BUILDING RESEARCH INSTITUE

BY

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A THESIS

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DEDICATION

I'm dedicating this thesis to the following:-

--- My mother Mrs. Sazeya Ahmadu
who has laboured to train me
from Elementary school to high
school level.

--- My fellow Christian brothers and
sisters whose earnest prayers and
concern have helped me in preparing
my thesis.

--- Above all My Lord Jesus Christ
whom I serve and whose grace has
been sufficient for my thesis.

ABSTRACT

I observed that our country Nigeria has been bless tremendously with local building materials e.g. Laterite and lateritic soil, timber, bamboo, oil from which plastics is a by product etc. Its sad to notice that this country imports on an increasing trend building materials, some of which the raw materials arc ore available in this country e.g. Brick.

Our country is very diverse climatically; ranging from the rain forest of the south to the semi-arid region of the North. Therefore the influence of climatic agents (wind, rain, temperature etc) on our building materials varies.

At this stage of our National Development when the federal Government has just realised that we are not so much rich as wo thought we were, the early wo embark on research in building construction and materials the better for us. It is definitely check inflation in the construction industry.

So far there is no such an Institute in the country therefore I'm the first person to handle such a design. From existing ones in India, Canada, there is a lot of rooms for improvement as far as the Architecture of such an Institute is concerned. There is great need of flexibility and growth.

ACKNOWLEDGEMENT

I feel greatly indebted to Professor K.C Datta of Department of Architecture, University of Nigeria Emugu Campus whose ideas right on the onset of my thesis gave me a sense of direction which has helped me in getting my design principle.

I also acknowledged the ideas and facts from Professor DMochowski of Jos Museum whose findings about traditional materials in and around Jos helped me in my thesis.

I thank my Mentor Mrs. Dr. Hajnosz and the lecturers in the Department of Architecture, Ahmadu Bello University Zaria whose criticism have helped in bringing my work to standard.

Finally I thank Mr. A.R.C. Bello of Department of Civil Engineering for helping me with technical data for the various laboratories.

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INTRODUCTION

This study is a hypothetical one in that the whole scheme is not a life project but a partial fulfilment of Master of Science Architecture degree. However it has some practical implications. The purpose of the study is to come up with Design principles which are applicable to designing of an Institute where Research on Materials and building problems would be done.

In this study I found some difficulties the main one being the fact that it was not easy getting technical information on the various laboratories and it was not possible to get the plan of an existing Building Research Institute for a case study. I wrote some organisation and Institutes but many either did not reply or the reply was of no use.

In this report chapter one deals with background report on scientific Research generally in Nigeria and Building Research in particular. Chapter two deals with the location and site analysis. In chapter three and four give the general description of the component parts of the Institute, while chapter five gives schedule of accommodation.

The design concept is described in chapter 6 and special planning problems in seven.

CHAPTER 1

MOTIVATION AND BACKGROUND REPORT

Motivation

Going through the National dailys on e finds report from the construction industry that shows there is a lot of room for improvement in that field.

For instance the New Nigerian Newspaper of 29/8/76 carries an article by Dr. I. Tahir title "Cement shortage in Nigeria - the crux of the matter", Nigerian Herald of 19/8/77 carries "Cement crisis many can't build their homes", "Mistakes discovered in the construction of Federal Housing Units" New Nigeria of 31/8/77 by Mu'azu Alhaji, and several others. These show that their has been no much done to study our building and housing problems with view of finding solution to them.

It is a fact that Nigeria has been bless tremendously with local building materials e.g. laterite and lateritic soils, timber, bamboo, oil from which plastics is a by product etc. Its sad to notice that this country, instead of developing these materials, import on an increasing trend building materials whose raw materials are the once available in this country e.g. brick.

Our country is very diverse climatically; ranging from rain forest of the south to the semi-arid region of the south. Therefore the influence of climatic agents (Rain, wind etc) on our building materials varies.

At this stage of our development when the Federal Government has just realised that we are not so rich as we thaught we were, the earlier we embark on a study of our building problems in an organised matter

the better for us, for this would check inflation in the construction industry.

Right from the time the Military came into power in this country in 1966, there has been a lot of changes in the structure of the country. It started with four regions (West, East, North and Mid-West), then 12 states, then 19 states with many local government areas. This shows that smaller towns are made state or local government headquarters. These towns therefore have the potential of growing into urban centres. It is therefore importa-nt to have a strong and workable town planning law to check the haphazard growth of these towns.

With all these observation it is obvious that a BUILDING RESEARCH INSTITUTE is needed for the country.

Building Research in Nigeria

To the best of my knowledge there is no such an establishment in the country. From historical point of view the West African Building Research Institute in Ghana, which is an international organisation finance by the Government of Ghana, Nigeria and Sierra Leone and administer on their behalf by the West African Research of Accra, had a branch in Zaria, Kaduna which died a natural death long ago.

There are some numerous efforts by some Ministries or organisation alone this lines which cannot be called Building Research e.g. Professor Dmochowski of the National Museum Jos in doing some good job in studying the traditional Architecture of many ethnic group in the country.

Efforts from Federal Government

Federal Military Government through Decree (No.6) established the Nigerian Council for Science and Technology in February, 1970. The function of the

N.C.S.T. are to:-

Determine and Advice the Government on National policy and to co-ordinate and promote scientific activities in the country

Field covered are:-

1. Agricultural sciences
2. Experimental sciences (physics
3. Industrial science (Engineering and Technology)
4. Medical Sciences
5. Environmental Sciences
6. Social sciences.

Existing Research Establishment

These researches are done in some University Faculties e.g. A.B.U. Faculty of Engineering and in some government establishment e.g.

1. Institute of Industrial Research
2. Federal Land survey
3. Geological survey

Research Councils

So far approved research council that have somethings doing with Building Research is the Industrial Research Council of Nigeria which was established by Decree No. 33 of 1971. The functions of the (IRCM) are:-

i) Determine Research needs which will accelerate industrial development in the nation.

ii) Examine how the existing industrial research establishments are responding to the needs.

iii) To co-ordinate and promote all industrial activities.

The Kind of Research

Research could be defined as "the Methodical, systematic, directional study of a subject which is still largely unknown".

Modern research could be basic or applied. Basic research is geared towards a theoretical explanation of the basis of existence solely to increase the store of knowledge - whereas applied research include definite project directed towards pratical application of knowledge.

The engineering aspect of research has come to be known as development, which is systematic use of research in design and production of materials, devices or the organising of methods, processes and systems for production.

Justification for such a project

As shown above Nigeria has many research establishment in other fields but non in the construction industry.

Validity and Official Government views

The National Science and Technical Development Agency recognises the need for such an institute. Under her Grants for Scientific Research Projects" 1977/78 has the following

"The National Science and Technical Development Agency intends to award grants for research projects to scientists working outside the research Institute of the Agency... the priority areas of research for grants are

b. Building and Road construction research

i. Research on use of new and alternative materials and methods for various aspect of building and road construction with the view to reducing building costs, and ensuring effectiveness.

ii. Research on functional requirements of building in the Nigerian environment;

iii) Characteristics of various binders like bitumen, tars, cement and their effectiveness with local aggregates in road construction". New Nigerian Newspaper 18/8/77.

The Purpose of the Study

The aim of this thesis is to provide an Institute where the professionals within the building team would work together and exchange ideas.

As an architect in the making my aim is to plan and design "Building research Institute" which will integrate offices, laboratries and the supporting facilities with flexible, adaptable and conducive architectural frame work.

The title of the thesis gives over all idea of its function.

The Scope of the "B.R.I"

There are various kinds of building research Institute. They could be broadly divided into two kinds:- (1) Acceptance (2) Acceptance and development.

1. Acceptance - here it is more of a quality control centre in that materials are accepted and their qualities are checked against certain standards.

2. Acceptance/Development: - Here is quality control and at sametime research with the view of finding new materials and methods.

There are some that specialise in one item only e.g. concrete research in London.

Since their is no such an Institute in the country and at this level of our development we need B.R.I. that will help in development materials and also new methods of construction.

The Function of the B.R.I.

The function of the Institutes include the following among others.

1. Undertake Research in various aspect of buildings ranging from foundation, soils, materials, function to the roof construction.
2. Informations or findings of the Institutes would be documented and such information could be made available to the members of the construction industry and the general public who may be interested.
3. Co-ordination:- because of the diverse climatic condition of the country and therefore diverse housing problems, I'm proposing Regional Stations whose activities would be co-ordinate in the B.R.I. Institute Jos.
4. Co-operation: this Institute would also co-operate and carryout Research on consultancy basis for the government, universities, manufactures of building materials etc.
5. Conferences:- The Institute will be expected to organise and host conferences at national an International level for the exchange of ideas and knowledge.

Special Requirements

1. Land: There is availability of land in this country so there is no fear of not having a place to build,
2. Manpower: Within the pass 5 years the number of universities in the country has almost trebled and therefore a lot fo graduates who will be working in such a research are also many. There are many colleges of technology in country producing graduates.
3. Fund: The Federal Government will finance this Institute as part of her effort towards solving our housing and building problems.

CHAPTER 2

Location

I'm locating this Building Research Institute in Jos the capital of Plateau state of Nigeria.

Geographic location of Jos

Jos lies on Lattitude 09°52' North and Longitude 08°54 East, it has an altitude of 1266 metres above sea-level.

Justification for the Location

Jos is on a Plateau therefore it has a cool and pleasant climate which easily attract people to it also has pleasant natural landscape.

There are some schools in Jos that would have some relationship with this Institute e.g. The University of Jos etc. Another reason for the location is the fact that Jos is close to the New Federal Capital at Abuja.

Climatic Condition

1. Temperature: - Generally Jos is cool and pleasant The hottest month is April with a maximum temperature of 87°F coolest month December - January with an average of 53 - 55°F.
2. Rainfall: Jos has fairly heavy rainfall. Raing period are April to October. It reaches maximum in July (37.4cm).
3. Relative humidity: Has high relative humidity, maximum ranges between 95-99% most humid months are August/September. Minimum relative humidity ranges between 8-10% and occurs in December to February.

Sunshines and Cloud covers

Most sunny period is from December to February with 7. 5 hrs/day of sunshine and 4.5 hrs/day of cloud cover.

Soil

The town has a rocky soil generally and well drained because of undulations.

See the accompanying sheets in this chapter for statistical data on climatic condition of Jos.

Site in Jos

In function, Building Research Institute resonates between an Industry and an Institution. It is industrially inclined because there is that idea of raw materials coming into it and the findings ("finished products") about them are taken out. It is institutionally inclined in that it is a deliberate attempt to know more on how best to use building materials.

In my site selection I wanted this to be seen. Therefore by site is on the Northern part of Bauchi. Just a after Naraguta village and between University of Jos and a Brick Industry by the Nigerian Mininining co-operation. This site has open landscape with chains of hills around.



National Road Communications

Kaduna, fortunately, is not yet throttled by through traffic mainly because the Kano-Lagos National Route A.1 veers westwards before reaching the city — and by-passes its northern boundary. Improvements on the Kachia Road to the south and south-west however could change this situation almost overnight if plans to straighten and re-grade this diversion route to the coast materialised and suggestions to bridge the Niger 250 miles to the South at Lokoja-Kabba are put in hand.

For this reason the Capital's proposed central spine road should be designed to carry between five and ten times as much through traffic as Ahmadu Bello Way, (which it will relieve), now takes.

REGIONAL TRAFFIC CENSUS



MAXIMUM REL: HUMIDITY PERCENT AT JOS AIRPORT 1964-72

PERIOD	MONTHS											
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
JOS 21 Yrs	33	31	55	78	90	94	97	97	95	84	54	39
'64	32	16	51	88	93	93	96	96	92	84	52	39
'65	89	92	89	98	99	99	99	100	99	99	62	76
'66	56	82	88	98	99	99	(99)	(99)	(88)	(92)	(75)	77
'67	49	89	89	95	98	98	99	99	99	99	96	96
'68	94	95	99	99	99	100	99	99	99	98	98	99
'69	89	84	98	100	95	99	99	100	99	99	95	43
'70	84	89	90	93	92	88	82	81	82	86	84	86
'71	32	50	66	76	83	96	91	95	95	85	25	25
'72	60	53	67	77	98	83	94	95	97	75	52	6

MINIMUM R.H. PERCENT AT JOS AIRPORT 1964-72

AIRPORT/ PERIOD	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
JOS 12 Yrs	13	6	32	33	52	63	72	74	63	42	20	16
'64	11	7	13	43	65	63	73	73	63	37	24	19
'65	6	1	1	7	12	33	48	41	43	18	5	5
'66	1	2	2	2	11	32	38	(49)	(41)	(15)	(16)	5
'67	2	3	3	4	19	23	45	57	40	12	7	5
'68	6	3	2	2	39	37	41	40	52	14	6	8
'69	4	3	5	16	27	29	41	57	45	31	12	8
'70	14	15	20	40	69	71	82	84	75	43	17	14
'71	8	4	5	4	38	45	45	56	35	13	7	10
'72	8	6	6	11	24	43	55	59	49	14	12	9

AVERAGE MONTHLY MEAN 09.00HRS GMT VAPOUR PRESSURE-JOS AIRPORT

JOS AIRPORT	MONTHS I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
PERIOD 16 Yrs	4.9	5.0	9.0	15.7	19.8	19.7	19.7	19.6	19.4	15.8	7.5	5.8
'64	4.5	2.3	7.5	19.0	21.7	20.2	19.7	19.4	18.8	14.7	7.6	6.5
'65	7.1	6.4	6.1	13.0	19.4	19.6	19.6	19.2	20.0	15.3	6.3	4.4
'66	2.4	(5.2)	5.7	15.9	15.9	16.9	18.2	19.5	19.7	(19.4)	(6.6)	4.4
'67	3.4	4.1	5.3	19.5	19.5	19.2	19.7	19.5	18.8	14.6	5.9	6.0
'68	7.2	7.3	13.6	19.3	19.3	19.0	19.0	19.4	18.7	15.0	8.7	6.6
'69	.	.	.	.	.	.	.	19.8	16.3	18.3	7.8	4.4
'70	3.8	4.3	6.4	20.1	20.1	19.9	20.0	19.6	19.3	12.8	4.7	3 5
'71	3.6	3.8	10.5	13.3	19.3	19.1	18.7	19.0	18.5	11.7	4.1	4.2
'72	4.8	6.1	9.7	19.3	19.3	18.9	19.4	19.5	19.4	15.3	5.1	5.8

Notes: Vapour pressure measured at 07.00 Hrs Nigerian time"

AVERAGE MONTHLY RAINFALL AT JOS AIRPORT 1964-72

PERIOD	MONTHS I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
JOS 44 Yrs	0.1	0 1	0.1	3 6	7.6	8.9	12.6	10.9	8.4	1.7	0.1	0.1
'64	0 0	0 0	0.0	2 8	6.6	9:0	12:7	12:6	7:3	1.7	1.0	0.0
'65	0 0	0.2	0.2	4:0	3:9	10:1	9.9	17:8	7:6	0:4	0:0	0:0
'66	0.0	0.0	0.0	4.6	6:5	10:3	14.7	12:3	(7:7)	(1:2)	0.0	0.0
'67	0.0	0.0	0.0	4.5	6:1	7:8	14:2	17:4	7:0	1.9	0.0	0.0
'68	0.0	0.0	0.0	0.2	8.3	7.2	10.7	15:1	6:0	0:8	0.0	0.0
'69	0.0	0.0	0.0	8.0	5.7	7.8	16.8	15.3	9.1	4.6	0.5	0.0
'70	0.0	0.0	0.0	2.8	6.3	4.6	9:5	10.0	9.8	0:6	0.0	0.0
'71	0.0	0.0	0.0	1.6	9.7	7:6	13.3	12:2	10:5	1.0	0 0	0.0
'72	0.0	0.0	0.0	2.1	9.4	7.2	9.9	16.3	7.9	0.2	0.0	0.4

Notes: Figures in brackets are estimates. Rainfall of 0.0 inches and above

Sources: Meterorological Stations, Jos Airport.

Generally the climate of the state varries from the hot humid conditions in the south to the cool and pleasant conditions on the Jos highlands Jos, the state captial has the collest temperature of all the state capital in Nigeria through out the year.

AVERAGE MONTHLY MINIMUM TEMP. IN JOS AIRPORT 1964-1972

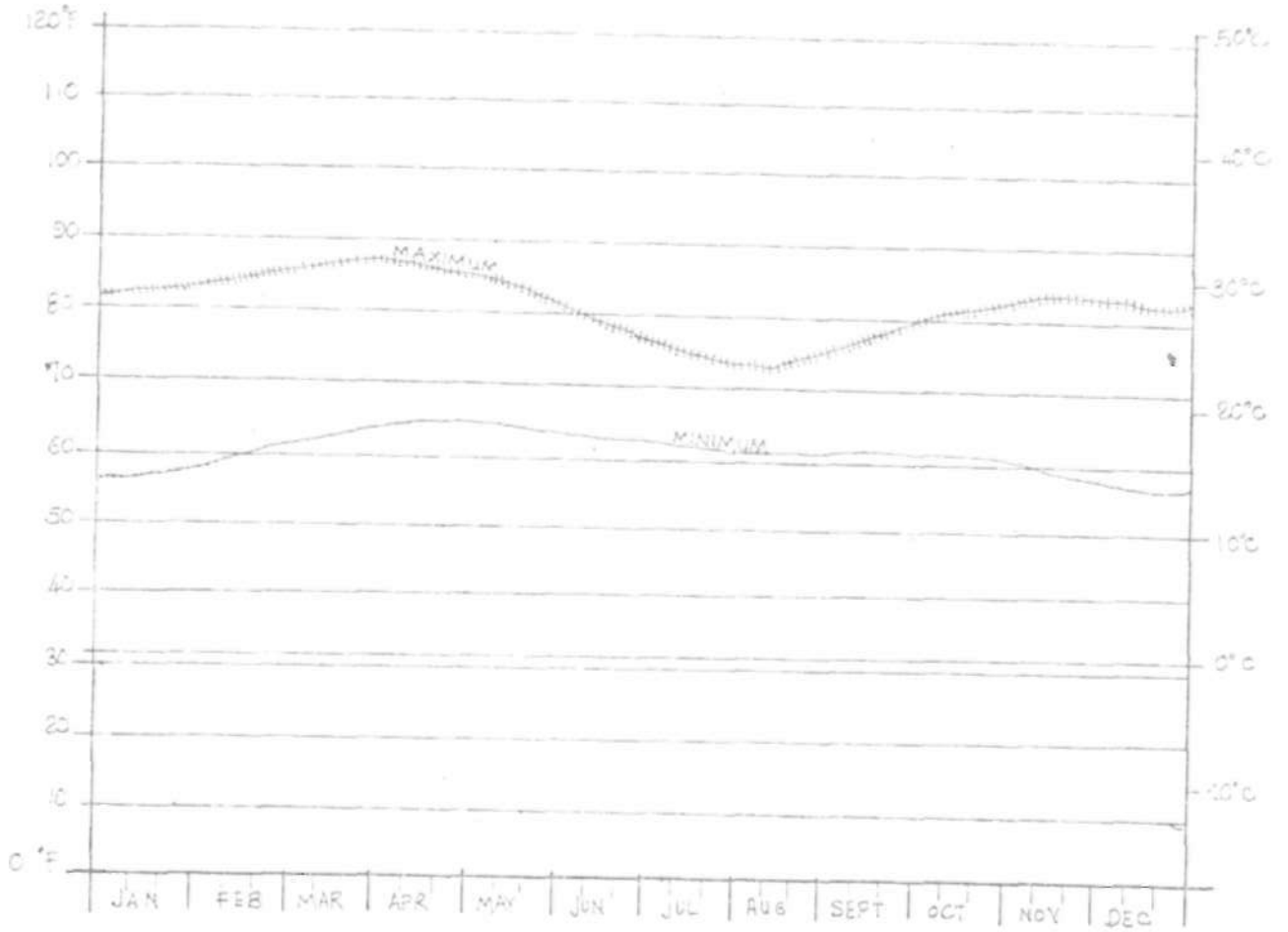
^{o}F

PERIOD	MONTHS											
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
5 14 Yrs	57	60	64	65	64	63	62	62	62	62	60	57
'64	58	60	66	65	65	63	62	61	62	62	61	58
'65	59	62	65	65	64	63	62	62	62	62	61	57
'66	58	60	65	66	65	63	63	(62)	(62)	(62)	(60)	(58)
'67	54	61	65	66	64	63	62	62	61	62	60	60
'68	56	60	62	64	64	59	62	62	62	63	62	58
'69	56	63	67	67	66	62	63	62	62	62	61	60
'70	59	60	63	66	65	63	62	62	62	62	60	58
'71	46	54	61	61	59	54	59	57	59	57	55	48
'72	53	57	61	60	57	60	59	59	59	59	51	50

The mean and maximum temperatures in January, April, July and October, on the average for 10 years up to 1966 are, 56, 65, 63, 71, 82, 87, 75 and 82 ^{o}F respectively.

AVERAGE MONTHLY RAINGDAYS IN JOS 1964-72

PERIOD	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
JOS 44 Yrs	0	1	2	10	15	16	23	23	15	7	1	0
'64	0	0	1	10	15	15	24	25	9	3	1	0
'65	0	1	1	6	11	20	27	19	17	5	0	0
'66	0	0	1	11	12	21	23	27	(16)	(5)	-	0
'67	0	0	2	8	12	20	25	27	15	5	0	0
'68	-	2	3	11	12	21	19	22	14	4	-	-
'69	0	0	0	12	16	22	24	28	18	10	1	-
'70	0	0	1	5	13	17	24	27	22	3	0	0
'71	0	0	3	4	16	17	27	23	20	4	0	0
'72	1	0	3	8	17	13	21	20	17	5	0	1



HISTOGRAMS OF MEAN MAXIMUM & MINIMUM TEMPERATURES

LEGEND

STATION = JOS AIRPORT

MAXIMUM TEMPERATURES

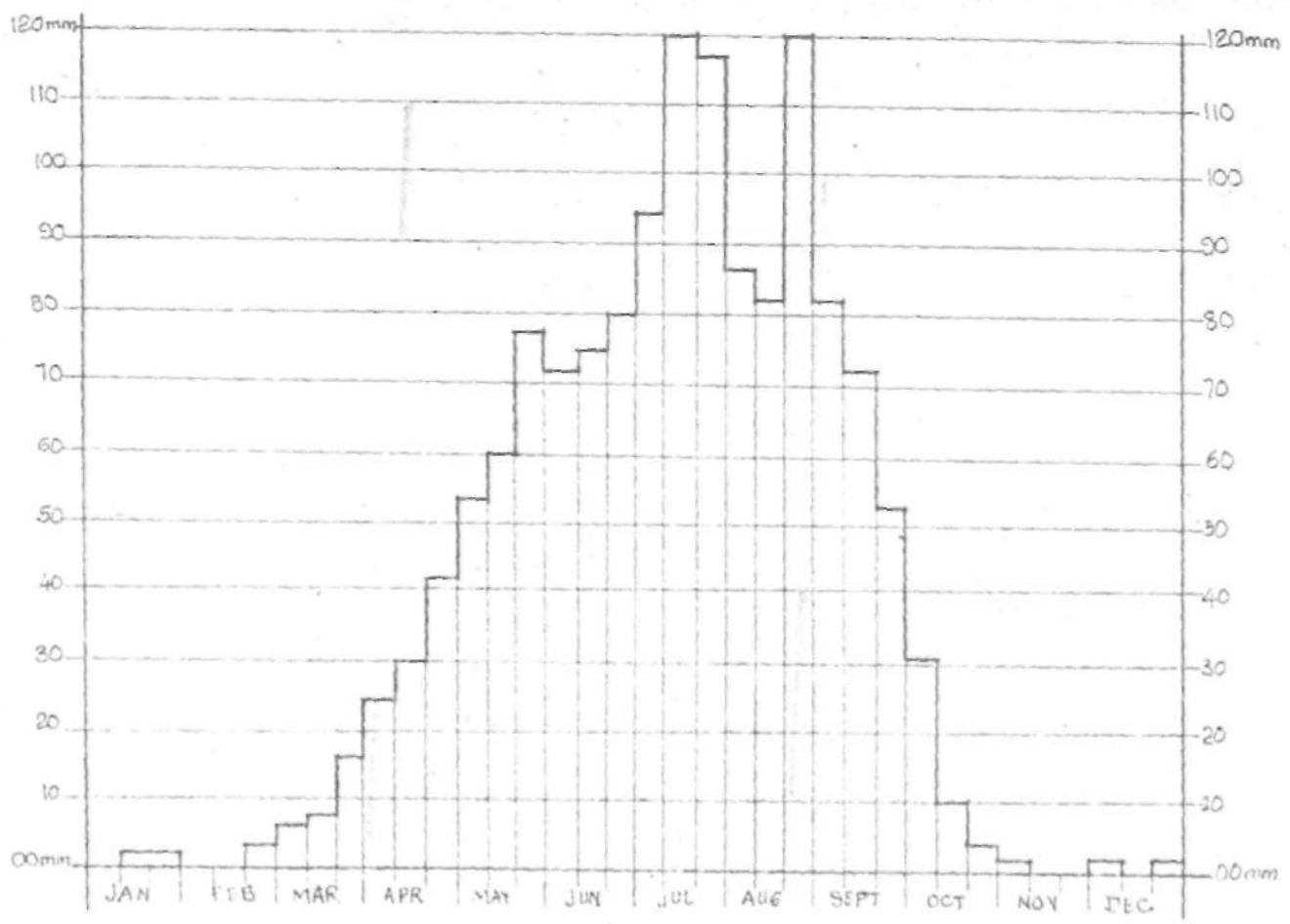
MINIMUM "

RANGE = 20°F

SOURCE = NATURAL RESOURCES ES & RESEARCH II, METROLOGICAL DIV. LAGOS.

JOS

MEAN TEMPERATURES



HISTOGRAM OF RAINFALL IN TEN-DAY PERIODS

LEGEND

STATION – JOS AIRPORT

LATITUDE – 09° 52' NORTH

LONGITUDE – 08° 54' EAST

ALTITUDE – 1238 METRES A.S.L.

TOTAL RAIN = 1380mm

SOURCE = KOWAL & KNABE P. 102.

JOS

ANNUAL RAINFALL [MEAN]

CHAPTER 3

COMPONENTS OF BUILDING RESEARCH INSTITUTE

There are four basic areas in any research complex viz:-

1. Administrative offices
2. General supporting facilities e.g. cafteria, confernece hall etc.
3. Service facilities
4. The Research area itself.

The addition of teaching facilities does not change this pattern much.

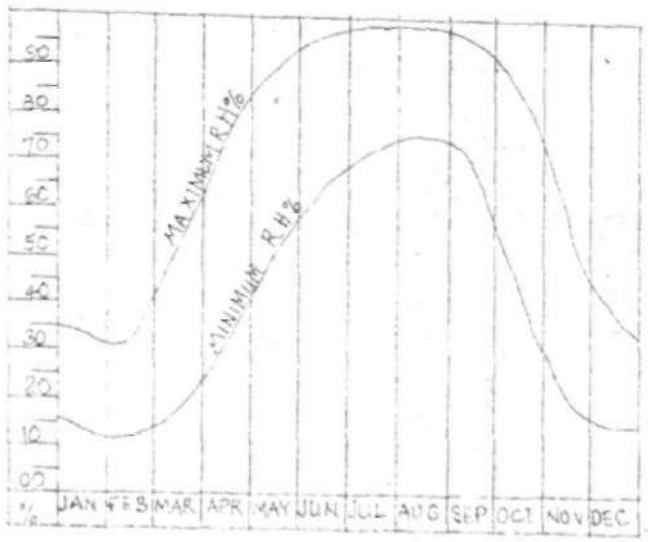
The main difficulty with the non-Research areas is to prevent them from interfering with the Research part. A badly located conference hall can strangle the expansion of the research facilities.

The best way of avoiding this is the overall planning grid. The master plan must make adequate provision for the growth of all the four parts, either through campus type of planning or through sufficient articulation and separation of each area. A sound knowledge of all the four parts would help in arriving at a comprehensive planning.

Administrative Offices

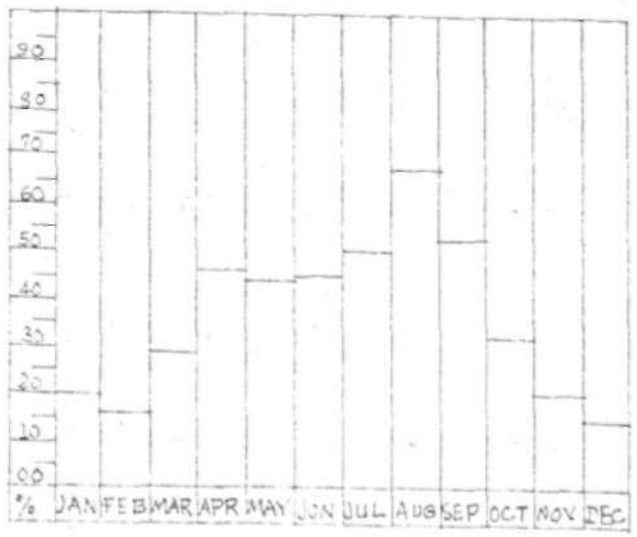
There are two kinds of offices - offices for those who are purely administrative staff and offices for technical staff (this would be handled under room associated with labs). In planning offices for the administrative staff, the area per employee depends on the nature of work and the rank of the officer, use of equipments and degree of privacy and storage needed.

The office of the directors should be large enough to allow for some committee meetings. High ranking officers (heads of department e.g.) should have separate offices while lower ones could share.



RELATIVE HUMIDITY %

THREE HOURLY MEAN MONTHLY RELATIVE HUMIDITY DURING 24-HOUR PERIODS.
LONG AVERAGE MAXIMUM — 71% (13 years).
LONG AVERAGE MINIMUM — 40% "
SOURCE NATURAL RESOURCES, LAGOS



CLOUD COVER %

CALCULATED AS PERCENTAGE OF THE POSSIBLE 12 HOUR SUNSHINE PERIOD PER DAY IN JOS.
AVERAGE HOURS OF SUN SHINE = 7·5 (5 years).
HENCE AVERAGE HRS OF CLOUD COVER 4·5 "
SOURCE : SAME

JOS

CLIMATIC CONDITIONS

The administrative area forms a bridge between the general public and the research Institute.

General Support Facilities

These are facilities that help in the effective function of the research complex and they include the following:-

2.1. Library

2.2 Publication Unit

2.3 Computer Unit

2.4 Exhibition (closed and open)

2.5 Cafeteria

2.6 Conference Hall and Seminar Rooms

21. Library

The function of a library in any Research establishment can never be over emphasised. The library provides information for two groups of people - the Research Staff and the public under special arrangement can use it for references. The search staff can borrow books to their Departments.

Activities in the library include:-

- making references to books and journals
- general reading and study
- administration of the library
- shipping and receiving of books and periodicals

Since collections of books, magazines, journals etc can increase quickly there is need to give room for expansion so that 30 years to come the Library will still be adequate.

2.2. Publication Unit

The aim of the Building Research is to serve the construction industry in Nigeria. This means more than just putting Research personnel to work in laboratories though the importance of such work cannot be over estimated.

Therefore the task of getting the information obtained in the labs to the men in the industry is very important. Only when this is done can the work in the labs be considered complete.

The publication unit can report quickly on the results of works carried out by the Institute and also distribute such report. This unit will help to bridge the gap in communication between the researchers and the construction industry. Accommodation for this unit includes the plant room, stores for raw and finished materials, and offices for administrative purposes.

3. Computer Unit

The use of computer in Research is ever increasing. The National Office of Management Association (U.S.A.) has defined computer as "a device capable of accepting information; applying prescribed processes to information and supplying the result of these processes from internally stored instructions as opposed to calculatros where the sequence are impressed manually from tape or from cards".

Users of the Computer

There are three categories of computer users:-

a. the public who may visit the Institute, they could be introduced to same aspect of computer.

b. the computer staff who see to the operation of the computer.

c. the research staff who use it in their calculations.

Accommodation Requirements

This includes:-

a. Offices for computer analyst, programme writers, maintenance engineer, operational manager and clerical Assistant.

b. Users room (where terminus are)

c. Main computer room

d. Machine room

e. Storage spaces

f. Library and seminar room may be provided.

Special Requirement of Computer

1. The first consideration is the provision of adequate space for the particular kind needed. Since there are various kinds, the space requirement also varies from 370 - 3,500 sq. ft. or more.

2. Floor strength and construction. The unit making up the computer are heavy, giving rise to concentrated loads on the floor. Currently the prefared method of solving the problem is by the provision of secondary floor raised on the building floor slab. This has advantages e.g. inter-connection power cables and receptacles may be concealed yet remain easily accessible, space between floors may be use to house air conditioning duct and future changes in the layout may be done with minimum cost of time and experience.

3. Air-conditioning:- the computer unit needs very close control of air temperature, humidity and dust if any of these is not kept at a prescribed limits the machines cannot work. The provision of the air-conditioning is therefore very necessary. Separate air-conditioning serving the computer alone is recommended The location should be in a room adjacent to the processing machines themselves.

4. Accoustical treatment. Many of the units in computer produce considerable noise. The worst offenders are such components as the card machines, printers and blowers Therefore accoustical treatment are needed for the comfort of the operators.

5. Vibrations. Computer Instalations cannot and should not be made there is large vibration.

6. Electric power:- the computer requires or places heavy load on the electrical system of an office building. Therefore it is important that the computer system feed does not feed other loads.

2.4. Exhibition (Close and Open)

The provision of this would further allow the public to see for themselves progress made in the Institute.

In the close exhibition (museum) there are three main areas namely:-

a. staff office for the few workers in the museum

b. Snack bar for the visitors

c. the exhibition area. Here things on display may include:- photographs of buildings completed and under construction, Architectural drawings models, and various kind of building materials.

The open exhibition is more of a "testing ground". Various kinds of materials that are developed in the Institutes are exhibited in the open and this reactions to climatic agents such as temperature, rain, wind etc. are studied. It is also open to the public.

2.5. Cafeteria!

This is strictly for staff only. Since the location is a bit far from Jos town where most of the staff would be residing, the provision of cafeteria would help the staff to get food during break without much waste of time.

2.6. Conference Hall and Seminar Rooms

The Institute also holds various meetings and seminars. The conference Hall is normally used for board meetings and when the technical staff are meeting

to draw up their research programmes and during review of such programmes. The Institute trains non specialised staff, who assist the researchers. This could be done in the seminar rooms. Conferences and seminars as means of given out information to the public are also organised.

The Conference Hall has a capacity of 250 people while the seminar rooms can take 40 people each.

CHAPTER 4

THE RESEARCH AREA

The most important area of the Research Institute is the laboratory areas. The planning of the lab area should aim at achieving suitable environment for the performance of specific scientific research. The planning should also aim at flexibility and growth of the labs.

Types of Research Labs.

There are two types broadly classified.

a. Bench labs.

b. Fixed plant labs.

Each type has it own implication on the architectural scale of the building.

Bench labs.

Here there is less plants and therefore the emphasis is on the scientist, so the heights, areas, orientation lighting, etc should relate to the man.

Most research areas need desk space as well as bench spacing.

Some experiment need controlled or regulated temperature and humidity or the elimination of outside interferences. There could be seminar rooms.

b. Fixed Plant Labs.

Here the machine dictate the scale of the building they may be labs for testing materials in industries, military labs and heavy labs workshops in engineering. They house bulky machines resulting on heavy loads on the floor. They should therefore be located on the ground floor. There are over head cranes carrying loads therefore calling for strong structural frame work.

General labs space

The most important way in which to consider the size of lab room is in terms of the number of staff it is to house, (often this is the only information available). But in fixed plant labs where bulky machines are used the size of the machines control the space requirement.

General labs space may be considered as a scientist working base and for the purpose of planning, it forms the centre of laboratory activities. This space is supplied with services or may be equipped with conventional benches. Rooms associated with labs (offices, stores, etc) should be provided and this would be discussed latter.

Lab space, bench length, bench with and spacing

The floor area needed in the laboratory for each worker is defined by two dimensions. "Length" is the total length of benching, sink, fume cupboards etc, which he needs for his work.

"Width" is established by the width of his benching, plus the clear floor space needed for movement while working and for circulation between the benches. There is however a difference between the area needed for an individual worker in a room by himself and the area he needs if he is sharing the room with others. This is because circulation space and to some extent working space are shared. Facilities such as washing up sinks, cupboards are nearly always shared.

Bench length this means the length of serviced wall or service spine against which benches, laboratory vigs or other items of lab equipment can be placed, and where the normal services are available. Generally speaking 10-12 ft. of bench run is enough to satisfy individuals

most of the time. However there are occasions when scientist need longer length and it is important that the planning of the laboratory is flexible enough to accommodate this.

Sinks and Draining Boards

Two kinds of sinks are provided in laboratories:- large sinks with draining boards, for wash-up, and drainaways or cup sinks intended to relcive the effluent from experiments. The provision of drain aways is an integral part of the servicing arrangements for the working bench.

Sinks for washing-up and their draining boards are additional normal benching.

Bench width

The benching could be planned such that it rans at right angles to the outside walls. Unit width will therefore tend to determine the position of structural columns and thus the structural grid of the building generally. The bench width varies between 0.60 - 0.75 m .

Bench spacing

In considering the space between parallel runs of laboratory benching, there are three relevant factors to which authoponetic data may be applied.

1. Space taken up by the worker when actually engaged in working at the bench. This is equivalent to having the upper arms vertical and the lower are horizontal.
2. the space taken up when working parallel and close to the bench.
3. Space needed for bending down in front of the bench. doors or drawers would not normally take up more space than a person in the bending position.

It is also important to take into account the possible need to move back and from the bench quickly in an emergency. Other factors which may affect the designers decision on bench spacing are the frequent use of trolleys for carrying supplies or equipment such as portable pumps or compressors, this calls for greater passage between benches. If the gang way is used as an access route to other working areas or special rooms, additional width may be required if undue disturbances are to be avoided.

Height of benches: Recommendations for sitting and standing are 0.60 and 0.90 m. respectively.

A Unit of Laboratory space

The unit under consideration is shown below. It is important to consider the suitability of the various shape alternatives.

The unit is shown with benching or laboratory planned to run along the long sides of the unit only. It is of course also possible to plan a square unit with benching running three sides as shown in B. It can be proved easily that such an arrangement is less satisfactory.

1. It is inconvenient, in that it does not provide the long, straight runs which have been shown to be necessary to meet peak demands for bench length.
2. It is more expensive to run services to benches arranged around three sides of a unit.
3. It is wastful of floor space
4. Financing a building composed of units planned as a rectangle will require less corridor and can be more compant and economical than one composed of square units.

Rooms Associated with Laboratory space

The general laboratory as discussed in so far is the scientist working base , where most of his time is usually spent. However from time to time the scientist uses other rooms, some of which are in close association with current work, that they must be very near to the general laboratory.

The functions and design of such rooms must be planned in close association with the laboratory area.

Rooms associated with labs fall into three groups.

1. Offices for scientist
2. rooms for special purposes
3. animal houses.

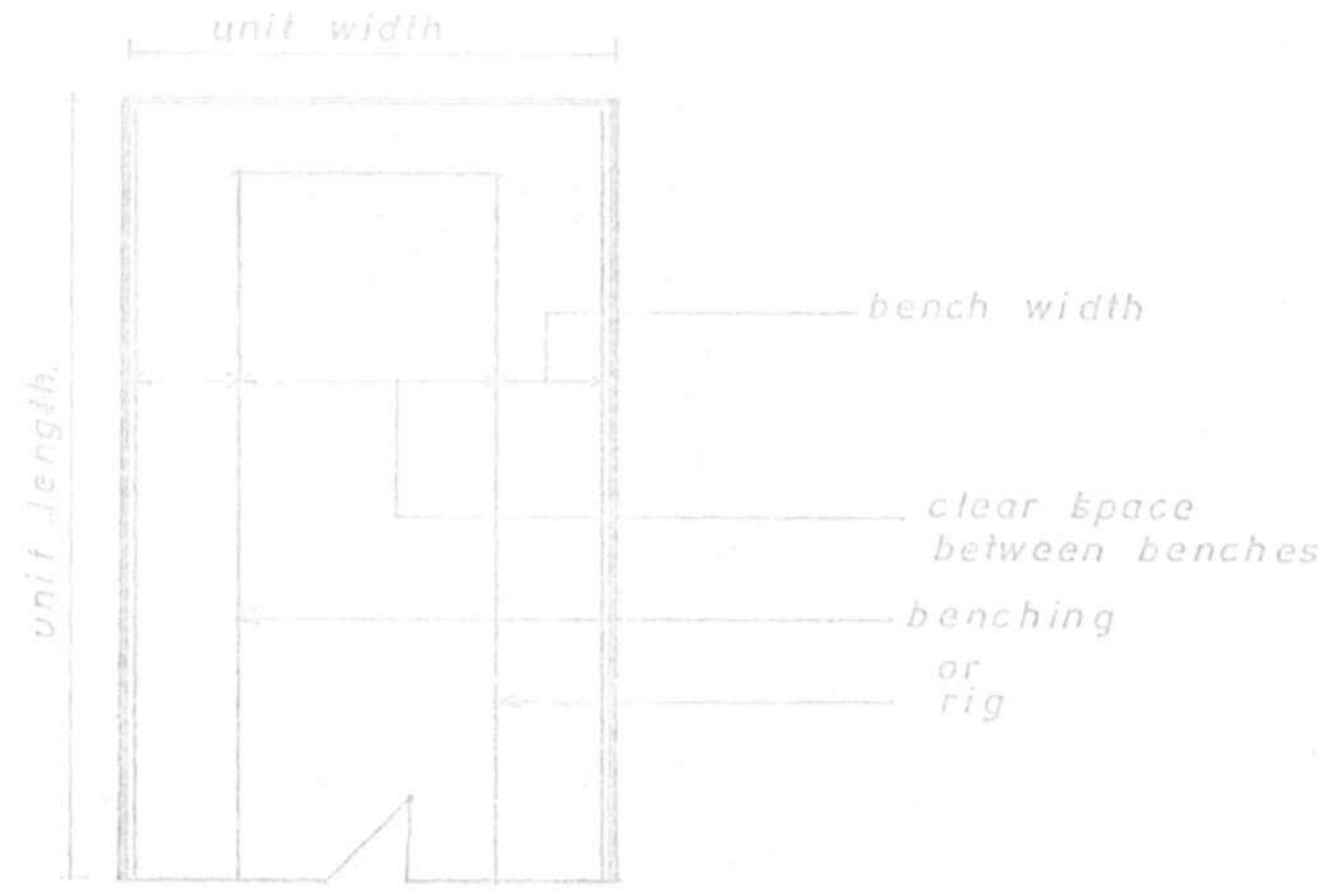
I don't have no. 3 in the thesis so that one will be left out.

1. Office for Scientists

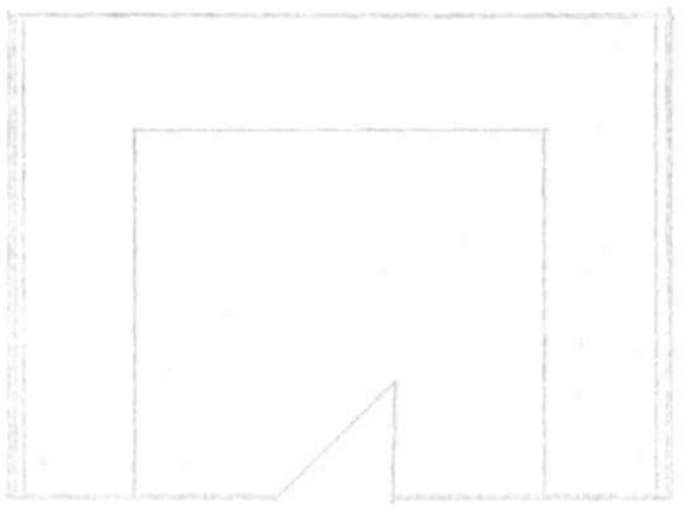
It is a common phenomenun that quite a reasonable time of the scientist is spent in reading and writing. It is therefore important that the design of laboratory makes provision for that. There are three possible alternatives:-

a. the provision of desks in the laboratory itself
b. the provision of separate offices adjoining to the laboratory.
c. the provision of separate offices more or less remote from the laboratory.

Most scientist prefer a permanent place in which they can read and write. The place should also have some measure of quite and privacy. This place also should be very close to the laboratory, if possible opening into the laboratory. This is important because their could be an urgent need to keep in close contact with an experiment that may be going on in the labs. However since flour space in the labs are very costly,


unit width
unit length
bench width
clear space
between benches
benching
or
rig

A



B

costing about twice as much as floor space in a wing devoted entirely to offices, a compromise solution between functional relationship and cost must be worked out. This could be done by planning small offices, no larger than cubicles and directly adjoining the laboratory. They should be large enough to contain the scientist's desk, his books and to allow him to interview one or two people in private. A very good design approach is to plan the labs on a dimensional grid, such that office space can be freely formed in a lab area by partitioning and subsequently revert to use as a lab where necessary.

Rooms for Special purposes

Other rooms associated with labs apart from offices are special rooms. There include instrument rooms, controlled environment rooms, and rooms housing special techniques such as chromatography and tissue culture which cannot be carried out conveniently or effeciently in the open laboratory.

Some of these rooms are more or less permanent particularly those designed to provide controlled environment, such as cold rooms and constant temperature rooms, others may be needed temporarily and become redundant after serving their function.

They are usually served with the normal labs services electricity, water, and drainage, and often require extract ducts for fume cupboards or special ventilation as well as accommodation for special plant such as compressors in the case of cold rooms. The best way of providing these special rooms is to make sure that the general lab. area lends itself to subdivision, in such a way to enable rooms of appropriate size to be made by temporary partitions.

These rooms, then can become partitioned off areas of the labs. When any of such rooms are no longer need, the partitions can be removed and the area becomes part of the general laboratory. In large establishment, it may be necessary to centralise special rooms in one area, instead of scattering them. This has the advantage of easy services.

Balance and Instrument rooms

There are occasionally used in the laboratory, but more frequently they are housed in separate room in the lab. they serve. Tables or benches must be of solid construction, giving a strong support on which instruments are placed. sensitive balances used for weighting; small substances, may need protection against vibration. This can be done by the use of modern instrument mountings. Slate slab or cast in situ concrete bench tops supported on concrete dwarf wall can be used. Balances should not be placed near heat sources, such as ovens or furnaces and should be protected against solar heat gain, the balance room should be as free as possible from contaminations by fumes, excessive humidity, dust etc. Air-conditioning balance room may be essential for micro-analytical work.

Rooms with controlled environment

The range of provision of controlled environment in Research labs varies greatly. In some cases small refrigerators; incubators, or ovens are placed in the laboratory and in some cases controlled temperature rooms are equipped for storage of large numbers of samples.

Very often temperature is the element under control, but at time humidity is also important.

CHAPTER 5

SCHEDULES OF ACCOMMODATION

Accommodation	No.	Area m^2	No. of people
(1) Administrative Offices			
1. Director	1	45	1
2. Secretary	1	30	1
3. Deputy Directors	2	60	2
4. Staff Officer	1	30	2
5. General Administrative Office	1	60	8
6. Chief Accountant	1	30	1
7. Secretary to Chief Accountant	1	15	1
8. Account Office	1	45	5
9. Head cleaner	1	15	1
10. P.R.O.	1	30	1
11. Secretary to P.R.O.	1	15	1
12. Store	1	45	-
13. Entrance lobby and reception	1	144	2
14. Toilets	6	30	-
TOTAL		594	26
(2) Bookshop			
1. Sales Manager	1	15	1
2. Store (books)	1	30	-
3. Book sales area	1	252	4
TOTAL		290	5

Accommodation	No.	Area m^2	No of people
(3) Library			
1. Librarian/Secretary	1	30	2
2. Mailing/Receiving	1	45	3
3. Reading/Book stacks	1	360	3 60 R
4. Toilets	6	20	
TOTAL		455	9
(4) Computer Unit			
1. Plant room	1	45	-
2. Computer Room	1	45	2
3. Maintenance Engineer	1	15	1
4. Operation Manager	1	15	1
5. Programme writer	1	30	1
6. Computer Analyst	1	30	1
TOTAL		180	6
(5) Production Unit			
1. Plant room	1	45	6
2. Raw materials store	1	45	-
3. Finished product store	1	30	-
4. Production Manager	1	30	-
5. Editorial	1	30	4
6. Graphic Artist	1	15	1
TOTAL		200	11
(6) Staff Snack bar			
1. Snack bar	1	288	8
2 Kitchen	1	36	4
3. Toilets/bath room	8	120	-
TOTAL		444	12
(7) Seminar Rooms	2	144	50 seats
(8) Conferance Hall	1	300	250
TOTAL		444	

Accommodation	No.	Area m^2	No. of people
(9) Close exhibition			
1. Exhibition	1	576	
2. Reception	1	9	1
3. Office for staff	1	30	2
4. Cool drinks	1	144	3
5. Toilets	12	30	-
TOTAL		789	6
(10) Laboratories			
Architecture/Planning			
1. Offices	13	600	15
2. Modeling studio	1	60	2
3. Draughtman studio	1	72	3
4. Gallery/entrance	1	144	-
5. Toilets	6	30	-
6. Store	1	30	1
TOTAL		936	18
(11) Climatology			
1. Offices	4	120	10
2. Plotting room	11	60	3
3. Experiment Area	1	252	-
4. Toilets	4	12	-
TOTAL		314	13
(12) Building physics			
1. Offices	5	105	8
2. Experiment Area	1	144	-
3. Reverbarting chamber	1	144	-
4. Store	1	45	-
TOTAL		438	10

Accommodation	No.	Area m^2	No. of people
(13) Soil Mechanics			
1. Offices	5	75	8
2. Chemical lab.	1	60	-
3. Balance room	1	30	1
4. Experiment area	1	216	-
5. Equipment store	1	72	-
6. Toilets	3	30	-
TOTAL		483	10
(14) Material lab.			
1. Offices	6	120	18
2. Aggregate lab	1	120	-
3. Asphalt/Bitumen	1	60	-
4. Brick and tiles	1	120	-
5. Timber	1	60	-
6. Metals	1	192	
7. Equipment store	1	72	
8. Store for mat.	1	60	
TOTAL		604	18
(15) Structural lab.			
1. Stal line	1	864	8
2. Concrete line	1	936	10
3. Timber line	1	600	6
4. Local material	2	288	4
5. Workshop	1	216	3
6. Changing room	1	108	-
7. Common Room	1	108	-
8. Room storage	2	360	-
TOTAL		3480	31

Accommodation	No.	Area m^2	No. of people
(16) Services			
1. Generator/Fuel	1	216	2
2. Garage	1	360	6
3. Water tank	1	12	-
4. Boiler plant	1	12	-
TOTAL		600	8
(17) Open Spaces			
1. Testing ground or exhibition (open)	2	10600	-
2 spaces	-	20400	-
Grand totals		42000	200
Plus 40			40
Total		42000	240

CHAPTER 6

DESIGN CONCEPT

The Design of a Building Research Institute is a complex one because there are various functions which have to be integrated into one whole. It is industrially inclined and at the sametime institutional.

The Institute is a big complex which cannot be design at once therefore Iam evolving a planning concept that is flexible to take on additional laborations without much change in the basic concept. That is the concept should aim at flexibility and growth particularly the research areas.

The whole of the Institute is zoned into four parts as follows:-

1. Zone one - is the most noisy and dusty area. This zone include the structural laboratory, the material arrival bay and services such as stand-by generator, garages for the Institute Vans. Noise in this zone is due to machines and tippers bringing materials to the laboratories.
2. The second zone is the testing ground where the materials are tested and are also exposed to weather so that their reaction to weather agents such as rain, temperature are studied. Exhibition Hall is also included in this zone.
3. Third zone embraces the quiet laboratories where the instruments are simpler and less noisy. The laboratories in this zone are soil mechanics, Building physics, climatology and the material laboratories.
4. The fourth zone embraces the supporting facilities namely: Administration, Library, computer unit, Architecture and planning, conference and seminar rooms, Bookshop, snack bar and printing unit.

There is a little of machine noise due to the computer unit and the printing unit, which are placed in a half - a basement.

In order to meet the problem stated above that is that of flexibility and growth, I'm evolving a concept I called "Double figure planning" See the next page for the diagram.

General Description of Project

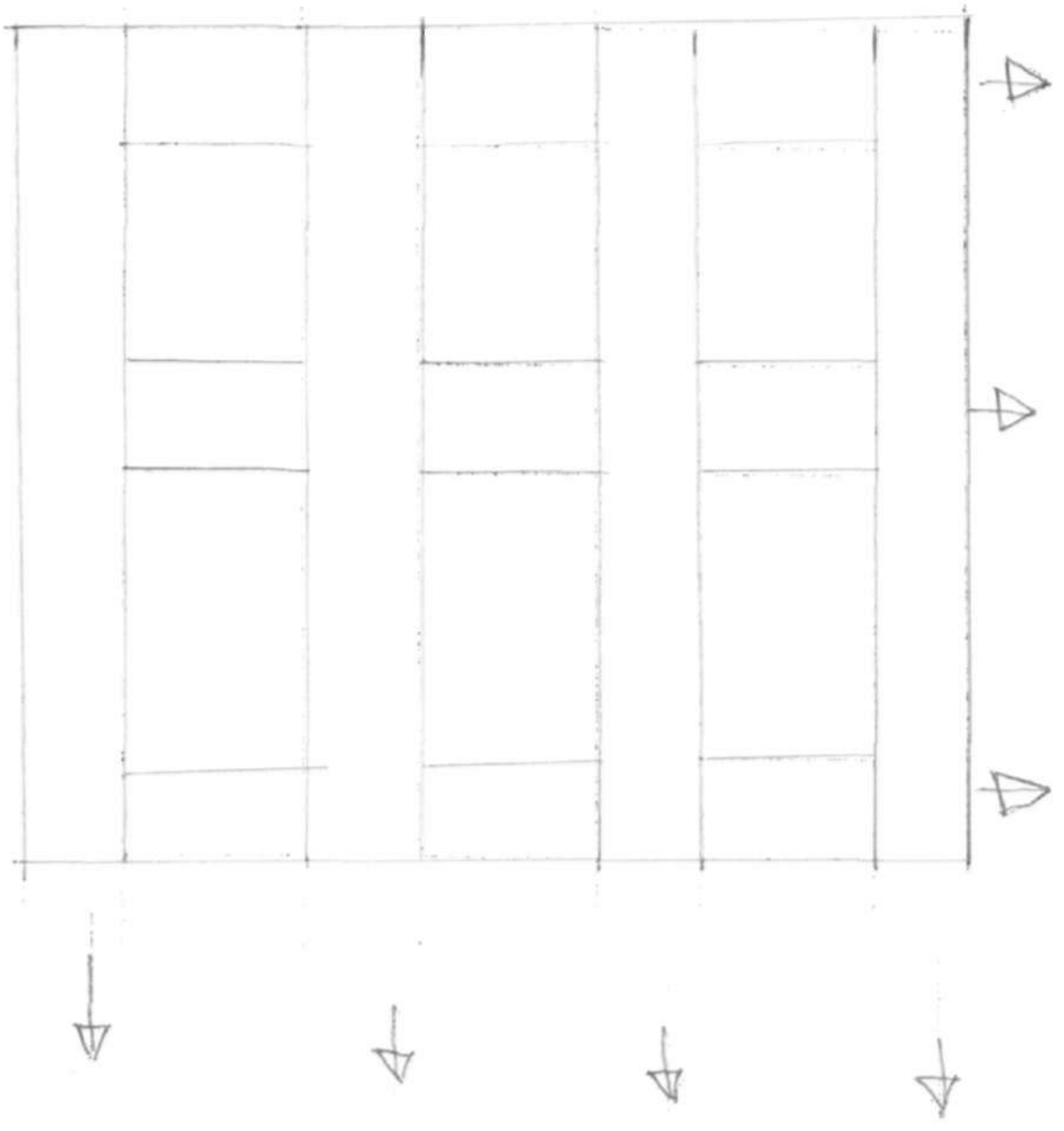
The site of the project is in Jos along Bauchi Road just after Naraguta Village and before the Brick Industry by the Nigerian Mining Co-operation. The site lies between the Brick Industry and University of Jos. From Jos town going towards Bauchi the site is on the left.

There are two gates leading into the Institute, which has a fence round it.

The main gate is reached first. This is used by staff and visitors of the Institute. The main gate leads the visitor into a prominent entrance which is glazed thus inviting the visitor in. This entrance leads into a big lobby which form the main distribution point, because from here people can move right to the bookshop, go straight into the account area, printing area, public relation area, or go left into the conference hall and seminar room. From the entrance lobby people can go up to the main administrative area, library and into the snack bar and also the conference hall.

Architecture and physical planning division is on top of the main administrative floor.

Adjucent to the main entrance is the entrance into the exhibition hall. Here visitors are conducted around and on top of part of the hall cool drinks are available to the visitors.



ARROWS SHOW LINE OF EXPANSION.

Staff have a separate entrance at right angle to that of visitors. They enter from the south.

The laboratories are at the back of the supporting facilities.

CHAPTER 7

SPECIAL PLANNING PROBLEMS

In this chapter we will consider measures taken to reduce environmental nuissance (noise etc) and measures taken to ensure safety of scientists at work. This would be done under the following topics:-

1. Noise reduction
2. Reduction of vibration
3. Fire precausion
4. Safety precausions

1. Noise Reduction

Noise nussance both from outside and inside sources of noise are important environmental problems. All parts of the labs. where people work should be protected from offensive noise. Measures to reduce noise are:-

a. Planning against noise:

This begins from site selection. It is better to locate the building far away as possible from possible troublesome source of eternal noise than to take expensive structural measures to reduce noise. Proper site analysis should be carried out and the location of building from noise source weighed against availability of main services, access, orientation etc. The most important aspect of planning against noise is the disposition of the parts of the building in relation to each other, and the internal arrangement of the rooms themselves.

Areas of the building where noise are generated should be group together and placed together as far as possible from quiet zones.

Often rooms that are used only for a shorttime (store etc) which are themselves quiet could be used as a buffer zones between the two extremes above.

Ideally noisy rooms (unloading bay, boiler plant etc) should be in a separate building. In multi-storey laboratories, if souces of structure borne noise have to be contained in the laboratory building, they should, if possible be placed at basement or on the ground floor.

b. Noise Reduction at Source

Noise in a building are made up of noises which can be eliminated or reduced by good design and choice of materials and equipment. Some noises which labs have in common e.g. footsteps and door bangs, can be easily dealt with by means of resilient floor finishes and silent door closes. Wheeled equipment such as trolleys, movable cupboards etc should have resilient typers. Wash - up areas can be designed with noise reduction in mind, using resilient linings or edgings wherever possible.

Electric fans:- The amount of noise produced by rotating fan blades depends upon their peripheral speed. From the point of view of reduction, large slowly rotating blades are better than short and fast rotating blades. There should be a good clearance between the blade tips and the fan casing.

Electric motors:- Different sizes of these are used in labs.

Here noise control is largely a matter of selecting the equipment for quiet running. Such motors usually have specially designed frames, sleeve-bearings, restraining devices to prevent lateral movement of the spindle and casings which completely enclose the moving parts.

Resilient mountings are needed to prevent amplication of noise by resonance where motors are fixed to the structure.

Noise in Water Systems

These are caused by badly designed equipment, by movement of water or by vibration within the piping system. The precausions outlined in above can be used to reduce the noise.

2. The Reduction of Vibration

In the design of labs it is important that the question of interference from vibration should be considered at the planning stage. This is extremelly important when one considers the fact that their are wide range of apparatus which are very likely to be affected by vibration. These include sensitive balances of various kinds, galvanometers etc.

Ways of preventing transmission of vibration

a. An area in which sensitive apparatus is housed should be given the most suitable position so that it suffers least possible interference from sources of vibration within the building.

b. Known sources of mechanical vibration on the premises should be adequately isolated by means of anti-vibration mountings, mats or foundations.

c. Apparatus may be supported on isolated piers or heavy blocks.

d. Anti-vibration mountings will often be needed for individual items such as balances etc.

e. Apparatus consisting of many parts should be mounted on the same base to prevent differential movement between the various components.

d. Precausions should be takenagainst door slamming which can cause severe local vibration affecting walls for some considerable distance away from the source. Door springs or closers should therefore be fitted where possible.

Planning against vibration

Possible external sources of vibration should be fully considered in choosing the site for a lab.

There should be proper zoning of the various labs so that those that give vibration are father away from sensitive areas.

Isolation of machinery

It is very important to try to reduce vibration at the source itself. This can be done by providing anti-vibration mountings for machinery which is to operate within the labs.

Spring supported floor slabs

This kind of structural treatment may be suitable for protecting limited areas from external vibration. The procedure is to mount the floor slab on a suitable elastic support, direct contact between the slab concerned and other adjacent floor slabs being avoided. The floor itself should be as rigid as possible and the spring system should be carried on a firm foundation.

This system can be used successfully against vibration from external source.

3. Fire Precau-tions

The degree of fire hazard inherent in the work carried out on in a building affects the arrangement of rooms, the dimensions and layout of vertical and horizontal circulation, and the choice of structural and finishing materials.

It is important to differentiate between precausionary measures built into the building and fire - precautions, which is largely a matter of staff discipline and training. Simple precautions such as the use of abestos mats under heat sources is taken to prevent

fires: elaborate fire - resisting construction is designed to minimise their effect. Fire hazard of building could be divided into three groups.

a. Damage hazard to the structure and its contents.

b. Personal hazard to the occupants.

c. Exposure hazard to fire spread from surrounding buildings.

a. Damage hazard - this depends on the amount of combustible materials in the building.

b. Personal Hazard - the risk to a person using a building depends mainly on two aspects of the occupancy the population characteristics and building function. Population density & fleet panic risks in case of fire. Fire hazard is directly related to the nature of the apparatus and substances used in the laboratory processes.

Planning and Construction in Relation to Personal Fire Hazard

Structural elements, the design of which is affected by fire - load rating, also play an important part in personal safety in an outbreak of fire. Structural walls and floors must remain intact and safe while the occupants escape.

a. Restricting spread of flame

When a fire begins in an occupied room, danger to the occupants depends upon the speed at which the fire spread in the content of the room and on the wall, floor and ceiling surfaces.

In the labs. the working apparatus vary with their varying technique. It is assumed that the staff would be disciplined and trained in the uses of the apparatus to minimise the spread of fire.

b. Restricting the spread of smoke and hot gases

When a fire begins to spread the danger to other occupants is in direct relation to the case with which smoke and hot gases can spread through the building, especially in the circulation areas. Escape routes should therefore be protected and hot gases and smoke be confined as far as possible to where the originate.

d. Planning against personal hazard

So far we have been considering the structure and finishes in fire hazard, but the overall lab. planning is worth considering. The following items affect labs planning.

i) The provision of sufficient exits, suitably located.

ii) Limitation of travel distance to exists or to some point protected by compart marting.

iii) the provision of corridors and stair cases of adequate width.

iv) the provision of adequate escape routes from working positions.

Fire-alarm system and fire-fighting equipment.

Where more than 20 people are employed in the same building, or explosive or highly inflammable materials are stored or used in any building in which persons are employed, effect we provision shall be made in giving warning in case of fire, which shall be clearly audible throughout the building.

Fire alarm systems can be either manually or automatically operated.

Staff should be instructed on calling the fire service and the use of hand extinguishers, hose reel etc.

Safety Precautions

Safety precautions are taken against hazards of two kinds, accidents and long term cumulative effects on health. Although the elimination of hazards is primarily a matter of internal organisation and discipline on the part of staff using the building, the designer can make safety precausions easier, and ensure that hazards are not built into the scientists environment.

General Considerations Affecting Laboratory Safety

The provision of the right amount of space for the work in hand is an important factor in governing safety.

Where the scale of work allows, potentially dangerous or noxious processes should be carried out in special rooms expressly designed for the purpose.

Natural and artificial lighting are vital factors in determining visual efficiency and therefore in the precaution of accidents caused by the mishandling or faulty observation of apparatus.

The design and layout of laboratory furniture also have a direct bearing on safety. Heating, ventilation, the effective and rapid disposal of noxious fumes, and the control and suppression of noise all affect the comfort of the working environment.

They are related to safety in that they can impair the mental awareness of the laboratory worker.

Design factors affecting safety

1. Overall planning - See overall planning fire precaution.

2. Layout of Laboratory rooms - Escape routes and furniture and cupboards etc. should be layout properly so that workers can easily escape.

3. Storage:in the labs. Inflammable liquids, reagents etc. should not be stored at the back of benches because of the danger of spelling when reading forward, possibly over or through assembled apparatus. An adequate and easily accessible chemical store is essential to safety in laboratory rooms.

Poisonous chemicals should be kept in a separate lokable room or cabinet.

4. Service outlets and controls - Service controls should be placed so that the user does not have to run the risk of accidentally coming into contact with apparatus on the bench.

5. Drainage and Waste disposal - Dilution of liquid wastes should occur as near the sink as possible of receivers are used it may be necessary to provide one for each room, so that substances which became dangerous in contact are not brought together by people from different rooms.

Inflammable liquids should not be discharge into the waste systems. but deposited in metal containers provided with lids, and disposed of away from the working areas.

6. Electrical Installations - A number of general prints may be made about safety in relation to electrical instllations.

a) Instlattions should be

b) An insultating floor finish such as rubber or linoleum and non conducting materials for bench tops may help to prevent injury.

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