ABUBAKAR TAFAWA BALEWA UNIVERSITY SENATE BAUCHI (A DESIGN PROPOSAL)

TOWARDS SOLVING FIRE PROBLEMS IN THE EVENT OF FIRE OUT BREAK

BY

BABA MA'AJI KABIR

A THESIS SUBMITTED TO THE POST GRADUATE SCHOOL AHMADU BELLO UNIVERSITY, ZARIA IN PARTIAL FULFILLMENT OF THE REQUIREMENT OF THE AWARD OF THE DEGREE OF MASTER OF SCIENCE IN ARCHITECTURE.

DEPARTMENT OF ARCHITECTURE
FACULTY OF ENVIRONMENTAL DESIGN
AHMADU BELLO UNIVERSITY, ZARIA
NIGERIA.

NOVEMBER, 1997

DECLARATION

I hereby declare that the information contained herein is the result of a research undertaken by me and that no part of it had been accepted for publication in any journal or magazine.

All sources of informations are specifically acknowledged by means of references. Direct references to the texts have also been quoted.



SIGNATURE

27/1/98

DATE

CERTIFICATION

This thesis entitled, Abubakar Tafawa Balewa University Senate Bauchi, Towards solving fire problems in the event of fire out break, meets the regulations governing the awards of the decree of MASTER OF SCIENCE IN ARCHITECTURE of Ahmadu Bello University Zaria and is approved for its contribution to knowledge and literary presentation.

S.S. Tulpule ..... 04.02.1999.....

Chairman, Supervisory Committee **Date**

..... 4.2.98

Member, Supervisory Committee **Date**

..... 10/08/99

Member Supervisory Committee **Date**

....

Member, Supervisory Committee **Date**

..... 18/8/99

Head of Department **Date**

HEAD, DEPT. OF ARCHITECTURE
Faculty of Environmental Design
A. B. U. Zaria - Nigeria.

..... 03/05/00

Dean, Post Graduate School **Date**

DEDICATION

This research work is specifically dedicated to my parents, Alhaji Babama'aji Abubakar, Hajiya Ladi Baba Ma'aji and my family.

I appreciation all the love, care and concern shown to me.

ACKNOWLEDGEMENT

I must first of all thank the Almighty Allah for giving me the courage, guidance, ability and the opportunity to attain this position in my career and academic pursuit.

I am indebted particularly to my supervisor, Arc. S.S. Tulpule who sacrificed his precious time in going through the manuscript and offered a lot, his material guidance and fruitful suggestions and corrections in writing up this thesis. I would also like to acknowledge all the lecturers of the department (Architecture) on their ability to enlighting students through constructive criticisms at improving their educational standard.

Many people have contributed immensely towards the success of my study to the completion of this research. As such, I would like to use their opportunity to express my gratitude and acknowledge the efforts of my parents (Alh. Baba Ma'aji and Hajiya Ladi), my wife (Hajiya Maryam Mohammed), Alhaji Sanusi Maijama'a, Arc. Mohammed Dewu, Alh. Garba Moh'd Gadi, Alhaji Umar M. Faruk and Mrs. H.T. Mohammed, Hajiya Sa'adatu Faruk for all the support they have rendered both morally and financially.

I also owe a great deal of thanks to all my brothers and sisters. I wish to express my gratitudes to my friends, they include; Abubakar Idris, Ishaku Nata'ala, Mustapha Zubair, Lawal Bello, Aminu Rabiu, Nura Isah, Mohammed Mansur Adamu, Kamaluddeen Dahiru Abubakar, Mohammed Tajuddeen (T.J) Suzan Salisu (Mrs) and Haruna Daniyan.

In the end, I would also like to express my sincere gratitude to the management of the Bauchi State Urban Development Board.

ABSTRACT

The University system, in the whole world is known to be an institute of scholars, seat of knowledge, centre of Liberal education, agent of national or regional development and mother of the professions and advancement of knowledge through provision of service to the society. In view of this, there has to be an administrative set up to enhance smooth running and coordination of the all activities. This can only be achieved if there is a well planned environment.

This thesis, therefore is aimed at providing a well designed administrative office that would accommodate the entire administrative staff of Abubakar Tafawa Balewa University Bauchi in order to boost the moral spirit of the workers; to enhance interaction and unity among workers with an attempt towards solving fire problems in the event of firebreak in order to reduce or eliminate if possible the risk of personal injury or death and to reduce total loss of buildings; plants and goods.

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CHAPTER ONE

1.0 GENERAL INTRODUCTION

The Federal Government's decision to create seven new technological universities derives from the nation's need for a greater supply of skilled technical and professional man power. In determining the locations of these new technological institutions, two factors have been borne in mind. Firstly, to assist in modifying the economic concentration and the unbalance in the national economy and secondly to extend social benefits throughout the nation by providing higher educational opportunities in states without such facilities of which Bauchi was one.

For any university to be successful and fully operational, an administrative order has to be set up. The Central administration could be said to be the nerve centre of the university, concerned as it should, with problems ranging from senate and council matters, staff and student matters, overall governance, to responsibility for a variety of municipal facilities. Hence, a senate building is being proposed for Abubakar Tafawa Balewa University, Bauchi (A.T.B.U.).

1.1 RESEARCH AREA: TOWARDS SOLVING FIRE PROBLEMS IN THE EVENT OF FIRE OUTBREAK. (A DESIGN PROPOSAL).

From the past experience, fire incidents in Nigeria have taken lives of many Nigerians and as well destroyed many valuable assets. For instance, on Monday January 24th, 1983 a 37 storey Nigeria External Telecommunications (NET) gutted with fire; January 1985, 25 storey cocoa house in Ibadan gutted with fire. Similarly, Defence Head quarters and twelve storey Investment house in 1993 all gutted within Lagos to mention but

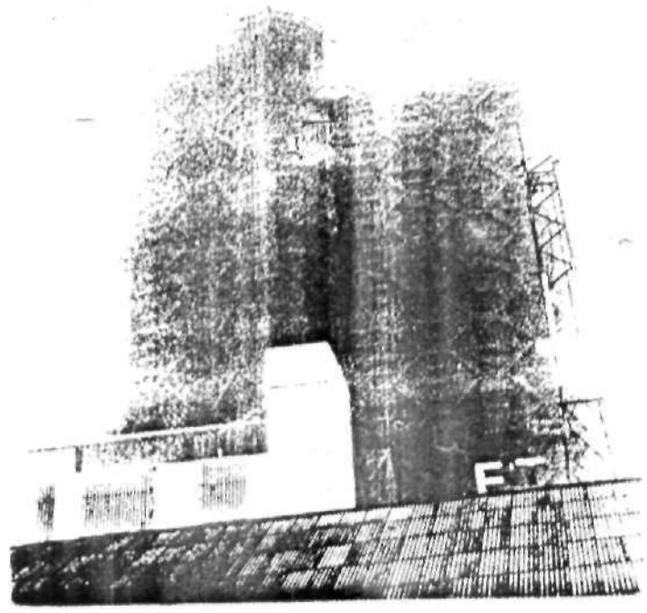
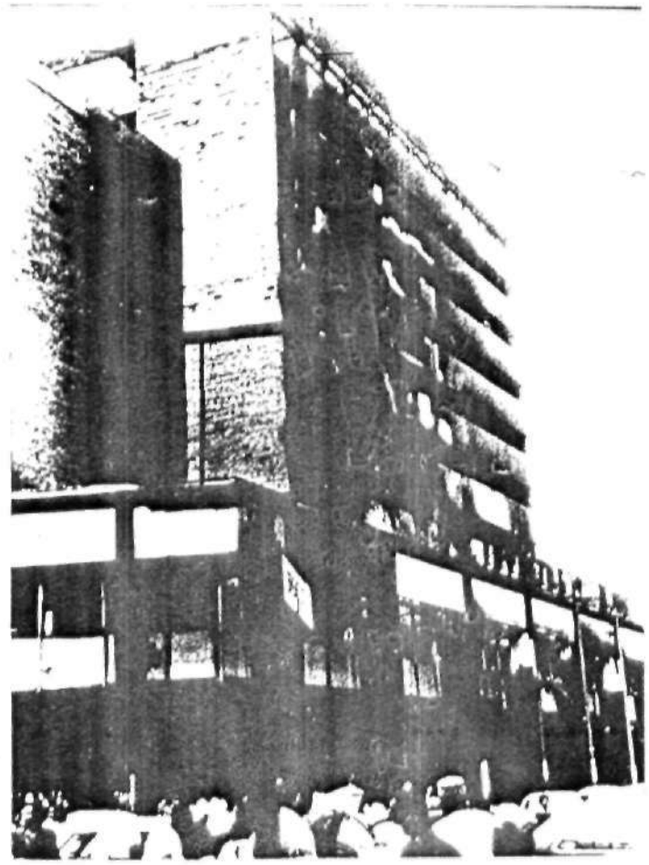


Plate 1a



Plate 1b

Nigeria External Telecommunication (NET)



Investment House Lagos Plate 2a

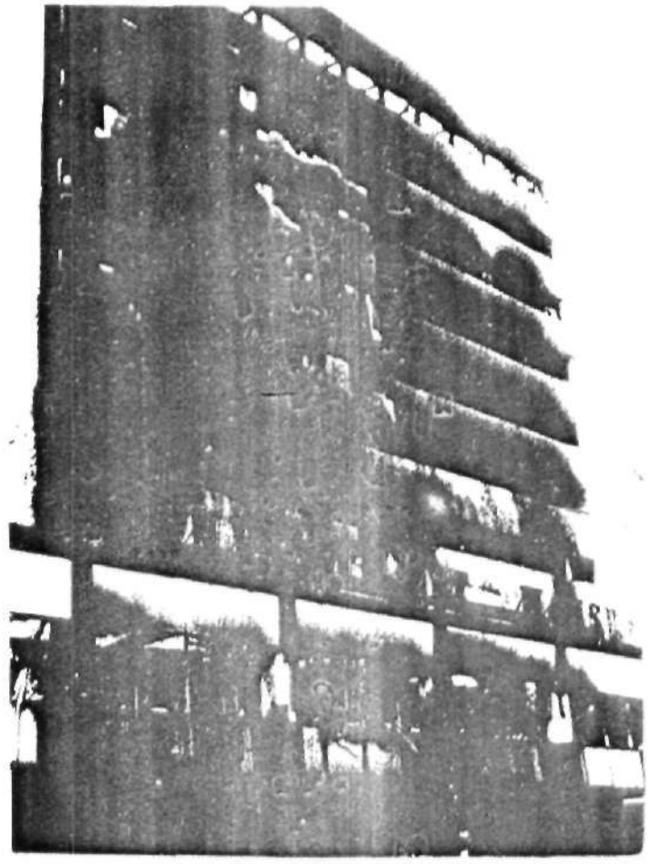
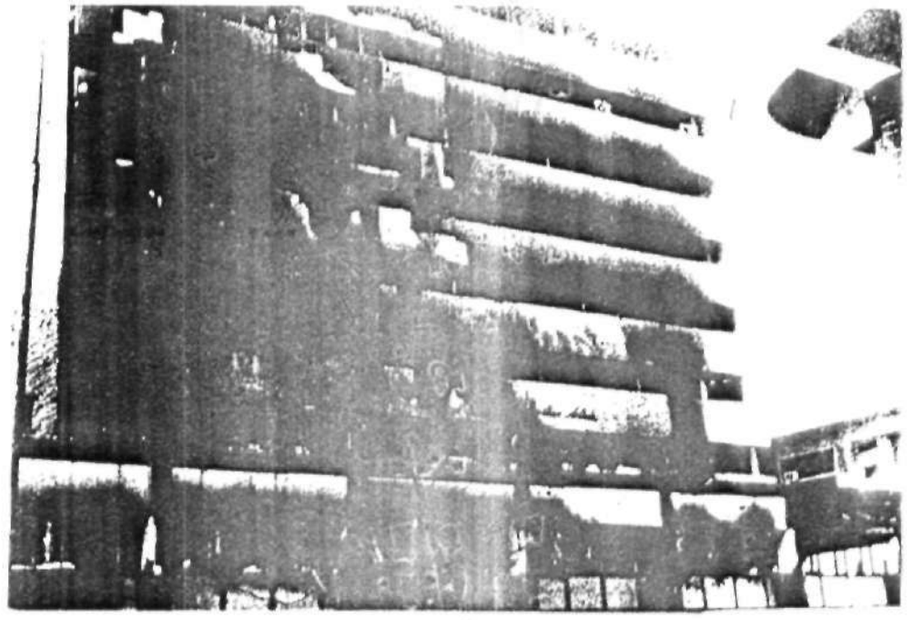


Plate 2b



Investment House Lagos Plate 2c

a few. In this regard, fire safety became a necessity in buildings because, the present day common building materials are not only flammable but also encourage the spread of fire.

However, the larger the building, the more costly and the greater will be its saving in the event of fire outbreak. The aim in taking extra precaution is to reduce the overall risk of fire loss through a good fire preventive design.

For these reasons the need for fire safety arose and two basic factors are considered.

i. To reduce or eliminate if possible the risk of personal injury or death.

ii. To reduce total loss of buildings, plants and goods.

1.2 AIMS AND OBJECTIVES:

The main aims and objectives of this project could be seen as listed below.

a. To provide for office accommodation for the University Staff.

b. An attempt towards solving problems of fire in the event of fire outbreak.

c. To uplift the moral spirit of workers.

d. To enhance Interaction and Unity among workers

e. To create a well planned environment for effective administrative operations.

1.3 MOTIVATION:

1. With the rate at which fire destroys the lives and properties of individuals and organisation, is important to finding its solutions.
2. The University, has an intention of building its Senate, in this regard, it is convenient to propose one with fire preventive oriented design.
3. As part of University requirements for graduating M.Sc. Students, I see it as a challenge to undertake such a proposal and more so to specialise in institutional buildings.

1.4 *METHODOLOGY*

Towards achieving the aims and objectives of this research, the following research methodologies have been employed. They include:-

(a) Literature

(b) Case studies

(c) Personal observations

(d) Dialogues (interviews).

1.4.1 *Literature Review*

The backbone of this thesis shall be a review of literature dealing with the topic. The review is undertaken to familiarise with the subject and help in obtaining a proper theoretical background.

1.4.2 *Case Studies*

A thorough review of existing senate/office design will be undertaken to appraise and keep the author abreast with challenging problems and how they were solved. Unsolved ones would be reviewed in order to find a workable solutions to them.

CHAPTER TWO

2.0 HISTORY OF NIGERIAN UNIVERSITIES

2.1 THEME

Nigerian University system has been divided into four main phases. The first phase began in 1948 with the establishment of University of Ibadan which sported as a College. However, Yaba College of Technology had taken off in 1934 due to the persistent demand for University education from the colonialists to serve the need of West African nations by West African intellectuals and nationalist. These colleges failed to meet the yearnings of the vocal enlightened public that wanted nothing but a full spelling University.

In this regard the colonial Government began to change its attitude towards higher education in the colonies. In the late 30's the Elliot Commission was set up and the report led to the establishment of the University College, Ibadan in 1948. In 1962, the College became autonomous because of its relationship with the University of London.

Due to the persistent need and political pressures that saw the development of Universities, four others took off in the second phase. The political development's pace and increasing educational needs of the nation, clearly showed that the country needed more Universities with a capacity and a different orientation from that of Ibadan.

A commission was set up by the Government with an international composition in May 1959 and its report led to the establishment of the four Universities: University of Nigeria Nsukka in 1960, University of Lagos in 1962, Ahmadu Bello University, Zaria in 1962 and the University of Ife in 1962. This period witnessed a turning point in the scope of

the Nigerian University system in terms of course offering, curriculum and indigenisation of staff and programme.

The third phase began in the 70's after the country had experienced considerable political changes (coups and civil war).

Nigeria became active with the establishment of the National Universities Commission (NUC) in 1962, to plan, co-ordinate and ensure balanced development and growth of the universities. Further more new other universities were established; the University of Benin (1970), Bayero University, Kano, University of Calabar, Port-Harcourt, Ilorin, Maiduguri, Jos and Sokoto (1970's). However, Bayero University, Kano Ilorin and Port-Harcourt were established as Colleges in 1975 and later become autonomous in 1977.

The forth phase began in 1980 with the Federal Government's decision to create seven new technological universities which derives from the nation's need for a greater supply of skilled technical and professional manpower. These include: Federal University of Technology, Bauchi Makurdi and Owerri (1980) Yola, and Akure (1981) Abeokuta and Minna (1983). Subsequently state universities were established. They include: River State University of Science and Technology, Imo State University, Bendel, Ondo, Ogun, Lagos and Cross River State University.

Following the decision of the Federal Government to reduce the number of federally sponsored universities in October 1984, other Universities were merged with the older ones. Abeokuta was merged with Lagos, Bauchi with Ahmadu Bello University Zaria, Makurdi with Jos and Yola with Maiduguri. However, Minna, Akure and Owerri were allowed to remain.

In 1988, merged universities, gained full autonomy due to change in government. After being given full autonomy Federal University of Technology Bauchi, became Abubakar Tafawa Balewa University and Abeokuta and Makurdi became Universities of Agriculture.

2.2 CAMPUS PLANNING

2.2.1 Introduction

There are basically four areas of activities identified in the traditional campus planning. These include: the Central administration (Senate), teaching/research, housing (staff and students) and recreation. Recreation is usually incorporated in to the design of the students and staff housing or the central administration.

The Central administration; various faculties for teaching and research formed the main campus core. The central administration constitutes the administrative offices like the registry, the bursary, the Vice-Chancellor's office and the Senate Chamber. The faculties on the other hand constitute the theaters, laboratories, seminar rooms, and various departments.

What actually determined the overall Campus form and the basis for its planning concept has the direct bearing on circulation, services, functional relationships and consequently on the interaction among the users of its facilities. These concepts include:

2.2.2 Ring Concept

This is referred to as the concentric ring concept, that is, the activity areas are arranged all around one another in rings.

The Central administration being at the core, is surrounded by teaching/research facilities which are surrounded too by the housing areas for both the students and staff. Interaction among members of the university community is enhanced through opportunities created by the application of this concept, while the distances between activity areas for instance, the teaching and housing are highly minimised.

This ring concept is perhaps the most widely used of all the campus planning concepts.

2.2.3 Loose Tie Concept

This concept of spatial relationship; all the four activity areas are independent of one another but the central administration being placed to one side of the central area and the teaching/research facilities and the student/staff housing on the other.

The facilitating of the individual expansion of the elements and the integrity of the original concept remain uncompromised. Its major disadvantage is the long distances between activity areas and a direct bearing on cost through lengthy walking corridors and roads. It also has a disadvantage in the limited intra campus interaction due to rigid distinction consequent upon which there is a weak relationship with the activity areas.

2.2.4 Close Knit Concept

This concept is particularly a characteristic of the early and formative stages of most Nigerian Universities. Several self sufficient units each comprising of the four basic activity area make up the close knit or multiple unit concept.

In essence, different schools or faculties are located at different places within the town of the university's location.

2.2.5 Segregated Type Concept

In this type of concept, there exist a strong inter-relationship between the campus planning elements of spatial relationship. Here the, teaching/research and central administration are fused together to form a centre but the students and staff housing on the opposite sides.

This concept is more advantageous compared to the loose concept in terms of spatial relationship. However, expansion would be difficult especially in the central administration unless room is grounded at the onset for expansion, which could result in a sparse and seemingly scattered development at the start.

2.3 AIMS AND OBJECTIVES OF UNIVERSITIES OF TECHNOLOGY

A technological University is an innovation in higher education in Nigeria, and therefore its aims and objectives will appear innovative. These have been fully explored by the Vice-Chancellor, Professor A.O. Adekola ( ) in the Academic Plan.

The aims and objectives of University of Technology can be summarised as follows:

- To answer the Nations call for qualified people who are practice and result-oriented, with problem-solving capability.
- To take an account of the long and short-term needs of Nigeria, particularly her need to reduce the reliance on imported goods and technology.
- To focus on courses which relate to specific, present and future technological needs.
- To produce graduates who are truly "finished Products" - ready for gainful employment in their fields of specialisation, having gained sufficient practical experience during their courses.
- To prevent a reversion of the older model of a University with a proliferation of degree courses in humanities and social sciences, already well catered for at existing institutions, but also to ensure that the students are still exposed to these humanising and liberalising influences.

In the achievement of there objectives, the university need for practical teaching facilities and methods will be facilitated by the selling up of a Centre for Industrial Studies (CIS), similar to that used at Loughborough University of Technology in England. The CIS is to be developed simultaneously with first school of study in the building programme on the permanent site. The University will in addition, seek all forms of support from industry and government for the establishment of selected industries on the University's Industrial Estate.

2.4 HISTORICAL BACKGROUND OF ABUBAKAR TAFAWA BALEWA UNIVERSITY

2.4.1 Introduction

The Federal Governments decision to create seven New Technological Universities derives from the nation's need for a greater supply of skilled technical and professional manpower. It is in this regard that Federal University of Technology Bauchi was established (Abubakar Tafawa Balewa University Bauchi).

2.4.2 Theme

Abubakar Tafawa Balewa was established in 1980 by the Federal Government of Nigeria. It however, took off with its first intake of students in October 1981. The intended initial enrolment of the university was 450 students with the aim of reaching 5,000 enrolment figure by the end of the first decade and an ultimate figure of 10,000 according to the guideline on student enrolment by the National University Commission. The University became a college of Ahmadu Bello University, Zaria in October, 1984 following the decision by the Federal Government to reduce the number of federally sponsored universities.

The Federal Government again upgraded the University (ATBU) to a full fledged university in January, 1988. The university started with only one school, that is the School of Science and Science Education. There are now four schools namely, Schools of Agriculture, Engineering, Environmental Technology and Science and Science Education.

The Instrument which established the University stipulated that it is established to accelerate the technological development of the nation. It will produce teachers of Science as well as Scientists and technologists capable of finding solutions to problems which affect the lives of its local community and the nation. The current student enrolment is about 4,000 while that of academic staff is 300.

2.5 AIMS AND OBJECTIVES OF ABUBAKAR TAFAWA BALEWA UNIVERSITY

The University of Technology, Bauchi seeks to be strongly linked to work experience and practical training in all fields of study. Those links are to be concentrated on relationships with both Manufacturing industry and agricultural development. The aims and objectives of the University could be summarised as follows:

- To encourage the advancement of learning and to hold out to all persons without distinction of race, creed, sex or political conviction to the opportunity of acquiring a higher education in technology.
- To develop and offer academic and professional programmes leading to the award of diplomas, first degree, postgraduate research and higher degrees which emphasize planning, adaptive, technical maintenance, development and productive skills in engineering, scientific, medical and allied professional disciplines with the aim of producing socially mature men and women with capability not only to understand, use and adapt existing technology but also improve on it and develop new ones.

- To act as agents and catalysts, through postgraduate training, research and innovation for the effective and economic utilisation, exploitation and conservation of the country's natural, economic and human resources.
- To establish appropriate relationships with other national institutions involved in training, research and development of technologies.
- To offer to the general population, as a form of public service, the results of training and research and to foster the practical application of these results.
- To identify technological problems and needs of the society and to find solutions to them within the context of overall national development.
- To undertake any other activities appropriate for a University of technology of the highest standard.

CHAPTER THREE

3.0 CASE STUDIES

Most Nigerian universities have established their Senate Buildings while some still remain on the temporary site. Amongst those that are yet to have a permanent one is the Abubakar Tafawa Balewa University, Bauchi. Those that have established their include Ahmadu Bello University Zaria, University of Lagos, and Obafemi Awolowo, University of Ibadan.

Due to difficulty in getting foreign Universities, they have not been documented in this thesis.

3.1 ABABUKAR TAFAWA BALEWA UNIVERSITY BAUCHI (A.T.B.U)

Abubakar Tafawa Balewa University was established in 1980 by the Federal Government of Nigeria, on a temporary site.

3.1.1 The Site Yelwa Campus (temporary site)

The administrative block is temporarily located within the academic area. However, it was not designed to suit its purpose but rather a class room block was converted. It is bounded to the west by the new engineering block, to the east by computer center, to the south by class room blocks and to the north by the students hostel.

3.1.2 General Description

The building is just one storey office building used by the administrative staff. It is rectangular in shape surrounded by trees with simple mono pitch roof and drain gutter around it. It is also a single banked corridor design.

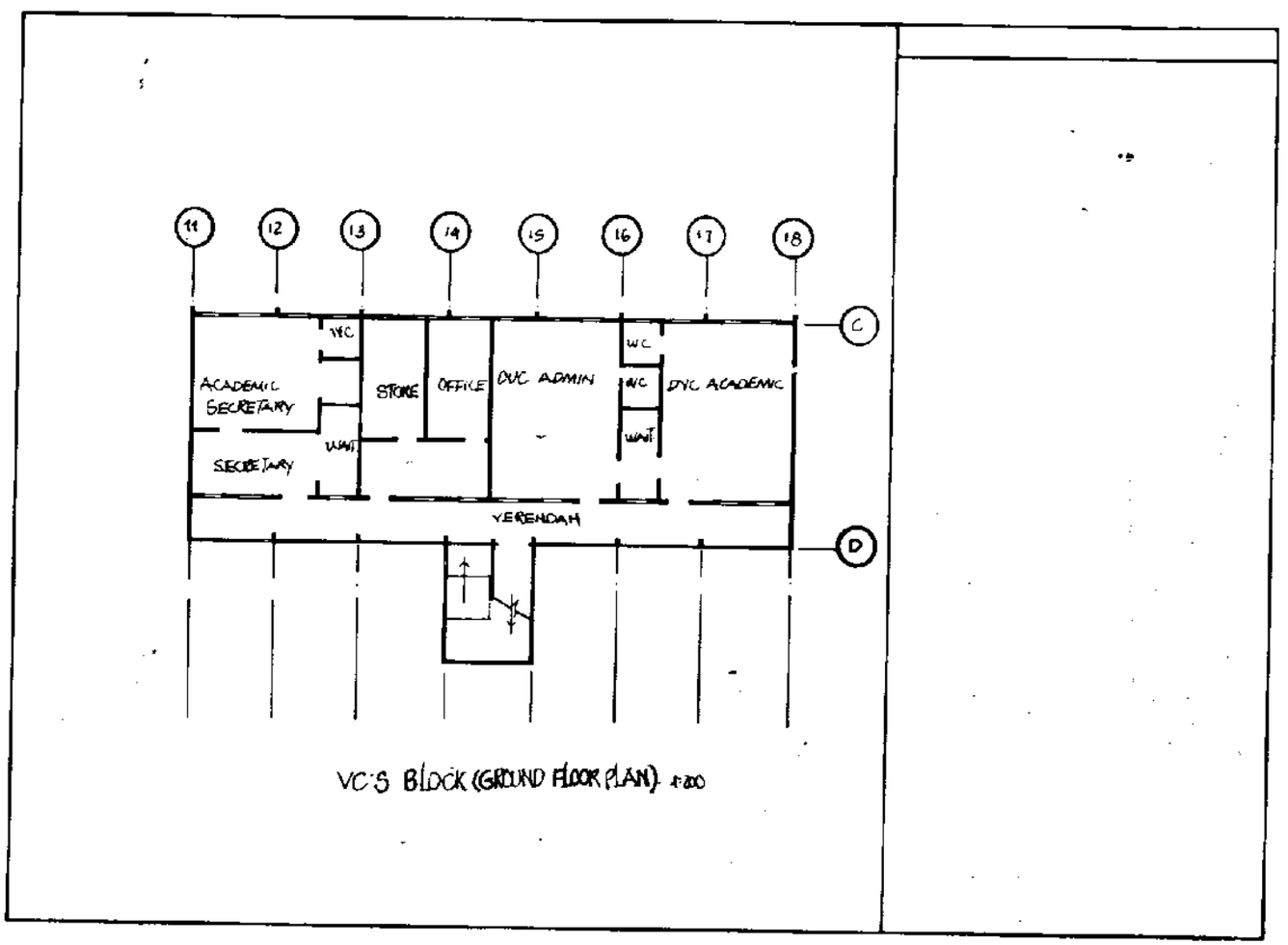


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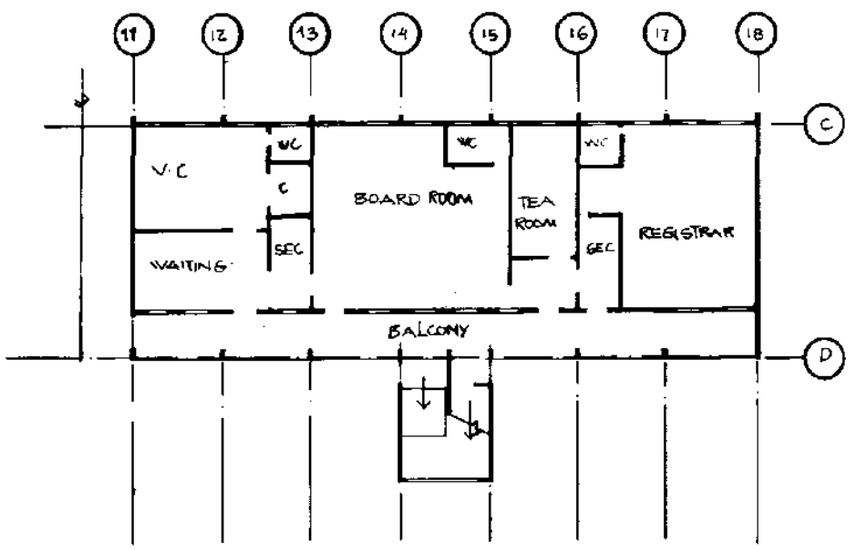
- A ACADEMIC BUILDING
- B HOSTELS
- C SENIOR STAFF HOUSES
- D STAFF HOUSES DUPLEX
- E WORKS & SERVICES
- F GUEST HOUSES
- G SPORTS FIELD & S/CLUB
- H CAFETARIA
- I MEDICAL CENTRE
- BH BORE HOLE
- L POULTRY
- BK BOOKSHOP
- K LIBRARY
- S STAFF SCHOOL
- M LECTURE THEATRE
- N SITE FOR RELIGIOUS C.
- O SITE FOR NURSERY SCH.

N

SCALE: 1:5000



VC'S BLOCK (GROUND FLOOR PLAN) 1:100



V.C'S BLOCK (FIRST FLOOR PLAN) 1:200





3.1.3 Circulation/Services

For Vertical Circulation, there is only one stair case centrally located from the approach which hindered entry except through the corridor.

3.1.4 Materials Used

- **Long span alluminium roofing sheets**
- **Steel trusses/rafters.**
- **Sandcrete block walls**
- **Mild Steel roads.**
- **Reinforced Concrete.**

3.1.5 Merits

- **Very simple rectangular form**
- **Ease of maintenance**
- **Centrally located within the academic area.**
- **Good orientation.**

3.1.6 Demerits

- **It is not easily accessible from the main gate**
- **It is not a focal points**
- **Very poor communication among staff.**

- It does not house all the administrative staff.
- No definite entrance.

3.2 AHMADU BELLO UNIVERSITY, ZARIA.

Client: Ahmadu Bello University

Architect/Planners: Dar-al-handasah-(Shair and partners)

Sponsor: Ahmadu Bello University Zaria/Federal Government of Nigeria.

3.2.1 Site; (Samaru Main Campus):

The site is located in the Samaru Main Campus in Sabon Gari Local Government area along Sokoto road, Kaduna State.

It is located on the elevated plain that slopes down towards the Kubani river. The site commands some interesting views of the river and Kufena hills.

The site of the main senate building is located in the eastern part of the central area of the main campus. It is bounded to the west by the assembly hall and to the east by the old administrative block now a postgraduate school (administrative blocks).

3.2.2 General Description

Ahmadu Bello University Senate building is an eight storey building, comprising of office spaces for administrative staff. This structure however, comprises of two storey plaza elements and six storey tower with its senate chamber in between them. The structure

3.2.6 Services

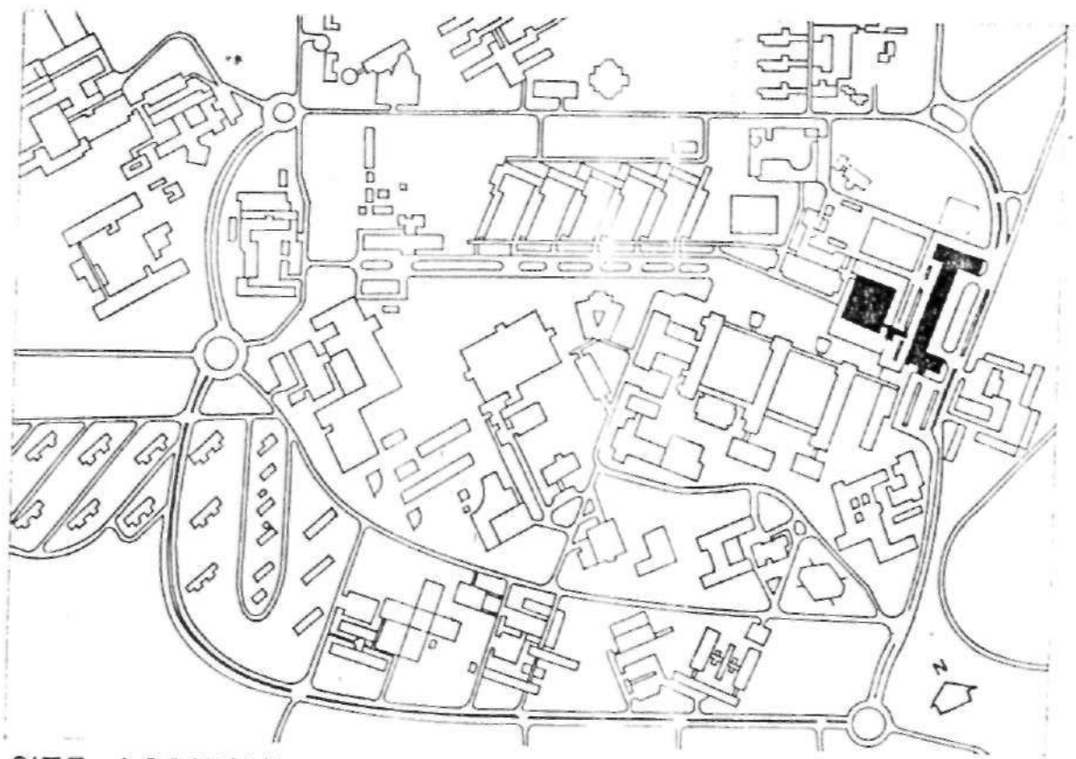
All buildings are connected through sanitary systems to the main campus waste disposal/treatment plant. Although, individual buildings have electrical and water service installation.

3.2.7 Merits

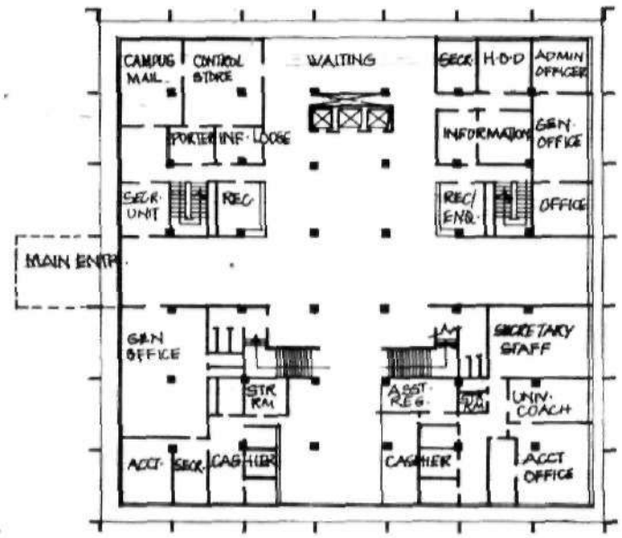
- Ease of access from the other parts of the university.
- The grid pattern made its construction easy.
- It is a very elegant structure
- The Entrances are large enough for fire escape
- Good single banked corridors.
- Effective sun shading devices.

3.2.8 Demerits

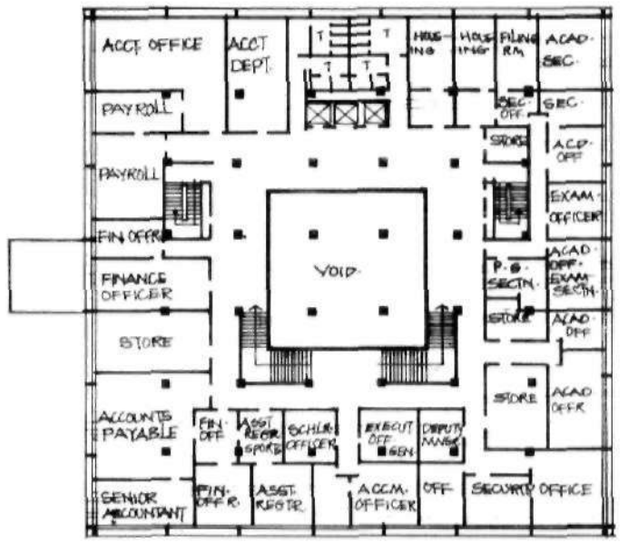
- Undefined parking spaces
- Poor land scape
- Accesses and turning point radii are too tight
- No compartmentalisation
- The height of the building makes it difficult for fire fighting.
- Stair cases are dark and hidden.
- The sun shading devices act as obstacle for fire fighting.



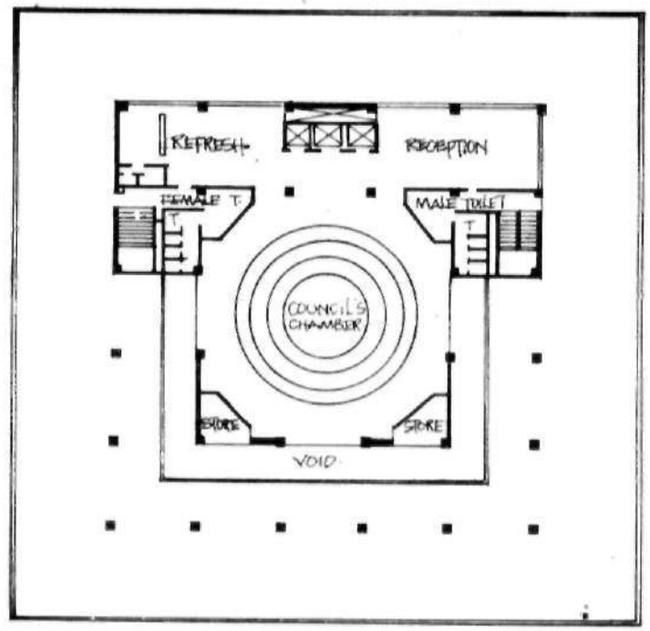
SITE LOCATION SCALE 1/6000



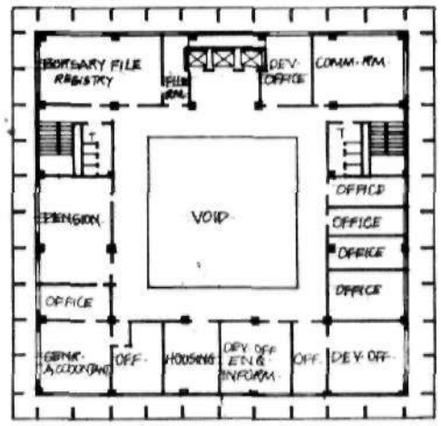
GROUND FLOOR PLAN. 1:400



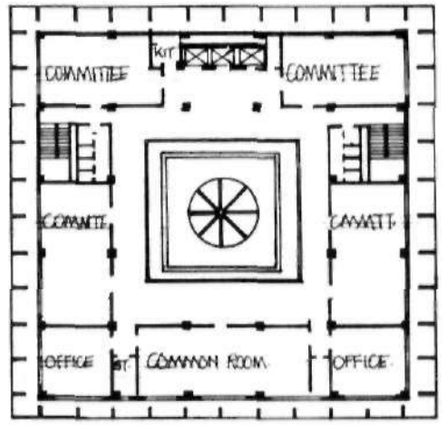
FIRST FLOOR PLAN 1:400



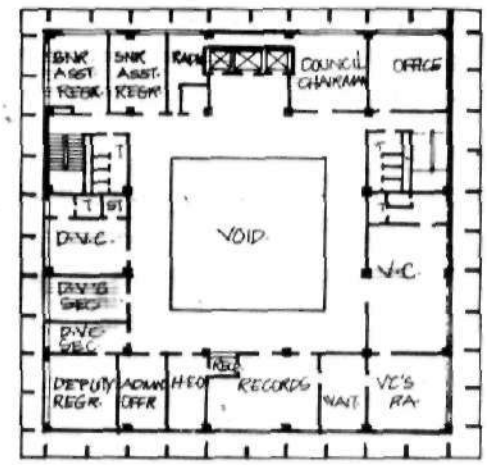
SECOND FLOOR PLAN 1:400



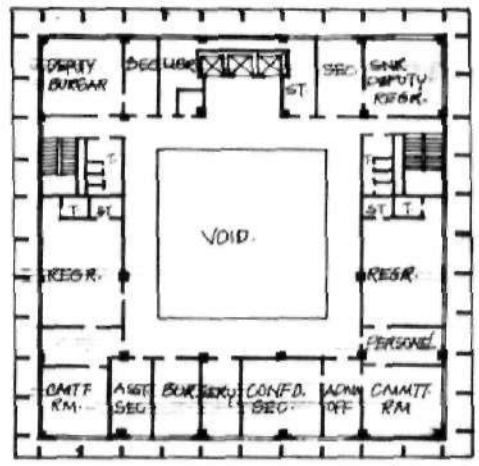
FOURTH FLOOR PLAN.



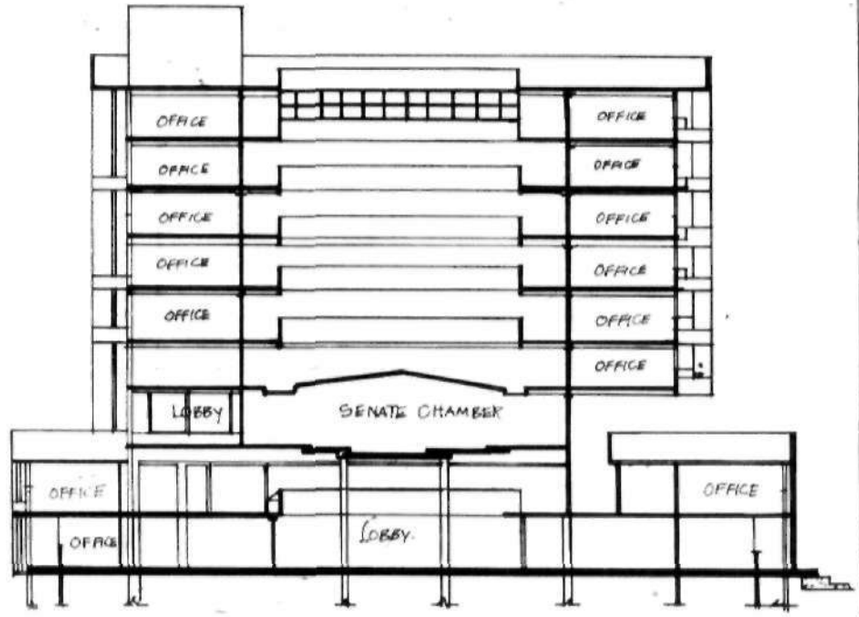
THIRD FLOOR PLAN 1:100



EIGHT FLOOR PLAN 1:400



SEVENTH FLOOR PLAN 1:400



SECTION THROUGH SENATE



3.3 UNIVERSITY OF LAGOS (SENATE HOUSE)

Client : University of Lagos

Architects: James Cubitt and Partners.

Sponsor: University of Lagos

3.3.1 The Site

The university senate house is located axially from the University main gate which acts as a dominant and focal structure which catches the eyes of the visitors. It is bounded to the west by arts block lecture theatre, to the east by the old administrative building and to the north by the department of advanced legal studies.

3.3.2 General Description

The university's senate house is a 12-Storey Structure which consists of a three storey plaza housing the bursary and the a high tower which houses the Registry and the Vice-Chancellors office. The Senate Chamber projects outwards to form part of the building. The building, however, has laid more emphasis on its scale and it is more profound than the surrounding buildings.

3.3.3 General Concept:

The entire structure is basically a composition of a rectangular and circular concept with a drop in height at various level. This shows a kind of dynamism.

The structure is in two basic parts:- a horizontal three storey wing housing the Bursary and a vertical block housing the Senate Chamber, then Lounge, and the Registrar's and Vice-Chancellor's offices.

3.3.4 General Circulation

There are four enclosed stair cases, two staircases at the horizontal end and two located at the tower. There are also two adjacent lifts, which service the building from the ground to the top most floor.

The entrances in to the offices are recessed from the wall so as to enhance the free flow of traffic through the corridors.

The circulation in and around the building is quite good due to the provision of many accesses into the building.

3.3.5 Services

Ducts and toilets are positioned around the stair cases in three different positions along the building. There are only a set of toilets in the tower both for male and female unlike the other sets which are detached from one another.

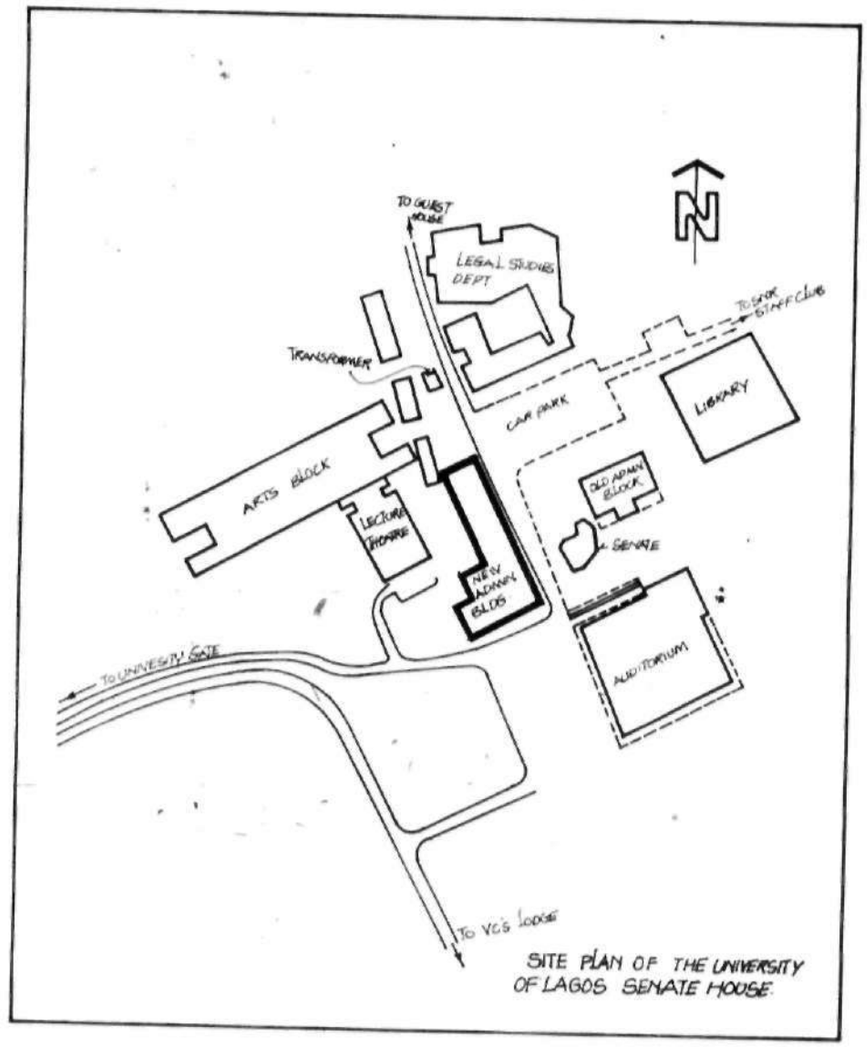
3.3.6 Merits

- It serves as a focal point due to its height and location

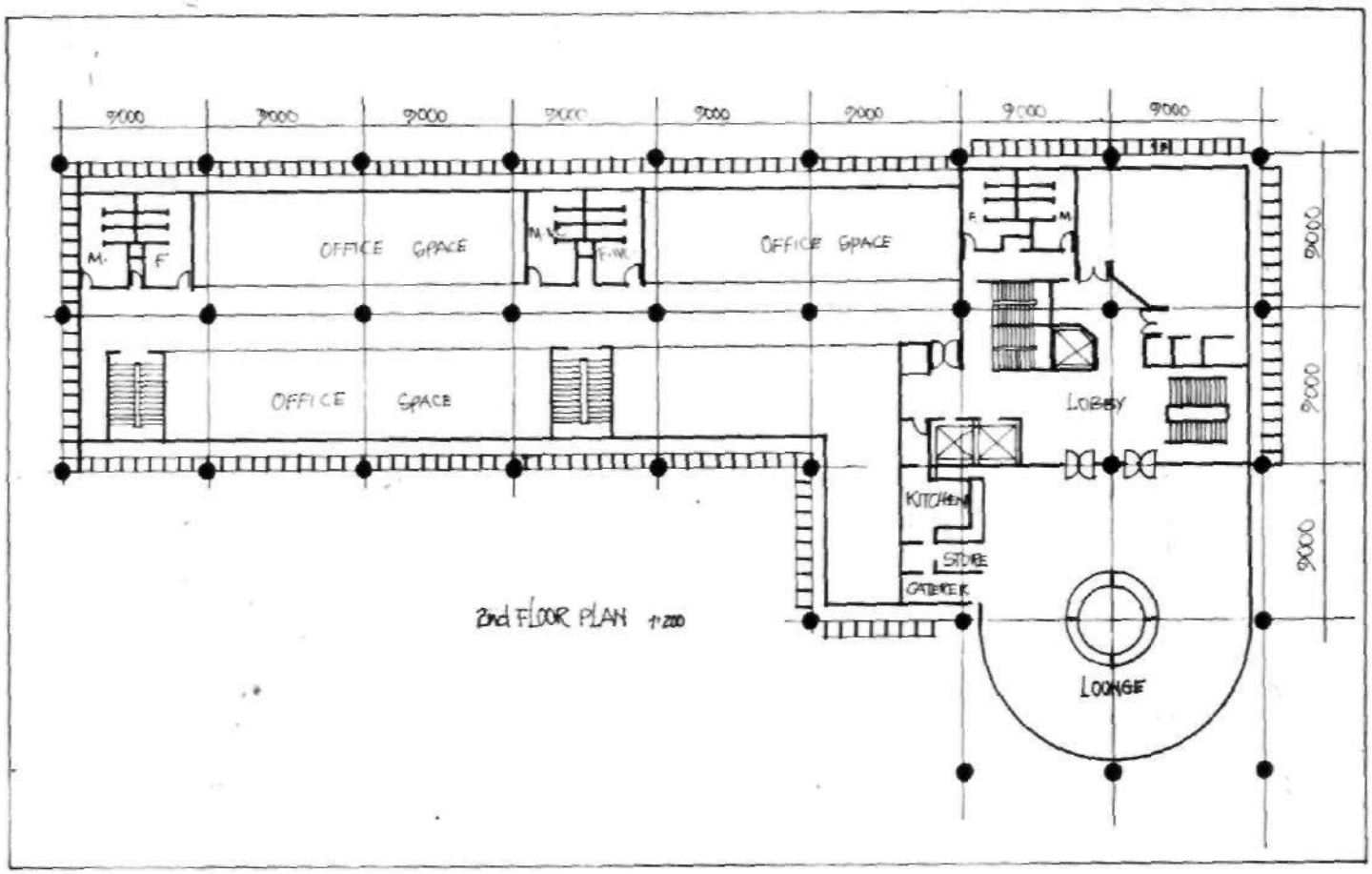
- Good circulation around the building
- The building form is appealing and dynamic
- Good ventilation especially at the upper floors
- Good composition of forms (rectangular and circular).

3.3.7 Demerits

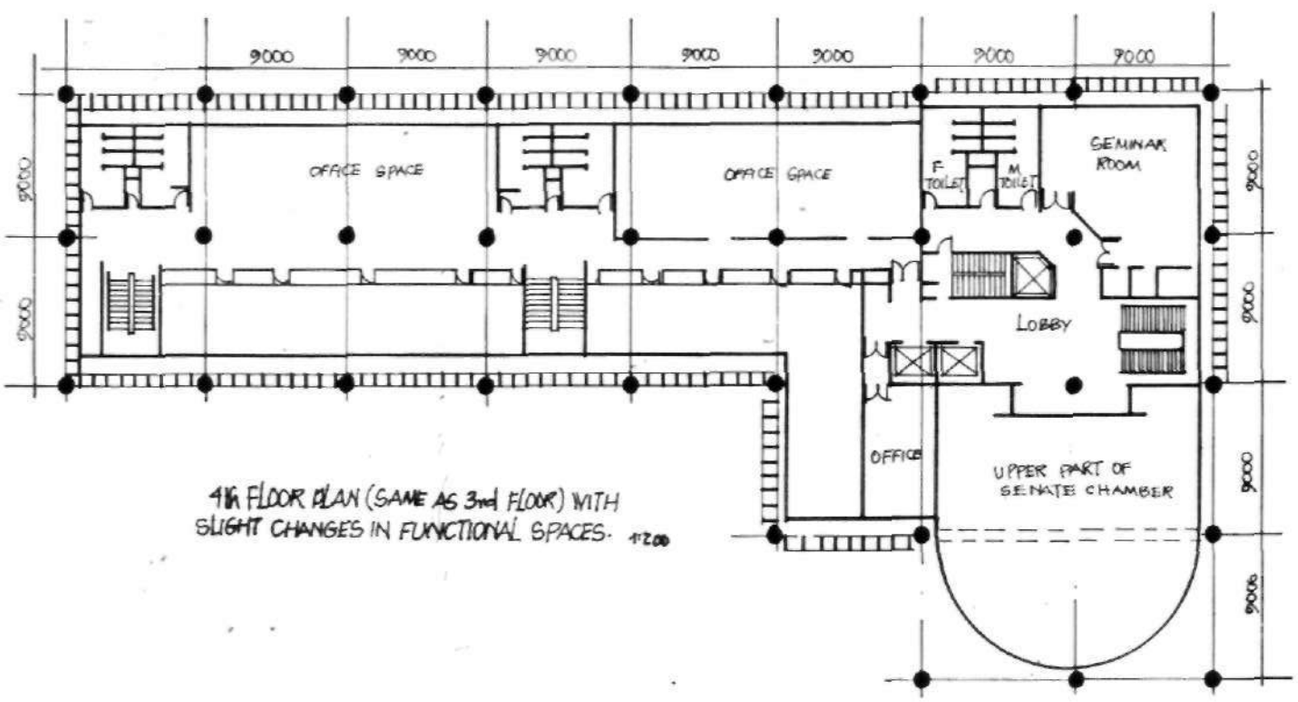
- Fire fighting will be difficult due to height
- Escape routes and exit stairs are hidden.
- There is no smoke out let which is the killer in the event of fire out break.
- Buckling is noticed in the third floor due to construction error.
- Space allocation to some offices is excessive.
- No compartmentalization.



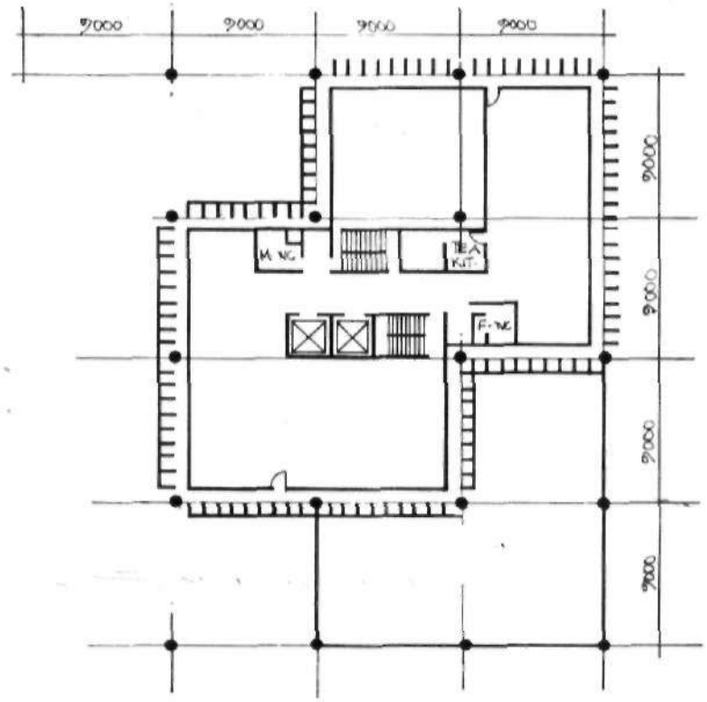
SITE PLAN OF THE UNIVERSITY OF LAGOS SENATE HOUSE.



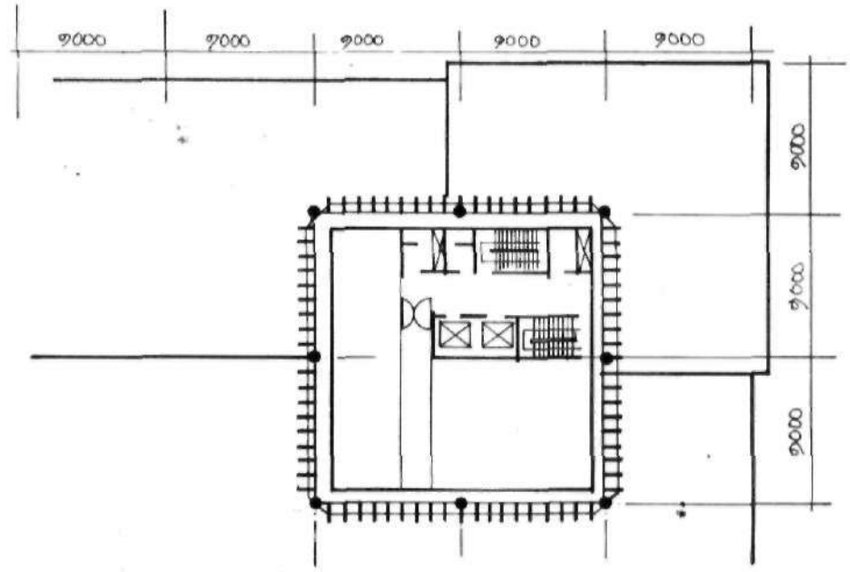
2nd FLOOR PLAN 1:200



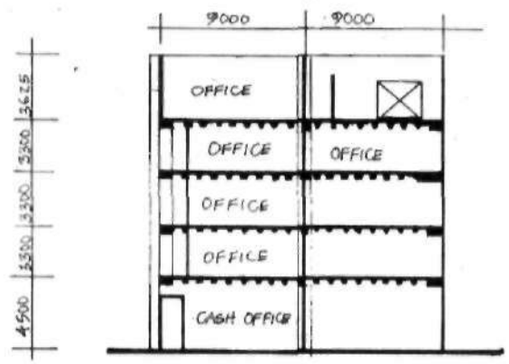
4th FLOOR PLAN (SAME AS 3rd FLOOR) WITH SLIGHT CHANGES IN FUNCTIONAL SPACES. 1:200



5-8 FLOOR PLANS 1:200



9-12 FLOOR PLANS 1:200



SECTION THROUGH BURSARY.

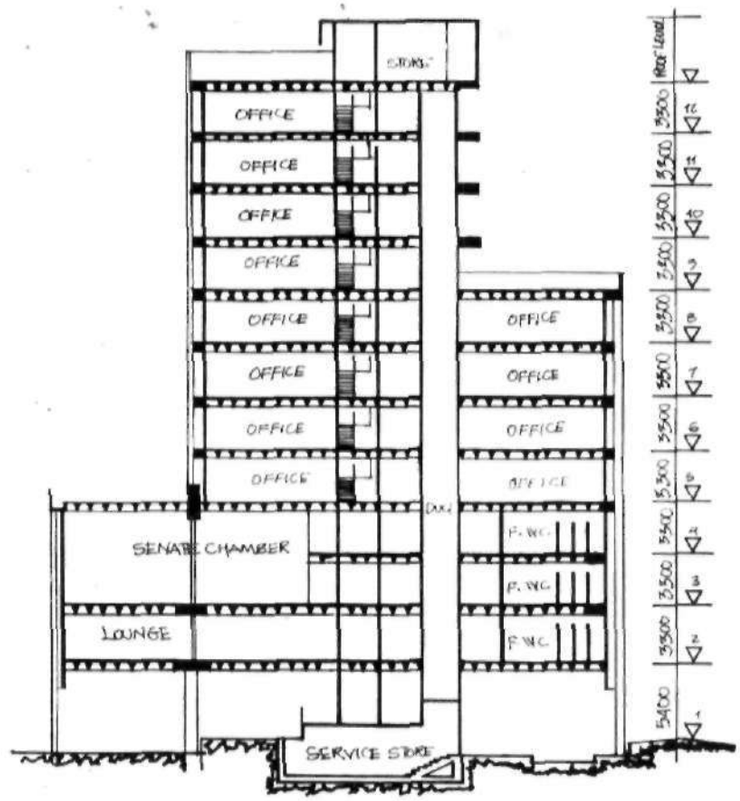

OFFICE
SENATE CHAMBER
LOUNGE
SERVICE STORE
P. W.C.
Roof Level
SECTION THROUGH TOWER 1:200



Plate 5a

University of Lagos

Plate 5b

Plate 5c

CHAPTER FOUR

TOWARDS SOLVING FIRE PROBLEMS IN THE EVENTS OF FIRE OUTBREAK.

4.0 INTRODUCTION

Fire is the active principle operative in combustion, particularly conceived as a substance visible in the form of flame or of ruddy glow or incandescence. It could also be defined as the rapid excitation of combustible materials and gases providing heat and light.

Man has used fire in many centuries for heating and cooking purposes and there is a danger (always) of the fire becoming uncontrolled. It has also been found cheaper to use combustible rather than incombustible material in construction. It was only after a great fire incidence had occurred that people have realised its danger and accepted to take precautions.

The need to safeguard lives and properties, to preserve our ecosystem and our atmospheric air can not be over looked. In this regard, it is important to clarify some general concepts about fire so that the role of architects in fire precaution measures can be examined.

For instance, the great fire disaster of London in 1666 marked the turning point in the history of fire prevention. It was soon after this fire, that comprehensive regulations were deviced and enforced to prevent its spread.

4.1 CLASSIFICATION OF FIRE

Fire is basically classified into four main groups.

Group 1:

The fire involving some combustible materials. These materials include: wood, cloth, paper, etc.

Group 2:

Fire involving Flammable liquids such as petrol, oils, grease, fats, where blanketing or smothering effects or agents which exclude oxygen are most effective to prevent it.

Group 3

Fire involving lived electrical cables or equipment where the non conductivity of extinguishing agents is of paramount importance towards suppressing it.

Group 4

Fire involving metals such as steel, alluminium copper, zinc, lead etc.

The aim in taking extra precaution is to reduce the overall risks of fire loss through an efficient fire preventive design and planning. For this reason, two basic factors are to be considered.

To reduce or eliminate the risk of personal injury or death.

To reduce total loss of structure, plants and goods.

4.2 SITE PLANNING FOR FIRE

One of the major categories of the decisions to be made in the design process of a building in order to provide an effective fire safe design is site planning. For this reason, the following steps are considered.

4.2.1 Site Accessibility:

The building site should provide adequate drive way with turning point radii and parking spaces on firm level surfaces for fire apparatus. The fire apparatus turning radius or radii should be between 7 - 13m for vehicle length of 13-20m.

Apparatus:-

- Ladder Truck: This carries ladder and equipments to the site.
- Pumper: Provides water pressure for hydrants for the suppression of fire.
- Tanker: Provides water in the absence of hydrant.

4.2.2 Barrier to Site access:

Fence by Bollard are potential barrier to site, while fences for security should have gates of sufficient width and open to the outside. Bollard on the other hand should be removable for fire apparatus. Furthermore, major road and all buildings should be accessible to fire station.

4.2.3 Site drive Ways:

There should be adequate turning points at each individual block to allow fire fighting apparatus and dead ends should be avoided.

4.2.4 Site planning check List:

In public buildings, such as high rise office building, hotels, libraries etc. etc. Architects should provide adequate spatial distances between buildings. In cases of building such as office building, markets etc, architects should sure that site access to building is well co-ordinated with the placement of lighting, utility poles, out door sculptures, fountains and general land scape.

They must make sure that fire apparatus has an unobstructed drive way access to building by designing adequate clear road width and turning point radii as the case may be. Architects should avoid locating public buildings at the edge of cliffs or other steep grades, which could restrict fire apparatus to only one side, they should consider using T-turns, cul-de-sac and curved drive way lay out to allow for fire apparatus to maneuver.

4.2.5 Building Spacing:

Buildings should be spaced adequately. The minimum spacing between one Building and the other is twice the height of the building (2h). Where `h' is the height of the building.

4.2.6 Building heights:

Buildings (very tall) have posed a lot of problems in the cause of fire fighting. In as much as possible, it should be limited except for some very obvious reasons.

4.2.7 Building Openings:

The sizes of the external doors and windows should be decreased.

4.3 CAUSES OF FIRE

Before one can study the way and manner on how to prevent the spread of fire in the event of fire out break, the main causes must be ascertained. In any case, the major cause of fire in building is the user of the building.

4.3.1 Natural Causes:

4.3.1.1 Lightening:

Some of the providential causes of fire is lightening and thunder storm. This occurs when there is sufficient heat to ignite a combustible material and mostly occurs in tropical climate. If it strikes a line National Electric Power Authority (Cable), it follows it into the building right into the junction box and blows fuses that are likely to start fire. Circuit breakers with copper wire are used to protect this type of earthening or shortcircuiting.

4.3.1.2 Volcanoes:

This is as a results of a molten magma in rocks due to excessive heat from the deeper part of the core. Volcanoes are of two types, intrusive and extrusive volcanoes. The former is associated with tremors which may cause destruction to buildings because it takes place beneath the earth's surface while the later is the reverse and may also result in forest and bush burning.

4.3.2 Artificial Causes:

4.3.2.1 Accidental Causes:

This occurs due to bush burning, careless cigarette smokers, short circuits, surface wiring, high voltage from National Electric Power Authority, cooking etc.

4.3.2.2 Incendiary Origin:

This is due to spontaneous heating, malicious setting of fire on buildings and properties by individuals involved in criminal activities. It may however, occur from the heat generated from appliances e.g. T.V. sets, Refrigerators etc.

4.4 FIRE SPREAD

In the event of fire outbreak, fire spreads from room to room, office to office and building to building. There are two basic spreads, vertical and horizontal.

4.4.1 Vertical Spread:

Fire in the form of flame spread in upward direction can be rapid as convected heat accelerates burning by preheating fuel above the flames.

4.4.2 Horizontal Spread:

Fire spread in the horizontal direction is less rapid due to hat being convected away from the incombustible material. As a result, fire spread along ceilings generally is more rapid than along floors except for some timber floors.

4.5. MATERIALS FOR CONSTRUCTION

There are various types of building materials used today in the building industry. Concrete, Timber, Plastics, Rubber, Glass, Clay, Asbestos, Stones, to mention but a few.

The concept of structural fire protection involves a new design approach to ensure their combination which will meet a minimum fire endurance rating.

4.5.1 Metals:

Metal is one of the most widely used building material all across the globe and Nigeria being no exception.

Different materials fall under this group. They include, Steel, Iron, Aluminium, Lead, Copper and Zinc. These come in different shapes and forms depending on their usage and/or the manufacturers.

All metals are ductile and malleable when subjected to heat. They are strong, durable and provide high resistance to fire. However, Steel is one of the most widely used

building materials.

The strain-stress characteristics of steel under high temperature are as follows. At about 300°F - 500°F the ultimate tensile strength of steel begins to decrease and with continuing increase in temperature, the strength drops rapidly and at about 900°F bulking occurs. When the temperature is further increased to about 1000°F - 1300°F it deforms which leads to a failure of steel construction.

Aluminiun on the other hand is being used as non load bearing curtain walls, widows and door frames, roofing sheets. It melts at low temperature.

Metals in general have a disadvantage of rapid loss of strength with increase in temperature.

4.5.2 Concrete:

Concrete could be defined as a mixture of sand, aggregates, water and cement in a laid down ratio yielding a solidness to achieve a desired strength.

The behaviour of concrete under high temperature solely depends on the components of its mixture. Amongst concrete mix, cement is the most unstable under high temperature.

At 200°F (temperature), concrete begins to loose its strength, however, it is not significant until the temperature exceeds 1400°F when it starts to disintegrate.

4.5.3 Timber

In the earliest days, timber has been recorded as one of commonest building materials and it is also one of the most important and widely used all over.

It is either being used as roofing structures or partition walls in most public buildings. Timber like other building materials undergoes dimensional changes commensurate with increasing temperature. Members of large sections have a relatively inherent resistance to fire, loosing strength slowly and deforming little by little until failure is approached. On the other hand, small sections of timber have appreciable inherent resistance to fire, but this will depend largely on the quality of the section.

4.5.4 Plastics:

Even-though plastics in general, are said to be bad fire resistant, there are some special types like thermoplastics which could be used in fire area to a degree. Plastic units used in ceiling, will melt during fire and cannot be relied upon. Fire detectors, alarms and sprinklers be placed in the ceiling for immediate action.

4.5.5 Stones

Stone blocks and slabs are generally satisfactory in fire (but not granite) and where high fire resistance is required. Limestone when heated, gives of CO_2 with loss of strength. In this regard, it has a high rate of fire resistance.

4.5.6 Clay

Clay products behave well in fire proofing, having being manufactured at temperatures in excess of those normally encountered in building fires. Examples of such materials manufactured from clay are bricks.

Fire resistance of brick walls is expected to last for four hours.

4.5.7 Aluminium

A material not at present used structurally, but its behaviour in fire is vital: It has a melting point of 650^{0}C which is considerably lower than that of steel. It also has twice the conductivity rate than steel. It therefore needs protection to resist the effects of fire when used structurally.

4.5.8 Glass:

Various types of heat resistant glasses are widely used today. Wired glass units are fire resistant. Toughened glass has little fire-resistance but can withstand fire shock at 500^{0}C and when cold water is poured on, it will not shatter.

4.5.9 Asbestos:

Asbestos in its pure form is used as a sprayed insulation. The ability of asbestos based products to resist fire, depends to a large extent upon the amount of asbestos fibre in the products.

468212

Asbestos cement, although non-combustible, may shatter violently in the early stages of fire depending on its moisture contents.

4.6 CONSTRUCTION TECHNIQUE

Columns are the major structural elements in complex buildings like industries and public buildings which require large spaces for its numerous functions.

Columns being exposed in all sides are more liable to severe conditions of exposure in a fire, than walls and floors, for heat may attack it from all sides.

Three building materials are used as columns; steel, concrete and timber. However, the later is not so prominent now. It is a standard design practice to protect steel with suitable insulating materials or traditional concrete. This measure provides a composite structural effect.

As a matter of emphasis, structural engineers should discourage unprotected steel columns in public buildings such as hotels and office buildings. The purpose of fire protection to steel frames is to ensure that during fires, the temperature of the frames does not rise to a figure in which its strength will not be affected for a period of time.

4.6.1 Types of Protection (steel):

There are two basic types of protection to steel. They include: solid casing of concrete, blocks or bricks and light weight casings of plaster or building boards.

A solid casing is most commonly used and is the cheapest method of protecting steel. The concrete casing is usually reinforced with small sections of Steel bars or mesh to restrain shrinkage and cracking of concrete and to ensure a firm bond around the steel. The concrete cover around the steel members is the thickness of the concrete measured from the face of the concrete or extreme edges of the flanges of the members. The solid concrete casing also protects the steel against corrosion on the external faces of buildings. Light weight casing varies from proprietary light weight fire protection casing to steel employs:

(a) - Sprayed limpet asbestos

(b) - Plaster applied to expanded metal wrapped around the steel work.

(c) - Building boards of plaster or asbestos.

(d) - Light weight building blocks around steel.

It should be noted that concrete casing around structural steel, binds to the steel and acts with it under load so that the concrete casing bears a part of the stress induced under load. A concrete encased steel frame, therefore, acts as a form of composite construction.

4.6.2 Protection of Reinforced Concrete

The minimum size of reinforced concrete columns to give various fire resistance period is specified in building regulations of 1965. Greater resistance to fire can be obtained for a given side of column by using limestone aggregates instead of other natural stones or by including a mesh reinforcement in the cover to the main bars and both methods give the same fire resistance for column size.

Good quality control is very vital and hence can not be over emphasized at both design and construction stages. This is so, because most aggregates are contaminated by organic materials. This organic material to a great extent, reduces the quality of cement paste and degree of concrete.

Architects are faced with problems of providing fire resistance in beams and floor slabs to meet bye law requirements, using materials and forms of construction which are desirable on other hand. However, this problem has been solved with the introduction of composite construction.

4.7 FIRE ESCAPE ROUTES

This can be defined as a continuous and unobstructed way of exit travel from any point in a building or structure (in case of fire out break), to a public way and it consists of three distinct parts.

a. The way of exit

b. The exit

c. The way of exit discharge.

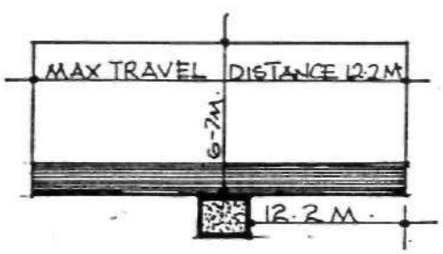
4.7.1 Fire Exit:

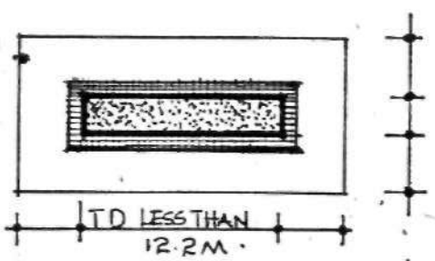
The design and protection of escape routes must be carefully done and normal entrance and exit points should also function as to escape routes.

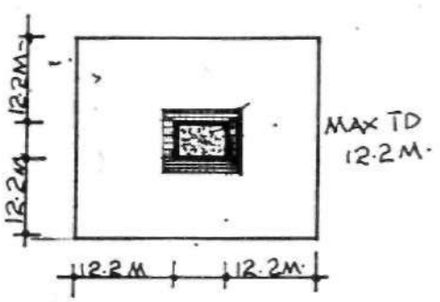
It should also be noted that fires tend to spread upwards and considering the number of people to be evacuated from the building, the floor of origin and the one immediately above it should be considered. The elements of corridors leading to escape stairways must be fire resisting to ensure safety from heat and smoke. Escape staircases

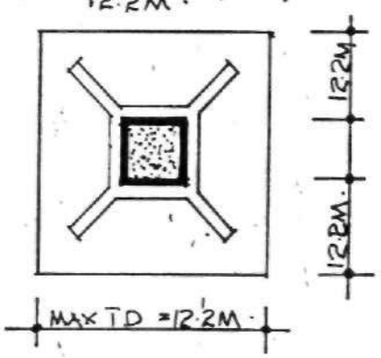
ESCAPE ROUTE DESIGN REQUIREMENTS

- MAXIMUM TRAVEL DISTANCE WITH ESCAPE POSSIBLE IN ONE DIRECTION ONLY – 12.2 METRES EXCEPT ON THE FIRST FLOOR.



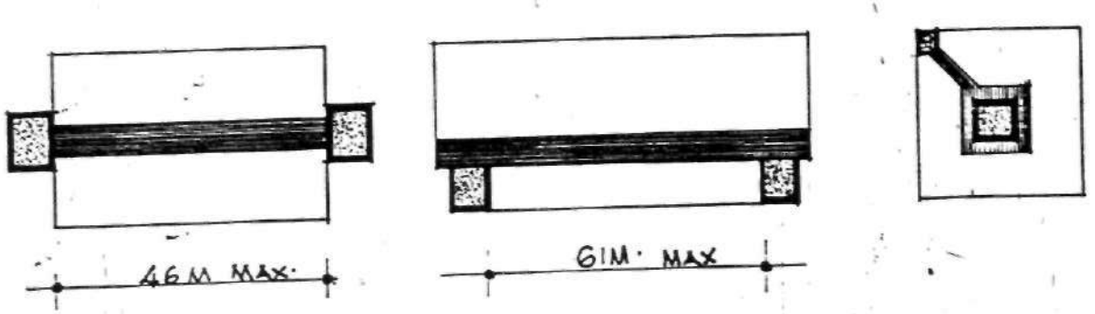






ESCAPE ROUTE DESIGN REQUIREMENT.

MAXIMUM TRAVEL WITH ESCAPE POSSIBLE IN ALTERNATIVE DIRECTION 46 METERS WITH NO POINT MORE THAN 12·2M TO THE NEAREST EXIT.



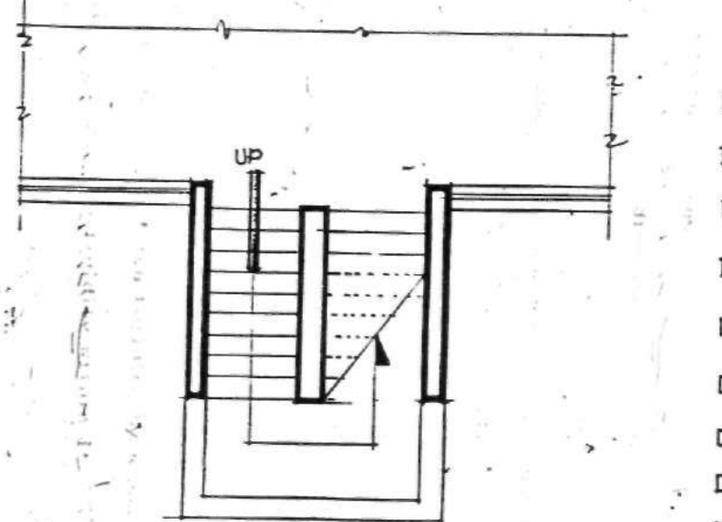
EXIT AT ALTERNATIVE DIRECTION MAX TRAVELLING DISTANCE 46METERS.

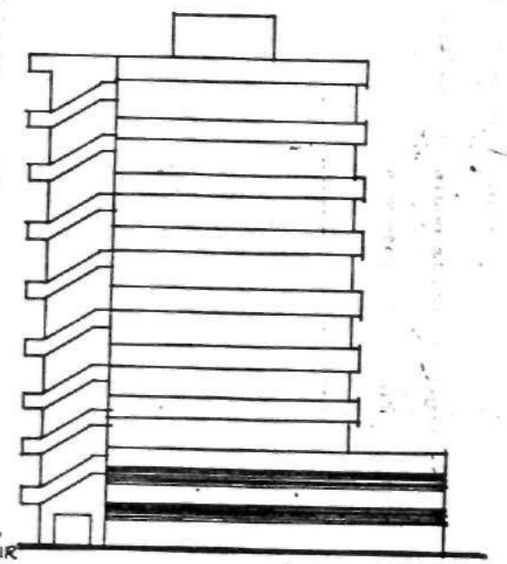
TWO ADJACENT EXIT MAX TRAVEL. DISTANCE 61M.

EXIT ROUTE, POSSIBLE IN ALTERNATINE DIRECTION.

Fig.

FIRE FIGHTING STAIR FOR BUILDINGS OVER 18·3M ABOVE GROUND LEVEL.





- IT SHOULD BE CONTINOUS THROUGH OUT THE BUILDING
- HAVE ACCESS AT GROUND LEVEL DIRECT TO OPEN AIR
- HAVE OPENABLE WINDOWS AT EACH LANDING LEVEL.
- HAVE PERMANENT VENTILATION AT THE TOP.
- HAVE PROTECTED & VENTILATED LOBBY AT EACH FLOOR.

or corridors or both may be slightly pressured to reduce regress of smoke and hot gases. The distances of the means of escape is usually regulated and its relationship to the occupancy level of a building depends on a sleeping or non sleeping area. In other words, whenever fires may start when people are sleeping should have early detections warnings and fire fighting equipments.

4.7.2 Compartmentalization:

This is defined as a construction design in which a building is divided in sections that can be sealed off from other parts of the building to contain fire and smoke in the area of origin and prevent its spread to the adjacent compartments. This leads us to fire area which is a portion of a building separated from the remaining by fire resistance construction (floors, walls, ceiling etc), in which all communicating openings are protected by doors, windows and other assemblies having appropriate fire resistance rating. From the above, one thing is clear, walls, floors columns, doors, roofs etc, must be fire resistant in the compartment.

The manner where architects just design large spaces, and these spaces are left to the client to partition should be stopped or discouraged. Architects must therefore try as much as possible to design buildings with two or more compartments as the situation may be.

4.7.3 Escape and Refuge - Method of Safety to Life:

Manual Disruption:	Refuge:
(To defend occupants in place)	(Move occupants to safe area)
- Prevent heat intrusion with fire rated construction	- Adequate number of exits and exit capacity).
- Prevent smoke infiltration with barriers and pressurizers.	- Fire detection, warning signals and conditions for orderly movement.
- Manual or automatic suppression system (to defend against heat intrusion).	- Move to safe area through protective routes enclosed fire rated construction.
- Vents (to defend against smoke infiltration).	- Safe destination in building (of adequate capacity).

Escape and Refuge Check List

1. **Determine exist requirement by evaluating the building occupancy example, type of office, school store etc. Fire Exit should be direct and unobstructed, well illuminated and clearly marked.**
2. **In general, a minimum of two exits, located remotely from each other will be required.**
3. **Avoid dead end corridors.**
4. **Occupied offices should not be within the access routes**
5. **Do not locate storage rooms, trash rooms etc. within the exit access as fire may originate from them.**
6. **Use automatic closing door hardware.**
7. **Provide smoke proof stairway enclosures.**
8. **Provide emergency lighting.**

CHAPTER FIVE

5.0 FIRE PROTECTION SYSTEMS AND EQUIPMENTS

5.1 INTRODUCTION

With all the best fire safe building design in the world fires still do occur and when they occur, the spread will depend among other things on the fire protection arrangements made for the building.

To combat the different types of fires, various kinds of fire protection systems and equipments, have been developed whose operations are dependent upon a variety of chemical and mechanical actions. Some of these systems and equipments in use are;

5.2 FIRE ALARM

Engineer's fire prevention approach consists of design and installation of fire detection and alarm system in the building concerned. Fire alarms are either installed manually or automatically to detect fire at the incipient stage and to signalize its occurrence. Fire alarm systems compose the followings.

- Call points, either manual or automatic (Fire detectors)
- Sounders
- Power supply
- Conductors (Cables)
- Circuitry.



plate 6a

THE KAC MANUAL CALL POINT
(KAC Alarm Company).



plate 6b

THE GLASS IS BROKEN IN A KAC
MANUAL CALLPOINT

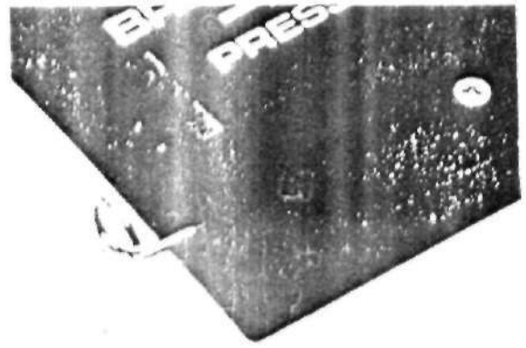


plate 6c

THE TEST PROBE IN POSITION IN A
MANUAL CALL POINT

Source: Underwood (1-2)

5.2.1 Manual fire alarm points

Manual fire alarm call points are usually of the break-glass pattern and the following factors should be borne in mind when looking at a piece of well designed apparatus.

- No live parts should be exposed
- The operating button should be spring loaded and held in the `off' position by a glass cover in such a manner that the breaking of the glass releases the button and initiates the alarm.
- It must not be necessary for the person giving the alarm to have to stand to operate the device.
- The cover should be opaque so that it does not appear that a person has to stand and press a button. If the caller does not panic and press the button the call would, of course be suppressed.
- Fire alarm - break glass should be clearly indicated.
- There must be means for testing the action of the alarm.
- The alarm point should be coloured red and it is advisable to number each point for easy reference.

Manual call points are of different type; surface fitting type suitable for factory or general use, a flush fitting type with a high class finish for offices and similar situations, a weather proof type for out door use etc.

The manual call points must be provided in all parts of the building. They should be fixed at a height of 1.5m from floor level, in an easily accessible, well illuminated and very conspicuous position.

5.2.1.1 Automatic Call points

Sounder, is a term used for any method of giving warning in the case of fire even though no sound is produced.

When comparing the various types of machines that produce noise, the loudness in determined in decibel units abbreviated to dB. However, when comparing decibel readings, there can be considerable vibrations unless the conditions under which the readings were taken is known.

It must not be possible for fire warnings given by sounders to be confused with any other form of warning or for any other purpose. This applies especially to the use of bells. Today it is better to avoid the use of bells for-giving warning of the conditions.

The essential feature is that the sound must be loud enough to attract attention and to awaken a sleeper if necessary. Everyone in the building must be able to hear it and they must be able to recognise the sound and identify its meaning. It is generally recognised that a sound of 75 dB is required at the bed-head to awaken a normal sleeper.

5.2.3 Power Supply

The weakest part of fire warning system is probably the power supply. It is laid down in the British Standard Code Practice CP1019: 1972 that the power supply for a fire alarm system shall be exclusive to that system, there being a similar rule for intruder alarm systems. However, there is a growing opinion that it be permissible for these two systems to have a common power supply. This is especially noticeable when dealing with domestic alarm systems.



plate 7
A SIMPLE SOUND METRE
(Dawe instrument)

Source: Underdown G.W.

Where automatic calls are to be transmitted to the police or fire brigade, it could be good practice to do so but even then it should be remembered that the fire brigade always notify the police of any call they receive.

The power supply for fire alarm purposes can consist of the following:

- Mains with a secondary battery kept in a fully charged condition from the mains supply.
- Mains supply with primary battery as a stand-by.
- Mains only
- Primary battery only.

5.2.4 Circuitry

In older systems and in some small systems where only a very few call points and sounders are required, it is common to connect up the various parts of the system by an `open' circuit wiring. Occasionally a heat detector may also be included but when heat and certainly when smoke detectors are required a safer form of wiring in used. Open circuit wiring means that, there is no current flowing in the circuit until a call point is operated as compared with `closed' circuit in which the reverse is the case.

5.2.5 Conductors and Cables

The choice of cables is governed by two factors: the size of the metal conductor and the type of insulation round the conductor is governed by the area of the core, and by the voltage drop caused by the resistance of the conductor for its length through which the

current has to pass.

If the current is not flowing long enough to cause overheating but the demand of power for the apparatus is too high for the size of conductor employed, the result would be that there would not be sufficient power available at the apparatus (i.e the sounder) for it to operate efficiently. In either case, longer conductor should be provided.

The insulation of the conductor is important not only to prevent short circuiting between conductors or from conductors to earth but it must be capable of withstanding heat from a fire which has occurred and for which warning is required.

5.3 FIXED INSTALLATIONS

Although, there are no building regulations in relation to fire protection in this country at the moment, it is emphasised that architects should include in their drawings, especially high rise buildings fixed pipe work systems employing water as the extinguishing medium. These system are acknowledged to be efficient means of protecting buildings and many other risks against extensive damage resulting from an out break of fire. Such systems could be looked into the following classes.

- Automatic Sprinklers
- Drenches
- Water spray projector.

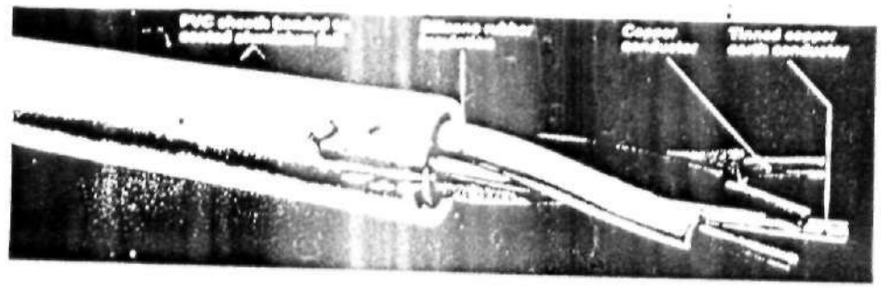


plate 8

FIRE RESISTANT CABLE

(Pirelli General Cable Works)

5.3.1 Automatic Sprinklers

Automatic sprinkler installation are designed to hold a fire in check and to give warning of a dangerous situation. They do not necessarily extinguish a fire, but often do so. They are not subject to any of the limitations of the fire fighting services such as smoke or a delayed call.

Objections are often raised that automatic sprinklers cause a lot of water damage. This is very often an excuse rather than a fact. A sprinkler installation is no more likely to leak than a domestic water supply: probably less because the installation will have been made by specialists and in any case will do less damage as a serious leak will actuate the alarm signal thus drawing attention to the leakage. If the damage referred to is meant as a damage in extinguishing a fire, that damage is surely justified rather than have a total loss by fire.

5.3.2 Drenchers

Drencher installations are used to protect openings in walls and combustible parts of walls and roofs from an exposing hazard.

The installation of external drenchers is governed by special rules of `Fire Officers' Committee (FOC). These rules require all sprinkler heads to be an approved open pattern under a master control. This master control must be so situated that it can be operated on safety.

The rules cover the protection of all window openings on the top two of storeys and of an alternate storeys below these. Roofs have to be protected by a line of drenchers

situated on the apex of the roof. Drenchers may not be more than 2.5m apart nor more than 1.2 from the window jamb. The piping must be arranged so that it will drain naturally when the water is shut off.

5.3.3 Water Spray Projector

These are specialised development of automatic fire protection designed to combat oil fires. Apart from these systems, other fixed installation such as hosereals Risers, (wet or dry risers) should be incorporated in the design of such buildings.

5.4 FIRST AID FIRE FIGHTING EQUIPMENTS

Portable fire extinguisher are essentially fire fighting appliances for use only on fires of certain type when caught in their incipient stages. They are small and light in weight to be carried by hand. These are known as first aid fire fighting appliances to prevent fires.

Extinguishers should be sited as near as possible to exits, if they do not form any sort of obstruction, they can be placed just out side an exit door.

Until recently, small fires that could be dealt with by means of a portable fire extinguisher were considered as falling into one of three classes and many existing extinguisher will have reference to these classes marked on them. The three classes are `A' carbonaceous, which included wood, paper, cloth and similar solid materials, class `B' petrol, oil, grease, fats and similar flammable liquids and class `C' electrical fires. Fire engineers have realised for some time that fires involving live electrical apparatus were not a separate class because as soon as electric power was shut off they became either class A or

B. Similarly, they have felt the need of a class for metal and metallic dusts and have already begun to refer to this class of fire as class D.

5.4.1 A' Carbonaceous (Water/gas pressure)

In this extinguisher, a compressed gas (carbondioxide) is used to expel water. The extinguisher mostly holds about eight litres of water and compressed gas in a container which is made up of steel. The extinguisher is operated by piercing a sealing disc on top of the cartridge.

5.4.2 B' Liquids (foam types)

Foam for fire fighting purposes is formed by bubbles of gas or air which are trapped by a foam binding solution in water. The bubbles float on top of the burning liquid making a barrier between the burning liquid and the air. The bubbles are broken up and destroyed by the heat of the fire and the foam must be applied at a greater rate than their destruction by heat or the solvent action of the flammable liquid.

5.4.3 C' Vaporizing Liquid extinguisher

These extinguisher have a complicated chemical reaction when in contact with heated and burning materials. The result is the production of large quantities of gas which so dilutes the oxygen in the atmosphere that it can no loner support combustion. The gas is heavier than air and settles down on the burning surface excluding air.

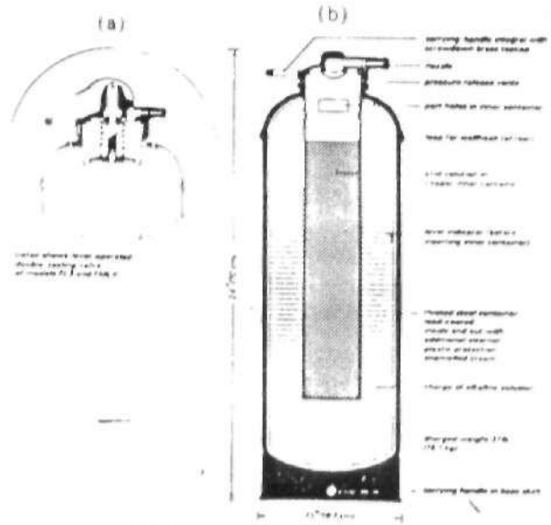


Fig. 18a
CHEMICAL FOAM FIRE EXTINGUISHER
(a) Double seal type, (b) Open type
(The pyrotenax company)
Source: Underdown G.W.

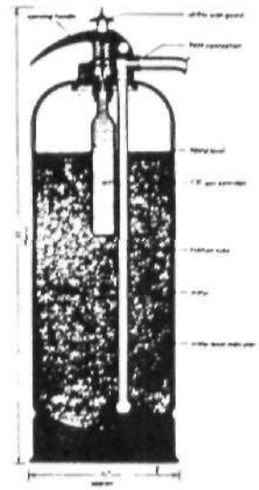


fig. 18b
GAS CARTRIDGE DISCHARGE TYPE (pyrene company)

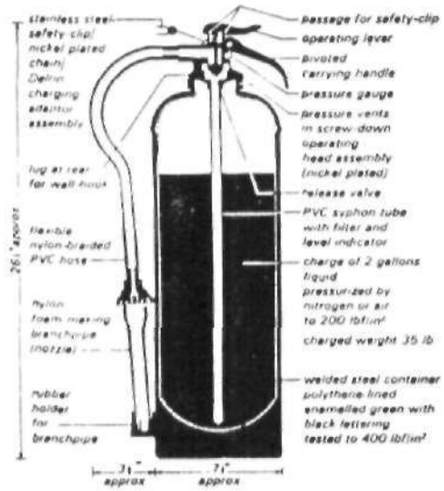


fig. 18c
PRESSURE TYPE (Constant pressure type).
Source: Underdown. G.W.

Finally, there is an inhibiting effect on the chemical action which takes place during the process of burning. This has been described as a negative catalyst action.

5.4.4 D' Dry powder extinguisher

These extinguisher consists of a very finely prepared powder, so fine that it will move like a liquid. Special chemicals are added to it to prevent it from caking.

These extinguisher serve general purposes i.e carbonaceous, fires involving wood, paper, cloth as well as flammable liquids and electrical fires. They are therefore ideal for all special risks such as metals or fires involving vehicles.

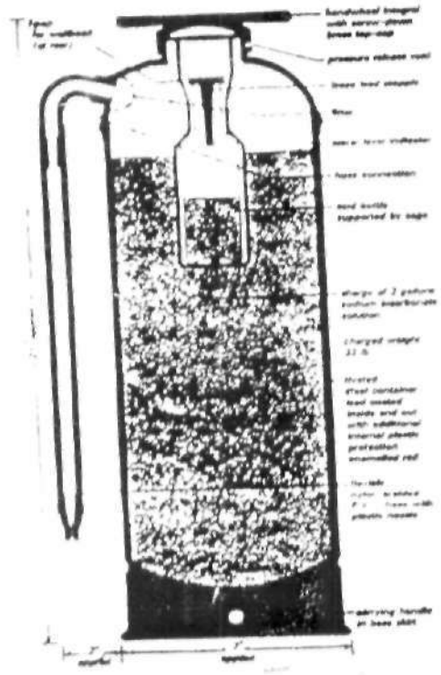


Fig 18d

SODA ACID FIRE EXTINGUISHER - TURN OVER TYPE
(The pyrene Company)
source: under down G.W.

CHAPTER SIX

6.0 GEOGRAPHICAL BACKGROUND OF BAUCHI

6.1 Introduction

Bauchi became a State in the boundary re-organization of 1976. Formally, a province of the North-Eastern State. It covers an area - of 67,000 square Kilometers (7% approximately of Nigeria land mass) it is now subdivided into 20 local government area. It lies in an Area of crystalline uplands approximately 600 meters above sea level on a distinct watershed.

Initially, it was founded as a trading centre in the early 19th century. The town Bauchi, is said to have derived its name from a hunter known as Baushe; (later changed to Bauchi). Tradition has it that Yakubu the founder of Bauchi decided to name the settlement after him.

Economically, Bauchi state was not developed at the same rate as other southern states. Improvements in some sectors however, have accelerated during the plan period. Regional road networks have improved and major development projects in the agricultural, industrial and educational sectors have been instigated.

Public and private sector industrial investment has also been enhanced by the creation of intermediate and heavy industrial projects. Similarly, small scale industrial development has been promoted by the federal and state incentives. The location of the university, which is fifteen kilometers north of Bauchi, the state capital, will make an important contribution to the areas socio-economic life.

6.1.1 Location

Bauchi State is located between latitudes $9^{0}30'$ and $12^{0}30'$ North of the equator and longitudes $7^{0}42'$ and $10^{0}50'$ East of the Greenwich Meridian. It runs 1320km across from East to West.

Bauchi city itself lies in the western spur of the old North Eastern State of Nigeria at about 9^{0} 49' east and $10^{0}17'$ north with an attitude of about 609.3 meters.

6.1.2 Relief

Bauchi town lies in the crystalline uplands of Northern Nigeria. The Northern part of the town has the highest uplands of crystalline rocks and most of the town lies 150m above sea level. Most of the hills and rock out crops within the town consists of an isolated rocks, hills and low ranges. Some of these are easily visible, namely; the Wambai and Warinje to the north-east, Kodi, Idi and Dumi in the south. The Jahun and Gudum in the West, Kobi, Tudun Wada and few other hills which dominates the relief features of the town.

However, these potentials have not been fully exploited and incorporated in the design and development of the city's landscape.

6.1.3 Geology:

The micro geology of Bauchi consists of Charnockite and Bauchite which forms the majority of the lithology. The formation of such rock type are older granite site of Paleozoic age.

However, partly towards the Miri area, coarse foliated granite forms the lithology formation which is also Paleozoic age, while the Tirwun area has granite genesis lithological formation of Basement Complex of Paleozoic to Pre-cambrian age.

The macro geology which covers the whole state consists of an ancient crystalline basement which also comprises the remnants of Igneous and highly metamorphosed sedimentary rocks of old age. Few rocks are as a result of volcanic activity.

The general geology of Bauchi town and its environment shows that the area consists of Amphilobolite facies, and older granite complex of acid and intermediate rocks. The Fayalite quartz Manzonite commonly described as Bauchi-Bauchite and quartz diolite which occurs widely in the older granite complex of the area. The Bauchites are said to stretch over an area up to 10km and are closely associated with porphyritic biotite hornlende granites while the quartz diorite occur in smaller intrusions. These rocks especially the fine grained special are quarried for road and concrete construction works such as that located near junctions of South by-pass with Gombe road etc. They have also given rise to the soil types overlying the area. Concretionary iron masses of concretions and the predominantly reddish friable sandy clays are commonly found. These rock out crops and soil constitutes an excellent construction materials readily available for sub-base, surfacing of roads and for all other possible concrete works.

6.1.4 Hydrogeology

The hydrogeology of Bauchi State is made up of units of crystalline rocks with weathered lithology with Aquifer joints. The water table or water rest table is shallow (3m - 18m) deep.

In any case, Bauchi is blessed with uplands and as a result of these, most streams take up their courses from these uplands as water sheds. Most of these streams take their sources of either in river Gongola which also enters the river Benue while some ends up to Yobe Hadjia river while some drain to the lake Chad Basin, this natural endowment, if well harnessed, could ease sewage and storm water drainage of the city.

6.1.5 Climate

Basically, Bauchi has two climatic seasons, the dry and wet season. The town lies on the side of the plateau with mean annual rain fall of 1000mm with its peak in August. April is the month that has the highest temperature with maximum shade temperature reaching 40^{0}C.

Predominated winds are the North-East trade wind which is dry and often brings with it the harmattan which is cold. Its duration is usually from November to March while the South-West trade wind which is humid and worm brings the rainfall.

6.1.6 Vegetation

At Macro level, the vegetation of Bauchi is situated within the set of open Savanna woods which is characterized by tall trees which has been greatly reduced due to farming activities such as cutting and bush burning. This has significantly affected the general vegetation cover of the area.

6.1.7 Rain fall

The wet season is defined as running from the first 10-day period with 25mm rainfall. It begins at Bauchi about April 20-May and ends about October 1st to October 20th. Figures for its average duration vary from 140 to 170 days, 150 being the most probable. Rain mostly occurs in heavy showers and most of the rain in a shower, falls in the first twenty minutes or so. The early wet season storms are especially intense, with the high winds driving the rain almost horizontally. Short duration of rain fall recorded at the aerodrome are:

60 minutes - 46.7mm
120 minutes - 57.3mm

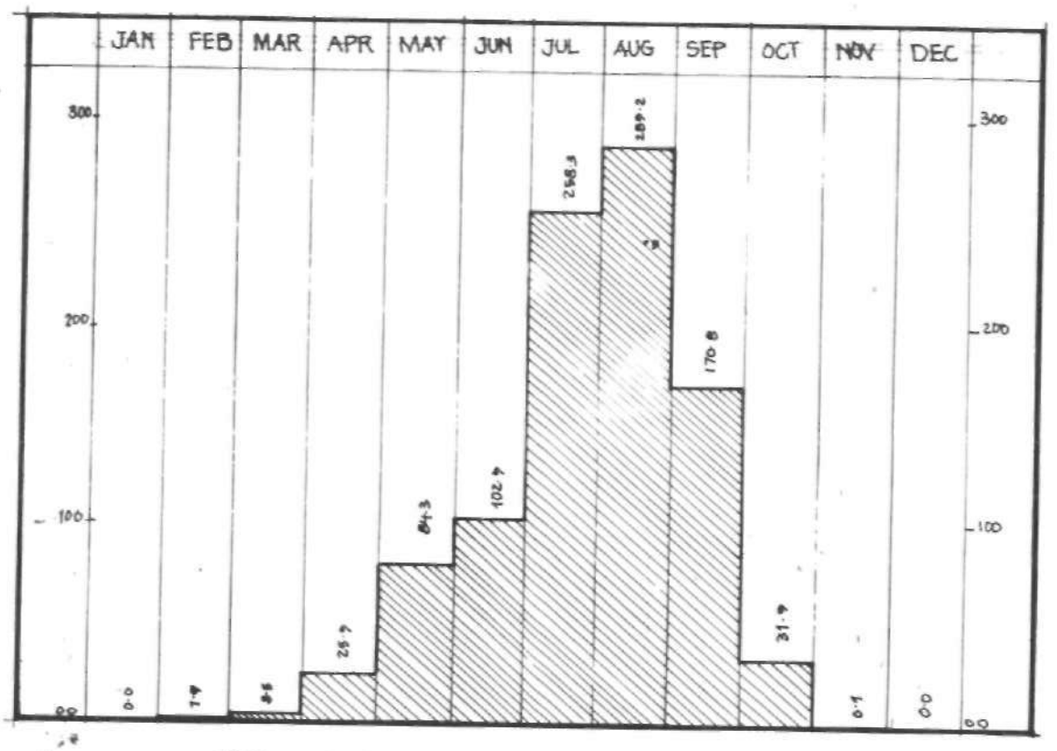
August is the wettest month averaging over 250mm of rain. Occasional showers occur in the dry season, but these are too short and isolated to be of any benefit.

The nearby Jos, Plateau has a strong shedding effect on local rain fall causing it to decline eastwards in contrast to the national pattern of declining northwards: The main university site is north east of the recording stations and probably has an annual rainfall of between 980 and 1,050mm.

6.1.8 Winds

There are basically two wind direction i.e Primary and Secondary wind directions. The secondary wind direction is often almost as frequent as the primary one. The year is also divided almost equally between the two main air masses blowing south west, south and east, north east.

It is necessary to prevent dust ladens, high velocity winds penetrating buildings.

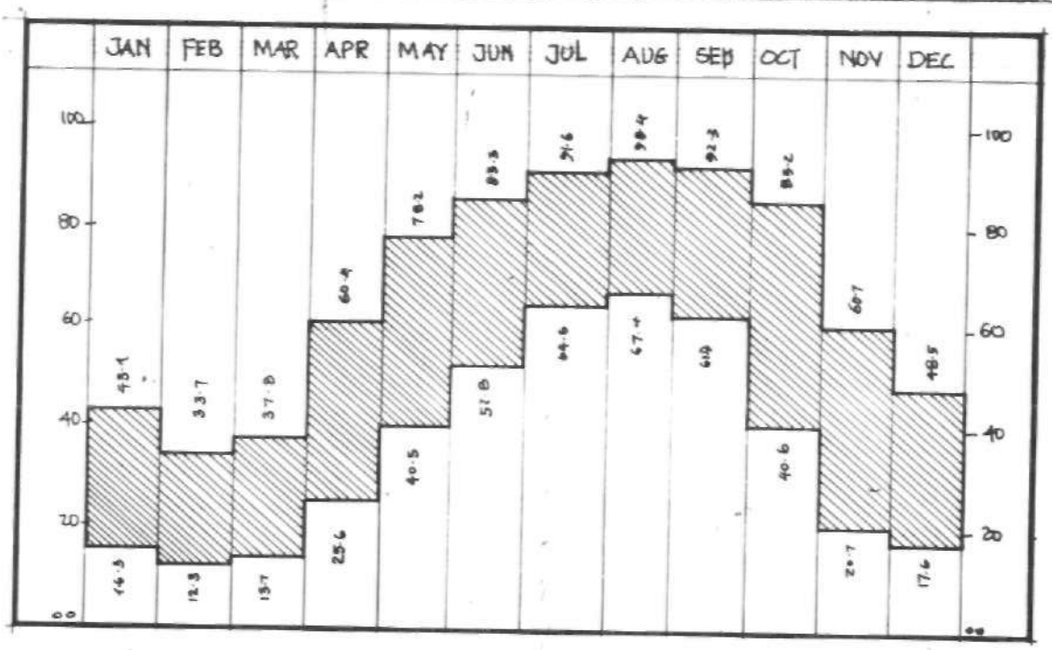


Average Monthly Rainfall (mm)

RAINY SEASON OCCURS BETWEEN APR-OCT YEARLY

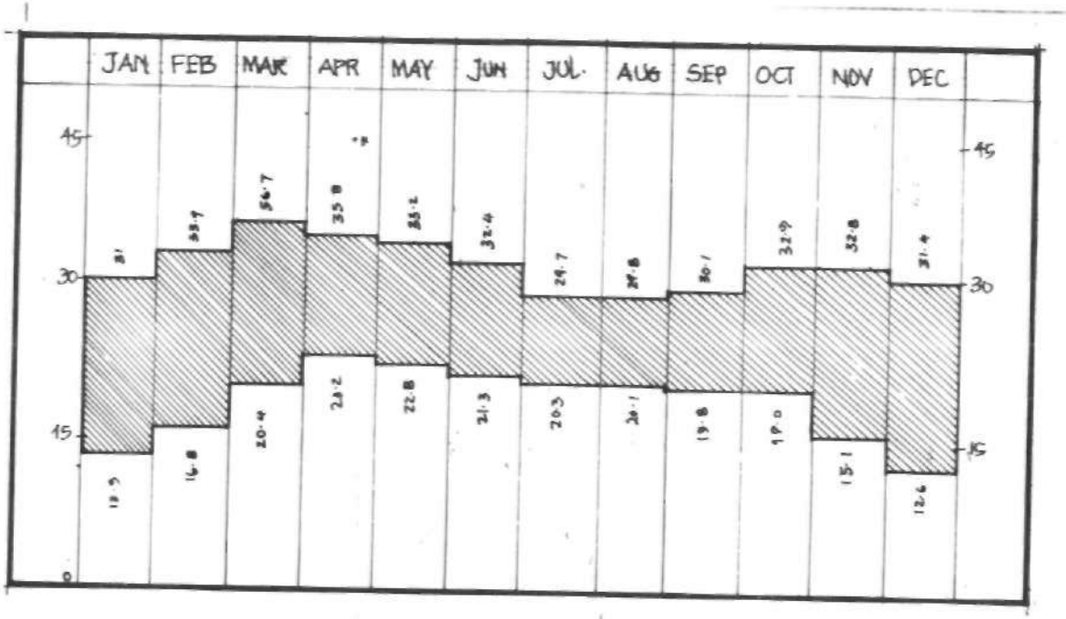
HIGH INTENSITY OF RAINFALL OCCURS BETWEEN JULY-SEPTEMBER

RAINFALL IS CHARACTERISED BY STRONG WINDS



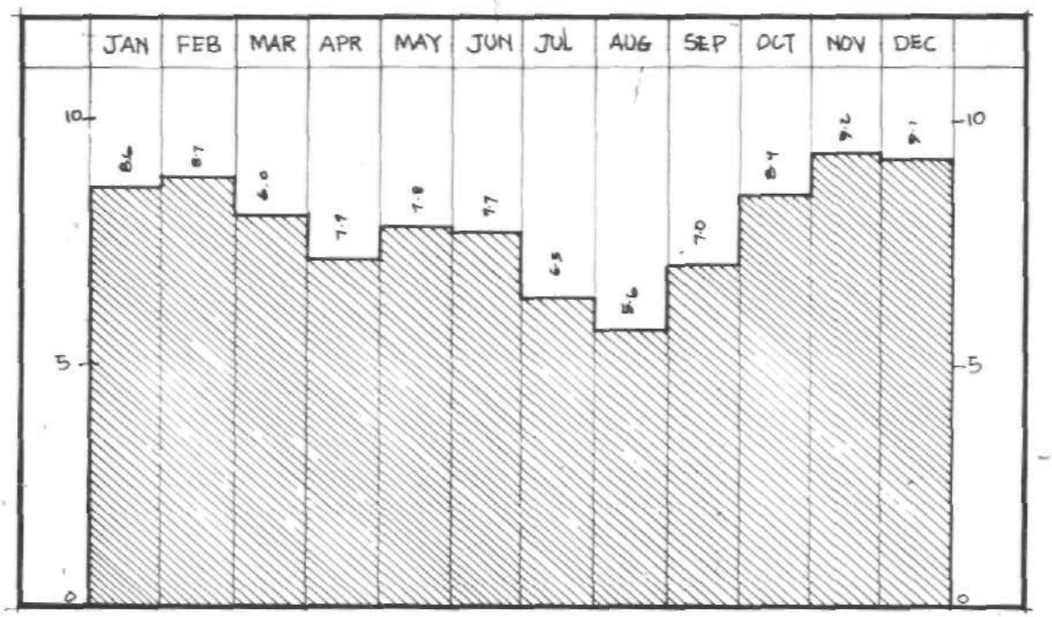
Relative Humidity

Average ~~Monthly~~ Relative Humidity At 0600 And 1200 Hours
~~Relative Humidity~~ is low in the dry season
and reaches its peak in the rainy season.



Temperature (Average monthly max and min in °C)

The site records its highest temperature during the dry season when the sky is clear of clouds. Temperature is lower during the rainy season due to dense cloud cover.



Sun Shine Hours (Daily mean Hours)

During the dry season (NOV- MAR) the monthly variation in the amount of sun shine, follows a trend of an increase over the area

The least value of sunshine Hours is noticed in August

6.2 ABUBAKAR TAFAWA BALEWA UNIVERSITY MAIN CAMPUS

The site for the new university has already been selected and its suitability has been established. Its selection was based on its proximity to Bauchi, the nearest urban centre, with suitable communication and road links. It contains sufficient land for initial needs but also sufficient reserve of land for all the foreseeable future needs of major technological university with strong connections to industry and agriculture. Furthermore, the land appeared to be sound both topographically and geologically and possessing only minimum limitations to any landuse pattern appropriate to large university.

6.3 SITE ANALYSIS

6.3.1 Location

The university main campus is located 15 kilometers North of Bauchi. It is bounded to the North by Ningi-Kano road and to the East by Old Maiduguri road, and to the south by Gubi dam and Bauchi which supplies water to Bauchi metropolis and around.

6.3.2 Access

There is road access to the site on two sides. On the North from Bauchi-Ningi-Kano road and on the East by the old Maiduguri road.

The old Maiduguri road, which seems to be the best to provide access to the university campus, is at present in poor condition and will require substantial upgrading if it is to serve the increasing traffic to be expected from the University.

6.3.3 Geodesical Features (Topography):

The topography of the site is well suited to the range of land uses proposed. A feature of the site is the granite inselbergs which form impressive backdrops to the major building areas. Bare rocks of varying heights covers 8% of the total site area.

The gentle plains running from the base of the inselbergs to the major watercourses provide suitable land for agriculture and building and provide views across the site. Shallow valleys also provide topographic and climatic variation to general flatness and will provide a rich source for future planting areas.

6.3.4 Geology

The geological formation of the site appears to be Igneous or metamorphosed Igneous rock with evidence of residual clay underlying laterite hard pan occurring along the western boundary. The predominant rock type is granite which forms large out crops that are dominant features both of the site and the area generally. Based upon the initial laboratory tests, the ground-bearing capacity appears to be good.

6.3.5 Hydrology:

The coarse nature of the soil and the presence of hard pan provides moisture retention but has produced a well defined drainage pattern. The site is divided into four major catchment areas, the largest of which occupies the central and southern areas of the site. Of the four water courses which flow out of the site, the largest of them provides an eminently suitable area for on-site impoundment (where water is being collected).

Care should be taken in the positioning of all new drainage channels to direct water to the impoundment area and the integrity of the existing water courses should remain intact. A general policy of water conservation will be an important factor in site layout especially in the academic core.

6.3.6 Vegetation:

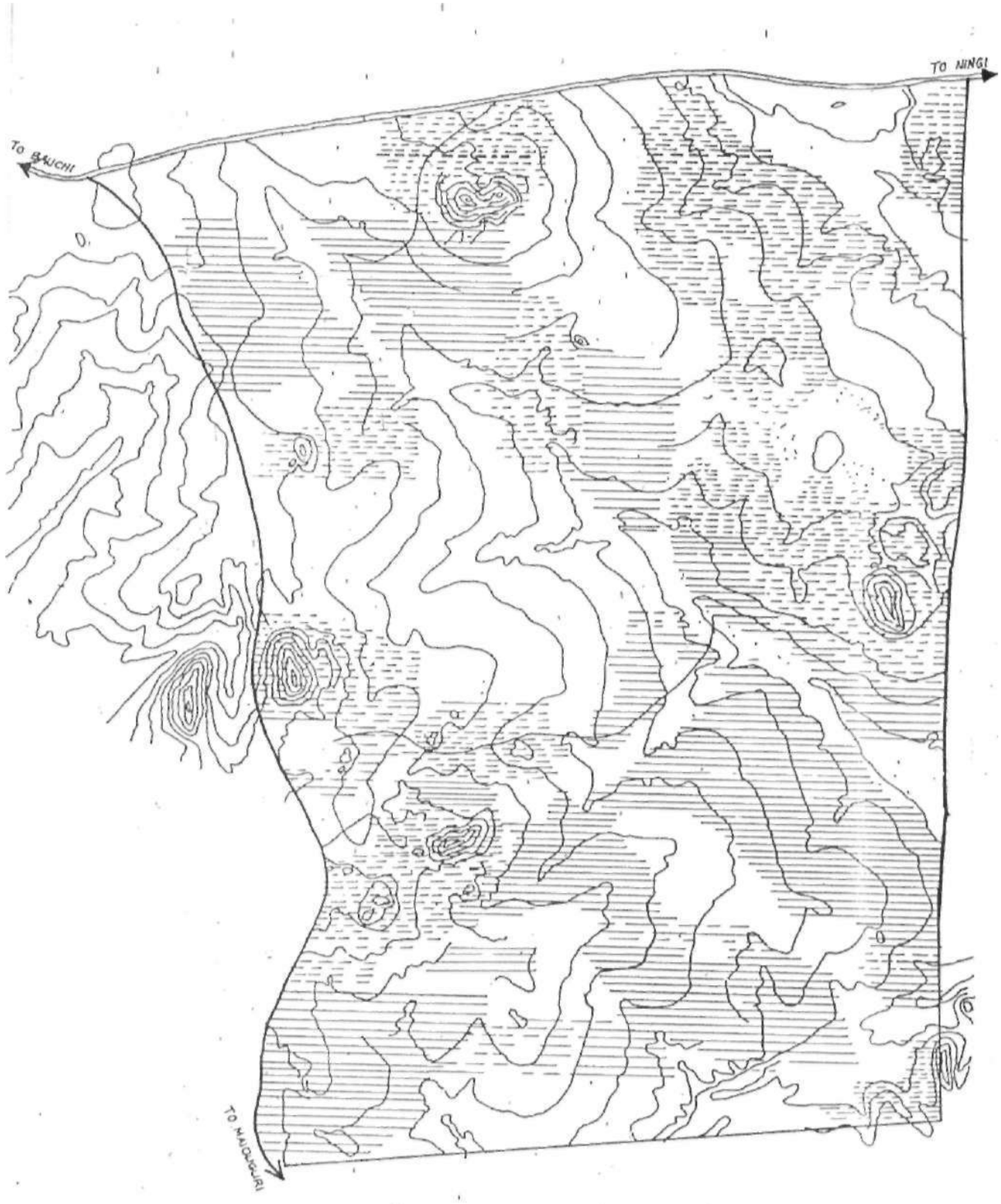
This site is covered by a vegetation of Savannah wood-land and shrub savannah, with areas of cultivated parkland around some small settlements and along the fadamas.

The land vegetation is divided into two zones; the Guinea Zone vegetation and the Sudan Zone vegetation is a mixture of soft-leaved and thorny species, with grasses only growing 1.0 to 1.5m high.

The Land Resources Development Council report on the Bauchi Plains divided the vegetation into six complexes. The Yelwa site (temporary site) is in the Bauchi complex and the Main Campus site is divided between the Bauchi and Miya complexes.

Miya Complexes:

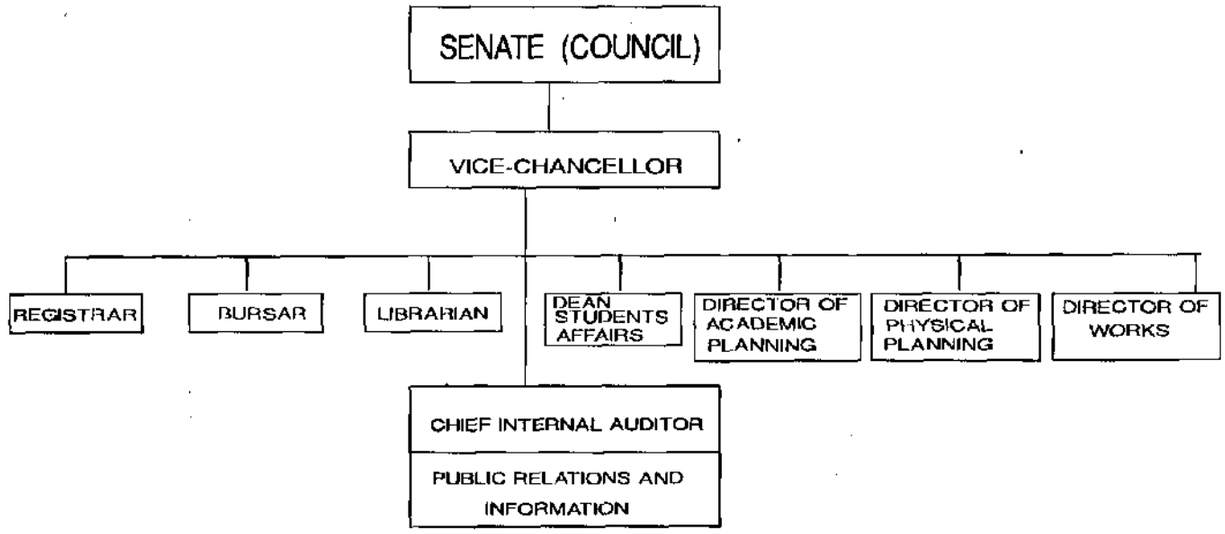
This is intermediate between the Guinea and Sudan Zones. Wood land can be well developed, typical trees being Anogeisus, Khaya and Isobelinia, with Terminalia Macroptera in damper places and Acaciaseyal on the frequent heavier soils. Afzelia and Boswellia are frequent on rock and sands around the inselbergs.


TO NINGI
TO BAIICHI
TO MAIDHGURI

CHAPTER SEVEN

7.0 DESIGN PARAMETERS

7.1 UNIVERSITY ADMINISTRATION/ORGANOGRAM



7.2 FUNCTIONS OF KEY OFFICIALS

7.2.1 The Registrar

The Registrar shall be responsible to the Vice-Chancellor for the day-today general administration of the University which shall include appointments of administrative staff and all personnel problems. He shall by virtue of that office be the Secretary of the Council. He shall also be responsible to the Vice Chancellor and Senate for appointments of academic staff and technical staff in academic areas, the admissions, registrations of students and the coordination of all university examinations. He shall be responsible for keeping students records including statistics that may be needed for planning. He shall by

keeping students records including statistics that may be needed for planning. He shall by virtue of that office be secretary of congregation and convocation.

7.2.2 The Bursar

The Bursar shall be the chief financial officer of the University and shall be responsible to the Vice-Chancellor for the day-today administration of the financial affairs of the University.

7.2.3 The Dean Student Affairs

The Dean shall be responsible for the welfare of all Students including the maintenance of halls of residence, catering and with suitable assistance to students counselling.

7.2.4 Director of Physical Planning

He shall be responsible for implementing decisions of the University's Development Committee in the context of the university's approved planning strategies and for liaising between Executive Consultants and the various users in the University. He shall be responsible to the Vice-Chancellor for coordinating the works of consultants and contractors, where applicable and ensuring compliance with the approved overall planning goals of the University. He may also be required to initiate designs and/or estimations of projects if within his professional competence.

7.2.5 Director of Academic Planning

He shall be responsible to the Vice-Chancellor for the implementations of the decisions of the university's Academic Planning Committee which frames plans for academic development of the University. He also keeps students and staff statistics for planning and budgeting.

7.2.6 Director of Works

The director, shall also be responsible to the Vice-Chancellor for coordinating Supervision by Executive Consultants of the Construction of major capital projects, in conjunction with the planning unit where appropriate, or for direct supervision of projects in respect of minor works initiated by his department and for enforcing quality control. He shall also be responsible for dealing with the Maintenance of roads, University houses, furniture, vehicles and electrical, refrigeration and air conditioning equipments, and the maintenance of services like telephone, electricity and water supply in the University.

7.3 THE BRIEF

The University has indicated its intention to put up its Senate/administrative building with the aim of providing full office accommodation for its entire staff inorder to enhance full administrative work. The brief is here by broken down as follows.

7.3.1 Vice-Chancellor's Office

This should include apart from the Vice-Chancellor's office, one Personal Assistant and two Secretaries, two Deputy Vice-Chancellor's offices; two principal Assistants/Senior

Assistant Registrar's Office; one Conference room adjacent to the Vice Chancellor's office and offices for other supporting staff as indicated on the staff projection.

7.3.2 Senate and Council Chamber

A composite Senate/Council Chambers to sit 100 members; two Conference rooms each to sit about 20 members; one refreshment foyer; two preparatory offices for the preparation and production of Senate Council Materials; two offices for typist.

7.3.3 Physical Planning Unit

One office for the Director of Physical Planning; one office for the Director of Academic Planning both large enough to take in addition to the director's table a conference table for 12 persons; one conference room adjacent to the director of Physical Planning's office for conferences with consultants; and display of drawings: office for storage of drawings, one drawing office to take four architects/architectural draughtsmen, one architect's office, one quantity survey's office; one office for academic planning officer; one town/physical planner's office.

7.3.4 Central Administration

This should include the Registrar's office large enough to take in addition to the Registrar's table a conference table for about 12 person; one secretary's office; one office for officer incharge admissions; one large office for processing admissions; one office for officer incharge of student's records; one office for officer incharge of examinations, one

large office for handling examination matters; one office for officer incharge of matters relating to appointments and promotions of staff; four additional offices juxtaposed as to house assistants to each of the officers referred to above; offices for other supporting staff as indicated on the staff projections.

7.3.5 Bursary

This should include the Bursar's office similar to that of the Registrar, one office for Deputy Bursar; Six offices for Accounting staff; three offices for customs and passages staff; three offices for Chief Internal Auditor and his Staff; one large accounting office.

7.3.6 Student Affairs

One office for the Dean Student Affairs similar to that of the Bursar; one Secretary's office; one office for the accommodation officer and his secretary; one office the Director of Sports, offices for other supporting staff.

7.3.7 Post Graduate Section

One office for the Dean of the postgraduate school similar to that of the Dean of Student Affairs; one office for the assistant dean; one conference room; store; two other offices for supporting staff; one student's records office.

7.4 DESIGN CONCEPT

7.4.1 Planning Criteria

The Ultimate purpose of a design is the satisfaction of its users, visitors and spectators. Though, the proposal is aimed at providing full office accommodation for the entire administrative staff of the university, it is also to create an environment which can be absorbed through maximum number of senses.

The University Senate is observed to be area of heavy patronage by staff visitors and students, especially on resumption days. In response to this issue, the designer has taken measures to cater for this heavy patronage by identifying and separating such areas of patronage (noise) from the main office areas (quite) and making entrance and circulation spaces very wide enough to fairly accommodate large number of people at the same time.

Although, the entire study has been able to identify four major areas that constitute the central administration (Senate), which include the Vice-Chancellor's office; the Registry, Bursary, the Senate Chambers; it has also been discovered that the Bursary in the highest fire risk area. In view of this; some design measures have been considered. The Bursary has been located at the first floor with a very tight security and made easy for fire brigade in the event of fire out break.

Towards achieving this, a simple octagonal concept have been devised.
Two basic reason were responsible for the choice of this concept. Firstly, it blends very well with other existing buildings within the academic core and secondly, it is easier for the suppression of fire by fire brigade in the event of fire outbreak and a good compartmentalization is achieved.

7.4.2 Site Planning

The site which forms the bedrock of the overall design is based on the principle of organisation to produce a dramatic view by composing and reflecting the function of the building and personality. The Primary aim of its planning to aid easy accessibility and effective combation of fire when it occurs. The site is planned to include the followings.

- The main complex
- Access
- Parking
- Fire hydrant
- Services.
- Under ground water tank.
- Landscape

NB: The site takes the advantage of the Gubi river and Gubi Dam which keeps it humid at all times.

7.4.2.1 Orientation

The building is so oriented North-East along its access in order to take the advantages of the climatic condition.

CHAPTER EIGHT

8.0 CONCLUSION

This thesis has dealt with a wide range of complex situations associated with office design. A lasting solutions to these problems can be achieved through careful implementation of the findings, suggestions and inferences drawn from various topics of the chapters of this thesis. However, the approach to the design of office buildings involves the integration of various functional components of the buildings in a single volume.

Where applicable, it is desirable to locate a university Senate building within the central academic core. This will enhance easy accessibility by both vehicles and pedestrians.

It has been discovered that, there is the need for a well planned environment, with a good Vehicular access and suitable turning point radii, parking spaces and water hydrant points for an effective fire fighting in the event of fire out break.

The use for the courtyard concept of design in any office building, to allow for smoke diffusion and ease of escape by the occupants is also very significant.

It was also discovered that there is the need for a good compartmentalization of various functions of a design such that each compartment could be easily sealed off in the event of fire outbreak and to properly identify escape routes. However, the door of these escape routes must open in the direction of escape or safe area.

High rise office buildings have also posed a lot of problems due to their heights in the suppression of fire. In this regard, it is advisable to in as much as possible limit the number of floors.

The researcher also finds out that the use of light partitions in office buildings encourage the spread of fire (due to their low resistance) in the horizontal direction, as they should be discouraged. Upward spread of fire to upper flows can also be discouraged through the use of elements on elevations.

It has also been suggested that portable fire fighting equipments, smoke detectors and fire alarms be introduced in any design for the discovery and suppression of fire when they occur.

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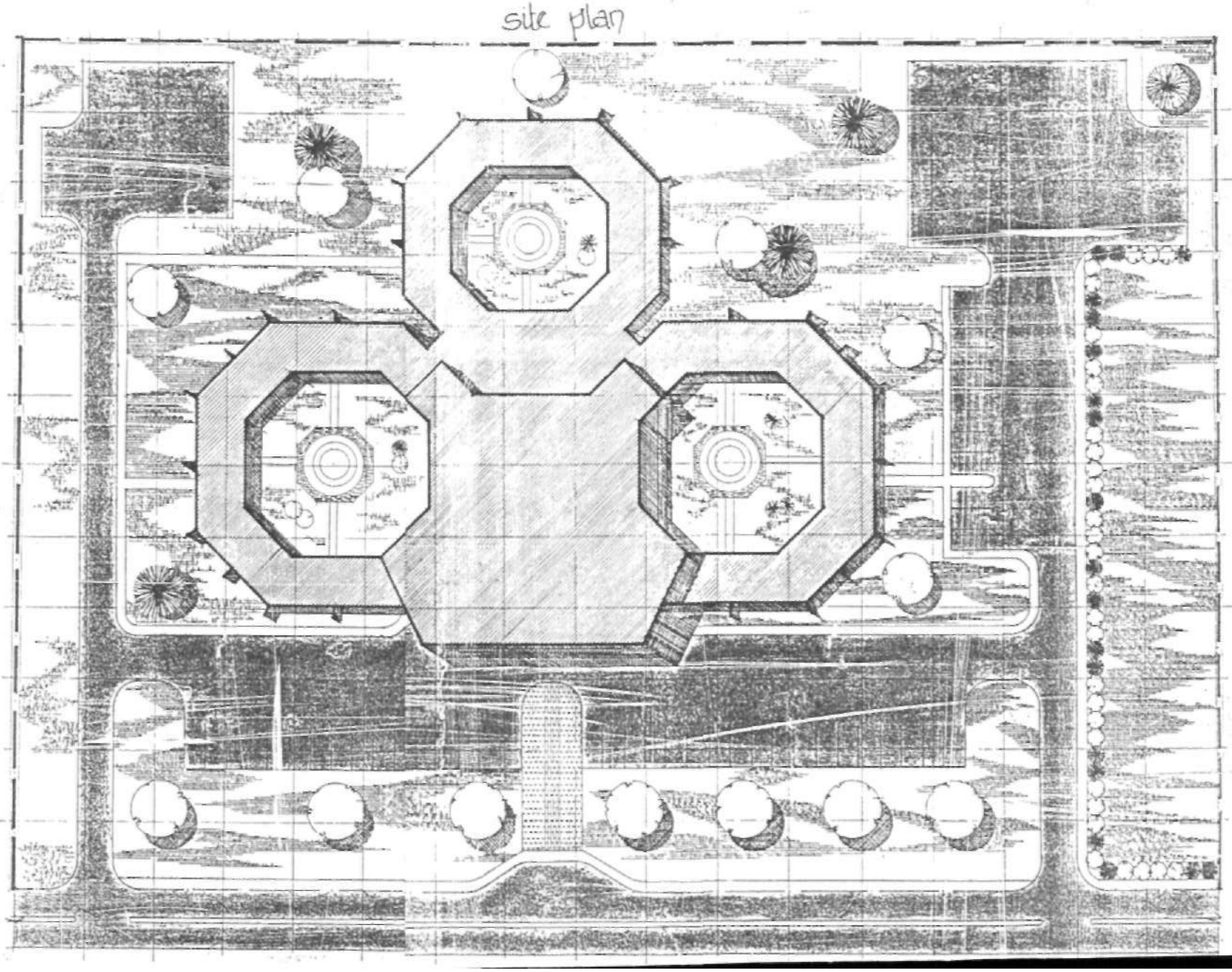
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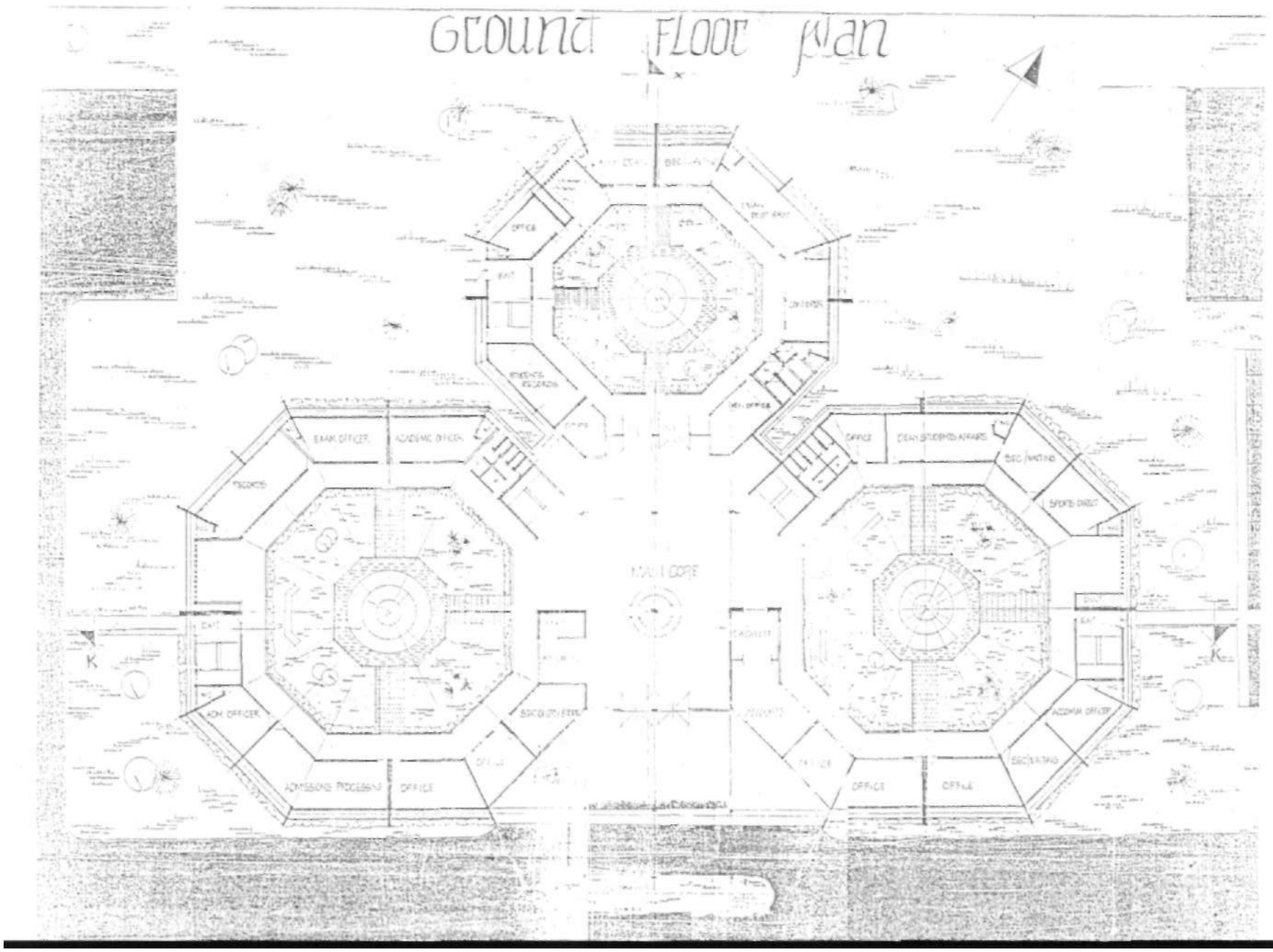
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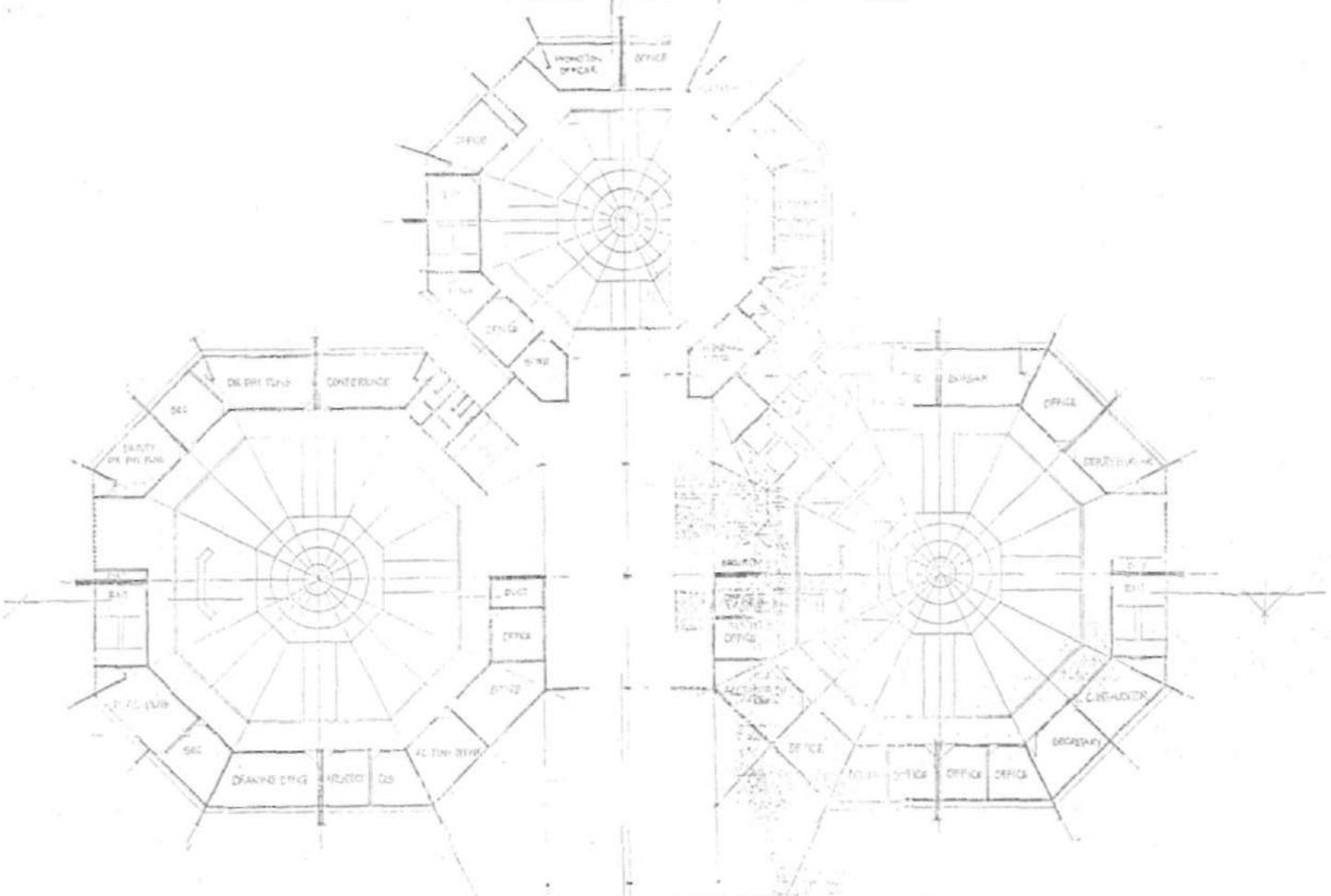
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site plan

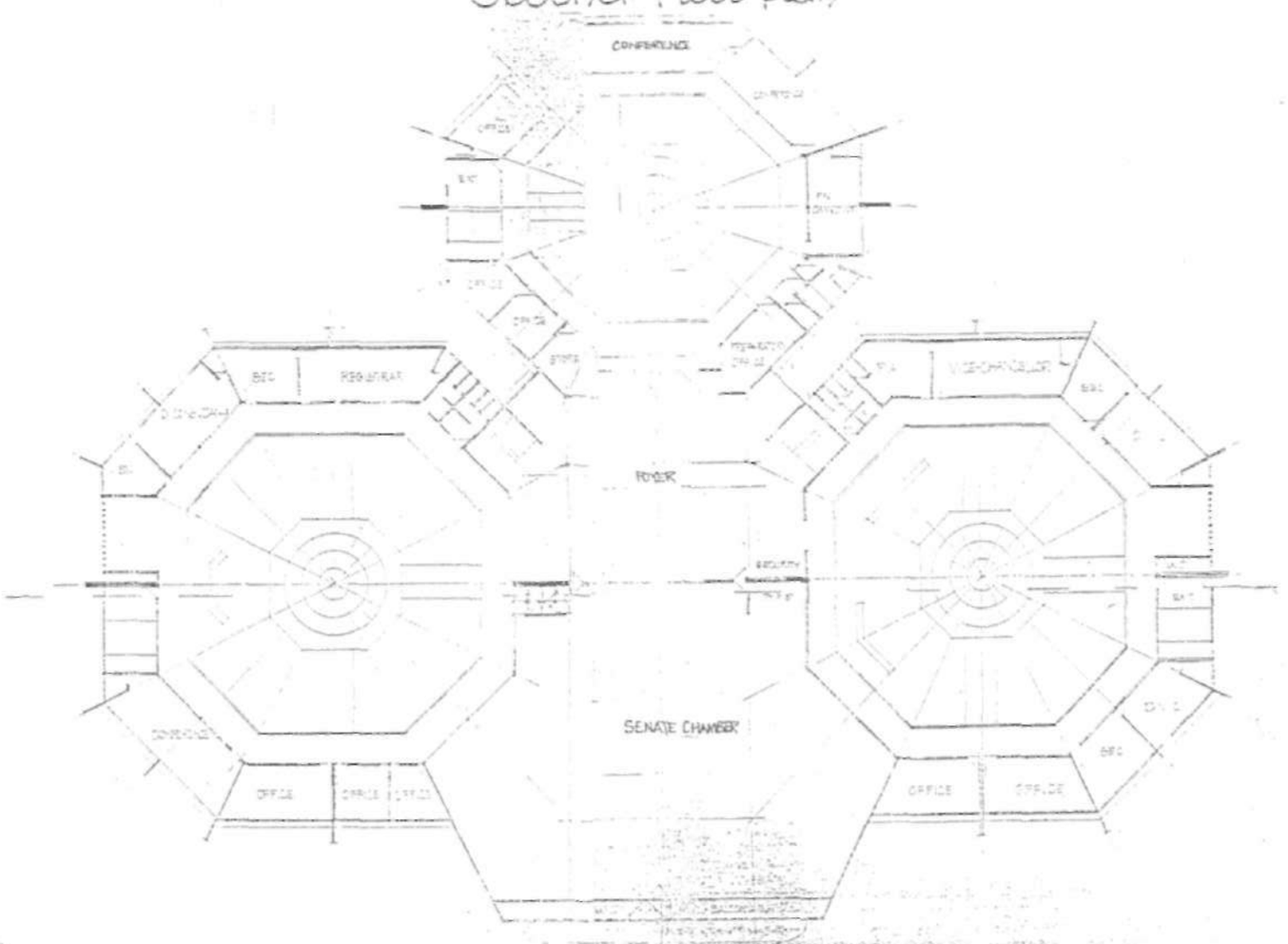


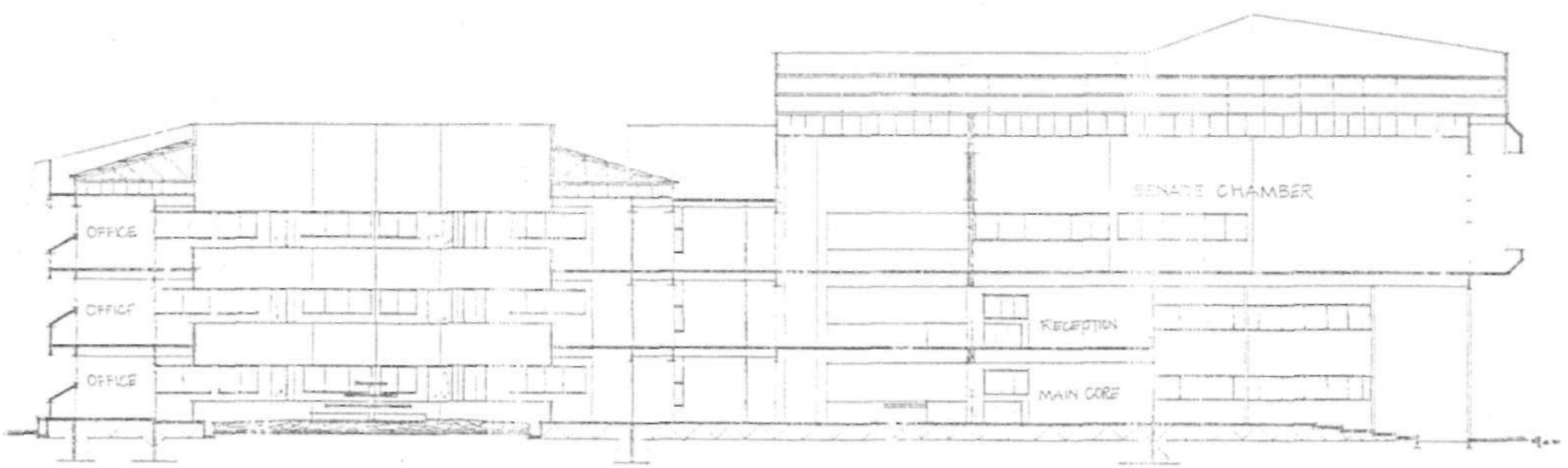

GROUND FLOOR PLAN
OFFICE
DEAN STUDENTS AFFAIRS
SPORTS DIRECT
MAIN CORE
OFFICE
OFFICE

First Floor plan

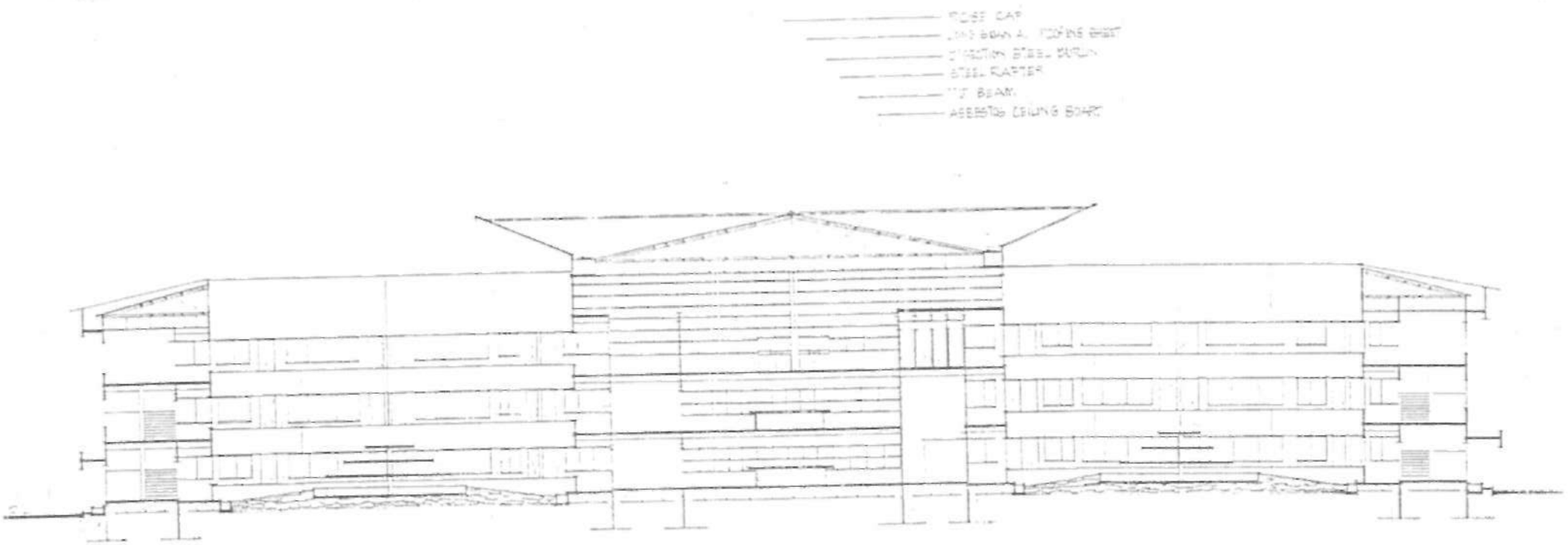


Second Floor plan

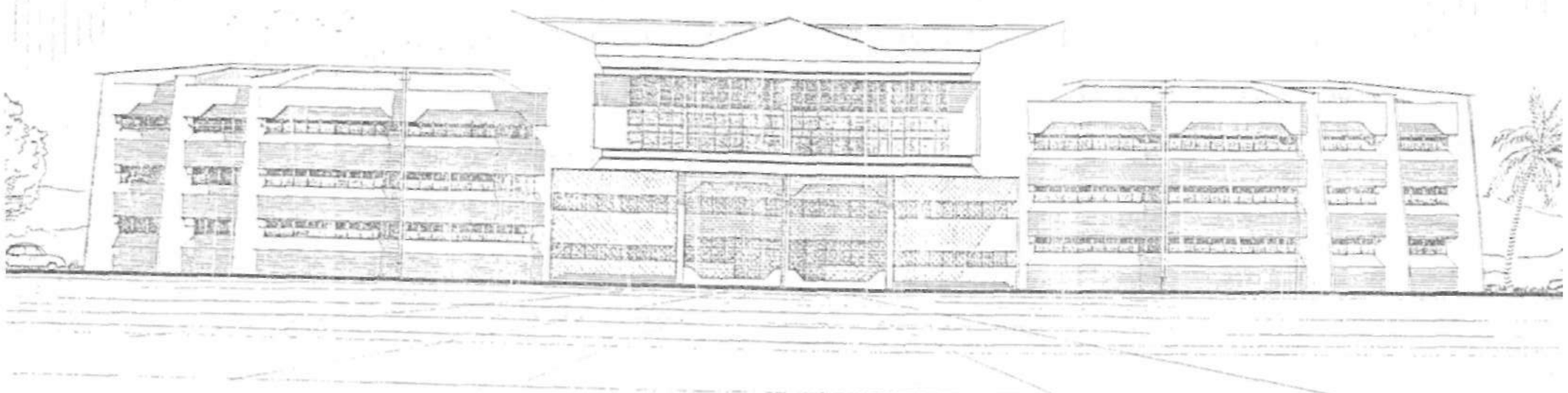




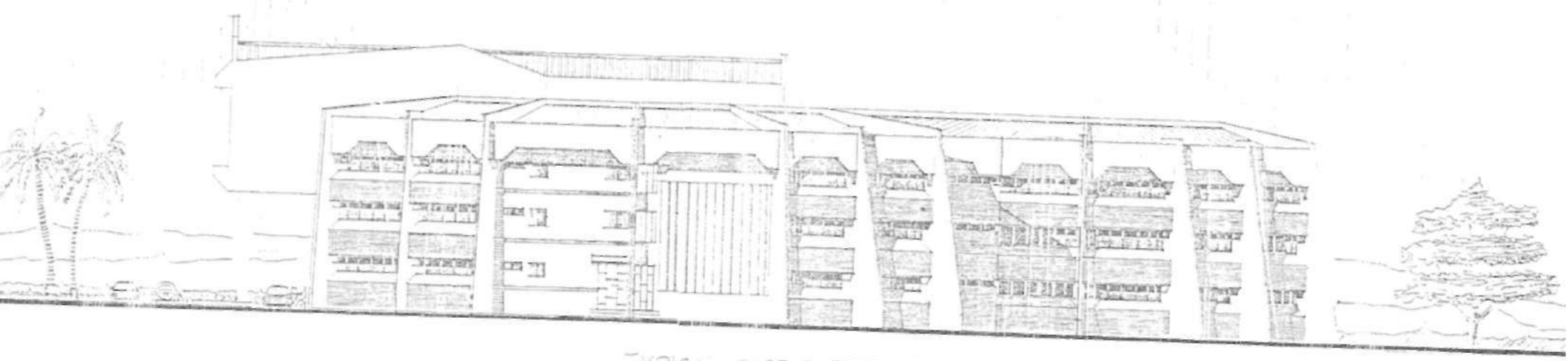
SECTION X-X



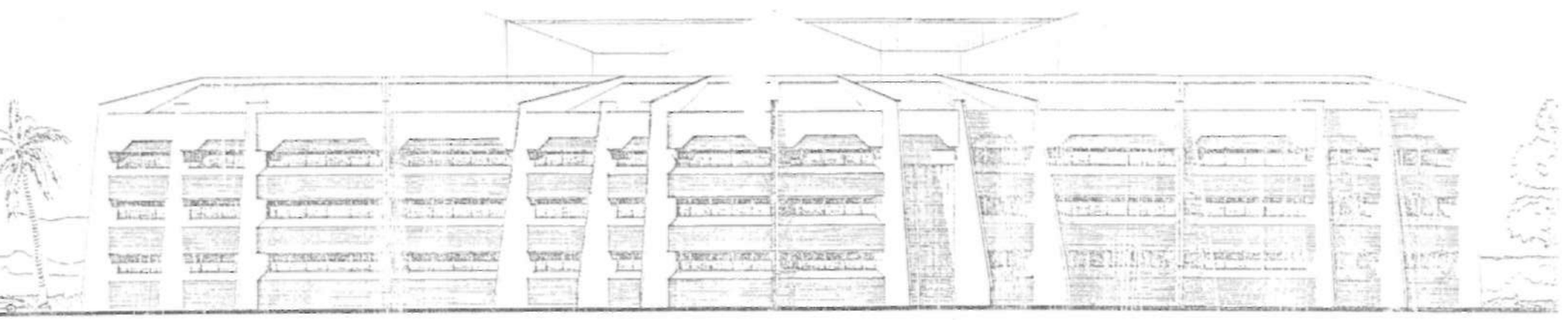
SECTION X-X



APPROACH



TYPICAL SIDE ELEVATION



REAR ELEVATION

Roof plan

