# IMPACT OF CLIMATE ON BUILDING MATERIAL

# IN

# ABUJA (MUNICIPAL)


**BY**

**ISMA'ILA MUSA**

***PGD/GEO/2000/2001/182***


**ENVIRONMENTAL MANAGEMENT**


**DEPARTMENT OF GROGRAPHY**

**FEDERAL UNIVERSITY OF TECHNOLOGY**

**MINNA**



MARCH, 2002

# IMPACT OF CLIMATE ON BUILDING MATERIAL

# IN

# ABUJA (MUNICIPAL)

**BY**

**ISMA'ILA MUSA**
*PGD/GEO/2000/2001/182*

BEING A DISSERTATION PROJECT

SUBMITTED TO THE DEPARTMENT OF GEOGRAPHY

SCHOOL OF SCIENCE AND SCIENCE EDUCATION

FEDERAL UNIVERSITY OF TECHNOLOGY

MINNA

*AS A PARTIAL FULFILMENT FOR THE AWARD OF POST GRADUATE*

*DIPLOMA (PGD) IN ENVIRONMENTAL MANAGEMENT*

# CERTIFICATION

I certify that this work was carried out by Isma'ila Musa with registration number PGD/GEO/2000/2001/182 of the Department of Geography, Federal University of Technology Minna and accepted for the award of a Post Graduate Diploma in Environmental Management.

---

STUDENTS NAME & SIGNATURE

---

DATE

---

Prof D. O. Adefolalu

PROJECT SUPERVISOR

---

23/03/02

DATE

---

Dr M. T. Usman

HEAD OF DEPARTMENT

---

23/03/02

DATE

---

EXTERNAL EXAMINER

---

DATE

---

Dr J. A. Abalaka

DEAN, PGS

---

DATE

# DEDICATION

This project is dedicated to my wife HALIMATU SADDIYYA ISMA'ILA and my daughter FATIMA BINTA ISMA'ILA.

# ACKNOWLEDGEMENT

Thanks are due to the Almighty Allah for the bounty bestowed on me on the successful completion of this course.

My unreserved gratitude goes to my supervisor Prof. D. O. Adefolalu for his constructive suggestion, criticism and makes available material in the course of this project.

M. T. Usman (PhD) my head of department, every other lecturer and personnel of the Department of Geography for their support.

I am indebted to my boss Alhaji A. D. Abdullahi, the Deputy Director Quantity Surveyor (FCDA-Abuja), for his encouragement and kind gesture and also other of my colleagues in the office.

My sincere gratitude goes to my wife for her patience and also Alhaji Muhammad S. Zuntu for all assistance he gave me.

Finally, my special thanks to friends, course mates and persons whom I come in contact with that contributed to my successful completion of this course.

# ABSTACT

This project examines the effect of climate on houses in Abuja (municipal), a hot humid region, in a bid to providing acceptable indoor climate Thermal comfort is a product of diversified factors, ranging from almost all the climatic conditions in hot humid regions. It tries to highlight on the need to practice green building and sustainable construction, through the use of appropriate building material and building climate zoning.

The research work comprises of five chapters; chapter one is the introduction, chapter two literature review, and chapter three is the methodology and is carried out through collection of data viz, response to questionnaire and recoinance survey within Garki, Wuse, Asokoro and Maitama in the city., while chapter four consist of data analysis and finally chapter five states the summary, conclusion and recommendation.

# TABLE OF CONTENTS

**CHAPTER THREE**



**CHAPTER FOUR**



**CHAPTER FIVE**

## LIST OF TABLE



## LIST OF PLATES

# CHAPTER ONE

## 1.0 INTRODUCTION

## 1.1 BACKGROUND REVIEW

The major function of buildings is to provide shelter and protection for elements, it is important to design them to provide a safe, healthy environment, taking into account the prevailing climatic conditions. The fact that climate is an important factor in the design and orientation of buildings cannot be overemphasized, this is because a building is primarily designed amongst its other functions, to protect man from the direct impact of weather elements like rainfalls, solar radiation and wind. Although it is not possible to attain a perfect indoor climate, but it is possible to improve on whatever is available through the use of structurally fitted building materials.

Abuja a model capital city booming with construction, building and infrastructure, activities and influx of so many people has now alter completely the climate of the environment, from a rural kind to one of urban. With urbanisation of the area the climate circulation of air is disrupted thereby causing temperature to rise. Therefore, it become so uncomfortable with the indoor microclimate and relieve has to be sought by using some means to attain a comfortable indoor microclimate.

As we know, houses constitute man's permanent residences, the evaluation of the effects of the climatic environment on residential houses is mainly the evaluation of the climatic effects on the people living in them.

Climatic elements such as temperature, humidity, rainfall and wind have controlling effect on the choice and or usage of building materials in modern societies.

For example, taking cognisance of expansion and contraction of material, which on the long run have effect such as creating cracks on wall, over or under sizing of doors and windows, leakage in roof, melting of electricity wires thereby causing fire outbreak are as a result of variance in temperature; also, (Green, 1982) says that 'there is some evidence that direct effect of high relative humidity is to reduce susceptibility to respiratory infection'. While, its indirect effect is to facilitate the growth of moulds, which may cause infection and allergic reactions. It is pertinent then that movement of air must be regulated.

Similarly with concentration of rain, water may become stagnate if there is no adequate provision for external drainage. Stagnated water if prolongs on the ground becomes contaminated and henceforth, varieties of tropical diseases carrying organisms breed such as mosquitoes transmitting malaria parasite, lurked snails bear schitomiasis that sometimes spend part of its life in human, others are bilharizia.

Also the correlation of wind direction, wind speed and precipitation one can usually restrict expensive additional protective measures to specific parts of the building also the issue of blown off roof is dealt with (example, Abuja municipal experience of 1990).

Thus because of these adduced climatic effects, a correlated picture of climate would promote economical building, human comfort and healthy environment too. the execution of these constructions not

minding reinstatement of the destruction made to natural habitation, the climate becomes

## 1.2 AIMS AND OBJECTIVE

The aim of this project is to examine the effect of climate on building materials as it relate to building elements in the provision of acceptable indoor climate. The objective is to highlight on some type of material that adapt with the climatic condition that can aid in the attainment of acceptable in door climate.

## 1.3 STATEMENT OF THE PROBLEM

Climatically Abuja belong to the tropics, the enveloping temperature can be so high up to $37^{0C}$ on a clear day that interception of solar radiation before making impact will have little consequence on the heat exchange and flow process. Achieving indoor microclimate is paramount. Therefore, correlation of climate in the orientation of buildings and the choice of suitable materials that adapt with climatic elements and promote indoor physiological comfort are necessary. In Abuja, most of these residential houses are design without due regard for the prevailing regional climate. Most houses have some kind of mechanical mechanisms use in attaining indoor microclimate. It is thus an additional budget to building cost and also running cost through electricity bills to less privileged.

## 1.4 SCOPE OF THE STUDY

This dissertation is a response to the growing number of residential buildings that are more to aesthetics than provision of natural

comfortable indoor climate other than using artificial solutions. Hence, the scope of this study shall cover such area of alternative building material for some of the building elements. Integrating them in construction will aid in achieving acceptable indoor climate and also reduce other climatic effect on building (such as undue wearing).

## 1.5 JUSTIFICATION OF STUDY

In justifying this study let us see what climate is. Climate can mean the 'average weather' and its longer-term variability over a particular period or over a month, season, year or several years. While the weather, means what we experience on a day-to-day basis. And man is affected by climate more than any other element of his physical environment; his health, energy and comfort are conditioned by the state of weather and climate.

Primarily in humid regions, the problem with the climate is mainly that of scorching sun, which makes even the surrounding air temperature very unbearable during the day. The need to achieve indoor comfort through the use of construction materials that adapt with the climate and also by means of shading the sun from direct impact on building is much to be desire.

## 1.6 THE STUDY AREA

**1.6.1 Location and size:** Decree No. 6 of 1976 created Abuja, the Federal Capital Territory (FCT). The territory is located between latitudes 8°25'and 9°25'north of the equator and longitudes 6°45'and 7°45'east of Greenwich. The territory covers an area of 8,000 square kilometres,

lying close to the centre of the country within the region referred to as "Middle Belt" and bordered on all sides by four states namely Niger, Nassarawa, Kogi and Kaduna. It start from the village called Izom on 7°E longitude and 9°15'latitude, project a straight line westwards to point just north of Lehu on river Kemai; then project a line along 6°47.5'E southwards passing close to the villages called Semasua, Zui and Bassa down to a place a little west of Ebagia in Kogi state, thence project a line along parallel 8°27.5'N latitude to Ahinza village 7°6'E; thence project a straight line to Bugu village on 8°30'N latitude and 7°20'E longitude; hence draw a line northwards joining the villages of Odu, Karshi and Karu. From Karu the line should proceed along the boundary between the North-West and Benue-Plateau States as far as Karu; thence the line should proceed along the boundary between North-Central and North-Western States up to a point just north of Bwari village; then the line goes straight to Zuba village and thence straight to Izom.

**1.6.2 Climate:** The FCT-Abuja records its highest temperatures during the dry season when there are few, or if any, cloud cover. The Maximum temperatures occur in the month of March with amounts varying from $37^{OC}$ in the south-west to about $30^{OC}$ in the north-east. During the raining season, the maximum temperature is lower due to the dense cloud cover. Diurnal annual range is also much lower, sometimes no more than 22 $^{OC}$ in July and August.

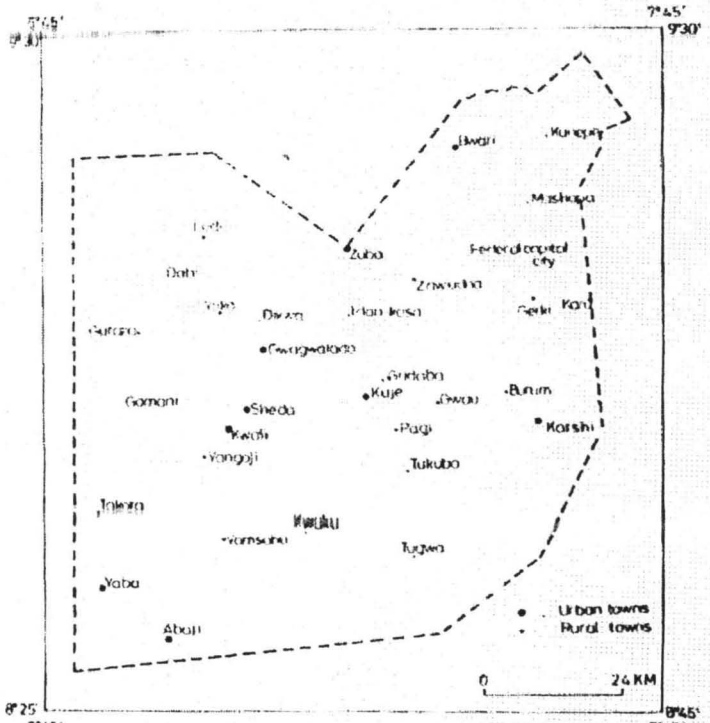


Fig. 1.1 The Federal Capital Territory

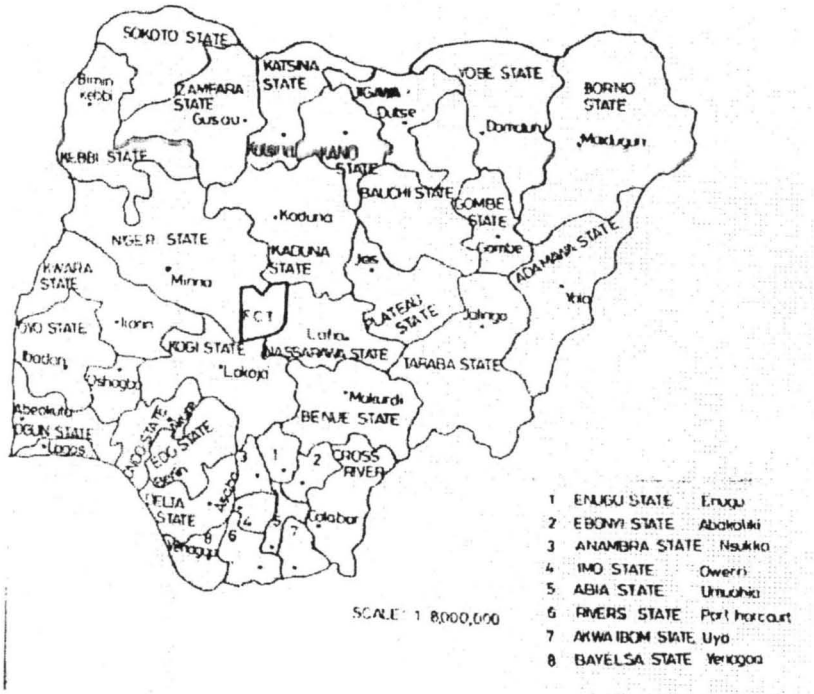


Fig. 1.2 The FCT national setting

During the dry season, relative humidity falls in the afternoon to as low as 20% in the city. This low relative humidity, coupled with high afternoon temperatures, account for the desiccating effects of the dry season. In the rainy season, the relative humidity is much higher, especially in the morning hours when it can reach as high as 95%. When this situation occurs, the general feeling is to be uncomfortably hot. For any given amount of moisture content in the air of a dwelling the lower the temperature, the higher will be the relative humidity.

The start of the rainy season in north-eastern FCT-Abuja is around the month of April. The mean monthly distribution shows a tendency for concentration in three or four months. In Abuja 60% of the annual rainfall is in the months July, August and September.

Two major air masses dominate the climate of the FCT-Abuja. These are the tropical maritime air mass and the tropical continental air mass. The former is formed over the Atlantic Ocean to the south of the country and is therefore warm and moist. It moves inland generally in a south-west to north-east direction and create wet season. While the latter, is developed over the Sahara Desert and therefore is warm and dry and blows in the opposite direction, northeast to southwest and is associated with the dry season. The oscillation between the air masses produces the highly seasonal characteristics of weather conditions in Abuja and the country at large.

**1.6.2 Population:** Over the years, the population density of the FCT has been increasing from less than 9 persons per km2 in 1952, through 16 persons per $km^2$ in 1977 to 47.3 persons per $km^2$ in 1991. Today, it is about 60 persons per $km^2$. Projected to the year 2000, the density is to be 67.4 persons per $km^2$. Municipal area council has the highest density in FCT. This positive growth of the population is largely die to natural increase and immigration of people from different parts of the country to the seat of Government, the FCT.

**1.6.3 Economy:** The economy of FCT is mainly agricultural and some small-scale pottery work. According to available official data over 80% of the population engaged in agriculture. This is expected in view of the territory's abundant arable land estimated at about 800,000 hectares, and rain is also generally adequate for crop production in most parts of the country. It produces the bulk of incomes for most rural families of the territory. The contribution of agriculture to the economic development of the territory has continued to be very significant despite the high rate of urbanisation and availability of other occupations.

# CHAPTER TWO

## 2.0 LITERATURE REVIEW

### 2.1 SUSTAINABILITY OF URBAN CLIMATE IN DEVELOPMENT

Since the Rio Earth Summit there has been a steady increase in awareness of the importance of environmental issues associated with almost all development. Sustainable development with respect to shelter is to ensure that everyone has safe, secure living environment that will promote health and well being upon which all human development will depend.

On the development of living environment, the selection of sites for the construction of houses is one of the most important factors that determine the effect of climate on a building. Others are design, orientation and materials used in construction of houses. This would mean that, with all these factors taken into due consideration, it is possible to minimise the adverse effect of building on microclimates and vice versa.

However, Abuja mostly experiences the characteristics of warm humid zone, which characterises the seasonal variation throughout the year with dominant effects of hot and rainy, with occurrence of dusty windstorm. Annual range of air temperature is 33 $^{OC}$ and 22 $^{OC}$, mean relative humidity is from 20 % to 95 %. Annual monthly average precipitation is 112.29 mm and may exceed up to 239 mm in one month during rainy season, solar radiation is very strong with painful glare, especially in hot weather.

Table 1. AVERAGE WEATHER CONDITION OF ABUJA (sources WMO @ yahoo.com)

| **Month** | **Monthly Average high** | **Monthly Average low** | **Monthly Precipitation** |
|---|---|---|---|
| January | $35^{OC}$ (94.5 $^{O}$F) | $20^{OC}$ (68.7 $^{O}$F) | 1 in |
| February | $37^{OC}$ (98.2 $^{O}$F) | $23^{OC}$ (73 $^{O}$F) | 2 in |
| March | $37^{OC}$ (98.8 $^{O}$F) | $25^{OC}$ (76.1 $^{O}$F) | 5 in |
| April | $36^{OC}$ (96.3 $^{O}$F) | $25^{OC}$ (76.6 $^{O}$F) | 2.4 in |
| May | $33^{OC}$ (91 $^{O}$F) | $24^{OC}$ (74.7 $^{O}$F) | 5.4 in |
| June | $31^{OC}$ (87.3 $^{O}$F) | $22^{OC}$ (72.1 $^{O}$F) | 6.9 in |
| July | $29^{OC}$ (84.4 $^{O}$F) | $22^{OC}$ (71.8 $^{O}$F) | 8.1 in |
| August | $29^{OC}$ (83.8 $^{O}$F) | $22^{OC}$ (71.2 $^{O}$F) | 8.8 in |
| September | $30^{OC}$ (86 $^{O}$F) | $22^{OC}$ (70.9 $^{O}$F) | 9.4 in |
| October | $32^{OC}$ (89.6 $^{O}$F) | $22^{OC}$ (70.7 $^{O}$F) | 3.9 in |
| November | $34^{OC}$ (93.9 $^{O}$F) | $19^{OC}$ (66.9 $^{O}$F) | 1 in |
| December | $35^{OC}$ (94.5 $^{O}$F) | $19^{OC}$ (66.7$^{O}$F) | 0 in |
| **Annual Average** | **$33^{OC}$ (91.5 $^{O}$F)** | **$22^{OC}$ (71.6 $^{O}$F)** | **4.49** |

The urban climate presents some of the most impressive examples of man-made modification. This include such as street canyons, parks and inner courts. Such conditions also affect the indoor climate. In search of comfortable indoor climate in building, we should consider the factors of seasonal effects like, solar radiation in the hot-dry season and precipitation and humidity in rainy season. Effect of

FIG 2.1 **Residential House in Wuse with trees as breakers to the building**

**and house without provision of breakers to building**

solar radiation and precipitation in respective seasons require special attention at the design stage and selection of proper building material and proper building setting for comfort. Even though, the physical nature of building elements, the wall, roof and openings (windows and doors) including their type of material components, are certainly responsible for the maintenance and regulation of the interior environment of a building.

**2.1.1 Solar radiation in hot-dry season:** The earth receives almost all its energy from the sun in the form of radiation, the intensity of radiation reaching the upper surface of the atmosphere is taken as the solar constant 1395 w/msq, but it may actually vary +/- 2% due to variations in the output of the sun itself and it varies +/- 3.5% due to changes in the earth surface distance (Koenigsberger et al, 1974). The total amount of heat absorbed is balance by a corresponding heat loss. The building receives heat from the sun directly in diffuse form. Wall and roofing elements are responsible for the major quantity of heat absorbed by the structures. The adverse effect of solar radiation on building materials and structure manifest in two ways: Firstly, the thermal exposure conditions of structural components become more severe. Secondly, the normal inner structure of the materials is disturbed, especially by the ultraviolet portion of the spectrum, which for example, prevents polythene, pvc, polystyrene and similar plastics from being integrated into building. Also, solar radiation accelerates quite a number of chemical processes, such as the oxidation of paints. High temperatures induce thermal stresses in structures, accompanied by deformations, which may spoil the air tightness or leak proof ness

of joints between wall panels. The situation is further worsened by the well-pronounced instability in temperature pattern.

**2.1.2 Precipitation and humidity in rainy season:** The amount and intensity of rainfall have a marked effect on design and construction practice. In areas lacking rainfall for a long time, the upper layer of the soil hardens and cracks considerably, which is often the cause of dust storms. While heavy rainfall increases the moisture content of soil and is often the cause of soil heaving or subsidence and unwanted deformation of foundations.

Considerable precipitation raises the ground water level so therefore, the water proofing of substructures has to meet more stringent requirement.

When evaporation occurs from earth surfaces, certain amount of water vapour is always present in the atmosphere. The water vapour content of the air characterizes its relative humidity, which has its resultant effect.

It is the indirect effect of humidity on health in building, which is of concern. 'Like moulds require damp conditions for growth and can be expected to appear on internal surfaces of external walls if the relative humidity exceeds 70% for a prolong period (Bravery, 1985)'. This figure, therefore, represents a possible maximum recommended relative humidity.

In general, experience suggest that if ventilation is adequate to control mould growth, then air indoor quality is not likely to lead to health problems from other air pollutants likely to be found in housing.

Adequate minimum ventilation seems to be of the order of 0.5 – 1.0 air changes per hour (Building Research Establishment, 1985).
High humidity notably accelerates corrosion of metals. Also not desirable is seasonal variations in relative humidity, which could lead to sudden changes in the moisture content of building materials and products accompanying with swelling, warping, and similar undesirable situations.

## 2.2 BUILDING MATERIALS

The use of building materials in hot areas is inevitably associated with certain unfavourable exposure conditions, which speed up the wear and cut down the service life of building and other structures.
The exposure conditions encountered due to solar radiation, high temperatures, high humidity, and some other factors such as attack by wind, dust, sand, mineral ground water, micro organisms and the like differ.
The wear caused by the incidence of solar radiation is generally attributed to thermal effects and chemical transformations triggered by sunlight. The latter have to do with changes in properties due to polymerisation and oxidation of organic materials, such as paints, bitumen, plastics and rubber. Varying thermal action may speed up the ageing of materials, physical factors has to be reckon with. Expansion due to heating in daytime and contraction in the night, which result in cracks and weakened connections between structural components. Example is a flat roof decking, spurred by daily temperature fluctuations, alternate expansion and contraction of its reinforced concrete members may run into 10 mm within a length of

18 m. Timber, which is an inherently water bearing material, loses moisture and, hence, over dries, warps and cracks.
Shrinkage of some soils, which may, after they have been allowed to dry for a long time, results in a differential settlement of foundations and thus causes a substantial damage to buildings and other structures. Accumulation of dust and sand particles on roofs and exterior walls reduces the durability, insulating properties and reflectance surfaces of building materials and structures. Highlight on some materials in building elements are:

**2.2.1 Cement:** These are substance, which bind together the particles of aggregates (usually sand and gravel) to form a mass of high compressive strength, i.e. concrete and block. The most commonly used type of cement is Portland cement, which may be of the ordinary variety or be rapid hardening. Cement is stored in dry places; when stored in humid condition the material tend to absorb moisture and carbon dioxide from air and hardens prematurely therefore, cement is usually cheaper in rainy seasons.

**2.2.2 Sand:** These are natural sand from riverbed and must be free from organic impurities. Therefore, sieving is important in removal of particles.

**2.2.3 Gravel:** This is primarily natural or crushed rock gravel of various sizes used in concrete. The type of aggregate used directly influences the thermal insulation qualities of the concrete.

**2.2.4 Block:** This is made from mixing of sand and cement; the ratio is dependent on purpose of the block. The blocks are manufacture in special hollow portable unit under static pressure of about 20 Mpa or by dynamic compaction. They harden under natural condition; therefore, suffer no thermal stresses usually associated with heat treatment.

Another kind is the clay brick, mostly Kiln-burnt or hand made. In hot weather, clay bricks should be brought to their optimum moisture content before laying. They should be soak in water for sometime or wetted. From thermal as well as environmental point of view (to save wood fuel) and to reduce the pressure on agricultural soil, hollow sandcrete block can be an alternative to burnt brick.

## 2.3 BUILDING ELEMENTS

**2.3.1 Walls:** The sun's rays must therefore, either be intercepted before they make impact on the wall or the wall must be of such material and texture as to afford reflection of sun's rays once these have made their impact on the surface. The walls must afford the necessary protection against direct heat penetration.

Varying solar radiation causes surfaces temperatures to fluctuate in time about a mean value. These fluctuations occur with a time lag whose extent depends on the physical constructional nature of the wall i.e. thickness and type of materials used. The interior surface temperature, therefore, doe not reach its maximum for a considerable time after the outside surfaces has reached its maximum. It is, therefore, possible that the cold stored in the wall mass at night can be release to the interior during the daytime when the ambient outside

temperature is very high. This calls for a proper use of materials and appropriate wall thickness to ensure that cold is stored in the mass of the construction at night (i.e. hollow sandcrete blocks or bricks).

**2.3.2 Roof:** The roof has the biggest exposure to the sun and remains unprotected most of the time. Its primary function is to seal the building against the weather and to maintain it over a considerable number of years. The durability of roof membrane is dependent on the exposure condition (i.e. amount of solar radiation, wind, ambient temperature, etc), temperature and moisture content and physio-chemical properties of the material used.

The roof should not absorb or retain any solar radiation and consequently should be lightweight and reflective. For highly absorptive roofs, the difference between the surface and ambient air temperatures may be as high as 50°C (90°F), while for less absorptive (high-albedo) roofs, such as white coatings, the difference is only about 10°C. Clearly, reflective roofs are recommended for hot climates due to the need to cool the buildings.

Roof emissivity can have a substantial effect on both heating and cooling energy use. In cold climates, a low-emissivity roof can add resistance to the passage of heat flow out of the building and result in savings in heating energy use. In cooling dominant climates, a low-emissivity roof will lead to a higher roof temperature and, hence, a higher cooling loads from the roof. In hot climates, changing the roof emissivity from 0.9 (emissivity of most nonmetallic surfaces) to 0.25 (emissivity of fresh and shiny metallic surfaces) can result in an increase in annual utility bills for cooling.

Aluminium alloy offer good resistance to climate, while asbestos cement material is a poor choice for exposed building in hot climatic regions: it frequently cracks in cyclic heating and cooling; the continuing hydration of the cement promotes cracking; mildew growing on dirty surfaces softens the material; structural elements are highly sensitive to sudden impact stresses.

In the case of flat concrete roof finish with bituminous felt, at times of intense sun energy at noon the solid bitumen melts. Rapid cooling in the night causes quick contraction and subsequently cracks. It is thus observed that concrete roof because of its heat resistance and flexibility is a better choice in roof covering if the economics is put aside. The application of double roof with a sandwich of air in between was considered to be more effective if the airflow could be maintained in the space in between.

**2.3.3 Openings (windows and doors):** Openings in an external wall provide the greatest access for solar heat. This disadvantage is, however, outweighed by the function of openings as windows to allow light and air into the room.

This can however be remedied by passive means of thermal control. Passive thermal design, orientation, shading devices, use of internal blinds, position, size and control of openings, is a technique by which building components can take the advantages of allowing only the acceptable climatic forces and repelling others. In this case, provision of external shading device is to prevent direct impact from heat radiation. The example of the advantages and liabilities of a window

is a good demonstration of the multiple functions of building elements.

**2.3.4 Finishes:** Its main function is to decorate exposed rough surfaces. Though it is noticed that some material provide for improve comfort in the interior. The U-value of some finishing materials should be given consideration in the choice of type of finishes as it could be the last element in stabilizing indoor climate.

There are various kind of ceiling material viz; ordinary asbestos cement board, particleboard, concrete decking and Plaster Of Paris (POP). Amongst these, concrete decking and POP provide more comfortable environment than others due to their good resistance to climatic factors.

With floor finishes, cement and sand screed is most popular in this category. However, other kind of material like monolithic terrazzo, ceramic tiles, granite and marble are available. Marble offers a reasonable degree of comfortability in attainment of indoor microclimate. This is thus achieved through repellence of heat radiation with its glazed surface in an adequately ventilated environment.

## 2.4 ESTABLISHING BUILDING CLIMATIC ZONE

Climate has effect upon almost all building design problems. The pattern of interaction between climate and building is intricate and complex. Buildings and their components, being surrounded by the earth atmosphere, are constantly acted upon by climates and their elements. To consider these climatic effects, the building

professionals require climatic data appropriate for both active and passive design that is tailored to their different and separate professional needs.

To take full advantage of local climatic potentials and provide architectural solutions to the problem of building and urban planning in accordance with climates of the regions, establishment of building-climate zones is essential in Nigeria.

Building-climatic zoning should be a form of applied climatic zoning. Unlike the natural climatic zoning, applied climatic zoning should assumes the function of expressing in general the laws of division of climates in the territory as a whole and its significance to practical ends in specific terms. It is thus, important that specific effects of the climate on construction and urban planning be known.

In some developed countries a variety of climatic zoning methods have been developed. However, they may be classified in two categories viz:

- The geo-climatic method characterised mainly by the selection and formation of the systems of climatic differentiation levels and climatic zoning criteria
- The math-climatic method characterised by the selection and concurrent analyses of a large scale matrix of climatic characteristics on the network of stations

The former is a popular method used not only in natural climatic zoning but in applied climatic zoning as well. While the latter, mainly the analysis of multivariate statistics has vigorously developed over recent decades in natural climatic zoning.

# CHAPTER THREE

## 3.0 METHODOLOGY

This project work is based on data collected from various sources viz: primary and secondary sources. The direct, observation made on various houses, in term of achieving comfort with regards to type of material used in the construction of houses, and interview which was conducted amongst residents/tenants, construction professionals, environmental practitioners.

## 3.1 QUESTIONNAIRES

Questionnaires were distributed to 100 resident within the city centre, using cluster system and simple random techniques. Responses for the questionnaires issued for the study were obtained and analysis made. Though not without hitches at first, the unpopular nature of the topic bring about reluctance in the way and manner they accept the questionnaire.

| DISTRICT/LOCATION | QUESTIONNAIRES SHARED |
|---|---|
| Garki | 30 Numbers |
| Wuse | 30 Numbers |
| Asokoro | 20 Numbers |
| Maitama | 20 Numbers |

## 3.2 RECOINNANCE SURVEY

The recoinnance survey which is secondary data collection and were library researches from magazines, journals, commissioned reports, seminar papers and textbooks on matters relating to this project.

# CHAPTER FOUR

## 4.0 DATA ANALYSIS

**From that questions issued to tenants of houses within Garki, Wuse, Asokoro and Maitama**

| | | |
|---|---|---|
| Total Number of circulated questionnaire | - | 100 |
| Total Number of respondent | - | 100 |
| Number of those living in the area | - | 100 |
| Number of those that notice the effect of climatic conditions in achieving indoor comfort | - | 60 |
| Number of those that did not notice the effect | - | 40 |
| Number of those that are optimistic on the type of Material used | - | 35 |
| Number of those that are pessimistic | - | 25 |
| Number of those that agree with orientation of building affect indoor comfort | - | 45 |
| Number of those that do not agree | - | 15 |
| Number of those buildings with spacing between neighbours twice its height | - | 40 |
| Number of those buildings with spacing between neighbours less than twice its height | - | 60 |
| Number of those that have garden and protect building from direct impact of solar rays | - | 35 |
| Number of those that do not have | - | 65 |
| Number of those houses that are adequately ventilated | - | 70 |
| Number of those houses that are not | - | 30 |

Number of those using mechanical appliances in regulating indoor microclimate - 100

Using percentage count in data analysis:

Hence: **Question 2**

| Value label | Frequency | Percentage | Value Percentage |
|---|---|---|---|
| Those that notice | 60 | 60 | 60 |
| Those that did not notice | 40 | 40 | 40 |
| Total | | | 100 |

Source: Personal field survey, 2002

60 percent of respondent from the table above answered Yes to notice on effect of climatic conditions, while 40 percent says No.

**Question 5**

| Value label | Frequency | Percentage | Value Percentage |
|---|---|---|---|
| Those that have spacing twice its height | 40 | 40 | 40 |
| Those that are less than | 60 | 60 | 60 |
| Total | | | 100 |

Source: Personal field survey, 2002

40 percent of respondent from the table above answered Yes to building spacing between neighbours twice its height, while 60 percent says No.

## Question 6

| Value label | Frequency | Percentage | Value Percentage |
|---|---|---|---|
| Those that have garden | 35 | 35 | 35 |
| Those that do not notice | 65 | 65 | 65 |
| Total | | | 100 |

Source: Personal field survey, 2002

35 percent of respondent from the table above answered Yes to garden for protection against direct impact of sunrays, while 65percent says No.

**Question 7**

| Value label | Frequency | Percentage | Value Percentage |
|---|---|---|---|
| Houses that are adequately ventilated | 70 | 70 | 70 |
| Those that are not | 30 | 30 | 30 |
| Total | | | 100 |

Source: Personal field survey, 2002

70 percent of respondent from the table above answered Yes to adequate ventilation of houses, while 30 percent says No.

**Question 8**

| Value label | Frequency | Percentage | Value Percentage |
|---|---|---|---|
| Those that use mechanical means | 100 | 100 | 100 |
| Those that do not | - | - | - |
| Total | | | 100 |

Source: Personal field survey, 2002

100 percent of respondent from the table above answered Yes to use mechanical means of regulating indoor microclimate, while 0 percent says No.

It is thus viewed that majority of the respondent (occupants) took no notice of the effect of weather on building probably due the fact they are using one means of mechanical mechanism or the other. This is not unlikely that only very few are optimistic on whether choice of building materials contribute to uncomfortable nature of indoors microclimate especially during hot season.

The practice of green building and building regulations are mostly been not adhere with.

# CHAPTER FIVE

## 5.1 SUMMARY

The focus of this research is to acknowledge the interaction between atmosphere and man modified surfaces with a view of achieving comfortable indoor microclimate in Abuja (Municipal). In the survey conducted, the result have shown that majority of the respondents are sensitive to the plight of man modified environment and they do care to notice that spacing regulation of setting out of the buildings are not adherently been abide by and provision of garden within the compound for protection from direct sunrays is not there. Also even though most houses are well ventilated they still make use of mechanical means in achieving some cooling in the houses.

## 5.2 CONCLUSION

Buildings represent more than half the Nation's wealth. The design, construction and maintenance of buildings have a tremendous impact on people and nature. Green building should become a popular movement among architects and other related professionals as well as owners who control the funding.

Knowledge of the interaction between atmosphere and man modified surfaces, however, will only be of value to urban planner and their cohorts if the bioclimatological significance of the changed climatic conditions were documented. Were as even the occupants are not concern on the nature of the environment.

## 5.3 RECOMMENDATIONS

In the field of urban planning the meteorological conditions in the near-ground living space of the human being i.e. the urban canopy layer are, are of special interest.

Some developed and developing countries, like Vietnam, are practising climate zoning; Nigeria too should not be left out in the use of this method. Construction professionals and environmentalist should work hand in hand in establishing these.

Government being the major employer of labour must incorporate the green building mechanism into its programmes. Whilst this is done, she should be strictly enforced all sanctions, fines, penalty for adherence with environmental guidelines and building regulations.

Construction professional bodies like the Nigeria Institute of Quantity Surveyors, Nigerian Institute of Architects, Nigerian Institute of Builders, Nigerian Institute of Town Planners, Nigerian Institute of Estate Surveyors Nigeria Society of Engineers and the Institute of Environmental Management efforts and programmes be geared toward increase awareness on the to develop Green development in our construction activities.

Finally, we are aware of the fact that sustainable building must meet current building needs and reduces impacts on future generations by integrating building materials and methods that promote environmental quality, economic vitality, and social benefit through the design, construction and operation of our built environment.

# BIBLOGRAPHY


1. Central Libra, What is sustainable building? http://www.cityofseattle.net/sustainablebuilding/benefits.htm
2. Federal Capital Development Authority, The Master Plan for Abuja; International Planning Associates (IPA) 1979, Pp 52-53
3. Hashem Akbari, Ph.D., Steven J. Konopacki; The Impact of Reflectivity and Emissivity of Roofs on Building Cooling and Heating Energy Use. http://www.ashrae.org
4. Ivor H. Seeley, Building Technology; Macmillan Pp25, 41-45, 98-119
5. Mark P. Ternes, Michael K. Barcik, Dennis B. Creech; Achieving Sustainable Construction in Affordable Housing. http://www.ashrae.org
6. P. D. Dawam, Geography of Federal Capital Territory; Asanlu publishers Pp1-3, 9-21, 70-99, 107-127
7. R. Yinka Adebayo, Climate and Human settlement; UNEP Pp 46-50
8. T. M. Stoll, G. I. Evstratov; Building in hot climate; Pp 9-17; 27-29; 338-347
9. World Meteorological Organisation (1994), Report of the technical conference on Tropical Urban Climates; Dhaka, Bangladesh. Pp 163-171; 391-393; 395-404
10. World Meteorological Organisation (WMO) @ yahoo.com
11. World Meteorological Organisation (WMO) 1999 No 892, Weather, Climate and Health; Pp7-10
12. World Meteorological Organisation; Climate and human Health (1987) Pp 165-171, 185

# APPENDIX I

## QUESTIONNAIRE FOR THE ASSESSMENT OF IMPACT OF CLIMATE IN ACHIEVING INDOORS COMFORT

*ISSUED TO PEOPLE LIVING IN THE CITY CENTRE (GARKI, WUSE, ASOKORO AND MAITAMA)*

NAME: ----------

AGE: ---------- SEX: ----------

OCCUPATION: ----------

ADDRESS: ----------

---

(PLEASE TICK IN THE APPROPRIATE BOX)

1. Do you live within the above-mentioned areas?

   Yes ☐ /No ☐

2. Did you notice the effect of climatic conditions in achieving indoor comfort in the house?

   Yes ☐ /No ☐

3. If yes, are you optimistic towards the type of material being used?

   Yes ☐ /No ☐

4. Do the orientation of your building affect indoor comfort?

   Yes ☐ /No ☐

5. Is the spacing between your building and the neighbours twice its height?

Yes ☐ /No ☐

6. Are there garden in your compound with trees and shrubs grown to shade the building from direct impact of solar rays?

Yes ☐ /No ☐

7. Is your house adequately ventilated?

Yes ☐ /No ☐

8. Are you using any mechanical appliances in regulating the indoor microclimate?

Yes ☐ /No ☐