A TERM PAPER ON THE COLLECTION OF CLIMATIC DATA FOR AKURE IN THE YEAR 1986, AND ITS IMPLICATIONS FOR ARCHITECTURAL DESIGN

BY

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The inspiration

*"The work of an architect is an expression of his **inner being**, understanding the forces of **nature**(precipitation,wind,temperature,Solar radiation,and humidity),organization of **spaces** for human comforf,connecting the **cultural** values of the users, application and selection of materials in terms of **texture** so as to create a sustainable **structure**"*

ANONYMUS

*"A great challenge to an **architect** is posed by **aesthetics.** A good design should be **functional, structural, and reflect our culture"***

Prof Olu Ola Ogunsote
Excerpts from lecture note on applied climatology, Arc 810, Chapter 4, Page 15

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1.0 INTRODUCTION

The need to design with climate has always been a major consideration in architecture, in other to achieve this, the architect needs to harness (***NATURE, SPACE, CULTURE, AND TEXTURE TO PRODUCE A SUSTAINABLE STRUCTURE*****).**Thus there is a dire need for a comprehensive understanding of the climatic peculiarities of the climate of Akure as a point of focus in this term paper (rainfall, temperature, solar radiation, wind and relative humidity) of an area in question for the space of at least 20 years, Thus a climatic data of Akure in 1986 was collected from several sources for building design purposes and its resultant effect on architectural deign especially in the area of thermal comfort are discussed in this paper.

2.0 **THE DESCRIPTION**

2.1 **THE SOURCE**

The datas in this term paper were primarily gotten from two sources namely

I. The Nigerian metrological Agency, Federal Secretariat, Department of civil aviation, Igbatoro, Akure Ondo state.
II. Agro climatologically and ecological unit Alagbaka, Akure, Ondo state.
III. Other sources are through the internet, e-books, e-magazines.

AGROCLIMATOLOGICAL /ECOLOGICAL UNIT.

This is is the only source that can be discussed on pertaining to their history, objectives, structure and activities due to shortage of information on the federal secretariat. The agroclimatoligical unit was established in 1992 primarily to complement the various developmental efforts of the state.

OBJECTIVES:

The main objective is to strengthen the advisory roles of the state Government through agricultural extensions to numerous farmers with respect to the most suitable months and specific weeks of planting and transplanting, and also saddled with the responsibility of generating agroclimatoligical data in the local government area of the state.

ACTIVITIES:

The project unit deals with environmental, ecological and edaphic issues as it affects agricultural production has successfully carried out research which led to the p0roduction of an atlas on agro-climatologically and ecological zones of the state to enhance the planning capability of the state ministry. The activities of the unit include collection, collation and analysis of climatological data on local government basis to determine precipitation effectiveness measurement by utilizing instruments which include **Thermometer,rain guage,wind vane, class "A" pan for evaporation** ,**sundial** for sunlight/solar radiation,**hygrometer f**or relative humidity. It is unfortunate that most of the readings are still taken manually even with the emergence of the computer. According to the metrological agency in Igbatoro, readings between the years 1983-1993 were tedious to take due to low level awareness of computing technology.

2.2 TIME:

The documentation of Climatic data is very sensitive to time, the basic parameters of climate for design design purposes (precipitation, temperature, relative humidity, wind and solar radiation are taken at particular time frame and also kept in a weather shield called **Steven seen screen(**only readings of temperature and humidity are kept in this shield.

i.**Temperature:** The thermometer used by the two primary sources was a narrow glass tube filled with mercury or alcohol; it works on the principle that mercury expands when heated. A temperature taken in open daylight is very high because it measures the direct insolation of the sun. The max. and min. are measured by the **maximum thermometer** and the **minimum thermometer**. The maximum temperature for the day is taken at a **clock time** of 12:00 noon, or the hottest time of the day. The minimum thermometer records the lowest temperature reached during the day, or probably occurs in the middle of the night or early in the morning, taken between 6:00-7:00am **clock time**, the

element of probability in the readings would have been wiped out if the **thermometer used by the sources were to be automated thermometer.** All the necessary data on the temperature of Akure in 1986 is shown in figure, the **climatic data sheet of Akure in the year 1986.**

ii.Precipitation:

According to the meteorological agency in federal secretariat, Igbatoro akure declares that a rained day is reckoned as a period of 24 hours with at least 0.25mm (0.01 inch) or more rain being recorded. If the amount exceeds 1mm (0.04 inch) it is considered a **wet day.** For Example in 1986, the Month of October Recorded the highest mean monthly precipitation of 315mm, this is reflected in **figure** showing the readings of the weather in the year 1986.This figure has a resultant effect on the type of roof and the slope to be used in the building design of Akure metropolis for thermal comfort, this will be discussed fully under the implications of climatic datas on architectural design of Akure.

iii. Relative Humidity:

The readings needed for architectural purposes are mean daily mimimun, mean daily maximum and mean humidity. The relative humidity in Akure is normally high in the morning of the raining season called the **cessation (**of about 9 months in the whole year).The readings are usually taken in the 9th hour to avoid falsification of results. If it reaches 100%,the air is completely saturated ,the air is said to be at **dew point** ,when the relative humidity is high ,the air is moist, from the readings, the month of July records the highest records the highest value of 78% and a dew point of 25.4%.

iv.Wind:

Wind is air in motion and has both **direction** and **speed.** Since it is not seen but felt, since wind direction is always deflected by trees and tall buildings, thus the wind vane and anemometer are erected in an exposed position(Figure shows wind vane and anemometer from agro climatological unit and the weather station of Federal university of technology Akure.The prevailing wind blowing through Akure in 9 months of the rainy season is the **south west trade wind.** it provides a soothing effect in the interior, best location for bedrooms, but as a result of glare in the evening, there is a need for sun shading devices to ensure thermal comfort. The north east trade wind is the secondary wind that hails from the Sahara zone, it is harsh, blows during harmattan, and it is dry and dusty. Landscape design for micro climate should be considrred.This will be discussed in its implications to architectural design. Also the wind that blows in Akure is always violent,**12th day of march, 20007** was a typical example when the Ondo state sport complex was blown off, not to talk of many publics primary schools became roofless and many homes were victim of this, design consideration for **roof types** and **slopes** becomes a necessity to avert this environmental trauma. For example the highest wind recorded in 1986 is 1.7m/s in the month of September.

vi.Solar Radiation:

Akure lies in latitude 7'14N and Longitude 5,17'E, the latitude is the factor that determines the level of sunshine.Akure the state capital of Ondo state justifies her name being called the sunshine state ,and akure being the sunshine capital, the sunshine duration in Akure sometimes spans for almost 9 hours per day, as at present in this dry season, the sun rises at 9:00am and sets at 5:30pm,in 1986,the

month of October records the highest value of about 6.9 hours, this shows clearly that the level of solar radiation in Akure has increased over the years of about 66.67%.

3.0 THE ANALYSIS OF THE CLIMATE OF AKURE (1986 CLIMATIC DATA)

To design with climate for the enhancement of thermal comfort, there is a need to understand the climate of Akure which will eventually stimulate the essence of achieving thermal comfort with the collected data of Akure in the year 1986.

3.1 Akure Physical Setting:Akure is located in the equatorial zone, within latitude 10N and south of the equator, characterized by the following climatic features:

i.Hot/wet equatorial climatic type.

ii.Approximate annual precipitation of 2413mm

iii.All year type of rainfall with double maxima in June and September. Conventional predominant type of rainfall accompanied by violent wind usually results to blowing off of roofs.

iv.South west trade wind and north west trade wind are the prevailing wind blowing the city.

v.Mean annual temperature of 27^0c .

3.2 location: Akure: is located on lat $7^0$15'N and Longitude $5^0$17E at an altitude of 370m.

3.3 Results of the 1986 climatic parameters:

3.3.1.Precipitation: From the climatic data sheet, the highest **mean monthly precipitation was recorded in the, month of October (315mm***) in* **18 days** of the month with an annual precipitation of **1912mm**, the implication is that, the heavy down pour requires a **roof** of considerable slope that can ease easy drainage, with causing dampness, parapet roofs are not advisable to be used in Akure, and if considered, proper drains should be incorporated in the **roof (type, material used, span and design).**

3.3.2 Temperature: From the climatic data sheet (fig 1), The temperature of Akure is relatively high throughout the year, with **February** having the highest **mean monthly temperature of 33.9^0 c**, the the **annual mean temperature** is 26.3^0 c, annual mean monthly temperature is 30.7^0 c and annual mean monthly minimum is 21.05^0 c the implication of this is, that there is a need for **heat loss** at night so as to achieve comfort, **air temperature** range limit for comfort is between 16 and 28 degrees. This can only be achieved though short time lag, low thermal capacity, high insulation and reflective roofs. (Lecture note on applied climatology by Prof. Olu Ola Ogunsote).

3.3.3 Relative humidity: Akure experiences a high relative humidity throughout the year, in the 1986 data, the month of **July** records the highest humidity of **mean monthly max** of 89%,**mean monthly minimum** of 67.1%,this connotes that akure's climate is a **warm humid climate** that is characterized with low diurnal temperature range,high humidity and generally high temperatures, the implication of this is the design of the roofs and roofs depends on the relative duration of the season, reflective roofs and low thermal capacity material for the walls.

3.3.4.Solar radiation: Akure experience a vertical solar insolative mid day sun with a much concentrated solar insolative, from the climatic data sheet, the month of September records the highest duration of sunshine for **9.2 hours,** the implication of this is that the heat during the day is absorbed during the day and during the night there will be emission of heat, the interior becomes unbearable, there is a need for sun shading devices to exclude sun through out the year and also utilizing **landscape design** (use of landscaping vegetation, use of building fabric and design in the interior, and the use of passive technologies for cooling,heating,ventilation and lighting) for the control of tropical micro climate.

3.3.5. Wind: Akure is accompanied with conventional and violent wind which on most occasions causes hazards like felling of electric poles, blowing of roofs and even causing collapse of buildings, recently the rain that fell 12th of march this year blew up the Akure sport complex roof. The north east trade wind blows heavily between Novembers to march as reflected in the climatic data sheet fig 1, the south west trade blows across the remaining months of the year, **September** records a mean wind velocity of **1.7m/s**, the implication of this is that the type of roof to be used (buildings with **hip roofs** in the city experience little of the hazard compared to **gable end** and other type of roofs, roof slope of 25^0 recommended for easy run off,600mm eave projection to be considered and also a proper understanding of **wind load**, and coplanar forces will ensure a detailed structural roof members(ridge cap, roofing covering especially corrugated aluminum sheets, hard wood purlins,rafters,tie beam, wall plate and ceiling noggins, all in their correct specification for architectural design. Most buildings in Akure have roofs that have incomplete structural roofing members to withstand the wind load.

4.0 The implications of the data to architectural design in Akure.

4.1 **Thermal design**: The results of data collected in the year 1986 as shown in the climatic data sheet calls for appropriate design measures to achieve thermal comfort, according to Prof Olu Ola Ogunsote, there are comfort limits that are moderated by some factors like:

i.**Air temperature**: comfort achieved between 16 and 28 degrees Celsius, the result of 1986 has temperature range of 21.05 to 30.7 degrees annually, i.e it is beyond comfort limit.

ii.**Air velocity**: 0.1 to 1.0m/s is comfortable indoors, and 2.0m/s out doors September records a mean velocity of 1.7m/s which is the highest in the year, with this result landscape design (planting trees at specific location to serve as wind breakers, dust filters and control the micro climate around the building.

iii.**The Relative Humidity**: from the result in figure 1, reveals that Akure experiences high relative humidity throughout the year, June records the highest RH of 89%, to achieve comfort, good ventilation through standard window sizes, restriction of heat flow into the building, reflective roof materials and high insulation must be in the design.

4.2 Other considerations:

4.2.1 Roof: The roof type, roof slope, roof structural members, roof span of buildings in the design of buildings plays important role in achieving comfort. Corrugated aluminium roofing sheet, roof slope between 15^0 to 25^0 for proper

drainage, eave projection not less than 600mm with over hang to counter the excessive wind velocity.

4.2.2 **Use of court yard and verandahs in design**: Since the major design challenge in the tropics is ventilation, court yard should be inculcated into the design for moderation of air temperature and air velocity of the interior, also verandahs/terraces is equal a design solution for thermal discomfort.

4.2.3 **Use of low Thermal capacity appliances and building materials in the interior**: Artificial lighting appliances used in the interior also generate heat, there fore with the climatic readings of Akure in 1986; appliances that generate heat should be wisely specified by architects in their design also the **texture** of building materials and the **color** of interior can also cause thermal discomfort

Conclusion:

It can be inferred from the climate data of Akure in the year 1986 in comparison with the work of other colleagues on this term paper that the climate of Akure is likely to be **warm humid climate** that is characterized by low diurnal temperature, high temperature and high relative humidity, high solar radiation, the knowledge this climatic peculiarities is to aid the architect to design a building that adapts to its climate naturally without the extravagant reliance on passive technology of heating ,cooling, and ventilation.

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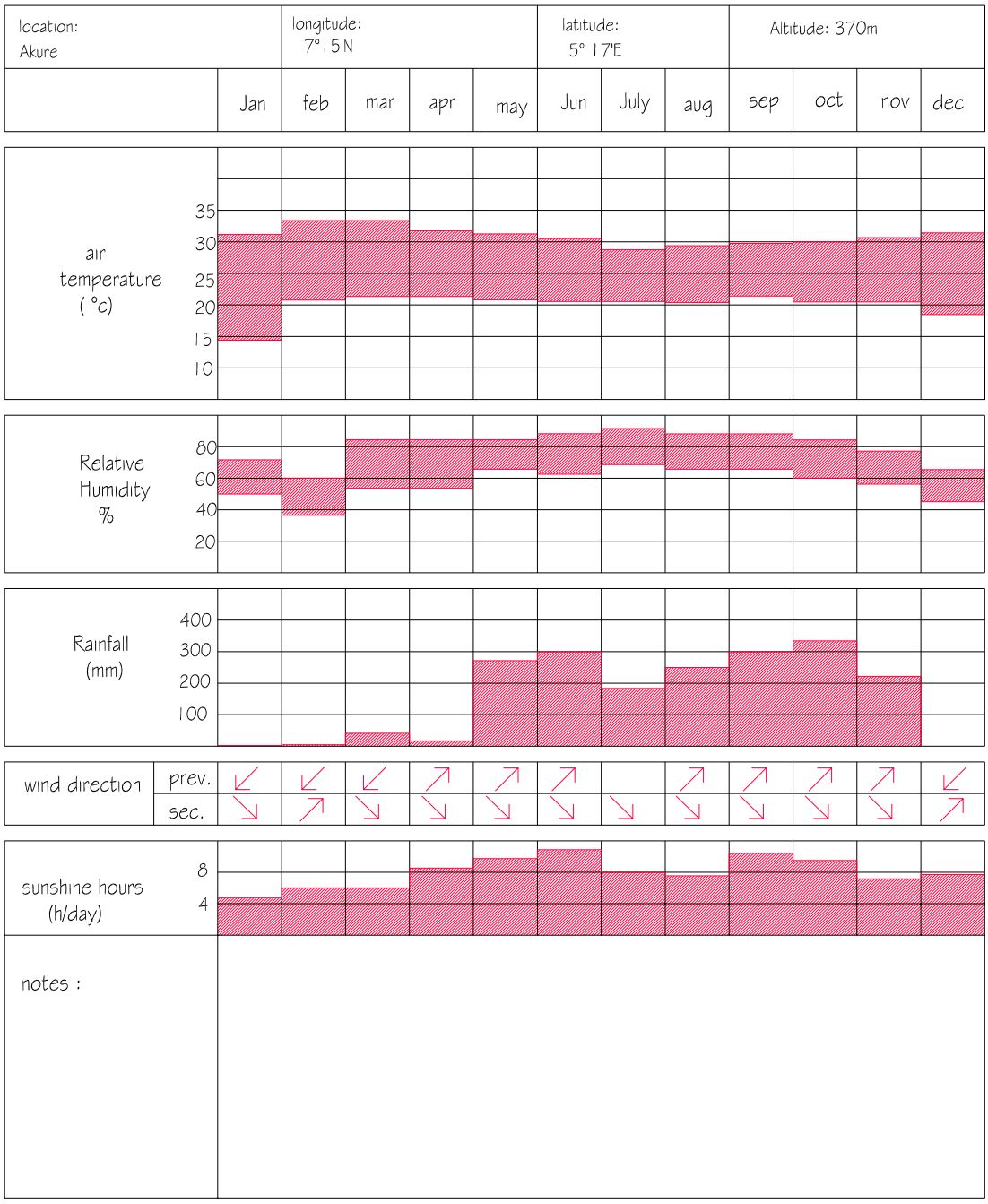

° CLIMATIC CHART FOR AKURE IN THE YEAR 1986 Figure:2

Location, Year: 1986 Akure	Latitude :$7^{0}15^{1}$ N	Longitude : $5^{0}17^{1}$ E	attitude : 370m above the Sea level
Source, various	Collection by:	Notes :	

		J	F	M	A	M	J	J	A	S	O	N	D	
Dry Bulb Temperature ^{o}C	mean monthly maximum.	33	33.9	34	32.8	30.9	29.7	26.6	27.2	27.9	29.7	31.1	31.6	30.7
	mean monthly minimum.	14	22.2	22.8	23.5	22.4	21.9	21.3	21.1	21.5	22.2	21.9	17.8	21.05
	mean monthly temperature.	23.5	28.1	28.4	28.2	26.7	25.8	24.0	24.1	24.7	26.0	26.5	29.7	26.3
	mean daily maximum.													
	mean daily minimum.													
	mean diurnal range.													
	extreme maximum.	35	37	34	35	33	32	29	30	30	32	32	33	32.7
	extreme minimum.	14	15	18	20	20	20	19	18	20	20	20	14	18.2
Relative Humility	mean daily maximum(%)	73	61	82	82	82	85	89	87	87	81	79	65	79.4
	mean daily minimum (%)	51	36.6	57.9	57.9	68.9	61.8	67.1	65.2	65.2	58.6	56	45.3	57.6
	mean Humidity(%)	63	48.8	69.9	70	75.4	73.4	78	76.1	76.1	70	67	55.2	74.7
	mean vapour pressure	23.9	27.4	28.3	29.1	28.0	27.1	25.4	24.9	26.2	21.5	25.9	16.7	25.4
	no of days of fog													
Prec. (mm)	mean monthly(mm)	1.27	7.96	54.8	28.3	282	293	187	244	296	315	203	-	1912
	maximum in 24 hrs.(mm)													
	days with 0.25mm/more	1	4	7	3	12	14	10	11	18	18	10	-	108
Sky	hours of sunshine	5.5	6.8	7	8.2	9.0	9.9	8.0	7.0	9.2	8.6	6.9	7.8	7.8
	Cloud cover, oktas (or %)													
Wind	maximum velocity (m/s)													
	mean velocity (m/s)		1.42	1.24	0.97	1.21	1.5	1.2	1.2	1.7	1.4	1.5	1.6	1.4
	Prevailing direction.	NE	NE	NE	SW	SW	SW	SW	SW	SW	SW	SW	NE	
	Secondary direction.	NW	SW	SW	NW	NW	NW	NW	NW	NW	NW	NW	NE	