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## PROPOSING A PLANTING PLAN DESIGN FOR RESIDENTIAL BUILDING WITH SELECTED SHRUBS AND TREES SPECIES

## BY

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#### Abstract

The study proposed a prototype planting plan design for residential building with selected shrubs and trees for physical well-being of the occupants. Five different quadrats of 2m by 2m were established for each species using line transect for the determination of frequency value. Design process was based on the concept of ecological landscape design, used as determinants in the formulation of floor plan, elevation plan, animation production and perspective of the prototype residential building design with plants. Introduction of shape grammar to computer software application packages - Auto-Cad 2018 was used to developing a system for interactive manipulation of architectural floor, site layout, elevation and perspective plans. The study conclude that the prototype residential building designed with plants ranged from site layout plan, building, elevation and perspective drawing using plant species Codiaeumvariegatum and Ficusbenjaminaas less varieties and more repetition species and Auricariaheterophylla, Mussaendaerythrophylla, and Acalyphawilkesianaas more varieties and less repetition species. Plant species family of Euphorbiaceae out of 4 families would be good candidates for aesthetic and air quality improvement, while the families of Moraceae, Rubiaceae and Araucariaceae would be good candidate for physical health and well-being of the occupant.

Keywords: Shrubs, Trees, Design, Building and Planting plan

## Introduction

Plants are packaged in many ways – their aesthetic qualities are as diverse as the species we have to choose from. Plant aesthetic qualities include the overall habit or shape of the plant and its foliage, flowers, fruit, and bark. The combinations of plant forms, foliage, flowers, fruit and bark can result in creative, artistic displays. Plants serve three major functions in our landscapes: architectural, engineering and environmental. Individually or in concert, plants are the foundation of the landscape and reinforce the intended use of our outdoor space, whether the use is active or passive. We can liken the development of our landscape to the development of rooms in our homes – each room is shaped for its intended use and is accessorized accordingly. Plants serve an architectural function by defining the floors, walls and ceilings of our outdoor rooms. Floors direct our movement into and around the rooms. Plants can also serve an architectural function by highlighting or masking architectural features of a house or building. Framing with plants can emphasize features or downplay an unwanted view. Plants also serve a very important role in shaping the rooms in our landscape. Their form provides the structural framework, and their foliage, flowers and branches provide the wallpaper and decorative appeal. When we speak of an environmental role for plants, our attention focuses on their influence on microclimates within the landscape. "Microclimate" refers to temperature, wind and light in a relatively small area. Plants can modify microclimates in our landscapes and thus contribute to human comfort. The success or failure of a landscape is often judged on the visual quality of the plants.

Landscape is an essential part of the environment as it is one of the most visual needs of people. Landscaping involves the systematic design and engineering of outdoor areas, landmarks and structures. It probes existing social, ecological and social conditions that will produce environmental restoration, green infrastructure planning and provision (Van Assche, 2013). The character of a landscape helps define the self-image of the people who inhabit it and a sense of place that differentiates one region from other regions. Landscape designing according to Cervelli (2005) is popular with the average homeowners, however using plants in landscape design has always been oversimplified and misinterpreted. Plants are the most emphasized visual attractions within a landscape and one of the most basic, important and classic aspect that are often overlooked within planting design, but can evoke the longest lasting overall impression. In landscape designing, the diversity of plant species and the multitude of cultivars, hybrids and varieties make for creative and appealing compositions. We may be attracted to their ornamental appeal or call upon them to serve a specific function or purpose in the landscape, such as providing a screen, blocking unwanted views, or stabilizing a soil bank. Others may be selected because of their ability to adapt to poor soils or simply for the ease of subsequent care. However, the freedom to choose from a wide variety of plants depends on the flexibility or a restriction imposed by the individual, the site or in some cases the local availability of plants. To ensure the integrity of the planting we must plan accordingly and identify the amount of space we want or will allow the plants to cover. The size of the available space influences the type of plant we

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select. Each plant type sparks an image, some large, some small. "Shade tree" implies large canopy; "evergreen tree" usually suggests dense foliage and a conical shape; an ornamental/flowering tree could be a small, delicate thread-leaf Japanese maple or a wide-spreading crabapple. Shrubs offer a diverse array of sizes from dwarf barberries to massive viburnums. Ornamental grasses and perennials offer seasonal changes in color and texture as well as in size.

The sophistication and detail in a set of planting plans design may vary based on the site analysis, building design, owner's needs and the landscape horticulturist on what precisely, is the role of plants in the landscape? What principles are effective and what practices necessary for the design, plant selections, installation and maintenance of a good landscape. Most research into planting design has been quantitative in nature, and has been undertaken within the field of environmental science, social science and economic modelling (Carpenter *et al.*, 1990). Much research has been undertaken by those well-versed in aesthetics and visual design principles and few studies have adopted a more appropriate qualitative or mixed-method research methodology by Taxonomists.

## Literature Review

Landscape is known to be one of the most visual needs of the people as it is an essential part of the environment which includes topography, vegetation and associated plants and soil, water bodies, and their spatial configuration. According to Cervelli (2005), Landscaping incorporates various aspects of urban design, architecture, geography, ecology, civil and structural engineering, horticulture, fine arts, industrial design, botany, soil sciences and environmental psychology. Architects work on structures and external spaces in landscape designing for large or small, rural, suburban or urban, with building materials and plant materials whilst integrating ecological sustainability. Landscape design is concerned with the aesthetic and functional elements of landscaping as landscape designers are guided by some basic rules that helps them to create aesthetically pleasing designs in their clients' space. Aesthetics which basically pertains to the study of beauty appreciation or beauty perception where landscape design is concerned, studies subjects such as the role of focal point, color theory, form and texture, and how our perception of line and scale influences our opinion of scenery (Beaulieu, 2018).

According to Beaulieu (2018), one of the aesthetic debates that arose between designers over the last few canturies had been focused between the styles of formal yard design and informal design of which the former leans towards symmetrically tight structure with a sense of orderliness and class, in contrast to the latter which is marked by a wild riot of color and lack of orderly organization with a sense of refined rusticity. However, in recent decades the landscaping discourse is tending to shy away from the idea of aesthetics while focusing on the notions of functional and sustainable design (Rudi van Etteger, 2016). In landscape design, as much as aesthetic beautification is considered, practical landscaping elements should be carried along as in reality, both are united and serve a practical purpose.Plants are the dominant foundation of the landscape and reinforce the intended use of our outdoor space. The diversity of plant species makes up for creative and appealing landscape compositions (Schutzki, 2005). Plants create life in the environment through color, texture, and aroma. They provide balance to the structure of the home and hardscape, frame a view and provide shade. They provide a feeling of intimacy and act as buffer for sound, wind, and privacy. They also provide seasonal color. In recent years researchers have undertaken a number of literature reviews on the linkages between human health and well-being and urban nature or design of the built environment including landscapes. Pretty (2004) conducted a literature review of the contributions of nature to metal and physical health, and found a strong correlation between people being in or viewing nature and feeling healthier. A comprehensive review of the relationship between nature and health was undertaken by Grinde and Patil (2009).

Abraham *et al* (2010) carried out a scoping study reviewing over 120 studies examining the health-promoting aspects of natural and designed landscapes, he concluded that: landscapes have the potential to promote metal wellbeing through attention restoration, stress reduction and the evocation of positive emotions; physical well-being through the promotion of physical activity in daily life as well as leisure time and through walkable environments; and social well-being through social integration, social engagement and participation, and through social support and security. Recent epidemiological studies provide evidence of the positive relationship between health, well-being and green places (De Vries*et al.*, 2003). Other studies also emphasize the importance of walkable green spaces for older people (Takano *et al.*, 2002).

### **Research Objectives**

The objective of this study is to design, select and use the ornamental shrubs and tree species in the proposed prototype built environment for physical well-being of the occupants.

## Methodology

This study area is Kwara State University Co-operative Land, Sobi Area, and Ilorin, located at 137 ° SE. It lies between latitude 8° 10' and 19° 50'N and between longitude 3° 10'N and 6° 05'E, at altitude 893.86ft. Fresh leaves were collected at ornamental nursery garden in Ilorin, Kwara State for identification at the Herbarium. The voucher specimens of all the collected plants were deposited at the University of Ilorin Herbarium, Plant Biology Department. Identification and nativity was also done using local floras (Keay*et al.*, 1990).

## **Determination of Frequency Distribution**

Five (5) different quadrats of 2m by 2m were established in the nursery garden for each species using line transect. The occurrence of the selected species in each quadrat was recorded. The frequency of each species was determined as follows:

 $Frequency = \frac{Number of occurrence of each species}{\text{Total number of all occurrences}} \times 100$ 

Table 1:	Proposed Selected	Ornamental Plants S	Species for the	Planting Plan Design

Botanical Name	Common Name	Family
Codiaeumvariegatum	Croton	Euphorbiaceae
Auricariaheterophylla	Auricaria	Araucariaceae
Ficusbenjamina	Ficus	Moraceae
Acalyphawilkesiana	Acalypha	Euphorbiaceae
Mussaendaphillipica	Queen of Philippines	Rubiaceae

## **Design Process with Plant Species**

Application of some basic design process (site analysis, aesthetic, spacing, selection, climatic and soil characteristics) and principles of design was used in the of prototype site layout plan. These principles consist of various uses of line, form, texture, colour, repetition, variety, balance and emphasis. All of these terms apply to any aesthetic composition or work of art. Scale: more variety and less repetition can be used in a small-scale design such as a residential garden and in contrast to a large-scale design such as an urban park (Carpenter, *et al.*, 1990)

### **Computer Aided Architectural Design**

It was based on the concept of ecological landscape design, which is the recognizing and mapping out natural processes in the landscape and this was used as determinants in the formulation of floor plan, elevation plan, animation production and perspective of the prototype botanical garden (McHarg, 1995; Chen *et al.*, 2008). Introduction of shape grammar to computer software application packages - Auto-Cad 2018 was used to developing a system for interactive manipulation of architectural floor, site layout, elevation and perspective plans.

## Results

# Selected Trees Species in the Study Area

About 120 plants species were identified in the study area. Details of spatial distributions of the selected ornamental plants species in the study are summarized in Table 1. Among the ornamental plants species, *Ficusbenjamina* and *Codiaeumvariegatum* dominant with frequency value of 41.67% and25% respectively. The species with least occurrence in the landscape were *Auricariaheterophylla*, *Mussaendaphillipica* and *Acalyphawilkesiana* 

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Botanical Name	Common Name	Frequency Value (%)		
Codiaeumvariegatum	Croton	25.0		
Auricariaheterophylla	Auricaria	8.33		
Ficusbenjamina	Ficus	41.67		
Acalyphawilkesiana	Acalypha	16.67		
Mussaendaphillipica	Queen of Philipines	8.33		

### Table 2: Frequency Value of the Selected Ornamental Plants

# **Design Process with Plants Species**

### Site plan

Site plan showing the location of all structures and physical features, such as road, walks, fence, wall, existing trees and the newly introduce ornamental plants species is presented in Figure 1. The information gained from site plan,

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the landscape horticulturist then considers the form, size, texture and colour of the ornamental plant to be used for aesthetic purpose in the landscape.



Fig. 1: Site Plan

# **Perspective Drawing**

From the site plan, the three-dimensional drawing (3D) known as perspective was generated and decorated in a variety of styles in Figure 2 and 3. Each available style with the ornamental plant is specified in a style template, listing the geometric and material properties of the building element: windows, doors, wall segments, gables, stairs and roofs. The style template also records the desired spacing of the building and ornamental plants in the landscape.



Fig 3: 3D Perspective drawing Computer Aided Architectural Design

# The ground floor plan

The ground floor plan showing the arrangement of rooms, verandah or corridor, position of door and window and other openings along with their respective sizes in Figure 4. Floor plan design is commonly governed by considerations of comfort and accessibility.



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# **Elevation or front view**

Elevation or front view is the outward view of a completed building along any side of the building as showing in Figure 5 and 6. When a building is seen by standing in front of it, the view that can be viewed is known as front elevation, similarly, backside view is called rear elevation or from any side of it which is known as side elevation.



Fig 6: Right side view elevation

## Discussion

The proposal centered on the usage of soft landscaping material according to the planting plan produced by the landscape horticulturist in the company of other professionals such architect, designers, ecologists, plant taxonomists and maintenance specialists worked together in reaching design solution to human health and wellbeing in a good landscape and built environment. Too often landscape plants such as trees and shrubs are thought of only for their beauty, without regard for their functional value, and the term ornamental plants is indicative of this limited concept. Yet plants can be used for much more than beautification; they can improve the quality of an environment functionally (Carpenter *et al.*, 1990). The form and branching pattern of trees and shrubs will determine their appropriate role in the landscape design. Plants with regular, symmetrical, full forms are most effective in reinforcing the geometric pattern of the formal landscape design. Evergreen plantings are highly favoured in this regard, lending to the popularity of *Auricariaheterophylla* for a year-round effect. A few trees and shrubs with symmetrical growth patterns suitable for formalistic settings in the proposed planting plan include the *Codiaeumvariegatum, Ficusbenjamina, Acalyphawilkesiana* and *Mussaendaphillipica*. Several shrubs in their natural state have irregular growth patterns but can forced into a beautiful geometrical shape by the maintenance crew, care must be taken when choosing plants to ensure their tolerance for such frequent pruning.

In the past, attitudes toward plants and their function in the landscape were generally subjective and restricted to romantic, gardentesque application because of the aesthetic qualities of plants; many of today's landowners understandably still hold this attitude. However, this study is proposing a landscape that is well design with plants for functional purposes as most plants can serve other important functions that are not as obvious to the average property owner. There is a well- established link between participation in physical activity and the attributes of the physical and beautiful environment (Booth *et al.*, 2000). Considerable research supports the idea that the presence of green, natural settings can facilitate physical activity (Sallis and Glanz, 2009). Also, recent epidemiological studies provide evidence of the positive relationship between health, well-being and green places (De Vries*et al.*, 2003). Other studies also supported the use of plants species in a built environment by emphasizing the importance of walkable green spaces for older people in the built environment (Takano *et al.*, 2002).

Coordinate the development of unity, order and rhythm within a space through the establishment of an overall development in the proposed planting plan. The theme should be appropriate to the function of the space as well as

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reflect the architecture of the building. The four types of basic themes that can be given to a space: (1) rectilinear; (2) angular; (3) curvilinear and (4) a combination of the three. This proposed study was in line with the curvilinear or angular theme which is more appropriate to the typical and somewhat smaller bungalow-type homes and more contemporary, stylistic built structures. The function of the outdoor space in this situation is intended to include more casual entertaining, day-to-day living activities, hobbies, recreation and leisure. The intended effect is on the physical health, well- being, comfort, relaxation, flexibility and spontaneity. Due to frequent use by the occupant after the establishment of the ornamental plants in the landscape, the informal space must be able to provide variety and interest to the people.

Basic design principles are common to all art works. This proposal shows a quality planting plan design for a residential built environment, this quality make artistic creations continually beautiful, interesting and meaningful. Plants as well as man-made structure in the landscape can be combined in an infinite variety to bring about balance, unity, and rhythm. The design concept of rhythm is similar to unity but serves the important function of creating variety and interest in the landscape composition. Rhythm is generally achieved through repetition of a series of forms, colours and textures in a particular order or pattern. This repetition will also include slight variations or a progression to serve as a treat for the eye or ear within a comfortable and continuous setting. This proposed planting plan design for built environments make use of repetition of the selected ornamental plants in the landscape for better physical health and well-being can be enhance by environmental factor modification such as air quality and climatic variables such as heat extremes and shading by ornamental or green plants (Popkin*et al.*, 2005)

Plants with respect to architecture can perform two roles. They can complement and reinforce the existing architecture of the house or structure and they can create outdoors environment as it was shown in the proposed planting plan design in this study. The trees, shrubs and groundcovers can be used to emphasize the desirable architectural lines and masses of the house. The form and the branching pattern of the proposed trees and shrubs can echo the vertical, horizontal and diagonal roof and wall of the proposed building in the study which will eventually give a pleasing, unified and harmonious appearance as shown the proposed planting plan design for a residential built environment (Fig. 2 and 3), which according to Cervero and Duncan (2003) have the potential to promote physical well-being through the promotion of physical activity in daily life as well as leisure time and through walkable environment. In one study by De Vrieset al., (2003) explored the relationship between green areas and health in the Netherlands, by combining data on the self-reported health of over 10000 people with land use data on the amount of green space in their living environments. People living in a greener environment were found to be significantly healthier in all three health indicators. Therefore, the outcome was also in line with the objective of this proposed planting plan design for residential built environment using trees and shrubs. The aesthetic values can be found in plant parts. Texture, colour and a feeling of design movement show in a wide variety of bark. The swirling patterns of knots are another element of design. Leaves provide a wide variety of forms and shape, most of them symmetrical in character. Subtle colour changes and patterns are created by leaf veins. Some leaves are green above and powdery white below. Vivid colour is provided by some, such as Codiaeumvariegatum and Mussaendaphillipica (Sandoval, 2020).

# Conclusion

The most successful functional and aesthetic uses of plants in the design come about when the landscape horticulturists, designers, architects, ecologists, plant taxonomists and maintenance specialists fully understands plants, their environments and construction and maintenance problems. Their efforts must then be followed by those of the contractors who can faithfully install the materials according to planting plan design and freely communicate with the designer; further work is needed by the maintenance supervisor who can understand the intent of the designer and who will care for, prune and replace plants according to the design. If any one of this three-member team goes his own way without regard for others, the objective of the proposed planting plan design using trees and shrubs in the built environment for physical health and well-being of the occupant and the aesthetic values may be partially or even totally defeated or lost.

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