). The 15 special stones are positioned within a rectangular 248 square meter area of white sand. By this special arrangement, not all the rocks can be viewed at the same time. No matter what angle they are being viewed from, at least a stone remains out of sight

Another attraction in Ryoan- ji garden is the strolling garden. Just as the name implies the place is meant for strolling. The pond area is surrounded by a forest of trees that display colourful seasonal effect particularly in autumn.

There is also a tea house used for religious rituals by worshippers. A water basin is placed on the approach for the hand and mouth washing ceremony before entering the tea house.

Ryuan-ji is a United Nations Educational, Scientific, and Cultural Organization (UNESCO) World Heritage Site that was built during the Muromachi Period in the late 14^{th}- 16^{th} century.

Indian Gardens 2500- 1500 BC

The history of Indian gardens is associated with the Indus valley civilization of 2500 BC to 1500 BC. Ramayana and Mahabharata are epics of the Aryan people which mentioned palaces characterised by beautiful gardens, trees, flowers, fruits, and lotus flowers filling lakes in the Vedic civilization (Sharma et al., 2022). This is expository to what Indian gardens are composed of in ancient times. The grandeur of the palace is an embodiment of regality and architectural style, a combination of Indian, Persian, and Islamic cultures. The abundant variety of plants used is an indication of how nature was highly valued.

The Hindu belief that God permeates everything is what is translated into garden design by creation of forests, planting of trees, construction of fish ponds and pools filled with Nelumbo nicifera (lotus plant). Natural sanctuaries are often included for birds and animals.

Indian gardens creatively depict serenity using water, land and vegetation. Trees, when planted, are spaced appropriately using shade and fruit trees like mangos. Fragrant trees such as *Sterospermum suavelens* (fragrant Padri tree) are also used. The gardens are made colourful by the use of blooming flowers such as *Hibiscus rosa- sinensis*, *Nerium oleander,* including potted plants. *Nelumbo nicifera* (Lotus) and *Heliantus annuus* (sunflower) for their religious significance.

Statues are used as a religious symbol alongside; lanterns and pedestals and carving are placed on walls and columns. Enclosures are created by the use of decorated or perforated walls.

There are different types of Indian gardens such as the Udyan Garden meant for royals which are places for playing chess and entertained by dancers. Paramadodvana are the gardens for royal couples, while Vrikshavatica gardens are for courtiers, and Nandanavana garden for Hindu worship of the deity Lord Krishna the god of love.

Indian Islamic Mughal Gardens 1631- 1643 CE

The Mughal gardens were influenced by the Persian gardens, especially the Chahār Bāgh structure, which intended to create a representation of an earthy utopia in which humans co-exist in perfect harmony with all the elements of nature. The gardens were characteristically designed in rectilinear layouts placed within walled enclosures. Typical features of these gardens were pools, fountains and canals.

The gardens had religious symbolisms and were thought to represent paradise. They were also used as a status symbol to give a sense of power and wealth. There are different variations of Islamic Garden designs. These gardens were based on simple but powerful themes of water and shade. Their most identifiable architectural design reflects the chahār bāgh quadrilateral layout with four smaller gardens divided by walkways or flowing water. The gardens were intended for rest, reflection and contemplation and had

a major focus to provide a sensory experience by use of elements such as water and aromatic plants.

Water was important and was sourced through: lakes or tanks, wells or step-wells, canals, harnessed from the rivers, and natural springs. The locations selected were often mountain slopes with gushing water and layout gardens. Most gardens had buildings such as residential palaces, forts, mausoleums, and mosques.

Example of a Classic Indian Mughal Garden

Taj Mahal, in Agra, India

This garden was built and commissioned in 1632. It is a mausoleum that was built by emperor Shah Jahan as a burial place for his wife Munitaz. The mausoleum building, and the two symmetrical mosque buildings located on each side, are iconic buildings of Mughal architecture, a blend of Indian, Persian, and Islamic architecture. The grounds are well laid out on a 42-acre of land on the right bank of river Yamuna. The garden is divided into four quarters which are further divided into 16 sunken parterres each surrounding a long reflection pool that reflects the image of the mausoleum signifying mourning. The edge of the pool is lined with topiary trees on both sides and linked by a raised walkway. This garden is classified as a United Nations Educational, Scientific, and Cultural Organization (UNESCO) as a World Heritage Site.

Summary

The history of human settlement and garden design provide a theoretical basis for the study of landscape architecture. The conscious planning and design of out- door spaces began systematically from the progress made by pre- historic settlements in agricultural practice. The various contributions by different civilization periods in history and the different cultures over time have produced the gardens of today. These gardens are a reflection of man's intrinsic desire for nature around him. The gardens produced have defined garden design principles that are time tested and still relevant today.

Exercises

1, Why is it important to study the history of Garden Design?

2. Describe a typical Garden of Mythology.

3. The French formal gardens were usually grand in scale and used plants and water to establish "Outdoor rooms". Discuss.

4. The oriental gardens had a totally different concept from the gardens of Europe. In what ways were they different?

5. What are the ideals of the Islamic Garden and how did they achieve such interesting water fountains?

6. Discuss briefly the characteristics of settlements in prehistory and how they transitioned into today's cities.

7. Discuss your understanding of either Chinese or Indian traditional planning concepts. For any one chosen, what has contributed to modern urban planning in general.

8.Trace the contribution to open space planning from Pre-classical, Medieval, Graeco-Roman, mediaeval, Renaissance and Baroque Enlightenment Europe, to Modern planning period.

9. What are the trends and issues in contemporary town planning for cities? How does this affect open space planning?

10. Identify a garden near you and describe the similarities and differences in the design concepts used with either a Chinese or Japanese garden design concept.

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She has a first degree in Geography from Ahmadu Bello University, Zaria (1982), and a Master's in Philosophy in Landscape Architecture from the University of Edinburgh, United Kingdom (1986). She has previously served as the President of the Society of Landscape Architects of Nigeria (SLAN) and a Fellow of the Society, were she pioneered many landscape architecture innovations in the country, and served as Mentor to many graduates of landscape architecture in exploring career opportunities and setting goals.

Wanya is an adjunct lecturer in the Department of Landscape Architecture at Bingham University, Karu, Nasarawa State, a PhD researcher at the Ahmadu Bello University, Zaria. She has several published works and conference paper presentations and sundry signature landscape projects. Her hobbies are reading, travelling and a passion for nature. She is happily married with four children.

History of Traditional Architecture and Open Spaces Planning in Nigeria

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Overview

Historical antecedents in any form helps one to know what had happened before and build on it for future generations. In this case, traditional architecture in Nigeria is fast fading and there is a need to recall and record the past so that our children and generations yet unborn might learn something from there to infuse into their future designs. Historical development in architecture helps one to go down the memory lane on how our forefathers built, with what they built and why they built that way.

The text discusses how the issue of open spaces is embedded in our traditional architecture just like the Roman and Greek architecture were centred on the 'Roman Forum' or the 'Greek Agora'. There were open spaces in the traditional architecture in Nigeria, the family compound was arranged around a common space used for family gatherings, cooking, etc. Then also there was the village square that housed the shrines, markets and also served for other things like meetings, (Emenike, 2014). All these, with proper research would aid current designs in architecture, especially now that the sustainability concept has taken centre stage in all that one does.

Objectives

The objectives of the course are to:

1. define traditional architecture;
2. identify the traditional architecture of the different regions in Nigeria;
3. describe the difference between secular and religious traditional architecture;
4. explain the construction type and materials of construction;
5. discuss open spaces and open spaces in traditional architecture; and
6. examine open space planning issues in Nigeria.

What is Traditional Architecture?

This is the architecture of a place in time past, whereby they build with the materials locally available and affordable. It usually shows form and symbol at home in a particular place or group of people. The buildings were used for shelter both for humans and animals, storage of agricultural foods and tools, security post and spiritual worship centres, (Izomoh, 1994). In addition to being used for shelter, the buildings were used as status symbols, the wealthier or more senior in rank (ruling class) the more the size and embellishment of the houses, (Saad, 1991).

Generally, the building materials consist of but not limited to bamboo, thatch, adobe (mud), stones, timber, palms (raffia, oil, coconut, etc.) and grasses, (Emenike & Agu, 1998).

Traditional Architecture in Nigeria.

In Nigeria, the traditional architecture follows closely along the regional lines and many ethnic groups in Nigeria have their designs and way of putting them up. There were major changes in the form, but the function largely remains the same across board. The form of the buildings was influenced by the environment, climate, social organisations, religious beliefs and symbolism, technology and historical circumstances, (Saad, 1991). The construction and materials did not differ much either but were mainly based on what is available in the region which was mostly stones, mud, laterite, sticks and grasses.

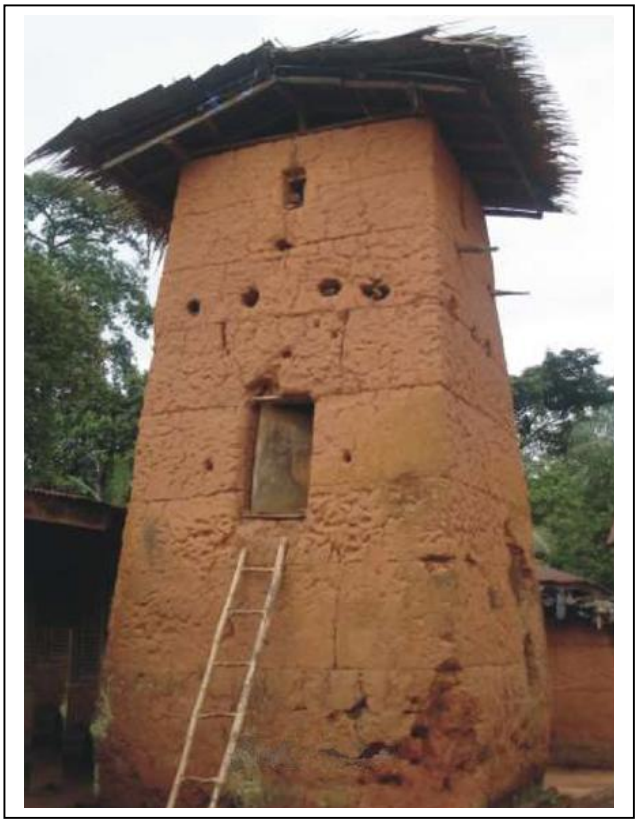


Figure. 1 *security out post.*

Design of the traditional architecture.

In the design of traditional architecture in Nigeria the homestead is different from the farm settlement, that is the farms are far away, (Folaranmi & Ademuleya). The homes are of two types; a circular building of mud walls with pointed thatch roof and rectangular shaped buildings with gable roofs made of thatch. This was found in homes which are different from religious buildings which are more rectangular in shape but made of the same mud and thatch roof and a lot of ornamentation. This in essence made the traditional architecture to be in two styles; the religious and the secular. The religious buildings were situated in quiet areas surrounded by trees and bushes giving the atmosphere of serenity and awe-inspiring always associated with shrines and churches. This building was on a square or rectangular base, surrounded by pillars, raised above the ground and very importantly these shrines were located on open spaces at the village square or near the entrance to individual family compounds, (Emenike, et la, 1998).

The secular buildings consisted of a group of houses within a compound for the man, his women and children, occasionally storage barns, kitchen and shelter for domestic animals were built differently. When the kitchen, storage and domestic animals are not separated, they cohabit with their owners. The buildings were arranged in circular form with the man's own at the entrance for security of his homestead. In this compound arrangement, there was the main entrance gate leading directly through the man's quarters, to one side of the gate is the family shrine, further inside are the other houses for the wives and grown-up children. The younger children stay with their mothers. The size and shape of the buildings are the same, but the functions inside differ and so does the interior decoration. These elevations in fig 2 through to fig 5 show some huts across the country, North and South of Nigeria. Take a good look at figs 2, 3, 4, and 5 you will notice the similarities in the photographs, in as much as these people have not travelled anywhere, there was no copying of ideas and very little differences are noticeable, going across Nigeria.

Fig. 2. A house in South East Nigeria.

Source: Dmochowski, 1990

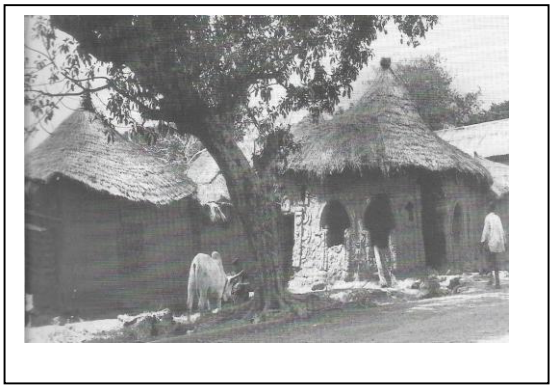


Fig 3. A house in North Central Nigeria.

Source: Dmochowski, 1990

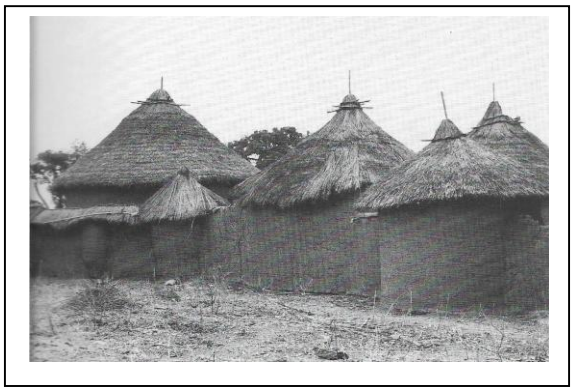


Fig. 4. A house in North Central Nigeria

Source: Dmochowski, 1990

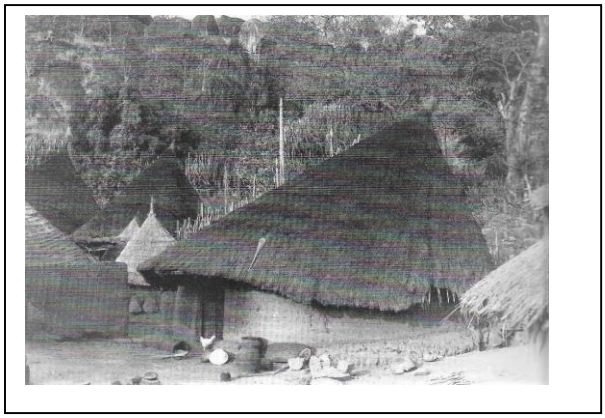


Fig.5. A house in North Central Nigeria

Source: Dmochowski, 1990

The secular buildings for the wealthy, chiefs and the ruling class assume some grandeur both in scale, size and decoration. Plans of some of these from across the regions are there in the appendix.

Materials for Construction.

Materials used in construction, finishing, furnishing and decorating were derived from the immediate environment. They include earthen works (loam, laterite, stones), ceramics (white clay and red clay), charcoal, timber (Oil Palm, and Raffia palm), bamboo, cow dung and grasses of various species, (Dmochowski, 1990).

Loam is a processed earth which varies in quality from claylike to viscous solid and colours between reddish brown to gray soil. It was used in wall construction, as seat, as well as bed. There were half walls built up to serve as seats which were usually adorned with ceramics and served in places of worship. Also, beds were built up with mud and the top was finished with bamboo and mats. There were also half walls used as storage spaces (shelves) inside the rooms.

White and Red Clay was used in plastering the walls and floors and then in making artistic decorations on the walls. These were prepared for use by soaking in water for days.

Timber was used in traditional architecture to achieve monumentality tempered by elegance. Here the unsawed tree trunk is used as posts, wall plates, rafters and purlins where they carry the load of the roof and transmit the same to the ground leaving the walls free of any load. Other parts of the timber like the oil-palm and raffia palm are also used in making roof tiles/mats and framework for the wattle and daub walls.

Cow-dung was soaked in water for days (3-4 days) to remove the smell. It was used with some leaves for rubbing on the walls and flooring as plaster. This deters insects and plant growth on the mud walls and the floor.

Construction Method.

In the traditional society, there are divisions of labour between the sexes in house construction. The men invariably erect the framework, the roof and also dig out and prepare the loam for the wall construction. The children (boys and girls) carry the clay when prepared to the building site. They also fetch water. The men and women both erect the walls. The women give finishing touches by plastering and decorating the walls and floors when ready.

The structure (walls) depends on the quality of loam available. There were two main techniques used here, either the loam was made into balls and erected in thick solid layers. The loam is processed for use, then made into lumps and thrown into position. It was pressed hard with hands into layers of 30-50 cm then left to dry out before another layer was added. Here the walls definitely will not carry the roof.

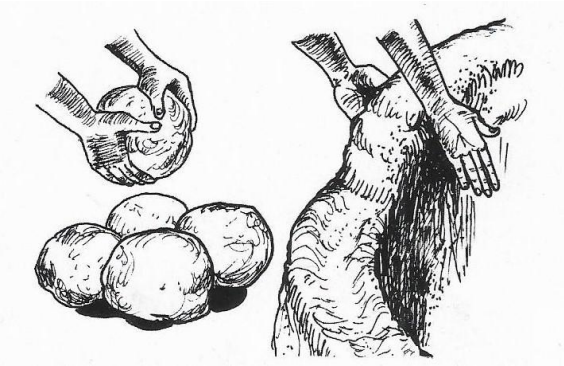
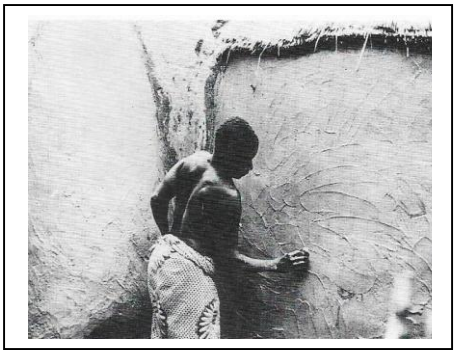


Fig.6. Making mud balls and construction of walls. Fig.7. Wattle and daub wall

Source: Schreckenbach, 1986

Then there was the wattle and daub method, this technique consists of a number of vertical rods at approximately 15 cm centres bound on both sides with horizontal laths tied with a binder. Smaller lumps are placed in between them, then left to dry out before being plastered. In this case the walls are reinforced.

Wall Finishes. The walls were plastered in and out with a mixture of cow-dung, clay and leaves. The women of different ethnic groups have developed high artistic skills in decorating finished walls, (Schreckenbach, 1986).



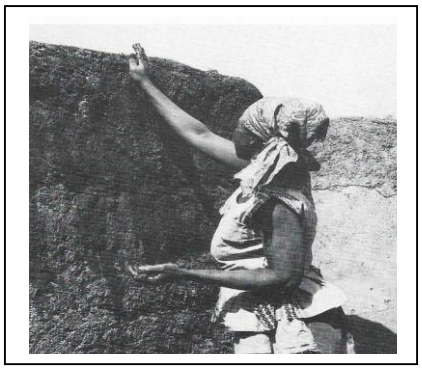


Fig.7. Final dressing of the walls Source: Schreckenbach, 1986

Floor Finishes. The floor laying was amongst the last jobs of the building construction. Loam mixed with sand was spread on the floor; the women beat the floor with special wooden implements amidst sprinkling of water. The finished floor was then smoothed with the mixture of cow-dung and leaves which must have been immersed in water for three (3) days or more to ferment. This fermentation removes the obnoxious and repelling odour that would have come from fresh dung. This mix deters plant growth and ant infestation.

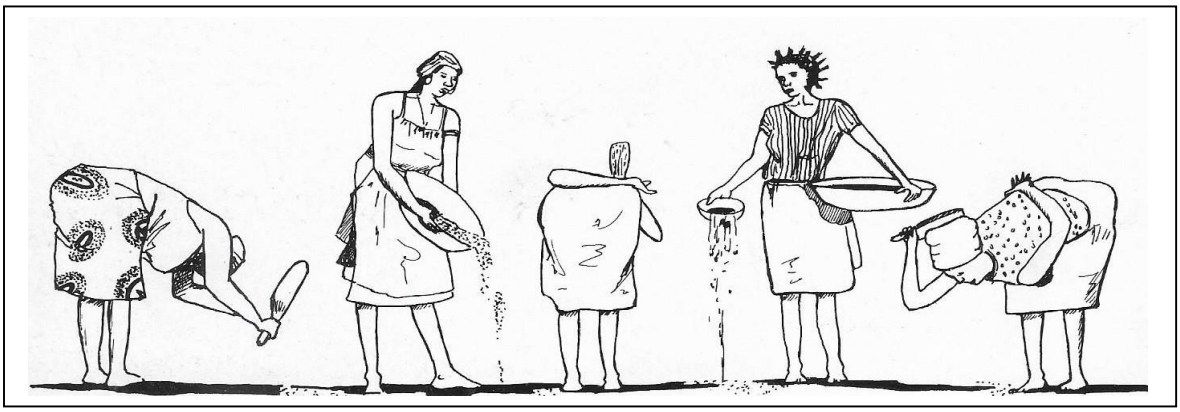


Fig 8. Flooring; all the stages of flooring (beating, watering and scrubbing)

Source: Schreckenbach, 1986

Ceilings. The upper floor mostly served as storage and also shelter for women and children when the men were at war. It was made up of thick bamboo which rested on the external post and carried thinner bamboo used as laths.

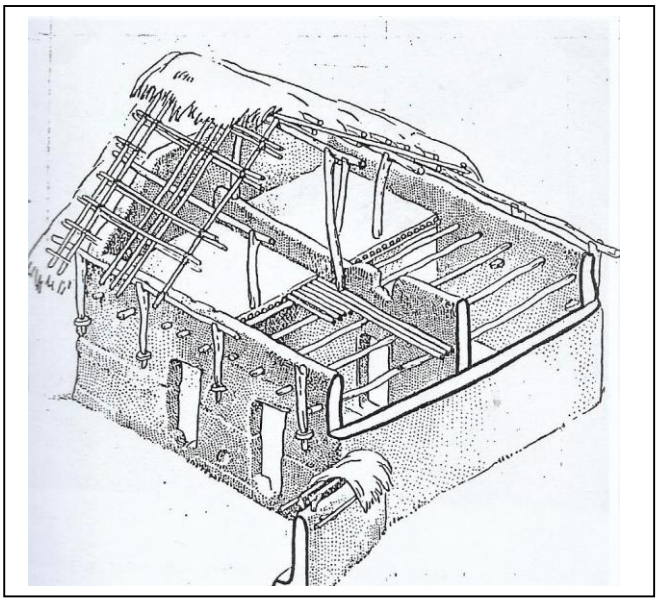
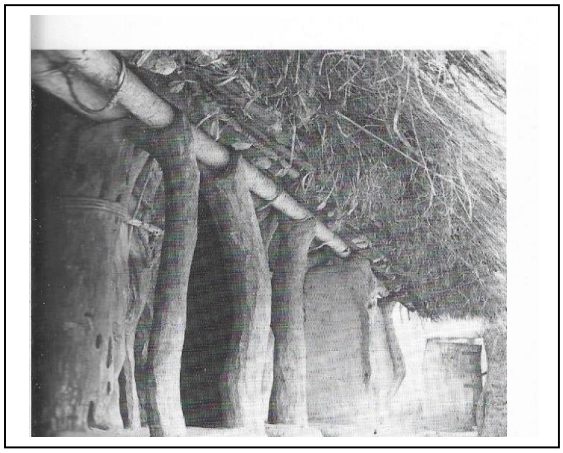


Fig.9. The roof from inside of room Fig: 9 Roofing (Source: Schreckenbach, 1986)

Roofing. The roof was carried by forked tree trunks (pegs) embedded in the mud walls. The rafters were placed on the pegs with laths (purlins) overrun tied together with a creeper plant.



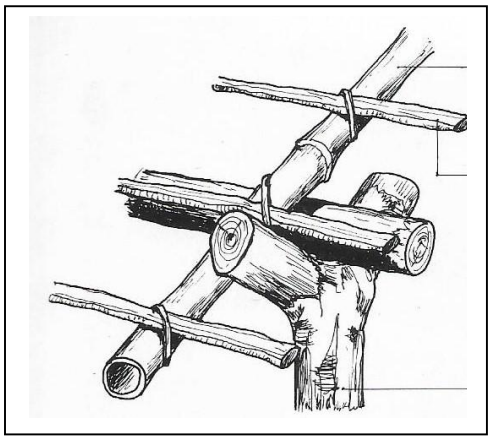


Fig. 10. Roof support at the eaves. Fig. 11. Rafter forked peg and lath tied with creeper plant.

Source: Schreckenbach, 1986

Mud-bed. The bed was framed with mud and covered by bamboo as laths for sleeping. The space created inside was used for the henhouse. On the top of the mud-bed, there was a built in of about three or four strong bamboos across the width, while the lath was

placed on them. The whole was then covered with a mat or two depending on the taste and economy of the user. The mud-bed had two openings; one served for heating and warming of the bed for the user continuously throughout a cold night. The other was used by the chickens which were equally warmed, and the firewood used was such that it did not give off much smoke that could discomfort the user or choke the chicken.

Storage Shelves. Pillars are constructed with mud to serve as shelves at corners of the wall or a whole length of wall could be used. Such valuables as snuff boxes and cooking utensils were kept handy on them.

Seats. Mud seats were provided which flanked the building and a stone was inserted in one corner, for grinding things used in cooking.

Fig. 12. Outside showing bed frame from mud.

Fig. 13. Mud chair with holes for fire, Jos-gwom area.

Heath-The heath was used in cooking. It is made up of three big stones kept standing to lift up the pots off the ground while fire is made underneath them.

Carved chairs-The chairs, stools and the doors were carved to depict the local artistry. These were also carried to the wooden posts at the frontage and the king post in the centre of the room. These carvings are also extended to the mortar and pestle used in the kitchen.

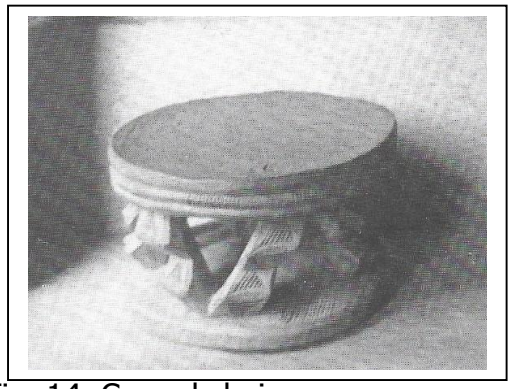


Fig. 14. Carved chair

Calabashes-They were used for drinking, holding water and foodstuffs. They also have various designs carved on them. They were hung on the wooden pegs on the walls together with wooden or mud plates. Sometimes they were hung from the roof.

From the materials used and the construction techniques, one can observe that nothing was left out from the design of the building to construction, to furnishing and fittings; such that building so put up will be functional, durable and aesthetically pleasing.

The traditional architecture in the whole of Nigeria did not change much. The forms of the traditional buildings changed slightly, especially in depicting class in size and grandeur but the building materials and method of construction remained the same. The finishing and furnishings in the buildings for the rulers and the palace of the chiefs showed a great difference, they were large in size (many rooms), highly decorated and ornamented (Folaranmi & Ademuleya).

Open Spaces in Traditional Architecture.

As can be seen from discussions above, the use of open spaces was embedded in Nigerian Traditional Architecture. Each family had a space within the compound to gather and let off steam. Large family settings (Extended family) have open space where the families meet.

As the population increases, so the size of open spaces increases and the functions that can take place there also increases. These spaces are used for gatherings, for meetings, as play areas, for buying, selling and religious activities. There are even some spaces left and used in checking erosion and flooding, here mud pots are buried on the ground for collecting the flood water, for use at a later date and breaking the force of the flood, (Emenike & Ezugwu, 2006).

Open space is a topical issue in our world today, maybe due to our need for the outdoors. Open spaces compliment the functions of nature and enhance their ability to support us in our daily requirements (fresh air, clean water, etc). Open spaces were used for social gatherings, religious activities, markets in addition to being used as water catchments for flood control and preservation of sensitive land areas.

Open Space in Nigerian Cities.

The cities have various sizes and types of open spaces which help to define the urban form and urban centre in general. Open spaces serve various needs in the society such as; buffer zones, which separate different land uses (residential areas, commercial areas, and industrial areas) from each other, and affect the land development in many ways. The open spaces affect the real estate value, air quality and environmental quality positively. They serve as air purifiers, wind shields, dust filters by the use of trees, plants and ground covers. These plants and trees also help in temperature control by modifying

microclimate around the open spaces. Open spaces also help in flood control, soil conservation and aquifer recharge, (Emenike, 2014).

Open space is a green space which is open, undeveloped land not built up and most times is accessible to the public (parks, community gardens, cemeteries, wildlife and native plant habitat, river fronts, etc.). It is a very important feature in urban centres; to man and all living organisms. It supports human health, enhances natural processes and rejuvenates the urban areas with portions of urban forest. Open spaces allow access to buildings (right of way, allowance for light, sunshine and fresh air); is used as structuring and connecting the urban form in addition to all other benefits, (McHarg, 1992)

Open spaces in cities are classified in a way to acknowledge different scales and levels of ownership, functions or dominant use, density or planning orientation. We can talk about home-oriented spaces, Mini Parks, Neighborhood, Community, City, Regional, and Green-belt. Open spaces can also be grouped into (a) public open spaces where one can go to freely without breaking any law (parks, conservation sites, woodland, river front, etc.), (b) semi public open spaces where there is limited access (cemeteries, allotments, buffer zones, etc.). They can also be described according to function as; i) active public open spaces for structured and organised sports. (ii) Passive public open spaces for recreation and informal activities, (Rutherford, 2012).

Open Spaces Planning in Nigeria.

Open spaces can be traced to be part and parcel of our traditional architecture in Nigeria. In Nigeria as whole, open spaces planning was embedded into our town and country planning by our colonial masters. The benefits of having open spaces in our towns cannot be over-emphasized. This should be taken care of in physical development plans alongside other urban land use. Open space planning is part of urban landscaping which helps in defining the form of cities giving credence to cultural values.

Open spaces planning was either based on population served; for every 1000 people, a specific size of land is advocated. In Britain, where we started, it was for every 1000 people that 1-2 hectares of land was reserved. A second criterion was based on geographical location. This relates to the provision of Open Spaces to the city built-up area, whereby it is advocated that 10% of the city size should be reserved for Open spaces, (Emenike, 2014).

Summary

Nigerian traditional architecture showed our peoples ingenuity in trying to provide for themselves comfortable homes with whatever is available in their locality both as in materials and the techniques of doing it. The architecture differed only from place to place only in size, grandeur and embellishment. That is to say our traditional architecture relied on traditional forms, local materials and native technology. It is sad to note that

our traditional architecture is fading very fast, becoming extinct and where they still exist, many parts have been replaced by modern materials.

Our value system has driven the way we build, our towns were organised around open spaces. These spaces were seen to promote an ideal environment for healthy growth and wellbeing. These spaces should be encouraged not to disappear entirely from our modern towns, by instituting a proper framework for its management and development.

Exercises

1. Find the oldest house in your village, find out when it was built, what materials were used, take photographs if possible.
2. Still in your village, trace the open spaces available, try and find out how they came about.

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Appendix

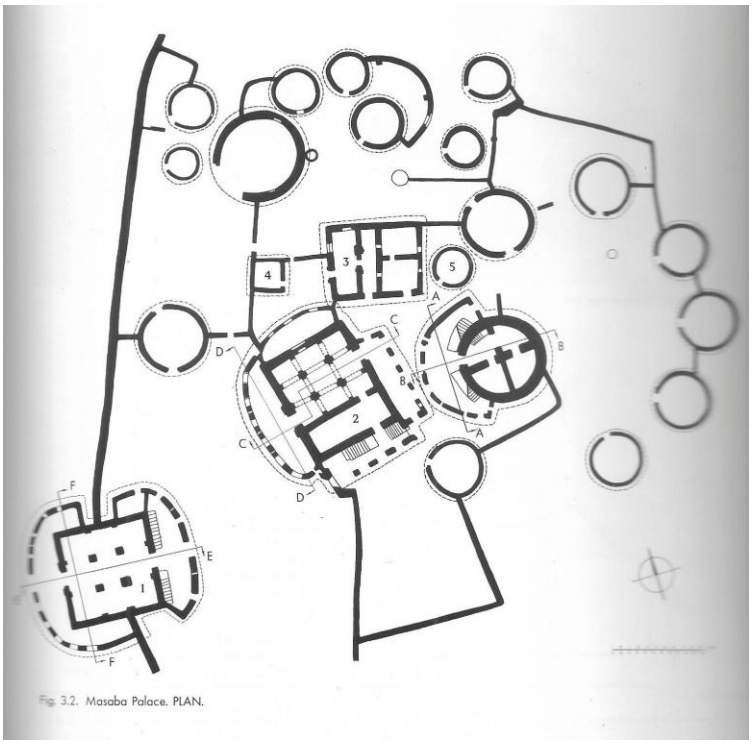


Fig. 15. A palace in Bida, north central Nigeria.

Source: Dmochowski, 1990

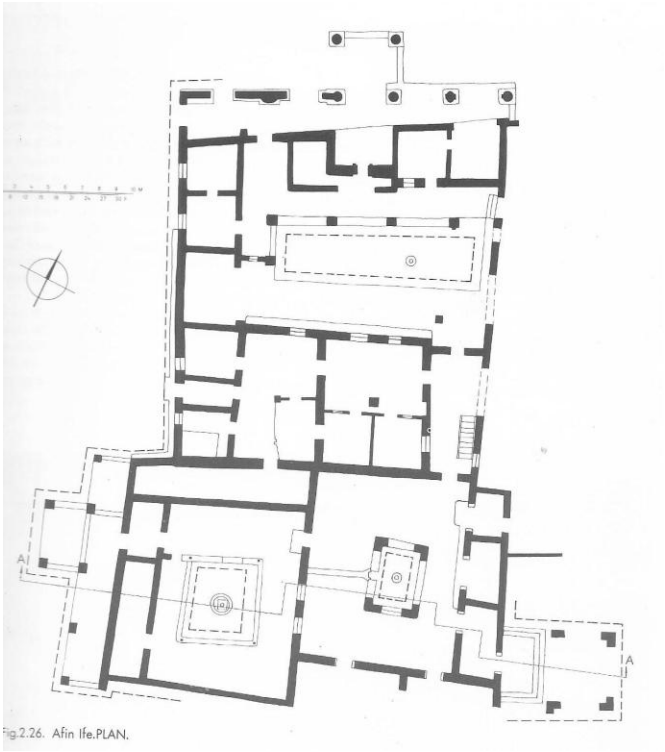
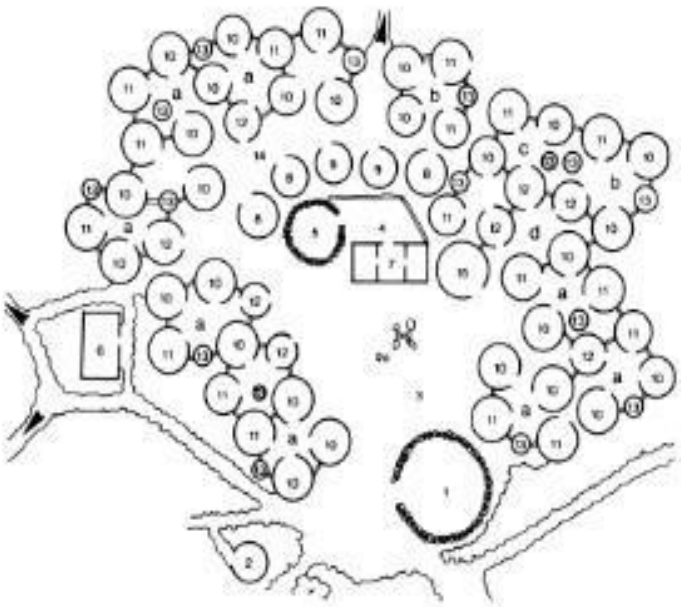


Fig. 16. A palace at Ile-Ife

Source: Dmochowski, 1990

Fig. 17. Oba's palace Benin

Source: Dmochowski, 1990



Analysis of Garam palace

1. Cattle pen (bwgwing)
2. Sacrificial hut
3. Outer open yard (popsag)
4. Chief's yard/domain
5. Private ritual court
6. Storage house
7. Chief's private apartment
8. Chief's son's hut
9. Sleeping hut for male guests
10. Wife's bedroom
11. Wife's private cooking/store
12. Entrance hut (kulang)
13. Granary (ger)
14. Male/female transition
15. Reception hall for male visitors (gongsog)

a. Inner female courtyard (dewok)
b. The chief's brothers' compound
c. Chief of royal body guards' compound
d. Outer female courtyard (dining)

Fig. 19. Guaram chief' house, NE, Nigeria.

Source: Saad, 1990

CHAPTER FIVE: PLANT MATERIALS AND DESIGN

Conceptual Attitudes Behind the use of Visual Character, Ecological Values, Plant Heritage and Ecosystem Restoration

Prof. Akunnaya Pearl Opoko, *Bells University of Technology Ota* **Titilayo Anifowose**

Overview

The terrestrial ecosystem is very rich in biological diversity which includes many endemic and rare plant species. Endemic species are plants and animals that exist only in one geographic region. Species can be endemic to large or small areas on earth. Rare plants are plants that have very limited ranges or that exist in low numbers. Some are naturally rare, such as those adapted to geographically specific soils, micro-climates or pollinators. These species have contributed significantly to the sustenance of human life. Unfortunately, cumulative human activities over the years are threatening the continued existence of these species. Reports indicate that some species are already extinct. Loss of plant species have severe consequences to human beings as it threatens the economic,

This chapter focuses on plants as components of the ecosystem. It explores their various values to mankind over the ages despite the negative impact of human activities on the plant heritage. It highlights various aesthetic attributes or visual concepts which are used in evaluating landscape visual character. It also discusses the different world views that have conditioned mankind's interactions and responses to its plant heritage. Noting the threat posed to this heritage by human activities, strategies for the restoration of plants within the ecosystem are proffered.

Objectives

The objectives of this chapter are to:

1. discuss the place of plants in the ecosystem;
2. highlight the importance of plants as ecological elements;
3. identify some aesthetic attributes used in evaluating landscape visual character;
4. identify and explain the philosophical values that influence mankind's attitude to plant heritage; and
5. discuss the concept of ecosystem restoration.

The Ecosystem

An Ecosystem is a geographic area where plants, animals and other organisms as well as weather and landscape, work together to form a bubble of life. Ecosystems are the planet's life-support systems - for the human species and all other forms of life. The ecosystem consists of the terrestrial and aquatic components. The terrestrial part of the

ecosystem is composed of living and non-living things. Living things are made up of organisms including human beings and various plant species. According to Kirleis, (2018), plants constitute a formative component of human life.

Plant Heritage

Heritages are endowments that have been passed down from one generation to another (Arua, et al, 2019). as such, they must be handled with care and sense of responsibility to ensure continuity. Plant heritage is the collection of indigenous plants found in a location whose origin may have spanned several centuries. Native or indigenous plants are essentially plant species found in the areas where they originated. Muhammad, Wuyts and Samson (2022) stated that plant heritage included species which appear in a location by natural means that do not involve the intervention of human beings. Thus, what may be indigenous to one community may be foreign to another. These native plants are naturally more adapted to their local environments. Protecting plants within their natural ecological contexts help to preserve the natural ecosystem.

Ecosystem Services of Heritage Plants

Heritage plants provide several ecosystem services. Plants, especially trees, provide shade and shelter for terrestrial living things. They also form components of traditional and modern building construction. Plants are a major source of nourishment for man and other living things. All through the ages, plants and their fruits have been used for nourishment, medicinal and therapeutic purposes. They are vital components of both traditional and contemporary medicine globally. Plants also improve human physical and mental health as well as well-being by providing avenues for aesthetic experience, recreation, relaxation and meditation. Plant extracts have continued to provide pleasant fragrances and body beautification especially for the womenfolk. Plants are critical for climatic regulation and ecological control (Solecka et al, 2022). They are used as sinks to enhance air quality in industrial and other areas characterised by heavy air pollution. Their roots prevent soil erosion while their decomposed foliage also helps to fertilise soils for improved agricultural yields. They also help in flood control. The process of photosynthesis also consumes carbon dioxide (CO_2) - a key greenhouse gas in exchange for the life-giving oxygen. Plants also have symbolic, religious and cultural values (Janeckova et al, 2023). Old trees in communities are often history laden and serve as important landmarks and place identity elements. They also provide clothing and fuel for both domestic and industrial uses (2018, Kirleis).

Visual Character

Plant species are dominant features of ecological settings which help to determine their character. The character of an ecological setting is composed of observable unique and consistent features and elements that distinguish one ecological setting from another.

These may be the elements including plants, their composition or arrangement and their density.

There are certain indicators which can be used to assess and determine the character of ecosystem settings. Nine visual concepts used to characterise visual landscapes, of which plants are central, are briefly presented in this section. These are image-ability, visual scale, naturalness, historicity, complexity, coherence, disturbance, stewardship, and ephemera. In reality all these are interrelated and sometimes may even overlap. The concepts are conceptually presented in Figure 1.

1. Image-ability: Image-ability connotes the capacity of an ecological setting to have vivid, novel and captivating features whose qualities not only distinguish it but also create strong visual images and impressions that linger in the memory of those who encounter it for a long time. Alamoush and Kertesz (2021) identified four major functions of image-ability. These are Ease of mobility, Provision of knowledge of the setting, sense of comfort, ease and emotional security for people, and provision of symbols and strong associations with the place. Image-ability makes a setting easily recognisable. It creates familiarity, sense of place, and place identity. Elements of image-ability are paths, nodes, edges, districts, and landmarks.
2. Visual scale: Visual scale in relation to a landscape refers to the level of openness in the landscape. It is a measurement of the degree of visibility or enclosure experienced in a landscape setting. It can be assessed by the proportion of open areas, view-shed size, depth of view, density of obstructing objects and degree of visual penetration of vegetation.

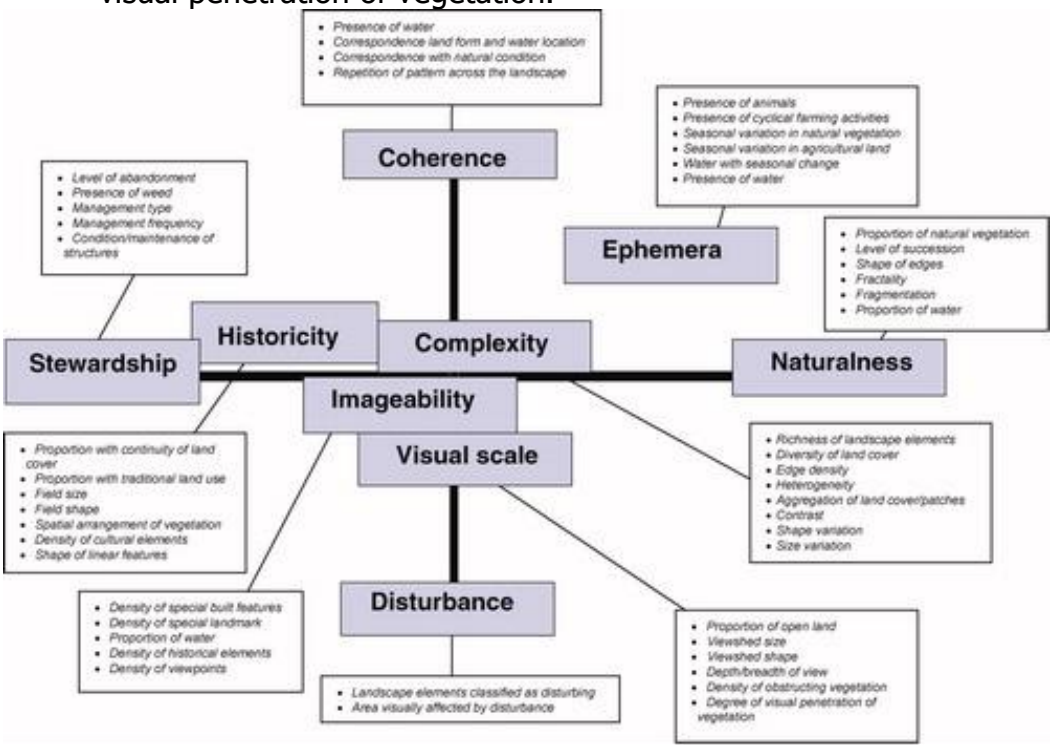


Figure 1: *Indicators for Assessing Visual Character*

Source: Ode, Tveit and Fry (2008)

3. Naturalness: the concept of naturalness seeks to ascertain how close an ecosystem is to preconceived natural state or condition. Naturalness is very important because of the desire of human beings to be close to nature. It is therefore considered necessary for ecosystem restoration. Three measures of naturalness are: naturalness of vegetation, pattern in the landscape and presence of water in the landscape. Assessing the extent of naturalness of vegetation can be done by determining percentage of natural vegetation, level of vegetation succession and shape of vegetation. Patterns in the landscape can be estimated using fragmentation and fractional indices. Negative human activities decrease landscape aesthetic and naturalness values.
4. Historicity: provides visual information on two important areas. First is the cultural robustness of the ecosystem measured by the quantity and diversity of cultural elements found in it. The second is the historical layers present within the ecosystem. An ecosystem with high historical value will exhibit not only a variety of plant species but also plants of different ages. These are the elements that tell the story of the place and give indication of the historical continuity of the ecosystem.
5. Complexity: Zhang, Xu and Zhang, (2022) defined complexity as one of the factors that determine the visual quality of a landscape. This includes ecosystems. A complex ecosystem contains a rich variety (in terms of content and spatial configuration) of different elements. This creates interest and mystery. Complexity also connotes complexity diversity, variety, richness, heterogeneity (Mundher et al 2022). Sometimes, complexity is used to describe naturalness. However, when not properly handled, this can also lead to confusion and illegibility of the ecosystem. complexity can be assessed using three types of indicators as reported by Ode, Tveit and Fry (2008). These are i) distribution of landscape attributes, which focuses on the quantity of landscape elements in terms of density of the elements and diversity of their attributes; ii) spatial organisation of landscape attributes represented by edge density, heterogeneity and aggregation, and iii) variation and contrast between landscape elements evidenced by degree of contrast, shape variation and size variation.
6. Coherence: Coherence is a concept which shows the degree of uniformity, unity, and harmony on balance of the ecosystem setting (Mundher et al 2022). This can be measured in terms of consistency in colour, texture, height, shape or form, configuration and repetition of a particular plant or group of plants within the landscape setting. It also reflects the degree of compatibility of the elements within the setting. This includes compatibility between the various species and between the plant species and other elements within the setting. Consequently, fragmentation will reduce the degree of coherence.
7. Disturbance: This concept measures the degree to which an ecosystem lacks coherence, fit, consistency or contextual stability. Disturbance can be seen as the

opposite of coherence and depicts a haphazard collection of ecosystem elements.

8. Stewardship: Stewardship can therefore be measured by the level of observed order and cleanliness which invariably suggests the degree of care, upkeep or maintenance. Stewardship will in turn convey safety. Landscapes that are abandoned and overgrown by weeds are indications of poor management and care.
9. Ephemera: Ephemera as a concept refers to the seasonal changes observed in a landscape or ecosystem. Seasons are characterised by weather changes in terms of temperature, humidity, rainfall patterns and wind. These affect soil condition and supply of nutrients to plants. It also affects the visible parts of plants like tree trunks, leaves and fruits. During the harsh harmattan climatic season in Nigeria, for instance, some trees shed their leaves and regrow them when the rains set in.

Ecological Values

Variations in the ecosystem affect all the components within it. The way human beings use and manage the ecosystem depends on the importance or value they place on it. Value is essentially the worth of something to an individual or a community of people. Therefore, it varies from person to person. Though often measured in monetary terms, it can also be measured within other contexts like social, cultural, religious depending on how it benefits the person or community.

Basically, there are two main philosophical or world views with respect to ecological values. Ecosystems can be valued because of the utilities derived from them or benefits human beings derive from it. This is the utilitarian paradigm of value. There is also a non-utilitarian value paradigm which posits that ecosystems can be of value in and for themselves, whether or not human beings benefit from them. This is referred to as intrinsic value and is influenced by ethical, religious and cultural perspectives. Protection of animals and other endangered species for instance, is usually based on their intrinsic value and the notion that those species have a right to live. Both paradigms are not always exclusive and therefore interact. This infers that an ecosystem may have both utilitarian and intrinsic values at the same time. These therefore have to be considered while making decisions concerning the ecosystem.

Within environmental contexts, there are also the anthropocentric, biocentric, and ecocentric worldviews. The anthropocentric worldview accords more value on human beings placing them central in decision-making. The biocentric worldview is based on the equality of all species in the ecosystem while the ecocentric worldview is focused on the relationships between species in the ecosystem.

Choice of Heritage Plants

Choice of plants depends on a variety of factors. Before selecting plants, the purpose they are to serve must be established. If the selection is to build up the "traditional" forestry reserves that can be used for construction for instance, then issues like quality

of the wood, capacity to produce large quantities, and disease susceptibility should be considered in the selection process. However, if the purpose is for "urban" forestry development like parks, then more consideration should be given to criteria like their ability to provide shade, resilience to urban stresses, aesthetic characteristics like flowering, colour, canopy characteristics, shape, height, which determine their attractiveness and aesthetic appeal. Thereafter, the ecosystem services and/or disservices should be critically evaluated (Muhammad, Wuyts and Samson, 2022). Other factors include their source/origin, invasive potential, environmental suitability, size, speed of growth, ease of maintenance, polluting characteristics like propensity to emit allergens and biogenic volatile organic compounds (BVOC). Availability is also a critical criterion (Cavender-Bares, et al, 2020; Muhammad, Wuyts and Samson, 2022).

Ecosystem Restoration

Human activities deplete resources in the ecosystem. When this happens, there is an imbalance within the ecosystem which results in negative consequences. These include loss of natural habitats and species, loss of employment and income generating opportunities and **loss of capital assets. Capital assets comprise of** both renewable resources and non-renewable resources. Losses occur through willful exploitation, ignorance or carelessness in resource management. It thus becomes necessary to replenish or restore the degraded ecosystem. Restoration is a holistic intervention aimed at bringing a disturbed or damaged ecosystem to as near as practicable, its original state. Due to the global significance of the ecosystem, the United Nations set aside the period between 2021 and 2030 as the UN Decade of Ecosystem Restoration. The ecosystem includes the plant heritage. Every country has a rich plant heritage. Unfortunately, several species of this heritage are presently either extinct or at risk of extinction.

To ensure continuity, Arua, et al, (2019) cautioned that heritages including ecological and cultural, must be consciously preserved and conserved. Traditional African societies which relied heavily on native plant species for physical and spiritual sustenance made conscious efforts at preserving these plant species not only for themselves but also for posterity (kirleis, 2018). Strategies included demarcation of some forests or even species as sacred. The Osun grove in Nigeria with its rich forest of over 400 plant species is an example of a people's heritage that has served religious, cultural, medicinal and tourist purposes over the years. A sustainable conservation practice therefore is to ensure that indigenous/native plants are selected for ecosystem restoration purposes.

Anwadike (2020) identified major challenges to conservation efforts to include Competing needs, inadequate finance, Paucity of trained manpower and Threat of climate change. Ecosystem restoration involves several key steps. Firstly, the degraded site requiring restoration should be thoroughly assessed so that the extent of damage can be determined. Based on this assessment, a realistic goal can be established that will comprehensively address issues identified from the assessment. The goal will further be

broken down to objectives. The implementation stage of the restoration process is the period when activities needed to achieve the objectives and ultimately goals are executed. To ensure the restoration project proceeds as expected, there is a need for monitoring. Feedback from monitoring may be used in reviewing activities at the implementation stage. It is important to note that these stages involved in restoration do not always proceed in a linear manner. Often there are reasons to go back and forth due to feedback received, availability of more information or changes in the scope of work. Documentation is essential throughout the entire process. Documentation is mainly for proper record keeping which can be useful for planning future projects. Proper documentation can provide relevant information needed to resolve issues in the event of disputes.

Summary

This chapter addressed plant heritage within the context of ecosystems. It examined some of the main ecological values and world views which influence attitudes of human beings to ecosystems and heritage plants in particular. Also discussed are relevant indicators or variables used to determine visual character of an ecosystem. It identified the need for ecosystem restoration and briefly highlighted relevant steps that can be taken in this regard.

Exercises

1. Briefly discuss the relevance of heritage plants.
2. Highlight ten criteria to be considered while choosing plants?
3. Explain four world-views that have influenced the attitude of human beings to plants within the ecosystem.
4. Enumerate nine key indicators/criteria that can be used to assess ecosystem visual character.
5. Describe the major steps that should be taken in restoring a damaged ecosystem.

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Planting Design, Orientation, Arrangement and Human Needs

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Overview

Plants design, direction, layout, and human needs are vital when designing outdoor landscapes. Plant design involves choosing and arranging plants based on their needs. Plant orientation is the way they are placed, whereas arrangement is how they are positioned in relation to each other and the landscape. Plants can create outdoor spaces that satisfy human needs like privacy or shade, therefore planting design takes these into account. Landscape designers may create beautiful and effective outdoor environments that benefit people and the environment by taking these considerations into account.

This text focuses on planting design, and how they can be arranged in a visually pleasing manner. It also discusses the uses and functions of plants in outdoors spaces as well as the variety of plants used in outdoor spaces.

Objectives

The objectives of the text are to:

1. explain how plants are arranged in visually appealing ways;
2. discuss practically how plants in outdoor environments compliment the surroundings and suit human requirements;
3. Identify and explain how to organise plants to promote healthy development and sustainable landscapes;
4. Explain how plant orientation is used to achieve and create maximum sunlight and shade for plant growth and comfort; and
5. Discuss how plants create outdoor spaces that meet people's needs.

Introduction

Planting design is an essential part of landscape architecture, which involves the design of outdoor spaces to cater to the requirements and preferences of people while also improving the aesthetic appeal and functionality of the area. It requires careful consideration of the site conditions, the client's preferences, and the growth patterns and characteristics of the plants. A successful planting design calls for a careful arrangement of plants, considering the various heights, colours, and textures of the plants in order to create a composition pleasing to the eye. There are many different ways to approach planting design, from making a naturalistic or wild garden to a more formal or structured one. Planting design is the process of creating an outdoor environment that is aesthetically pleasing and harmonious, in addition to being valuable and sustainable.

Plants, Characteristics and Use

A botanical organism that is classified under the kingdom Plantae is commonly referred to as a plant, which means a living organism. The Plant is characterised by the presence of complex cellular structures, the capacity to perform photosynthesis, and reproduction mechanisms that entail the production of seeds or spores. Plants can be categorised into various categories based on different criteria, including lifespan (annuals, biennials, perennials), growth pattern (herbs, shrubs, trees), or leaf morphology (broadleaf, needleleaf).

Plants fulfil various essential functions in the field of landscape design. Outdoor spaces are enhanced by the provision of aesthetic appeal, which contributes to the addition of beauty and visual interest. Vegetation has the potential to serve as a means of establishing privacy barriers, demarcating limits, or enhancing the general ambiance of a horticultural or ecological setting. In addition, they make a valuable contribution towards environmental sustainability through their provision of shade, mitigation of soil erosion, and enhancement of air quality. In addition, certain botanical specimens possess practical applications, such as serving as consumable produce, possessing therapeutic qualities, or drawing advantageous insects for the purposes of pollination or pest management.

Planting Design Principles

The effectiveness of a planting design is heavily dependent on the use of various design principles, and designers put these principles to use to produce a layout that is visually appealing and satisfies the project's functional and aesthetic objectives. These design principles are applied in various ways and varied combinations, depending on the landscape's desired aesthetic and practical outcomes. Some fundamental principles of planting design include:

Unity

The landscape design principle of unity is one of the main principles that must be adhered to produce a coherent and harmonious outdoor space. It refers to using plants in a landscape design that work well with one another and provide a sense of complement for one another, producing a sense of cohesiveness and continuity throughout the entire design. A coordinated planting design has the potential to produce a sense of tranquillity, calmness, and harmony that is not only aesthetically pleasing but also inviting.

When it comes to planting design, a few different approaches are taken to establish unity. One of the most important techniques is to utilise a limited palette of plants, which will create a consistent and harmonious appearance. The designer can create a coherent and aesthetically pleasing composition by selecting plants with similar colours, textures, and forms. A sense of harmony and oneness are cultivated, for instance, by using a planting design that incorporates a variety of green foliage colours, all of which have comparable forms, textures, and shapes.

Using plants that have similar growth patterns and care requirements is yet another method that is utilised to produce unity. Grouping them helps to produce a unified and visually pleasing environment that is simple to maintain and requires little effort. When plants have the same requirements, it is much simpler to care for them and ensure their continued good health and vitality. This will also assist in cutting costs associated with maintenance and the amount of time spent on it because the plants are cared for more efficiently. Repetition of plant groupings or using the same plants in different landscape parts are additional methods for creating unity in a landscape design. This helps to create a sense of continuity and helps to tie the many aspects of the landscape together, ultimately providing an appearance that is cohesive and harmonious.

Source: Whiting, and Jong, (2014)

Balance

The distribution of plants and other components of the landscape in such a way that produces a sense of equilibrium and harmony is an essential component of the planting design that adheres to the idea of balance. Establishing balance in the composition helps generate a feeling of order while making it more cohesive and aesthetically pleasing. This catches the viewer's eye and gives the composition a sense of direction. There are some approaches one can take to establish visual equilibrium, including the following:

Symmetrical-balance:

A landscape that has symmetrical balance is one in which the plants and other components of the landscape are organised in a manner that is a mirror image of one another on each side of a central axis. This lends a feeling of formality and order to the space, and it is a design element frequently found in gardens with a more classic or formal aesthetic.

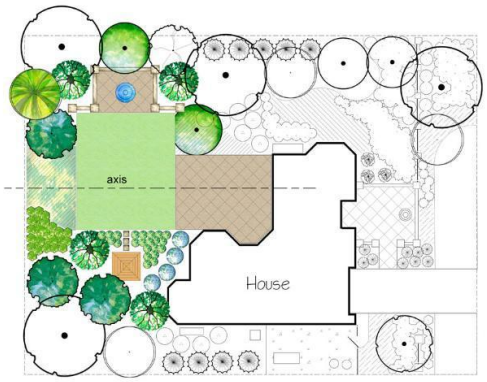
Asymmetrical-balance:

A sense of equilibrium is achieved in a landscape design by avoiding using a central axis and instead distributing the plants and other features in such a way that they generate a

sense of equilibrium. This strategy can produce a more organic and engaging composition, and it is frequently implemented in more current types of garden styles.

Radial balance

Radial balancing is achieved by arranging plants and other components around a central point to produce a circular or spiral pattern. This method, which can produce a sensation of movement and flow, is often used in gardens that have a circular or oval shape. When developing a planting design, it is essential to consider the plants' size, shape, colour, and texture, as well as the other features of the landscape. For instance, larger plants are balanced by a collection of several smaller plants of a shape or colour comparable to the larger plant. In a similar vein, plants with vivid hues should counterbalanced by others with colours that are more subdued.



Symmetrical balance around an axis

Asymmetrical balance around an axis.

Source: Hansen (2021)

Contrast

Using plants with contrasting colours, textures, and forms is one of the most significant planting design concepts. The goal of employing this principle is to generate visual appeal and variation throughout the landscape. Using plants that have varying leaf shapes, sizes, and textures is one technique to produce contrast. Another way is to use plants with varying bloom colours, shapes, and sizes. For instance, you can achieve a striking contrast in texture by mixing plants with huge, spherical leaves with small, needle-like leaves. Stunning contrast in colour can also be achieved by placing plants with bright yellow or red blooms next to plants with dark green leaves on the same plant.

The use of contrast can also be employed to draw attention to particular aspects or elements of the landscape. For instance, positioning plants with colourful flowers or foliage close to a focal point, such as a fountain or sculpture, can attract the viewer's attention, producing a sense of visual intrigue and excitement. While employing contrast in the design of plantings, it is essential to consider the overall composition and

equilibrium of the landscape. When there is not enough contrast in a landscape, it might appear lifeless and uninteresting, yet when there is too much contrast, it can generate a chaotic and overpowering impact. For this reason, it is essential to strategically use contrast to balance uniformity and variation in the environment. The use of contrast can also be employed to draw attention to particular aspects or elements of the landscape. For instance, positioning plants with colourful flowers or foliage close to a focal point, such as a fountain or sculpture, can attract the viewer's attention, producing a sense of visual intrigue and excitement.

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Source: National Parks Singapore (2014)

Proportion

A fundamental principle of planting design is called proportion, and it ensures that the size and scale of plants and other parts of the landscape are suitable for the area in question and the building immediately adjacent to it. It is essential to get the proportions of the overall space and the sizes and scales of the individual landscape pieces to work together aesthetically pleasing. It is essential while planning a planting scheme to consider the plants' size once they have reached their full maturity. This is because plants will develop new characteristics and grow with time; therefore, monitoring their progress and ensuring that they stay in the area and are calm is essential. Similarly, the size and scale of other landscape elements, such as hardscape features like walls, patios, or water features, should also be evaluated in relation to the size of the available space.

The interaction between the components of the landscape and the buildings that are in the area should also be taken into consideration when attempting to achieve proportion. Elements of the landscape should be scaled and positioned to the building or other structures to complement the architecture and increase the overall visual appeal of the

space. This is accomplished by using the building as a reference point. For instance, low-growing groundcovers or horizontal elements can emphasise the horizontality of a building's design. In contrast, tall trees or vertical elements are used to complement the vertical lines of a tall building. Another possibility is to use vertical elements to emphasise the horizontal lines of a building.

The use of "negative space," often known as the spaces between the various landscape components, is another essential aspect of proportion. Since it gives an area room to breathe and gives the eye a place to rest, negative space can create balance and harmony in a landscape. While designing a space, it is vital to consider not just the size and shape of any negative space but also the surrounding architecture and the overall design of the area

Source: Tome (2021)

Rhythm:

When it comes to the design of plantings, the term "rhythm" refers to the practice of using patterns, forms, or colours that are repeated in order to provide the impression of movement and flow within a landscape. Repetition of elements within the environment, such as plants, textures, or colours, can help establish visual harmony and continuity while directing the viewer's gaze over the area. Using plants with forms or shapes similar to one another is one technique to establish a rhythm in the design of a planting scheme. For example, you could use a row of trees with a similar shape or a mass planting of grasses with a consistent form. The use of these forms in a repetitive manner generates a feeling of movement and continuity, which guides the viewer's eye around the landscape.

Using plants with similar hues, such as planting red-flowering plants distributed around the landscape, is another technique to establish a rhythm in a landscape design. The use of multiple shades of one colour helps convey a sense of cohesion and harmony while directing the viewer's attention across the room. Creating a feeling of rhythm through the repetition of plant groupings is another option. For instance, creating a sense of

movement and flow in the landscape is accomplished by planting groups of perennials in a regular pattern across the entire property.

To keep a landscape from falling into a rut, finding a happy medium for repetition is essential. A landscape might appear lifeless and monotonous if there is excessive repetition, which is why it is essential to alter the rhythm using opposing aspects such as the plants' size, texture, or colour.

Prinzing (2012)

Focal Point

A focal point is a design element that directs the viewer's attention to a particular area or feature in the landscape. This is accomplished by drawing the viewer's attention to a feature in the landscape. A focal point is established in planting design through plants that contrast in colour, shape, or texture; alternatively, a focal point is established through design elements such as sculptures, water features, or architectural buildings.

When designing a landscape, one of the most effective ways to generate attention and make an impression visually is to use plants as focal points. For instance, you may choose a large flowering shrub or tree in vibrant colours to create a dramatic focal point in a dull garden bed. Similarly, a collection of plants with different leaves or textures can attract the viewer's attention and produce exciting visuals.

A focal point in the design is achieved with the use of plants or any number of other design components. For instance, a water feature like a fountain or pond can serve as a point of interest that captivates the observer's attention while also inducing feelings of peace and calmness in them. Similarly, a sculpture or other artwork can create a dramatic focal point that adds visual interest and depth to the environment. This is accomplished by placing the artwork in a prominent location within the landscape.

Employing other planting design elements, such as contrast and balance, in conjunction with creating a focal point in the landscape are extremely useful in achieving the desired aesthetic effect. The landscape designer can achieve a sense of unity and continuity in

the environment and create visual appeal and impact by drawing the eye to a particular region using plants and other design elements to call attention to that area.

On the other hand, it is essential to use focus points in moderation and with careful planning since an excessive number can give the impression of congestion and confusion. The landscape designer can create a beautiful and valuable environment that captivates the observer's attention while fostering a sense of calm and relaxation by carefully selecting and placing focal points.

Malde (2020)

Repetition

Using the same plant or plant groupings in various parts of the landscape is an example of the planting design idea known as repetition, which aims to create a feeling of continuity and unity throughout the environment. Landscape designers can produce an environment that is cohesive, harmonious and gives the impression of having been intentionally and skillfully constructed by repeating particular plant groups or combinations across the landscape.

The creation of a sense of rhythm and flow in the landscape is one of the key benefits that come from employing the use of repetition in the planting design process. By repeating particular plants or groupings, designers can create a visual pattern that pulls the eye and generates a sense of movement around the room. This helps create a more dynamic and exciting landscape with an engaging and aesthetically pleasing atmosphere.

Another benefit of recurrence is that it helps to create a sense of oneness in the landscape. By employing the same plants or groupings throughout the space, designers can create a sense of coherence and uniformity that connects the landscape. This strategy is beneficial when designing more significant landscapes or gardens, where using a diverse range of plants can give the impression that the place is disconnected or chaotic. In the design of plantings, repetition is utilised in a wide variety of different ways.

To generate a sense of continuity and coherence throughout the landscape, a designer may, for instance, repeat the same plant several times. An alternative approach that a

designer may take is to use a collection of plants with similar qualities, such as colour or texture, to generate a feeling of repetition and rhythm. When employing repetition in planting design, avoiding overuse or monotony is a crucial aspect that should be considered. While it is true that repetition is an effective technique, its use to an excessive degree might cause it to become tedious or predictable. When designing a landscape, designers need to strike a careful balance between the use of repetition and the application of other design concepts, such as contrast and variation, to produce an interactive and visually attractive environment.

Ribbey (2023)

Sustainability

In landscape architecture, environmental friendliness is an essential consideration in planting design. The use of efficient irrigation systems, the incorporation of native or drought-resistant plant species, and the planning of the landscape with long-term upkeep and health in mind are all essential techniques for the creation of sustainable outdoor areas. There are many advantages to using native plants in your landscaping design.

Native plants require less water, fertiliser, and upkeep than non-native plants because they have adapted to the local climate, soil, and water conditions. In addition, native plants bloom earlier in the year. They supply native wildlife with not only food but also a place to live, which helps to increase the overall biodiversity of the environment. Plants that can survive periods of drought are another factor that should be considered during the sustainable landscaping design process. These plants have adapted to live in dry conditions and use significantly less water than other types of plant life.

While designing a landscape, it is beneficial to use plants that can survive in dry conditions as this can assist in cutting down on the amount of water used and aid in saving resources. This is especially important in regions where water is in short supply or during drought. Another critical step in developing sustainable landscapes is installing effective irrigation systems. Drip irrigation, for instance, feeds water directly to the plant roots, which reduces the amount of water lost to evaporation or runoff.

Additional methods for conserving water include collecting rainwater, reusing grey water, and using soil moisture sensors. In order to achieve sustainability, landscape design must also consider how it will be maintained over time and how healthy it will be. This includes choosing plants that are well-suited to the conditions of the location, arranging them in a way that encourages their health and growth, and organising the space so that it is simple to access and take care of. Landscapes that have been thoughtfully designed are more resistant to illnesses and insects, call for fewer chemical applications, and are easier and cheaper to manage over the long term.

The concepts of planting design are an essential component of landscape architecture. They contribute to the creation of outdoor areas that are attractive, functional, and environmentally friendly. However, for the planting design principles to be effective and for the project to accomplish its functional and aesthetic objectives, the fundamental planting design concepts in landscape architecture below must work hand in hand with the planting design principles.

Site Analysis

The analysis of a site is a critical step in designing a landscape or gardening a garden. It helps to understand the specific characteristics of a site, such as the type of soil, the amount of sunlight that hits the site, the wind patterns that blow through the site, and the amount of available water. When choosing plants, it is vital to consider the soil type, pH, sun exposure, and water amount. Strong winds can cause harm to plants and inhibit their growth if not adequately accounted for in wind patterns. Inadequately drained soil can result in root rot and other issues, so it is essential to consider the site's drainage patterns. This strategy ensures the plants' continued good health and reduces the time and money required for expensive upkeep and irrigation. The analysis of a site is a critical step in designing a landscape or gardening a garden. It helps to understand the specific characteristics of a site, such as the type of soil, the amount of sunlight that hits the site, the wind patterns that blow through the site, and the amount of available water. When choosing plants, it is vital to consider the soil type, pH, sun exposure, and water amount. Strong winds can cause harm to plants and inhibit their growth if not adequately accounted for in wind patterns. Inadequately drained soils can result in root rot and other issues, so it is essential to consider the site's drainage patterns. This strategy ensures the plants' continued good health and reduces the time and money required for expensive upkeep and irrigation.

Design Concept

Developing a design concept is an essential step in the landscape architecture process. This step entails formulating an all-encompassing strategy for designing outdoor areas that are tailored to the requirements and inclinations of the customer. The architectural style of the building or space, as well as the planned purpose of the landscape, should be reflected in a design idea for it to be considered successful. In order to come up with

an idea for a design, a designer will first do an in-depth site investigation. This involves evaluating the various aspects of the natural environment, including the terrain, the quality of the soil, and the vegetation. After gathering this data, the next step is to use it to decide the types of plants, hardscape materials, and layout that will work best in the area.

After that, the designer will think about the requirements and preferences of the customer. This may include conversing about their anticipated uses for the space, their aesthetic preferences, and any particular features or aspects they wish to incorporate into the design. Next, a design is developed that fulfils the client's requirements and reflects their unique sense of style. The client's needs and desires will be considered. However, the designer will also consider the architectural style of the structure or area, including components that are complementary to the architecture of the building, such as materials or colours that match the structure's exterior, which is one way to achieve this goal.

Plant Selection:

Plant selection is an essential part of landscape design, as it involves selecting appropriate plants for the site and contributing to the aesthetic appeal. It involves considering various elements, such as soil, climate, solar exposure, and water availability. It is also essential to consider the growth habits and features of the plants, such as their height, spread, and shape, and how they will fit together to form an aesthetically pleasing composition. To create a dynamic and exciting landscape, blending plants with different leaf textures is accomplished, and creating an eye-catching visual display throughout the growing season by combining plants that have flowers of varying hues or shapes are accomplished. Plant selection is an essential part of landscape design, as it involves selecting appropriate plants for the site and contributing to the aesthetic appeal. It involves considering various elements, such as soil, climate, solar exposure, and water availability. It is also essential to consider the growth habits and features of the plants, such as their height, spread, and shape, and how they will fit together to form an aesthetically pleasing composition. To create a dynamic and exciting landscape, blending plants with different leaf textures is accomplished, and creating an eye-catching visual display throughout the growing season by combining plants that have flowers of varying hues or shapes is achieved.

Plant Placement

Plant placement is the act of organising and positioning plants in a way that increases the visual appeal and functioning of a room. This process is referred to as "plant placement." The objective is to produce a plant arrangement that is both harmonious and balanced, with plants that complement one another and the area in which they are placed. When it comes to the arrangement of plants, balance is one of the most important considerations. This entails sprinkling the plants about the area in a consistent manner

while taking into consideration their dimensions, forms, and hues. It is possible to achieve a sense of stability and equilibrium in an arrangement by putting plants of a similar size or colour on opposing ends of the room. This creates what is known as a balanced arrangement.

Another element of plant placement is called rhythm, and it entails arranging plants to create a sense of movement and flow throughout the space. This is achieved by using the same plant variety multiple times or alternating between plants with various shapes and textures. When placing plants, the proportion is also very important since it ensures that the plants are the appropriate size in relation to the area around them. Big plants are utilised to anchor the corners of a space, and smaller plants are put in between the larger plants to create the illusion of multiple layers.

Sustainability

The term "sustainability" refers to actions and behaviours that are continued over an extended period without having a negative impact on the natural world or using up all of the available natural resources. In landscaping and gardening, adopting sustainable methods means developing and maintaining outdoor areas to reduce the amount of damage done to the environment while simultaneously producing an aesthetically pleasing space with an intended purpose.

One method to incorporate sustainable practices is to prioritise using native or drought-resistant plant species, which have a lower water requirement and are less likely to be affected by pests and diseases. Another strategy to promote sustainability in landscaping is to design it so that it uses water as efficiently as possible, such as irrigation systems, mulch, rain barrels or other water storage systems. Additionally, reducing the application of chemical fertilisers and pesticides is another step that could be taken to encourage sustainable practices.

Maintenance

Keeping a landscape in good health and vitality requires regular care and attention, which is what is meant by the term "maintenance." While designing for long-term maintenance, one must consider the particular requirements of the plants, soil, and climate in the area and devise a strategy for the routine trimming, fertilisation, and watering of the landscape.

During the pruning process, you will remove any diseased or damaged branches, shape the plant for optimal growth, and maintain its size. Using fertiliser supplies the plants with the necessary nutrients, encouraging healthy growth and lowering the plants' susceptibility to illness. Irrigation guarantees that the plants will receive the adequate amount of water they require to live and flourish.

While designing for long-term care, it is crucial to select plants that are well-suited to the local climate and the soil conditions in which they will be growing. This helps to limit the need for excessive watering or fertilising, both of which can have adverse effects on the environment and are expensive. In addition, minimising the quantity of trimming and other required care is achieved by selecting plants with low maintenance requirements.

Integration of Hardscape Elements

Integrating hardscape elements involves strategically using man-made materials like concrete, bricks, stones, and wood to enhance the utility and beauty of outdoor areas. These materials are used to create a variety of different hardscape features. It refers to harmonising these features with natural surroundings and producing a smooth transition between indoor and outdoor portions of a building or space. The construction of pathways, which connect various landscape features while also directing people around the area, is a typical method for incorporating hardscape elements. Walkways are constructed out of various materials, such as pavers, gravel, or concrete, and they can take on a design complementary to the area's natural topography.

Patios are yet another essential component of hardscape that are incorporated into outdoor living areas. They provide a location to sit and rest, eat, or entertain visitors, and they are constructed to complement the architectural and design style of the surroundings in which they are situated. It is possible to construct retaining walls in outdoor areas to not only serve their primary purpose of halting soil erosion but also contribute to the landscape's overall aesthetic and functional attractiveness. They are built fromvarious materials, including natural stones, concrete blocks, or even timber.

Ecological Considerations

Incorporating environmental and ecological principles into decision-making processes is essential for fostering the health and resiliency of ecosystems. This includes developing and preserving habitats for various species of flora and fauna and developing new habitats by installing birdhouses, bat boxes, and other structures. Maintaining and increasing biodiversity is essential for keeping diverse ecosystems alive and well.

A holistic approach must consider the interdependence of environmental, social, and economic factors and the maintenance of the environment's long-term health and viability. This can help us develop a future that is more sustainable and resilient for ourselves as well as for future generations. Incorporating environmental and ecological principles into decision-making processes is essential for fostering the health and resiliency of ecosystems. This includes developing and preserving habitats for various species of flora and fauna and developing new habitats by installing birdhouses, bat boxes, and other structures. Maintaining and increasing biodiversity is essential for keeping diverse ecosystems alive and well. A holistic approach must consider the interdependence of environmental, social, and economic factors and the maintenance of

the environment's long-term health and viability. This can help us develop a future that is more sustainable and resilient for ourselves as well as for future generations.

Examples of Nigerian native plants that can be used in planting design include:

1. Yoruba Balsam (Iresine celosia): This native ground cover has colourful foliage.
2. African Star Apple (Chrysophyllum albidum): produces edible fruit and is commonly used in agroforestry practices.
3. African Corkwood Tree (Duboscia macrocarpa): The shade or decorative tree is appreciated for its enormous, spectacular blossoms.
4. Nigerian Dwarf Palm (Raphia hookeri): This tropical-looking palm tree is often used in landscaping.

Orientation

While designing a landscape, it is crucial to consider orientation because it plays a significant part in determining the general health, growth, and aesthetic appeal of the plants as well as the landscape. The right orientation can help to make the most of the natural resources that are present at a particular site, such as the amount of sunlight, the amount of shade, and the amount of wind, and it can also improve the functionality and sustainability of the landscape. The orientation of the space is frequently affected by the topography of the site, the vegetation that is already there, and the environment that is all around it. The direction in which a property is oriented can have an impact on the kinds of plants that are chosen, where they are placed, and how they are arranged. It can also have an effect on the layout of hardscaping elements like sidewalks, patios, and retaining walls.

In building and planning a landscape, an important consideration to give attention to is the orientation of a site in relation to the sun. The amount of sunshine that is received at a site can have a considerable influence on the kinds of plants that can flourish there, as well as how they should be grouped to achieve optimal growth. There is a wide variety in the amount of light that various plant species need. Some can only grow when exposed to the full sun, while others do well when they have shaded some or all of their leaves. While designing landscapes or tending gardens, it is helpful for landscape architects and gardeners to be aware of the orientation of a site in relation to the sun. This allows them to choose the plants most likely to thrive in the given environment.

Plants that need to have their leaves completely exposed to the sun might thrive in an area that gets sufficient sunshine throughout the day. On the other hand, if the location receives a significant amount of shade for the majority of the day, it is recommended that you select plants that can survive or even flourish in either partial or complete shade. In addition, the direction that a site faces in relation to the sun is another factor that is considered when deciding where specific plant species would thrive best. For instance, vegetation that thrives best in direct sunlight ought to be positioned in such a way as to

take advantage of the optimum amount of daylight that each day has to provide. This will help to guarantee that they receive the required quantity of sunlight in order for them to grow and flourish.

It is vital to consider the orientation of the site in relation to the predominant wind direction while coming up with a strategy for planting vegetation. This will assist you in determining the optimum areas for planting and selecting plants suited to those locations that can survive the wind. It is vital to consider the orientation of the site in relation to the predominant wind direction while coming up with a strategy for planting vegetation. This will assist you in determining the optimum areas for planting and in selecting plants that are suited to those locations and can survive the wind. It is vital to consider the orientation of the site in relation to the predominant wind direction while coming up with a strategy for planting vegetation. This will assist you in determining the optimum areas for planting and in selecting plants that are suited to those locations and can survive the wind.

If the location of the planting site is in an area prone to being affected by strong winds, consider the possibility of utilising windbreaks to safeguard the plants. You may lessen the toll that the wind takes on your plants by erecting windbreaks with the assistance of trees, shrubs, or fences. Windbreaks can also help protect the plants from the elements. Also, the orientation of the planting scheme might affect the amount of sunshine the plants receive. If the site is susceptible to being buffeted by strong winds, consider planting more sensitive plants in areas shielded from the wind, such as in the lee of a building or behind a windbreak.

Moreover, wind can cause an increase in the rate of transpiration in plants, which can result in the loss of water and, ultimately, dehydration of the plant. This is particularly problematic in hot and dry situations, as it can cause plants to wilt and eventually die. When selecting the plants to be used in the planting scheme, it is essential to consider the effects wind will have on the environment.

A property's orientation can also be influenced by the environment surrounding it. For instance, if a piece of land is situated close to a busy road, facing it in a direction that keeps the noise and pollution at bay could be preferable. Alternatively, a piece of property is located in close proximity to a body of water or a picturesque view. In that case, facing the property in the direction of that body of water or view might be advantageous.

When the orientation of a property has been figured out, it is possible to use that information to guide the choice of plants and their arrangement. For instance, if a piece of land faces south and gets a good deal of sunlight, it is appropriate for planting heat-loving plants such as succulents and cacti. On the other hand, a property that faces north and receives less sunshine is more suitable for growing shade-loving plants such as ferns and hostas because it receives less direct sunlight. When the orientation of a property has been figured out, it is possible to use that information to guide the choice of plants

and their arrangement. For instance, if a piece of land faces south and gets a good deal of sunlight, it may be appropriate for planting heat-loving plants such as succulents and cacti. On the other hand, a property that faces north and receives less sunshine is more suitable for growing shade-loving plants such as ferns and hostas because it receives less direct sunlight.

The orientation of a property is an essential consideration that must be considered while designing and planning the landscaping for that property. Its orientation is influenced in various ways, including by the site's terrain, the vegetation already there, and the environment around it. Landscape designers can craft aesthetically pleasing and practically useful outdoor areas that are in harmony with their environments when they consider the aspects listed above.

Human Needs

When planning a planting scheme for an outdoor space or garden, it is essential to consider the people's needs and preferences. People utilise outdoor spaces for several purposes, and the plants chosen for these spaces should reflect these functions and adapt to the interests of the people who will be using them.

In the process of planting design, one of the most important things that should be considered is the safety of human beings. It is essential to pick non-hazardous plants when designing an outdoor space, mainly if it will be used by people, animals, or both, including children. Avoid coming into contact with any plants that are poisonous or have very sharp thorns. In addition, plants should not be allowed to get in the way of people's views or provide risks for people to trip over. In the process of planting design, one of the most important things that should be considered is the safety of human beings. It is essential to pick non-hazardous plants when designing an outdoor space, particularly if it will be used by people, animals, or both, including children. Avoid coming into contact with any plants that may be poisonous or have very sharp thorns. In addition, plants should not be allowed to get in the way of people's views or provide risks for people to trip over.

Functionality is another essential factor to consider throughout the planting design process. The function that the outside area will serve ought to guide the plants' selection. For instance, if the space is intended for outdoor eating or entertainment, plants that give shade and shelter, such as trees or large bushes, would be ideal. Plants that have a relaxing effect, such as lavender or chamomile, could be an excellent choice for decorating a place for relaxation. While designing a planting scheme, it is essential to consider practical considerations, aesthetic considerations, and personal preferences. The individual or group that owns or utilises the area has to have their own style and personality reflected in the plants selected for the space. For instance, a formal garden may need tidily clipped hedges and symmetrical planting, but a more relaxed environment may benefit from the addition of wildflowers or a planting design that is more naturalistic.

A person's cultural preferences might also be considered throughout the planting design process. For instance, certain societies may prefer plants with some symbolic or cultural significance. Plants that have significant meaning to culture can contribute to developing a sense of place and belonging in a community.

Last but not least, while selecting plants for a planting scheme, sustainability in relation to the surrounding environment should be taken into consideration. Plants native to the area are frequently the most environmentally friendly choice because they are used to the weather and soil conditions of the place in which they were initially developed. Native plants not only aid local species by providing a habitat for them, but they also contribute to preserving the ecosystems in which they live.

Summary

Planting design, orientation, arrangement, and human needs are crucial to producing practical and visually appealing outdoor spaces that meet both humans and the environment. Planting Design, Orientation, Arrangement, and Human Needs focuses on creating and arranging plants to create outdoor areas that are both functional and visually appealing. The course covers the fundamentals of design, such as colour theory, shape, texture, and scale, in addition to the more practical aspects of site analysis, plant selection, and upkeep. In addition, the orientation of the room is considered in relation to the sun, wind, and water. The necessity of planning outdoor spaces with human needs in mind, such as ease of access, security, and opportunities for social contact are emphasised throughout the course. Students are taught how to design planting plans that consider the requirements of both the location and the people who will be using it.

Exercise

1. What are the main factors to consider when creating a garden planting scheme?
2. How does building orientation impact energy efficiency?
3. How can you meet aesthetic goals while meeting human needs in your planting design?
4. When designing a landscape, discuss the importance of plant maintenance.
5. Go round your vicinity and identify the various plants.

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Some Common Plants in Nigeria

(Elaeis guineensis)

African tulip tree (Spathodea campanulata)

Flame of the forest (Delonix regia

Bougainvillea (Bougainvillea spp.)

African violent (Saintpaulia spp)

Nigerian hibiscus (Hibiscus rosa-sinensis)

Elephant ear (Colocasia esculenta)

Bird of paradise (Strelitzia reginae)

Nigerian trumpet flower (Allamanda cathartica)

BIODATA OFASSOCIATE PROFESSOR DORCAS AYENI

Dr Dorcas Ayeni, an Associate Professor in the Department of Architecture at the Federal University of Technology Akure (FUTA). is an accomplished architect and academic specialising in Landscape Architecture and Sustainable Tourism. She holds a Bachelor of Science in Architecture and a Master of Science in Architecture from Ahmadu Bello University, Zaria. She obtained her PhD in Architecture and Sustainable Tourism from De Montfort University, Leicester, in the United Kingdom.

With a passion for research and education, Dr Ayeni has received grants and awards throughout her career. She has published over 80 papers in esteemed local and international journals and has served as a reviewer for reputable academic journals. Additionally, she has supervised several Master and doctoral students.

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Dr Ayeni is an Associate Professor in the Department of Architecture at the Federal University of Technology Akure (FUTA). She teaches various architecture, landscape design, tourism, and heritage conservation courses. Her research interests include Architectural Tourism, Sustainable Tourism Development, Heritage Studies, Landscape Architecture, Urban Design Studies, and Architectural Education.

Beyond her academic and professional achievements, Dr Ayeni is actively involved in philanthropic work. She founded the Widows and Widowers Window of Hope, a non-profit organisation that supports widows, orphans, and "seniors.". She also enjoys travelling, has visited over 22 countries globally, and is keenly interested in collecting flags.

She has significantly established collaborative partnerships between FUTA and international universities, including London South Bank University and De Montfort University

Plant Materials, Classification and Uses in Landscape Design

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Overview

Plants and plant materials along with air, moisture, water, atmosphere, gravity, and life forms are unarguably exceptional gifts of nature that distinguish our spaceship earth from all other stars and planets in the solar system. Land, water, plants/vegetation, air, and sunlight are all interlinked in a complex web driven by the energy of the sun. In this web, geology/soils, climate, and water powered by sunlight determine the type of vegetation/plant materials that act as a carbon sink, delivering freely to humans, animals, and organisms, directly or indirectly, food, fibre, air, energy, and numerous ecological services. As noted in Waterman (2009), an understanding of plants has been fundamental to human survival through time and especially now with the warming global temperatures and climate change. Beyond these, plant materials that constitute the 'softscape' along with the 'hardscape' are the main ingredients of landscape design.

This text discusses the scientific and botanical classification of plants based on their kinship, evolution, and structure into division, class, order, family, genus, species, variety, and form (Chen, 2011; Laurie, 1986). This could sometimes be confusing to a non-plant specialist. The horticulturist however uses botanical (genus) and common names to classify plant materials while also classifying them by form into trees, shrubs, herbaceous and annual plants, groundcovers, and vines. This is considered by Laurie (1986) as a useful breakdown of the plant kingdom for landscape architecture and design. In the real sense, it is these diverse plant materials that are the "building blocks" valued for their architectural usefulness for all soft landscape aspects of a landscape design. In nurturing a working knowledge of plant materials and their use in landscape design, this essay is geared toward providing a simple classification of plant materials in addition to highlighting their design attributes with the criteria for their selection.

Objectives:

the objectives of this chapter are to:

1. identify and explain the classification of plant material by genus, species, and common name as appears on the landscape planting plan;
2. explain their classification by appearance, form, habit with examples with some Nigerian plants;
3. identify and describe the design attributes of plant materials; and
4. identify and explain the criteria for plant selection in landscape design.

Plant Classification

Botanists classify plants according to their evolutionary order within the plant kingdom. There are several groupings depending on which professional is concerned. Figure 1 below shows the evolutionary order and the relationship between the different groupings. Four (4) of the groupings are of interest to landscape architects/designers in deriving plant materials for landscape design. These are mosses, ferns, conifers/ cycads and flowering plants. Mosses and ferns are non-seed producing plants, while conifers (such as pines, hemlocks, firs, and spruces) and cycads have "naked seeds" produced on male and female cones or strobili and classified as gymnosperms. The last of this grouping are the flowering plants or angiosperms comprising trees, shrubs, herbaceous plants, ground covers, vines, etc.

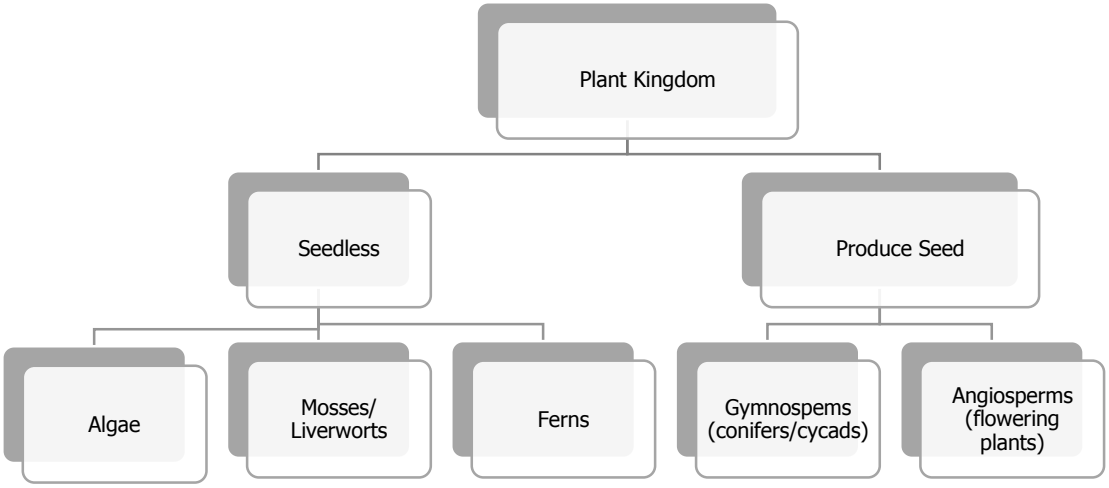


Figure 1: *Plant Kingdom Classification by Evolutionary order* (*Source*: Adapted from Streich & Todd, 2014).

Classification of plant materials by Genus, Species, and common names

A simple classification system commonly used in planting schedules that accompany landscape planting plans is explained below for its straightforwardness. In this classification, each plant is identified by its botanical name, which is in Latin and universal, along with a common name used in an area in the region. The botanical name comprises genus and species (Figure 2), a couple of examples of which can be thus: *Delonix regia* (common name: Flamboyant tree or Flame of the Forest) and *Ixora chinensis* (common name Ixora). In some instances, the species name can help reveal the country of origin as with *Ixora chinensis* which is native to China.

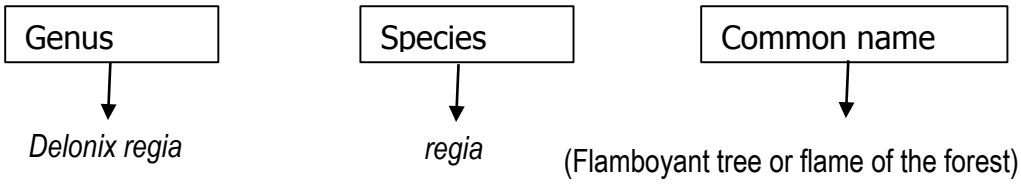


Figure 2: *An example of classification by botanical and common names.*

The naming of a plant gets longer when a third name is added to name a cultivar or a variety (Table 1). A cultivar is a plant that has been carefully propagated for some unique traits such as colour, fruit size, and shape. This type of plant does not produce true-seed, meaning that if the seeds are planted, they may fail to produce a replica of the plant's true form. To name a cultivar, the name is added to that of the genus and species as the third name starting with a capital letter and is set out in single quotation marks. For instance, in these shrubs *Acalypha wilkesiana 'Moorea'* (acalypha) and *Codiaeum variegatam 'Rubrum'* (croton), *'Moorea'* signifies the cultivar of Acalypha while *'Rubrum'* or red colour is the type of Croton plant. However, if true form seedlings are to be produced, these plants are best reproduced from stem cuttings, bulb division, or tissue culture.

A variety is a plant with unique characteristics that can produce true-to-seed, meaning the seeds can be planted to reproduce the traits of the mother plant as illustrated by this ground cover example named *Vinca rosea var. alba* (white Vinca).

Hybrids are different from cultivars and varieties as they are reproduced by the process of cross-pollination of two similar plant species to produce seeds. The seeds are then planted to produce a new plant with different features from the initial parents. An example is *Hibiscus rosa-chinensis* which has many hybrids producing different types of flowers. Another example is *Hibiscus rosa-sinensis* or *'Butterfly'* which has golden yellow blooms, while *Hibiscus rosa- sinensis 'Brilliant'* has red flower blooms.

Cultivars, varieties, and hybrids offer the landscape designer a unique range of plants with specific features. When using them on a planting design, they should also be properly named to distinguish them from their close relatives.

Table 1.

Typical plant schedule showing botanical and common names and some cultivars.

S/N	Botanical	Common Name	Plant Code	Spacing or	No of plants	Remark

	Name			Interval Between	Required	
A	TREES					
	Callistemon viminalis	Weeping bottle brush	CV	5.0m	5	
	Acacia auriculiformis	Acacia	AA	6.0m	3	
	Treminalia mentalis	Step tree	TM	7.0m	2	
	Kigelia Africana	Sausage tree	KF	As on plan	4	
	Plumeria rubra	Frangipani	PR	5.0m	3	
B	PALMS					
	Bismarchia nobilis 'silver'	Bismarchia palm	BN	As on plan	1	
	Cocus nucifera	Coconut	CN	As on plan	1	
	Elaesis guineensis	Oil palm tree	EG	7.0m	38	
	Arcrohtophoenix alexandrae	Kings palm	AA	7.0m	50	
C	SHRUBS / VINES					
	Bougainvillea spectabilis 'Elizabeth Angus'	Bougainvillea	BS	0.5m	25	
	Quisqualis indica	Quisqualis	QI	1.0m	15	
	Ixora javanica	Ixora	IJ	0.5m	55	
	Codiaeum variegatum	Codiaeum	CV	0.5m	68	
	Duranta variegate	Variegated yellow bush	DV	0.3m	428	Hedge

	Euphordia milii	Crown of thorns	EM	0.3m	220	
D	GROUND COVERS					
	Gomphrena globose	Globe amaranth	GM	100m	650	
	Tradescantia spathacea 'Dwarf'	Dwarf tradescantia	TP	200m	450	
	Alternanthera paranychiodes	Alternanthera	AP	200m	376	
	Axonopus compressus	Port Harcourt grass	AC	100m	250sq.m	Use sprigs
	Zoysia matrella	Carpet grass	ZM	sod	243sq.m	Use sods
	Stenotaphrum secundatum	St Augustine grass	SS	100m	179sq.m	Use sprigs

(*Source*: Authors' works).

Importance of the use of botanical names in planting design and specification

It should be noted that the main identity for each plant in the table above is the botanical name which is in Latin as a universal standard that is used in planting design and subsequently used in the preparation of a planting schedule. The use of botanical names allows for the sourcing of the right plant material from the plant nursery. Planting design specifications require that the true plant stock be provided for a job ensuring that only the intended plant in the design is ultimately supplied by the contractor during implementation.

This is alluded to by Streich and Todd., (2014). Plant classification enables professionals like landscape managers, and gardeners to communicate with ease between themselves and construction practitioners across the world. In this way, decisions on propagation, control, and management of landscape plants are made easier, avoiding the distortion that common names bring with them.

Common names are only peculiar to a locality and therefore are limiting even though they are included in a planting schedule. They can however become confusing when 2 or more plants share the same common name. A good example is *Spathodea campanulata* and

Delonix regia which share the same common name as "Flame of the Forest". Sometimes a common name cannot be used to identify the plant being requested for in the plant nursery because the common name may be alien to the plant dealer. Since botanical names are never repeated, this is best to set them apart.

Other useful plant classification for landscape design

Apart from the botanical classification of plants, there are many other useful classifications of plants that are of architectural relevance and therefore used by landscape architects in deciding plants to use. They include the following:

1. Classification by appearance, form, and habit such as trees, shrubs, ground covers, vines/climbers, palms, aquatic plants, desert plants etc.
2. Classification by plant size such as: tall, medium, small and dwarf.
3. Classification using leaf drop such as deciduous, e.g. *Cassia fistula* (Golden shower), or evergreen e.g. *Khaya ivorensis* (Mahogany).
4. Classification as broad-leaf, e.g. *Teminalia catappa* (Indian almond), or coniferous, e.g. *Pinus caribala* (Pine).
5. Classification as herbaceous plants, e.g Annuals such as *Tegetes erecta* (African Marigold); Biennials like *Zingiber officinale* (Ginger), Perennials like *Canna x generalis* (Canna Lily).
6. Classification based on wind tolerance: low, medium, high.
7. Classification based on Life span such as short > 20 years, medium 20 - 100 years, and long,100years and above.
8. Classification based on country of origin: native (indigenous), or exotic.
9. Classification based on the foliage of the plant: fine, medium, or coarse.
10. Classification based on the preferred soil type: swamp, clay, sandy.
11. Classification based on the flower type, fragrance, colour, etc.
12. Classification based on its landscape use: shade, screen, specimen/ accent.
13. Classification based on the preferred aspect: sunny, shade, or semi-shade.

Types of plant materials

Nature is so diverse in its provision of different types of plant materials that can be used in landscape design. Nigeria spans six vegetation zones from forests to savannah, each offering a variety of plants. Knowledge of what grows best in each zone is needed to achieve a successful planting design when working in any of the zones. Based on design criteria/ requirements, environmental requirements, and stock availability, the landscape architect or designer can make an informed choice from the vast pool of plant materials as follows: -.

a. Trees are woody perennial plants that usually have a single stem and bare branches some distance above the ground. Exceptions exist for multi-stemmed trees. Trees typically grow beyond 6 meters in height. Examples are *Cassia fistula* and *Jacaranda mimosifolia*. An example of a multi-stemmed tree is *Hyphaene thebaica* (Hyphaena palm).

b. Shrubs are perennial woody plants with many stems arising at a distance from the ground. They are smaller than trees and can reach heights of 3 - 6 meters. Examples are *Codiaeum varieagatum* (croton) *and Ixora chinensis* (ixora).

c. Ground covers are herbaceous low-growing plants; some can however reach a height of 1meter. They grow to cover the ground as the name implies. *Gomphera globose* (Globe amaranth) and grasses such as *Axonopus compressus* (carpet grass) are good examples.

d. Climbers are vines or any plant with weak stem parts that need support. They have the habit of clinging, twining, or clasping on their support. Examples are *Combretum indicum* (Rangoon creeper) and *Bougainvillea spectabilis* (Bougainvillea).

e. Aquatic plants are plants that can grow partially or fully in water. Some float on water. They can be used in ponds and natural pools or for planting swampy areas, e.g. *Nelumbo nucifera* (Water lotus).

f. Mosses are spore bearing, non- vascular plants implying they do not have stem matter and do not bear flowers. They grow on clumps in a wet environment. They are used in Japanese gardens to symbolize aging. They can be useful materials in specialized landscape work. Examples include *Plagiomnium cuspidatum* (Baby tooth moss) and *Thuidium tamariscinum* (Tamarisk moss).

g. Perfume or scent plants are used for their therapeutic effect. Perfume plants give out perfume in strong sunshine, after a rainfall, at night, or when bruised. Examples of perfume plants are *Lantana camara* (Lantana), *Jasmine officinale* (Queen of the night), both shrubs, and *Plumeria rubra* (Plumeria) , a tree. They are best used where there is a change in level or in areas where people slow down, and in wind direction to derive their best benefits.

h. Desert plants are plants that can grow in arid regions. These plants can be used in the semi-arid region of Nigeria where the water supply for plant growth is limited to Agave *altenuata* (Foxtail agave) and Opuntia *valgaris* (Prickly pear) cactus. Where irrigation is available, more plant types can be used in arid regions.

i. Exotic plant materials. There are materials that are not indigenous to a particular area. Many plant materials have been moved from one climatic zone to another and from one country to the other where they have adapted to the new environment and are doing well. Exotic plants are available in Nigeria and can be used in many design works. Indigenous plants are however the best for natural planting. Some examples of exotic plants include *Hydrangea macrophylla* (Hydrangea) and *Culluna valgaris* (Heather), both temperate plants that can grow in parts of the country where the weather is cool and wet.

Design Attributes of Plants for selection in landscape design

Aesthetic attributes

This can be in the form or shape of the plant material. Trees can be pyramidal, round, vase, columnar, broad, layered, irregular, and weeping (Figure 3 and Plate 1a-d below).

Examples include: pyramidal- *Thuja plicata* (Thuja), columnar - *Saraca indica* (Masquerade tree), weeping- *Ficus benjamina* (Weeping ficus), layered – *Terminalia catappa* (Umbrella tree or Fruit' tree, *Terminalia mentalis* (Stepped tree or Pagoda tree), round – *Mangifera indica* (Mango at young age), irregular – *Casuarina equisetifolia* (Whispering pine) and others. Shrubs can be fully covered, bare stemmed, vase, have special large flower blooms, or even large leaves. Examples of shrubs include: - fully covered e.g. *Ixora chinensis* (ixora), bare stemmed - *Adenium obesum* (Desert rose) and Vase-shaped e.g. *Jathropha integerrima* (Jathropha).

Other aesthetic attributes are line or vertical effects which trees can be used to create. Trees for instance have single or multiple stems, clear trunk/stem, or linearity of their trunks at a given height, with the canopy spread going with it. All these qualities serve an important role that a designer should look out for. Colour also is a desirable attribute ranging from cool, to warm colours, abundant in plant materials such as in leaf, stems, flowers, and fruits, providing the designer with a variety to choose from. Seasonal colour variation is equally an important attribute, especially in leaf colour that can be used to express transitions in the landscape. Some plants have variegated leaves, having more than one colour on their leaves, and can be an interesting combination with other plants on a planting scheme. Seasonal colour particularly on leaves in autumn is more pronounced in temperate climates than in the tropics. A good example of a tree that shows colour transition in the tropics is *Terminalia catappa* (Indian almond or Umbrella tree). This characteristic can be explored and carefully used to achieve good results in planting design.

The texture of plant materials is also another aesthetic quality they display. Texture can be from tree barks, and from leaves, comparatively. Lastly, size and scale in terms of human scale in relation to function and space are other aesthetic factors that should be used in determining the selection of plant materials to make such places functional and usable by people. All the above attributes are elaborated on with pictorial examples in Alao (2020).

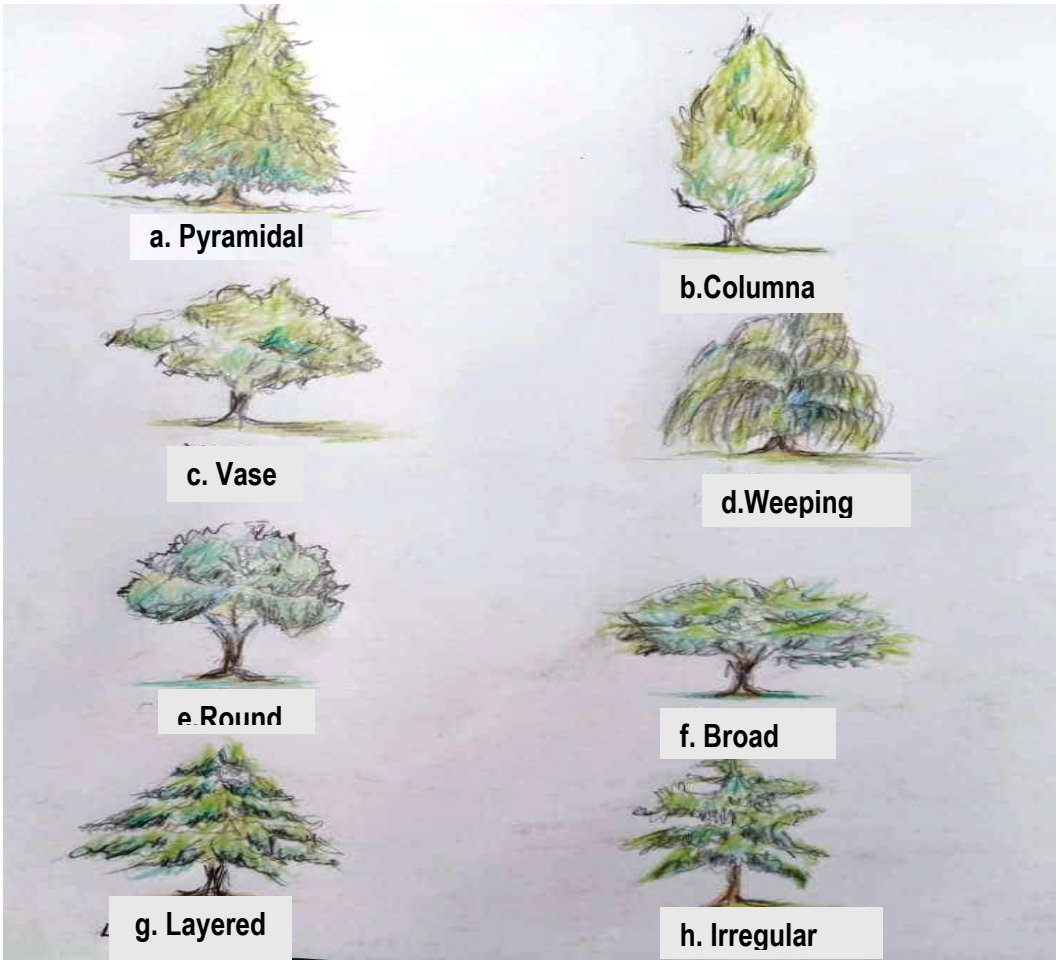


Figure 3: Forms of Trees Landscape Design (Drawn by Alao A. A).

a. Spreading shrub - *Tuneria subulata*

b. Bare stem e.g. *Adenium*

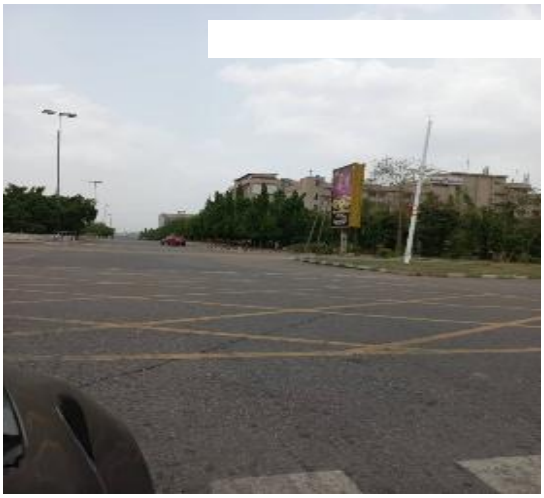
c. Large Flower Blooms e.g. *Nerium oleander*

d. Fully Covered Shrub e.g. *Ixora*

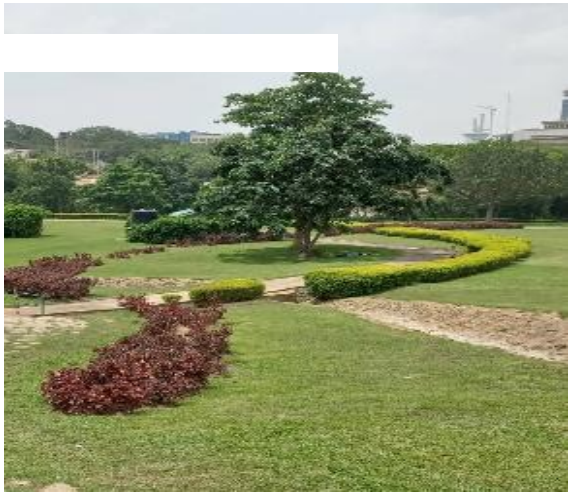
Plate 1: Forms of some shrubs in landscape design (Photographs by Nenchi D. W).

Functional attributes (space-making with plants)

These functional attributes are in the capacity of plants to be used for outdoor enclosure/barriers/edge definition – visual screening, defining lines or movement paths for pedestrian and vehicular traffic, or even for control of movement as with the use of hedges (Plate 2a-h).



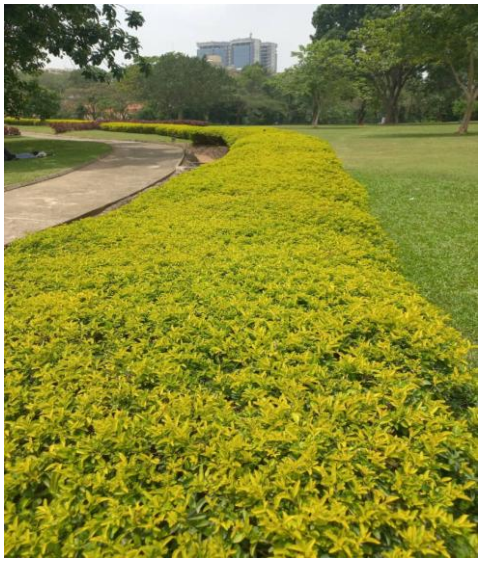
Shelter planting around building. Using trees



b. Breaking up open space using shrubs.

c. Planting to relate trees to building

d. Directing Pedestrian traffic using shrubs. Note the complementary colours of the *Acalypha wilkeseana* and the pavement



e. Contrasting soft scape with hard scape using shrubs and grass.

f. Screening of building using shrubs

g. Screening of building using trees

h. Directing pedestrian and vehicular traffic

Plate 2a-h: Functions of Trees and Shrubs in landscape design (Photographs by Nenchi D. W and Alao A. A).

Another functional attribute of plant materials is their capacity to deflect noise and sound (Rubenstein, 1996); so dense hedges or trees are planted sometimes on highways and motorway embankments to act as sound barriers or deflectors.

Plant material help to moderate the microclimate and can serve this purpose when planted along the east and west of buildings to reduce the thermal load on buildings, or as an overhead plane using vines on pergolas and trellis to provide shade or in the planting of trees that can shade the ground from the effect of the hot tropical sun thus moderating the microclimate. They also help clean the air through utilising polluting carbon dioxide and emitting oxygen during photosynthesis while also filtering out particulate pollutants like smoke, dust, pollen, and fumes (Runebstein, 1996). Plant materials such as trees and shrubs when selected and combined as a windbreak or shelter also perform the role of moderating the microclimate. Plant materials such as trees, shrubs, and ground covers such as grasses are useful in erosion control as their roots hold the soil together just as their leaves intercept the rain, decreasing splashing thereby increasing runoff percolation into the soil.

Plant selection in landscape design

Plant selection in landscape design is therefore based on aesthetic and functional attributes above in addition to growth requirements, the functional requirement of the brief and site along with aesthetic criteria in terms of the mood and ambiance to be created in the composition. The ambiance to be created may be a reflection of the corporate image of the organisation or institution. Added to these of course are maintenance requirements.

Growth requirements have a lot to do with the climate and seasonal characteristics. In Nigeria there are 2 major seasons, the dry and wet seasons which vary in duration across the climatic zones affecting growth rate, spread, habit, and habitat. The characteristics of the plant roots, whether shallow or spreading roots or deep tap roots, will influence how close such plants can be to a building, fence line, parking lot or any structural element within the landscape.

Functional requirements based on the brief and site are considerations on whether the site is urban or rural, the uses it is meant for, such as creating a corporate image for an organisation, or whether it is for recreation or other purposes.

Aesthetic criteria have to do with the mood to be created, which can be influenced by the design style used and the ultimate design scheme created. For example, a formal layout and design with formal planting can exude a corporate image of order and organisation as exemplified in the French formal gardens.

Maintenance requirements vary from plant to plant. The degree of maintenance for the establishment and nurturing of the plants chosen is very important. A planting scheme can be designed to be of low, moderate, or high maintenance on purpose by the types of plant material selected for use. Routine maintenance activities for plants involve watering, raking, pruning, weed control, manure or fertiliser application, treatment for infestations such as termites and others should be worked into the design as part of the maintenance schedule.

How to use plant materials (trees shrubs and groundcovers) in planting design

Plant materials provide the building blocks for the design of a planting scheme. They are the soft landscape components; designed on their own or along with the hard landscape component on a design scheme to express their architectural qualities. Plant materials when properly composed serve as green infrastructure in the landscape carrying out roles that care for the environment in a sustainable way. Considering the attributes for the selection of plants already discussed above, in addition to their green infrastructure qualities, plant materials can be used in the following suggested ways: -

a. To create "out- door rooms' ', or external places, plant materials such as trees, shrubs, and groundcovers can be used. Such materials that can provide horizontal and vertical effects are useful in demarcating boundaries (Plate 2b & d). Examples include *Murraya paniculata* (Orange jasmine), and *Acalpha wilkesiana 'Macrophylla'* (Red acalypha*).*

b. Direction can be provided easily when plants are used. Shrubs planted and maintained as hedges along a pedestrian path can help direct pedestrians (Plate 2d). So also when trees are used by emphasising their verticality and planting them in the direction of vehicular or pedestrian traffic flow on a planting design. Trees with clear stems are excellent for this as avenue planting with palms such as *Roystonea regia* (Royal Palm), and *Elaesis guineensis* (Oil palm).

c. Vertical effect can be achieved using tall trees and to an extent some shrubs also. Plants that have columnar, pyramidal, and conical form or habit can be very useful. Again, Royal palm, Masquerade tree, *Coscus nucifera* (Coconut) , *Terminalia mentalis* (Stepped tree or Pagoda tree) and *Eucalyptus citrodora* (Eucalyptus) are few examples of such trees (Plate 2h and Plate 3a & b). Verticality is used in shelter belts. However, this is usually in a combination of trees and shrubs to make the shelter effective and efficient.

Plate 3a: Trees (Masquerade tree) used for vertical effect around tall buildings (Photograph by Nenchi, D. W.)

Plate 3b: Verticality of stems of *Casuarina equisetifolia* (Whispering pine) used to achieve shade in a park (Source: ESUT Landscape architecture class, 2019).

d. Channeling of views for instance from an object like a building to a desired view, is a useful outdoor experience that plant materials can be used to achieve. Tall trees with straight trunks as in Plate 2h above are good examples of trees that can be used to achieve this.

e. The diverse colour palette and texture of plant materials can be used to contrast or complement other materials such as paving materials, water, or buildings. Using the principle of balance and harmony in a design, creativity is required to achieve this while using trees, shrubs, and ground covers.

f. The texture of the stems and leaves as well as colour of planting materials can be used to contrast with other hardscape materials such as paving (Plate 2e) or finishing of a retaining or free-standing wall.

g. By using plant materials such as shrubs or ground cover at eye level, external spaces can be visually linked. For instance, ground covers planted in a sweeping manner in mass within an open lawn area using *Acalypha wikesiana* (acalypha) and *Duranta rapens* (yellow bush), or *Russelia juncea* and *Lantana sellowiana* will provide scenes of warmth and happiness.

h. When there is change in levels, plants can be used to emphasize or accommodate this by planting them in a mass in such a location, e.g. *Ixora lutea* (Dwarf Ixora).

i. Plants are useful screen materials when used on boundaries, and to create privacy by blocking views. Plant materials with full coverage can be used such as *Thuja ocidentalis* (Thuja), and *Polyalthia longifolia* (Masquerade, or Ashoka).

j. Climbers when assisted to climb by the use of a climbing frame can be used for screening and for splitting up spaces.

k. For creating the impression of an ageing landscape (Plate 4a), such as in a Japanese garden, mosses are useful. Contrasting light and shade using climbers on a pergola, they provide shade, and light effect as the climber casts its shadows while providing light shade

l. Displaying an aesthetic feature of climbers and vines can be achieved by raising climbers on an arbour, arch, or on a pergola to display large flower blooms or leaf texture (Plate 4b).

m. Palms are tropical and sub- tropical trees in the Aceraceae family that grow without branches and have a crown of long evergreen leaves called fronds (some palms can be shrubs). They can be single-stemmed or multi-stemmed. They are a favourite plant material used in landscaping around the world, popular for the tropical effect they bring on a landscape. In Nigeria, they grow very well across the vegetation zones, apart from the indigenous palms,

(b).

Plate 4: (a) Aging of concrete embankment with mosses; (b): A climber, *Quisequalis indica* growing on an arbour (Source: Authors' fieldwork).

exotic ones have been introduced and are doing well in many zones. There are quite a wide variety of palms. Their form, colour, and textures, of fronds, stem distinguish them as a useful and very useful plant material.

n. Some plant materials are poisonous to humans and to animals. A landscape architect must take every precautionary measure before using them. Poison can be in the berries or fruit, stem leaves or roots. Those that produce bright coloured fruits should not be planted where children can be attracted to eat them. Examples of poisonous plants are *Dieffenbacia seguine* (Dumb cane) and *Thevetia peruviana* (Yellow oleander).

Type of Nursery stocks

For reference purposes in plant specification especially with the absence of Nigerian standards for plant nursery stocks, the British Standard (BS) provides a guide to nursery stocks for trees and shrubs under different codes. Most nurseries specify plants based on girth size and heights such as Light Standard (LS) 6-8cm girth, and height of below 2.0 M, Standard (S) 8- 10cm girth and 2.0 -3.0M height, Select Standard (SS) 10 - 12cm girth and 2.5 - 3.5M height, Extra Heavy Standard (EHS), 12 - 14 cm and girth 4.0 - 4.0M, Advanced Heavy Standard (AHS) girth 16 - 14 cm and 4.0 - 4.5M height, Semi Mature girth 18 - 20 cm and 4.0 - 4.5M. Another variant is Standard with clear single trunk up to a minimum of 1.8M, half standard 1.2 - 1.5M, ¾ standard 80 - 90 centimeters, ¼ 1.2 - 1.5M, feathered have a central stem with branching from the ground level, while multi-stemmed have several stems taking off from ground level but are usually pruned down to three in the nursery for stability.

In Nigeria, nursery seedlings are not necessarily based on this or any specific standard even in the established nurseries. This may be attributed to the absence of a standard for plant propagation up until this time. Plants are propagated in small, medium, and

large potting bags. These bags come in polybags or used cement bags Some big nurseries use plastic buckets of various diameters for shrubs and trees. The bigger the size of a container used in propagation, the faster it is to attain a big size. For a high-quality landscape design implementation, it is possible to use the BS standard to guide the selection of plants from the plant nursery. With time and constant demand, plant nurseries in the country may upgrade as a response to the demand.

Summary.

From the foregoing, a good knowledge of plant classification is relevant in the selection of plant materials in a planting design. There are several classifications that landscape architects use to make the task easy to accomplish. Plants have been shown to have architectural relevance when it comes to their aesthetics and functional values. They contribute to the sustainability of the environment by lending themselves to be used as green infrastructure. Nigeria's six vegetation zones, which are an outcome of the climatic conditions, provide an array of unique ecologies and plant species to choose from. Plant materials such as trees, shrubs, ground covers, climbers and vines, aquatic plants, and desert plants including mosses are abundantly available around us. Plant selection is done by carefully combining factors of aesthetic and functional values as well as growth characteristics in creating the outdoor spaces that serve their ideal purposes.

Exercises

1. Discuss 6 plant classifications relevant to planting design.
2. What factors are important when selecting plant materials for planting?
3. With examples describe 3 ways you can use various plant materials in design.
4. Discuss 4 types of plant material that you can use in a design project.
5. Arrange a field trip to a plant nursery nearby to see how plants are under propagation. Prepare an overview of plant varieties that are in stock under: - trees, palms, shrubs, ground cover, grasses, herbaceous plant, vines and climbers. Also record the sizes of potting bags or containers used for each plant type by documenting them in a notebook. Also check if you can identify trees that meet the BS standard i.e. standard, 3/4 standard, ½ standard.1/4 standard, multi-stemmed and feathered.

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CHAPTER SIX: LANDSCAPE COMPONENTS AND METHODS

Street Furniture and Their Role in Enhancing Urban Legibility

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Overview

For proper and rational development to take place land use planning is involved to allocate land for competing and sometimes conflicting uses. By this, the development of land in the city is controlled in an orderly manner to enhance the urban experience. Cities are planned entities and all their components are carefully managed by all relevant professionals. While urban designers are concerned about the setting of urban areas and how it appears and functions, landscape architecture concerns themselves with the design of outdoor spaces; especially streets and how to make them enhance city functioning.

This chapter discusses different types of street furniture and how they help city dwellers make sense of the city. It focuses on the different types of street furniture; explaining them and also describing their functions. Finally it describes how street furniture enhance the legibility of the city.

Objectives

The objectives of this chapter are to:

1. define street furniture;
2. identify types of street furniture;
3. discuss the importance of street furniture to Landscape design;
4. discuss /explain the functions of street furniture;
5. discuss the placement of street furniture; and
6. describe the connection between street furniture, legibility, and urban design.

Introduction

Street furniture is a collective term for objects and pieces of equipment installed along streets and roads for various purposes. They serve practical purposes giving people a sense of place. Street furniture functions to make our outdoor spaces usable. The activities of moving elements such as people are as noteworthy as that of the static element within it, Lynch, 1982. Street furniture which are the static features as well as people that use them are all important in the design scheme.

Street furniture is found in urban landscapes providing important amenities for urban dwellers by adding functionality and vitality to the urban realm, thus enhancing urban legibility. Legibility is one of the principles of Urban Design whereby the urban realm is made to be memorable and

becoming to behold. It is the ability of the physical components to resonate a strong image of the city, Lynch, 1982. This suggests that an urban dweller can decode with easy symbols that are enhanced by certain provisions at strategic locations of the city like the path, nodes, edges, districts, and landmarks being the key Urban Design elements, a large urban environment is the sum of many or the urban design principles (Tonmory, 2017). Street furniture occurs in all these places enhancing how people feel and perceive the public realm of the city (o'neil, na)

Types of street furniture and their social functions

Street furniture are those items added to roads, footpaths, and verges that influence road users' behaviour while assisting them to have a better feel of the city. They support social interaction by providing opportunities for it outdoors. They can be in different forms such as.

1. Traffic Lights: used in directing traffic both vehicular and pedestrian in that process avoid collusion of human and vehicular entities.
2. Traffic barriers (bollards): placed on sidewalks and used to separate vehicular traffic from pedestrians and even tricycle users. They are also used as a stopper within parking lots.
3. Shelter e.g. at Bus stops/Tramp stops: They are for the comfort of travellers who need to stay at a place to wait for or change their mode of transport. It protects from the climate/weather.
4. Kiosks and information boots: used for vending and providing information. They are found in open spaces around the city.
5. Directional signs and street name signs: providing information to people, especially when seeking direction and other relevant information, etc.
6. Benches: are popular, they provide for urban dwellers to sit on and rest place-tired feet.
7. Billboards (static, LED, and others): are used for advertisements or for information dissemination.
8. Shelters in different designs such as (bus shelters, kiosks for vending, etc): are for temporary activities or events, for instance carnival events. Shelters are used for dispersing information for instance information kiosks
9. Trash receptacles or bins: are for the collection of trash and litter and are placed along human traffic routes.
10. Cycle rakes: They are used as temporary storage for bicycles/ bikes racks, etc.
11. Clock: as a timekeeping edifice, a clock tower can be mounted at strategic locations in cities and rural areas for example Idumota clock in Lagos, Nigeria.
12. Streetlights: on streets for illuminating streets, walkways, and parks.
13. Public sculpture and memorials: are cultural elements within the urban sphere. They are located at strategic spots in the city. For instance, the Abuja city gate edifice is located at the city gate of Abuja.
14. Public lavatories and conveniences: for public use in markets, parks, and open spaces are provided in markets, parks, and public areas in Nigeria.

Other types of street furniture include telephone booths which have become extinct due to more modern technologies in communication. Traffic enforcement cameras, surveillance cameras for traffic enforcement and security, Parking meter, Portable toilet, Police box, Ticketing machine, Newspaper vending machine, Manhole, and manhole covers, Fire hydrant, Grating post, etc.

Determining Factors in Choosing and Placement of Street Furniture

Street furniture is an important complementary feature of the outdoor space and so their placement must be done to complement other existing city features and not to distract from it. The scale of the furniture should be such that when placed in a location it 'sits perfectly and in harmony with other surrounding features and landscapes. Standard designs when used will provide this requirement.

Design factors are:

Ultimate placement of street furniture is a professional one that evokes the creative instincts of the designer, so, functionality, scale, form, texture, material choice, colour, etc. are critical design factors for street furniture placement.

1. Usage: who uses the furniture whether the elderly, young, or very young, comes to play and is very important
2. Functionality defines what use or purpose the street furniture is to serve. This will determine what concept to apply as a design solution, (Goken, 2013).
3. Scale and dimensions are useful in determining the appropriateness of the street furniture placement by comparing it with other existing landscape elements.
4. Safety of the street furniture when in use. Only those that are certified as safe by the relevant agencies should be used so as not to endanger the safety of users. Another important factor to consider is weather resistant properties of the materials used. Some furniture may become unsafe if corroded. Whatever is finally decided on, it should be able to cope with expansion and contraction and withstand harsh climatic conditions.
5. Street furniture is expensive and mostly installed by the government. The high cost involved can hinder their deployment. The cost has to do with the available budget to fund placement.
6. Street furniture is supposed to be durable products as they are not changed on a regular basis. Public items that are not sturdy and robust easily attract attention and can become items for vandals to destroy.
7. In all of the open spaces, the furniture style needs to consider the local setting of the open space itself, but also the landscape character of the broader area, ensuring that a reasonable range of consistency is achieved across the various landscape character types; without the furniture dominating the landscape. (Urban Design Manual, 2013).
8. Some design standards and guidelines are usually provided by some municipal authorities for the placement of street furniture. Such guidelines/ manuals often prescribe flow, setback, and so on, such that pedestrian and vehicular traffic flow are not jeopardised by their placement and also such details as the preservation of the cultural landscape identity of the city.
9. In Nigeria, the Department of Development Control in most cities are guided by the Nigerian Urban and Regional Planning Decree of 1992. In Abuja, the Federal Capital City, for instance, the Department of Development Control is in charge of all developments in the city. They have jurisdiction over street furniture placements and can specify standards from time to time.

10. The Time-Savers for Landscape Architecture (Harris Charles, n.d.). and some other text materials provide additional information on street furniture and how it is to be placed.

Case Study on Provision of Street Furniture in Nigerian Cities

Abuja the Federal Capital City of Nigeria

Abuja the Federal Capital city of Nigeria was created through the Federal Capital Territory Decree of 1976. This was because Lagos was considered congested and lacking in cultural diversity. A symbol of unity was considered more desirable for security ethnic neutrality, central accessibility, comfort and health and having enough space for expansion. (Abuja master plan, 1979).

Abuja was designed to be a planned, modern city at initio. The Abuja master plan set up the city around the neighbourhood system, with different land use provisions. In the past 47 years, the city has developed to be one of the best-planned city in Nigeria with well-laid-out infrastructure such as roads, streetlights, and water supply servicing the diverse land use areas such as commercial Housing, Recreational, Industrial, etc.,

Street furniture has also become prominent in defining the landscape, and cityscape of Abuja. Some of the street furniture include:

1. Bus shelters are found along the streets and in parks, a few have small booths for vending. Some are branded and are used for advertisement.
2. Trash receptacles are found along major streets, markets, shopping malls and public buildings, and areas with high human traffic in the city.
3. Bills boards dominate the commercial areas in the city e.g the Central Business District (CBD), and Wuse 2, and serve for advertisement and information dissemination. Both static and LED types of billboards are found in the city. More green billboards powered by solar power are beginning to be installed.
4. Shelters and booths mostly for newspaper vendors. During festive periods such as Abuja Carnival, temporary booths are placed in strategic locations for information dissemination and for vending.
5. Street lights are commonplace in the city. The major expressways such as the Umaru Musa Yar' Adua expressway and Bill Clinton way leading into the city from Nnamdi Azikiwe Airport into Abuja, the Kubwa Expressway, Constitution and Independence Avenues.
6. Bollards are also found on major streets to control pedestrian and vehicular traffic.

Figure 1: Abuja Master plan

Source: Abuja Master Plan 1979

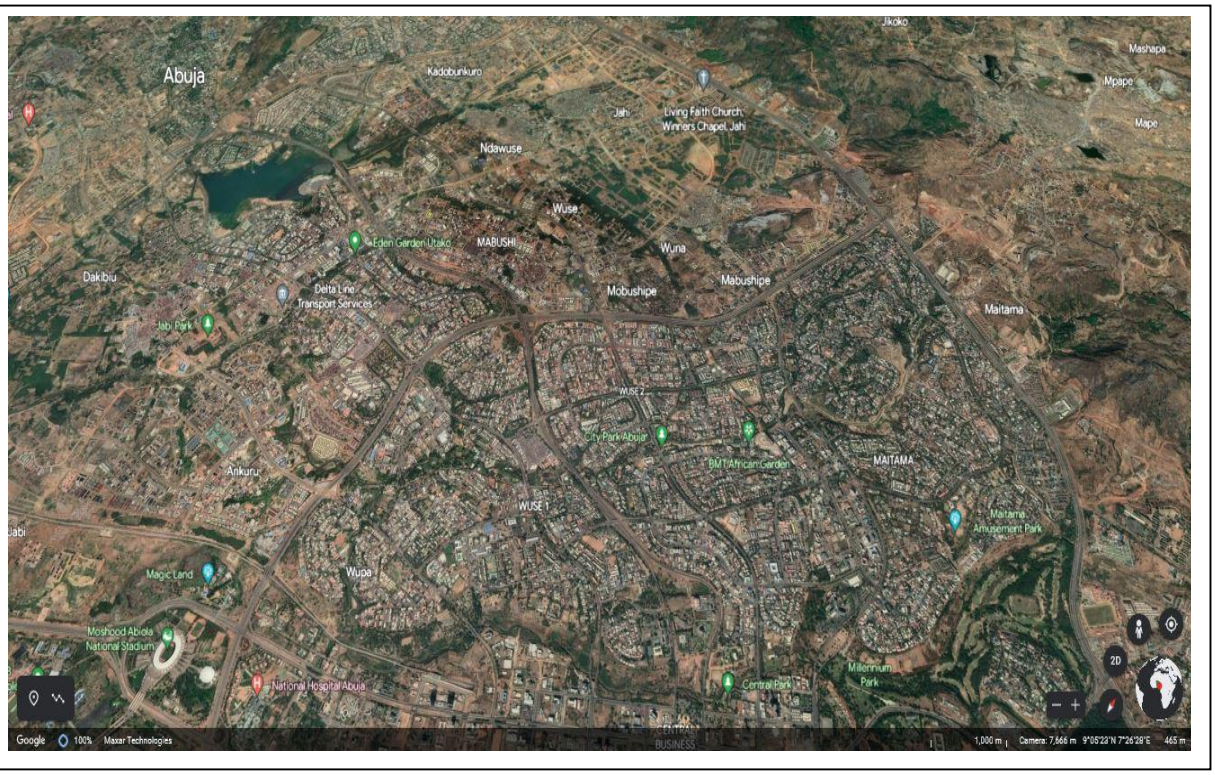

Plate 1: Abuja capital city.

Source: google earth accessed 24/03/23 10:30pm

Plate 2: Traffic light, street light, Abuja

Plate 3: LED bill board, Abuja

Plate 4: Waste bin, Abuja

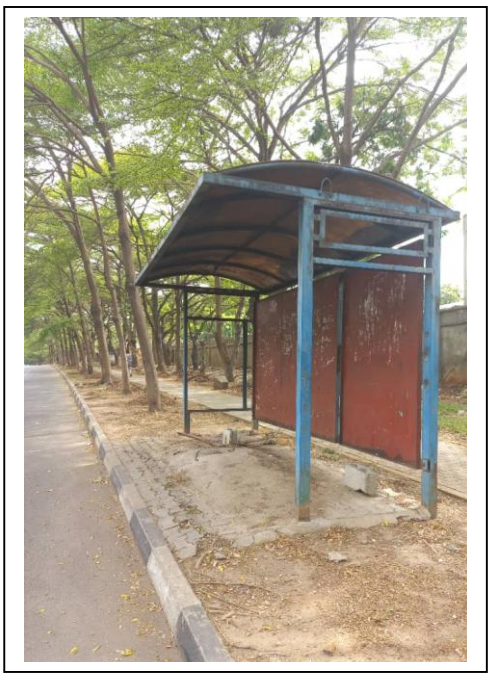

Plate 5: Bus stand, Abuja

(ii) Case Study of Enugu the Capital of Enugu State

Enugu is an old town in the Eastern Region of Nigeria. Enugu acquired township status in 1917 as second class with other towns like Ibadan, Aba, Kano after Lagos (Emenike, 2014). It functioned as the capital of the Eastern Region until states were created in 1967. It became the capital of the East Central State, then Anambra State in 1976 and finally Enugu State in 1991. All these time, Enugu has grown and keeps growing engulfing a lot of rural enclaves surrounding it (Ogui Nike, Amechi, Awkwanano, Emene, Ngwo), which has made the development of Enugu very difficult because, once there is creation of a new state the emphasis shifts, Enugu has to start again to re-order itself. There have been several attempts at Master-planning, the last was that of 1979, which entailed the demolishing a whole village and compensation making the cost development very high, then it was stalled. The subsequent governments settled for incremental development in sectors. Enugu has well laid out roads, some open spaces, street lights, public taps, public convenience, waste collection points, billboards, street names, traffic lights, bus stops, and a handful of sculptors at some prominent road junctions. The public taps, public toilets, waste collection points are down in history and are no more.

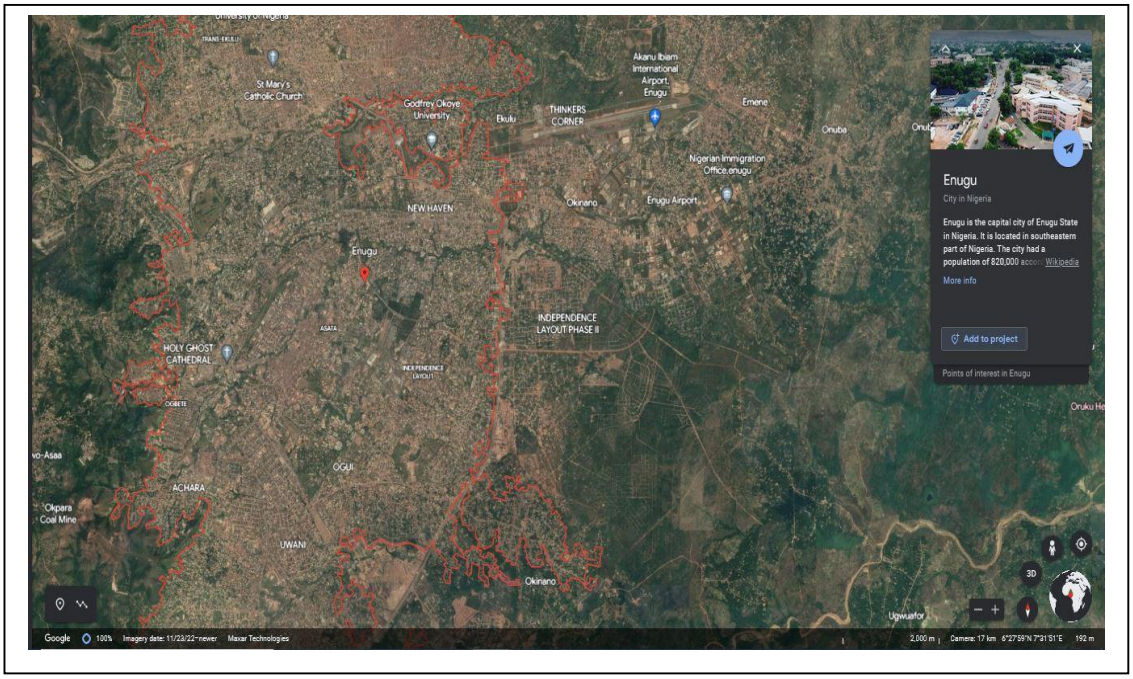

Plate 6: Enugu urban centre.

Source: Google Earth, accessed on 24/03/23 by 10:35pm

Plate 7: Street light, Enugu

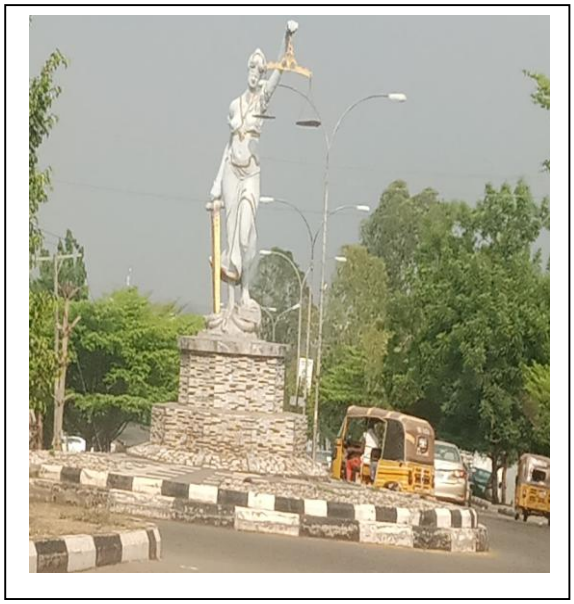

Plate 8: Statue at street junction, Enugu

Sights And Scenes of Street furniture From A Foreign Country

The pictures below show how street furniture is in use in Nottingham, United Kingdom to promote urban legibility. When compared with what is available in Nigeria, it is certain that a lot can yet be done.

Plate 9: Street furniture (seat, tree protection, grate, bollards), Nottingham, United Kingdom

Plate 10: Waste bin and street light, Nottingham, United Kingdom

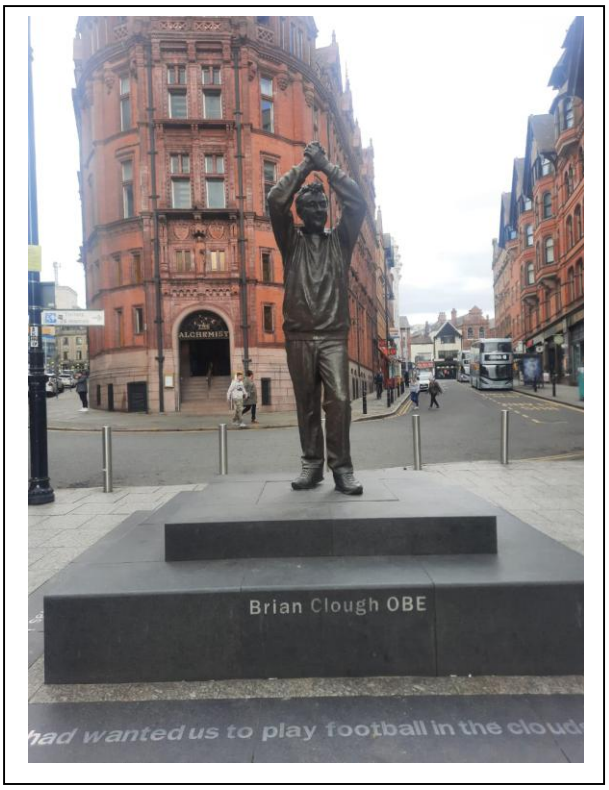

Plate 11: Statue, Nottingham Nottingham

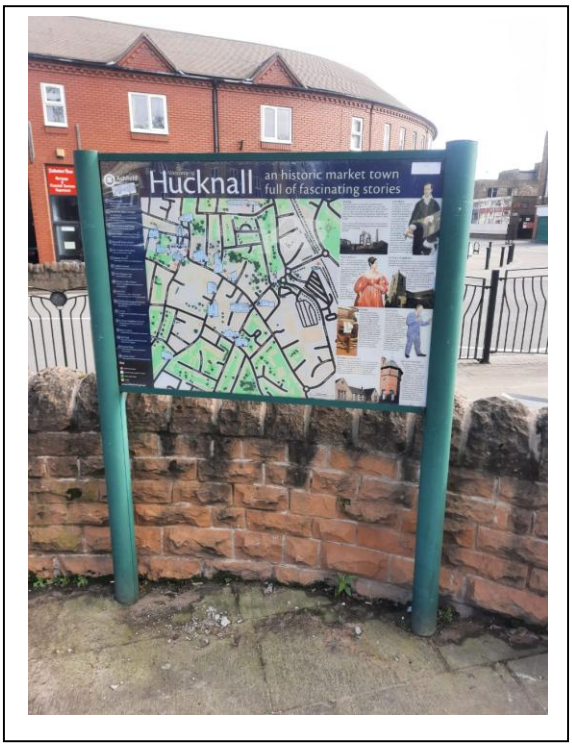

Plate 12: Street direction, Hucknall,

Summary

Street furniture is a vital instrument in urban spaces development. It revitalises and rejuvenates urban centres by creating functional and attractive areas for people to visit and relax. It can improve and make a difference to the physical and emotional well-being of the populace. A good composition of street furniture also endears legibility to urban areas.

Exercise

1. Design one of the following: (a) a kiosk for new paper-stand, (b) a park seat (for 3 persons), (c) a billboard for an up-coming hotel in a neighbourhood.
2. List five types of street furniture that the Urban Development Board of your city should immediately place in strategic places. For each one describe the social functions they will provide to improve your city.
3. You have been asked to place benches around your university campus. Describe 5 factors that will guide you on this assignment.
4. Identify five types of street furniture in your city or town. Comment on the social functions they play and what improvements may be needed.

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CHAPTER SEVEN: INTRODUCTION TO INTERIOR ARCHITECTURE AND DESIGN

Interior Architecture as A Discipline

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Overview

Interior Design is one of the new and rapidly growing professions in the design professions and is also expanding in knowledge base as an academic discipline. In the developed countries there are already professional associations and regulatory bodies for both the profession and the education of interior architects and designers. In many countries the reference to the profession and discipline as interior architecture and interior design is interchangeable, in this section the terminology-interior architect and interior architecture will be predominantly used.

This course explores the complex world of interior design education and practice, while discussing the meaning and scope of the profession, examining the regulatory frameworks governing the practice of interior design globally and in Nigeria, and exploring the history, pedagogy, and practice of interior design. It also identifies the challenges and opportunities for the growth of interior design education and practice in Nigeria. In this course, the diverse aspects of the interior architecture knowledge base are examined and described, with relevant supporting examples.

Objectives

The course objectives are to:

1. explore the Historical Evolution of Interior Design and Architecture;
2. define the Scope and Principles of Interior Design and Architecture;
3. examine the Role of Interior Architecture in the Built Environment;
4. demonstrate knowledge of the components of Interior Design and academic knowledge base; and
5. examine the history of interior design education globally and locally.

Introduction

This course is divided into three sections. The first is Interior Design as a Discipline. Interior design is a multifaceted discipline that incorporates elements of art, science, and technology to create beautiful and functional spaces. This section explores the academic discipline of interior design, including its theories and approaches. It also examines the

interdisciplinary nature of interior design and its relationships with other fields such as architecture, engineering, and psychology.

The second section focuses on History of Interior Design Education Globally and in Nigeria. Interior design education has evolved significantly over the years, both globally and in Nigeria. In this section, we will explore the historical development of interior design education globally and examine the current state of interior design education in Nigeria. It also identifies the challenges and opportunities for interior design education in Nigeria.

And the last section is about Interior Design Pedagogy and Practise Globally and in Nigeria. Interior design education and practice are constantly evolving, driven by advances in technology and changes in the industry. This section illuminates the pedagogy and practice of interior design globally and in Nigeria, including the role of technology. We will also examine the challenges and opportunities for interior design pedagogy and practice in Nigeria.

On completion of the course, students should be able to: provide a comprehensive overview of the historical development of interior architecture as a distinct discipline; clearly define the scope and fundamental principles of interior architecture as a discipline; analyse the significance of interior architecture in shaping the built environment; discuss the evolution of interior design as a discipline and its knowledge base; articulate the history of interior design identifying key landmarks in each period.

Interior Design as a Discipline

Interior design is a complex and multifaceted field. It is the technical, creative, and problem-solving profession that aims to improve the functionality and aesthetics of interior spaces. Interior design is a discipline that encompasses a wide range of skills that are necessary to design and create functional and beautiful interiors. This section explores the knowledge base of interior design as a discipline, discussing its history, principles, and current trends.

Historical Overview

Interior design has been practised for centuries, even if just formally recognised as a discipline in more recent times. Throughout history, different cultures have developed distinct styles, reflecting their traditions, values, and beliefs. For instance, ancient Egyptians, Greeks, and Romans created monumental interiors that embodied their respective civilisation's grandeur and love of aesthetics. In the Middle Ages, Gothic architecture gave rise to magnificent interiors characterised by high arches, pointed ceilings, and intricate details.

However, as a discipline, interior design emerged during the 20th century when it became necessary to adapt interior spaces to accommodate growing urbanisation and technological advancements. Modernist architects like Le Corbusier and Walter Gropius

rejected traditional ornamentation and decoration and proposed functional and minimalist interiors that adhered to the principles of Bauhaus. Simultaneously, designers like Gio Ponti, Charles Eames, and Ray Eames explored the versatility of new materials, such as plywood, plastic, and fibreglass, to create comfortable and practical interiors. In the 1960s, the postmodern movement challenged the modernist orthodoxy, leading to the emergence of diverse styles that emphasised pluralism and a return to decoration (Lees-Maffei, 2008).

Interior design is a rapidly-growing field that involves a wide range of theories and approaches. The primary goal of interior design is to create an aesthetically pleasing and functional space for people to live in. However, the theories and approaches that dictate the design process can vary greatly based on the designer, the client, and the intended use of the space. In this article, we will explore some of the key theories and approaches to interior design.

Approaches to Interior Design:

Creative Approach - This approach is focused on the designer's artistic vision and creativity. It often involves experimentation with colour, texture, and other design elements to create a unique and visually appealing space. An interior designer might create a visually striking restaurant by using bold colours, unusual lighting, and modern furniture to create a unique and memorable dining experience.

Functional Approach - This approach prioritises the functionality and practicality of a space over its aesthetic appeal. Interior designers who use this approach often work closely with the client to determine their needs and create a space that meets those needs. An interior designer might create a functional and practical home office by prioritising storage solutions and ergonomic furniture to ensure that the space is comfortable and easy to use.

Sustainable Approach - This approach is focused on creating environmentally-friendly spaces that minimise waste and reduce the carbon footprint of the design process. Sustainable designers often use recycled materials, energy-efficient appliances, and other eco-friendly elements in their designs. An interior designer might create an eco-friendly home by using reclaimed wood, recycled materials, and energy-efficient appliances to reduce the carbon footprint of the design process

Collaborative Approach - This approach involves working closely with the client and other stakeholders in the design process to ensure that everyone's needs and preferences are taken into account. Collaborative designers often use a mix of creative and functional approaches to create a space that meets everyone's needs. An interior designer might work with a family to create a shared living space that meets everyone's needs, incorporating features like comfortable seating, storage solutions, and appealing decor that reflects each person's personality and preferences.

Knowledge

The next iterations of that question move the discussion in three principal directions. What kinds of knowledge do interior designers need to do their work? What knowledge does the interior design profession require to remain viable now and not merely relevant in the future, but a powerful force for social change? Ultimately, how can design practitioners and educators create a body of knowledge that is unique to interior design? How can this body of knowledge put us on a level playing field with other professions, sustain our profession over the long term, and give designers opportunities to influence new thinking in our industry.

Knowledge Base of Interior Architecture

Expert knowledge of the arts, sciences and social sciences in recognised institutions offering interior design as a specialist design field is a requirement that the discipline is different from decoration, fashion or just commerce. The scientification of the curriculum in institutions also makes it distinct from the superficial nature of decoration, furniture design and upholstery and aligns it with the other scientific-driven design disciplines like architecture and engineering (Cys, 2013).

The tendency to distinguish interior architecture, interior design, interior decoration and architecture and other 'neighbours' or distinguishing the discipline from the 'others' is often debated in interior design academy. Knowledge required by interior designers include:

1. Fundamentals of Design

Creativity should be innate to any design student and the skill to initiate and represent and present ideas should be developed. Art and design theories, design principles, design and human behaviour, and design-related history and design process are critical knowledge areas.

2. Spatial Design Thinking and Performance

'*Spatial ability, defined as the ability to visualise, imagine, translate, and interpret 2D and 3D spatial information, is a crucial building block required for the interior design and architecture professions*' (Cho and Suh, 2021).

Design concepts or ideas from the mind is translatable in 2 or 3D drawings, sketches or models. The spatial ability to represent space and everything within it including circulation, views, and experiences; their presentation and communication to others is essential for an aspiring interior architect. Spatial ability and spatial thinking are critical to problem solving, academic and practice success in interior architecture (Ndovela & Olalere, 2023). It is so important that recently an Architecture and Interior design Spatial Ability Test (AISAT) using environmental data indices rather than abstract objects has been in the process of development in the past 10 years (Cho & Suh, 2021).

Interior design is an art and science of enhancing the interior spaces to achieve a healthy and aesthetically pleasing environment. The discipline focuses on the design of the interior space, including furniture, layout, and lighting. Interior design as a discipline requires an understanding of various fields such as architecture, engineering, and psychology. It involves designing spaces that meet both functional and aesthetic requirements. Interior designers work with architects to ensure that the spaces they design meet building codes and regulations. They may also work with contractors, engineers, and other professionals to ensure that the project is delivered within the budget and the specified timeframe.

Interior design also takes into consideration various environmental factors such as lighting, acoustics, and airflow. Designers must ensure that spaces have ample natural light, proper ventilation, and adequate sound insulation. They may also incorporate sustainable or eco-friendly materials in their designs to minimise the impact on the environment. One of the key elements of interior design is spatial planning. Designers must understand the flow and use of space to create a functionally efficient and aesthetically appealing environment. They must consider the movement of people within a space and how different areas of the space will be used.

In addition to spatial planning, interior designers must also consider the selection of materials, colours, and textures. They must have an eye for detail when selecting pieces of furniture, fixtures, and decorations. They must consider how different materials will work together to create a cohesive design scheme and how colours and textures can enhance the mood of a space. Interior designers must also consider the needs and preferences of their clients. They work with their clients to understand their lifestyle, interests, and vision for the space. Designers must be able to communicate effectively with their clients and understand their needs to create a space that reflects their personality and style. The discipline of interior design has evolved over time. Today, it is a multi-faceted field that incorporates various skills, including graphic design, modelling, and rendering. Interior designers use computer programs and software to create 3D models and visualisations of their designs, allowing clients to see how the finished project will look before construction begins.

Principles in Interior Design

Interior design is based on several principles that guide designers in creating functional and aesthetic spaces. The following are the foundational principles of interior design:

1. Functionality

Functionality is the most crucial principle of interior design. Interior spaces should address the needs of its occupants, perform its intended purpose, and be aesthetically pleasing. The design of interior spaces should enable people to move around freely, avoid clutter, and enhance their quality of life. A functional space utilises every square inch of the room without being cramped.

2. Balance

Balance refers to the distribution of visual weight in a space. Interior spaces should be balanced in terms of colour, texture, and visual elements. Balance can be symmetrical, whereby each side of the room is identical, or asymmetrical, whereby various components are balanced through their visual weight.

3. Harmony

Harmony refers to the cohesiveness of interior design elements. Within a room, it dictates that each element should complement each other and create a unified look, feel, and atmosphere. Furniture, fixtures, and decorative items should create a harmonious arrangement.

4. Rhythm

Rhythm refers to the repetition or progression of visual elements in a room. It can be achieved through the careful planning of furniture placement, lighting, colour combinations, or pattern arrangements. Rhythm creates movement and continuity within a space.

5. Emphasis

Emphasis refers to the focal point in a room. It can be created through a contrasting colour, texture, or a unique piece of furniture, lighting, or artwork. Emphasis guides the viewer's attention to a particular item or area in the room.

Current Trends

Interior design is constantly evolving, and current trends reflect changes in the way we live, work, and interact with each other. The following are some of the recent trends in interior design:

1. Sustainability

Sustainability has become a buzzword in interior design. Designers and consumers are increasingly aware of the environmental impact of the products they use and seek to make environmentally responsible choices. Sustainable design focuses on reducing waste, conserving energy, and utilising eco-friendly materials (Allu-Kangkum & Ebohon, 2018; Affandi, Za'bar, Yaman, & Noorhani, 2022).

2. Natural and organic elements

Natural and organic materials like wood, stone, and clay create a welcoming and soothing environment, prompting people to reconnect with nature. Furniture and décor made from natural materials create a sense of comfort and relaxation.

3. Mixed materials

Designers are integrating different materials, textures, and finishes to create unique and visually compelling interiors. Combining metals, wood, glass, and other materials can create an interesting balance and add visual interest to any space.

History of Interior Design Education Globally and in Nigeria

The history of interior design education in the Tropics dates back to the colonial era when design education was introduced to African countries. Informal interior design education began with the craftsmen guilds during the pre-colonial era. The craftsmen in Nigeria formed guilds to protect their interests and maintain standards of quality in their work. These guilds were often based on family or ethnic ties and included blacksmiths, woodcarvers, potters, weavers, leatherworkers, and others. With the arrival of European colonialism in the late 19th and early 20th centuries, guilds were disrupted as traditional crafts were undermined by the introduction of Western goods and commercialised production techniques.

After Nigeria gained independence in 1960, there was a renewed interest in indigenous crafts and artisanal skills, and some efforts were made to revive traditional guilds. However, modernisation, globalisation, and urbanisation have continued to challenge the role and relevance of craft guilds in Nigeria's economy and society.

Formal interior design education in Nigeria did not exist until the first interior design studies were introduced under the architecture programme which was established at the Ahmadu Bello University in Zaria in the 1960s. Programmes were designed to remotely promote the study of interior design as an aspect of industrial design and art education, focusing on regional materials and integrating traditional African concepts into contemporary interior design.

In the 1970s and 1980s, other design schools such as Yaba College of Technology in Lagos and Auchi Polytechnic in Edo State also started offering courses in interior design. These courses primarily focus on teaching students' technical skills such as painting and furniture making. The 1990s marked a sea change in the way interior design education is taught in Nigeria. The emphasis was on a more holistic approach combining technical skills with theoretical knowledge and research.

More programs are beginning to appear at universities across the country with the goal of producing graduates who can compete on the world stage. Interior design education is on the rise in Nigeria today with an increasing number of universities offering degree programs in the field. The program is designed to equip students with the skills, knowledge and experience needed to excel in the interior design industry locally and internationally.

Globally, there are programs that combine intermediate science, architecture, engineering and ecological in the comprehensive education and design and interdisciplinary design. In addition, the principle of design is the centre of many internal design programs, which reflect the increasing situation of the environment. In short, interior design education evolved in the 20th century from a specialised approach to a standardised, specialised discipline. As the industry continues to evolve, more changes

and advancements may occur as the profession adapts to new trends, materials and technologies.

Evolution of Interior Design Education

Interior design education has undergone significant changes over the years, both in terms of curriculum and teaching methods. The evolution of interior design education has been driven by changes in industry trends, advancements in technology, and the need to produce well-rounded graduates who can meet the demands of the profession. In the past, interior design education was often focused on the technical aspects of the profession, such as drafting and rendering. However, with the advent of computer-aided design (CAD) software, these skills have become less important. Today, interior design programs focus more on design theory and the creative process, as well as business skills such as marketing and project management.

Another significant change in interior design education is the move towards interdisciplinary studies. Many programs now offer courses in related fields such as architecture, engineering, and sustainability. This approach helps students to understand how their work fits into the broader context of the built environment and encourages collaboration between different disciplines. The use of technology has also had a significant impact on interior design education. Students now have access to a wide range of software tools that allow them to create 3D models, visualise designs in virtual reality, and collaborate with team members remotely. These tools have made it easier for students to experiment with different design ideas and to present their work in a more professional manner. In addition to changes in curriculum and teaching methods, there has also been a shift towards more diverse and inclusive interior design education. Many programs now focus on issues such as social justice, cultural sensitivity, and environmental sustainability. This approach helps students to understand the impact that their work can have on society and to develop a more holistic approach to design.

Interior Design Pedagogy and Practise Globally and in Nigeria

Interior design is a dynamic and ever-growing discipline that is rapidly gaining popularity in the world of design. It is the art and science of designing and creating spaces that not only look aesthetically pleasing but are also functional and safe for human occupation. The primary goal is to equip students with the necessary skills, knowledge, and expertise to succeed in this highly competitive industry.

Understanding the design process

The interior design process involves several stages, from conceptualisation to implementation. It is important for students to understand each stage and the role they play in order to effectively execute a project. Students should learn about the fundamental principles and elements of design, such as colour theory, space planning, proportion, balance, contrast, texture, and lighting (Hamdy, 2017; Ontita, Chepchumba,

& Serem, 2019). These principles and elements are the building blocks of interior design and should be understood and applied by students in their design work.

Design is not just about aesthetics; it also involves conducting research on the client's needs, the space, and its intended purpose. Students should be taught how to conduct user-centred research and apply the findings to their design solutions. Interior design is a collaborative process that involves communication between the client, designer, and various stakeholders. Students should learn how to effectively communicate their ideas through sketches, renderings, and 3D models, as well as verbally and in writing.

Interior designers have a responsibility to design spaces that are environmentally sustainable and socially responsible. Students should learn about sustainable materials, products, and practices that can be incorporated into their designs to create healthier and more sustainable spaces. Technology is rapidly evolving and is an essential tool in interior design. Students should be taught how to use design software, such as CAD and 3D modelling programs, as well as other tools that can enhance their design work (Siltanen, Oksman & Ainasoja, 2013).

Pedagogy

In a rapidly changing and ever-evolving field like interior design, pedagogy plays a crucial role in shaping the way students learn and correlate theory with practice. The pedagogical approach to teaching interior design should foster creativity while at the same time, encouraging students to think critically about the various aspects of design. To achieve this objective, A student-centred approach to teaching that aims to create a conducive learning environment, is encouraged as it is both inclusive and engaging.

The student-centred approach to pedagogy places the student at the centre of the learning process. It means that students are actively engaged in the learning process, and the lecturer serves as a facilitator. The lecturer provides necessary guidance, support, and direction, but the students are given the freedom to explore and develop their own ideas and concepts. The process involves a series of interactive activities, wherein students are encouraged to express their creativity, think independently, and critically analyse various design cases. In doing so, they learn to develop their style and approach to interior design and eventually build their confidence in making informed design decisions.

To facilitate this learning process, a variety of teaching strategies, such as lectures, group discussions, case studies, design projects, and field trips are utilised. Lectures are the most common teaching method in interior design classes, where lecturers provide students with theoretical knowledge and concepts that are fundamental to the discipline. Students learn the principles of design, colour theory, space planning, and ergonomics to gain a comprehensive understanding of the design process.

However, the lecture format is inadequate to cover all aspects of interior design. Therefore, it is supplemented with other teaching strategies that encourage students' active participation. Group discussions are effective in stimulating critical thinking, wherein students share their ideas, thoughts, and opinions on different design cases. This approach promotes collaboration, teamwork, and enhances communication skills.

Design projects are essential in interior design courses as they provide students with hands-on experience in different design processes. Students work on projects that challenge them to apply their design skills, creativity, and knowledge of different design principles to a real-world problem. This approach provides a platform for students to encounter diverse design problems and develop innovative solutions. During design projects, students learn to integrate theory into practice, work collaboratively, and develop their problem-solving and decision-making skills.

Field trips are an excellent extension of interior design courses, as it allows students to experience design in real-life settings. They visit design firms, design exhibitions, and architectural landmarks that provide exposure to different design trends, styles, and approaches. This approach allows students to co-relate theory with practice and understand the relevancy of interior design in today's world.

Practice

Apart from imparting theoretical knowledge, it is equally important to teach students to apply design principles to practical situations. Therefore, in interior design courses, students are encouraged to take part in various design competitions, exhibitions, and internships that provide them with an opportunity to apply their skills in industry settings. Interior design is a profession that requires ethical conduct, business skills, and knowledge of industry standards and practices. Students should learn about the legal and ethical aspects of the profession and the different career paths available in the field.

Design Competitions, Exhibitions and Internships

Design competitions are an effective way for students to showcase their skills and gain recognition. It gives them an opportunity to take their design work to a larger audience and compete with other designers in the industry. Competition also provides students with positive feedback, which promotes perseverance, creativity, and problem-solving skills. Design exhibitions provide an opportunity for students to showcase their work to a wider audience. It helps students develop effective ways of communicating design concepts to a broader audience and be aware of contemporary design trends.

Internships are an excellent avenue for students to connect with the industry. It provides practical experience in different areas such as design, marketing, sales, and project management. It helps students to learn about the different career paths available in the industry and work with experienced professionals who can provide valuable guidance and mentorship.

Summary

Interior design is a complex and multi-disciplinary field that combines technical skills with creativity and artistry. A deep understanding of the principles of balance, harmony, rhythm, emphasis, and functionality is paramount for effective interior design. Understanding the historical evolution and current trends helps designers stay current and relevant in designing spaces that are functional, aesthetically appealing, and sustainable.

The theories and approaches used by designers can vary greatly based on the client, the intended use of the space, and other factors. The approaches to design, like the creative approach and the functional approach, provide a roadmap for achieving the client's goals. Ultimately, the key to successful interior design is to listen to the client's needs and preferences and use the theories and approaches that best meet those needs.

Interior design as a discipline plays a vital role in shaping the built environment. It combines art and science to create functional, aesthetically pleasing, and sustainable spaces (Chou, 2023). Designers must have a broad range of skills and knowledge to address the challenges of designing spaces that cater to the needs of their clients and the environment (Moubarak, Eid, El Zahraa, & Khalil, 2020). As the field continues to evolve, interior design will remain an essential discipline that helps shape the way we live and work.

Overall, the evolution of interior design education has been driven by a desire to produce graduates who are well-equipped to meet the demands of the profession. By embracing new technologies, interdisciplinary studies, and a more diverse and inclusive approach, interior design programs are preparing students for a rapidly changing industry.

In addition, the primary goal is to provide students with the necessary theoretical knowledge and practical skills that will enable them to succeed in the industry. The student-centred approach encourages students to think critically, develop their style, and apply their creativity to solve real-world problems. Additionally, the practice is a crucial aspect of interior design courses, allowing students to apply their skills in different contexts, gain recognition and connect with the industry. Interior design courses not only teach students to create a visually pleasing design but also make an environment that is functional and safe for human occupation. These are just a few of the key topics that should be included in interior design pedagogy. It is important for students to develop a well-rounded education that prepares them for the dynamic and complex field of interior design.

Exercises

1. What is the academic discipline of interior design?
2. What are the various theories and approaches to interior design?
3. How does interior design relate to other fields, such as architecture and

psychology?
4. How has interior design education evolved over the years globally?
5. What is the current state of interior design education in Nigeria?
6. What are the challenges and opportunities for interior design education in Nigeria?
7. What is the role of technology in interior design education and practice?
8. What are the unique challenges and opportunities for interior design education and practice in Nigeria?
9. How can interior design education and practice be improved in Nigeria?

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Interior Architecture as A Profession

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Overview

Interior Design is one of the new and rapidly growing professions in the design professions and is also expanding in knowledge base as an academic discipline. In the developed countries there are already professional associations and regulatory bodies for both the profession and the education of interior architects and designers. In many countries the reference to the profession and discipline as interior architecture and interior design is interchangeable, in this section the terminology-interior architect and interior architecture will be predominantly used.

This course explores the complex world of interior design education and practice, while discussing the meaning and scope of the profession, examining the regulatory frameworks governing the practice of interior design globally and in Nigeria, and exploring the history, pedagogy, and practice of interior design. It also identifies the challenges and opportunities for the growth of interior design education and practice in Nigeria.

Objectives

The course objectives are to:

1. demonstrate knowledge of the scope of interior design as a profession;
2. develop students understanding of the role and responsibilities of interior designers in the built environment;
3. discuss the challenges facing interior design as a profession and the struggle for identity;
4. explain regulatory practices and methods of gatekeeping interior design as profession globally and locally and;
5. examine professional aspects of the history of interior design professional education globally and locally.

Introduction

This course is divided into three sections. The first section is interior design as a profession. Interior design is a complex profession involving transforming spaces into functional and aesthetically pleasing environments. This first section examines interior design as a profession, including its meaning and scope, job opportunities, and the importance of creativity and innovation.

The second section is about the regulation of interior design as a profession globally and in Nigeria. Regulation is an essential part of any profession, and interior design is no exception. In this section, we will explore the regulatory frameworks governing the

practice of interior design globally. We will also discuss the current state of regulation of the profession in Nigeria and the importance of regulation in promoting professionalism and protecting the public.

Finally, the third section focuses on the history of interior design professional education globally and in Nigeria. Interior design education has evolved significantly over the years, both globally and in Nigeria. In this section, we will explore the historical development of interior design education globally and examine the current state of interior design education in Nigeria. It also identifies the challenges and opportunities for interior design education in Nigeria.

Objectives

On completion of the course, students should be able to:

1. describe the interior architecture profession and its scope;
2. understand the role and responsibilities of interior designers distinct from other professionals in the built environment;
3. identify and discuss challenges facing interior design as a profession locally and globally;
4. understand regulatory practices in interior architecture as a profession; and
5. articulate professional aspects of the history of interior design identifying key landmarks in each period.

Interior Design as a Profession

Interior design is a dynamic profession that involves designing the spaces we live, work and play in, which involves creating attractive environments with functional layouts. With the rapid growth of the construction and real estate industry, the demand for interior designers is increasing and creating substantial opportunities for professionals. This section aims to provide a comprehensive understanding of the interior design profession as a whole.

The History of Interior Design

Interior design can trace its roots back to the ancient civilisations that were obsessed with their living spaces' aesthetics. The Egyptians were known for their luxurious yet practical interior designs. The Greeks and Romans went a step further by incorporating columns, domes, and other decorative elements into their architecture. The Gothic and Renaissance periods saw a revival of intricate designs that featured ornamental and colourful features. Today, interior design has evolved to reflect modern, minimalistic and high-tech preferences.

Qualities of Successful Interior Designers

Interior designers must possess excellent interpersonal, communication, and problem-solving skills. Successful designers must be creative and innovative in their approach to

projects. They must also be organised, detail-oriented, and able to work well under pressure. Additionally, interior designers must be able to work within a budget and meet project deadlines efficiently.

Educational Requirements for Interior Designers

A career in interior design carries many pre-requisite qualifications. A bachelor's degree in interior design, architecture or a related field is required to enter this profession in most countries. A master's degree in interior design or architecture can increase employment opportunities within the field and open doors to more significant job responsibilities. In addition to formal education, the professional designer must also be familiar with the latest design software and technology to keep up with the industry's ever-changing technological landscape.

Career Opportunities

Interior designers can work in several sectors, including residential, commercial and hospitality. They can also specialise in specialties such as healthcare, sustainable design, or lighting design. Career opportunities in interior design include design consultants, design studio managers, teaching, and government positions. Established interior designers may choose to focus on areas such as home staging or design wholesale (Bureau of Labor Statistics, U.S. Department of Labor, 2022). Furthermore, interior designers can work independently or work with large design firms that offer their services globally.

Professional Identity?

Professional identity for Interior design refers to the unique set of qualities, skills, and practices that distinguish an interior designer from others in their field. It encompasses a combination of technical, creative, and communication abilities that enable designers to collaborate with clients, contractors, and other professionals to create interior spaces that meet specific functional, aesthetic, and budgetary requirements (White, 2009; Mwanza, 2016). Professional identity for interior design also includes a solid understanding of design principles, building codes, and industry regulations, as well as the ability to seamlessly integrate technology and sustainability into their work. It also demands a dedication to ongoing learning and professional development, maintaining ethical standards, and upholding professional conduct. Overall, a strong professional identity is critical for interior designers to build their reputation, establish their expertise, and ultimately succeed in this competitive and ever-evolving profession.

Interior Architecture and the struggle for identity

Interior Architecture is now one of the design professions. It is distinct from Architecture and Interior decoration. Interior architecture as the nomenclature clearly spelt out deals with everything that makes the inside of built environment functional, safe and

aesthetically satisfying in differing sociocultural and economic contexts amongst other design product attributes (White, 2009). However, interior decoration has priority for beauty or embellishment of surfaces and products often without design principles since practitioners lack design education and professional ethos. Craftsmen, Artists and Architects earlier designed interiors for the wealthy before the advent of interior decorators and interior architects. The profession grew out of the need of corporate organisations, especially owners of office buildings' desire for uniqueness. Art Gensler, a Cornell University graduate, located this need and established an office in San Francisco in 1965.

A few architecture firms offered corporate interior design services, for example, Skidmore, Owings & Merrill's Davis Allen but Gensler purposely organised and positioned their small office for design and interior architecture. In the developed world there was the initial struggle to distinguish between architecture, interior architecture and interior decoration. However, the struggle of identity is over in the developed world with the market and demand for interior architecture services and the gradual professionalisation and academic institutionalisation, a process just being followed in many developing countries including Nigeria (Kunrath, 2019).

Every profession has a history of struggles for recognition including architecture from which interior architecture is developing from. There are many specialisations that have come out of architecture since the age of the architect as the 'master builder' and in contemporary times each of these specialisations now compete for design needs in the construction and built environment as Built Environment Professionals (BEPs). What distinguishes every profession as a profession or discipline is creating a unique knowledge base, establishing relevance in the society, continuing professional and academic development to sustain present existence and reinventing in interaction with the society to meet future needs.

Characteristics of a Professional

Professionalism is attained through the process of formation to attain professional identity. Ideas of 'new professionalism' 'hybrid professionalism' and 'organisational professionalism' posit that today professionals are not always practising as the self-employed Anglo-American sociology of the professions but are usually in organisations needing competing managerial, commercialisation, and public accountability skills (Chaney, 2007; Aven & Andreassen, 2020). An ongoing debate is whether the social and public responsibility roles of the professions combined with the sense of morality imposed by professional ethics have dwindled and given way to expert professionalism in the latter half of the twentieth century. Brint (2015) while emphasising specialised training of professionals in commercialised ventures perceives that expert professionals rarely have issues with utilising expert skills in dealing with low-minded business people (Aven & Andreassen, 2020).

Earlier writers' dwell on understanding and correctly interpreting the history of the profession and present concerns and commitment to the advancement of the profession and its future as markers of professionalism. Keeping up-to-date about latest advances and professional attitude in dealings with other professionals in the industry and clients and being business-like in all operations characterise professionals.

The Future of Interior Design

The interior design industry is consistently evolving with advances in technology, changing market trends, and client demands. The trend towards sustainable and eco-friendly designs is also gaining popularity (Afacan, 2013). The future of this profession is expected to be shaped by the need to promote green and wellness designs for homes and workplaces.

Regulation of Interior Design as a Profession and Globally in Nigeria

The need for regulation in the interior design industry

The interior design industry is a dynamic and rapidly growing profession that has become a significant contributor to the global economy. The demand for interior design services has increased due to the growing interest in enhancing spaces, whether they are residences, workplaces, or commercial establishments. With this increase in demand, regulation has become a pressing concern for many in the industry. There are several reasons for need for regulation of the fast-developing profession of interior design:

Public Safety

The most crucial reason for regulation in the interior design industry is to ensure public

safety. Interior designers work on spaces that people inhabit, and the designs they create must ensure that these spaces are safe and functional. Safety hazards such as wiring, lighting, ventilation, and structural issues need to be taken into account when designing. These issues require trained and skilled professionals who understand the requirements for safe and functional spaces. Regulation provides assurance that an interior designer meets qualifying standards such as education, experience, and training.

Professionalism

Regulation in the interior design industry ensures that only qualified and professional individuals can work on projects. During the certification process, interior designers go through specific standards and criteria to ensure competency in the industry. Being certified implies that the designer meets predetermined standards and codes of ethics. As such, certification enhances professionalism and trust in the industry—a critical requirement for ensuring that interior designers remain responsible and accountable in their work.

Standardisation

Interior designers work in various countries and states, and standards vary widely from place to place. Regulation can create a standard that can be adopted by the industry. A set of guidelines to follow creates a degree of uniformity in design, ensuring consistent quality work. It enables the industry to create a minimum requirement for education, training, and experience, ensuring that they meet a particular level of competency. Certification ensures the level of consistency in the interior design industry.

Quality assurance

Regulation in the interior design industry ensures that consumers will receive quality assurance. Industry regulation ensures that designers use materials that are up to societal standards. The quality of products used in a home or a workplace has a direct impact on personal health and wellbeing. Regulation also ensures that interior designers complete a specific project within a specific period without compromise on quality.

Economic Growth

The interior design industry contributes significantly to the global economy. Regulation in the industry enhances investor confidence, which leads to the creation of more jobs and economic growth. Regulation attracts investors to the sector, and it gives consumers the confidence to hire interior designers, knowing they are professionally trained and passed an examination. The consumers' trust in the industry leads to professional commitment to the consumer, resulting in high-quality work.

Consumer Protection

Regulation in the interior design industry can help protect the consumer. The regulation aims to ensure that interior designers follow certain guidelines to ensure environmental sustainability. The interior designer is obliged to create eco-friendly and sustainable design. It ensures that the interior designer will not ignore the current and future environmental needs of society. The areas that need to be sustainable are lighting, insulation, energy conservation, and waste management. Interior designing can affect the broader environment, and regulation ensures that interior designers must consider matters concerning the environment.

In conclusion, the interior design industry has experienced tremendous growth over the years. With increasing demand, regulation has become necessary in ensuring public safety, enhanced professionalism, standardisation, quality assurance, economic growth, and consumer protection. Interior designers must be qualified and professional to ensure that their designs are safe, functional, and sustainable. Industry regulation ensures that interior designers are accountable for their work, and this makes the industry more reliable, consistent, and trustworthy

Interior architecture and gate-keeping

Every profession starts by having associations even if not backed by law for social interaction and accompanying benefits of networking and preparation for eventual regulation, registration and public authorities' recognition. Friedrichs (2002) informs that the American Society of Interior Designers (ASID) and International Interior Design Association (IIDA) had to embark on this struggle for recognition and protection of interior design practitioners before the coming of registration boards, licensing and regulatory authorities in the United States. The associations in the United States include Council for Interior Design Accreditation (CIDA), American Society of Interior Designers (ASID), Interior Design Educators Council (IDEC), International Interior Design Association (IIDA), National Kitchen and Bath Association (NKBA) and regulatory and licensing board include National Council for Interior Design Qualifications (NCIDQ) in the United States. Also, In the UK, Europe, Asia and Africa, there are regional interior architecture bodies such as International Federation of Interior Architects/Designers (IFI), African Institute of the Interior Design Professions (IID), Association of Professional Interior Designers (APID) in the MENA region and Dubai. In Nigeria we have burden associations like the Interior Design Association of Nigeria (IDAN) that are holding the forte while the Nigeria Institute of Architects and the Architects Registration Council of Nigeria are taking steps to integrate the Interior Architects into the association and regulatory frameworks.

Gatekeeping is a necessary step to define the framework of all professional fields to protect the interest of all stakeholders- the potential clients and client organisations, the society at large, public welfare against individual wellbeing, the rights of each against that of the 'others', and the rights, benefits and risks of professionalism for the professionals.

The debates about what constitutes the minimum knowledge or qualification of an interior architect will continue to evolve as the profession develops in the midst of other certified BEPs and non-certified practitioners will continue as the demand for interior services and the response in supply and qualitative services continues. The accreditation bodies for institution-based interior architecture design programmes exist with more coming up as the profession grows from the developed countries to the developing countries. There is the Council for Interior Design Accreditation (CIDA) while Interior Design Educators Council (IDEC) facilitates interaction of educationists and interior design schools in the US. In addition, interior architects associate closely with Architects by being members of the American Institute of Architects (AIA) and with continuous academic development register with the U.S. Breen Building Council (USGBC) and the Construction Specifications Institute (CSI).

Three major steps are necessary for an occupation to become professionalised. One of the major steps in professionalisation of an occupation that is being practised is to define the knowledge necessary for training new entrants, use this defined knowledge to

accredit training institutions with this knowledge derived from the requirements of practice and academic progress of the occupation to become a present and future discipline.

Regulatory frameworks for interior design in Africa

Regulatory frameworks for interior design in Africa vary widely between countries, and the practice is still in its early stages in many nations. However, several African countries, including Nigeria, have developed regulatory frameworks to guide the practice of interior design. The NIA has developed a code of conduct that outlines the standards of professional practice for architects, including interior designers who are registered with the institute. The code aims to ensure that architects, including allied professionals, adhere to ethical and professional standards in their practice.

The Architects Registration Council of Nigeria (ARCON) is the regulatory body responsible for regulating the practice of architecture and its related disciplines, including interior design. As per the provisions of the Architects Registration Act of 2004, ARCON's mandate is to:

1. regulate the training of architects in Nigeria;

2. maintain the register of architects in Nigeria;

3. regulate the practice of architecture;

4. represent the interests of architects; and

5. regulate architectural education in Nigeria.

While ARCON's primary focus is on regulating the practice of architecture, it recognises interior design as a related discipline. As such, ARCON has a role to play in the regulation of interior design in Nigeria. ARCON has laid out specific requirements for interior designers and how they should practise interior design. The Interior Designers Association of Nigeria (IDAN) established in 2007, seeks to promote and advance the interior design profession in Nigeria. ARCON also specifies that interior designers must work under the supervision of registered architects, who should sign and seal their designs. Thus, ARCON's involvement in interior design regulation is through collaboration with professional organisations', including IDAN.

Furthermore, ARCON's mandate to regulate architectural education ensures that interior design education in Nigeria meets industry standards. This includes ensuring that interior design programs provide adequate education in technical aspects such as safety and functionality requirements in designing interior spaces. Interior design educators and curriculums in Nigeria must be accredited by ARCON for their programs to be recognised by the regulatory body.

The Interior Designers Association of Nigeria (IDAN)

IDAN is Nigeria's leading professional organisation for interior designers. The organisation aims to promote and advance the interior design profession in Nigeria. It provides a forum for professional development, networking, and information sharing among interior designers and other stakeholders in the industry. IDAN advocates for the recognition of the interior design profession in Nigeria and represents Nigerian designers to regulatory bodies and other stakeholders. IDAN requires its members to hold a degree (BSc or HND) in interior design from a recognised institution and must have a minimum of 2-5 years post-graduation experience. In addition, IDAN members are expected to adhere to a code of ethics that guides their professional conduct. The code outlines the designers' roles and responsibilities, principles of practice, and ethical standards.

History of Professional Aspects of Interior Design Education Globally and in Nigeria

History of Interior Design Education as a step towards professionalisation of the discipline

Interior design education has a varied history, with different stages of development depending on the region and cultural context. The general direction of the evolution of interior design education is the attempt to professionalise the discipline by acquiring, standardising and institutionalising knowledge and skills (Lees-Maffei, 2008).

1. Early 20th Century: The Emergence of Interior Design as a Profession During this period, interior design was not yet recognised as a profession and there were no formal training programs. Instead, aspiring designers learn through mentors, apprentices, or self-study.
2. In between World Wars 1 and 2 -1920-1940: Rise of the Upholstery School The early 20th century saw the rise of the Upholstery School. These schools typically teach courses in aesthetics, colour theory, and textiles. One of the most influential was the Parsons School of Design in New York, which offered majors in interior design in the late 1940s.
3. 1950s and 1960s: Growth of Interior Design Education After World War II, the demand for interior designers increased. Interior design education spread and universities began offering bachelor's programs in interior design. The first interior design program in the United States began at Michigan State University in 1950.
4. 1970-1980: The Transition to Research and Theory In the 1970s, interior design education began to shift from a purely technical focus to research and theory. The first doctoral program in interior design was established in 1972 at the University of Wisconsin-Madison.

The current state of the professional aspects of interior design education in Nigeria

The current state of interior design education is a mix of progress and challenges (Whiting, Cullen, Adkins, & Chatteur, 2023). While efforts have been made to improve the quality of education, there are still areas that require attention. Here are some key aspects of the current state of interior design education in Nigeria:

1. Professional Recognition: Interior design as a profession is gaining recognition in Nigeria. There is an increasing understanding of the value that interior designers bring to projects, including their expertise in space planning, aesthetics, and functionality. Professional associations such as the Interior Design Association of Nigeria (IDAN) and the Nigerian Institute of Interior Designers (NIID) play a role in setting industry standards and promoting the profession's recognition.
2. Industry Demand: The demand for professional interior designers is growing in Nigeria. As the economy expands and urbanisation continues, there is a greater need for skilled interior designers who can create functional and aesthetically pleasing spaces in various sectors, including residential, commercial, hospitality, and healthcare. This demand presents opportunities for interior design graduates to find employment or start their own design firms.
3. Integration of Technology: The integration of technology has become increasingly important in the field of interior design. Design software, computer-aided design (CAD) programs, and other digital tools are now integral to the design process. Interior design education in Nigeria is incorporating technology into the curriculum to equip students with the necessary skills to use these tools effectively in their professional practice.
4. Practical Training: Interior design programs in Nigeria are placing greater emphasis on practical training. Students are engaged in hands-on projects, design competitions, and industry collaborations to develop their skills and gain real-world experience. Some institutions provide internships and field trips to expose students to professional design environments and projects. Practical training helps students bridge the gap between theory and practice, preparing them for the challenges of the profession.
5. Entrepreneurship and Business Skills: Interior design education in Nigeria is recognising the importance of entrepreneurship and business skills. Many programs now include courses or modules that cover topics such as project management, marketing, budgeting, and client management. These skills are essential for interior designers to succeed in the industry and effectively manage their own design businesses.
6. Continuing Professional Development: Interior design is a field that constantly evolves, and it is essential for professionals to engage in continuous learning and development. Some institutions and professional associations offer workshops, seminars, and conferences that provide opportunities for interior designers to enhance their skills, stay updated with industry trends, and maintain professional growth.

7. Collaboration with Industry Professionals: Collaborations between educational institutions and industry professionals are increasingly being fostered. Design firms, manufacturers, and industry associations are invited to participate in workshops, guest lectures, and design critiques. Such collaborations provide students with exposure to industry practices, networking opportunities, and valuable insights into the profession.

While there have been significant advancements in the professional aspects of interior design education in Nigeria, there are still areas that can be further improved. These include enhancing industry-academia collaborations, updating curriculum to reflect industry needs, providing state-of-the-art facilities and resources, and promoting research and innovation in the field. By addressing these areas, interior design education in Nigeria can continue to evolve, producing highly skilled professionals who can contribute to the growth and development of the industry.

Challenges and opportunities for the professional aspects of interior design education in Nigeria

Interior design education in Nigeria faces both unique challenges and promising opportunities that can shape the future of the profession. Let's explore them in detail:

Challenges:

1. Limited infrastructure: One of the key challenges is the lack of adequate infrastructure and resources for interior design education. Many educational institutions may struggle to provide well-equipped design studios, computer labs, and libraries, which are essential for practical and theoretical learning.
2. Outdated curriculum: Another challenge is the presence of outdated or insufficient curriculum that does not keep pace with the rapidly evolving industry. The interior design field is constantly changing, with new materials, technologies, and design trends emerging. It is crucial for educational institutions to update their curriculum to reflect these changes and provide students with relevant knowledge and skills.
3. Limited industry exposure: Students often face limited exposure to the industry during their education. Opportunities for internships, industry collaborations, and site visits may be scarce. This can make it challenging for students to bridge the gap between theoretical knowledge and practical application, and it can affect their readiness for professional practice.
4. Perception of the profession: Interior design is sometimes viewed as a less prestigious career path compared to other professions like architecture or engineering. This perception can lead to a lack of recognition and support for interior design education, resulting in limited resources and funding for programs.

Opportunities:

1. Growing demand: Nigeria's growing economy and population present opportunities for the interior design profession. As the country experiences urbanisation and an increasing middle class, the demand for professional interior designers is expected to rise. This creates opportunities for interior design

education institutions to cater to this growing market need.

2. Industry collaborations: Collaboration between educational institutions and industry professionals can help bridge the gap between academia and real-world practice. Establishing partnerships with design firms, manufacturers, and industry associations can provide students with valuable insights, internships, and mentorship opportunities.
3. Technology integration: Technology plays a crucial role in modern interior design practice. Embracing technology in the education curriculum can enhance students' skills and knowledge. Integrating computer-aided design (CAD) software, virtual reality (VR), and other digital tools can better prepare students for the industry's technological advancements.
4. Cultural diversity: Nigeria's diverse culture, rich heritage, and vibrant aesthetics provide a unique advantage for interior design education. Incorporating cultural elements and sustainable design practices into the curriculum can foster creativity, promote local identity, and encourage sustainable design solutions.
5. Professional associations: Encouraging students to join and participate in professional associations such as the Interior Design Association of Nigeria (IDAN) can offer networking opportunities, access to industry events, and exposure to industry standards and best practices.

To address the challenges and seize the opportunities in interior design education in Nigeria, it is crucial for educational institutions, industry professionals, and policymakers to collaborate. This collaboration can help update the curriculum, improve infrastructure, provide industry exposure, and promote the profession's recognition and value. By investing in the future of interior design education, Nigeria can nurture a new generation of skilled professionals who can contribute to the country's development and enhance the built environment.

Summary

Interior design is a profession that offers plenty of opportunities to creative problem-solvers with an eye for detail. By being creative, innovative and adaptable, an interior designer will continue to thrive and succeed in this dynamic and rewarding profession. This chapter has provided an overview of the industry, educational requirements, career opportunities and the future prospects of the interior design profession.

Also, regulatory frameworks for interior design in Africa, including Nigeria, are still in their early stages. While organisations such as IDAN are leading the way in developing regulatory frameworks for the interior design profession, more work is needed to create a comprehensive, national regulatory framework. Interior designers must comply with the regulations set up by each organisation to practise in their field. Understandably, IDAN, NIA, and other professional organisations play a critical role in maintaining professional development, professional conduct, and the growth of the interior design industry in Africa. It is important for interior designers to remain licensed and registered

with these organisations to ensure conformity with the regulatory frameworks and improve their professional status.

Exercises

1. What are the regulatory frameworks in place for interior design in different countries?
2. What is the current state of regulation of interior design as a profession in Nigeria?
3. Why is regulation important in the interior design industry?
4. What is the difference between interior design and interior decorating?
5. What are the different types of interior design jobs available?
6. What skills are required to be successful in the field of interior design?
7. How has interior design education evolved over the years globally?
8. What is the current state of interior design education in Nigeria?
9. What are the challenges and opportunities for interior design education in Nigeria?

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Materials and Elements Used in Interior Architecture and Design

Associate Professor Faizah Mohammed Bashir, *University of Hail*

Overview

Interior architecture and design are crucial in creating spaces that are not only functional but also visually appealing and inviting. The choice of materials and elements used in interior design can greatly impact the overall look and feel of a space and also the health of the occupants.

This chapter discusses some of the materials and elements used in Interior Architecture. The aim of the paper is to explore ten materials and elements commonly used in interior architecture and design and their unique characteristics that can influence the design of a space.

Objectives

The objectives are to:

1. explore materials and elements used in interior design;
2. identify the characteristics of materials and elements when creating spaces that are both functional and visually appealing;
3. discuss the selection of materials and elements based on the specific design goals of a space; and
4. consider the properties of each material and element.

Interior architecture and design are complex fields that require a range of materials and elements to create functional, comfortable, and aesthetically pleasing spaces. Interior design is the process of designing the interior of a building, home, or other indoor spaces to achieve a healthier and more aesthetically pleasing environment for people using the space. Interior designers use a variety of materials and elements to enhance the appearance and functionality of interior spaces.

Materials and elements are integral components of interior design, and the selection of these elements can make or break the overall look and feel of a space. The selection of materials and elements must be made based on the specific design goals of a space, such as the desired aesthetic, functionality, and level of comfort. The chosen materials and elements must also be able to withstand the wear and tear of everyday use while remaining visually appealing.

Commonly Used Materials in Interior Design

There are ten materials and elements commonly used in interior design that can have a significant impact on the overall look and feel of a space. These materials and elements

are bamboo, wood, stone, glass, metal, textiles, plastics, concrete, ceramic, plants, and lighting.

Bamboo

Figure 1: *Use of bamboo in building* (Fairs, 2021)

Bamboo is a natural material that is increasingly being used in interior architecture and design due to its sustainability, durability, and aesthetic appeal. As a type of grass, bamboo grows rapidly and is considered an eco-friendly material (Khadka, 2020). In this section, we will explore the different applications of bamboo in interior design, its properties, and the benefits of using bamboo in sustainable interior design.

Applications of Bamboo in Interior Design

Bamboo is a versatile material that can be used in a variety of interior design applications, including flooring, wall coverings, furniture, and decorative items. Bamboo flooring has become increasingly popular in recent years due to its durability, sustainability, and unique look. It is available in a range of colours and finishes, from light and natural to dark and bold, and can be installed in a variety of patterns, including horizontal, vertical, and strand-woven (Bamboo Flooring Company, 2019).

Bamboo can also be used as a wall covering, providing a natural and warm look to a space. It can be installed in panels or as individual planks and can be used to create a feature wall or to cover an entire room. Bamboo wall coverings are available in a range of styles and finishes, from smooth and glossy to textured and rough (Bamboo Living, 2023). An example of its usage can be seen in figure 1.

Bamboo furniture is also becoming increasingly popular in sustainable interior design. Bamboo chairs, tables, and shelves are lightweight, durable, and aesthetically pleasing. Bamboo furniture can be designed in a range of styles, from modern and minimalist to rustic and traditional (Bamboo Revolution, 2022).

Properties of Bamboo

1. Bamboo is a durable and flexible material that is resistant to moisture, pests, and fire.
2. It is also lightweight and easy to work with, making it an ideal material for interior design applications.
3. Bamboo has a natural and warm look that can enhance the aesthetic appeal of a space.
4. It is available in a range of colours and finishes, from light and natural to dark and bold (Nguyen, 2018; Khadka, 2020).

Benefits of Using Bamboo in Sustainable Interior Design

Bamboo is considered an eco-friendly material due to its sustainability and renewability. Bamboo grows rapidly and can be harvested without damaging the environment, making it a more sustainable option than many other types of wood. Additionally, bamboo is a carbon sink, meaning that it absorbs more carbon dioxide than it produces, making it an effective way to mitigate the effects of climate change (Han & Jeon, 2015).

In addition to its sustainability, bamboo has several other benefits for sustainable interior design. It is durable and long-lasting, meaning that it can be used for many years without needing to be replaced. Bamboo is also easy to clean and maintain, making it a practical choice for high-traffic areas.

Wood

Wood is a versatile and timeless material that is commonly used in interior architecture and design. It can be used for flooring, furniture, wall panelling, and even as decorative elements such as beams and mouldings. The texture and grain of wood can add warmth and character to a space. Different types of wood have different characteristics that can influence the design of a space, from the rich and luxurious look of mahogany to the natural and rustic feel of reclaimed wood. Using wood in interior design can also have a positive impact on human well-being (Alaperi et al., 2019).

Figure 2: *Furnitures made of wood* (Fairs, 2021)

Applications of Wood in Interior Design

Wood can be used in a wide range of interior design applications, including flooring, wall panelling, cabinetry, furniture, and decorative accents like in Figure 2. Wood flooring is a popular choice due to its natural beauty, warmth, and durability. It is available in a range of species, finishes, and colours, and can be installed in a variety of patterns, including plank, herringbone, and parquet.

Wood panelling is another popular application, providing a classic and timeless look to a space. It can be used to cover entire walls or ceilings, or as an accent to a room. Wood panelling is available in a range of styles and finishes, from smooth and glossy to rough and rustic (Nelson, 2020).

Cabinetry and furniture are other popular applications of wood in interior design. Wood cabinets can be designed in a range of styles and finishes, from modern and minimalist to traditional and ornate. Wood furniture, such as chairs, tables, and bookshelves, can be crafted in a variety of shapes, sizes, and finishes, adding warmth and texture to a space (Serbedzija, (2020).

Properties of Wood

1. Wood is a natural material that has many unique properties that make it ideal for interior design applications.
2. It is durable, strong, and long-lasting, meaning that it can withstand heavy use and last for many years.
3. Wood is also a good insulator, helping to regulate temperature and humidity in a space.
4. Wood has a natural beauty and warmth that is difficult to replicate with other materials.

5. It is available in a range of species, each with its own unique characteristics and aesthetic appeal.
6. Wood can be finished in a variety of ways, including staining, painting, and sanding, allowing designers to create a custom look for each project.

Benefits of Using Wood in Sustainable Interior Design

Wood is a sustainable and eco-friendly material that can help to reduce the carbon footprint of a project. Wood is renewable, meaning that it can be grown and harvested without depleting natural resources. Wood also sequesters carbon, meaning that it removes carbon dioxide from the atmosphere and stores it in the wood fibres. Additionally, wood is biodegradable, meaning that it can be recycled or disposed of without harming the environment.

Wood has several other benefits for sustainable interior design. It is durable and long-lasting, meaning that it can be used for many years without needing to be replaced. Wood is also easy to clean and maintain, making it a practical choice for high-traffic areas.

Stone

Stone is a durable and long-lasting material that is commonly used in interior architecture and design. It can be used for flooring, countertops, and even as a decorative element such as a feature wall. Stone comes in various types such as granite, marble, and limestone, each with its unique characteristics that can influence the design of a space. For example, marble is valued for its luxurious and elegant look, while limestone has a more natural and earthy feel, using natural stone in interior design can create a sense of connection with nature and improve well-being (Vierra, 2022).

Applications of Stone in Interior Design

Stone can be used in a variety of interior design applications, including flooring, wall coverings, countertops, sinks, and decorative accents. Stone flooring is a popular choice due to its durability and natural beauty. It is available in a range of styles and finishes, including marble, granite, limestone, and slate. Stone flooring can be polished, honed, or textured, providing designers with a range of options to create a custom look for each project (Vierra, 2022).

Figure 3: *Stone cladding*, (Jain, 2022).

Stone wall coverings are another popular application, providing a luxurious and elegant look to a space. Stone walls can be used as an accent to a room or to cover entire walls. Stone wall coverings are available in a range of styles and finishes, from smooth and polished to rough and rustic. Countertops and sinks are other popular applications of stone in interior design. Stone countertops are durable, easy to clean, and provide a natural and organic look to a space. Stone sinks can be designed in a variety of shapes and sizes, adding a unique and elegant touch to a bathroom or kitchen (HGTV, 2022).

Properties of Stone

Stone is a natural material that has many unique properties that make it ideal for interior design applications.

1. It is durable, strong, and long-lasting, meaning that it can withstand heavy use and last for many years.
2. Stone is also a good insulator, helping to regulate temperature and humidity in a space.
3. Stone has a natural beauty and elegance that is difficult to replicate with other materials.
4. It is available in a range of colours, patterns, and finishes, each with its own unique characteristics and aesthetic appeal.
5. Stone can be finished in a variety of ways, including polishing, honing, and sandblasting, allowing designers to create a custom look for each project.

Benefits of Using Stone in Sustainable Interior Design

Stone is a sustainable and eco-friendly material that can help to reduce the carbon footprint of a project. Stone is a natural material that is harvested from the earth and does not require significant amounts of energy to produce. Additionally, stone is a durable and long-lasting material that can be used for many years without needing to be replaced.

Stone has several other benefits for sustainable interior design. It is easy to clean and maintain, making it a practical choice for high-traffic areas. Stone is also resistant to moisture and bacteria, making it a hygienic choice for kitchens and bathrooms. Additionally, stone is a natural and organic material that can help to create a calming and serene environment in a space.

Glass

Glass is a versatile material that can be used in various ways in interior architecture and design. It can be used for windows, doors, partitions, and even as a decorative element such as a glass sculpture. Glass can add visual interest and depth to a space by allowing light to pass through and reflecting the surrounding environment. Different types of glass have different properties, from clear glass to coloured glass and frosted glass, each with its unique characteristics that can influence the design of a space.

Figure 4: *Glass in building* (Constro, 2022)

Applications of Glass in Interior Design

Glass can be used in a variety of interior design applications, including windows, doors, partitions, flooring, wall coverings, countertops, and decorative accents. Glass windows and doors are a popular choice due to their ability to allow natural light to filter into a space, creating a bright and airy atmosphere. Glass partitions are also popular, providing a sleek and modern look to a space while still maintaining an open and airy feel (Architectural Digest, 2022).

Glass flooring and wall coverings are another popular application, providing a unique and contemporary look to a space. Glass can be tinted, frosted, or textured, providing designers with a range of options to create a custom look for each project. Glass countertops and decorative accents can be designed in a variety of shapes and sizes, adding a modern and elegant touch to a space (Houzz, 2022).

Properties of Glass

Glass is a transparent material that has many unique properties that make it ideal for interior design applications.

1. It is durable, strong, and long-lasting, meaning that it can withstand heavy use and last for many years. Glass is also a good insulator, helping to regulate temperature and noise in a space.
2. Glass has a natural beauty and elegance that is difficult to replicate with other materials.
3. It is available in a range of colours, patterns, and finishes, each with its own unique characteristics and aesthetic appeal.
4. Glass can be finished in a variety of ways, including tinting, frosting, and texturing, allowing designers to create a custom look for each project.

Benefits of Using Glass in Sustainable Interior Design

Glass is a sustainable and eco-friendly material that can help to reduce the carbon footprint of a project. Glass is a natural material that is harvested from the earth and does not require significant amounts of energy to produce. Additionally, glass is a durable and long-lasting material that can be used for many years without needing to be replaced.

Glass has several other benefits for sustainable interior design. It is easy to clean and maintain, making it a practical choice for high-traffic areas. Glass is also resistant to moisture and bacteria, making it a hygienic choice for kitchens and bathrooms. Additionally, glass allows natural light to filter into a space, reducing the need for artificial lighting and helping to save energy.

Metal

Metal is a strong and durable material that is commonly used in interior architecture and design. It can be used for furniture, lighting fixtures, and even as a decorative element such as a metal sculpture. Metal comes in various types such as stainless steel, brass, and copper, each with its unique characteristics that can influence the design of a space. For example, stainless steel is valued for its sleek and modern look, while brass has a warm and vintage feel. According to a study by Li and Li (2019), using metal in interior design can create a sense of contrast and balance in a space.

Applications of Metal in Interior Design

Metal can be used in a variety of interior design applications, including lighting fixtures, furniture, wall art, hardware, and decorative accents. Metal lighting fixtures are a popular choice due to their ability to add a sleek and modern touch to a space. Metal furniture, such as chairs, tables, and shelving units, are also popular, providing a sturdy and long-lasting option for high-traffic areas. Metal wall art and hardware, such as doorknobs and hinges, provide a unique and elegant touch to a space (Elle Decor, 2022).

Properties of Metal

Metal is a strong, durable, and long-lasting material that has many unique properties that make it ideal for interior design applications.

1. It is available in a range of colours, finishes, and textures, providing designers with a range of options to create a custom look for each project.
2. Metal is also a good conductor of heat and electricity, making it ideal for lighting fixtures and other applications that require the use of electricity.
3. Metal has a natural beauty and elegance that is difficult to replicate with other materials.
4. It is available in a range of finishes, including polished, brushed, and textured, each with its own unique aesthetic appeal.
5. Metal can also be finished in a range of colours, including silver, gold, bronze, and black, providing designers with a range of options to create a custom look for each project.

Benefits of Using Metal in Sustainable Interior Design

Metal is a sustainable and eco-friendly material that can help to reduce the carbon footprint of a project. Metal is a natural material that is harvested from the earth and can be recycled, reducing the amount of waste produced by a project. Additionally, metal is a durable and long-lasting material that can be used for many years without needing to be replaced.

Metal has several other benefits for sustainable interior design. It is easy to clean and maintain, making it a practical choice for high-traffic areas. Metal is also resistant to moisture and bacteria, making it a hygienic choice for kitchens and bathrooms. Additionally, metal can be finished with non-toxic paints and coatings, reducing the amount of harmful chemicals released into the environment.

Textiles

Textiles are soft and tactile materials that are commonly used in interior architecture and design. They can be used for upholstery, curtains, and even as a decorative element such as a tapestry or rug. Textiles come in various types such as cotton, silk, and wool, each with its unique characteristics that can influence the design of a space. For example, wool

is valued for its warmth and texture, while silk has a luxurious and elegant feel. According to a study by Jia and Wei (2019), using textiles in interior design can create a sense of comfort and relaxation.

Types of Textiles Used in Interior Design

There are many different types of textiles used in interior design, including natural fibres, synthetic fibres, and blends. Natural fibres, such as cotton, wool, silk, and linen, are a popular choice due to their durability and comfort. Synthetic fibres, such as nylon and polyester, are often used for their durability and affordability. Blends, such as cotton-polyester blends, offer the best of both worlds, combining the comfort of natural fibres with the durability of synthetic fibres.

Properties of Textiles

1. Textiles have a range of properties that make them ideal for interior design applications. They are available in a range of colours, patterns, and textures, providing designers with a wide range of options to create a custom look for each project.
2. Textiles can also be used to add warmth and comfort to a space, helping to create a sense of cosiness and relaxation.
3. Textiles have several other properties that make them ideal for interior design applications.
4. They can be easily cleaned and maintained, making them a practical choice for high-traffic areas.
5. Textiles are also versatile, as they can be used in a variety of applications, including upholstery, drapery, rugs, and wall coverings.

Benefits of Using Textiles in Sustainable Interior Design

Textiles are a sustainable and eco-friendly material that can help to reduce the carbon footprint of a project. Natural fibres, such as cotton and wool, are renewable resources that are harvested from the earth. Additionally, textiles can be recycled, reducing the amount of waste produced by a project. Synthetic fibres, such as polyester, can also be recycled, reducing the amount of waste sent to landfills.

Textiles have several other benefits for sustainable interior design. They can be used to create energy-efficient spaces, as they can help to insulate a room, reducing the amount of energy needed to heat or cool it. Textiles can also be used to create healthier indoor environments, as they can be made from natural fibres that are free from harmful chemicals and toxins.

Plastics

Plastics are versatile and lightweight materials that are commonly used in interior architecture and design. They can be used for furniture, lighting fixtures, and even as a

decorative element such as a plastic sculpture. Plastics come in various types such as acrylic, polycarbonate, and PVC, each with its unique characteristics that can influence the design of a space. For example, acrylic is valued for its clarity and transparency, while polycarbonate is known for its impact resistance. According to a study by Zhang (2020), using plastics in interior design can create a sense of modernity and innovation.

Types of Plastics Used in Interior Design

There are many different types of plastics used in interior design, including polyvinyl chloride (PVC), polycarbonate (PC), and acrylic (PMMA). PVC is a popular choice for flooring, as it is durable and easy to maintain. PC is often used for lighting fixtures and glazing, as it is strong and impact resistant. PMMA is a popular choice for furniture and decorative objects, as it can be moulded into a variety of shapes and is available in a range of colours.

Properties of Plastics

Plastics have several properties that make them ideal for interior design applications.

1. They are lightweight and easy to work with, making them a popular choice for furniture and fixtures.
2. Plastics can be moulded into a variety of shapes, allowing designers to create custom pieces that fit the unique needs of each project.
3. Plastics have several other properties that make them ideal for interior design applications.
4. They are durable and resistant to damage, making them a practical choice for high-traffic areas.
5. Plastics are also easy to clean and maintain, making them a popular choice for healthcare and hospitality environments.

Benefits of Using Plastics in Sustainable Interior Design

Plastics are a sustainable and eco-friendly material that can help to reduce the carbon footprint of a project. Plastics can be recycled, reducing the amount of waste produced by a project. Additionally, plastics are often used in energy-efficient applications, such as lighting fixtures and glazing, helping to reduce the amount of energy needed to light a space.

Plastics have several other benefits for sustainable interior design. They are low maintenance, requiring minimal cleaning and upkeep. Plastics are also resistant to moisture and humidity, making them a popular choice for bathrooms and kitchens.

Concrete

Concrete is a durable and robust material that is commonly used in interior architecture and design. It can be used for flooring, walls, and even as a decorative element such as a concrete countertop. Concrete can add an industrial and modern look to a space.

Different types of concrete have different finishes, from smooth to textured and polished, each with its unique characteristics that can influence the design of a space, using concrete in interior design can create a sense of authenticity and rawness.

Properties of Concrete

Concrete is a composite material made from cement, water, and aggregates, such as sand or gravel. It has several properties that make it an ideal choice for interior design.

1. Concrete is durable, fire-resistant, and has good thermal mass, which means it can help regulate the temperature of a space (Shafigh, Asadi and Mahyuddin, 2018).
2. Concrete can be cast into a variety of shapes and sizes, making it a versatile material for interior design.
3. It can be left exposed or polished to create a sleek and modern finish, or it can be stained or coloured to create a unique look.

Benefits of Using Concrete in Interior Design

Concrete has several benefits that make it an attractive choice for interior design. It is a sustainable material, as it can be locally sourced and has a long lifespan. Concrete is also low maintenance, as it is resistant to stains and scratches and does not require sealing or waxing.

Concrete is also a cost-effective material, as it can be used as both a structural and decorative element in a space. It can be used for flooring, walls, countertops, and furniture, creating a cohesive and streamlined look.

Innovative Uses of Concrete in Interior Design

Concrete is being used in innovative ways in contemporary interior design. For example, it can be cast into modular shapes to create unique seating or storage solutions. Concrete can also be used as a design element in lighting fixtures, with the ability to be shaped and moulded into intricate designs.

Concrete can also be combined with other materials, such as wood or metal, to create a contrast in textures and colours. It can be used to create feature walls or sculptural elements, adding a sense of drama and visual interest to a space.

Ceramic

Ceramic is a versatile and durable material that is commonly used in interior architecture and design. It can be used for flooring, walls, and even as a decorative element such as a ceramic sculpture. Ceramic comes in various types such as porcelain, terracotta, and earthenware, each with its unique characteristics that can influence the design of a space. For example, porcelain is valued for its durability and elegance, while terracotta has a warm and earthy feel, using ceramic in interior design can create a sense of continuity and harmony.

Properties of Ceramics

Ceramics are a group of materials that are formed from inorganic, non-metallic materials that are heated at high temperatures.

1. They are typically hard, brittle, and resistant to high temperatures, chemicals, and abrasion.
2. Ceramics are versatile and can be formed into a range of shapes, sizes, and finishes.
3. They are also available in a variety of colours and patterns, making them a popular choice for decorative applications (Mart, 2022).

Benefits of Using Ceramics in Interior Design

Ceramics have several benefits that make them an attractive choice for interior design. They are durable and long-lasting, with the ability to withstand heavy foot traffic, moisture, and stains. Ceramics are also easy to clean and maintain, requiring only a damp mop or sponge for regular cleaning.

Ceramics are also versatile and can be used in a range of applications, from flooring and walls to countertops and decorative accents. They can be combined with other materials, such as wood or metal, to create a contrast in textures and colours.

Innovative Uses of Ceramics in Interior Design

Ceramics are being used in innovative ways in contemporary interior design. For example, large format tiles are becoming increasingly popular, creating a seamless look on floors and walls. Ceramic tiles can also be used to create a unique mosaic pattern on a feature wall or as a backsplash.

Ceramics can also be used as a decorative element in lighting fixtures, with the ability to be moulded into intricate designs. Ceramic sculptures and vases can be used to add a sense of texture and colour to a space, creating a focal point or adding visual interest to a room.

Plants

Figure 5: Plants in Interior (Cottee, 2020)

Plants are living elements that can be used in interior architecture and design to bring life and nature into a space. They can be used as a decorative element such as a plant wall or a potted plant. Plants come in various types, from small succulents to large trees, each with its unique characteristics that can influence the design of a space, using plants in interior design can improve air quality, reduce stress, and enhance well-being (Thomsen and Hans, 2011).

Benefits of Using Plants in Interior Design

Plants have several benefits that make them an attractive choice for interior design. They are natural air purifiers, improving the air quality by removing pollutants and increasing oxygen levels. Plants also have a calming effect and can help reduce stress levels, making them a great addition to any space.

In addition to their health benefits, plants can also add a sense of texture, colour, and life to a room. They can be used to create a focal point or as a decorative element to complement other design elements.

Types of Plants Commonly Used

There are many types of plants that can be used in interior design, from small succulents to large tropical plants. Some of the most commonly used plants include:

Succulents

These small, low-maintenance plants are perfect for adding a touch of greenery to a space without requiring much upkeep.

Ferns

Ferns are a popular choice for adding texture and a sense of movement to a room.

Ficus

Ficus trees are a larger plant that can be used to create a statement piece in a room.

Spider plants

Spider plants are easy to care for and can be used to create a cascading effect in a hanging planter.

Pothos

Pothos are a trailing plant that can be used to add a pop of colour to a room.

Innovative Uses of Plants in Interior Design

Plants are being used in innovative ways in contemporary interior design. For example, living walls are becoming increasingly popular, with plants being grown vertically on a wall to create a stunning visual effect. Plants can also be used as a divider in open-plan spaces, creating a sense of privacy and separation between different areas.

Plants can also be used to create a unique lighting effect. For example, a plant lamp is a lamp that uses plants to create a natural light source. The plant is placed in a container with LED lights, which are powered by a battery. As the plant grows, it illuminates the room with a soft, natural light.

Lighting

Lighting is an essential element in interior architecture and design. It can be used to create different moods and atmospheres in a space. Lighting fixtures come in various types such as chandeliers, lamps, and even natural light, each with its unique characteristics that can influence the design of a space. According to a study by Rea (2017), using lighting in interior design can impact circadian rhythms, enhance visual comfort, and improve well-being.

Figure 6: *Lighting in interior design* (Ledmi, 2020)

Benefits of Using Light in Interior Design

Light can significantly impact the ambiance of a space. It can create a sense of warmth, comfort, and relaxation, or a sense of drama and excitement. Proper lighting can also enhance the functionality of a space, making it more comfortable and usable.

Additionally, lighting can be used to highlight architectural features, artwork, or decorative elements. By using light creatively, designers can create an entirely different look and feel to a space, even with minimal changes.

Types of Lighting Commonly Used

There are several types of lighting commonly used in interior design, including:

Ambient lighting
Ambient lighting is the general lighting in a space, providing overall illumination. It can be achieved with ceiling fixtures, wall sconces, or other lighting sources that provide a soft, even glow.

Task lighting
Task lighting is used to provide focused illumination for specific tasks, such as reading, cooking, or working. Examples of task lighting include table lamps, floor lamps, and under-cabinet lighting.

Accent lighting
Accent lighting is used to highlight specific features or areas in a space, such as artwork or architectural details. It can be achieved with track lighting, wall washers, or recessed lighting (Devenish, (2020).

Innovative Uses of Light in Interior Design

Lighting is being used in innovative ways in contemporary interior design. For example, smart lighting systems are becoming increasingly popular, allowing users to control the intensity, colour, and timing of lighting with a smartphone or voice command. These systems can be programmed to adjust lighting throughout the day to mimic natural light, creating a more natural ambiance (Wipro, 2020).

Another innovative use of light is the incorporation of LED lights into furniture and decor. LED lights can be used to create a unique lighting effect, such as a glowing coffee table or a backlit headboard (Cullen, 2020).

Finally, lighting can be used to create interactive experiences. For example, a museum might use lighting to enhance the experience of viewing an exhibit, using different colours and intensities to create a specific mood or ambiance.

Summary

In summary, the materials and elements used in interior architecture and design can greatly impact the overall look and feel of a space. Wood, stone, glass, metal, textiles, plastics, concrete, ceramic, plants, and lighting are ten materials and elements commonly used in interior design, each with its unique characteristics that can influence the design of a space. It is important for designers to consider the properties of these materials and elements when creating spaces that are both functional and visually appealing.

In addition, the use of materials and elements is essential in creating a functional, comfortable, and aesthetically pleasing interior space. The selection of materials and elements must be made based on the specific design goals of a space, such as the desired aesthetic, functionality, and level of comfort. Interior designers must consider the properties of each material and element, such as durability, maintenance requirements, and energy efficiency, before selecting them for an interior design project. The ten materials and elements commonly used in interior design, including wood, stone, glass, metal, textiles, plastics, concrete, ceramic, plants, and lighting, can have a significant impact on the overall look and feel of a space. By carefully selecting and combining these materials and elements, interior designers can create unique and beautiful interior spaces that meet the needs and desires of their clients.

Exercises

1. Identify properties of any 3 types of materials used in the interior.
2. Can you differentiate the application of the 3 materials discussed above?

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CHAPTER EIGHT: COLOUR THEORY AND PSYCHOLOGY OF INTERIOR SPACES

Principles and Elements of Colour

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Overview

Colour is one of the most important finishes used in building design. It is principally used to increase appeal, harmony and balance. It can also be used as a protective coat on some materials like wood and metal. Colour tends to evoke emotions and so one has to be careful in choosing colours to suit the purpose and function of a room or space.

This course explores the basic principles of colour for the interior designer. In learning about colour, there are fundamental assumptions guiding its use, both in design and in the real world. A student has to be very conversant with designing in grayscale (black and white) focusing in creating solid visual hierarchy, before using and mixing colours, (Babich, 2019). This enhances the versatility of a person in the use of colours eventually.

Objectives

The objectives are to:

1. explain colour;
2. identify types of colour;
3. identify colour terminology;
4. discuss the uses of colour;
5. explain colour perception; and
6. discuss the feelings different colours evoke.

The Meaning of Colour

Colour is like music and poetry, when arranged well, is pleasing to the eye, creating a sense of order and exciting visual experiences. Colour is very subjective, evoking an emotion in one and the opposite in another. This might be due to cultural background, previous associations (experiences) or just personal preferences. Colour cannot easily be defined but dictionary says it is a spectral composition of visible light.

Colour is light that has passed through a prism and separates into various wavelengths, as seen in the colours of the rainbow. Each colour has a unique wavelength starting with red with the longest wavelength to blue and purple with the least, this makes a rainbow always appear curved with an inner circle of purple and outer circle of red.

Colour is a universal language, very vast and a powerful communication tool. Colours have an inherent meaning that varies from country to country, culture to culture and have an impact on people's perception.

The Colour Wheel

Colour is best explained by the use of the colour wheel, that is the arrangement of colour in a circle. Colour wheel consists of three (3) parts: primary, secondary and tertiary. These are interwoven among themselves, showing their relationship on the wheel.

Primary colours are made up of Red, Blue, and Yellow; they are positioned in an equidistant triangular form. All other colours depend on them.

Secondary colours are made up of Green, Orange, and Purple. They are formed by mixing the primary colours. They can also be placed in an equidistant triangle on the primary colours in such a way as to maintain 60^0 from any primary colour. The primary and secondary colours form a hexagon, being placed at the sides of the hexagon.

Tertiary colours are made up of Yellow-Orange, Red-Orange, Red-Purple, Blue-Purple, Blue-Green and Yellow-Green. They are formed by mixing a primary and a secondary colour. They are placed at the tips of the hexagon formed and maintain 30^0 distance from any colour (both primary and secondary).

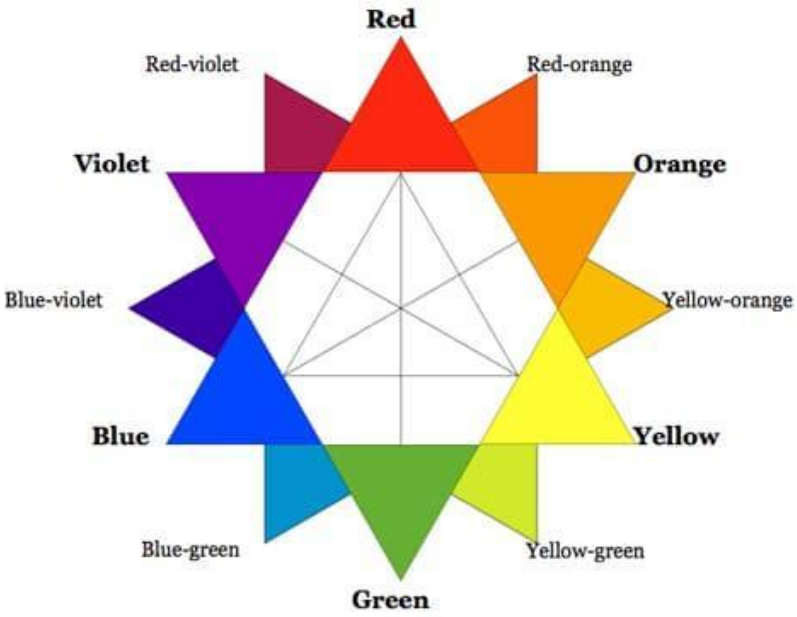
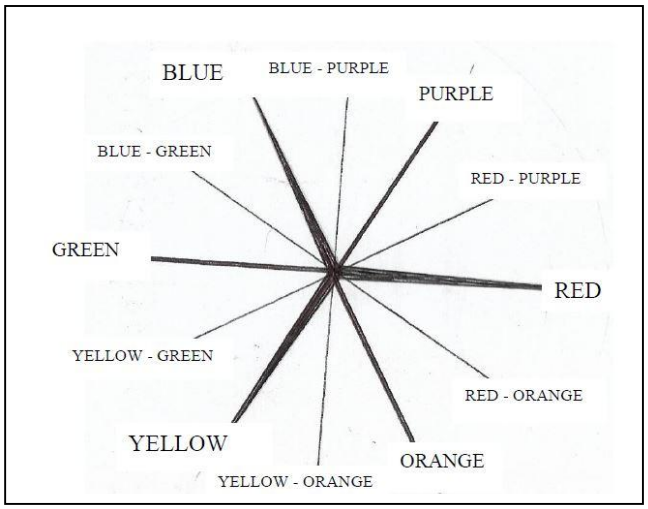


Figure. 1 *The Colour Wheel* (12 spoke).

The colour wheel is basically made up of 12 distinct colours, but a variety of colours can be formed by mixing colours (primary and tertiary, etc), (Cousins, 2012). The more colours are mixed, the more variety of colours will be produced. The colour wheel is calibrated in such a way as to imitate the face of the clock; there is a colour at each hour hand.

To learn these colours and their positions on the colour wheel better, the wheel is made up of 360^0. Place the primary colours at an equidistant angle of 120^0 starting with red at 3'oclock and move anticlockwise (red, blue, yellow). The secondary colours are then placed in sequence at 60^0 intervals to the primary colours (purple, green, orange) still in the same direction. Finally place the tertiary colours in between the primary and secondary colours as they are formed, making up the remaining 30^0 that is dividing the 60^0 into two (red-purple, blue-purple, blue-green, yellow-green, yellow-orange, red-orange).



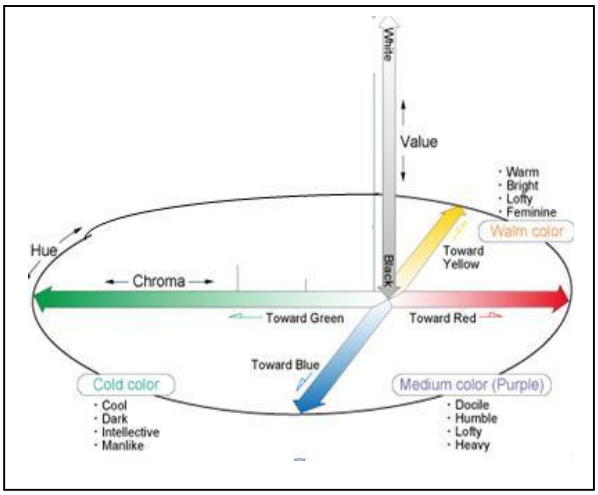


Figure. 2. *The Colour Wheel*.

Figure. 3. *Colour Terms*.

Colour terminology

There are terms used in describing colours such as tints, shades and tones, which are all variants of hues. Let us explain them one by one;

Hue is the most basic of colour terms and it means the colour itself (red, blue, green, etc). It is another name for colour. Hue can also be described as the temperature of colour. This can be described on a scale of 0^0 - 360^0. Starting with red at 0^0 and every 30^0 transitions into another new family of colour. With reference to fig. 2, starting at 0^0 (red) going clockwise at every 30^0 there is a new hue (colour) until the 360^0 is complete.

Chroma is the purity of colour that is where there is no white, black or grey added to a hue. When these are added the chroma is reduced. Using hues of the same chroma in design creates a harmonious background pattern.

Saturation is how hue appears under lighting; which can be weak or strong, pale or pure; in fact it is the strength of the hue. It can also be said to be the degree of neutrality on a scale of 0 – 100, 0 is absolutely neutral and 100 is maximum saturation, (Johnpaul). A pure hue is more saturated than its tint or tone.

Value is lightness or darkness of colour whereby lighter colour has higher value than dark colours. In design, use hues of different values and high chroma, high contrasting values makes for more aesthetically pleasing designs.

Tint is a hue to which white has been added making it lighter e.g. Red + White = Pink. Tints of colours are used in making more feminine or lighter designs and are much calmer than their saturated counterparts.

Shade is a hue to which black has been added making it darker e.g. Red + Black = Burgundy.

Tone is a hue to which black and white (gray) has been added. This darkens the original hue making the colour appear more subtle and less intense, (Decker, 2022). It makes pure hue duller and softer.

All these are very necessary in colour schemes formation, because the use of only pure hues with similar values and saturation levels may become overwhelming, creating a boring colour scheme. The use of a lot of pure hues in colour scheme creates fun and playful atmosphere. Shades, tints and tones of the basic hue expand on the colour scheme for balance and harmony.

Use of Colour (Colour Scheme)

In using colour, one has to understand how humans' perceive colour, the visual effect of colour, the act of mixing, matching or contrasting colour for use in interior spaces, (Decker, 2022). Colours convey messages and when used wrongly could convey the wrong message which effects might be very devastating. To understand colour, there are formulas; for proper harmony. Colour harmony is the pleasing arrangements of colours that will create a sense of order and balance in the visual experience. When colours are not harmonious, they become bland, boring and chaotic. Colour harmony is a dynamic equilibrium gotten by the use of colour schemes, which ensures there is harmony in the colour composition.

Also, in the choice of colours, one has to think of the visual weight which concerns the size of the object, colour of the object and the surrounding (background) colour. To get the balance in the colour scheme that promotes harmony, there are some simple rules of thumb;

60:30:10, this means the use of 60% of one colour (usually a neutral) plus 30% of a complementary colour and 10% accent (the object of interest). This goes well with the second which is;

Using a maximum of three colours in any colour scheme, that is limiting the number of colours to three (3) and if need be, using darker or lighter variations of the chosen three in the colour scheme, (Babich, 2019).

So in choosing the right colours, to create the best possible feelings in any colour scheme, we have to aim at combining the properties, energies and synergies of colours in all schemes. Colour scheme can be described as follows:

Analogous Colour is created by using any three colours side by side on a twelve point color wheel. Traditional analogous colour schemes have hues of the same chroma level; using tones, shades, and tints for interest and individual needs.

Figure. 4. *Analogous colours for a scheme*. *Source*: Pinterest by Colleen Hommel

Complementary Colour is created using two colours that are directly opposite each other in the same 12 point colour wheel. They could be called opposite colours. It consists of only two colours but can be expanded using tones, tints and shades of those two colours.

Figure. 5. *Complementary colours for a scheme*. *Source*: www.curriculumnacional.cl

Split Complementary Colour adds more complexity to regular complementary colour scheme by using the colours on the two sides of the opposite colour.

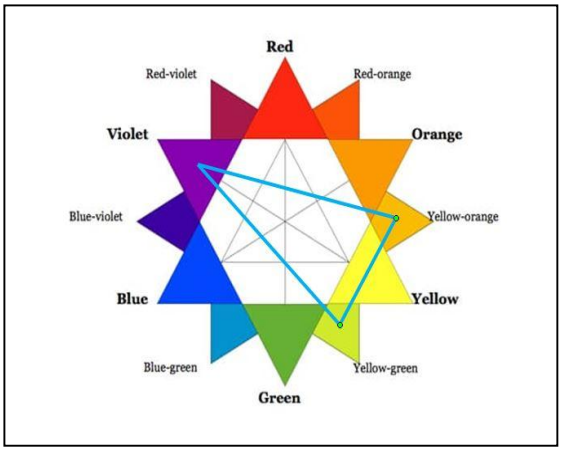


Figure.6.*Split complementary colours for a scheme*. *Source*: archi-living.com

Nature / Custom Colour has no technical formula or rule to create and is very hard to work out, but provides a perfect departure point for colour harmony. All colours could have similar chroma and saturation levels but can still create a sense of cohesion.

Triadic Colour uses 3 colours equidistant from one another, on the 12 point colour wheel to form a harmonious and balanced piece of work.

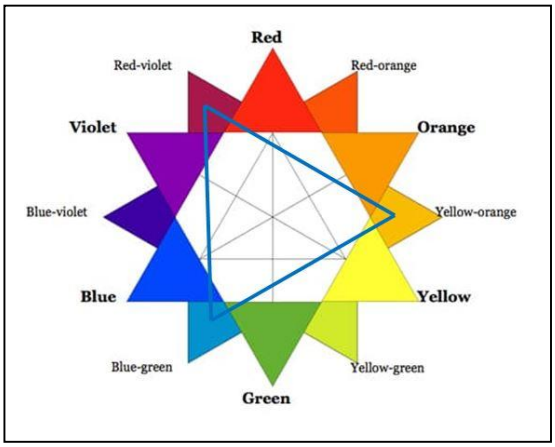


Figure . 7. *Triadic colours for a scheme*. *Source*: Pinterest by Flickr

Tetradic Colour (Double Complementary/Rectangle) uses a combination of four colours with one dominant. It could use one primary colour and the others as accents, (Cousins, 2012).

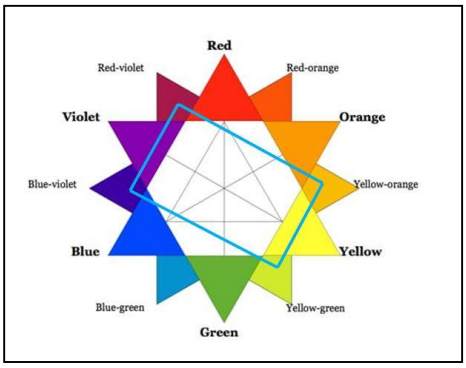


Figure. 8. *Tetradic colours for a scheme*. *Source*: Pinterest by Bobbi Billard

Monochromatic is a scheme built up around one colour with tint, tone and shade of that same colour. It is easy to create but can be boring; black or white can be added to lift the boredom.

Source: https://www.elledecor.com.

Achromatic schemes use only shades of black, white and gray in making a colour scheme.

Neutral schemes use only browns and tans in building up the colour scheme, in this any colour can be neutralised by mixing with its complement.

Colour Perception

Understanding colour is very crucial to human experience of colour especially in the use of colour and living with colour. This helps in the use, mixing and matching of colours. Colour can be divided into warm or cool because of the way they are perceived and what it evokes in the minds, feelings and actions of people.

Table 1. Perception of Colours.

Warm colours	Cool colours	Neutrals
Red, Orange, Yellow, plus all their variants.	Green, Blue, Purple, plus all their variants.	Black, Gray, White, Brown, Tan
Red and Yellow are primary colours. Warm colours appear closer to the observer.	Blue is the only primary colour. Green has attributes of Yellow. Purple has attributes of Red. Cool colours appear subdued and further from the observer	Neutrals are affected by their surroundings.

Source: Adapted from colour Basics @ usability.gov

Warm Colour (Red, Orange and Yellow and all of their variants) are generally associated with energy, brightness, excitement, passion and positivity. They are the colours of fire, sunset and sunrise

Colour Red has to do with fire, violence, excitement, action, danger and passion and increases heart rate and blood pressure creating a sense of urgency. Here, Valentine comes to mind whereby everyone dresses up in red. Red is also associated with anger, importance (red carpet reception) and danger (traffic stop light).

Colour Yellow is the brightest and most energising of the warm colours. It sparks enthusiasm, mental clarity and logical thinking. It is optimistic, youthful, fun, and full of sunshine. It has a negative trait associated with it, that of deceit and cowardice. In design it lends a sense of happiness, cheerfulness and permanency. Manufacturers of children's toys and products use it a lot.

Colour Orange is confident and cheerful, fun, friendly, uplifting, enthusiastic and full of energy. It can also be associated with the changing seasons, creativity and movement in general. Orange commands attention without being overpowering when used in design projects.

Cool Colour (Blue, Green and Purple and all their variants) are associated with calmness, peace, reliability and serenity. They are often subdued, reserved and relaxing. Blue is a primary colour and is used as a warm colour in the formation of green and purple. So green takes on some attributes of yellow while purple takes on some attributes of red.

Colour Blue has a calming and relaxing effect associated with maturity, integrity and trustworthiness. It is soothing and reassuring, creating a sense of security and conveys honesty, reliability and professionalism. No wonder hospitals always tend to use Sky-blue walls, Blue curtains, in fact everything blue. It has religious and spiritual connotations.

Colour Green connotes growth, freshness and good health with calming effects. It is the dominant natural colour (environment) representing new beginning, growth, renewal and abundance. In a negative sense it is associated with envy and jealousy (hence the saying 'green with envy'). It has attributes of blue and yellow, the parent colours. When used in design, it has a balancing, harmonising effect and is very stable.

Colour Purple is associated with creativity and imagination. It has attributes of red and blue. It is associated with royalty.

Neutrals (black, grey, white, brown and tan) are affected by their environment or surroundings.

Colour Black is associated with power, elegance and formality. Negatively it is associated with evil, death and mystery. Black is conservative, modern or traditional in fact unconventional depending on the surrounding colours.

Colour White is the opposite of black, and works well with any colour. It is associated with purity, cleanliness and virtue.

Colour Gray is on the cool end of the colour spectrum. It can be moody, depressing, conservative, modern and formal.

Colour Brown is associated with the earth, wood and stone. It can be dependable, reliable, steadfast, earthiness and dull.

Colour Tan / Beige can take on cool or warm tones depending on the surrounding colours. It has the warmth of brown and the coolness of white. It can be conservative and represent piety.

Colours of the Rainbow

The colours of the rainbow as we are taught are seven, in actual sense are more than that. The fact is that all the colours of the colour wheel are represented but some are merged into others (overlapping). It maintains a curved stance because of the wavelength of the colours as already noted. Red has a wavelength of 780 nm the longest to purple having a wavelength of 380 nm the shortest.

To remember the colours of the rainbow, a short phrase was coined Richard Of York Gave Battle In Vain (metoffice, UK). Red, Orange, Yellow, Green, Blue, Indigo, Violet are the discernable colours of the rainbow with others overlapping within.

Summary

Colour is one of the most important building materials which is used for its appeal, harmony and balance. Just like music, when used well, is very appealing and pleasing to behold. Colour is a universal language of communication.

Colours are in nature, the visible white light can be disintegrated into the colours of the rainbows. Basically there are three colours (red, blue, yellow) and the rest are mixtures of them in various proportions. Colours are divided into primary, secondary and tertiary colours depending on the mixing components. Colours have different properties, energies and synergies which must be combined properly to give harmonious and balanced colour schemes.

Exercise.

1. Make a Colour Scheme for a children's room
2. In making a Colour Scheme for a nursery playroom in a Primary/Nursery School, what are the basic considerations?

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CHAPTER NINE: INTRODUCTION TO FURNITURE DESIGN

Introduction to Furniture Design

Prof. Musa Lawal Sagada, *ABU Zaria*

Overview.

The importance of furniture to human life cannot be overemphasised, either in private, public, educational, institutional and commercial usage. From the very early beginning of human life, man has developed and used artefacts which serve as furniture. Mankind has developed and used accessories for diverse purposes to make his life and living more comfortable. Furniture design and their form changed from simple to intricate, depending on the period in which they were made. Humans use a lot of furniture in their daily activities and interaction, either in interior or outdoor spaces. Furniture determines and conditions the way we experience a space and environment as it provides the space with the necessary support.

This text discusses an overview of the history and types of furniture. It begins by first defining the term 'furniture' and thereafter looks at the development of furniture and furniture design. It also explains the different types of furniture and introduces the students to tools used in furniture design.

Objectives

The objectives of this chapter are to:

1. explain in an overview the history of furniture;
2. describe the concept of furniture;
3. identify different types of furniture;
4. describe the types of materials used for furniture making;
5. identify and discuss the techniques for the manufacture of furniture; and
6. explain the different types of fasteners.

Definition of Furniture.

Furniture are objects that are created to support various human activities, such as seating, eating, and sleeping. They are also objects that are used to store things, and to hold objects at convenient heights. Furniture are movable objects that are created to support various human activities and to provide mankind with a comfortable work environment.

From very early in time people have used objects found in nature, rocks, stump of trees for sitting and other to support their activities. Later as civilization advanced, conscious efforts were made using diverse materials to create and construct their own artefacts for use. It is believed that complex construction techniques of what is regarded as furniture began during the early dynasty period of ancient Egypt (Oates, 1981; Pinto, 2012; Smardzewski, 2015).

Constructed wooden pieces that included stools and tables with decorated metals and ivory were discovered. The evolution of furniture throughout human civilization has been influenced by advances in science, technology and materials.

History of Furniture

The evidence of the use of furniture by man dates back to the prehistoric period as reflected by archeological excavations. Early man used fallen tree trunks as seating tops and other naturally occurring artefacts for various purposes (Smardzewski, 2015). As human civilization advanced different artefacts were developed and used to meet the needs of the society at any particular period in time. There is evidence that shows that furniture was developed and used during the late Paleolithic and early Neolithic periods (Oates,1981). Stone figurines of seated and sleeping figures of women attest to the use of furniture during the Neolithic era. The history of furniture is generally accepted to be situated in the first dynasty of the ancient Egyptian period. Egyptian antique furniture is among the only surviving examples of ancient furniture (Oates,1981).

The Greeks who conquered the Egyptians inherited part of their furniture heritage. The Greek furniture styles were simple, elegant and tasteful and reflected their love for beauty and art. It was not over-decorated, even though they used carvings and overlays. Greek furniture consisted of couches known as klines which were made of wood with bronze legs cast in animal styles. The klines had a headboard which was used as backrest and elegantly upholstered. The Greeks used decorated chests of various types for storage purposes. Greek furniture was typically constructed of wood, however, other materials such stone, marble, or metal (bronze, iron, gold and silver) were used.

The form of furniture during the Roman period was simple, homes were sparsely furnished, however in wealthy homes the decoration was often ornate. The basic furniture item found in the homes were couches or beds (lectus), chairs and stools, tables and lamps, candelabra and chests, and wooden cabinets with doors. A large formal dining room is found in the homes of the wealthy with couches of different sizes and shapes for hosting guests to dinners. Higher magistrates used a type of folding chair known as the curule chair, it was designed with curving legs and inlaid with ivory. The Roman seats and stools were based on Greek prototypes.

In AD 330, Constantine moved the capital of the Roman Empire to Byzantium, which was later changed to Constantinople. The Roman Empire was divided into the Western and Eastern Empires. While the western part fell into what is known as the dark ages, the eastern part prospered as the Byzantine empire. The western part fell under the destructive activities of the barbaric tribes from the north who destroyed everything about urban life until the restoration of urban life in the eleventh century. Byzantine furniture was influenced by late Roman art as most of the craftsmen and artists were from the Roman empire, however, the later period became influenced by Ottoman arts.

The collapse of urban life affected the development of furniture, in the early Middle Ages huge areas of Europe were uninhabited, and landowners had to be continually on the move to

administer their scattered properties. Furniture was very limited during the mediaeval period; it was made of local resources as there was little trade during the period. Furniture-making techniques were in its crude and primitive state; coarse nails were used to join pieces of wood boards, rough mortises and tenons, animal hides, crude iron structures and woven marsh grasses.

The Romanesque period, which lasted between the 11th and 12th centuries, saw the re-emergence of European civilization from the Dark Ages following the fall of the Roman Empire. At the beginning of the period, artists, architects and furniture designers copied Roman styles in crude fashion which they later improved upon. The furniture was predominantly designed for churches and for the aristocracy, while the poor classes had just a bed, or mattresses made of straw and storage chest, dining tables were made of a board supported by tree trunks. Church furniture was ornate, decorated with carvings or paintings in imitation of Roman furniture. The carving uses simple animal and plant forms with many of the items brightly painted. Chairs were used as a symbol of power, and they were heavily decorated with carvings, paintings and inlays.

From the 12th century, furniture became more functional, with their designs more decorative with simple ornamentations through geometric carvings. It reflected the changes that were taking place in the society, with the return of peace came the increasing desire for comfort among the wealthy. The Gothic style which emerged in the 12th century was gaining popularity in western Europe and reached its fullest and most harmonious peak in France in the 14th century, even though it never got acceptance in Italy. Gothic furniture was characterised by grotesque figures, architectural ornamentation, dark, glowing wood, and arched forms. Furniture Items include High-backed cathedral chairs; two-part dressers; heavily carved beds and chests.

The period after the dark ages in Europe was known as the Renaissance period, it was characterised by a revival of learning and renewal of interest in Greek and Roman arts, philosophy and culture. The renaissance movement began in Italy, as a result of the return of peace, which made the nobles and men of wealth to patronise arts. Furniture design had its basis and guide in Architecture,

The early fifteenth century Italian furniture was rich in detail and of large dimensions but rather sparsely distributed. The attitude to furniture however changed in the mid-century, when classical rules of proportion and decoration were applied to design before this attitude to furniture changed: only when classical rules of proportion and decoration were applied to its design. The chair that was used a symbol of power was democratised and transformed it into

an accessible staple of home life. The most common was the X- chair or a faldstool which for luxury were covered with silver lining or upholstered with velvet and, the sgabello chair which is basically a side stool with an octagonal seat (Miller, 2006).

With stability the aristocracy did not have to move from one home to another and residential life had become permanent, therefore the need for portable furniture was no more. Furniture

pieces were designed for specific rooms and even for particular positions within the room. The 16th century saw the emergence of the Baroque styled furniture, it was designed on a grand scale with the intention to impress. Furniture pieces had dramatically carved structural elements taken from architectural forms with motifs drawn from Classical or Renaissance styles.

The Industrial Revolution, which began in the later part of the 17th century, swept across Europe in the 18th century, and brought about cultural changes rooted in freedom, progress and development of knowledge. Archeological discoveries at Pompeii and Herculaneum in 1748, brought about renewed interest in ancient Greek and Roman arts. The study of the art and life of ancient Greece and Rome resulted in the Neoclassical Movement in the second half of the century, and it was a result of reaction to the opulent and extravagance of baroque and rococo styles in different countries. Neoclassical furniture in its earliest form used architectural motifs adhered into furniture forms, such as acanthus leaves, swags and foliage, guilloche bands, and scrolls. The style tends to be rectangular and lack curves. Neoclassical furniture is characterised and identified by the use of columns, gilt, classical reliefs, moderate ornamentation, and satin upholstery. The style used decorative motifs, detailing and classical antiquity in its design (Staff, 2020).

The 20th century saw the emergence of several diverse styles of furniture, the Art Nouveau, Art Deco, Modern, and Postmodern. The Art Nouveau is a term that means "new art" in French that appeared from 1890 to 1910 and became popular. It was essentially a conscious attempt to abandon any notion of dated revivalist styles of the past. It was a distinct, decorative style that embraced the new industrial aesthetics that often combine naturalistic forms with geometric shapes, in particular arcs, semicircles, and parabolas. Art Nouveau furniture was distinguished by long elaborative curves and twists, it was known by different names in different places.

The Art Deco style emerged after the First World War as a collection of different and sometimes contradictory styles. The style was extravagant, following the principles of symmetry and geometric forms, it utilises expensive materials with fine craftsmanship. The style is associated with luxury and modernity and also utilises modern materials like chrome, stainless steel, and inlaid wood. Art Deco featured bold shapes like sunbursts and zigzags and broad curves.

20th century furniture is more diverse in terms of styles because of the availability of a wider array of materials and the expanding awareness of historical and cross – cultural aesthetics. The Modern Movement saw the emergence of simple geometric shapes, the absence of decorations, and smooth surfaces. The rise of the modern movement saw furniture as an interrelation between form and function rather than the earlier perception of furniture as ornamentation. Furniture production became mechanised thereby making it affordable and functional. Notable modernist architects designed furniture that harmonised with their buildings. Modernist furniture sort to create designs that fit with the human form by the interaction of design and the user.

Furniture Design

Furniture is a type of industrial or handcrafted design that is used to facilitate human activities. Every piece of furniture is designed with the needs of the user in mind. The purpose of a piece of furniture, such as sleeping (beds), eating (tables), or seating (seats), is determined by its function (chairs).

It's an applied art that draws upon different areas and necessitates an understanding of materials as well as fabrication techniques. So furniture design, it's no one thing. It's more of a holistic discipline, drawing upon many other areas.

Creates Structure – Usage of furniture to formalise the open spaces in a room. The right furniture designs give the room a balanced look and feel. It can help to create an airy, yet well-put-together room by making even the intentionally unused spaces look more beautiful.

Types of Furniture

Different types of furniture are used by humans for various activities including sitting, eating, and sleeping. The type of furniture is determined by the type of activity it is going to support or going to be used for. In the selection of furniture, the general rule is the consideration of comfort first, then expressiveness, style, beauty, its usefulness, scale and construction. The cost of the furniture must be taken into consideration. Contemporary furniture is both functional and aesthetically appealing. The type of furniture items and furnishing can make an environment inviting and comfortable or make it less attractive.

Types of Furniture can be classified either by the type of function it supports or by the material with which it is constructed, or even by the period of its origin.

Types classified by materials

- Wooden furniture.
- Bamboo furniture.
- Wicker or rattan furniture.
- Metal furniture.
- Plastic furniture, also known as acrylic furniture.
- Glass furniture.
- Concrete furniture.

Types classified by functions

- Seating.
- Sleeping.
- Eating.
- Storage.
- working
- Office Furnishings

Types of Materials, Selecting and Understanding the Nature of Materials

Wood is the most commonly used material in the production of furniture, there are many kinds of wood, however, some have qualities that make them superior to others. Wood is a material that can be treated in various ways, it can be stained, painted, gilded and glued. Wood can either be shaped by hand or with machines. Through the application of technology, new wood - based products have been developed, such as veneer, carcass wood, plywood, laminated board, particle board and hardboard. Wood is a durable material if stored in favourable conditions.

Metals have also been used since antiquity in the production of furniture. Metals were mainly used in the construction of frames and accessories, or for coverings or linings with precious metals like gold and silver.

Plastic materials have been used in the production of chairs and tables since the 19th century. While glass is used purely for decorative purposes.

Material Properties (physical, inherent qualities and how they can be manipulated), and applications, uses of furniture.

Manufacturing Techniques.

The processes used in the manufacture of furniture include the cutting, bending, moulding, laminating, and assembly of such materials as wood, metal, glass, plastics, and rattan. However, the production process for furniture is not solely bending metal, cutting and shaping wood, or extruding and moulding plastics.

Furniture and the Interior of Spaces

For the best utilisation of space, furniture is placed to allow free movement. This makes the space around furniture as important as its arrangement. Thus, furniture works as a functional and circulatory element in interior design. Interior designers use furniture to establish a pleasing sense of order. Furniture can be employed to give a space distinct and unique character.

Local Industry/ Other Industries, others include Planning Wood Products

The local furniture industry is a growing industry, this is especially because the population is growing, and the real estate market is developing. The growth of furniture usually depends on the growth of the wood industry and other industries.

Furniture Styles,

Developments in furniture design have always been subject to various factors – economic and political change, technological advances, necessity, status, and fashion. Not all countries have experienced exactly the same influences, nor are the features of any one style seen in all the furniture made at that particular time. However, each period style does have its own defining

characteristics, whether it is the overall shape of a piece, how it is decorated, or the materials used, which make it easier to identify as belonging to one era rather than another.

Design Factors, Function, and Social use of Furniture

Defining space (including matters of comfort, performance, intended purpose, activity, structural integrity, spatial order, and aesthetics)

The liveability of a home depends largely on its comfortable furniture items and furnishings. Function and social use are interpreted broadly to include matters of comfort, performance, intended purpose, activity, structural integrity, spatial order, and aesthetics,

Primary categories of function and social use include:

1. Providing support for the human body.
2. Containing human activities.
3. Providing ornamentation and aesthetics.

Types of Fasteners, Safety Rules, Synthetic Materials, Tools for Woodworking.

Fasteners are devices that are used to mechanically join two or more objects together. Normally, fasteners can be permanent or non-permanent but are often used to create non-permanent joints. This allows the joints to be dismantled or removed without damaging the joined parts. In furniture production fasteners are used to join wood and other materials together. Fasteners are selected based on materials and the type of joinery that is required. In the selection of fasteners, some considerations have to be made such as:

The material to be joint, accessibility, ease of assembly, weight restrictions, applied load on the fastener, etc. Most common materials used for the production fasteners is steel, other metals such as aluminium, titanium, copper and various alloys are also employed for construction of metal fasteners.

Wood fasteners include nails, screws, bolts and nuts, adhesives and glues.

Deep-Threaded Type *Screws* · Nuts, *Bolts* · Large Washer Head Type *Screws* · Combo Truss Head Type *Screws.*

Safety Rules

1) Always wear safety glasses or goggles, or a face shield.

2) Wear hearing protection that is suitable for the level and frequency of the noise you are exposed to in the woodworking shop. If you have trouble hearing someone speak from three feet away, the noise level from the machine is too high. Damage to hearing may occur.

3) Use gloves to protect your hands from splinters when handling wood but do not wear them near rotating blades and other machinery parts where the gloves can catch.

4) Always wear protective footwear.

5) Make sure the guard is in position and is in good working condition. Check and adjust all other safety devices.

6) Inspect stock for nails or other material before cutting, planning, routing, or carrying out similar activities.

7) Ensure that all cutting tools and blades are clean, sharp and in good working order so that they will cut freely, not forced.

8) Turn the power off and unplug the power cord before inspecting, changing, cleaning, adjusting a blade or machine. Also turn the power off when discussing the work.

A large number of *synthetic* and natural *materials* have been fabricated into aerogels such as metal, metal oxides, polymers, carbon *materials*, cellulose, etc.

There is a vast array of tools available on the market, however, there are five classes of basic woodworking tools. Those are tools to cut, finish, assemble, measure and hold wooden parts while transforming raw materials into completed projects. The must-have tools for woodworking include the following:

Hand saws

Power saws

Planes

Sanders

Files

Hammer

Mallet

Drill

Screw Gun

Tape Measure

Square

Sawhorses

Workbench

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CHAPTER TEN: SPATIAL DYNAMICS OF ERGONOMICS AND ANTHROPOMETRICS IN INTERIOR SPACES

Anthropometrics Measurements for Furniture Design – Beginners Course

Olugbenga Adewolu *Bells University of Technology, Ota*

Overview

Anthropometric measurements are essential in furniture design as they help ensure that the furniture is comfortable and ergonomically suitable for its intended users (Ismaila, Musa, Adejuyigbe, & Akinyemi, 2013). This course – Anthropometric Measurements for Furniture Design has been designed for the 100 to 200 Level students in the undergraduate program of the Faculty of Architecture in a Nigerian University. The main aim of this document is to enable a smooth learning environment for the learner and the Mentor/Professor of the subject. It is meant to acquaint the learner with the background information in the subject area as prescribed.

This course has been subdivided into modules that enable the teaching to be conducted over the weekly interactive periods throughout the semester. At the end of the Semester, an end-of-semester Project is expected to be designed by the Course Mentor/Professor, followed by a Jury. The Jury is expected to be attended by all Lecturers in the Department, Faculty, or College

Objectives

The objectives of the text are to:

1. explain the basic concepts in anthropometrics;
2. identify and describe the tools used measuring the human body and furniture;
3. describe the key anthropometric measures and data sets and their uses in furniture design;
4. explain how to use and apply anthropometric data to inform furniture design; and
5. discuss the techniques and issues involved in the use of measuring tools.

Introduction

Anthropometric measurements, which refer to the study of human body dimensions and proportions, are essential in furniture design for several reasons:

Ergonomics: Anthropometric measurements provide designers with the necessary data to create furniture that fits the human body comfortably and safely. By using these

measurements, designers can ensure that furniture promotes good posture, reduces the risk of musculoskeletal disorders, and supports different body types (Taifa & Desai, 2017).

Aesthetics and user satisfaction: Anthropometric measurements can also inform the design of furniture in terms of aesthetics. By understanding the proportions of the human body, designers can create furniture that looks visually appealing and harmonious with the human form. Ultimately, designing furniture with anthropometric measurements in mind can increase user satisfaction.

Materials and Tools needed for Measuring

The materials and tools needed for measuring anthropometric dimensions depend on the specific measurements being taken. However, some common materials and tools that may be used include:

Tape measure: A tape measure is a flexible ruler that can be used to measure body dimensions such as height, waist, chest, and hip circumference.

Callipers: Callipers are instruments used to measure the distance between two opposite sides of an object or body part, such as the width of a hand or the thickness of a skinfold.

Anthropometer: An anthropometer is a specialised measuring tool used to measure body dimensions such as arm length, leg length, and shoulder height.

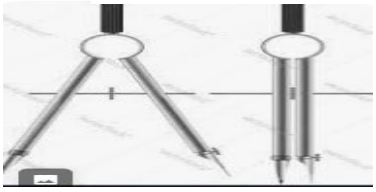
Scale: A scale is used to measure body weight, which is an important factor in determining appropriate furniture size and support.

Pencils: A range of graphite pencils in different hardness levels (e.g., 2H, HB, 2B, 4B) are needed for creating precise lines of different weights and shading.

Paper: High-quality, acid-free paper is essential for technical drawing as it provides a smooth surface and prevents smudging and fading.

Erasers: High-quality erasers (e.g., kneaded erasers or vinyl erasers) are essential for removing unwanted lines and correcting mistakes.

Compass: Compasses are used to draw circles and arcs of precise sizes.



T-squares: T-squares are used to draw straight lines parallel to the edge of the drawing board.

Scaler rulers: Scale rulers are used to measure and draw precise lines and shapes to scale.

Triangles: Triangles are used to draw straight lines and angles accurately.

Computer and software: A computer with appropriate software (such as AutoCAD or SketchUp) is necessary for digital drawings.

Graphics tablet and stylus: For creating digital drawings by hand, a graphics tablet and stylus can be used to create precise lines and shapes.

Printer: A high-quality printer is essential for printing final copies of digital drawings.

In general, the materials and tools needed for technical drawing in landscape architecture require careful consideration to ensure that they are of high quality, appropriate for the type of drawing being created and meet personal preferences. In addition to these specific tools and materials, it is also important to have a suitable measuring environment, such as a private space with adequate lighting, as well as ensure that the person being measured is standing or sitting in the correct posture (Tremblay, Lalancette, & Roseveare, 2012).

Understanding the Basic Concepts of Anthropometry

Anthropometry is the study of human body dimensions and proportions. It is used in many fields, including furniture design, ergonomics, and product design, to ensure that

designs are safe, comfortable, and accessible to people of all sizes and shapes. Some of the basic concepts of anthropometry include (Neufert & Neufert, 2003):

Anthropometric dimensions: These are the measurements of various parts of the human body, such as height, weight, chest circumference, and arm length.

Body proportions: Anthropometry also involves the study of the relationship between different body parts, such as the length of the arms compared to the legs, or the circumference of the waist compared to the hips.

Ergonomics: Finally, anthropometry is closely related to the field of ergonomics, which focuses on designing products and spaces that are comfortable, safe, and efficient for human use. Anthropometric data is essential for understanding the physical needs and limitations of the human body in various contexts.

The Importance of Considering Human Measurements in Furniture Design

Considering human measurements in furniture design is crucial for several reasons:

Comfort and health: Furniture that is designed with human measurements in mind is more likely to be comfortable and supportive for the human body, which can contribute to better health and well-being. Furniture that is too large or too small can cause discomfort, strain, and even injuries.

Accessibility: Furniture that accommodates a range of human measurements and body types can be more accessible and inclusive. For example, adjustable chairs, desks, and tables can be more easily used by people with varying heights, ages, and physical abilities.

Aesthetics: Furniture that is designed with human measurements in mind can also look visually appealing and balanced. Proportions that are in harmony with the human form can create a pleasing and inviting atmosphere.

Functionality: Furniture that is designed with human measurements in mind can also be more functional and efficient. For example, a chair with armrests at the right height can provide support and comfort for the arms, reducing fatigue and strain.

Overview of the Key Measurements of the Human Body

The human body has many different measurements that are important for furniture design and other applications (Taifa & Desai, 2017). Here are some of the key measurements:

Height: The height of a person is typically measured from the floor to the top of the head. This measurement is important for designing furniture that accommodates people of different heights, such as chairs and desks.

Seat height: The height of a chair or other seating surface is also an important measurement. The seat height should be adjustable to accommodate people of different heights.

Hip breadth: Hip breadth is the width of the hips when a person is sitting down. This measurement is important for designing chairs and other seating surfaces that are comfortable and supportive.

Armrest height: The height of armrests on chairs and sofas is an important measurement for providing support and comfort for the arms and shoulders.

Understanding how to Measure the Height, Width, Depth, and Circumference of the Body

Measuring the height, width, depth, and circumference of the body is an important part of anthropometry and furniture design. Here are some tips for measuring these dimensions accurately:

Height: To measure height, the person being measured should stand with their back against a wall or other flat surface. Use a tape measure to measure the distance from the floor to the top of the person's head.

Width: To measure width, use a tape measure to measure the distance across the widest part of the body. For example, to measure hip breadth, measure the distance across the hips when the person is sitting down.

Depth: To measure depth, use a tape measure to measure the distance from the front of the body to the back. For example, to measure seat depth, measure the distance from the back of the seat to the front edge of the seat.

Using Anthropometric Data to Inform Furniture Design

Anthropometric data can be used to inform furniture design in several ways (Luximon & Luximon, 2021). Here are some examples:

Determine optimal dimensions: Anthropometric data can be used to determine the optimal dimensions for furniture pieces. For example, data on the average height of a population can be used to design chairs with seat heights that are comfortable for most people.

Design adjustable furniture: Anthropometric data can also be used to design adjustable furniture. For example, data on the range of hip breadth measurements in a population can be used to design chairs with adjustable armrests that can accommodate different body types.

Improve ergonomics: Anthropometric data can be used to improve the ergonomics of furniture pieces. For example, data on the average distance between the elbow and the

wrist can be used to design computer mice and other input devices that are comfortable and easy to use.

Different Types of Tools Used for Measuring

There are several different types of tools used for measuring furniture design (20 Different Types of Measuring Tools - Home Stratosphere, 2022). Here are some examples:

Tape measure: A tape measure is a flexible tool used to measure length, width, and circumference. It is commonly used to measure the height of chairs and desks, the width of a room, and the circumference of different body parts.

Callipers: Callipers are tools used to measure the distance between two points. They are commonly used to measure the thickness of different materials, such as wood or metal.

Rulers: Rulers are straight, flat tools used to measure length and width. They are commonly used to measure the dimensions of different components of furniture pieces, such as the length of a table

Regularly check the calibration of your measuring tools: Over time, measuring tools may become less accurate due to wear and tear. To ensure precise measurements, periodically check the calibration of your tools and make any necessary adjustments or repairs.

Selecting the Appropriate Measuring Tools for Specific Applications

Selecting the appropriate measuring tool for specific applications is critical to ensure accurate measurements (Modern Machine Shop, 2023). Here are some common measuring tools and their recommended applications:

Tape measure: Tape measures are useful for measuring long distances, such as room dimensions, and for measuring irregularly shaped objects. They are typically available in metric and imperial units.

Calliper: Callipers are used to measure small dimensions, such as the thickness of materials, the diameter of holes, and the width of gaps. They are available in digital and analog versions and can be inside, outside, or in-depth callipers.

Square: Squares are used to ensure right angles when marking or cutting materials. They are available in different sizes and are useful in carpentry, woodworking, and metalworking.

Techniques for Measuring Body Dimensions Accurately

Here are some techniques for measuring body dimensions accurately:

Take measurements at the right locations: Know the correct body landmarks for taking measurements. For example, for chest measurements, measure at the widest point of

the chest. For waist measurements, measure at the natural waistline, which is usually at the narrowest point of the torso (Neufert & Neufert, 2003).

Use consistent pressure: Apply consistent pressure when taking measurements. Too much or too little pressure can affect the accuracy of the measurement.

Have a Consistent Measuring Technique: Develop a consistent technique for measuring body dimensions and use the same technique each time. This can help to ensure accuracy and reliability.

Common Errors in Measuring and How to Avoid them

Accurate measurements are crucial in many fields, from construction to science to fashion. However, there are common errors that can occur when measuring. Here are some of the most common errors and tips on how to avoid them:

Parallax error: This error occurs when the observer's eye is not perpendicular to the measurement scale, resulting in an incorrect reading. To avoid this, make sure your eyes are directly in front of the measurement scale, and avoid looking at it from an angle.

Incorrect units: Using the wrong units of measurement can lead to errors in calculations. Make sure to use the correct units of measurement and convert them if necessary, to ensure accuracy.

Inconsistent pressure: Inconsistent pressure can cause variations in measurements, especially with tools such as callipers or rulers. Ensure that the same pressure is applied each time when measuring.

Poor lighting: Poor lighting can make it difficult to read measurement scales and lead to inaccurate readings. Use proper lighting when measuring to ensure accurate readings.

Recording and documenting measurements

Recording and documenting measurements is essential to keep track of measurements, compare them over time, and share them with others. Here are some tips for recording and documenting measurements:

Use a consistent format: Use a consistent format for recording measurements, including the type of measurement, the units used, and any notes or comments. This can help to ensure consistency and accuracy in recording measurements.

Use a notebook or spreadsheet: Use a notebook or spreadsheet to record measurements. Keep it organised by including columns for the date, measurement, and any additional notes or comments.

Label measurements: Label measurements with the appropriate name or description, so they are easily identifiable later. This is particularly important when measuring different parts of an object or body.

Take photos: Take photos of the object or body being measured, along with the measurement tool in place. This can help to provide additional context and ensure accurate documentation.

Understanding Anthropometric Data and its Sources

Anthropometric data is a type of data that is used to describe and measure the physical characteristics of the human body. These measurements include things like height, weight, body mass index (BMI), waist circumference, and various other body dimensions (Casadei & Kiel, 2022). Sources of anthropometric data can include:

National surveys: Many countries conduct regular surveys of their populations to collect data on various aspects of health and wellbeing, including anthropometric data. Examples of such surveys include the National Health and Nutrition Examination Survey (NHANES) in the United States, the Health Survey for England, and the Canadian Health Measures Survey.

Medical records: Medical records from hospitals and clinics may contain anthropometric data that has been collected during routine check-ups or other medical exams.

Research studies: Many research studies collect anthropometric data from study participants as part of their research protocols. This data can be used to answer research questions related to health outcomes or to test hypotheses about the relationships between anthropometric variables and other variables of interest.

Different Anthropometric Data Sets and their Uses in Furniture Design

Anthropometric data sets are used to design furniture that fits the human body comfortably and ergonomically. Here are some of the most commonly used anthropometric data sets and their applications in furniture design:

Anthropometric data for standing and seated heights: This data set provides information on the average height of individuals when standing or sitting. It is used to design chairs, tables, and other furniture that is appropriate for the height of the user.

Anthropometric data for body dimensions: This data set provides information on the average dimensions of different parts of the body, such as the length of the arm, the width of the shoulders, and the depth of the seat. It is used to design furniture that accommodates the size and shape of the human body.

Anthropometric data for reach and grasp: This data set provides information on the maximum reach and grasp distances of individuals. It is used to design furniture that is easily accessible and functional, such as shelves, cabinets, and drawers.

Anthropometric data for posture and movement: This data set provides information on the natural posture and movement patterns of individuals. It is used to design furniture

that supports proper posture and facilitates comfortable movement, such as ergonomic office chairs and adjustable desks.

By using anthropometric data sets in furniture design, designers can create furniture that is not only aesthetically pleasing but also comfortable, functional, and supportive of the human body. This can improve the overall user experience and reduce the risk of musculoskeletal injuries and discomfort.

International and National Anthropometric Standards and Guidelines

Anthropometric standards and guidelines are used to establish a common set of measurements and reference values for human body dimensions, which can be used in various fields such as ergonomics, clothing design, and product design. Here are some examples of international and national anthropometric standards and guidelines:

International Organization for Standardization (ISO): The ISO has developed several standards related to anthropometry, including ISO 7250, which provides guidelines for ergonomic design principles, and ISO 15535, which provides guidelines for the measurement of anthropometric data.

National Institute for Occupational Safety and Health (NIOSH): The NIOSH has developed several anthropometric databases that are used to develop and evaluate ergonomic solutions for a variety of workplaces.

Anthropometric Data and Engineering Anthropometry Resource (ANDREA): This is a national database of anthropometric data that was developed by the U.S. Army, and it is used to design military equipment and clothing.

How to Use Anthropometric Data in Furniture Design

Anthropometric data can be used in furniture design to create furniture that fits the human body comfortably and ergonomically (Taifa & Desai, 2017). Here are some steps to use anthropometric data in furniture design:

Collect anthropometric data: Use an appropriate anthropometric data set to collect measurements of the target population, such as standing and seated heights, body dimensions, reach and grasp distances, and posture and movement patterns.

Analyse the data: Analyse the anthropometric data to identify patterns and trends, and determine the appropriate reference values to use in the design process.

Use the data in design: Use anthropometric data to guide the design of the furniture. This may include adjusting the dimensions of the furniture to fit the target population, incorporating features that support proper posture and movement, and considering reach and grasp distances to ensure that the furniture is accessible and functional.

Design Considerations for Different Types of Furniture

Different types of furniture have unique design considerations that must be considered to ensure that they are both functional and aesthetically pleasing. Here are some design considerations for different types of furniture:

Chairs: Chairs must be designed to provide comfortable seating and support for the user's back and legs. The seat height, depth, and width should be adjustable to accommodate users of different sizes. The backrest should be contoured to provide support for the lower back and armrests can be added for additional support.

Tables: Tables should be designed to provide a stable surface for various activities such as work, dining, or gaming. The height should be appropriate for the intended use and the size should be proportionate to the seating area.

Beds: Beds should be designed to provide a comfortable and supportive sleeping surface. The size should be appropriate for the intended use and the height should be adjustable to accommodate different preferences.

Outdoor furniture: Outdoor furniture must be designed to withstand the elements while maintaining a visually appealing design. Materials such as teak, aluminium, and wrought iron are commonly used in outdoor furniture due to their durability and resistance to weathering.

Case Studies on The Application of Anthropometric Data in Furniture Design

Here are some case studies on the application of anthropometric data in furniture design:

Herman Miller: Herman Miller is a furniture company that has been using anthropometric data in their furniture design since the 1960s. They developed a series of chairs, including the Aeron chair, that were designed to fit a wide range of body sizes and shapes. The Aeron chair features adjustable seat height, tilt, and armrests, as well as a contoured backrest that provides support for the lower back.

IKEA: IKEA, the Swedish furniture company, uses anthropometric data to design furniture that is affordable, functional, and stylish.

Steelcase: Steelcase is a furniture company that uses anthropometric data to design furniture that supports the way people work. They developed a series of ergonomic office chairs, including the Leap chair, that is designed to accommodate a range of body sizes and shapes

Ergotron: Ergotron is a company that designs ergonomic workstations and furniture for the healthcare industry.

Kartell: Kartell is an Italian furniture company that uses anthropometric data to design furniture that is both functional and visually appealing. They developed a series of chairs,

including the Louis Ghost Chair, that is made of transparent polycarbonate and features a classic design that fits a range of body sizes and shapes.

The Importance of Prototyping and Testing in Furniture Design

Prototyping and testing are critical components of the furniture design process (Kuska, 2021). Here are some reasons why they are important:

Evaluate functionality: Prototyping and testing allow designers to evaluate the functionality of their designs. By creating physical prototypes, designers can test how the furniture functions in real-life situations and make any necessary adjustments.

Identify manufacturing issues: Prototyping and testing can help identify any manufacturing issues before the furniture is put into production. This can help to avoid costly mistakes and ensure that the furniture can be produced efficiently and at scale.

Refine aesthetics: Prototyping and testing also allow designers to refine the aesthetics of their designs. They can evaluate how the furniture looks in different lighting conditions, how it complements other furniture pieces, and how it aligns with the brand's overall aesthetic.

Techniques for Prototyping and Testing Furniture Designs

Here are some techniques for prototyping and testing furniture designs:

Mock-ups: Mock-ups are non-functional, low-fidelity models of furniture designs that are created using inexpensive materials such as foam boards or cardboard. Mock-ups can be used to test the size, scale, and proportion of furniture designs before moving on to more advanced prototypes.

3D printing: 3D printing is a technology that can be used to create physical prototypes of furniture designs. It allows designers to create complex geometries and test the fit and function of furniture components before producing a final product.

User testing: User testing involves observing how people interact with furniture designs in real- life situations. Designers can use user testing to evaluate the comfort, usability, and safety of their designs, as well as to get feedback on how to improve the design.

In summary, there are various techniques for prototyping and testing furniture designs

Collecting Feedback and Making Design Improvements

Collecting feedback from users is an important step in the furniture design process, as it allows designers to make improvements to their designs based on user needs and preferences. Here are some ways to collect feedback and make design improvements:

User testing: user testing involves observing how people interact with furniture designs in real- life situations. By watching users use their designs, designers can identify any usability issues or design flaws that may need to be addressed.

Social media: social media can be a powerful tool for gathering feedback from users. Designers can use social media platforms to solicit feedback from users, share images of their designs, and engage with their target audience.

The Relationship Between Sustainability and Anthropometry in Furniture Design

Sustainability and anthropometry are two important considerations in furniture design, and there is a relationship between the two (Nadadur & Parkinson, 2013).

Sustainability refers to designing products that meet the needs of the present without compromising the ability of future generations to meet their own needs. In furniture design, sustainability involves reducing the environmental impact of furniture production, use, and disposal. Anthropometry, on the other hand, refers to the measurement of human physical characteristics such as height, weight, and body dimensions.

When considering sustainability and anthropometry in furniture design, there are several key considerations:

Material selection: Sustainable materials, such as FSC-certified wood, bamboo, or recycled materials, can be used in furniture production. Designers can choose materials that are durable, environmentally friendly, and non-toxic.

Design for disassembly: Furniture can be designed for easy disassembly, making it easier to recycle or dispose of at the end of its life. This can also make it easier to repair and maintain, extending the lifespan of the furniture.

Ergonomics: Furniture can be designed to be ergonomically friendly and comfortable for users. This can help reduce physical strain and injury and make the furniture more comfortable to use.

Size and scale: Furniture can be designed to fit the anthropometric needs of its intended users. This can help ensure that the furniture is comfortable and supportive, reducing the need for users to replace it due to discomfort or pain.

Design Considerations for Sustainable Furniture

Sustainable furniture design is a process that seeks to reduce the environmental impact of furniture production, use, and disposal. Here are some key design considerations for creating sustainable furniture:

Material selection: Sustainable materials, such as FSC-certified wood, bamboo, or recycled materials, can be used in furniture production. Designers can choose materials that are durable, environmentally friendly, and non-toxic.

Design for disassembly: Furniture can be designed for easy disassembly, making it easier to recycle or dispose of at the end of its life. This can also make it easier to repair and maintain, extending the lifespan of the furniture.

Use of renewable energy: Designers can consider using renewable energy sources, such as solar or wind power, to power the production of their furniture.

Production methods: Designers can use production methods [like CAD] that minimise waste and reduce the environmental impact of furniture production.

Examples of Sustainable Furniture Designs that Incorporate Anthropometric Data

The Knoll Generation Chair: The Knoll Generation chair is a highly adjustable office chair that is designed to support a wide range of body types. The chair is made from sustainable materials and is designed for disassembly, making it easy to recycle at the end of its life.

The Loll Adirondack Chair: The Loll Adirondack chair is made from recycled plastic and is designed to be both comfortable and environmentally friendly.

The Muuto Fiber Chair: The Muuto Fiber chair is made from a sustainable material called "wood fibre," which is made from a mix of wood and plastic.

Applying All Principles Learned to Create a Final Furniture Design Project

Below is a general overview of the process to follow in creating a final furniture design project:

Define the problem: Identify the needs and requirements of your target audience. Determine what kind of furniture you want to design and what problem it will solve (Markoo, 2022).

Research: Gather information on the anthropometric data relevant to the type of furniture you are designing. Look for sustainable materials and production methods that can be used in the design.

Develop concepts: Generate multiple design concepts that address the problem and incorporate the research. Consider different materials, shapes, and functions.

Refine: Evaluate each concept based on its feasibility, ergonomics, and sustainability. Refine the most promising concepts by creating detailed drawings and models.

Prototype: Create a physical prototype of the design. Use 3D printing or other fabrication methods to test the functionality and ergonomics of the design.

Critique and Feedback from Instructor and Peers

Getting feedback from instructors and peers is an important part of any design project. Critique and feedback can help you identify areas where your design could be improved and can also help you understand how your design is being perceived by others. Here are some tips for receiving feedback from instructors and peers:

Be open to feedback: As a student, it can be hard to hear criticism of your work but remember that feedback is essential for growth and improvement. Students should be encouraged to be open to feedback, even if it is not what you were expecting.

Ask specific questions: When asking for feedback, Lecturers and Instructors should be specific about what they want to know. Ask questions that will help your students understand how your student design is being perceived and how it could be improved.

Listen carefully: When receiving feedback, listen carefully to what the other person is saying. Try to understand their perspective and why they feel the way they do.

Lagos furniture makers and factories

Bedmate Furniture

Adebola House, Opebi Rd, Opebi, Ikeja, Lagos Telephone: 0700-233- 6283

Url - http://bedmatefurniture.com E-mail: bedmatefurniturenigerialtd@gmail.com

IO Furniture

6/8 Industrial Street, off Town Planning Way, Ilupeju, Lagos Nigeria Tel:0706 300 0500, 0706 300 0600

Url - https://iofurnitureltd.com/ E-mail: service@iofurnitureltd.com

Alfim Nigeria Limited

4A, Funsho Williams Avenue, Alaka Surulere, Lagos0708 814 6981, 0815 270 7180 Url - https://www.alfimfurniture.com.ng/ E-mail: info@alfimfurniture.com.ng

Svengali Designs Ltd

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https://www.svengalidesigns.com/ E-mail: sales@svengalidesigns.com

The Chair Centre Ltd

Plot 18, Block 94 Providence Street, Lekki-Epe Expressway, Lekki Phase 1, Lagos Nigeria; Telephone: 0908 783 4561, 0908 783 456601 454 3309 Url: https://thechaircentrenigeria.com/ E-mail: enquiries@thechaircentrenigeria.com

ABUJA, FCT

Arcme Furniture Limited (Furniture Manufacturer)

ZONE 3, AMAC Plaza, Block AP -A1, Kabale Close, Abuja, FCT Telephone: 0803 864 5716; 0818 718 5750

The Wood Factory Ltd (Furniture Manufacturer)

154 Adetokunbo Ademola Crescent, Abuja, FCT Telephone:+234 906 658 0336

Julius Berger Nig Plc AFP Furniture Showroom Abuja

53 Gana St, Maitama 900271, Abuja, Federal Capital Territory Telephone: 0812 397 1938 ABUJA, FCT

Port Harcourt furniture manufacturers

Bedmate Furniture Company Port Harcourt III

Furniture store, Stadium Road, Port Harcourt Tel: 0705 849 0007

El-Bethel Furniture Company (Furniture Store)

Amadi Flat, 22 Ohia Street, Old GRA, Port Harcourt Telephone: 0803 339 6168

Kaduna furniture manufacturers

Haske Wooden Furniture (Furniture store)

B6, Rigachukwu Road, Tudun Wada, Kaduna, Kaduna Telephone: 0806 557 3275

Sanat Industry Limited (Furniture Store)

No. 28 Ahmadu Bello Way Telephone: 0807 349 999

D Furniture (Furniture Manufacturer) Asuka Side, Kabala Doki 800283, Kaduna Telephone: 0703 424 6937

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BIODATA ADEOYE OLUGBENGA ADEWOLU, Ph.D., MNIA

Dr. ADEOYE OLUGBENGA ADEWOLU is an esteemed senior lecturer in Architecture with an illustrious career spanning over 30 years in the university system. As a highly respected and experienced educator, Dr. ADEWOLU has made significant contributions to the field of architecture through teaching, research, and related works. Having obtained a Ph.D. degree in Architecture, Dr. ADEOYE ADEWOLU possesses a deep understanding of the subject matter and has developed strong expertise in various aspects of architectural theory and practice. Their extensive knowledge and passion for the discipline have been instrumental in shaping the minds of countless students who have had the privilege of being taught by them. Dr. ADEWOLU's teaching philosophy centres around fostering critical thinking, encouraging creativity, and nurturing a deep appreciation for the art and science of architecture. He is known for his engaging teaching style, employing innovative pedagogical techniques to ensure students receive a comprehensive education that combines theoretical concepts with practical applications. In addition to his teaching responsibilities, Dr. ADE ADEWOLU has actively pursued research endeavours throughout his career. Their scholarly work focuses on exploring emerging trends in architecture, sustainable design practices, and the integration of technology in the field. By staying at the forefront of advancements in the architectural domain, Dr. ADE ADEWOLU continually seeks to inspire students and fellow professionals alike, encouraging them to push boundaries and envision new possibilities.

Dr. ADEWOLU's contributions extend beyond the confines of the classroom and research lab. He has actively participated in academic committees, served as a mentor to aspiring architects, and collaborated with industry professionals to bridge the gap between academia and practice. His efforts to promote interdisciplinary collaboration and knowledge exchange have played a pivotal role in enhancing the architectural community within Nigeria and beyond.

Recognised for his expertise, Dr. ADE ADEWOLU has been invited to present at national and international conferences, delivering thought-provoking talks on topics such as sustainable design, urban planning, and the role of architecture in shaping societies. Their research findings have been published in reputable journals, further contributing to the body of knowledge in the architectural field.

With a career spanning three decades, Dr. ADEOYE OLUGBENGA ADEWOLU continues to be an influential figure in the realm of architecture education. Their commitment to excellence, dedication to their students, and unwavering passion for the subject have solidified their position as a respected authority in the field. As an author, their insights and expertise will undoubtedly enlighten readers and inspire future generations of architects and designers.

Understanding Material Properties and Types of Furniture

Asst. Prof. Yakubu Aminu Dodo Ph.D., *Najran University*

Overview

Furniture is an essential component of interior design, and choosing the right furniture can make a significant impact on the look and feel of your space. When it comes to furniture, the material properties play a vital role in determining the durability, comfort, and aesthetic appeal of the piece.

This text explores the different material properties and types of furniture available in the market to help you make an informed decision while selecting furniture for your home or office considering conventional and sustainable furniture products available in the market.

Objectives

The objectives of this text are to:

1. identify the materials used in furniture design and fabrication.
2. examine the properties of these materials.
3. discuss the types of furniture and how they are classified.

Furniture Materials

Wood

Wood is a popular choice for furniture due to its natural beauty, durability, and versatility. It is available in different types such as hardwood and softwood, each with distinct properties. Hardwood such as oak, maple, and teak are denser and more durable, while softwood such as pine and spruce are lightweight and affordable.

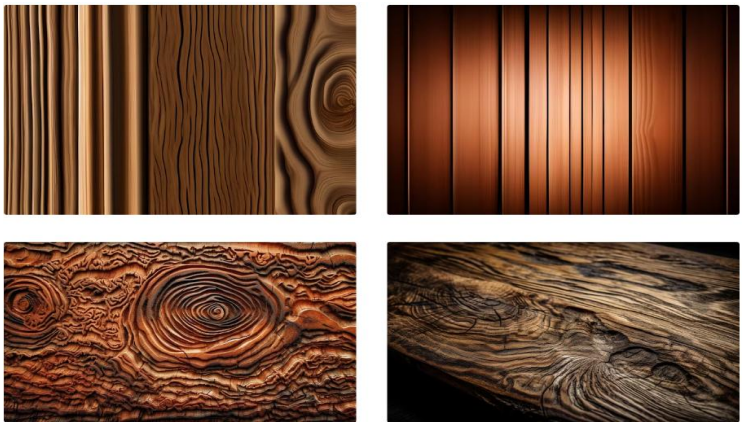

Figure 1 *sample of wood used for various furniture type*:

Source Freepik https://www.freepik.com/search?format=search&query=wood&type=ai

Metal

Metal is a sturdy material that is often used in contemporary furniture designs. Steel, aluminum, and iron are common types of metal used in furniture. Each metal has its unique properties, such as steel's strength and durability, aluminum's lightweight and corrosion-resistant nature, and iron's ability to withstand high loads.

Figure 2 *sample of metal use for construction of furniture (hollow pipe):*

Source authors' photo

Figure 3 sample metal use for constructing wall frame to receive timber and wood members: *Source* authors' photo

Plastic

Plastic is a popular material used in modern furniture due to its durability, lightweight, and low cost. It is available in different forms such as polypropylene, polyethylene, and polycarbonate. Each type of plastic has its unique properties, such as polypropylene's flexibility, polyethylene's toughness, and polycarbonate's transparency.

Figure 4 *Plastic usage for modern furniture:*

Source authors' photo

Aluminium

Another material that has gained popularity in recent years is aluminium. Aluminium is a lightweight, strong, and durable material that is resistant to corrosion, making it an excellent choice for outdoor furniture (Biswas et al., 2020). Additionally, aluminium is highly malleable and can be easily moulded into various shapes, making it ideal for modern and minimalist furniture designs (Chowdhury et al., 2021). Moreover, aluminium is a sustainable material as it is 100% recyclable, which reduces the environmental impact of furniture production (Saad et al., 2020). Overall, the properties of aluminium make it a versatile material for furniture production that offers both aesthetic and environmental benefits.

Figure 5 *Aluminium usage for partitioning of space Ahmadu Bello University 2nd Year Studio:*

Source authors' photo

Bamboo

Bamboo is a rapidly renewable and sustainable material that has gained popularity in the furniture industry due to its unique properties. Bamboo is a fast-growing grass that can reach maturity in just three to five years, making it an eco-friendly alternative to traditional wood materials (Han et al., 2020). Additionally, bamboo is highly durable and has a high tensile strength, making it an excellent choice for furniture that requires strength and stability (Sasaki et al., 2021). Furthermore, bamboo has a unique aesthetic that can add a natural and organic feel to furniture designs (Li et al., 2021). Moreover, bamboo has a lower environmental impact compared to traditional wood materials, as it requires less water and pesticides for growth (Li et al., 2021). In conclusion, the unique properties of bamboo make it a sustainable and versatile material for furniture production that offers both aesthetic and environmental benefits.

Figure 6: *Bamboo materials used for making flower verse carrier furniture*

source: https://www.freepik.com/search?format=search&query=bambooo%20furniture

Composite Materials

Composite materials are increasingly being used in furniture design due to their unique properties, including high strength-to-weight ratios, durability, and resistance to wear and tear. Composite materials are made by combining two or more materials to create a new material with enhanced properties. Examples of composite materials used in furniture include plywood, particleboard, and medium-density fiberboard (MDF). These materials are widely used in the furniture industry due to their cost-effectiveness and versatility in design. According to a study by Grand View Research, the global furniture composite materials market is expected to grow at a CAGR of 7.2% from 2020 to 2027, indicating the increasing adoption of composite materials in the furniture industry (Grand View Research, 2020). Panels and other composite for the kitchen countertops are manufactured using a combination of two or more materials such as quartz, paper, bamboo, wood pulp, acrylic materials, and resin.

Figure 7: *Composite materials used in the production of a kitchen medium density fibre [MDF] for the panels and other composite for the kitchen countertops*

Source: authors' photo

Computer Generated Material

One type of synthetic material that has gained popularity in recent years is composite materials. Composite materials are made by combining two or more different materials to create a new material with enhanced properties. According to a study by Kasal et al. (2020), composite materials have become increasingly popular in the furniture industry due to their lightweight, durability, and flexibility in design. These materials can be made from a variety of components such as wood, plastic, metal, and natural fibres, and can be customised to meet specific design and performance requirements. Composite materials have also been shown to have a lower environmental impact compared to traditional furniture materials, making them a sustainable option for furniture manufacturing (Kasal et al., 2020).

Figure 8: *Modern office equipment on wooden table indoors generated by AI*

Source: Freepik https://ln.run/OjmxX

3D Printed Materials

Another material that has gained popularity in recent years is 3D printed materials. 3D printing allows for the creation of intricate designs and shapes that would be difficult or impossible to achieve with traditional manufacturing methods. According to a study by Grand View Research, the global 3D printing materials market size is expected to reach USD 2.56 billion by 2025 (Grand View Research, 2019). Some common 3D printed materials used in furniture design include plastics, metals, and composites. These materials are lightweight, durable, and customizable, making them a popular choice for designers looking to create unique pieces of furniture (3Dnatives, 2021). A good example is Delta WASP: 3D Printed Furniture with Beauty & Form. A Guatemalan architect creates stunningly intricate furniture designs achievable only with a large format 3D printer.

Figure 9: *The Piegatto Truss chair in natural amber biopolymer from NatureWorks. Source:* Carolyn Schwaar, Images and project by piegatto.com https://www.3dwasp.com/en/3d-printed-furniture-when-art-meet-additive-manufacturing/

Properties of Furniture Materials

The properties of furniture materials can significantly impact the durability, aesthetics, and functionality of the furniture. The following are some of the essential properties of furniture materials:

Strength and Durability

Furniture must be strong and durable enough to withstand regular use. Materials like solid wood, metal, and plastic are known for their strength and durability.

Appearance

The appearance of furniture materials can impact the aesthetics of the furniture. Materials like leather, fabric, and wood can add to the beauty of furniture.

Weight

Furniture materials can be heavy or lightweight. Materials like metal and solid wood are typically heavier, while materials like plastic and engineered wood are lighter.

Maintenance

Some furniture materials require more maintenance than others. Materials like leather require regular cleaning and conditioning, while materials like metal and plastic are easier to maintain.

Types of Furniture

Sofas

Sofas are one of the most important pieces of furniture in any living room. They are available in different materials such as leather, fabric, and suede, each with its unique properties. Leather sofas are durable and easy to clean, while fabric sofas are available in a wide range of colours and patterns.

Figure 10: *An executive 2-seater sofas*

Source: authors' photo

Chairs

Chairs come in different types such as armchairs, dining chairs, and lounge chairs. They are available in different materials such as wood, metal, and plastic, each with their unique properties. Armchairs are ideal for relaxation, while dining chairs are designed for comfort and functionality.

Figure 11: *Classroom chair*

Source: authors' photo

Tables

Tables are essential pieces of furniture in any room. They are available in different materials such as wood, metal, and glass, each with its unique properties. Wooden tables are durable and versatile, while glass tables are elegant and easy to clean.

Figure 12: *An example of table with metal legs*

Source: authors' photo

Categories of Furniture

Seating Furniture

Seating furniture includes chairs, sofas, and recliners. These are designed for sitting and relaxing.

Figure 13: *Various seating furniture*

Source: authors' photo

Storage Furniture

Storage furniture includes dressers, cabinets, and shelves. These are designed for storing items like clothes, books, and other possessions.

Figure 14: *An example of storage furniture, a wardrobe for storing clothes*

Source: authors' photo

Sleeping Furniture

Sleeping furniture includes beds, mattresses, and headboards. These are designed for sleeping and relaxing.

Figure 15: *An example of sleeping furniture, it includes bed, mattress, and headboard Source*: authors' photo

Summary

Choosing the right furniture is essential for creating a comfortable and functional living space. By understanding the properties of furniture materials and types of furniture available, you can make informed decisions about your furniture choices.

Exercises

1. Highlight 4 types of materials properties of furniture you have learnt and briefly explain how it can enhance the choice of furniture selection
2. Differentiate between conventional and sustainable types of furniture that you have learnt from the text.

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Universal Design Considerations in Furniture Design

Asst. Prof. Yakubu Aminu Dodo Ph.D., *Najran University*

Overview

Furniture design is an essential component of interior design. While aesthetics and functionality are the primary considerations for furniture design, another critical aspect that should not be overlooked is universal design. Universal design is an approach to design that seeks to create products and environments that are usable by people of all ages, sizes, and abilities.

This text discusses universal design considerations in furniture design and their importance in creating inclusive and accessible spaces.

Objectives

The objectives of this text are to:

1. identify the universal principles applicable to furniture design and fabrication;
2. discuss these principles; and
3. examine how these universal principles benefit the user.

Design Considerations for Universal Furniture

Universal Design in furniture can be achieved through the use of certain design principles such as flexibility, adaptability, simplicity, and intuitive use. For example, furniture that is easy to adjust or reconfigure can accommodate different user needs and preferences. Similarly, furniture that is designed to be easily moved or stored can provide more flexibility in use and better space utilisation.

In addition to these design principles, there are also specific design features that can enhance the accessibility and usability of furniture. These features include adjustable height, easy-to-reach controls, non-slip surfaces, and tactile cues. By incorporating these features into furniture design, designers can create products that are more inclusive and user-friendly.

Some of the design considerations are discussed as follows:

Accessibility

Accessibility is another crucial consideration in universal furniture design. Furniture should be designed in such a way that it can be easily accessed and used by people with different physical abilities. This can include features such as grab bars or rails on chairs, tables, or beds to provide support and stability for people with mobility impairments. Additionally,

furniture should be designed to have a clear and unobstructed pathway to facilitate easy movement for wheelchair users.

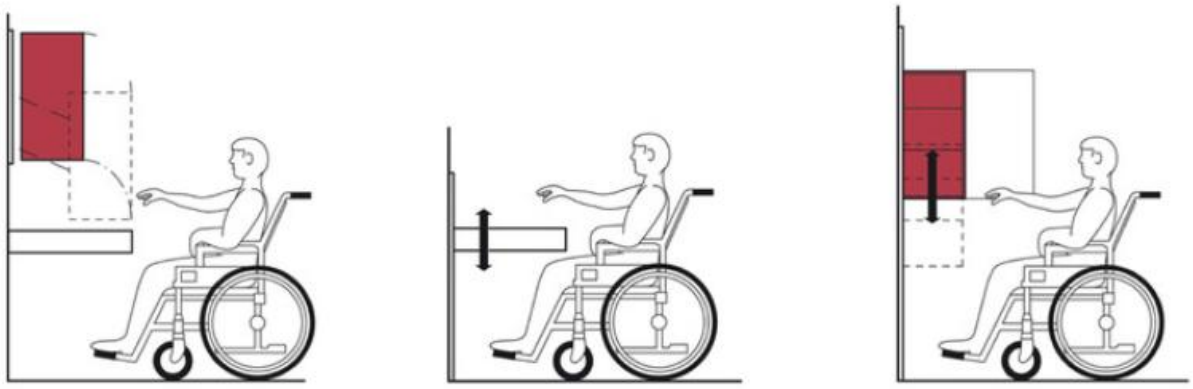

Figure 1: *How to Design an Accessible Kitchen: Adjustable and Multifunctional Furniture | ArchDaily*

Source : (Franco, 2019) https://www.archdaily.com/920447/how-to-design-an-accessible-kitchen-adjustable-and-multifunctional-furniture

Safety

Safety is another essential consideration in universal furniture design. The furniture should be designed in such a way that it does not pose a hazard to users. Sharp edges, slippery surfaces, and unstable furniture should be avoided.

Figure 2: *Meeting room round edge table and chairs poses a low hazard to users,*

Source: pixabay image https://pixabay.com/photos/meeting-room-cable-four-chairs-2170534/

Ergonomics

Ergonomics is the study of how people interact with their environment and the objects in it. In furniture design, ergonomics plays a crucial role in ensuring that furniture is comfortable, supportive, and safe to use. By considering the anthropometric measurements of a diverse range of users, furniture designers can create products that are suitable for people of different heights, weights, and body types. For example, adjustable height desks or chairs with adjustable armrests can accommodate users of different heights and ensure that they maintain a healthy posture.

F**igure 3:** *Free vector study hard position composition*

https://www.freepik.com/free-vector/study-hard-positioncomposition_6414054.htm#query=ergonomics&position=23&from_view=keyword&track=sph

Durability

Furniture should be durable enough to withstand the wear and tear of regular use. Durable furniture can reduce the need for frequent replacements and minimize waste. Durable furniture can also be more cost-effective in the long run. The use of high-quality materials and sturdy construction techniques can ensure that furniture lasts longer.

Benefits of universal furniture design

One of the key benefits of Universal Design in furniture is that it can improve the quality of life for many people, including those with disabilities, elderly individuals, and people with limited mobility. It can also reduce the need for special equipment or adaptations, which can be costly and time-consuming.

Some of the benefits are discussed as follows:

Inclusivity

Universal furniture design ensures that furniture is accessible and usable by everyone, regardless of their abilities. This promotes inclusivity and creates a sense of community.

Improved safety

Universal furniture design considers safety, which reduces the risk of accidents and injuries.

Enhanced comfort

Universal furniture design promotes ergonomics, which improves the comfort and health of the user.

Sustainable

Universal furniture design promotes durability, reducing the need for frequent replacements and therefore reduces wastes.

Summary

In summary, Universal design considerations are essential for creating furniture that is accessible, functional, and comfortable for everyone. By incorporating these principles and design features into furniture design, designers can help to create a more inclusive and welcoming environment.

Exercises

1. Discuss universal design application on office and commercial buildings in the context of accessibility and sustainability.
2. Flexibility, adaptability, simplicity, and intuitive use are some of the furniture design features that can be used to achieve universal design.

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CHAPTER ELEVEN: FREE HAND DRAWING

Principles of Sketching Human Figures and Furniture

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Overview

Principles of sketching human figures and furniture (Freehand Drawing) are essential in furniture design as they help ensure that the furniture is comfortable and ergonomically suitable for its intended users. This program – Principles of Sketching Human Figures and Furniture (Freehand Drawing) has been designed for the 100 to 200 Level students in the undergraduate program of the Faculty of Architecture in a Nigerian University. Sketching human figures and furniture is an important aspect of freehand drawing. Sketching human figures involves capturing the gesture, posture, and anatomy of the human body. Understanding the basic shapes and proportions of the human body is crucial for creating accurate and expressive figure drawings.

This freehand drawing course focuses on sketching human figures and furniture provides students with the essential skills and techniques necessary to create accurate and expressive drawings and sketches for a variety of purposes. The main aim of this document is to enable a smooth learning environment for the learner and the Mentor/Professor of the subject. It is meant to acquaint the learner with the background information in the subject area as prescribed.

Objectives

The objectives of the text are to:

1. identify and describe the tools used for free hand sketching;
2. explain the principle of proportions and light and shadow;
3. explain how to sketch basic shapes, capture movement, add details;
4. describe the anatomy of the human body; and
5. discuss some techniques and issues involved in freehand drawing.

Introduction

Materials and Tools Needed for Freehand Sketching

The materials and tools needed for freehand sketching can vary depending on the artist's preference, the subject matter, and the intended outcome of the sketch (CivilSeek, 2018). However, some basic materials and tools that most artists use for freehand sketching are:

Sketchbook or Drawing pad - A sketchbook or drawing pad is an essential tool for freehand sketching. It provides a surface for the artist to draw on and is portable enough to carry around.

Pencils - Pencils are the most commonly used tool for freehand sketching. They come in a range of hardness and are used for drawing lines of varying thickness and value.

Compass - A compass is used to create circles or arcs in the drawing.

Colored pencils - Coloured pencils can be used to add colour and detail to the drawing.

Watercolours - Watercolours can be used to add a wash of colour to the drawing and create interesting effects.

Basic principles of freehand drawing

Freehand drawing is an art form that relies on the artist's ability to observe and translate what they see into a two-dimensional image. There are several basic principles of freehand drawing that are essential for creating accurate and expressive drawings. Here are some of the most important principles:

Line: The line is the most basic element of drawing. It is used to define shapes, forms, and textures. The artist can use different types of lines such as thin, thick, curved, or straight to convey different qualities of the subject.

Shape: Shapes are created by the lines and outlines of the subject. They can be simple or complex, geometric or organic, and are used to define the subject's form.

Form: Form refers to the three-dimensional quality of the subject. It is created by the use of shading and highlights to create the illusion of depth and volume.

Proportion: Proportion refers to the relationship between the different parts of the subject. It is important to understand the basic proportions of the subject to create accurate and realistic drawings.

Understanding Proportions

The importance of proportions in sketching

Proportions are one of the most important aspects of freehand sketching, as they help to create an accurate and realistic representation of the subject. Proportions refer to the relative size and position of different parts of the subject, also understanding them is essential for creating a convincing drawing (Peachpit, 2018).

In summary, proportions are essential for creating accurate and convincing drawings. They help to convey important information about the subject and create a sense of balance and harmony in the drawing. By paying close attention to proportions and

ensuring they are accurate, artists can create more effective and visually appealing sketches.

Breaking down figures and furniture into basic shapes

Breaking down figures and furniture into basic shapes is a useful technique for freehand sketching. By using simple shapes as a foundation, artists can more easily capture the overall form and proportions of the subject and then build upon it with more detail and complexity. Here are some examples of how to break down figures and furniture into basic shapes:

Human Figures: When sketching human figures, it can be helpful to start with simple shapes such as circles, ovals, and rectangles. The head can be represented by a circle, the torso by a rectangle, and the limbs by cylinders or rectangles. These basic shapes can then be refined and adjusted to create more accurate proportions and details.

Chairs: When sketching chairs or other furniture, it can be helpful to start with basic shapes such as rectangles, triangles, and circles. The back of a chair, for example, can be represented by a rectangle, while the legs can be represented by cylinders or triangles. These basic shapes can then be refined and adjusted to create more detailed and accurate drawings.

Tables: Tables can be broken down into basic shapes such as rectangles, circles, and triangles.

Using proportion to create realistic sketches

Proportions are an essential tool for creating realistic sketches. Understanding how to use proportion in your sketches can help you to accurately capture the size and shape of your subject and create a drawing that is visually pleasing to the viewer. Here are some tips for using proportion to create realistic sketches:

Pay attention to scale: Another important aspect of using proportion is paying attention to the scale of your drawing. Make sure that the size of your subject is appropriate for the size of your paper or canvas and adjust your proportions accordingly.

Use basic shapes: Breaking down your subject into basic shapes can be helpful in establishing the correct proportions. Use circles, ovals, and rectangles to create a basic framework for your sketch, and then refine it as needed.

Practice: Using proportion effectively in your sketches takes practice. Take time to experiment with different techniques and approaches, and don't be afraid to make mistakes. With practice, you'll develop a better understanding of how to use proportion to create realistic and compelling sketches.

Starting with basic shapes

The importance of starting with basic shapes

Joshua Nava showed that starting with basic shapes is an important aspect of freehand sketching. It can help you to establish the overall form and proportions of your subject and create a foundation for adding more detail and complexity to your drawing (Joshua Nava Arts, 2023). Here are some of the main reasons why starting with basic shapes is important:

Establishing Proportions: Basic shapes can be used as reference points for establishing the proportions of your subject. For example, you might use a circle to represent the head, and then use that as a reference point to establish the height and width of the figure. By establishing the correct proportions early on in the sketch, you can create a more accurate and realistic drawing.

Creating a framework: Starting with basic shapes can create a framework or structure for your drawing. This can help you to establish the overall composition of the drawing and make decisions about how to position and arrange the different elements of the subject.

Different shapes used in sketching figures and furniture

Sketching figures and furniture requires a range of shapes to capture different elements of the design. Here are some common shapes used in sketching figures and furniture:

Circles: Circles are used to create round objects such as the head, joints, or the base of a lamp.

Ovals: Ovals are elongated circles and can be used to sketch objects that are slightly elongated or tapered.

Rectangles: Rectangles are used to create boxes or rectangular shapes such as tables, chairs, and bookshelves.

Squares: Squares are used to sketch objects that are square or have a square base such as boxes, cubes, and some chairs.

Triangles: Triangles are used to create pointed shapes such as the top of a Christmas tree or the roof of a house.

Trapezoids: Trapezoids are used to create objects that are tapered or slanted such as the legs of a table or a chair.

Arcs: Arcs are used to create curved lines such as the backrest of a chair or the sides of a sofa.

Lines: Lines are used to create straight edges or connect different shapes in the design.

Using basic shapes to establish composition and proportion

Using basic shapes is a fundamental technique in establishing composition and proportion when sketching figures and furniture. Here are some tips on how to use basic shapes to create a balanced composition and accurate proportions:

Start with the gesture: Before adding any details, sketch out the gesture of the figure or furniture piece. Use a loose line to indicate the overall shape and movement of the subject.

Refine the shapes: Once you are satisfied with the overall proportions, refine the shapes by adding more detail. Use smaller shapes to create the details such as the head, arms, and legs.

Gestures

The Purpose of Gestures In Freehand Drawing

Gestures are an essential part of freehand drawing as they help artists to capture the overall movement and energy of the subject. The purpose of gestures in the freehand drawing is to create a loose, fluid sketch that captures the essence of the subject in a few quick strokes (DonCorgi, 2023). Some reasons why gestures are important in freehand drawing are to:

Capture the movement: Gestures help to capture the movement of the subject, whether it's a figure, animal, or object. By sketching the gesture, the artist can quickly establish the direction and flow of the subject.

To establish the proportions: Gestures help to establish the overall proportions of the subject. By sketching the basic shape and position of the subject, the artist can quickly check for any major proportion issues.

Techniques for creating gestures

Creating gestures is an essential skill for freehand drawing. Here are some techniques for creating gestures:

Use your whole arm: When creating gestures, it's important to use your whole arm, not just your wrist or fingers. Use broad, sweeping strokes to capture the overall movement of the subject.

Draw quickly: Gestures should be created quickly and without hesitation. The purpose of gestures is to capture the energy and movement of the subject, so quick, loose strokes are essential.

Using gestures to warm up and establish movement

Using gestures is a great way to warm up and establish movement in your freehand drawing. Here are some tips for using gestures to warm up and establish movement:

Start with quick sketches: Begin with a series of quick, gestural sketches. Use your whole arm and draw loosely to capture the energy and movement of the subject.

Focus on the overall shape: When creating gestures, focus on the overall shape and movement of the subject. Don't worry about capturing every detail, instead, aim to capture the essence of the subject.

Experiment with different lines: Experiment with different types of lines, such as thick and thin lines, curved and straight lines, and long and short lines. This will help to create a sense of movement and energy in your sketches.

Anatomy

Understanding basic anatomy in freehand drawing

Understanding basic anatomy is crucial in freehand drawing as it helps artists accurately depict the human form and create realistic and dynamic figures (University of Port Harcourt, 2023). Here are some key areas of anatomy that are important to understand in the freehand drawing:

Skeletal structure: Understanding the skeletal structure of the human body is essential in freehand drawing as it provides the foundation for the figure. Knowing the basic shape and placement of bones will help artists accurately depict the proportions and movement of the figure.

Proportions: Understanding the proportions of the human body is essential in freehand drawing as it helps artists accurately depict the size and shape of the figure. Knowing the basic proportions of the head, torso, arms, and legs will help artists to create more realistic and balanced figures.

Perspective: Understanding perspective is important in freehand drawing as it helps artists accurately depict the three-dimensional form of the figure. Understanding how the figure appears from different angles and how it interacts with the environment will help artists to create more realistic and convincing figures.

Applying anatomy to create realistic figures

Applying anatomy is essential in creating realistic figures in freehand drawing. Here are some tips for applying anatomy to create realistic figures:

Start with the skeletal structure: Begin by sketching the skeletal structure of the figure. This will help you to establish the overall proportions and movement of the figure.

Practice regularly: Practise drawing figures regularly, paying close attention to the anatomy of the human body. By practising regularly, you can improve your ability to apply anatomy to create realistic figures.

Experiment with different poses: Experiment with different poses and positions to create dynamic and expressive figures. Pay attention to how the muscles and bones change shape as the figure moves and interacts with its environment.

Structure

Understanding the skeletal and muscular structure

Understanding the skeletal and muscular structure of the human body is essential in freehand drawing as it provides the foundation for the figure. Here are some key areas of the skeletal and muscular structure that are important to understand:

Skeletal structure: The skeletal structure of the human body includes the skull, spine, ribs, pelvis, and limbs. Understanding the placement and shape of bones is essential in creating realistic and proportionate figures. The skull, for example, provides the basic structure for the head, while the spine and ribs give shape to the torso.

Muscles: The muscular structure of the human body includes both voluntary and involuntary muscles. Understanding the major muscle groups and how they interact with one another is essential in creating realistic and dynamic figures.

Joints: Joints are where bones come together and allow for movement. Understanding the structure and function of joints is essential in creating figures that move realistically. The shoulder joint, for example, is a ball-and-socket joint that allows for a wide range of movement in the arm.

Depth and Dimension

The role of light and shadow in creating depth and dimension

Light and shadow play a crucial role in creating depth and dimension in freehand drawing. By using shading techniques, artists can create the illusion of three-dimensional space on a two-dimensional surface (The Virtual Instructor, 2022). Here are some ways in which light and shadow can be used to create depth and dimension:

Highlight and shadow: By identifying the areas of a drawing that are receiving direct light and those that are in shadow, artists can create the illusion of form and depth. Highlighted areas are the brightest and most intense parts of a drawing, while shadowed areas are the darkest and least intense.

Value: The value of a drawing refers to its range of lights and darks. By using a range of values, artists can create the illusion of depth and dimension. A high-contrast drawing

with a wide range of values will appear more three-dimensional than a drawing with a limited range of values.

Texture: Light and shadow can be used to create the illusion of texture in a drawing.

Techniques for creating shading and highlights

There are several techniques for creating shading and highlights in freehand drawing. These techniques help to create the illusion of form, depth, and texture in a drawing. Here are some of the most commonly used techniques:

Hatching and cross-hatching: Hatching involves creating a series of parallel lines to create shading or texture. Cross-hatching is similar but involves creating a series of intersecting lines. By varying the distance and angle of the lines, artists can create a range of shading effects.

Contouring: Contouring involves using lines to follow the contour of an object or figure to create the illusion of depth and form. By varying the thickness and intensity of the lines, artists can create a range of shading effects.

White charcoal: White charcoal is a tool that can be used to create highlights or to lighten areas of shading. This technique is often used in combination with other shading techniques to create a range of values.

Observing light and shadow in real-life subjects

Observing light and shadow in real-life subjects is an important step in creating realistic drawings. Here are some tips for observing light and shadow in real-life subjects:

Observe the Direction of Light: Take note of where the light is coming from and how it falls on the subject. This will help you to identify the areas of the subject that are in light and those that are in shadow.

Experiment With Different Lighting Conditions: Experiment with different lighting conditions, such as natural light or artificial light, to see how they affect the appearance of the subject. This will help you to develop a better understanding of how light and shadow work in different conditions.

Details

The importance of adding detail to sketches

Adding detail to sketches is important because it can bring a drawing to life, making it more interesting and engaging to viewers. Detail can help to create the illusion of depth and texture, and can add realism to a drawing (GCF Global, 2023). Here are some of the reasons why adding detail is important:

Creates realism: Adding detail can create the illusion of realism in a drawing. This can help viewers to better understand the subject and appreciate the skill of the artist.

Enhances texture: Adding detail can help to enhance the texture of a subject. For example, adding fine lines or cross hatching to a drawing of a tree can create the illusion of bark texture.

Provides context: Adding detail can provide context to a drawing. For example, adding details to the background of a portrait can provide a sense of location and atmosphere.

Engages viewers: Adding detail can engage viewers by providing them with interesting elements to discover. This can help to hold their attention and make the drawing more memorable.

Techniques for adding detail to figures and furniture

There are several techniques that can be used to add detail to figures and furniture in a drawing. Here are some of them:

Use fine lines: Fine lines can be used to add texture and detail to a drawing. For example, adding fine lines to clothing can create the illusion of fabric texture.

Add shading: Shading can be used to create depth and texture in a drawing. By adding shading to a drawing of a piece of furniture, you can create the illusion of depth and make it appear more three-dimensional.

Use crosshatching: Cross Hatching is a technique where lines are drawn at different angles to create shading and texture. This can be used to add detail and texture to clothing or furniture.

Add highlights: Highlights can be used to create the illusion of reflective surfaces or shiny objects. By adding highlights to a drawing of a piece of furniture, you can create the illusion of a shiny surface.

Paying attention to small details

Paying attention to small details is important in freehand drawing because it can make the difference between a good drawing and a great one. Small details can add realism, depth, and interest to a drawing, making it more engaging and memorable to viewers. Here are some tips for paying attention to small details:

Use a reference image: A reference image can be helpful in identifying small details in a subject. By studying a reference image, you can gain a better understanding of the small details that make up the subject.

Take your time: Paying attention to small details requires patience and focus. Take your time and work slowly to ensure that you are accurately capturing all of the small details in your drawing.

Use a magnifying glass: A magnifying glass can be helpful in identifying and drawing small details. It can help you to see details that are difficult to see with the naked eye.

Break the subject down: Breaking the subject down into smaller parts can help you to identify and draw small details. By focusing on one part of the subject at a time, you can ensure that you are capturing all of the small details.

Sketching Subjects

The importance of sketching subjects from different angles

Sketching subjects from different angles are important in a freehand drawing for several reasons (Joshua Nava Arts, 2023). Here are some of them:

Improves observation skills: When you draw a subject from different angles, you are forced to observe it more closely. This helps you to see the subject in a new way and to notice details that you may have missed before.

Improves understanding of form: When you draw a subject from different angles, you get a better understanding of its form. This is because you are able to see the subject from different perspectives and see how the form changes as you move around it.

Adds variety to your drawings: Drawing a subject from different angles adds variety to your drawings. It allows you to create a more dynamic composition and show different aspects of the subject.

Improves technical skills: Drawing a subject from different angles can be challenging, but it can also improve your technical skills. It requires you to think more carefully about proportions, perspective, and foreshortening, which can help you to improve your skills in these areas.

Techniques for sketching subjects from different angles

Sketching subjects from different angles can be challenging, but there are some techniques that can help you to do it effectively. Here are some techniques for sketching subjects from different angles:

Start with simple shapes: When you are sketching a subject from a new angle, it can be helpful to start with simple shapes. You can sketch the basic shapes of the subject and then build up the details. This can help you to establish the overall proportions and structure of the subject.

Use perspective guidelines: Perspective guidelines can be helpful in sketching subjects from different angles. You can use vanishing points and horizon lines to establish the perspective of your subject and to ensure that your proportions are accurate.

Pay attention to foreshortening: Foreshortening is the distortion that occurs when a subject is viewed from a different angle. It can be challenging to capture, but paying attention to the foreshortening can help you to create a more realistic drawing.

Perspectives

Understanding the importance of perspective

Perspective is an important concept in art that refers to the way objects appear to the eye in three-dimensional space. It is the technique used to create the illusion of depth and distance on a two-dimensional surface like a piece of paper or canvas. Understanding perspective is essential in a freehand drawing for several reasons:

Creates a sense of depth and dimension: Perspective creates the illusion of depth and distance in a drawing, which makes it more realistic and engaging.

Adds realism and accuracy: By using perspective, you can create a drawing that accurately represents how the subject appears in real life. This can make your drawing more believable and relatable to the viewer.

Helps to establish composition and balance: Perspective can be used to create a sense of balance and harmony in a drawing. By using perspective lines and vanishing points, you can create a composition that is visually appealing and balanced.

SUMMARY

The importance of regular practice

An amazing response from Quora showed that regular freehand practice is essential for anyone who wants to improve their drawing skills (Quora, 2018). Here are some reasons why:

Improves muscle memory: Drawing is a skill that requires hand-eye coordination and muscle memory. Regular practice can help to develop these skills, making it easier to draw accurately and quickly.

Builds confidence: Drawing can be a challenging activity, especially if you're just starting. Regular practice can help to build your confidence and improve your overall technique.

Encourages experimentation: Regular practice can also encourage experimentation with different styles, materials, and techniques. Trying new things can help you to develop your own unique style and push your artistic boundaries.

Helps to identify weaknesses: Regular practice can help you to identify areas where you need improvement. Once you know your weaknesses, you can focus on improving them.

Techniques for practising regularly

There are several techniques that can help you to practise freehand drawing regularly:

Schedule drawing time: Set aside specific times each day or week for drawing. Treat it like an appointment that you can't miss.

Start with short sessions: If you're new to drawing or finding it difficult to make time, start with short drawing sessions. Even just 10-15 minutes a day can make a difference.

Challenging yourself to sketch new subjects

Challenging yourself to sketch new subjects can be a great way to improve your drawing skills and creativity. Here are some tips for taking on new drawing challenges:

Choose a subject you are not familiar with: Drawing something you're not used to can be a great challenge. It can help you to push your skills and try new techniques.

Break down complex subjects: If the subject is complex, try breaking it down into smaller, more manageable parts. This can make it easier to approach and tackle.

Experiment with different materials: Trying out different materials can be a fun way to challenge yourself. For example, if you typically draw with a pencil, try using ink or watercolours.

Applying all principles learned to create a final project

Creating a final project in freehand sketches is an excellent way to bring together all the principles and techniques you've learned. Here are some steps to help you create a final project:

Choose a subject: Decide on a subject that you're interested in and that you'd like to sketch. It could be a person, an object, or a scene from nature.

Gather your materials: Choose the materials you want to use for your sketch. This could be pencils, charcoal, markers, or any other medium you feel comfortable with.

Plan your composition: Think about the composition of your sketch. Where will the subject be positioned? What will the background look like? Sketch some rough thumbnails to plan out your composition.

Final touches: Once you're happy with your sketch, add any final touches or details to bring it to completion. This could include adding shadows or highlights, refining lines, and edges, or adding a background.

Creating a final project in freehand sketches can be a rewarding and fulfilling experience. By applying all the principles and techniques you've learned, you can create a unique and personal work of art.

Critique and feedback from instructor and peers

Getting critique and feedback from an instructor and peers is an essential part of improving your freehand sketching skills. Here are some tips for receiving critique and feedback:

Be open-minded: Keep an open mind and be willing to accept criticism. Remember that feedback is meant to help students improve, not to tear you down.

Listen actively: Listen carefully to what the instructor and peers have to say. Pay attention to their suggestions and take notes if necessary.

Ask questions: If you don't understand something, ask for clarification. Ask questions that help you to better understand what you can improve on and what you did well.

Take action: Use the feedback you receive to make improvements to your work. Act on the suggestions you receive and apply them to your future sketches.

Offer feedback to others: Giving feedback to others can also help to improve students' own skills. They should always try to give constructive criticism that is helpful and supportive.

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BIODATA ADEOYE OLUGBENGA ADEWOLU, Ph.D., MNIA

Dr. ADEOYE OLUGBENGA ADEWOLU is an esteemed senior lecturer in Architecture with an illustrious career spanning over 30 years in the university system. As a highly respected and experienced educator, Dr. ADEWOLU has made significant contributions to the field of architecture through teaching, research, and related works. Having obtained a Ph.D. degree in Architecture, Dr. ADEOYE ADEWOLU possesses a deep understanding of the subject matter and has developed strong expertise in various aspects of architectural theory and practice. Their extensive knowledge and passion for the discipline have been instrumental in shaping the minds of countless students who have had the privilege of being taught by them. Dr. ADEWOLU's teaching philosophy centres around fostering critical thinking, encouraging creativity, and nurturing a deep appreciation for the art and science of architecture. He is known for his engaging teaching style, employing innovative pedagogical techniques to ensure students receive a comprehensive education that combines theoretical concepts with practical applications. In addition to his teaching responsibilities, Dr. ADE ADEWOLU has actively pursued research endeavours throughout his career. Their scholarly work focuses on exploring emerging trends in architecture, sustainable design practices, and the integration of technology in the field. By staying at the forefront of advancements in the architectural domain, Dr. ADE ADEWOLU continually seeks to inspire students and fellow professionals alike, encouraging them to push boundaries and envision new possibilities.

Dr. ADEWOLU's contributions extend beyond the confines of the classroom and research lab. He has actively participated in academic committees, served as a mentor to aspiring architects, and collaborated with industry professionals to bridge the gap between academia and practice. His efforts to promote interdisciplinary collaboration and knowledge exchange have played a pivotal role in enhancing the architectural community within Nigeria and beyond.

Recognised for his expertise, Dr. ADE ADEWOLU has been invited to present at national and international conferences, delivering thought-provoking talks on topics such as sustainable design, urban planning, and the role of architecture in shaping societies. Their research findings have been published in reputable journals, further contributing to the body of knowledge in the architectural field.

With a career spanning three decades, Dr. ADEOYE OLUGBENGA ADEWOLU continues to be an influential figure in the realm of architecture education. Their commitment to excellence, dedication to their students, and unwavering passion for the subject have solidified their position as a respected authority in the field. As an author, their insights and expertise will undoubtedly enlighten readers and inspire future generations of architects and designers.

Drawing and Concept Development Techniques in Furniture Design

Asst. Prof. Yakubu Aminu Dodo Ph.D., *Najran University*

Overview

Drawing and concept development are essential skills for furniture designers. The ability to visualise and communicate ideas is critical in creating successful designs that meet the needs of the client while also being aesthetically pleasing.

This text explores various drawing and concept development techniques that furniture designers use to create unique and innovative designs.

Sketching

Sketching is a fundamental tool in furniture design. It allows designers to quickly explore and refine ideas on paper before committing to a final design. Sketching can be done in various forms, including freehand sketching, technical sketching, and perspective sketching. Freehand sketching is useful for capturing rough ideas and exploring various shapes and forms. Technical sketching is used to communicate technical details, such as dimensions and material specifications. Perspective sketching is used to create realistic representations of furniture designs.

Figure 1: *Furniture Design Sketch*

Sources: Miss Amina Aliyu Ahmad 4th year Industrial design Student Ahmadu Bello University Zaria.

Rendering

Rendering is the process of adding colour and texture to sketches to create more realistic representations of furniture designs. Rendering can be done using various media, including markers, coloured pencils, and digital software. The choice of media depends on the designer's preference and the desired outcome.

Figure 2: *Furniture Design Rendering*

Sources: Miss Amina Aliyu 4th year Industrial design Student Ahmadu Bello University Zaria

Modelling

Modelling is the process of creating physical or digital models of furniture designs. Physical models can be made using various materials, including wood, plastic, and clay. Digital models can be created using computer-aided design (CAD) software. Modelling allows designers to explore various forms, dimensions, and materials before creating the final design.

Figure 3: *Furniture Design Modeling using Adobe Illustrator*

Sources: Miss Amina Aliyu Ahmadu 4th year Industrial design Student Ahmadu Bello University Zaria

Concept Development

Concept development is the process of generating and refining ideas for furniture designs. It involves research, brainstorming, and evaluation of ideas. The goal of concept development is to create a design that meets the needs of the client, is aesthetically pleasing, and can be manufactured efficiently. Concept development can be done individually or in a team.

SUMMARY

In summary, it is of essence that drawing, and concept development are essential skills for furniture designers. Therefore, furniture designers need to understand that in order to create unique and innovative designs, acquiring these skills are fundamentals.

Exercises

1. Differentiate between sketching and modelling as it is applied in drawing and concept development techniques in furniture design

2. What is the role of working as a team in conceptual development of a furniture design?

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Yakubu's expertise lies in areas such as sustainability in architecture, green building rating systems, day lighting applications in buildings, energy efficiency in buildings, and indoor environmental quality. He has a particular interest in topics like low carbon emissions in buildings, application of renewable energy in buildings, the integration of AI in buildings, and architecture education.

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CHAPTER TWELVE: INTRODUCTION TO BODY PHYSIOLOGY

Fundamentals of Human Physiology

Prof. Alexander Adelaiye, *Bingham University, Karu*

Overview

Physiology is the scientific basis of understanding the functions of the body in health and disease and its understanding is necessary not just for the management of disease conditions but also to maintain good health. Understanding the fundamentals of physiology is necessary in the development of furniture, tools and equipment that is essential for the normal function of the body at rest and in the office/workshops. Generally, the body functions best in physiological positions, deviations from this physiological positions and physiological environment can lead to discomfort, body pains, malfunction of the regions, pressure sores and organ failure. The body functions best and life expectancy is prolonged when we understand the fundamentals of physiology and apply it.

The text will focus on The Cell, body fluids and blood; respiratory and cardiovascular functions; and renal and reproductive functions. This will ensure that our students and graduates will have the correct scientific basis for the design and production of furniture that will not have negative effects on body functions.

Objectives

The objectives of this chapter are to:

1. identify and describe the normal functions of the body;
2. examine the relationship between functions and activities of the body;
3. discuss the factors in the environment that may have negative effects on normal functions; and
4. explain the scientific basis of restoration of these abnormal functions to normal functions.

The cell

A cell is the basic living structural and functional unit of the body. The basic cell is represented in all parts of the body with some modifications in relation to function. Basically a cell includes Plasma membrane, Cytosol, Cell organelles & Inclusions.

The study of the cell and its inclusions is called Cytology and it can be modified depending on which organ of the body is involved.

Membrane Physiology: The membrane functions in cellular communication with the establishment of an electrical gradient and the selective permeability. It is also selective permeable to some substances while restricting the passage of substance through the membrane is dependent on: Lipid solubility, Size, Electrical charges & Presence of channels and transporters.

The movement of substances across cell membranes can be any of the following methods 1. Passive process 2. Simple diffusion 3. filtration 4. Active process

Cellular function and machinery is related to protein synthesis. The cells manufacture different proteins by translating genetic information encoded in the DNA into specific proteins.

Cell division is the process by which cells reproduce themselves and it consists of nuclear division and cytoplasmic division called cytokinesis. Cell division that involves the body cells and involves structural division (mitosis) is called somatic division. Cell division that involves the sperm cells and acolytes is called reproductive cell division and it involves a nuclear division called meiosis and cytokinesis. Before mitosis and cytokinesis the DNA molecules replicate themselves so that the same chromosome

The physiology of RBCs

The RBCs are biconcave disc without nucleus but contain Hb. Their main function is transportation of oxygen and carbon dioxide. They have a life cycle of about 120 days and they vary in number from 4.8-5.4 mil/mm^3 depending on the sex, the higher figure being for males.

Production of RBCs: RBC formation is by a process of erythropoietin which occurs in the adult bone marrow. Hypoxia which is the most powerful stimulus stimulates release of erythropoietin from the kidney. RBC count is a diagnostic test that indicates the rate of erythropoiesis. Hematocrit measures the percentage of RBCs in whole blood.

The physiology of WBCs

WBCs also called leukocytes are basically nucleated cells. There are two principal types: the granulated – neutrophils, basophils and eosinophils and the granulated – lymphocytes and monocytes. The major function is to combat inflammation and infection. WBCs usually live for only a few hours and the number is between 5 – 10,000/mm^3.

Platelets

Platelets (thrombocytes) are disc shaped structures without nucleus. They are formed from the megakaryocytes and are involved in clotting. Normal blood contains 259,000-400,000 platelets /$mm^{3.}$ Platelets are important and indispensable components of the platelet plug which is one of the earliest responses to bleeding. The platelet count varies with age stress and varying stages of pregnancy being highest at the time of delivery.

Heamostasis

Hemostasis is the condition that refers to the physiological arrest of bleeding and it basically involves three stages which include vascular spasm clotting and platelet plug formation. Vascular *spasm* is the normal reflex spasm of the smooth muscle of vessels when it is injured, especially when the injury is sharp. This often leads to an arrest of bleeding. *Platelet plug:* The aggregation or clumping of platelets to form a plug is called the platelet plug while *Clotting* is the formation of a network of insoluble fibrin threads which is protein in nature. They are actually the end result of the coagulation mechanism which converts soluble fibrinogen into insoluble fibrin. This is actually a cascade of reactions with one stage amplifying the next.

Heamostaic control mechanisms

There is a delicate control mechanism that ensures that clotting does not occur in an unbroken blood vessel. However, if clotting occurs in an unbroken blood vessel it is called a thrombus. This often occurs in a vein if however it occurs in an artery, it may obstruct the flow of blood to vital organs. When such a blood clot is transported in the bloodstream it is called an embolus. This embolus can be fatal if it is lodged either in the coronary tree pulmonary vessels or in the cerebral vessels.

Blood groups

Individuals have different blood groups which are genetically determined and have their foundations on the response of the antigen –antibody. Though there are many blood group antigens noted, the commonly used ones are the Rh blood group and the ABO group. Individuals are classified according to the antigens (A/B) present on the red cell. The plasma on the other hand contains anti A and anti B antibodies and the Rh antibody. Individuals with the D antigens are classified as positive while those who lack the D antigen are classified as negative.

Disorders of the blood

The most common disorder of the blood is anaemia, and this is defined as a condition in which the oxygen carrying capacity of the blood is reduced. It is a sign not a diagnosis and the following types of anaemia have been described: Nutritional anemia, Pernicious anaemia, Hemorrhagic anaemia, Hemolytic Anaemia, Thalassemia, Aplastic anaemia, Sickle cell anaemia & Leukaemia.

Blood and body fluids

Function of blood, Characteristics of blood, Components of blood, Physiology of RBC, Physiology of WBC, Haemostatic mechanism, Blood groups and types, Disorders of blood.

Functions of blood

The major component of the ECF is blood. Blood transports oxygen, carbon dioxide, nutrients, water and hormones. It aids the regulation of blood pH, body temperature and fluid contents of cells. It prevents blood loss through clotting mechanisms and combat toxins and microbes through certain phagocytes and through specialised plasma protein – immunoglobulin

Characteristics of blood

Physical characteristics: Normal blood has a viscosity greater than H_20, temperature of $38^0/104^oF$, p H of 7.35 – 7.45 and constitutes about 8% of body weight. Its volume ranges from about 4 – 6L in adults. Do also consists of 55% plasma and 45% formed elements. Plasma consists of 91% H_20 and 8.5% solutes. The principal solutes are the proteins in albumin, globulin, fibrinogen, nutrients, hormones, respiratory gases, electrolytes and waste products.

The formed elements are considered to be the RBCs, WBCs and platelets. These formed elements are formed from hematopoietic stem cells from red bone marrow and this process is called hemopoiesis.

Several haemopoietic growth factors stimulate differentiation and proliferation of the various blood cells.

Gastrointestinal system

Basic anatomy

Events/ Activities in the mouth

The mouth is a normal physiological receptacle. Others include the vein in the intravenous line, the nose in nasogastric feeding, and the gastrostomy tube directly into the stomach for esophageal abnormalities, rectal hydration via rectum and also through peritoneum and subcutaneous tissue. These are all abnormal receptacles. But the mouth is specifically designed to take in, food masticate it, mix it with saliva, shape it into a bolus, the saliva also has salivary amylase which commence conversion of polysaccharide (starch) to disaccharide (maltose).

Pancreas

The pancreas is a triangular shaped organ that occupies the cap of the duodenum. It extends in the extraperitoneal space to the hilum of the spleen. It is divisible to the (i) head (ii) body (iii) tail and is connected to the duodenum.

Digestive hormones

Digestive hormones include the following: Gastrin, Secretin, Cholecystokinin, Gastric Inhibitory Peptide and Motilin; they help to regulate the human digestive process.

Absorption in the small intestine and large intestine

Storage in large intestine; Faeces formation; Defecation; Disorder of the GIT

This is the largest single organ in the body. It is made up of the right and left lobe and the right lobe are associated with the caudate and quadrate lobes. Division into right and left is now based on the blood supply not on the position of the falciform ligament or any other anatomical structure.

Functions of the liver

Briefly the liver functions mainly in Digestion, Blood Purification, Detoxification of drugs and hormone, Manufacturing, Storage, Excretion of bilirubin & Synthesis of bile salts.

Respiratory system

Basic Anatomy, Pulmonary Ventilation, Breathing patterns, Internal and External respiration, Gas Exchange, Gas transport, Control of Respiration, Exercise and respiration, Disorders of Respiration & Development of the respiratory System

Basically the respiratory system is made up of the nose trachea larynx bronchi and lungs; they along with the cardiovascular system work together to affect gaseous exchange.

Cardiovascular physiology

The Heart – situated between the lungs in mediastinum. The heart is divided into two lower and two upper chambers. Within the heat are valves – atria\ventricular and semilunar.

Cardiac cycle

Consists of systole – contract and diastole – relaxation divide into three phases – relaxants period, ventricular fitting and ventricular 0.85 – complete cardiac cycle.

Heart sounds

1st sound – blood turbulence associated with closure of all valves

2nd sound – blood turbulence associated with closure of semi lunar valves.

Cardiac output

Artery of blood ejected by the left ventricle or right ventricle into the aorta or pulmonary trunk. Matter considered as HR and strove vol. Cardiac reserve – max CO and Co at rest.

Endocrinology

Endocrine glands

By their nature are ductless glands that secrete their products directly into the bloodstream. They differ from end of which could be setaceous, mucous, salivary, sweat,

lachrymal, mammary, gastric, prostate and pancreatic non-endocrine secreting because exocrine glands secrete their products through direct into body cavities or into body surfaces.

The endocrine system is made up of endocrine glands and several other glands that secrete hormones e.g. pancreas, GIT testes, kidneys. The tissue on which a specific hormone exerts its effect is called the target tissue. `

Control of hormonal secretions

There is a balance to prevent either over – or under – secretion. This comes via signals from NS (2) chemical changes in blood (3) other hormones in circulation. Most often a positive feedback mechanism regulates hormonal secretion.

Body fluids

Fluid Compartment and Fluid Balance: Electrolytes, Acid Base balance, Regulation of fluid gain and fluid loss, Concentrations of solution, Electrolytes in Body fluids, Movement of body fluids, Acid base balance, Diagnosis of acid Base balance

The body is made up of fluids and solids the principal component of the fluid is water. The fluid compartment is divided briefly into Intracellular fluid compartment, which accommodates 2/3 of the total body fluid while the extracellular fluid compartment takes 1/3. The extracellular fluid compartment includes the interstitial fluid compartment, Plasma, Lymph cerebrospinal fluid fluids in the G.I.T. synovial fluids in the ear pleural fluid pericardial fluid peritoneal fluid and the glomerular filtrates.

Fluid balance means that the various body compartments contain the required amount of water and electrolytes. Body Water is the largest constituent of the body and makes up 45-75% of total body weight depending on age and amount of fat and adipose tissue present. The sources of water are mainly 1.ingested water and fluids and they can be classified as preformed water and water formed by cellular metabolism and from dehydration. H20 is lost in the kidneys and lungs, skin gut and G.I.T.

Renal system

Introduction, Basic Anatomy, Formation of Urine, Composition of urine, Control of urine formation and disorder

Introduction: The kidney is a bean shaped organ that occupies the paravertebral gutters it is retro peritoneal and has four principal functions: Formation of urine; Synthesis of Erythropoietin; Synthesis of Renin an important component renin-angiotensin system; Absorption of calcium in form of 1.2.3. dihydroxycholecalciferol.

Basic anatomy

Bean shaped organ measuring about 11 x 6x3cms and weighs about 140g they are two in number capped the suprarenal glands It has a good blood supply form the direct branches of the aorta and it drains via the renal vein to the inferior vena cava.

Formation of urine

Urine formation involves three main processes, and these include: Glomerular filtration, Tubular reabsorption & Tubular secretion

Control of urine formation

Neural Control & Hormonal control.

Disorders of urine formation

Anuria, Oliguria, Polyuria, Hematuria, Pyuria & Renal Stones

Special senses

Olfactory sensation – smell

Physiology of olfaction

Receptors for olfaction are located in the nasal epithelium. They are bipolar neurons in olfactory reception, a generator potential development and differs one or more nerve inputs. The threshold for smell is low, hence adaptation occurs easily.

Olfactory pathways

From olfactory receptors in nasal epithelium impulses travel through the olfactory nerve – 1st cranial – olfactory box, - olfactory tract – cerebral cortex prepyriform cortex and finally – limbic system.

Gustatory sensation – taste

Receptors for gestation or taste are gustatory receptor cells located in the taste buds. Substance to be tasted must be in saliva. This generates receptor cells and these receptor cells cause release of neurotransmitter which gives rise to nerve impulses in cranial V, VII, IX, X. These taste signals then pass to the medulla, thalamus and cerebral cortex, especially the parietal lobe.

Visual sensation

The eye is made up of the eyeball and accessory structures including the eyebrows, lids, lashes and lacrimal apparatus. The eye itself is made up of 3 coats (1) fibrous tunic (2) vascular tunic made up of choroid and ciliary body and (3) nervous tunic – retina consists of the pigment epithelial and neural portion contains the aqueous humour and the post chamber contains the vitreous.

Image formation in the retinal involves refraction of light rays by cornea and tens, ace of lens by thin curvature and construction of pupils to prevent light rays from entering the eyes from the periphery.

In convergence, the eyeballs move medially so they're both directed towards the object that is being viewed.

Physiology of vision

The first step in vision is absorption of light by photo pigments, that is, rods and cores called photoreceptors. Once receptor potential develops in rods and cones, it is the release of neurotransmitters. This induces gradient potential in bipolar cells.

Vision pathway

Horizontal cells transmit inhibitory signals to bipolar amacrine cells – ex to ganglion cells. This depolarizes and initiates nerve impulse.

Impulses from ganglion cells are conveyed into the optic nerve and through the optic chiasma and to the optic tract to the thalamus – cortex especially occipital lobes.

Auditory sensation and equilibrium

External or outer ear auricle, external auditory canal and the ear drum. The mid ear consists of ossicles, oval windows and round windows. Inner ear – bony and membranous labyrinth and the organ of sound waves results from alternate compression and decompression of air molecules 20 – 30,000Hz.

Frequency of sound vibration is called the pitch. The higher the frequency the higher the pitch. The higher the intensity or size of vibration, the louder the sound. Sound intensity is measured in units called decibels dB.

Physiology of sound

Sound waves from the external environment enter the external auditory canal. The waves strike the eardrum (tympanic membrane) sending vibrations which are transmitted to the three small bones called ossicles in the middle ear. The ossicles amplify the sound. They in turn send vibrations to the perilymph and endolymph which in turn stimulates the hair cells of the organ of Corti. The hair cells convert the sound vibrations to nerve impulses by releasing neurotransmitters which initiate nerve impulses. The Cochlear branch of the vestibulocochlear nerve transmits the impulses to the brainstem from where they are relayed to the auditory area of the cerebral cortex.

Equilibrium

Static and Dynamic

Static is overall of the body relative to the pull of gravity. Macula and saccule are the sense organs here. Dynamic is maintenance of the body equilibrium in response to movement. Cristae in semicircular duct are the sage organ whose impulses are converged termed the vestibular branch of the vestibulocochlear nerve. This branch enters the brainstem and terminates in the pons while the remaining enters into the cerebellum.

Disorders of homeostatic balance

1. Glaucoma – abnormally building high intracircular pressure due to build up of aqueous humour inside the anterior chamber. If the buildup continues degeneration of the optic disc and blindness results.
2. SMD – Senile Macular Degeneration – new blood vessels grow over the maculae and vision becomes distorted. It ultimately leads to blindness. It is a common disease of old age.
3. Deafness – divided into sensorineural and conduction deafness. Deafness is defined as significant or total loss of hearing. Sensorineural deafness is caused by impairment of conduction as a result of defects caused by internal and middle ear mechanisms during transmission of sound.
4. Meniers syndrome – characterised by the amount of endolymph that enlarges the membranous labyrinth.
5. Motion sickness – caused by excessive stimulation of the vestibular apparatus by motion, characterised by nausea and vomiting due to repetitive angular, corear or vertical motion.
6. Otitis media – acute infection of the middle ear that is very common in children. Its primary cause is bacteria.

SUMMARY

In sum, this text has discussed the normal functions of the body; the relationship between functions and activities of the body; the factors in the environment that may have negative effects on normal functions; and the scientific basis of restoration of these abnormal functions to normal functions.

Exercises

1. Discuss the physiology of antigen antibody complexes and add a note on the advantages and disadvantages.
2. Enumerate the hemopoietic growth factors and their role in blood cells formation. Add a note on types of anaemia that can result from dysfunction.
3. Discuss the stages of red cell production. Illustrate this with the aid of a diagram.
4. What changes in erythropoiesis is noted in the following condition (i) severe haemorrhage (ii) a plastic anaemia (iii) thalassemia (major).

5. Discuss the physiology of dynamic equilibrium and its disorders.
6. Write short notes on two of the following:
    a. SMD
    b. Gustatory pathway
    c. Meniere's syndrome
    d. Physiology of dynamic equilibrium and its disorders

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Prof Adelaiye is a recipient of the membership and fellowship of many Institutions. As a lecturer he has supervised over 20 PhDs and over 40 Masters Degrees. He is a holder of the Order of Excellence, the Living Legend both from Cambridge Institute, Enno Freerksen Scholar (Germany) etc. He has been external examiner/assessor in several Universities including: University Ibadan, Lagos State University, University of Calabar, Usman Dan Fodio University, Sokoto, University of Benin, Maiduguri, Jos, Bayero university, Kano etc. He has also been a visiting fellow professorial grade in the University of Jos, Maiduguri, Usman Danfodio University, Igbinedion University, Kogi State University etc. He has published widely in both national and international Journals with over 100 publications and over 1000 citations.

He is happily married with four children.

Common Workplace Posture and Motions

Prof Alexander Adelaiye, *Bingham University, Karu*

INTRODUCTION

Man, generally is a mobile "animal" from time in memorial. He needs to move around either to hunt, farm or for sports etc. all these movements and even sitting makes demand on body functions. The nature of furniture will either make it comfortable to perform these functions or make it uncomfortable. In this lecture we hope to highlight the relationship of structural design to function and the modifications that may be needed to make these functions better and less stressful.

This lecture involves basic understanding of body movement both at rest and in the workplace and also other normal physical activities. The general body movements involve:

Flexion and extension.

Rotation (twist).

Pronation and Supination

All these activities have a range of normal, when it goes beyond normal it brings pain and discomfort either in the structure, limb or the joints.

Objectives

the objectives are needed for the;

1. basic understanding of body movements;
2. movement in the workplace;
3. movement in special situations (vehicles);
4. peculiarities and modifications of body movement; and
5. relating structure design to body functions.

Common Workplace Posture and Motions

Posture

Posture is not just how you hold your neck or the slump of your shoulders and low back. Everything in the body is connected, and our posture is the coordinated workings of all the mechanical parts.

The term "posture" means the position of the body in space. It indicates the position of the body in space and has the purpose of maintaining the body in balance, during the dynamic movements and the stasis. Several factors contribute to the posture, including neurophysiological, biomechanical and psyche motive factors, linked to the evolution of the species.

Posture is an automatic and unconscious position and it represents the body's reaction to the force of gravity. It is maintained through the contraction of skeletal muscles, coordinated by a series of stimuli of various natures and through continuous adjustment of neuromuscular type. We can then define the posture as any position that determines the maintenance of balance with maximum stability, minimal energy consumption and minimal stress of the anatomical structures. These can be summarised as follows

Concept of spatiality: position assumed by the body in the three directions of the space and the spatial relationship between the various skeletal segments;

Concept of anti-gravity: gravity is the fundamental external force for posture adjustment, and the postural balance is a response to gravity;

Concept of balance: relationship between the subject and the environment. The subject adopts the most appropriate posture in relation to the environment and the mobility targets, in static and dynamic conditions.

The ultimate purpose of the posture is therefore the maintenance of equilibrium in both static and dynamic conditions. The balance is due to the interaction between different main and secondary anatomical structures. The main structures are vestibular organs, cerebellum, cerebral cortex and reticular formation, and the secondary are exteroceptors, (tactile and pressure) located under the foot, visual receptors and proprioceptors located in tendons, joint capsules and muscles.

The balance can be:

Static: the ability of a body to maintain the static position. In this kind of balance, the spinal column is stretched upwards from the base of the sacrum, on the midsagittal plane, with three physiological curvatures which are formed along the line of the centre of gravity.

Dynamic: the ability of a body to maintain a stable condition during different daily activities. In both static and dynamic balance, the centre of gravity is maintained according to anatomic structures but with the minimal energy consumption, distributing the body weight throughout the skeletal system. In addition, the muscular system uses antagonistic isometric contractions that determine postural tone, responsible for maintaining the posture. The posture is possible due to the interaction between the muscular system and skeletal system.

From a functional point of view, the posture can be:

Functional: characterised by absence of pain, normal muscle tone, absence of muscular tension, balance of kinetic chains and preservation of the harmonious relationship of skeletal segments in the three spatial planes.

Non-functional: characterised by pain, muscular dystonia, abnormal muscle tension, imbalance of kinetic chains and loss of harmony of skeletal segments in the three spatial planes.

From a purely motor function, the posture can be:

Static: an active resistance to the dislocation caused by the action of the forces of gravity on the body segments.

Dynamic: it maintains the balance through the synergistic action of active components (such as muscles), passive components (such as joints and bones), and control components (SNC, proprioceptive and exteroceptive systems, vestibular system).

The body's motion system controls posture. This system is called the neuro-musculo-skeletal system (NMS), and it is broken down into three sub-systems.

The Sub-Systems of Motion:

Contracting System: Muscles contracting to create motion: Also called the Active System, because it requires active control.

Connecting System: The framework of the body. Also called the Passive System, because we have no active control of these tissues, which include:

Bones: to hold the body up.

Ligaments: to hold the bones together at the joints.

Joint Capsule: ligamentous sack around every joint containing the synovial fluid for joint lubrication.

Tendons to hold the muscles to the bone.

Cartilage and discs: to protect weight-bearing and stressed surfaces where bones meet in joints.

Fascia: tissue holding all the pieces together.

Control System: Telling the muscles what to do, and when to do it.

Brain: gives the orders, both conscious and unconsciously.

Spinal Cord: main cable and low-level processing for information between the brain and everything in the body.

Nerves: the wires controlling the muscles.

Mechanoreceptors: sensors within muscles and joints telling the brain where the body is in space. For example, you can tell if your hand is open or clenched in a fist even without looking because of these deep sensors.

Our bodies move when, either consciously or unconsciously, brain and nerves of the control system tell the muscles what to do, within the constraints of the physical limitations of the muscles, ligaments, and tendons. The human body is literally designed to move, and that motion follows in a kinetic chain. Posture and body motion depend on the coordinated workings of the Contracting, the Connecting, and the Control systems.

Subsequently, when one link in the chain is not doing its job correctly, there is often a cascading effect leading to a cycle of injury, pain, compensation and adaptation. Whether it’s walking with a bad ankle or holding your face with toothache pain, any imbalance, injury, or malfunction of tissue can affect posture.

In order to maintain good posture, you must teach your body to stand, walk, sit, and lie in positions that put the least amount of stress on the muscles and ligaments that support your joints when you move or engage in weight-bearing activities.

The spinal curves

Your spine has natural curves that form an S-shape. The cervical and lumbar spines have a lordotic, or small inward curve, and the thoracic spine has a kyphotic, or slight outward curve, when viewed from the side. The curves of the spine act as a coiled spring to cushion blows, keep the body balanced, and allow for complete spinal column motion.

Flexors and extensors, two muscle groups, maintain these curves. The front flexor muscles, which include the abdomen muscles, are located there. These muscles allow us to flex, or bend forward, and are essential in lifting and controlling the arch in the lower back.

The back houses the extensor muscles. We can move things and stand straight thanks to these muscles. These muscle groups function as guy wires to support your spine when they work together.

What is good posture?

The way you hold yourself while standing, sitting, or lying down against gravity is called your posture.

Proper posture requirements: Strong postural muscles Normal joint motion Good muscle flexibility

A balance of muscles on both sides of the spine

An awareness of your own posture, plus awareness of appropriate posture will leads to conscious correction. With lots of practice, your old posture will gradually give way to the proper posture for standing, sitting, and lying down.

Correct Sitting posture: Shoulders over hips, flat feet, support for the low back, and chin positioned over the torso.

Proper Sitting Posture at Desk: Posture should start with shoulders over hips with adequate low back support. Details include: elbows flexed to 90 degrees, knees bent to 90 degrees, feet flat on floor or supported with stool/ phonebook (enough that there is a finger width gap between the knee and the chair). The head position should have the ears in line with the shoulders and the computer monitor at eye level. The elbow should remain bent while using the computer mouse if it is placed close enough. Finally, pens/phones should be kept within 14-16 inches of reach.

Proper Bending and Reaching Technique (Golfers Lift): Please be mindful that after lumbar fusion/kyphoplasty procedures, bending and lifting are contraindicated (proper bending and reaching technique, golfer's lift). This method is offered for those extremely rare circumstances when you definitely need items to be picked up off the ground. The subject has positioned herself so that she can use the leg as a lever arm to raise her body back to the upright position while keeping her back flat.

Proper Sleeping Posture: Proper sleeping position calls for placing a pillow under the legs when on your back. The neck, not the head, should be supported by a cushion, always.

Proper Side Lying Posture: The ideal side lying position is to place a cushion between the knees, one at the lumbar spine, one at the neck and head, and a third pillow between the knees. Only when there is a space between the bed and the waist is the lumbar support cushion required.

Log Roll: Bend your knees in your starting posture of lying on your back. Turn to your left. As you roll, keep your shoulders and hips together as a single entity.

Getting into the Car

When boarding the vehicle, lean back until you can feel the seat behind your thighs. While keeping your other hand on the dashboard for balance, extend one palm behind you towards the back of the seat.

Sit down slowly, then put each leg into the vehicle one at a time.

Push your pelvis back until your entire body is seated.

Getting out of the Car

Rearrange the bench so that there is plenty of room for the legs.

To prevent twisting at the spine, bring each leg out one at a time while turning your hips and shoulders with your body.

Put one hand on the dashboard or door frame and the other on the back of the bench. Do not drag yourself up to standing—push yourself up.

Tip: To make it simpler for you to slide into and out of the car, put an empty plastic bag on the seat.

Neurophysiology

The peripheral nervous system is also classified into somatic and the autonomic nervous system. The somatic is also called the voluntary and the autonomic is called the involuntary. The somatic nervous system consists of neurons that convey impulses from the special sense receptors to the central nervous system. The autonomic nervous system on the other hand contains the sense organs from the visceral organs and the motor neurons convey impulses from the central nervous system to the smooth muscle and the cardiac muscle.

The autonomic nervous system carries the visceral motor output of the CNS.

ANS centres within the brain stem regulate visceral activities by monitoring and adjusting visceral reflexes.

The most important ANS centres mediate multisystem responses to stimuli. These nuclei are located in the hypothalamus.

The output of the autonomic nervous system can be influenced by higher centres.

The central motor neuron communicates with ganglionic neurons that may be close to the spinal cord or within the tissues of peripheral organs.

Visceral efferents from the thoracic and lumbar segments form the thoracolumbar, or sympathetic, division of the ANS.

The visceral efferents leaving the brain and sacral segments of the spinal cord form the craniosacral, or parasympathetic, division of the ANS.

The Cerebellum:

The cerebellum is a mass of nuclei that sits astride the sensory and motor units of the brain stem. It is made of 3 layers of cells and it is thrown into convolutions or folds called folia. It has three main physical connections to the brain stem and these are:

1. Superior Cerebellar Peduncle
2. Middle Cerebellar Peduncle
3. Inferior Cerebellar Peduncle

Anatomically the Cerebellum is divided into three parts by two transverse fissures. Viz 1. Posterolateral fissures which separates the medial and the lateral flocculus, 2. The primary fissures divide the remainder into an anterior and posterior lobe (Lesser fissures divide the vermis into smaller sections approximately 10 lobules).

Functionally the cerebellum is divided into: 1. Flocculonodular node or vestibulocerebellum 2. Spinocerebellum 3. Neocerebellum

Flocculonodular Lobe (Vestibulocerebellum). This lobe is said to be the oldest and has vestibular connections concerned with equilibrium and learning induced changes.

Spinocerebellum: This receives proprioceptive impulses from the body and also a motor plan from the motor cortex. The cerebellum by comparing plan with performance smooths the activity of the motor system.

Neocerebellum: This is the lateral aspect of the cerebellum and is considered to be the newest and is concerned with planning and programming of movements. It is also said to be the most developed in man.

Microscopically, the cerebellar cortex contains only four types of neurons. These include 1. Purkinje fibres 2.Basket 3.Stellate cells 4.Golgi Cells It also has three layers viz an external molecular layer 2.inner molecular layer and an internal layer.

Functionally, the purkinje fibres are the biggest neurons with the major output from the cerebellar cortex and they go to the deep nuclei. The Basket cells which are in the molecular layer receive input from parallel fibres and project into the Purkinje cells. They are mainly inhibitory cells. The stellate cells are similar to the basket but they are more superficial while the Golgi cells which are also inhibitory are located in the molecular layer.

The Pathway

Inputs (afferents)

Pontocerebellar from the cerebellar. This is the largest input and originates from the basilar pontine nuclei.

Olivocerebellar inputs. This comes from cells in the inferior olivary nuclei.

Spinocerebellar. This comes from the spinal cord and the medullary.

Reticulocerebellar. Originates from the cell group of the reticular activating system in the brain.

Outputs

Vermis projects to the cerebellar nucleus and then to the vestibular nuclei.

Cortex of the intermediate zone projects via the Globus and emboliform nucleus to the ventrolateral and ventral anterior nuclei of the thalamus and from there to the cerebral cortex and the basal ganglia.

The Lateral hemisphere projects to the dentate cerebellar nucleus then to the anterior thalamic nucleus and finally to the cerebral cortex.

The Basal Ganglia

Functions of the Basal ganglia, Pathway of the activities of the Basal Ganglia, Disorders of the Basal ganglia, Principles of Management and current Concepts.

Functions of the Basal Ganglia

The functions of the Basal Ganglia are purely motor and in lower animals and birds in which the cerebral cortex is poorly developed the Basal Ganglia is the highest motor centre. However in man the Basal Ganglia:

Controls muscle tone.

1. Regulates and is essential for fine voluntary activities.
2. Performs familiar movements in the absence of paralysis.
3. Organises movements and works in proportionate measures.

The Basal Ganglia are subcortical nuclei usually four in number and subdivide as follows.

The Caudate Nucleus.

The Lentiform Nucleus.

Putamen (Outer part) Caudate and Putamen are called *Corpus Striatum. The striate Body*

Globus Pallidus (Inner Part)

Subthalamic Nucleus.

Substantia Nigra (located in the midbrain)

Basal Ganglia Connections Afferent Inputs

The Basal Ganglia is a fundamental part of the extra pyramidal system. The Afferent Inputs are from Cerebral Cortex to the Striatum (Putamen + Caudate Nucleus)

Putamen Circuit

Fibres form the Cortical motor area Motor Assoc/Cortical somatic sensory area Putamen-- Internal globus pallidus Thalamic Ventrolat Nucleus->

Primary motor area 4

From Putamen->Globus pallidus-> Thalamus->Motor Cortex.

From Putamen->Globus Pallidus->substantia Nigra. SPECIFIC FUNCTION OF THE PUTAMEN CIRCUIT

Store the program of learned patterns of motor activity and plays a major role in subconscious execution.

CAUDATE CIRCUIT.

Fibres from cortical motor and sensory Areas Caudate Nucleus->Internal Globus pallidus-> Thalamus Ventrolateral Nucleus->Cortical motor assoc areas.

SPECIAL FUNCTION OF CAUDATE CIRCUIT

Caudate circuit is concerned with the cognitive control of motor activity i.e. converting thoughts into motor activity

INTERCONNECTIONS

Negative feedback between External Globus pallidus and subthalamic'

Dopaminergic nigrostriatal connection.

GABA-ergic striate nigral and striato pallidal connections.

BRAIN STEM CONNECTIONS

Fibres from globus pallidus project to:

Reticular formation

Red Nucleus.

Vestibular Nucleus.

Inferior Olivary Nucleus.

All this goes to affect muscle tone and voluntary movements as they are transmitted via the spinal cord to the muscles.

NEUROTRANSMITTERS IN THE BASAL GANGLIA

Acetylcholine from the corticostriatal pathway.

Dopamine from the Nigrostriatal pathway.

GABA.from the striatonigral and striatopallidal neurons.

Norepinephrine Serotonin and enkephalin from neurons projecting from brainstem to the basal ganglia.

Others glutamate.

Note that acetylcholine and norepinephrine are excitatory while all the rest are inhibitory which is a predominant activity of the basal ganglia hence the basal ganglia circuits are predominantly negative feedback loops.

Efferent Outputs

These are mainly from the globus pallidus. Assignments

Role of neurotransmitters in CNS functions

Neuronal circuits

Pathophysiology of epilepsy and scientific basis of management

Physiology of sleep and its disorder

Higher Centre control of ANS

EXERCISE

1. Write an essay on what constitutes a comfortable workplace.
2. Discuss the role of Physical activity on cardiorespiratory health.
3. Write short notes on the following:
   a. Effect of exercise on venous return (circulatory effect)
   b. Oedema (Fluid in tissue spaces)
   c. Fatigue (Effect of accumulation of lactic acid in muscle tissues)

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