CLIMATIC ZONES FOR ARCHITECTURAL DESIGN WITH CLIMATE IN NIGERIA

BY

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INTRODUCTION

This paper looks into the climate of Nigeria in relation with climatic zones for architectural design. This study is based on design zones by Mahoney table, the Martin Evans method, the kopen system, the Atkinson system, the Olu Ola Ogunsote and set theory. In keeping microclimatic condition of an enclose space within the comfort limits, the architectural design must be achieved putting in mind the climate of the environment. The understanding of the climate will offer the architect a chance to evaluate comfort.

The climatic zones for architectural design are defined by boundaries where a change in the thermal comfort requirements should be reflected in changed building elements. Six such zones have been defined for Nigeria: the Coastal Zone, the Forest Zone, the Transitional Zone, the Savannah Zone, the Highland Zone and the Semi-desert Zone. There are some general design guidelines common to all these zones. However, site planning, design of openings, recommended structure and materials as well as need for provision of outdoor spaces require varying specifications.

AREA OF STUDY

The study area is Nigeria while the total area is 923,768 km². 910,768 km² of the area is land, while water takes up the remaining 13,000 km². Nigeria's total boundaries are 4,047 km in length. The countries it borders account for most of this. The border with Benin is 773 km, that with Cameroon is 1,690 km, Chad's is 87 km, and Niger’s is 1,497 km. Nigeria's coastline is 853 km.

Nigeria lies within the tropical zone, there are wide climatic variations in different regions of the country. Near the coast, the seasons are not sharply defined. Temperatures rarely exceed 32° C (90° F), but humidity is very high and nights are hot.
Basically, there are two distinct seasons: a wet season from April to October, with generally lower temperatures, influenced by an airmass originating from the south Atlantic ocean, locally known as the southwest wind, or by its main name, The Tropical Maritime (MT) airmass and a dry season from November to March, which blows from the Sahara Desert, locally known as, harmattan or by its main name, The Tropical Continental (CT) airmass, with midday temperatures that surpass 38°C (100°F) but relatively cool nights, dropping as low as 12°C (54°F). On the Jos Plateau, temperatures are more moderate. These two major wind systems in Nigeria, are known as the trade winds.

Average rainfall along the coast varies from about 180 cm (70 in) in the west to about 430 cm (170 in) in certain parts of the east. Inland, it decreases to around 130 cm (50 in) over most of central Nigeria and only 50 cm (20 in) in the extreme north.

In West Africa, Nigeria's climate is characterized by strong latitudinal zones, becoming progressively drier as one moves north from the coast. Rainfall is the key climatic variable, and there is a marked alternation of wet and dry seasons in most areas. Two air masses control rainfall—moist northward-moving maritime air coming from the Atlantic Ocean and dry continental air coming south from the African landmass. Topographic relief plays a significant role in local climate only around the Jos Plateau and along the eastern border highlands.

In the coastal and southeastern portions of Nigeria, the rainy season usually begins in February or March as moist Atlantic air, known as the southwest monsoon, invades the country. The beginning of the rains is usually marked by the incidence of high winds and heavy but scattered squalls. The scattered quality of this storm rainfall is especially noticeable in the north in dry years, when rain may be abundant in some small areas while other contiguous places are completely dry. By April or early May in most years, the rainy season is under way throughout most of the area south of the Niger and Benue river valleys. Farther north, it is usually June or July before the rains really commence. The peak of the rainy season occurs through most of northern Nigeria in August, when air from the Atlantic covers the entire country. In southern regions, this period marks the August dip in precipitation. Although rarely completely dry, this dip in rainfall, which is especially marked in the southwest, can be useful agriculturally, because it allows a brief dry period for grain harvesting.

From September through November, the northeast trade winds generally bring a season of clear skies, moderate temperatures, and lower humidity for most of the country. From December through February, however, the northeast trade winds blow strongly and often bring with them a load of fine dust from the Sahara. These dust-laden winds, known locally as the harmattan, often appear as a dense fog and cover everything with a layer of fine particles. The harmattan is more common in the north but affects the entire country except for a narrow strip along the southwest coast. An occasional strong harmattan, however, can sweep as far south as Lagos, providing relief from high humidities in the capital and pushing clouds of dust out to sea.
With the size of the country and its climatological cycle, there is a considerable range in total annual rainfall across Nigeria, both from south to north and, in some regions, from east to west. The greatest total precipitation is generally in the southeast, along the coast around Bonny (south of Port Harcourt) and east of Calabar, where means annual rainfall is more than 4,000 millimeters. Most of the rest of the southeast receives between 2,000 and 3,000 millimeters of rain per year, while the southwest (lying farther north) receives lower total rainfall, generally between 1,250 and 2,500 millimeters per year.

Mean annual precipitation at Lagos is about 1,900 millimeters; at Ibadan, only about 140 kilometers north of Lagos, mean annual rainfall drops to around 1,250 millimeters. Moving north from Ibadan, mean annual rainfall in the west is in the range of 1,200 to 1,300 millimeters.
The Guinea savanna starts in the middle belt, or southern part of northern Nigeria. It is distinguished from the Sudan savanna because it has more trees whereas the Sudan few trees. Rainy seasons decline correspondingly in length as one moves north, with Kano having an average rainy period of 120 to 130 days, Katsina and Sokoto having rainy seasons 10 to 20 days shorter. Average annual rainfall in the north is in the range of 500 to 750 millimeters.

The regularity of drought periods has been among the most notable aspects of Nigerian climate in recent years, particularly in the drier regions in the north. Experts regard the twentieth century as having been among the driest periods of the last several centuries; the well publicized droughts of the 1970s and 1980s were only the latest of several significant such episodes to affect West Africa in this century. At least two of these droughts have severely affected large areas of northern Nigeria and the Sahel region farther north. These drought periods are indications of the great variability of climate across tropical Africa, the most serious effects of which are usually felt at the drier margins of agricultural zones or in the regions occupied primarily by pastoral groups.

Temperatures throughout Nigeria are generally high; diurnal variations are more pronounced than seasonal ones. Highest temperatures occur during the dry season; rains moderate afternoon highs during the wet season. Average highs and lows for Lagos are 31° C and 23° C in January and 28° C and 23° C in June. Although average temperatures vary little from coastal to inland areas, inland areas, especially in the northeast, have greater extremes.

There, temperatures reach as high as 44° C before the onset of the rains or drop as low as 6° C during an intrusion of cool air from the north from December to February.

CLIMATES IN NIGERIA

1. THE TROPICAL RAINFOREST CLIMATE OR THE EQUATORIAL MONSOON

This type of climate is found in the southern part of Nigeria. This climate is influenced by the monsoons originating from the South Atlantic Ocean, which is brought into the country by the (maritime tropical) MT airmass, a warm moist sea to land seasonal wind. Its warmth and high humidity gives it a strong tendency to ascend and produce copious rainfall, which is a result of the condensation of water vapour in the rapidly rising air.

The Tropical rainforest climate has a very small temperature range. The temperature ranges are almost constant throughout the year, for example, Warri town in the southern part of Nigeria, records a maximum of 28 °C (82.4 °F) for its hottest month while its lowest temperature is 26 °C (78.8 °F) in its coldest month. The temperature difference of Warri town is not more than 2 °C (5 °F).
The southern part of Nigeria experiences heavy and abundant rainfall. These storms are usually convectional in nature due to the regions proximity, to the equatorial belt. The annual rainfall received in this region is very high, usually above the 2,000 mm (78.7 in) rainfall totals giving for tropical rainforest climates worldwide. Over 4,000 mm (157.5 in) of rainfall is received in the coastal region of Nigeria around the Niger delta area. Bonny town found in the coastal region of the Niger delta area in southern Nigeria receives well over 4,000 mm (157.5 in) of rainfall annually. The rest of the southeast receives between 2,000 and 3,000 mm (118.1 in) of rain per year.

The southern region of Nigeria experiences a double rainfall maxima characterised by two high rainfall peaks, with a short dry season and a longer dry season falling between and after each peaks. The first rainy season begins around March and last to the end of July with a peak in June, this rainy season is followed by a short dry break in August known as the August break which is a short dry season lasting for two to three weeks in August. This break is broken by the Short rainy season starting around early September and lasting to Mid October with a peak period at the end of September. The ending of the short rainy season in October is followed by Long Dry Season. This period starts from late October and lasts till early March with peak dry conditions between early December and late February.

2. TROPICAL SAVANNA CLIMATE OR TROPICAL WET AND DRY CLIMATE

This climate covers most of Western Nigeria to central Nigeria beginning from the Tropical rainforest climate boundary in southern Nigeria to Abuja, the central part of Nigeria, where it exerts enormous influence on the region.

The tropical savanna climate exhibits a well marked Rainy season and a dry season with a single peak known as the summer maximum due to its distance from the equator. Temperatures are above 18 °C (64 °F) throughout the year. Abuja, Nigeria's capital city found in central Nigeria, has a temperature range of 18.45 °C (65.21 °F) to 36.05 °C (96.89 °F), and an annual rainfall of about 1,500 mm (59.1 in) with a single rainfall maxima in September.

The single Dry season experienced in this climate, the tropical savanna climate in central Nigeria beginning from December to march, is hot and dry with the Harmattan wind, a continental tropical(CT) airmass laden with dust from the Sahara Desert prevailing throughout this period.

With the Intertropical Convergence Zone (ITCZ) swinging northward over West Africa from the southern hemisphere in April, heavy showers coming from pre-monsoonal convective clouds mainly in the form of squall lines also known as the north easterlies formed mainly as a result of the interactions of the two dominant airmasses in Nigeria known as the Maritime tropical(south
westerlies) and the Continental tropical(north easterlies), begins in central Nigeria while the Monsoons from the south Atlantic ocean arrives in central Nigeria in July bringing with it high humidity, heavy cloud cover and heavy rainfall which can be daily occurrence lasting till September when the monsoons gradually begin retreating southward to the southern part of Nigeria. Rainfall totals in central Nigeria varies from 1,100 mm (43.3 in) in the lowlands of the river Niger Benue trough to over 2,000 mm (78.7 in) along the south western escarpment of the Jos Plateau and the southern Kaduna highlands which extends into Nigeria's Federal Capital Territory, just north of Abuja city, due to orographic activities on the highlands in central Nigeria.

3. **THE SAHEL CLIMATE OR TROPICAL DRY CLIMATE**

This type of climate is predominant in the northern part of Nigeria. Annual rainfall totals are lower compared to the southern and central part of Nigeria. Rainy season in the northern part of Nigeria last for only three to four months (June–September). The rest of the year is hot and dry with temperatures climbing as high as 40 °C (104.0 °F).

4. **ALPINE CLIMATE OR HIGHLAND CLIMATE OR MOUNTAIN CLIMATE**

Alpine climate are found on highlands regions in Nigeria. Highlands with the alpine climate in Nigeria are well over 1,520 meters (4,987 ft) above sea level. Due to their location in the tropics, this elevation is high enough to reach the temperate climate line in the tropics thereby giving the highlands, mountains and the plateau regions standing above this height, a cool mountain climate.

**NEED FOR DESIGN WITH CLIMATE**

Architectural designs having climate in mind is a challenge that need to be met, because is it through this that comfort limit could be attain. The need for such finding is to collate a guidelines for design for the various climatic zones in Nigeria. According to Fitch (1971) the electronic computer has inevitable become an important tool’, this is so because of the large inpute of importation. This is supported by the fact that the very nature of the analysis involved in energy-conscious design encourages the use of computer (Ogunsote 1991a).

**DEFINITION OF CLIMATIC ZONES**

It is important to differentiate between climatic zones for architecture purposes and the climatic zones for architectural design. Climatic zones are defined for a better understanding of the workings of the global climatic system (Markus and Morris 1980).
The agricultural climatic zones are related to human comfort. The architectural zoning enable us to get a maximum use of our environment creating thermal comfort when the building is well placed, right from the building materials is selected for windows, walls and roofs.

**PURPOSE OF THIS STUDY**

- To define the climatic zones for architectural design in Nigeria
- To propose the climatic zones for architectural design in Nigeria using the proposed method.
- To analyse each location in respect of its climate, in order to have a template for architectural design

**RELATIONSHIP BETWEEN THE ZONES AND NATURAL VEGETATION**

Vegetation is not used in classifying climatic design zones but most climatic classification systems relate to it (Evans, 1980).

There are seventeen different zones and several sub-zones in the world. There is considerable variation within each zone or sub-zone caused by differences in topography, altitude, wind pattern and ocean currents. With the difficulty in defining climatic zones, the major challenge is the issue of mixing of flora and the distribution of natural vegetation that leads to change in climatic condition.

**THE ATKINSON SYSTEM**

This system is the basis for the proposal by the United Nation (1971), of house and plan typos for difficult climates. This is used for classification of hot climates in relation to building needs. This classification is bias towards a certain climatic types and it is not applicable to cold climate (Evans 1980).

**THE KOPPEN SYSTEM**

This system of climatic zones, which was first proposed in 1900, but it has been modified by several authors since, notable among which is Trewartha (1943). The classification recognizes seven major zones and several sub-zones (Ogunsote, 1990a). A major shortcoming of the system can be traced to its dependence on rainfall and temperature and as such, like classifications based solely on vegetational cover, it does not necessarily relate to building design for thermal comfort (Evans, 1980). In fact, the “classifications are not directly applicable to housing”. This is linked to the absence of humidity, an important thermal comfort factor, in the classification.
NATIONAL UNIVERSITIES COMMISSION METHOD

National Universities Commission (1977) only recognizes two climatic zones in Nigeria, (1) the Northern zone and (2) the Southern zone, though a transitional zone is also mentioned. Critically looking at it revealed that the NUC based the division of the country into climatic design zones on the Atkinson system of climate classification. The warm humid climate is the southern zone, while the composite or monsoon climate is the northern zone. The differences can be found in the specification of the various seasons and slight change in the temperature and humidity limits.

From the foregoing it can be argued that the NUC definition was not based on an in-depth analysis. Furthermore, the logical shortcomings of the method indicate that it may be unsuitable for the delineation of climatic zones for architectural design in Nigeria.

THE MARTIN EVANS METHOD

This was proposed after several analysis of different existing methods, including the Koppen system, the Atkinson system and the Mahoney table method (Evans, 1980). He defined seven zones in terms of differences in the air temperatures, the humidity, the rainfall, the sky conditions, the wind and other conditions. The Koppen classifications were identified for easy cross-referencing.

Evans proposed seven climatic types recognised the need to define zones in terms of thermal comfort for building design but he pointed out the relativity of standards and the importance of relating to social and economic contexts especially as regards traditional or conventional forms of construction.

The Atkinson system proposes more realistic limiting values of rainfall, temperature and humidity. The method however makes it difficult to systematically and uniquely identity zones with the aid of only very basic climatic data. This does not however negate the usefulness of the method in understanding the subtleties of the different climatic design zones.

CLIMATIC ZONES FOR ARCHITECTURAL DESIGN

The form of dwellings, the insulation value of roofs and walls, the orientation, size of windows and several other design variables are determined by the requirements for thermal comfort. Requirements for thermal comfort are related directly to the climate. There is therefore a strong link between the climate and building design, but this link should not be seen as a direct one. The same condition of thermal distress or comfort may be created by various combinations of climatic variables.
Climatic variables vary over distance and time in a continuous manner resulting in variations in thermal comfort conditions that are also continuous. It is however possible to determine the appropriate boundaries where a change in the climate and a change in the thermal comfort requirements should be reflected in changed building elements. These boundaries will effectively define the climatic zones for architectural design. There are several definitions of climatic zones for architectural design in Nigeria. Recent research by the author has identified six zones in Nigeria. The following architectural design zones are recognised for the purposes of our discussion.

1. **THE COASTAL ZONE**

This includes such cities as Ikeja, Lagos, Ondo, Benin, Warri, Port-Harcourt and Calabar. The climate is characterised by high humidity and hot discomfort for eleven or more months in the year. This makes provision of permanent ventilation essential. The monthly rainfall exceeds 200mm for three or more months making adequate drainage necessary. There is no need for thermal storage as a high diurnal temperature range of more than 10 degrees coupled with low humidity is not experienced for more than one month in the year. The maximum monthly temperature never falls below the comfort limit, thus no special precautions need be taken against cold discomfort.

1.1 **ARCHITECTURAL DESIGN IN THE COASTAL ZONE OF NIGERIA**

In the coastal zone, the layout of buildings should be north-south with the longer axis facing east-west. Where there two or more buildings lying beside each other, there should be large spaces between them to allow for effective ventilation. Buildings should be single banked to enable cross ventilation. The house form should reduce exposure to solar radiation. The openings should be large and situated preferably in north and south walls. Permanent ventilation should be provided. Their position should encourage body cooling. Sun-shading devices must exclude the sun throughout the year. Rain penetration through windows should be totally prevented.

In terms of Structure and materials, the walls and floors should be light and of low thermal capacity. This requirement is to satisfy for floors but walls can be made of louvred shutters and lightweight materials of minimal thermal storage capacities. The roofs should be light, with a reflective surface to reduce solar heat gain by the roof. The finishing of walls and roofs should be
light to reflect solar heat. These finishes should be able to protect the building against driving rain. Overhangs and verandas should be used for sun protection. Balconies should be provided in high rise buildings, so that occupants can enjoy the evening breeze. In bigger buildings, courtyards could be introduced in other to achieving cross ventilation.

2.0 FOREST ZONE

Forest zones covers Ibadan and Oshogbo. There is need for permanent provision for ventilation for ten months of the year as a result of the combination of high humidity and hot discomfort in the day. The monthly rainfall never exceeds 200mm. Despite the hot and humid nature of the climate, thermal storage is still needed for two months of the year as a result of the combination of low humidity and high diurnal range of more than 10 degrees Celsius. There is no need to provide outdoor living space and protection against cold is not required.

2.1 ARCHITECTURAL DESIGN IN THE FOREST ZONE OF NIGERIA

The designs of buildings on this zone should expose as little of the building surface to the western sun as possible, while the spacing between buildings should allow breeze penetration and single banking should be used. There is need to use trees and shrubs for protection against hot and cold winds to provide adequate shading. Medium size openings of approximately 25 to 40% of the wall area should be situated in north and south walls. Permanent ventilation should be provided. These openings should provide adequate body cooling and they must be shaded throughout the year from the sun and driving rain. The walls and floors should be of lightweight materials of low thermal capacity and short time lag. Roofs should be light, with a reflective surface and cavity. Wall and roof finishes should be light in colour. Walls should be protected against driving rain. Overhangs, verandas and balconies should be provided. Courtyard design should be used to improve cross ventilation in a bigger building.

3. TRANSITIONAL ZONE

This zone covers areas like; Makurdi, Ilorin, Lokoja and Enugu. There is need for cross ventilation for three to nine months in the year. Buildings should be protected from heavy rainfall as a result of downpours which exceeds 200mm in some months. There is need for
thermal storage for three to five months of the year. High humidity and low diurnal temperature ranges make external sleeping spaces unworkable. Severe cold does not constitute a problem.

3.1 ARCHITECTURAL DESIGN IN THE TRANSITIONAL ZONE

Buildings on this zone should be protected against solar gain by exposing minimal surfaces to the sun. This is achieved by laying out buildings with their longer axes facing east-west. The space between buildings should enable breeze penetration but trees should be used to protect from hot and cold winds. Buildings should be single banked.

Medium openings occupying 25 to 40% of the wall area should be used and permanent provision made for ventilation. The positioning of openings should help catch breezes which will be directed at the living level to provide body cooling. Sun shading devices should be used and openings protected from driving rain.

Walls and floors should be heavy with high thermal capacity and a time lag of over 8 hours. Roofs should be light and well insulated to prevent heat loss and heat gain. Surfaces should be reflective and water resistant.

Introduction of courtyards and verandas will help improve ventilation.

4.0 SAVANNAH ZONE

This zone covers a large portion of the country which includes towns like Kano, Potiskum, Yola Maiduguri, Yelwa, Sokoto, Gusau, Ibi, Minna, Bida, Abuja Zaria and Kaduna. There is need for cross ventilation for three to nine months in the year due to hot day discomfort, so thermal storage is needed for cooling interiors in the day and for providing warmth at night. There is need to protect buildings against rain as a result of the heavy downpours which is frequent in the area. Cold nights and hot days alternate for six to ten months of the year.

Outdoor sleeping space should be provided since it is impossible to achieve night comfort during the hot months.
4.1   ARCHITECTURAL DESIGN IN THE SAVANNAH ZONE

The orientation of the building must be accurate by placing the long axis facing east-west, to protect the surface from solar gains. There must be protection from hot and cold winds. Rooms should be single banked and permanent provision made for air movement. The openings should occupy between 20 to 35% of the wall area. These openings should be permanent and be able to allow for proper ventilation in order to improve body cooling. These openings must be protected against sun and rain penetration with the use of sun shading device. Walls, floors and roofs should be heavy with high thermal capacity and a time lag of over 8 hours. Shaded and partly enclosed outdoor living spaces should be provided in the form of courtyards and verandas which could be used for outdoor sleeping when the indoors temperature increases.

5.0   HIGHLAND ZONE

This is a cool climate to be found at high altitudes. This climate is associated with Jos on the Jos Plateau but it can also be found on the Mambilla plateau and other mountainous regions along the Cameroonian border. There is need for cross ventilation only during one month of the year though good ventilation is desirable during other months. Monthly rainfall exceeding 200 mm for three or more months in the year dictates the need for protection against heavy downpours. Thermal storage is needed for six to ten months in the year to dampen fluctuations in indoor temperatures. Outdoor sleeping spaces are not required and special provision for winter are unnecessary.

5.1   ARCHITECTURAL DESIGN IN THE HIGHLAND ZONE

Courtyard planning should be used to enclose private and semiprivate outdoor spaces. Air movement is not a prerequisite for comfort, so compact planning will help conserve heat. For the same reason double banking should be used with temporary provision for air movement. Provision of shade trees is important to act as buffer. The orientation of buildings should minimize solar
gain but orientation plays a minor role in this climate.

The openings on the outer wall should be between 20 to 35%. Internal walls should possess adequate openings for air flow through the building for proper and adequate ventilation. Outer openings should be protected against sun and rain penetration. The choice of material for walls and floors should be heavy with a time lag of over 8 hours. Roofs should also be heavy with a time lag of over 8 hours. Light and reflective finishes are good to use. Courtyards, verandas and patios are desirable and should be shaded.

6.0 SEMI-DESERT ZONE

Nguru and Katsina fall within this architectural climatic zone, where ventilation is important for one or two months in the year. This zone is known for its low rainfall with monthly readings of more than 200 mm occurring only during one or two months in the year. Hot and humid conditions are experienced during one or two months and thermal storage is needed for more than six months in the year. Provision of outdoor sleeping space is important.

6.1 ARCHITECTURAL DESIGN IN THE SEMI-DESERT ZONE

Courtyard planning should be used with double banked rooms and temporary provision for air movement. Trees should be used to provide shade, buffer and wind breaker. The openings should be small between 15 to 35% of the wall area. These openings should also be provided on internal walls and positioned to create body cooling. They should be protected from sun and driven rain through the use of shading device. Materials for walls, floors and roofs should be heavy with a time lag of over 8 hours. Outdoor living space must be provided in the form of courtyards. These must be shaded by trees and boundary walls and designed in a way that enables outdoor sleeping.

GENERAL ARCHITECTURAL DESIGN GUIDELINES WITH CLIMATE IN NIGERIA

Considering the climate of Nigeria, there are some design recommendations that are applicable all over the country. Mosquitoes and flies are common in all parts of the country, which makes it a challenge that need to be tackled. In keeping Mosquitoes and flies away from any building in any part of the country, protective screens should always be used. Protective screens should be provided for all openings both for doors and windows for effective performance. Protective screens could be used either outside or inside, depending on the convenience but the basic thing is that, it must be well laid to the wall leaving no space uncovered. Screens reduce the ventilation and day lighting and must be compensated for with the choice of window design.
Curtains provide privacy. It is used to regulate internal temperature also regulate ventilation. It also add to the aesthetical value of the interior space. Whenever good ventilation is needed it is advisable to design some internal openings without doors that is by introducing archways of dwarf wall.

Security bars are installed for security reasons. It protects properties from being cart away and protects the life of the occupant from being disturbed.

The type of windows used depends on requirements on the use of the internal space. Windows are use for regulating ventilation. Louvres help direct the flow of air, while casement windows eliminate rain penetration and draughts.

Rain protection is needed in all parts of the country, even in the dry areas like Savannah and Semi-desert Zones. This is because it is not only the annual rainfall but also the intensity of rainfall that matters.

The minimum roof slope in any part of Nigeria should be 10 degrees, preferably more in very wet zones. Flats roofs should be avoided since they will leak with time unless adequate waterproofing is done on it. There is a common belief that high ceilings improve comfort conditions, thereby ceiling height has been recommended between 2.5 to 3 m.

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CZ - coastal zone  
FZ - Forest Zone  
TZ – Transitional Zone  
HZ – highland Zone  
SZ – Savannah Zone  
DZ – semi-Desert Zone

Guidelines for design in the six (6) architectural zones in Nigeria. (source: Introduction to building climatology (1993) by Arc. Prof. Olu Ola Ogunsoye)
REFERENCES

