BUILDING DESIGN AND CLIMATE IN KPAKUNGU

BY

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DECLARATION

I hereby declare that this project titled "Building Design and Climate in Kpakungu" is an authentic work done by me and has not been presented else where for the award of any Degree/Diploma programme.

....

Student Signature

CERTIFICATION

I hereby certify that this work has been supervised, read and approved as meeting part of the requirement for the award of Post Graduate Diploma in Environmental Management of The Federal university of Technology, Minna, Nigeria.

.....	.....	.....
Dr P.S Akinyeye **Project Supervisor**	**signature**	**Date**
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.....	.....	.....
Dean, Post Graduate school	**signature**	**Date**
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External Examiner	**signature**	**Date**

DEDICATION

Life is a journey through time and at some point of the journey, self assessment becomes inevitable to ascertain the level of success or otherwise.

Mistake could be made along the way but keeping hope alive coupled with faith in ALLAH (SWT) is a vital weapon in other to forge ahead.

For me, I thank ALLAH (SWT) at this point of my journey and this work is therefore dedicated to HIM;

To the cherished memory of my dear late friend ***Zainab Iyabode Ibrahim***, she went too soon, may her gentle soul rest in perfect peace (amen) and: To all those who have impacted positively in my life.

ACKNOWLEDGEMENT

Surely Allah is the kingdom of the heaven and earth: He brings life and causes to die; and there is not for you beside ALLAH any guardian or helper" Quran 9:116

"But if they turn back, say: ALLAH is sufficient for me, there is no god but HE" on Him do I rely, and HE is the Lord of mighty power". Quran 9:129.

All praises due to Allah who has been and will continue to guide me. Alihamidulilahi.

To my project supervisor Dr. Shola .P. Akinyeye, I unleash a note of gratitude for rousing my creative spirit, for the many suggestions, ideas and corrections that enriched this wok.

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My heart goes to ***Misturat Oluwadamilola*** – my friend, my love, my pride, my everything. Thanks for believing in me, for your concern, your endurance and the cherished moments. You have been a wonderful friend all through these warped sessions and I know the cold, lonely night will be over soon. I love you, I have always and I always will.

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Infinite appreciation goes to my very supportive and dynamic friends: Funmi, Segun, Ellams, Andy, Ayo, Dr Lekan and the entire staff of *Regular Communications, Minna*, Haji Walas, Kazeem, Gabriel, Kenny, Mahmoud, Mr. K. German, BB Kanniz, Mogaji, Ahmed and the entire staff of *AO&A computers, Bida,* my sister Adekunbi, my brothers Mr. T, KC2, Arc Bamiji and Kunle Adebisi and others too, numerous to mention. I appreciate the good and rough time we shared. This is not the end of the road. There is a place for you and me at the top. So let us meet there.

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Finally to Bida and Minna, the capital of the power state (Niger): I give my gratitude, I had some of the best times and made some of the best decisions in my life here, I am off to the next phase but I will return to drop my laurels at your feet. Stay peaceful.

And finally to ALLAH, I give all my soul for being there and for being ever faithful. I will forever serve you. Thanks so much.

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ABSTRACT

Climatic considerations in relation to building design and general layout of estates have often been neglected and this we have often paid dearly for in terms of climate related disasters such as flood, erosion, collapse of buildings, diseases e.t.c.

This study centered on the assessment of the design of buildings in; and the general layout of Kpakungu, Minna Local Government Area of Niger State, relative to its climate.

Data were obtained for analysis by interviewing of the inhabitants, physical measurement and observation of vital parameters of study such as design of buildings, materials of construction, constructional methods, and climate variables e.t.c.

Questionnaires containing questions of relevance were distributed and response collated and analysed using statistical methods such as percentages, means etc; pictures (on the spot) were also taken and analysed.

Major findings from the study shows that the design of the buildings in the study area, the constructional methods employed and the building materials used mostly are not in conformity with the climate of the area. The entire layout of the area is absolutely not good.

climate related disasters such as flood, erosion, rainstorm and diseases of various types such as malaria, typhoid, meningitis, measles and others are prevalent in the area, few lives have been lost and there is a prediction of many more to come.

It was recommended among others that the occurrence of such slums should be discouraged and for the existing ones (the study area inclusive) corrective planning such as urban renewal should be carried out; it may be expensive though, but as long term advantages for sustainable environment. Protective measures such as construction of drainages etc should also be put in place.

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background

According to Choulnury (1994) natural disasters have been causing the loss of millions of life lives and resulting in colossal damage to the economy from the time immemorial.

However, over of the last few decades, those natural disasters have turned more devastating because of exposure of large number of people in denser settlements resulting from urban migration and population growth. The damage therefore tends to be more extensive if proper mitigating measures are not taken.

Hassan (1994) observes that the climate has effect upon almost all buildings design. The pattern of interaction between climates and building is intricate and complex. Building and there component being surrounded by earth's atmosphere are constantly acted upon by climate and there elements. On the other hand, there presence also exerts influences in the surrounding climate.

Thus in designing and constructing buildings in urban areas, climatic factors have significant role to play in the life span and conditions of the building structure.

Research carried out by the United Nations Commissioner for habitat and settlements (HABITAT) clearly demonstrated that the planet capacity to

support peoples well being is undermined by among other things, poor land management.

As to achieve the goal of sustainable development with respect to shelter is to ensure that everyone has safe secure living environment which will promote health and well being upon which all human development will depend.

Application of weather and climatological information will continue to be of importance in the tropics regarding house building and its weather related impact on settlement (Adebisi 2002).

Economic studies of application climatological and weather information in land use planning buildings and health should be focused on for sustainability.

According to Adebayo (1991) studies in urban climatology have revealed many facts and methods which could help towards the attainment of climate – sensitive design. In his words mis-use and non uses of climatological ideas for building design and urban planning have been caused mainly by: (1) Poor training; (2) Inadequate public education;
(3) Economic consideration; (4) Cultural impediments and (5) Rapid growth of settlements.

However, since climate probably affect man as individual more than any other element of his physical environment, his energy; his health and comfort are all conditioned by the state of weather and climate

Therefore the impact of climatic variable in relation to human comfort is very important in building design and layout; and shall be discussed; this of course shall be on existing housing structure designs and general layout of Kpakungu, Minna Local Government Area of Niger State, Nigeria.

1.2 Statement of the problem

Throughout history, natural disasters such as flood, drought, windstorm, thunderstorm, earthquake, erosion e.t.c have caused heavy losses to human lives and property (Choudnury, 1994).

With the rapid development of science and technology, increasing attention is been directed towards a better understanding of various types of disaster and more importantly coordinated measures for their mitigation are being adopted in many countries of the world (Nigeria inclusive)

In the word of Odongo 1979 in Aderamo 2000, the two conventional indications of housing shortages are overcrowding and slum conditions. Over crowding is a demographic phenomenon which occurs in slums as well as in conventional housing, overcrowding is believed to be a determinant of two major problems namely a health hazard and in particular encourages the spread of infections diseases such as typhoid and tuberculosis.

According to Margin 1967 (in Aderamo 2000), three major types of problems posed by the slum housing system are environmental health hazards whereby such an environment usually provides an appropriate breeding ground for a variety of infectious diseases such as cholera and tuberculosis. Secondly, is the generation of deviant behaviour where slum

housing has been viewed traditionally as generation of a host of criminality, prostitution and juvenile delinquency. Thirdly, slum housing has been viewed as a breeding ground of political radicalism and violence.

According to Choudnury (1994) fourteen percent (14%) of the world population lived in urban centers at the beginning of the 20th century, now it is almost forty – five percent (45%)

The interdependence of urban resident and increase importance of physical infrastructure means that should a major settlement be struck by any of disaster, the daily life of its residents would also be severely crippled.

Kpakungu, the study of area satisfies both conditions of slum and overcrowding and taking into consideration the problem posed by these two conditions as explained earlier, it therefore became a subject of study.

Kpakungu, the study area came into existence as a result of the urbanization drive mentioned earlier. Buildings of various types were put up in all sorts of manner using varied constructional methods and materials arranged informally without taking cognisance of the land form and climate, the end result been that of an entirely unplanned environment and indecent housing which is highly susceptible to climate related hazard and which can of course assume on endemic dimension.

1.3 Aim and objectives

This project aim at studying the design of buildings and the general layout of Kpakungu slum in the Minna Local Government Area of Niger State relative to the climate of the area;

The objectives include;

(a) Determining the suitability of the design of buildings in the area to the climate.

(b) Predict the occurrence and intensity of probable climate related disasters.

(c) Suggest corrective, preventive and mitigative measures that can be adopted to solve the slum and associated problems

1.4 Justification of the study

With the economy in decline, more people from rural areas are moving to the urban areas in search of job opportunities, this has led to over population of the urban areas. Since accommodation in the urban areas is limited, increasing number of people now reside in urban slums (Makanjuola, 2000). Living in a slum could pre-dispose to diarrhea (due to scarcity of potable water), tuberculosis (due to over crowding) malnutrition (due to poverty) etc.

A high rate of population growth also means a rapidly increasing rate of generation of refuse, where this is not matched by a rapid and efficient disposal system, problem of waste disposal, air and water pollution are bound to surface.

According to Ijaiya 2000, poor drainage forces sewage or waste water discharge to flow through holes in household walls into the ground outside and gives rise to stagnant pools for mosquitoes and moist soils on which hookworm ova readily develop.

Malaria is the single most widespread disease with 92,046 reported cases. Other related diseases given these bad of the environment are tuberculosis, typhoid and cholera. The consequence being a worsened health situation (World Bank 1994 in Ijaiya 2000).

As a result of the ever increasing population, the government is finding it difficult to meet up with the health needs of the people - provision of adequate and well stocked health centers and personnel's because of the dwindling economy culminating in lean financial resources at her disposal, coupled with other sectors requiring attention.

Hence, the need to look at ways of improving the living condition of the people, one of which is the provision of decent housing and environment, thus improving the health of the populace and reduced budget.

1.5 Scope and Limitations

This study is limited to Kpakungu, Minna local government area of Niger state, Nigeria. Design of buildings and the general layout of the area in relation to its climate is the main thrust of the study.

The limitation encountered was that of the unwillingness of the respondents to provide answers to the questions posed to them, this according to them was due to the fact that past studies about the area have not impacted positively on them.

CHAPTER TWO

2.0 BACKGROUND INFORMATION ABOUT THE STUDY AREA

2.1 LOCATION

Kpakungun is a settlement in Minna local Government Area of Niger State, Nigeria. The Local government itself is located in Minna.

Minna, a metropolitan town is the capital city of Niger state (the biggest state in Nigeria in terms of vast undeveloped land) and one of the thirty six states in the country. Minna metropolis falls within longitude 06° 28′, East and latitude 19° 41′, North of the Equator (see the attached Map).

Minna Local government is bounded to the North and North West by Shiroro Local Government area; to The South East by Paikoro local government area {see attached map} this then make it nearly equidistance from the extreme corners of the state and local government area because of the state capital - Minna

2.2 Population

The area is made up of many ethnic groups with different languages spoken. These includes Nupe , Hausa, Fulani, Ibo, Yoruba etc, the bulk of whom are low and middle income earners. The area has a population of 147,281 according to population census of 1991.

2.3 Socio- Economic Background

2.3.1 Land use pattern

Land by its nature is fixed, durable and immovable. It's also irreproducible. Land use data is one of the most important information

required in physical planning. It indicates the uses to which the developed area is put and intensity of development of the land in terms of activities and linkages.

In the study area, residential land use is the greatest and largest. There is some degree of public and semipublic land use and recreational land use. Circulation, the backbone of all activities is also an important land use recognized in the area.

Finally, agricultural land uses are of the peripheral and hinterland is recongnised. The predominant occupation of the people in the area is agriculture practiced particularly in the country side while trading and other activities also thrive in settlement centre.

The climate of the area coupled with nutrient and fertile soil influenced growing of both cash and food crop such as yam, rice, cassava, guinea corn, ground nut, maize etc.

The dry season after harvest, people engaged in cloth weaving, dying of cloths, pottery, blacksmith, fishing and leather works. notwithstanding, a considerable percentage of the people still engage in government service and self employment.

2.3.2 Physiography

Climate

The climate of the area is a semblance of tropic region of the world; the major wind direction is normally along South West and North East axis. The raining season lasts between 170-200 days (5-7 months); that is between

April and October with an annual means precipitate of about 1350mm (54 inches) with September recording the highest rain of 300mm (11.7 inches) Mean monthly temperature is highest in March at 35°C (85°F) and lowest in August at 25°C (75°F).

Also, there is Sahara air with very little or no rainfall between November and April. During harmattan, dry desert wind blows between November and Mid-February while night temperature is very low.

Relief and Drainage

The study area is characterized by rolling land forms with many prominent hills punctuating the entire area. Apart from the hills and low ridges, much of the land is fairly flat and rise over ten meters above the sea level.

Meanwhile the relief of the area usually dictates the type of drainage that can be found in the town. This land form is a great advantage for good drainage of the area because the land enables one to know the direction of flow which is the basic yardstick of drains.

Source of Information; Minna local government, information centre, Niger State.

MAP OF NIGERIA SHOWING NIGER STATE

Fig. 1

KEY

- INT. BOUNDARY
- STATE BOUNDARY
- NIGER STATE
- RIVER

ORIENTATION: N

SOURCE: AKINYELE LOCAL GOVERNMENT - IBADAN

SCALE: 20 0 20 40 60m

1 : 9,000 000

DATE: SEPTEMBER 1999

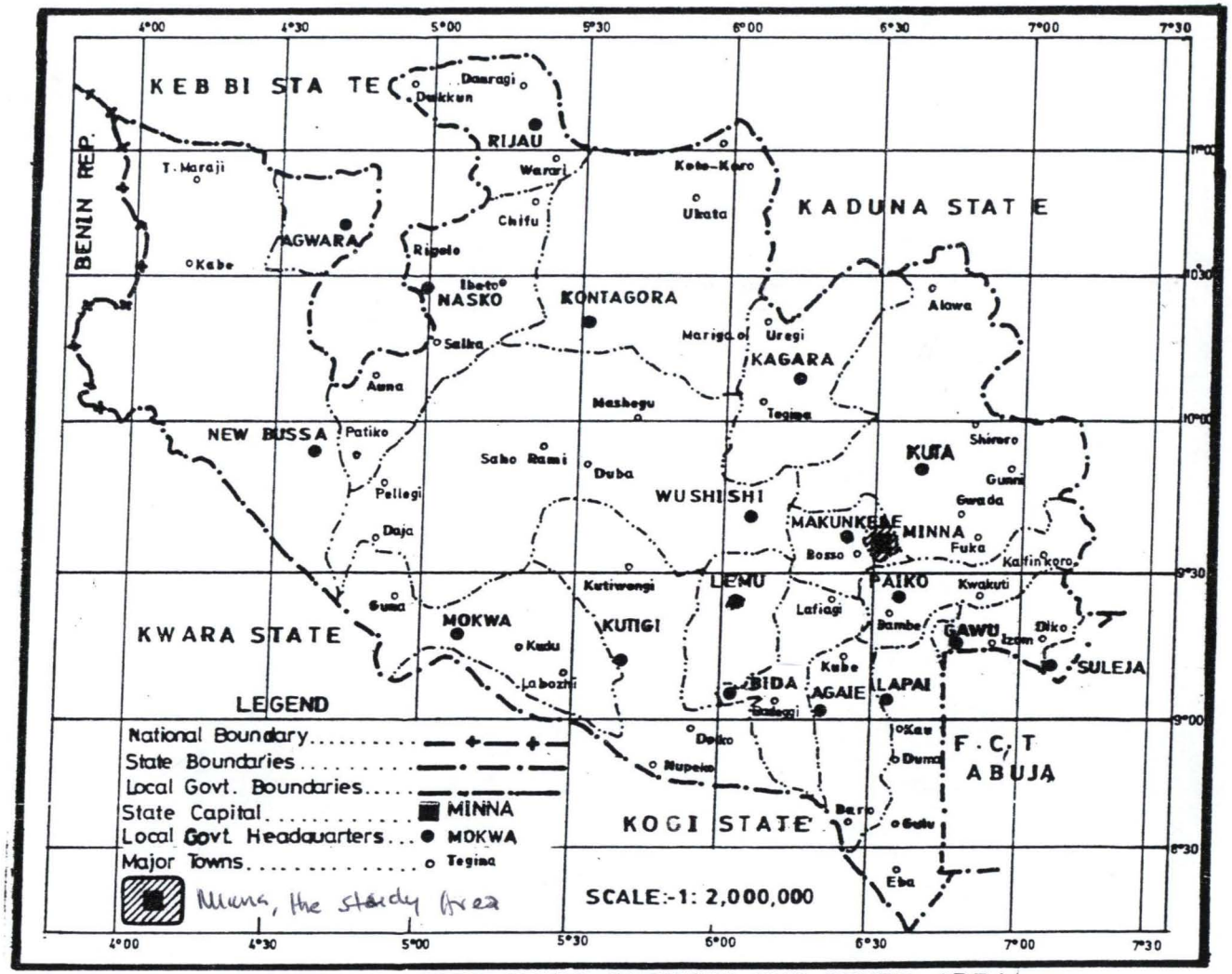


Fig.1 : MAP OF NIGER STATE SHOWING THE STUDY AREA

CHAPTER THREE

3.0 LITERATURE REVIEW

3.1 Building Design

Manning and Hassan 1982 (in Hassan 1994) described building design as a group or series of activities by which an original sense of need for a facility or resource or service is identified, refined, given shape and substance, made feasible and transmitted, generally in drawn, written and spoken media to those builders, contractors, manufacturers, suppliers, craftsmen and others who will contrive it".

Decision making activities for building design may be divided into a number of areas, each area being the domination of one or more building design professionals.

One proposal of this kind according to Manning 1982 (in Hassan 1994) is as follows; internal and external environment design, space planning, construction design, design implication of construction management, building services design, building economics and design management.

In varying degrees, climate affects all these aspects of building design, so there is a need for climate to be considered in all the above decision making areas (Hassan 1994 in Adebisi 2002)

Adebayo (1991) identified the fact that it is pertinent to pay attention to the role building plays in the modification of the climate of an area. He further stressed that man has found it difficult to survive under the direct

impact of climate element like rainfall, wind and sunshine; As a result of this, emphasis has been placed on indoor microclimate comfort for quite a long time.

Ogunsote (1991) asserts that the technique adopted for a particular building design is dependent upon the analysis of many site variables. The analysis includes;

- Infrastructural site analysis which covers existing buildings; roads, path and all services including electricity, surcharge, water telephone etc.
- Ecological site analysis which deals with dominant plant and animal communities, mapping of ground cover and trees to be re-refined.
- Cultural site analysis that involves the studies of the resident population includes; group and individual identification with importance attached to symbolic expression, hope, fear, wishes and preference,
- Aesthetic site analysis which is a study of the character of the site, vistas, view point, smell, rhythm of visual sequences
- Acoustic site analysis which maps out the sources of noise and means of prevention
-The climate site analysis which deals with the site climate; which is determined by climatic variables and should provide design guide line for layout, orientation, spaces between buildings, shade and height of buildings as well as house form.

Adebayo (1991) is of the opinion that the climate as an important factor in the design and orientation of buildings can not be over emphasized, this is

because a building is primarily designed, amongst its other functions, to protect man from direct impact of weather element, like rainfall, solar radiation and wind.

According to Ogunsote 1991 (in Adebisi 2002), building design is a complex processes but several attempts have been made to create a model of it. This model usually define the process as involving sequential stages using three concept namely; Analysis, synthesis, and simulation. This process is in principle a cyclic one.

3.2 Climate

Climate had in the past been variously defined, Adeyemo (2000) defines climate as average weather, and weather is the instantaneous atmospheric condition over a particular place.

Since it is an average weather condition, climate is an abstract phenomenon. It is a 'statistic' of weather events of some time past. This statistic are calculated for a period long enough to establish the statistical properties of the weather namely means, variance, standard deviation and probability o f extreme events among others.

Climate is perhaps the most important factor of the physical environment that influences man's activities in various ways (Raheem 2000). For example by such simple expedient as wearing clothes, living in houses, using fire and artificial lighting or practicing irrigation, drainage land for agricultural purposes.

However extreme climatic events are difficult to reverse. For instance, there is little man can do to combat artic cold, assuage torrential rainfall or dusty winds of the Sahara desert.

By implication, therefore, soils, plant growth, animal husbandry, house types, outdoor activities are tied inextricably to the climatic element of rainfall, temperature, sunshine, humidity e.t.c.

Climatic factors of consideration in building design includes: wind speed and direction, rain and flood water consideration, flood and logged water passing (Choudnury and Haque, 1994).

Choudnury and Haque 1994, from their study of buildings in Bangladesh arrived at the following;

Buildings constructed in urban areas and coastal shelters should be constructed in such a way that they can withstand high wind speeds. The wind passage should also be considered so that winds have easy passage.

They also concluded that water logging by torrential rain flood weakens the wall of buildings, and structure and let them crumble down to the ground.

Buildings and structures should have strong foundations to stand against muddy loose earth. The buildings should have their roofs sloped down in such a way that the rain water passes down quickly and easily.

They further related that flash flood and torrential rain sometimes causes water logging in urban areas. Poor drainage system according to them is another cause for water logging in urban areas.

Climatic factors which influences building design includes: ambient temperature, solar radiation and insolation; precipitation and air humidity: and wind and dust loading (Stall and Evstrastov 1987).

Ambient temperature is the temperature condition of a given locality and is decisive in choosing the type of load bearing and filler structure for a building.

Above all, this refers to the thermal conductivity and thermal stability of the structural components, because how much the ambient temperature will affect the micro climate of the interior largely depends on the massiveness of filler structure which may be expressed in terms of their thermal lag D.

Stoll and Evstrastov (1987) expressed the thermal lag D of a multilayered structure as $D = S_1\delta_1\lambda_1 + S_2\delta_2\lambda_2 + \ldots\ldots\ldots\ldots + S_n\delta_n\lambda_n$. Where $S_1, S_2 \ldots\ldots\ldots S_n$ is the thermal transmittance of the material forming each layer of the filler structure ($Wm^{-2}\ ^oC^{-1}$); $\delta_1, \delta_2 \ldots\ldots\ldots \delta_n$ is the thickness of component layer (m); $\lambda_1, \lambda_2 \ldots\ldots\ldots\ldots \lambda_n$ is the thermal conductivity or the k value of the materials ($Wm^{-1}\ ^oC^{-1}$).

In using the above formular, it should be remembered that the thermal transmittance air space equals zero and that the layers between an air space ventilated with the outside air and outer surface of the filler element need not be taken into account.

Log filler structures includes brick wall, blocks, clay tile, lightweight, concrete, brick, natural and man made stone, clay and the like can

accumulate much heat. They take a long time to heat up when exposed to a high temperature and once heated, cool down slowly. This makes them a good choice for hot arid areas;

Thermal conditions of a room are markedly affected by solar radiation and insolation. Solar radiation is a primary source of heat and visible light. Insolation is a direct exposure to sunlight which has thermal, a luminous and a biophysical affect on the surroundings.

The necessary level of solar radiation and insolation is determined by the amount of ultra violet radiation required for the human organism, and the amount of light required for adequate natural illumination of the rooms. It can be secured by choosing a proper architectural layout and structural design, for example, by arranging building of different height on the same site, by shading open spaces between the building, by planting trees and bushes, by using sun screens, by varying house density etc.

The amount and intensity of rain fall have a marked effect in building design. It is particularly important to consider rainfall in design of buildings and structures.

According to Stall and Evstrastov (1987) a three day shower which struck Lenkuran (Azerbaijan, the then USSR) in October 1982 resulted in a 436mm precipitation. The water flooded the ground floor of houses and residential and industrial building.

Heavy rainfall builds up the moisture content of the soil heaving or subsidence and undue deformation of foundations. Considerable precipitation

raises the ground level, so the water proofing of substructures has to meet stringent requirements.

The direction and speed of winds govern to a certain extent the temperature and humidity in a given locality .In warm humid regions; the wind helps to extent the life of building because it speeds up the drying of structure components (Stall and Evstrastov (1987). In view of this windows and doors of building erected in hot climatic zones should be arranged so as to ensure cross ventilation. Proper allowance for wind loads on building and other structure is a matter of great importance.

The most violent types of air motion are hurricanes, cyclones and typhoons (Stall and Evstrastov (1987). According to them, the cyclone of (1977) that attacked Andhra Pradesh and Tamilnadu in India killed over 10 thousand people. The windstorms (whose velocity reached 140 km/hr^{-1}), floods, and gigantic waves swept away 162,000 houses and seriously damages 50,000 square kilometers of farmland. Also a 1981 hurricane destroyed 2,000 houses and killed 200 people in Orissa, East India.

The formation and direction of winds are significantly influenced by large bodies of water and the character of the soil. The direction and velocity of wind also depends on the terrain and the presence of vegetation and buildings which obstructs the air motion. Accordingly, the velocity of air motion decrease with decreasing altitude above the ground level.

3.3 The site climate Analysis

Ogunsote (1991) has done some work with respect to the analysis of site climate. According to him the site climate, is the climate of the area to be developed. The site climate is affected by the followings; the climate variables, the ground cover and the topography

The climate variables include temperature, wind, humidity, rainfall, solar radiation, fog and dust storms.

The ground cover affects the flow of wind over the site and determines the intensity of shade provided. The topography covers the slope, orientation and elevation of the site.

He stressed the importance of determining the intensity of direct solar radiation and wind flow over the site as they greatly affects the thermal comfort in a building.

The necessary data are collected and adjusted where necessary to reflect actual site conditions. The thermal comfort conditions are established and general detail guidelines covers the layout, orientation, spacing, cross ventilation, special acoustic treatment, treatment of space between buildings, the need for shade devices, construction and materials of walls, floors and roofs; window size and position, roof slope, protection against glare and finishing of surfaces to provide protections against driving rains and direct sunlight.

CHAPTER FOUR

4.0 METHODOLOGY

4.1 Research methodology and procedure

This study was carried out to assess the effect of climate on building design in; and general layout of kpakungu, Minna local Government. For systematic collection and analysis of necessary data for the study, the following procedure was adopted.

4.1 Research method

Information which allowed for in-depth study of climatic effect on building design and general layout of Kpakungu was obtained by the use of descriptive survey method. This method allowed for information to be sourced concerning the current status, phenomena or happenings.

Descriptive survey method describes, interprets and is concerned with conditions/relationships that exist, opinions that are held, existence of effects, current and developing trends.

Samples and sampling techniques

Kpakungu is a large densely populated areas, therefore, a total number of one hundred and fifty (150) questionnaires were employed for use, one hundred and forty (140} were eventually used. The respondent were anybody found at home during the visit and findings shows that they are usually the head of the house hold, the spouse or another considerable member of the house hold who may be familiar or has sufficient knowledge about the

research topic. Buildings were visited scatteredly to give a good representation of study area information generation.

Data collection procedure

In line with the objectives of the study, data's for analysis were obtained as follows:

(A) Primary Data

(1) Ground trotting

(2) Physical survey of the study area for extensive personal observation of study parameters. This is done with a view of making inventory of existing condition and assembling of background data of the study area. Observed parameters includes; building design and layout with reference to orientation, spacing, materials of construction method of construction, drainage etc.

(3) Photographs were taken for later analysis

(4) Questionnaire containing questions relevant to the study were distributed to the inhabitant, response collated and analysed.

(5) Interviews were conducted with few individuals, this was done with a view to obtaining additional detailed information which cannot be provided on the questionnaires.

Secondary Data

Secondary data were sourced from textbooks, thesis, journals, monographs, seminar papers, newspaper reports and other published and unpublished materials on building design techniques and; climate. This data

were sourced and reviewed in chapter three as literature review precedent to field data collection.

Data analysis

For easy analysis of data, a two dimensional representation of statistical information (table) was drawn from assembled data, the responses from the questionnaire formed the core of the tables.

Statistical methods such as frequency distributions, percentage and charts were used for analysis, inferences drawn, conclusion made and suggestions/recommendations were proposed based largely on findings from the analysis of the informations.

CHAPTER FIVE

5.0 DISCUSSION OF RESULTS

This study aim at studying the building design in, and general layout of kpakungu (Minna local government area if Niger state) relative to the climate of the area. The results, analysis and discussion of findings from field survey is death with in this chapter.

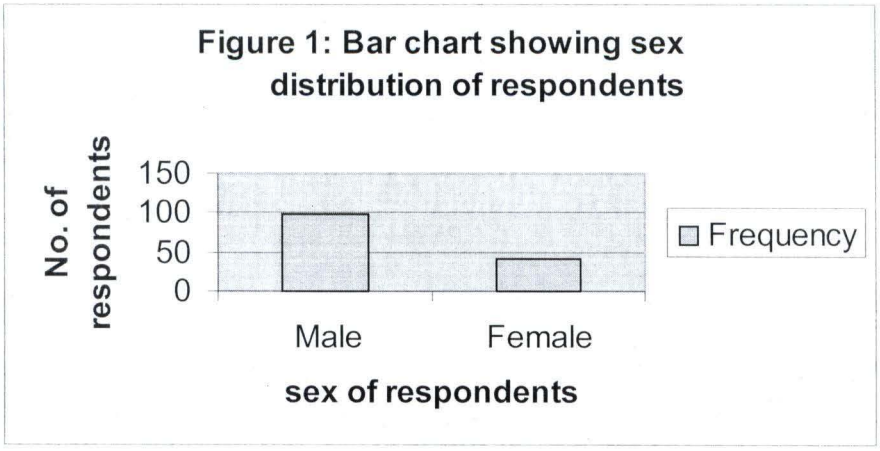
In the analysis of data, a simple frequency and percentage were used in the presentation. Bar charts were also used to give more clarity. A total of 150 questionnaires were prepared for use out of which 140 were eventually used. Below are the summary and analysis of data collected.

A. Socio – economic data

Table 5.1: Sex of respondent

Sex	Frequency	Percentage
Male	98	70
Female	42	39
Total	**140**	**100**

Source; Author's field Survey, 2003

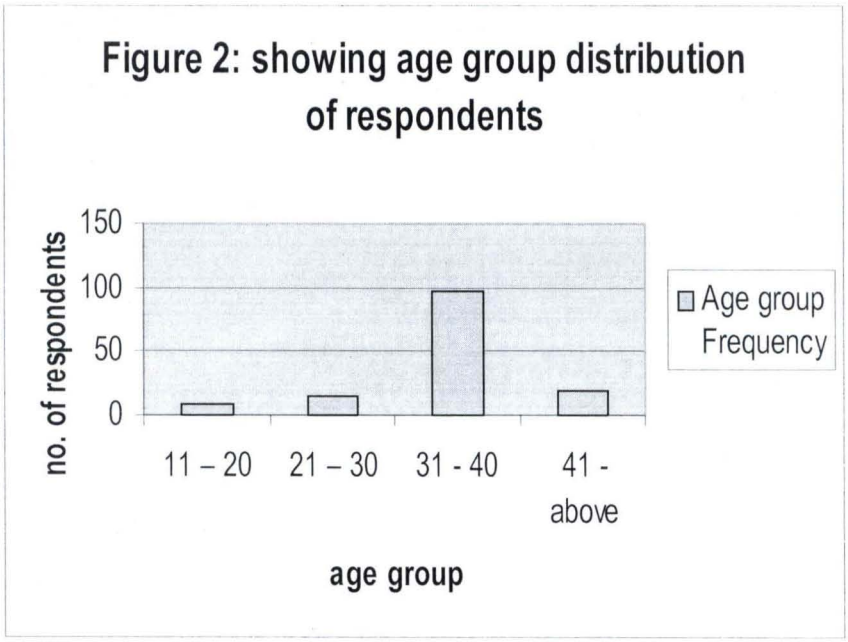


The table 5.1 above shows that of the 140 respondents, 98 respondents representing 70% were male who are either the head of the house hold of the building visited or an adult who can give factual and reliable information based on the familiarly with the topic of discussion. 30% of the respondents were females as can be seen from the table above.

Table 5.2: Age group of respondents

Age group	Frequency	Percentage
11 - 20	8	5.7
21 – 30	14	10
31 - 40	98	70
41 - above	20	14.3
Total	**140**	**100**

Source; Author's field survey, 2003



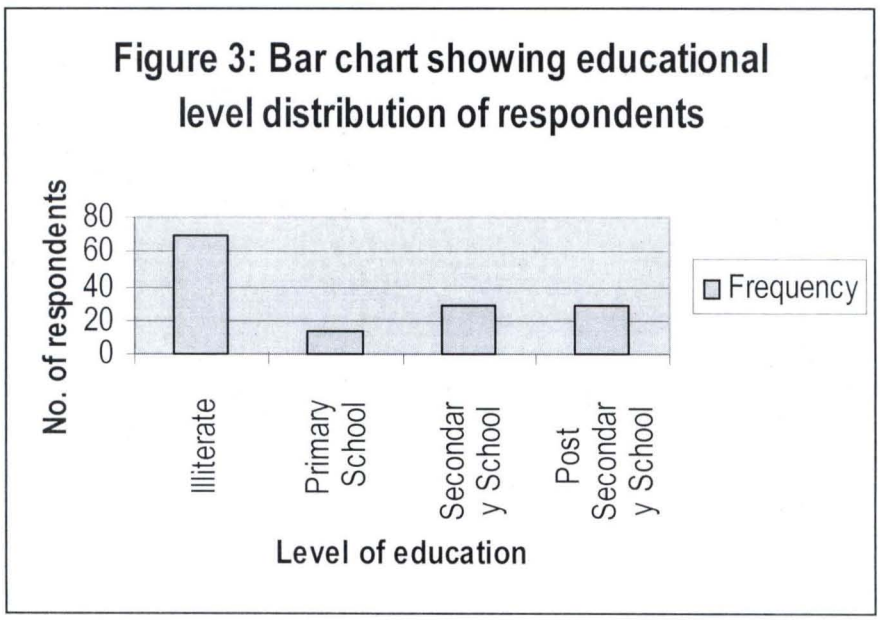
The table 5.2 above shows that the age group 31 – 40 representing 70% of the respondents was dominant while the rest age groups; 11 – 20; 21 – 20; and 41 above were represented as 5.7, 10 and 14.3% respectively.

The importance of this distribution lays in the fact that majority of the respondent are adults who have live long enough to have witness the trend of occurrence of events in the study area and thus be able to give reliable response.

Table 5.3: Level of education of respondents

Education Level	Frequency	%
Illiterate	70	50
Primary School	14	10
Secondary School	28	20
Post Secondary School	28	20
Total	**140**	**100**

Source; Author's field survey, 2003



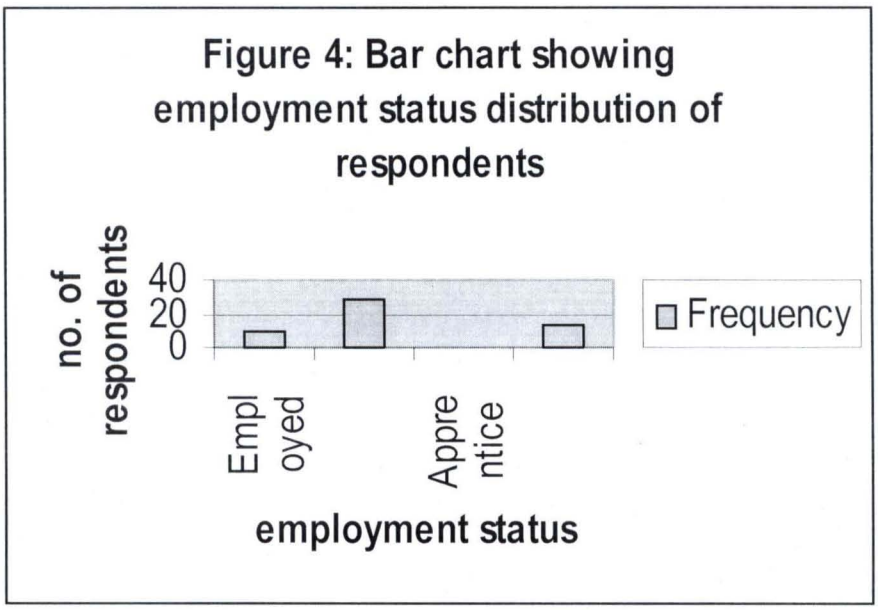
As seen from the table 5.3 above, the majority of the respondents are illiterates; 70 respondents representing 50%; while 14 representing 10% went to primary school and the rest 56 respondents are equally distributed for secondary and post secondary school leavers (that is 20% each).

The implication of this distribution will be shown together later with that of employment status and occupational distribution as they are interrelated and complimentary.

Table 5.4: Employment status of respondents

Employment status	Frequency	Percentage
Employed	9	70
Unemployed	28	20
Apprentice	0	0
Housewife	14	10
Total	**100**	**100**

Source; Author field survey, 2003



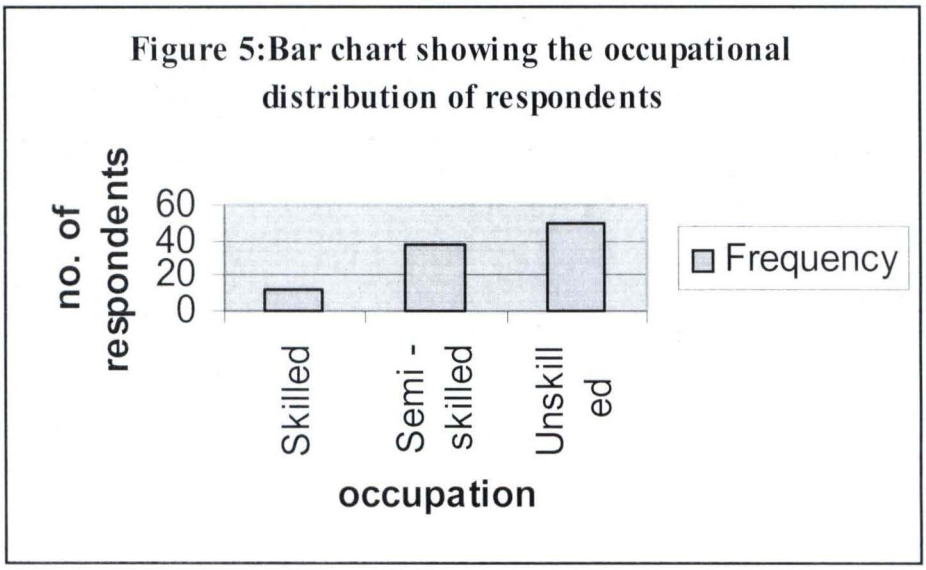
The table 5.4 below shows that 98 respondents representing 70% were employed; 28 representing 10% were housewives, while none were apprentice. Again the importance of this distribution shall be shown alongside that of educational level of respondents and occupational distribution.

Table 5.5: Occupation of respondents

Occupation	Frequency	Percentage
Skilled	12	12.20
Semi - skilled	37	37.80
Unskilled	49	50
Total	**98**	**100**

Source; Author field survey, 2003

Figure 5:Bar chart showing the occupational distribution of respondents



The distribution from the table shows that of the employed respondents 12 representing 12.20 % are skilled workers; 37 representing

37.8% are semi – skilled workers, while the rest 49 representing 50% are unskilled workers.

Skilled workers here means people who have acquired formal training on a particular profession and are working either in the public or private sector such as teachers, doctors etc. Semi–skilled workers includes mechanics, vulcanisers, masons etc who have gone through some degrees of training either informal or semi – formal while unskilled employees refers to those who have no formal training like traders, labourers etc.

The interrelationship or the complimentary tendencies that exists between the three distributions can be seen as that of the level of education determining to some extent the employment status and occupational trends.

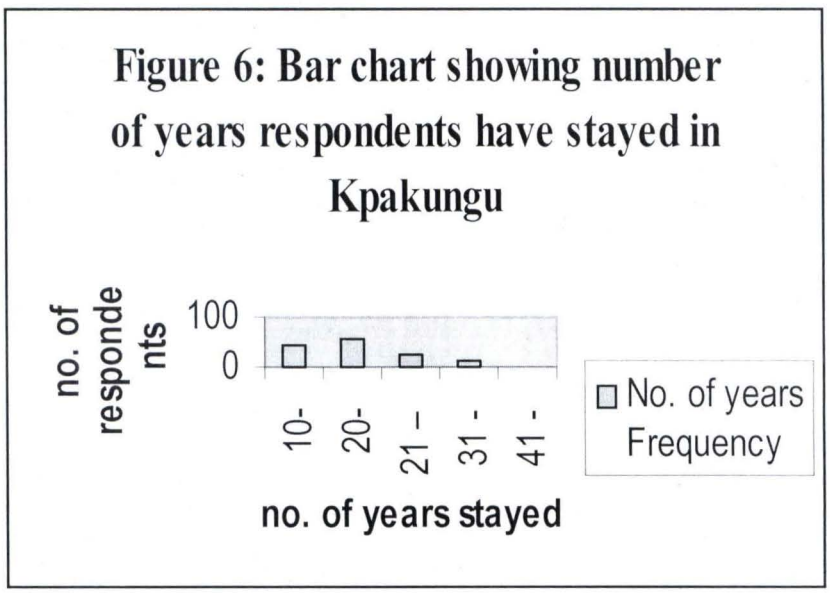
From the three distributions, it can be deducted that although majority of the people in the study area are employed, they are largely unskilled workers. The researcher observed that poverty was obvious in the study area and this may account for the shoddy building design and layout of the area. This finding is close to Mabogunje 1968 (in Aderamo, 2000). He asserts that

> the increasing urbanization of our cities, the inability of these cities to cope with the demands of urbanization in term of physical facilities and orderly growth usually lead to growth of slum neighborhoods and physical decay or deterioration of the urban environment. This condition also leads to low level of livability of many cities in the developing world and the quality of their management.

Table 5.6: Number of year respondents have stayed in Kpakungu

No. of years	Frequency	Percentage
1 - 10	42	30
11 - 20	56	40
21 – 30	28	20
31 - 40	14	10
41 - above	0	0
Total	**140**	**100**

Source; Author field survey, 2003



The distribution shows that 56 respondents representing 40% have stayed in Kpakungu between 11 – 20 years; 42 representing 30% have stayed between 1 – 10 years; 28 respondents (20%) respondents have stated between

21 – 30 years; while the rest 14 respondents representing 10% have stayed between 31 – 40 years.

This is a fair representation for the purpose of the study; the appreciable number of years which the respondents have been staying in Kpakungu is of advantage as facts regarding the study will be sure to be obtained. This distribution is complimentary to Age group distribution of respondents.

B. STUDY AREA DATA

Profile of buildings studied

(a) Types of building and materials of construction

(i) Wall

The survey showed that most of the building in the study area are bungalow and are mostly constructed with sandcrete blockwall (56 building representing 40%); and clay brick wall (84 buildings representing 60%). Some were rendered and painted (20%). 70 buildings representing 50% were rendered only while the rest 28 buildings of the 140 studied representing 20% were neither rendered nor painted.

Sandcrete and clay brick were used for wall construction are compatible with the climate of the area. They can accumulate much heat when exposed to high temperature and once heated cooled down slowly. This makes them a good choice considering the climate of the area.

(ii) Roof

As observed, the buildings were mostly roofed using galvanized zinc roofing sheets (126 buildings representing 90%) and few (14 buildings representing 10%) were roofed using long span alluminium roofing sheets.

Ogunsote (1991) has classified the study area as a savannah zone for building design and has recommended heavy roofing with high thermal capacity for protection against heavy rainfall and leakage owing to rust and aging and; also against wind storm.

Galvanized zinc unlike long span alluminium can only satisfy the requirement described above of heavy roofing to some extent. The researcher observed a lot of buildings whose roof hah either partially fallen off or about to be blown off as a result of wind/rain storm and some respondents agreed to their roof leaking to an appreciable extent. These conditions can have adverse effect on the health of the occupants.

(b) Ventilation

Table 5.7; Ventilation of buildings in the study area

Adequacy	**Frequency**	**percentage**
Adequate	12	8.57
Fairly adequate	28	20
Inadequate	100	71.43
Total	**140**	**100**

Source: Author's Field Survey, 2003

From the table 5.7 above, ventilation of 100 buildings (71.43%) is inadequate; while that of 28 buildings (20%) are fairly adequate and the rest 12 buildings (8.7%) are adequate. The windows are either too small or badly positioned (see Plate I).

The collapse of many buildings in the area among other factors can be attributed to poor ventilation since cross ventilation ensures good wind circulation in the building and help to speed up the drying of the building component thus prolonging their life.

Also a lot of discomfort is experienced by the people as the non availability of cross ventilation can increase the combination of high temperature and humidity which causes discomfort in dry season and may assume an appreciable level as to trigger off disease situations; measles, meningitis etc.

(c) Orientation of buildings

Orientation is important in the protection of the building against the direct impact of weather such as rainfall, solar radiation and wind.

Table 5.8: Orientation of buildings in the study area

Orientation	**Frequency**	**percentage**
Bad	98	70
Fair	28	20
Good	14	10
Total	**140**	**100**

Source: Author's Field Survey, 2003

As can be seen from the table 5.8 above, 70% of the buildings studied have bad orientation, 20% were fairly oriented, while 10% had good orientation.

According to Ogunsote (1991) the best building orientation in the savannah zone (to which the study area belongs) is the longer axis of the building facing the west-east direction.

Buildings in the study area because of bad orientation have suffered considerably from the direct impact of weather. The researcher noticed buildings with minor cracks, some buildings partially collapsed and some having their roof almost blown off – a direct of the weather variables mentioned earlier (see Plates II and III).

(d) Spacing

The spacing of buildings affects ventilation and lighting. Wider spacing increases ventilation and illumination. However, spacing relates not only internal ventilation and day lighting, external ventilation spacing, provision of shade, breeze and sun for outdoor comfort are also important.

Spacing also ensures adequate insolation and accommodation of large bodies of water and vegetation which are very effective in fighting against reflected radiation.

Spacing of buildings in the study area as observed by the researcher is highly inadequate; in fact it is almost non existent. Some buildings have their doors and windows almost touching those of the adjacent or opposite ones (see Plate IV).

(e) Drainage

Table 5:9: Drainage in the study area

5.9. a Availability of drainage

Availability	Frequency	%
Available	28	20
Not available	112	80
Total	**220**	**100**

5.9.b Adequacy of available drainage

Adequacy	Frequency	Percentage
Adequate	0	0
Fair	14	50
Inadequate	14	50
Total	**28**	**100**

Source: Author's Field Survey, 2003.

With reference to the table 5.9 above, of the 140 building studied, only 28 representing 20% have drainage while the rest 112 representing 50% do not have drainage and none of the drainage where available was adequate, 50% of the available drainage was only fair, while the remaining 50% were inadequate (see Plates IV and V). The implication of this will be seen later in the analysis of some parameters of study such as foundation settlement, collapse of buildings e.t.c.

(f) Foundation Settlement

Foundation Settlement results from shrinkage of subsoil which may be due to excess loads transfer from the superstructure through foundation to the soil. Foundation settlement may be even (all part of the foundation settles equally) when this occurs, it may not be noticed and this may be the situation in 70 buildings representing 50% of the buildings studied where foundation settlement was not noticed. It may also be that the buildings have good foundations.

Table 5.10: Settlement of foundation of buildings in the study area.

Settlement	Frequency	percentage
No settlement	70	50
Slight settlement	42	30
Strong settlement	28	20
Total	**140**	**100**

Source: Author's field survey 2003

Especially dangerous is the shrinkage of some soils which may have been allowed to dry for long time resulting in differential settlement. This may be the case of 42 buildings representing 30% and 28 buildings (20%) where fair and strong settlements were noticed.

Collapse of buildings

In many of the buildings studied, no collapse of any kind was noticed (112 buildings representing 80% and where collapses were noticed; 28 buildings representing 20%) it was partial, no whole collapse was observed. Some of the respondents interviewed said their buildings have collapse before but were immediately rebuilt (see Plates II and VII).

The cause of the collapse can be traced to the poor drainage situation analysed earlier, which is almost non-existent. Same for bad orientation and spacing which made buildings susceptible to attack by weather variables like rainfall, wind e.t.c. Collapse of buildings may also be traced to differential settlement of foundation. This finding complements the assertion of Choudnury and Haque (1994).

Frequency of repair / major repairs carried out

Repairs occurring to the study are often carried out in only a few percentages of the buildings studied (28 buildings representing 20%).

The repairs are mostly that of roof blown off as a result of heavy wind/rainstorm. This finding corroborates Ogunsote (1991) that the study area belongs to the savannah zone for building design and his recommendation of heavy roofing.

Major repairs are often in the form of repairs to damages resulting from windstorm (roofing completely blown off) or partial collapse of building.

Environmental Hazard Experience

Table 5.11 Environmental hazards experienced in the study area

Hazard	Frequency	Percentage
Flood	14	10
Rainstorm	28	20
Both	54	60
None	14	10
Total	**140**	**100**

Source: Author field survey, 2003

Of the 140 buildings studied, 14 representing 10% admitted to have experienced flooding in the past, 20% have experienced only rainstorm while 54 buildings representing 60% have experience both flood and rainstorm and the remaining 14 buildings representing 10% have not experienced any.

These environmental hazards largely result from inadequate spacing of building, poor drainage situation and bad orientation all of which have been analysed earlier.

Disease Experience

Table 5:11a
Disease experience in the study area

Disease	Frequency	Percentage
Malaria	49	35
Typhoid	14	10
Both	63	45
Others	14	10
Total	**140**	**100**

Table5:11b
Frequency of occurrence of disease

Frequency	Frequency	Percentage
Regular	84	60
Occasional	28	20
Seasonal	28	20
Total	**140**	**100**

Source: Author field survey, 2003

Disease prevalent in the study area as shown the above tables 5.11a & 5.11b includes: malaria as attested to by 49 respondents (35%), typhoid; 14 respondents (10%); Both Malaria and typhoid; 63 respondents (45%) while other diseases like measles, meningitis e.t.c. take the rest 10%

These disease according to the respondents are mostly experienced regularly (60%), occasionally 20% and seasonally (also 20%).

The disease, their frequency of occurrence and intensity are dependent or aggravated by some parameters of study analysed earlier; orientation of buildings, drainage, ventilation, spacing of buildings, poor waste disposal e.t.c.

For instance, the researcher observed different spots of stagnant water scattered around in the study area due to poor drainage or lack of space for rain water to run off. This stagnant water when prolonged for a long time on the ground may serve a breeding ground for mosquitoes which are carriers of malaria parasites (see Plates V and VII).

This finding agrees with the study of Gona (1994). Also observed was the inadequate provision for human waste disposal systems (bathroom/toilets). This can also aggravate disease situation which may assume an endemic dimension (see Plate VIII).

Plate I: Showing inadequate ventilation in a building studied

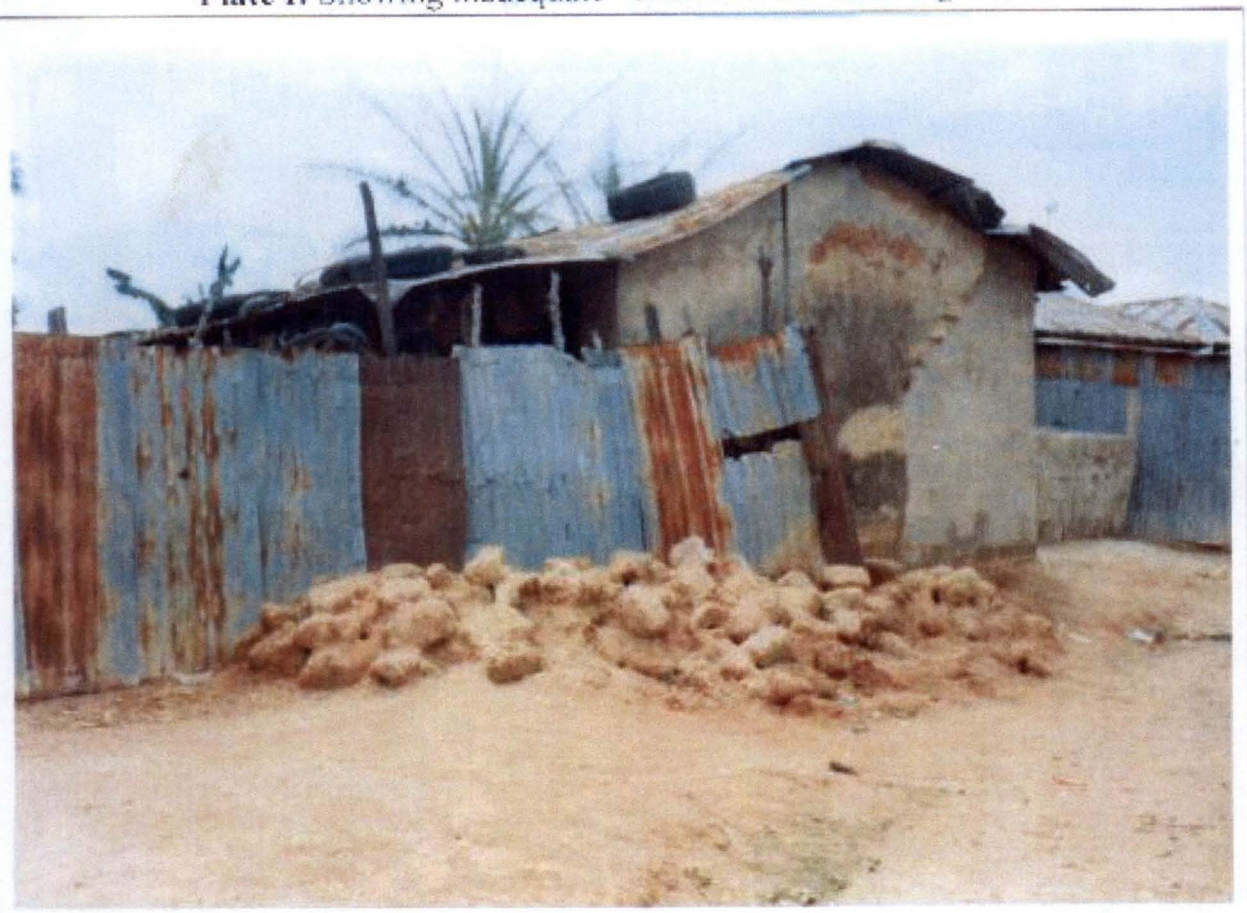


Plate II: Showing building partially collapsed (although re-built)

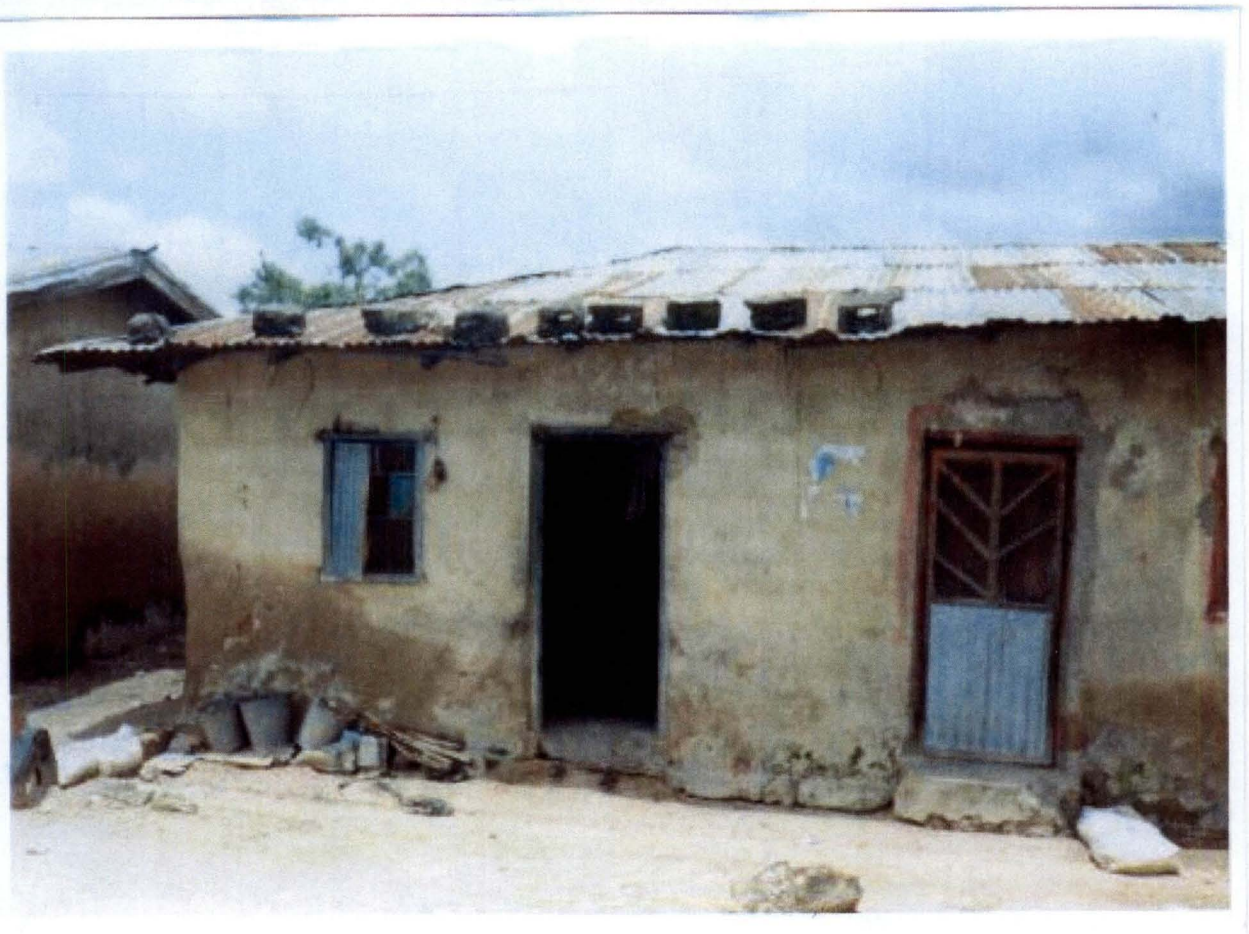


Plate III: Showing building whose roof is being threatened by wind/rainstorm

Plate IV: Showing inadequate drainage and poor spacing between buildings

Plate V: Showing bad drainage and poor waste disposal system prevalent in the study area

Plate VI: Showing one of the many stagnant pools of water in the study area

PlateVII: Showing a collapsed (but re-built) building

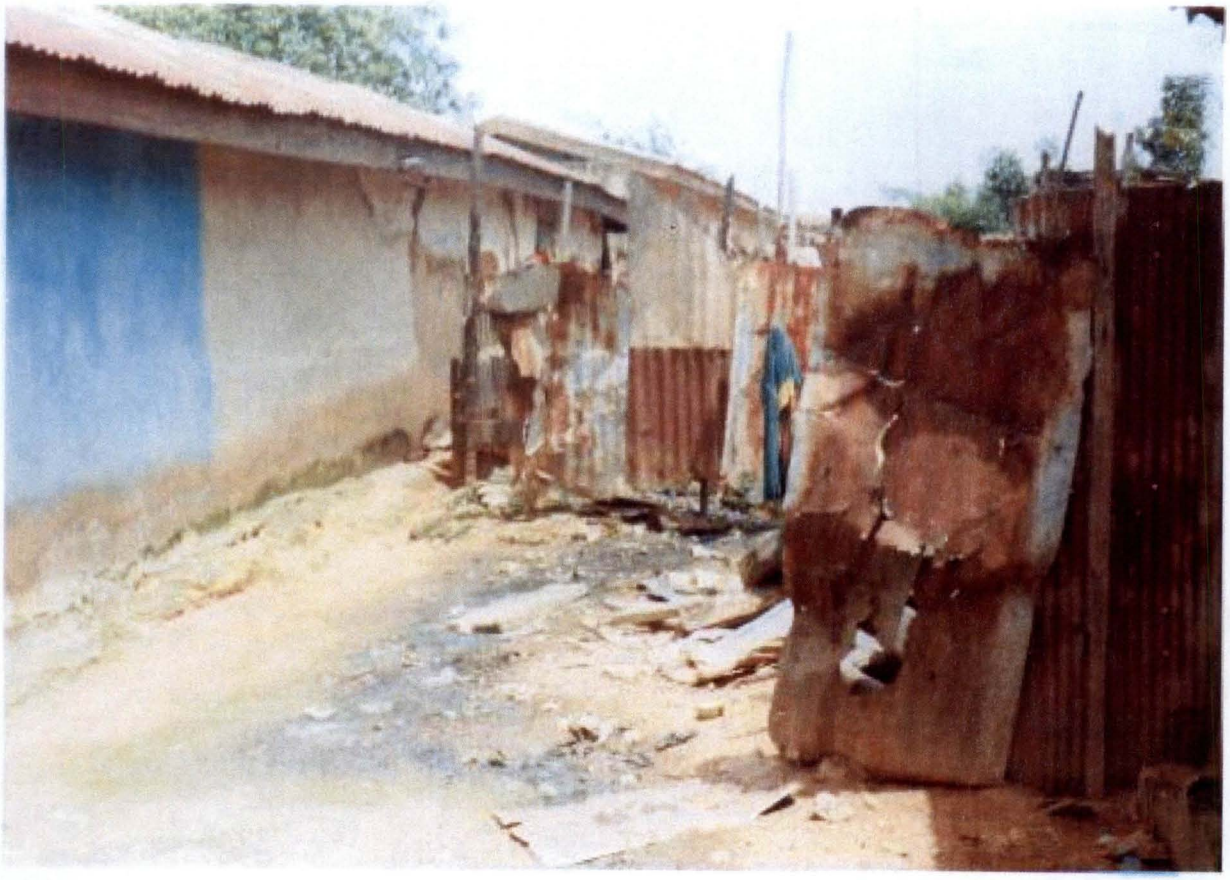


Plate VIII: Showing a typical bathroom/ toilet provision for buildings in the area

CHAPTER SIX

6.0 SUMMARY, CONCLUSION AND RECOMMENDATIONS

The form of dwellings, the insulation value of roofs and walls, the orientation, size of windows (ventilation, spacing, drainage and several other design variables are determined by the requirement of thermal comfort. Requirement for thermal comfort are related directly to the climate. There is therefore a strong link between the climate and building design.

From the study and analysis of data collected, the only aspect of building in Kpakungu that seems to conform to the climate of the area is the materials used for wall construction (that is sandcrete blockwall and clay walls); while the roofing to some extent (long span alluminium roofing sheet) conformed to the climate.

Galvanized iron sheet which is the most commonly used roof covering in the area is not suitable for the climate of the area, evidence to support this can be seen in the many leakages and the ease at which they are blown off by wind/rainstorm.

Ventilation, to building in the area is grossly inadequate and this has result in a lot of discomfort to the inhabitants.

Similarly, the buildings are badly oriented and hence the exposure of the building and by extension the occupant to direct impact of weather variable like rainfall, solar radiation winds etc.

Spacing of building is the worst of all the studied parameters. Spacing situation is so bad that some buildings almost open to each other. Should

there be a disease breakout; the spread will be easily accelerated by the closeness of the buildings. The bad spacing also affects ventilation and illumination of the buildings.

Drainage is grossly unavailable and this has lead to flood situations and weakening of foundation of buildings some of which have been serious enough to cause building collapse.

The building seen to have good foundation as evident from the lower percentage of buildings where settlement were notice; Few partial collapse of building prevailed in the area and this is largely attributed to poor drainage, inadequate spacing of buildings and bad orientation (exposing buildings to direct impact of climatic variables).

Repairs are not often carried out on the buildings but major repairs which are sparsely carried out are as a result of damage resulting from rain /wind storm (roof blown off) or flood (collapse of building).

The environmental hazards experienced mostly are flood (due to bad drainage, spacing and poor building orientation) and rain storm (also on the account of the design variables mentioned above).

Diseases prevalent in the area are mostly malaria and typhoid. Measles and meningitis are experienced in considerable proportion. These diseases are sometimes endemic in nature as evident in some death recorded.

Conclusively, one of the vital roles of buildings is to ensure the protection of man from of the adverse effect of climate. This should be done

not only by erecting a shelter, but also by ensuring that as mush as possible comfort is provided by taking climate into consideration.

The present situation with regards to building designs and general layout of Kpakungu with relations to climate call for more serious analysis. The chaotic situation of building design and shoddy layout of Kpakungu is not peculiar, the emergency of this ugly situation in the study area and else where is due to social, political and economic factors.

In the interest of the environment as well as human physiological comfort, it is been suggested that something be done about the precarious situation in Kpakungu.

Climatic hazards are experienced every year in different forms in Kpakungu and people as a result of this suffer in men and materials, social and economic development are affected. Effort must be made to address this trend.

The author would recommend that the occurrence of slums should be discouraged and for the existing ones (Kpakungu inclusive), corrective planning such as urban renewal should be carried out, though it may be expensive initially, but it have long term advantages for sustainability.

It was also discovered that poverty and illiteracy among the inhabitants of Kpakungu was also largely responsible for the housing design structures prevalent there, therefore the government must do all within her reach to improve the economy

There is also the need to educate the populace about their activities in the environment that can aggravate hazard situation and climatic studies with respect to building design and construction should be encouraged.

The researcher observed that the respondents were not willing to co-operate in the area of giving out information and allowing their building to be accessed for study. This according to them was due to the fact that previous studies carry out about the area have not impacted positively on them. In view of this, it is recommended that research work whether academic or otherwise should be endeavored to be implemented and not just dumped.

Finally, further research about the relatives of climate and building design in Kpakungu as well as other settlement of similar nature is advised to be carried out to give the study a broader scope and opportunity created for new findings and solutions.

REFERENCES

1. Adebayo Y.R (1991) Climate and Building in Ibadan: Some Observations: In: Climate and Human Settlement: Integrating Climate into Urban Planning and Building Design in Africa Ed. Adebayo Y.R, A 1991 publication of UNEP, Nairobi, Kenya pp 46.

2. Adebayo Y.R (1991) Perspective on Problems of the Urban Atmosphere within the Framework of Urban Planning and Building Design. In: Climatic and Human Settlement: Integrating Climatic Into Urban Planning and Building Design in Africa Ed Adebayo Y.R. A 1991 publication of UNEP Nairobi Kenya pp 41.

3. Adebisi A.A (2002) The Significance of Verifiable Techniques for Building Design to Avoid Climate Related Disaster, Term paper, Post graduate Diploma in Environmental Management, Federal University of Technology, Minna, Nigeria.

4. Aderamo A.J (2000) City Planning and Management Techniques. In: Contemporary Issues In Environmental Studies Ed Jimoh H.I and Ifabiyi I.P Haytee press and publishing co ltd Ilorin Nigeria pp 213.

5. Adeyemi A.S (2000) Climate Change and Environmental Threats. In: Contemporary Issues in Environmental Studies Ed. Jimoh H. I and Ifabiyi I.P Haytee press and publishing co ltd Ilorin, Nigeria pp 158.

6. Choudnury. A.M and Haque M.A (1994) Design of Buildings and Structure in Urban Areas Taking Into Consideration the Disastrous Climate

of Bangladesh. In: Report of the Technical Conference on the Tropical Urban Climate. World Metrological Organisation TD NO 647 127-129 pp UP; T

7. Choudnury J.R (1994) The Impact of Natural Disasters On Urban Infrastructure. In: Report of the Technical Conference in the Tropical Urban Climate. World Meteorological Organisation. TD NO 647 139-14 pp; UP; T.

8. Gona S.W (1994) Seasonal Weather Events and Settlement. In: Report of the Technical Conference in the Tropical Urban Climate. World Meteorological Organisation. TD NO 647 391-393 pp UP; T.

9. Hassan S.A (1994) A System of Presenting Climate Information for Building Design Application. In: Report of the Technical Conference in the Tropical Urban Climate. World Meteorological Organisation. TD NO 647 TD 647 pp

10. Ijaiya G.T (2000) Environment, Poverty and Women: A Perspective on Socio economic Forces. In: Contemporary Issue In Environmental Studies. Ed Jimoh H.I and Ifabiyi P.I. Haytee press and publishing co ltd Ilorin Nigeria pp 291.

11. Makanjuola A.B. (2000) Environmental Changes and the Health Implications. In: Contemporary Issue In Environmental Studies Ed Jimoh H.I. and Ifabiyi P.I Haytee press and publishing co ltd Ilorin, Nigeria, Pp 198

12. Ogunsote A.A. (1991) Introduction to Building Climatology, Zaria Ahmadu Bello University Press limited, pp 121 – 150.

13. Raheem S.A. (2000) The physical and Cultural Environment.

In :Contemporary Issue in Environmental Studies Ed Jimoh H. I. and Ifabiyi P.I. Haytee press and publishing co ltd, Ilorin Nigeria pp3.

14. Stall T.M. and Evstrastov G.I (1987) Building in Hot Climate, Moscow, MIV publishers pp 11 – 18

15. The Holy Quran translated by M.H Shakur, Lagos, Abiola Bookshop Press Limited. !990.

APPENDIX

FEDERAL UNIVERSITY OF TECHNLOGY, MINNA
SCHOOL OF POST GRADUATE STUDIES
DEPARTMENT OF GEOGRAPHY

QUESTIONAIRE ON BUILDING DESIGN AND CLIMATE IN KPAKUNGU, MINNA LOCAL GOVERNMENT AREA OF NIGER STATE, NIGERIA.

INSTRUCTION: PLEASE FILL AND TICK WHERE APPLICABLE APPROPRIATELY

A. SOCIO-ECONOMIC DATA

1 SEX: Male [ ] Female [ ]

2 Age group of respondent.

(a) 11-20 [ ]; (b) 21-30 [ ]; (c) 31-40 [ ]; (d) 41 and above [ ]

3. Level of education

(a) Illiterate [ ]; (b) Primary school [ ]; (c) Secondary [ ];

(d) Post Secondary school [ ];

4. Employment Status

(a) Employed [ ]; (b) unemployed [ ]; (c) Apprentice [ ];

(d) House wife [ ];

5. Occupation _____

6. Number of years stayed in Kpakungu

(a) 1-10 [ ]; (b) 11-20 [ ]; (c) 21-30 [ ]; (d) 31-40 [ ];

(e) 40 and above [ ]

B. STUDY AREA DATA

7. **Profile of building under study**

(a) Type of building _____

_____

(b) Materials of construction

- Foundation _____

_____

- Wall _____

_____

- Roof _____

_____

- Finishing _____

_____

(c) Ventilation: Adequate [ ]; Fair [ ]; Inadequate [ ];

(d) Orientation: _____

(e) Drainage: Availability:

Available [ ]; Not available [ ];

Adequacy: Adequate [ ]; Fair [ ]; Inadequate [ ]

(f) Foundation Settlement profile _____

---

8. Whole or partial collapse of building noticed?

Yes [ ]; Nature: Whole [ ]; Partial [ ]; No [ ]

9. Frequency of repairs and nature _____

_____

10. What type o f environmental hazard have you experienced in recent years? (a) Flood [ ]; (b) Rain storm [ ]; (c) Others (please specify)_____

_____

11. Have you carried out any major repairs? Yes [ ]; No [ ]; If yes, when_____

Nature_____

12. Disease experience

Type (s) _____

Frequency _____

Any loss of life? Yes [ ]; No [ ]: If yes, How many?_____