FEDERAL POLYTECHNIC LIBRARY COMPLEX AUCHI
AUCHI-ESTAKO WEST, EDO STATE.
(TOWARDS ACHIEVING NATURAL LIGHTING AND VENTILATION IN LIBRARIES)

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OCTOBER, 1999

DECLARATION

I, ALAO, Femi Stephen declare that this thesis was whole-heartedly undertaken by me. And, it has not been presented in this form in any kind.

However, all sources of information and references have been duly acknowledged.



ALAO FEMI STEPHEN
1999

CERTIFICATION

This thesis entitled FEDERAL POLYTECHNIC LIBRARY COMPLEX, AUCHI (Towards Achieving Natural Lighting and Ventilation in Libraries) meets the requirements to the award of the degree of Masters of Science (Architecture) of Ahmadu Bello University, Zaria, and is dully approved for its positive contribution to knowledge and literary excellence.

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DEDICATION

This thesis is dedicated to Him, the most high, the Almighty Father, the Lord of lords. And to the memory of my late father Mr. Moses Sunday Alao and my late uncles, Mr. Peter O. Alao and Mr. Edward O. Alao. May their soul rest in peace, (Amen).

Alao Femi Stephen

1999

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ABSTRACT

There Are various forms of acquiring knowledge in lifelong existing of mankind in our country Nigeria and global world. This has been acquired mostly through cultural and formal western education. Both forms, which have the common source as information, have the main aim of advancing development in the society. Cultural education is stored and imbibed within the society, while formal western education which involves writing and reading is stored in the library.

Library is a flexible agency for the delivery of information from a variety of sources and variety of formats to the eventual users. The library is a necessity to the survival of man as an agency for the storage of valuable information, which are the essential bases for the social political, economic, cultural and intellectual developments of the human race. It however caters for the three basic elements in its services, the books, the users and the staff.

As a valuable institution to human development, it has helped in development of nations, but quite unfortunately enough, this had not been substantial in the Nigerian situation. The library building had been rendered under utilized for some set backs analysed in the write-up.

federal Polytechnic Auchi as site for this thesis is

a major town in the northern part of Edo-state. The populations of the students are fast growing and the literate populace is not left out. To this end, the thesis addressed itself to providing a conducive environment for the three elements of the library.

The scope of this thesis provides the basic requirements in an academic/research library, making them as stimulating as possible for the readers. The building accommodates not only learning, research or reference sections, and cataloging section but the design has been made conscious of natural lighting, and ventilation. The modern age of the electronics where computers and Internet play a huge role in every day activities of man has been considered in the design.

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CHAPTER ONE

1.0 INTRODUCTION

The Federal Polytechnic Auchi is located in Auchi town, a rapidly developing urban centre and the administrative Headquarters of Estako West Local Government Area of Edo State. It is a distance of only hundred and thirty kilometres (130km) from Benin city, state capital. The campus occupies about 224 hectares and is situated on a stretch of undulating land along the west edge of the town. It is a modern self-contained campus with academic facilities for the five schools of which the institution is made up namely: Art and design, business studies, Engineering, vocational Education and Environmental studies. It has residential and recreational facilities for staff and students. The school has between 8,000 - 9,000 students in 22 departments. Presently, the institution has a small library that can only contain about 300 students on the whole and since the population of the institution is rapidly growing the need for a standard library complex was initiated.

In developing a community, institutions and nation, the need for acquiring widespread knowledge cannot be

over emphasized. Knowledge and culture are acquired by information passed on through generations which vital factors considered in the development of any nation. Library is an important institution for the storage of information and widely defined as tool for intellectual freedom and economic development necessary for the survival of man.

There are different types of libraries varying from academic/research to public and even special type. The Federal Polytechnic library complex Auchi is an institutional type for academic/research purposes and the proposed site at the campus.

Academic Library - it's the principal means whereby the record of man's thought, ideals and the expressions of his creative imagination are made freely available to all. It also provide materials for learning purpose e.g. course work, term papers project and thesis works.

1.1 PROBLEM DEFINITION

The academic and public libraries existing in the country today are very few, but unfortunately under-utilised due to many factors. These factors are:

i. Improper feasibility study and environmental impact to ascertain of sites. Most libraries in existence

are inadequately located which attributed to inadequate study.

ii. Inadequate attempt at designing for the users comfort within the prevailing climatic conditions of their sites. There is always the problem of improper ventilation most especially in the reading areas.

iii. Lack or inadequate natural lighting which is a very vital consideration in library design.

iv. In sufficient tight security of materials stored in the library whereby volume of books reduce as a result of stealing and vandalizing.

v. Inadequate provision for efficient circulation of materials for users and staff. Most movement are cumbersome and materials unable to be traced easily.

vi. Provision for harmonizing intellectuals and social values are not available for users to recreate or interact after they might have been exhausted with reading.

vii. Improper stacking of shelves and seating arrangement.

1.2 MOTIVATION

Federal Polytechnic Auchi is one of the early polytechnics in the country and growing in population. It is the only polytechnic that has low standard library of floor area of 460.42m^2 containing about 20,000 volumes of books with 100 reading areas. There was an extension made in 1993 to a floor area of 749m^2 to house about 38,320 books and subscribe to over 300 journal titles, which also now contains 300 reading areas.

Due to the growing population the need for a new library has been called for with a proposed site. Therefore I am motivated by the set backs in library design to provide a well deserving library in such an institution.

So long children are born into the world, people will continue to go to school and there is that tendency of people reading always and therefore where to get information of what they want is in the library. Those in the tertiary institutions use these libraries to get more information for their term papers, project works, assignment, thesis works and academic research work.

1.3 AIMS AND OBJECTIVES

The academic library will essentially be an open access library to users. The aims are:

i. To achieve maximum natural lighting and ventilation.

ii. To bring people to close relationship with common purpose to its resources.

iii. To provide maximum comfort within the environment.

To provide a conducive environment for acquisition of knowledge which in turn enhance a rapid development of the users.

The following objectives are necessary:

i. To provide adequate materials in support of the learning processes for students course work, project works, term papers, and research papers.

ii. To disseminate existing and new information by computers and Internet of the new technology.

iii. To have a good co-operation with other tertiary institutional libraries with a view of developing a network of academic library resources which are at the disposal of all students.

iv. To provide security for the materials available in the library to prevent stealing of books.

v. To enhance the cultivation of social values thereby fostering the better use of leisure time

1.4 SCOPE OF DESIGN AND LIMITATIONS

The design shall enhance all aspects as spelt out in the aims and objectives formulated, viz. an environment, which will provide access to books, information and audiovisual materials in condition of comfort, economy, efficient natural lighting, security, and ventilation.

The proposed Federal Polytechnic library complex shall involve:

i. Book leaning and consultation point for the students, entire tertiary institutions in Edo State and Nigeria in general.

ii. The library complex would accommodate more sections than other types of libraries, such as exhibition, administrative offices, periodicals, reserved section, references, outdoor reading, delivery bay, and other supporting facilities in respective zones.

1.5 RESEARCH METHODOLOGY

The research methodology of the proposed library shall entail the following data collections.

i. **FIELD WORK**

This shall involve visual assessment of proposed site, back up with illustrations, photographs where necessary.

ii. ***PRIMARY SOURCES***

This shall involve visitation to some existing institutional libraries to know the management systems adapted for funning of the library.

Use of questionnaires to know the views of users, with regards to facilities available and also for relevant statistical data.

iii. ***SECONDARY SOURCES***

This shall involve the collections of relevant information from journals published and unpublished texts.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 HISTORICAL BACKGROUND OF LIBRARIES

This aspect shall trace historical development of academic library buildings, identify a couple of building types which encapsulate the movement spirit in library design during the renaissance period in Europe and review the shift towards modern architecture in form of modular building type. We shall however try to stimulate the imagination through our review of historical antecedents and finally come up with an outline of a typical Nigeria academic library.

Adeyemi (1980), A modern brief for Nigerian University Libraries states the effects of socialization arising from the French revolution of the 18th century brought about a freedom of study are research for libraries. Libraries as storehouses of books and other form records have a historical background that goes back to the earliest days of recorded civilization in Mesopotamia. Evidences of developed literature were more often discovered in temples and the houses of prices or the palaces of kings. In Egypt, every temple had its

library and school. In pre-Hellenistic Greece the first truly extensive library in Greece was credited to Aristotle (384-322 B.C). In Rome the first libraries were all private and consisted of booting brought back from foreign wars. The first public library was credited Gaius Julius Caesar and was built sometimes between (39 and 27 B.C) by Gaius Asinius Pollio. The subsequent ones were built right through the time of the later Emperors towards the end of the Roman Empire.

The early middle age was a period during which monastic flourishing and Christian writings gained prominence. The Renaissance period marked a revival of learning in the 12th century. The rise of the cathedral school, translation of scientific and philosophical works from Arabic, a rebirth of Roman law - all fostered by social and economic conditions combined to produce an awakening that found its culmination of the birth of the universities. The monastic libraries in many cases underwent a period of decline and yielded supremacy to the cathedral schools and the episcopal libraries.

2.2 TYPES OF LIBRARY

There are various types of library with different functions and facilities varying from Academic/Research to Public and special type.

i. **Academic/Research Libraries**: These types of libraries are always situated in an academic environment like the universities, colleges of education, polytechnics and secondary schools. The bulk of the materials found there are books and other forms of reading materials. Large reading areas are common and in some case, audio-visual provision informs of microform reader, video, projectors and computers may form a part of the library collection. They are mainly for research purposes and getting information to acquire knowledge for intellectual freedom and economic development necessary for the survival of man.

ii. ***Public Libraries:*** These types of libraries are for a large community, state or nation. In an extract from the UNSEEN Public Library manifesto states the purpose of Public Library in convincing terms. The public library is a practical demonstration of democracy's faith in universal education as a

continuing and life long process, in the appreciation of the achievement of humanity in knowledge and culture. It is the principal means whereby the record of man's thought and idea and the expression of his creative imagination are made freely available to all. It's aims made it an indispensable institution in general education it renders services directly to the people around its location. It is meant to serve the interest of the general public and it is governed and administered by the authority or committee wholly or largely appointed.

iii. **Special Libraries:** They are libraries other than academic, and public libraries. Their collections are usually limited subject range that great depth of coverage of their particular interest. They acquire source material and produce it by scanning and abstracting to the exact requirements of the users. They also serve as information centres for their parent institutions. They are mainly attached to government ministries and agencies, research associations, trade union, professional association, industrial firms and societies. They exist individually.

2.3 DEVELOPMENT OF LIBRARIES IN NIGERIA

Peter, (1995). Library complex for Kaduna State Polytechnic Zaria states that Nigeria as a developing nation has no traditional experience in the evolution of the library and can only is said to have inherited an European legacy.

In the late fifties, through the British council, the British government decided to assist in the development of libraries in the country. Prior to this, a poorly equipped academic library had been in existence in the University of Ibadan from which other libraries drew some inspiration when they were about to be established. At it's inception, the collections made available were transferred from Yaba College in Lagos. Apart from the National Library, the academic libraries have been given more support and attention needed to keep them in the forefront of academic programmes of the various institutions they serve. Special libraries are well established in some government departments and public cooperation.

A library is meant to bring man in contact with the world in fulfillment of its role as a repository for knowledge. In the modern world, it is a dynamic centre for research and development.

Akinlotan (1995) Central library complex Ijebu-Ode, Ogun State states that library to a developing nation is meant to be a tool for cultural and intellectual freedom. An institution for economic development, a gateway to political and economic happiness and survival. But the library services in Nigeria have not been up to the required standard. The attitude of the Nation's colonial rulers towards the development of political, educational and socio-economic institutions did little to impress this standard. The colonial British Government established libraries to suit their interest and priorities neglecting the needs and inspiration of the governed.

Before the advent of British Government development of libraries in the country there was ill-equipped academic library existing at Ibadan University from which other libraries drew some respiration and guidance when they were about to be established.

Since the nation independence 35 years ago when the overall assessment of library services is looked at is yet up to expectations. The situation of the essential library services provided has not improved, despite its long years of establishment.

The University libraries of all the different types of libraries have been given the attention and support needed to keep them in the forefront of academic programmes of the various institutions they serve. Special libraries as well were established in some government departments and public corporation. The public, school and children's libraries respectively are still struggling for survival. The greatest progress in public library work was made in Eastern Nigeria where library programmes are based on law.

The National Library of Nigeria, Lagos was established in 1964 and inspite of this there are less than ten million books in all the libraries in Nigeria today. This is highly in adequate for a nation that has rapid educational policies and potentials. This is to say that libraries have not been accorded their rightful

place in the development of political, social, economical and most importantly in educational spheres of life of the Nigeria populace.

For a good network of libraries, the social and functional implications of state branches of the national library are of unique importance, irrespective of the political undertone they may have and this goes for the community libraries as well. They cannot operate in isolation. The rationale behind their establishment should be seen from the point of view of the creation of national resource centres. They are capable of acquiring in-depth the socio-economic educational, political and cultural materials of the states of their location and putting these materials at the disposal of the whole nation by means of an efficient communication network of various categories of libraries which exist. The roles of the National and community libraries in developing countries in particular call for an examination.

2.4 THE LIBRARY BUILDINGS

Adeyemi (1980), A model brief for Nigerian University libraries states that the architectural form of libraries took shape only in the last half of the 19th century. Earlier on, or prior to that time, the contents of library could be accommodated in almost any available

building. The discovery of the rotary printing press gave impetus to library building as a specialized form. In the non-specialised library buildings such as the trinity Hall College Library at Cambridge such buildings were charactised by high ceiling, which permitted the use of multitiered galleries along walls. Henri Labrouste in the library of ste-Genivieve in Paris (designed 1843 and built 1845-50) incorporated the idea of a separate room for books. His was the first library to be designed as an individual building. Externally it is a brilliant example of non-renaissance design, a rectangular iron framed building 80m x 23m (26Ft x 75Ft), which served as a model for the Boston public library. The Bibliotheque Nationale in Paris designed also by him in 1854 and built 1862-68 showed further advantage in planning and structure. The reading room is covered by a series of nine pendentived simple domes of terracotta, each pierced at its crown to provide natural top light and supported by twelve slender columns of irons. The stack room has tiers of top-lighted stacks with open gritted metal floors to allow light to pass to lower levels. The stacks flanked a central space, bridged at intervals by communicating gangways. Symey Smirke (1852-57) in his design of the British museum, developed the circular reading room 42.6m (140Ft) across and 32.3m (106Ft) high with surrounding book stacks, a pattern followed by the

law library at Columbia University and many others. A particularly resplendent library building is the old university library at Cambridge designed by Stephen Wright (1754-59), a renaissance building with unity of composition, rich and reposeful in effect.

2.5 DEVELOPMENT OF MODERN LIBRARY

It signifies the pride of place accorded libraries in academic institutions that the library is usually among the first departments to be established. With the high level of education in the century, there is high level of awareness, and modern library systems are fast developing. Indeed there is that better understanding of the fact that the library is a tool for intellectual freedom and economic development. It is the society's most experienced, widely accepted and flexible agency for the delivery of information from a variety of sources.

Library originated in ancient Rome and was used throughout antiquity and the renaissance. It consisted of a single, monumental hall for the three elements of the library (readers, books, and staff) decorated with sculpture and mural painting with book - cupboards or shelves placed against the walls and (later) galleries. At first, their libraries were generally connected with temples, later they were attached to or formed integral

parts of cathedrals and princely dwellings. The classical plan was designed readers. It ultimately failed because of this limitation and the noisiness of a large hall. The prototype was the Roman Library at Ephesus (AD 107). The third century A.D saw the opening of some Christian libraries and the replacement of papyrus rolls with velum codices and this was the most important change in the form of the books since the rolls suspended clay tablets. At the end of the fourth century A.D., the codex form had superseded the roll form which about the use of lesser space in libraries.

The Medieval Plan: Libraries of this age is invariably the same as ancient times connected with either palaces or temples so also the medieval period associated with the institution which in their era represented the heart of the society and the centre of temporal as well as spiritual power, the church.

A library of this period was therefore long and narrow, open (glazed or unglazed) to the light on one long, wall, screened off at one or both of the narrow side with books on the inner long wall, such a library would also have carrels for the older monks.

The function of carrels was not to give its user some privacy, but to provide a degree of confort. In the carrel itself, there would be a seat on the side and a

desk on the other, arranged so that light fell on the readers' left hand. Each carrel was 2.057m high, 1.219m long and 483mm deep, and so is only a shallow much, too narrow to accommodate a table, by just right for one reader sitting sideways to the window, the only source of light.

Three distinct stages have been traced in the development of the medieval library, especially of its internal arrangement of shelving. The church pew plan, the double lecture and stall system, but the medieval plans remain basically the same through out.

Church Pew System: Book shelves and seats were combined as a simple development of the church pew. With a bench or seat in front and a sloping shelf behind for reading while standing. The simplest development from the church pew would seem to be the lecture on the back of the seat itself. An example of this is the bibliotheca malatestiana (1452) at casena (Plate), measuring 41.2m x 11m with two rows of columns down the centre and desks set at 45 degrees on the back of each seat at reader's standing height.

Bibliotheca laurenzlana (plate), Florence, 1571 (medicean library) according to Anthony Thompson is an example of lively decorated pew with room measurement 47m

x 11m originally with 15 windows on each sidewall and 44 desks on either side.

Double Lectern or Book Desk System: This consists of a double-sided sloping desk on which the books may be read. This was derived from church pew, chained to a bar and a flat shelf when not used.

Stall System: This accommodates more readers and especially more books with double-sided bookcase and two shelves. The readers sit on the double-sided bench in aisle between the cases.

Sometimes, collecting were divided into two paints, some for general public use and other for more restricted use.

There were some attractive features that assisted in the studies at this period like the elaborate catalogues, globe maps, and astronomical instrument.

In summary the physical design of libraries in the medieval period, by the fifteen-century was the reaction of separate library building usually long narrow rooms lighted by many tall windows.

The shape of the room was designed to make as much use of natural light as possible. Inside the rooms the books desk were located between the window, so that the light falls directly on the reading shelf.

The Renaissance and Baroque Age: During library design, the sixteen-century onwards may be described as the age magnificence. Not until the twentieth century were the functions of libraries allowed to dictate the details of their physical form and even now the tradition of the prestigious and monumental building lingers on. To some extent, the renaissance continued the medieval system, there was still cupboards, stools and even lecterns but everything, became more richly and artistically developed. One of the finest artistic examples whose whole conception and atmosphere belong to the renaissance is bibliotheca medico leurenziana in Florence, which measures 47m x 11m. According to the Leigh (1929) he called it the "WILL TO FORM" of the renaissance, the demand for large, wide and monumental rooms in the classical tradition, library buildings as a genre, from the 18th century onwards have optimised the architectural ideals of the age of magnificence. A survey of libraries of this age makes this abundantly clear. Lofty column internally and externally enormous reading halls, great courtyards, dome, and landscaped. Setting vast flights of steps and stair ways, elaborate fenestration, friezes and frescoes and status in pedestals, ornate ceilings and decorative light fittings, long vistas of wall shelving and galleries richly tables and desk and beautiful tiled floors.

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It was generally accepted, however that the basic essential for a service was a reference library, a building library, a reading room and lecture hall was also considered desirable.

By nineteen century some important libraries worth mentioning are:

i. The bibliotheque saint - Genevieve at the university de Paris, (1843).

ii. Bibliotheque Nationals Paris, (1854)

iii. British Museum London (1857)

All these operate on closed book stack planning.

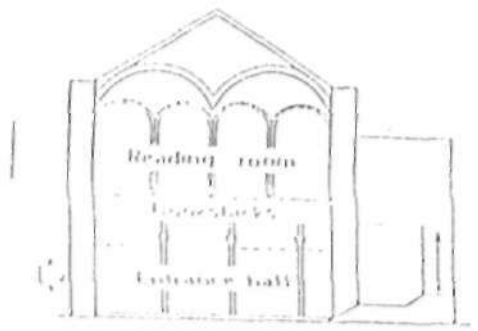


Fig 2.1 Section Through the Bibliotheque St- Genevieve Paris.



Fig 2.2 Bibliotheque Nationale, Paris.

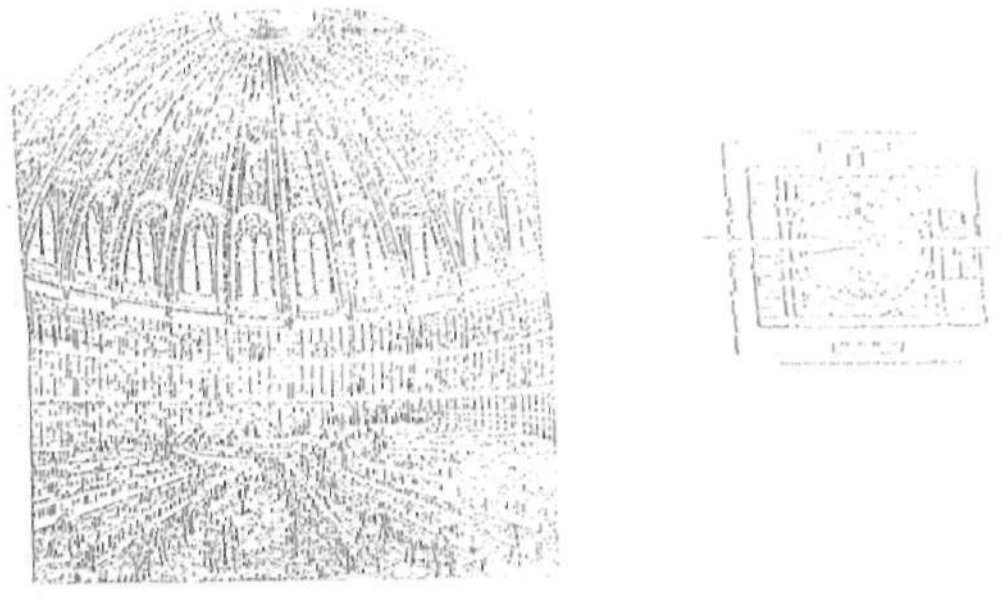


Fig 2.3 British Museum, London

Open Access Plan: The practice of keeping books in closed stacks must have stemmed from the notion that the library was primarily a repository. Faced with growing demand of books in nineteenth century, it is not suppressing the librarians first pulse was to protect the collection from the reader. In the middle Ages, books used to be chained to iron bars on library desks to prevent their being removed. In church libraries, monks wrote book curses into them to deter thieves. The same air of possessiveness was reflected in the various plan types that excluded readers from the stacks.

By the 1920s however, the whole philosophy of librarianship had begun to shift, services to users became far more important that it had been.

Books were, in any case, cheaper and more readily available. On the campuses, libraries came to be viewed less as passive responsitories of knowledge and more as an integral part of the teaching machinery. The open access building plans are the result of efforts is modern times to bring books and readers together. They developed in public libraries through the generous building funds provided by Andrew Carnegie and later in Colleges and University Campuses.

CHAPTER THREE

3.0 CASE STUDIES

This aspect of the chapter embarked on the purpose of:

i. Enabling the designer/author acquaint him/herself with what the study/project is all about with respect to the existing similar ones.

ii. Identify the inter-relationship of various functional spaces required in the scheme, as well as the adequacies manifest in the existing schemes.

iii. Assisting the designer/author in finding practical solutions thus serving as a guide towards evolving a new design.

The author understands the negative attitude of Nigeria towards reading. Hence he has concentrated on the study at existing schemes in foreign and Nigerian situation.

3.1 UNIVERSITY OF SUSSEX LIBRARY U.K

Historical Background: The philosophy was to create a library for the users in the University environment

Client/Users: Government maintains the library building and users are the students and staff.

Site Location: It is sited at the main central core of the university. The library is surrounded by Fulton court institute of development studies, educational development building, gardner arts centre, Falmer Hause and Language Centre.

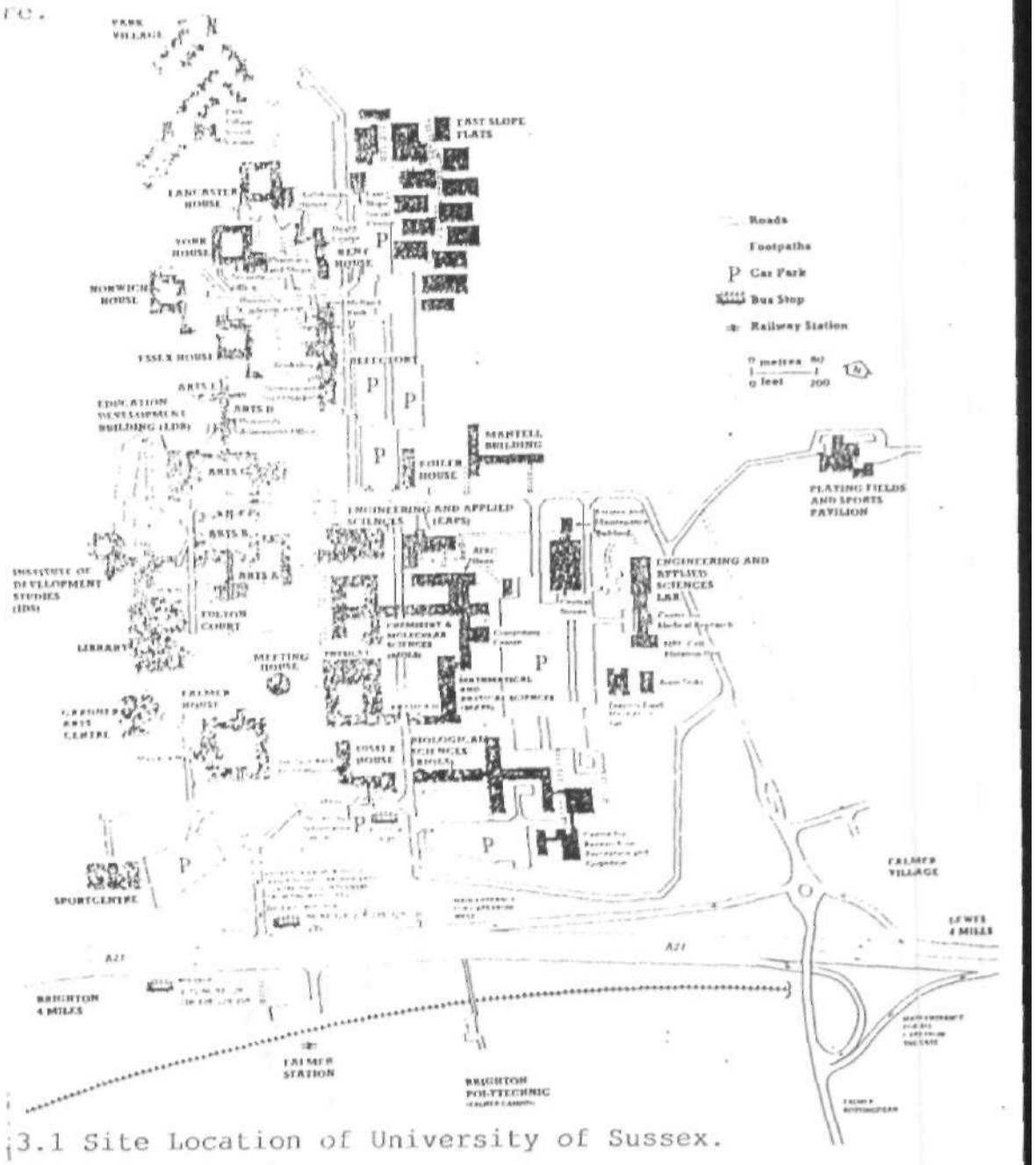
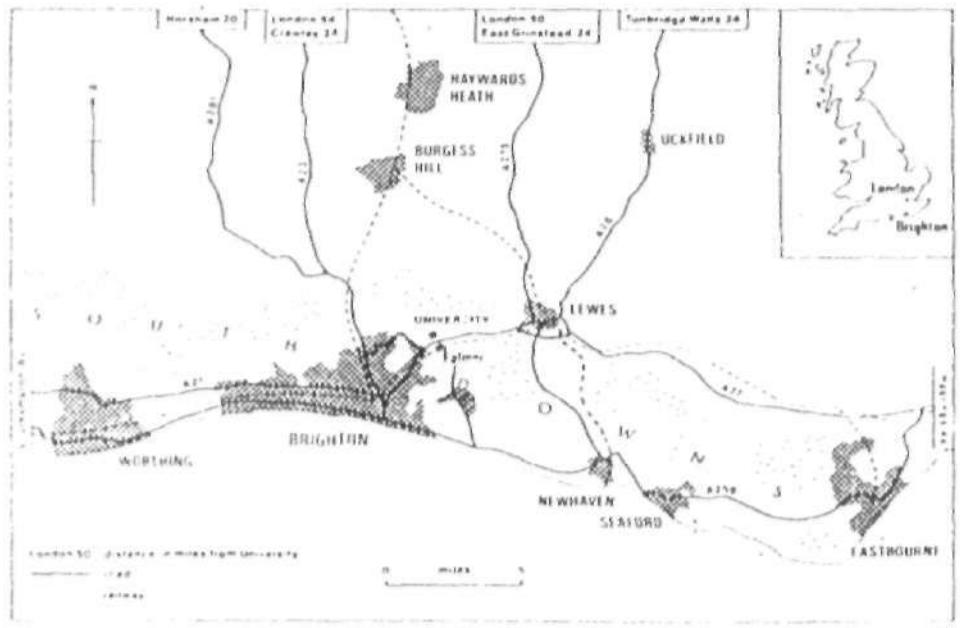


Fig 3.1 Site Location of University of Sussex.

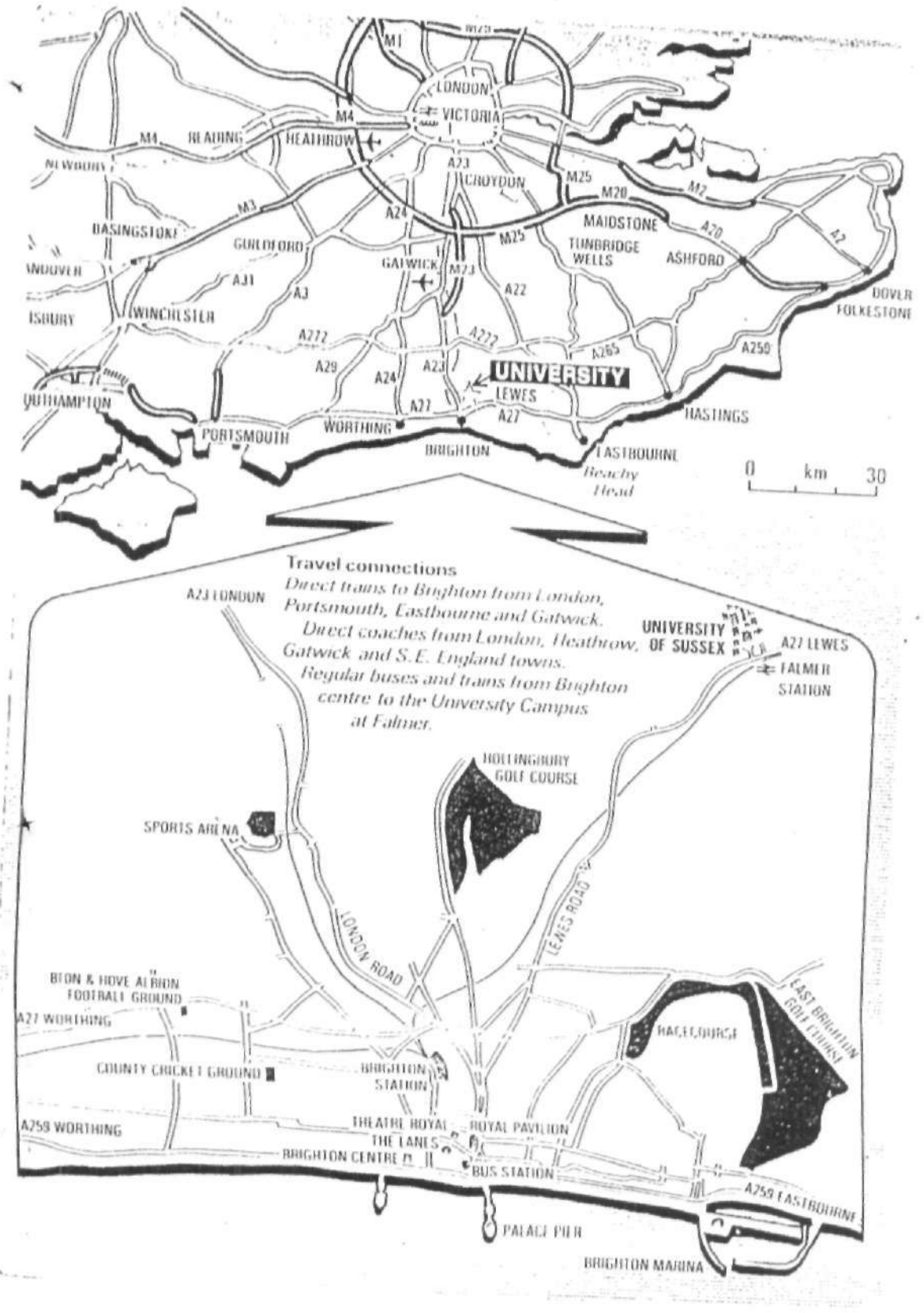


University Location

Transport to and from the University:

The University is situated at the village of Falmer, about half-way between Brighton and Lewes, and is connected to both by regular train and bus services. Falmer railway station is directly opposite the University entrance. Buses also stop nearby. Train services are every 20 minutes, and bus services every 15 to 20 minutes. Some students own cars or motorcycles; a few have cycles, but it is a fairly long ride (four miles) from both Brighton and Lewes.

London is only 55 minutes away by rail; Gatwick International Airport is 30 minutes away by rail, and the channel port of Newhaven is 9 miles from the campus.


M1
LONDON
VICTORIA
M4
READING
HEATHROW
NEWBURY
A23
CROYDON
M25
M20
M2
M3
A24
MAIDSTONE
A20
A2
BASINGSTOKE
GUILDFORD
GATWICK
M23
TUNBRIDGE WELLS
ASHFORD
ANDOVER
A31
A3
A22
DOVER
FOLKESTONE
ISBURY
WINCHESTER
A272
A265
A259
A29
UNIVERSITY
LEWES
OUTHAMPTON
A27
HASTINGS
PORTSMOUTH
WORTHING
BRIGHTON
EASTBOURNE
Beachy Head
0 km 30
Travel connections
Direct trains to Brighton from London, Portsmouth, Eastbourne and Gatwick.
Direct coaches from London, Heathrow, Gatwick and S.E. England towns.
Regular buses and trains from Brighton centre to the University Campus at Falmer.
A23 LONDON
UNIVERSITY OF SUSSEX
A27 LEWES
FALMER STATION
ROTTINGDEAN GOLF COURSE
SPORTS ARENA
LONDON ROAD
LEWES ROAD
BTON & HOVE ALBION FOOTBALL GROUND
A27 WORTHING
EAST BRIGHTON GOLF COURSE
RACECOURSE
COUNTY CRICKET GROUND
BRIGHTON STATION
THEATRE ROYAL
ROYAL PAVILION
A259 WORTHING
THE LANES
BRIGHTON CENTRE
BUS STATION
A259 EASTBOURNE
PALACE PIER
BRIGHTON MARINA

General Description: The building is rectangular shape having three floors, the basement, ground floor and first floor. The basement floor is made up of loading bay, locker rooms, staff rest room workroom, photographic unit staff common room, toilets and two stack rooms. On the ground floor is the main entrance, the control, a lecture room, catalogue hall, inquiries, staff reading room and administration area. The first floor is made up of the periodical offices, seminar room and reading areas.

Design/Planning Concept: The rectangular shape building has a provision made for comfortable lighting and ventilation due to courtyard provided. Adequate spacing of columns and fins to prevent glare from entering the building.

Structure, Construction Materials: The building is a frame structure with a modular grid bay; the floor slabs are of monolithic type. The walls are of normal sands creed, rendering and finished with facing bricks and paints. The roof members are of steel trusses and suspended ceiling boards. The roof in covered with concrete parapet.

Furniture Design/Arrangement: The furniture had be designed of wood and steel with good height for the chairs and tables. The stacks, designed of steel had been arranged

well enough to admit in light with the bays and thereby made picking of books by users from the shelves easy enough.

Design Appraisals:

Merits:

i. The use of good structural grid that could allow for Flexibility in use of space.

ii. Staff facilities distributed over the floors.

ii. The catalogue hall is close to the control.

iv. Control facing entrance

Demerits:

i. The use of columns right in the centre of entrance obstructs free flow of people.

ii. The periodical unit is place on the first floor that would have been better on the ground floor.

iii. Toilet facilities are not distributed over the whole building.

iv. Inquiries not very close in control.

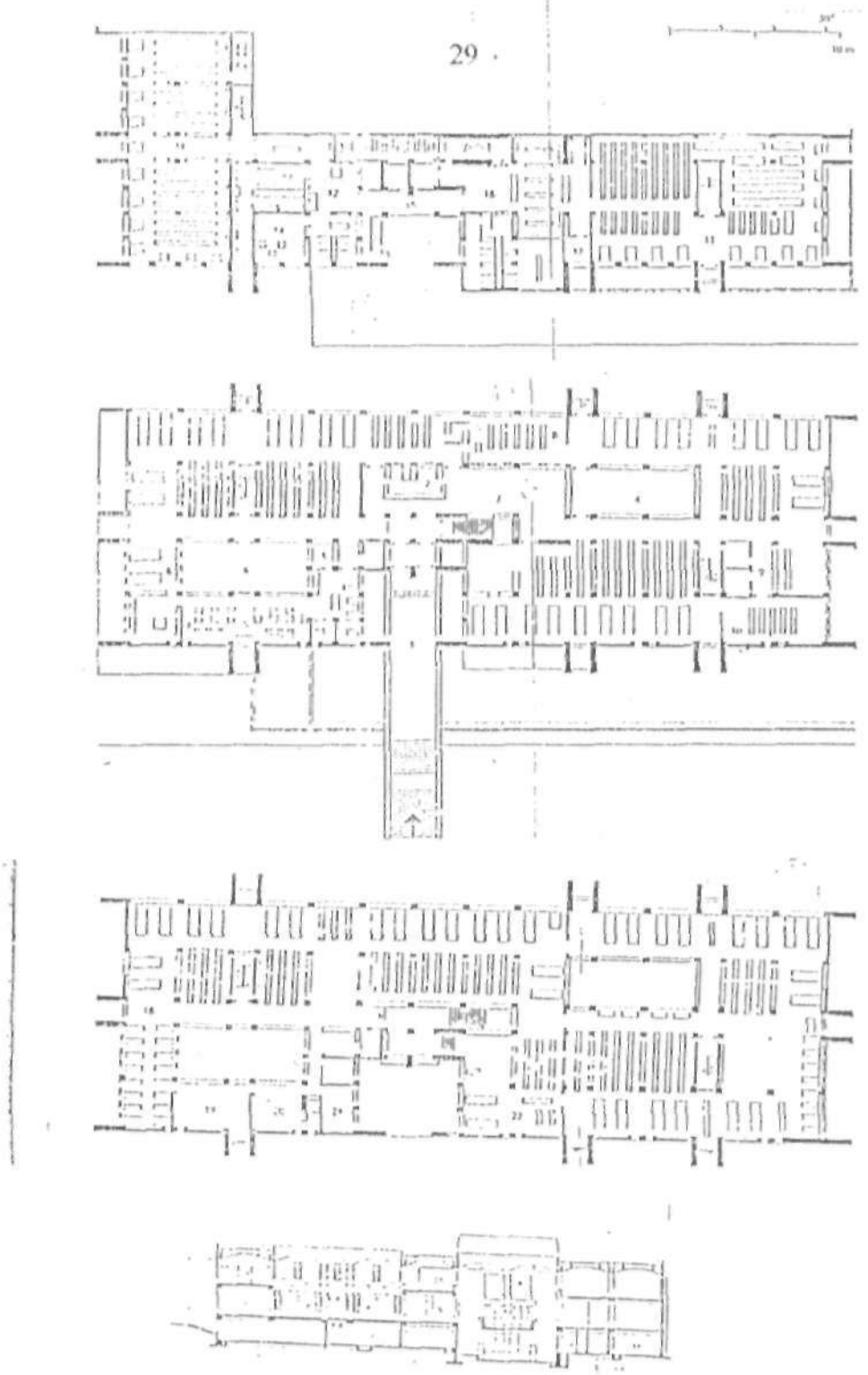


Fig 3.2 Floor Plans of University of Sussex.

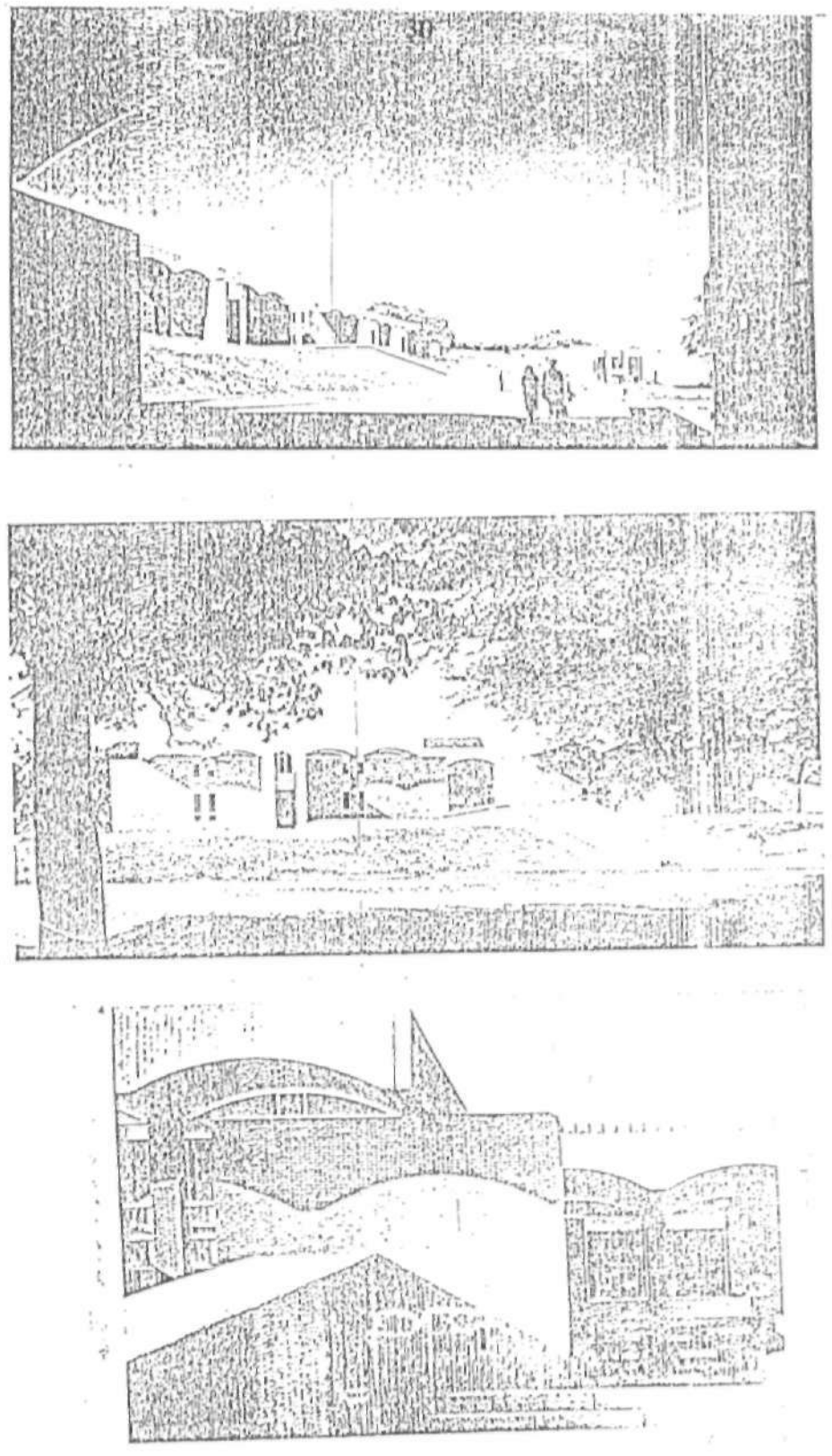


Fig 3.3 Elevations of University of Sussex.

3.2 ISA KAITA LIBRARY KADUNA POLYTECHNIC

Historical Background: Kaduna is the capital of Kaduna State where the library is situated. Isa Kaita library Kaduna Polytechnic genesis arose when the school envisages growing in population. The library is a modern structure and was established in 1982. It is centrally sited at the main campus where every user can easily reach.

Client/Users: Isa Kaita library of Kaduna Polytechnic was managed by "AREWA" that is the Northern states of Nigeria but, it has been taken over by the federal government of Nigeria. The users are the students, staff and other students from other tertiary institutions.

Site Location: It is located at the heart of the school that is within the reach of the faculties, administrative blocks and the students' hostels. The site is relatively flat and accessible by pedestrians and car owners.

General Description

It is irregular shaped three floors building with entrances at the ground floor. The ground floor contains entrance lobby/cloak area, circulation area, information desk, Acquisition, cataloguing serials, toilets, store and tearoom

The first floor contains reading areas and stacks for Colleges toilets and bindery. The second floor contains reference, reserve, media, store, conference/seminar and administrative offices, toilets.

Design/Planning concept: In the design of the irregular shaped building provision are made for future expansion but allowance was not made comfortably for natural lighting and ventilation. The walls are made of sandscreed blocks and the window are recessed at corners therefore vertical shading devices are not provided but horizontal. The exhibition hall opens on all the floors just like courtyard but covered at the roof with windows around it. Windows are not provided at the courtyard to throwing light and ventilation some places have high level windows where books are stacked. The slabs are waffle slabs and the floors are finished with terrazzo.

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Structure, Construction Materials: The structure of the building is normal frame structure with columns spacing of six metres. The external walls are load bearing while all the partitions are non-load bearing. Every unit can be converted to reading sections. The floor slabs are of terrazzo type of finished. In the courtyard we have mezzanine floor with waffle walls.

The roof members are timbers, concrete and aluminum with concrete parapet fascia. The windows are projected ones while the doors are aluminum sliding.

Furniture Design/Arrangement: The furniture are designed of wood steel and plastic. The tabletops are made of wood with steel frame stand, the chairs are made of steel and plastic top. The shelves are of wood arranged close to the wall while the tables and chairs are arranged for eight people. They are conformably made for reading.

Design Appraisal:

Merits:

i. The library is centrally sited.

ii. The use of structural grid for flexibility of space

iii. It does not contain load-bearing internal partitions.

iv. Good circulation for users, staff and materials.

v. Toilet facilities are well distributed.

Demerits:

i. No natural lighting and ventilation at the reading sections.

ii. No provision made for social interaction and discussion.



Plate 1. Entrance View of Isa Kaita Library, Kaduna Polytechnic.



Plate 2. Side View of Isa Kaita Library, Kaduna Poly.

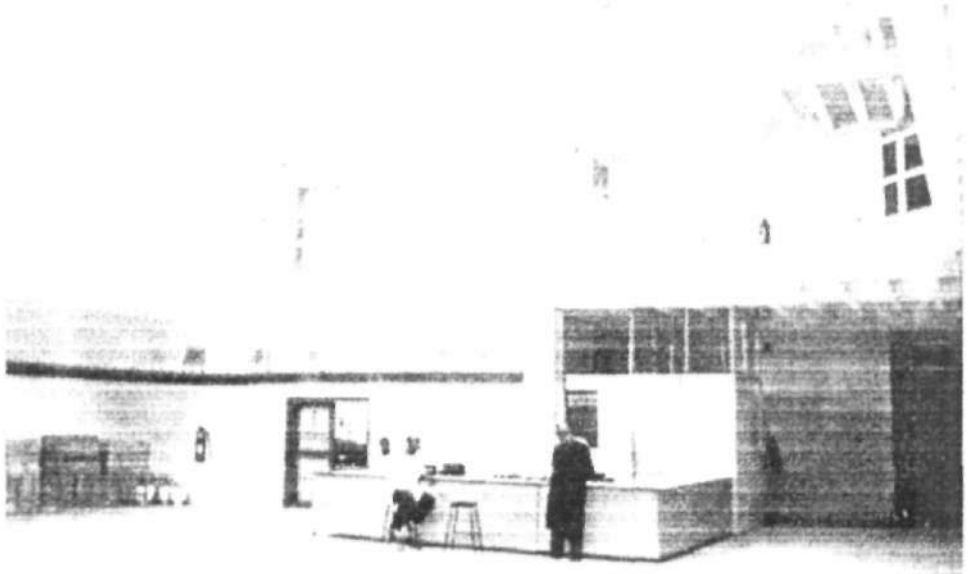
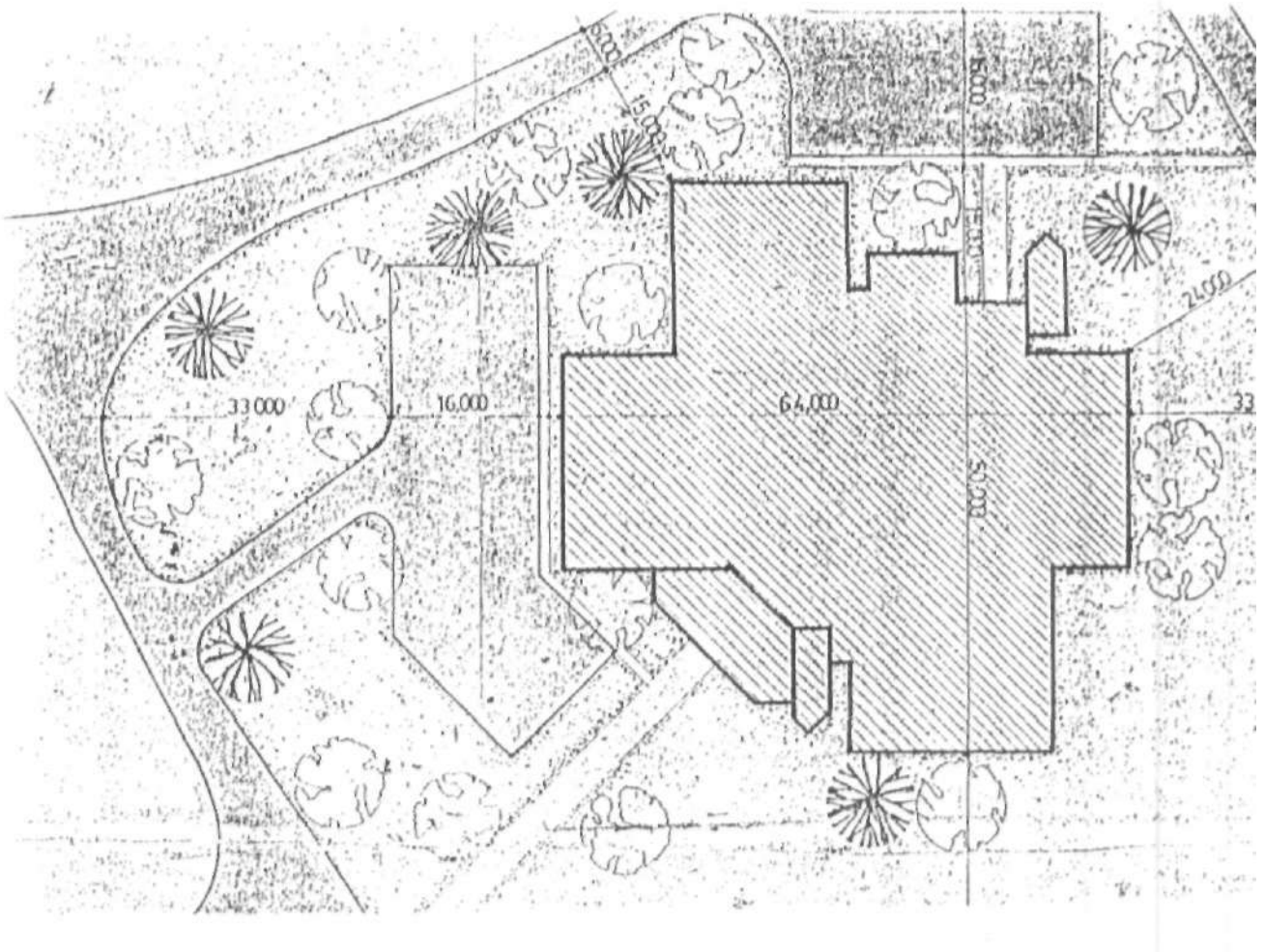
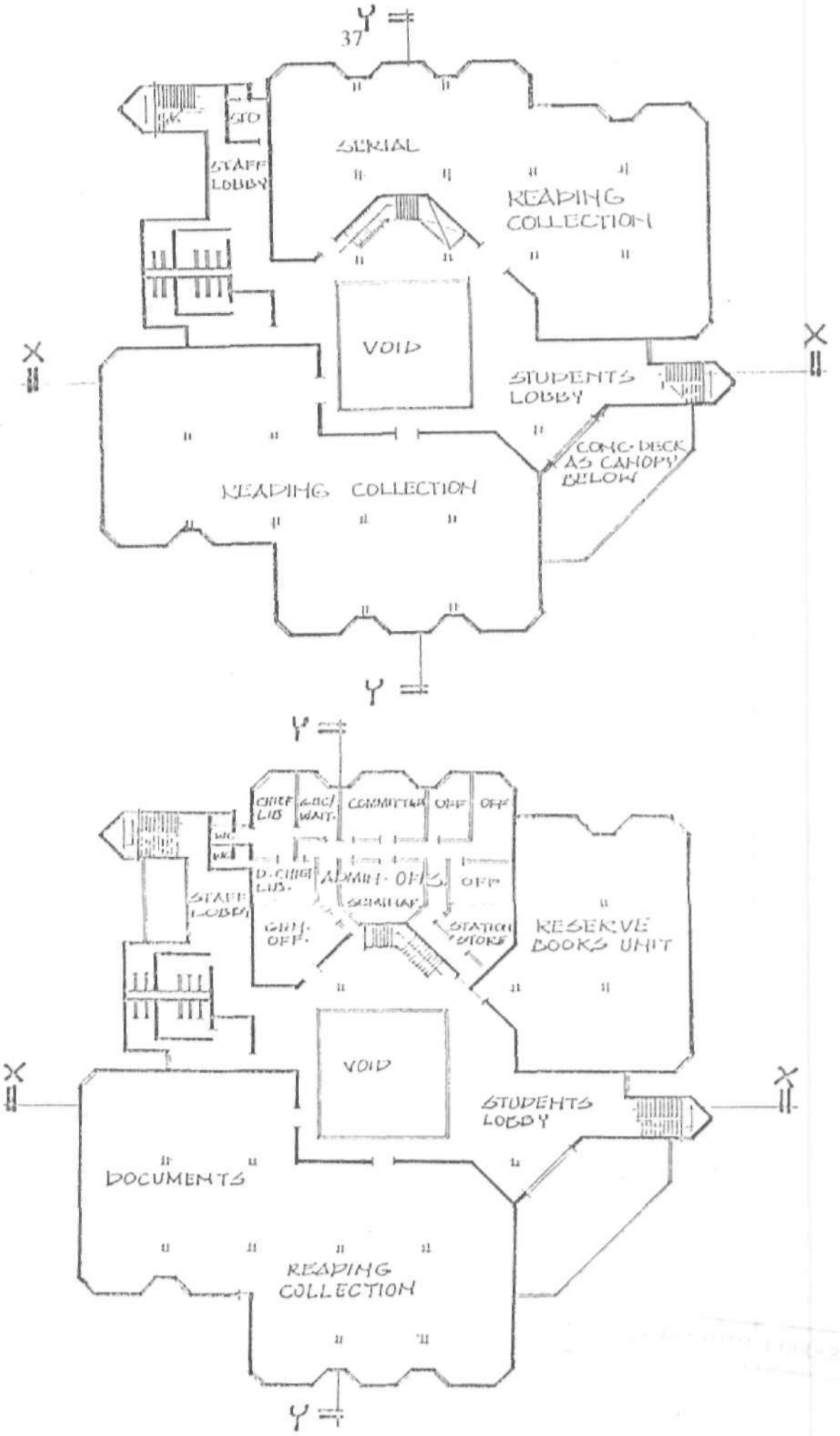
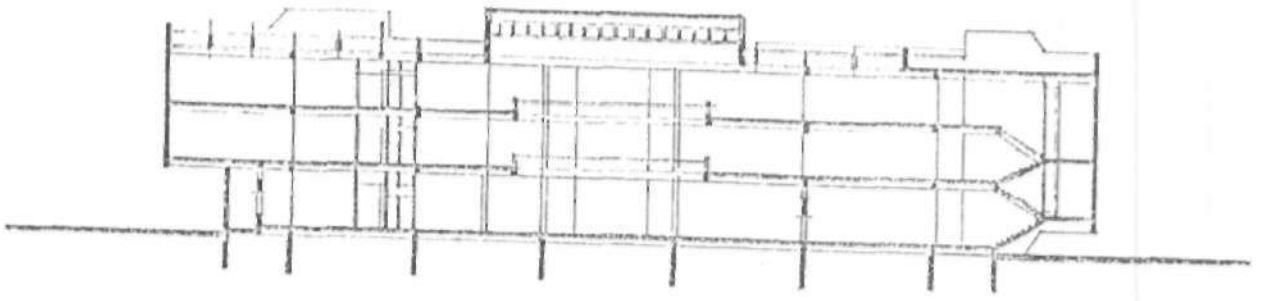


Plate 3. Exhibition Hall, Circulation Area, and Catalogue at the Ground Floor. Subsequent Floors are seen with a Mezzanine Floor, while the Void is covered with Windows around it.


33 000
16 000
64 000
24 000
BINDERY AND ACQUISITION
CATALOGUE
CIRCULATION/ EXHIBITION
REFERENCE
LOBBY
ENT.
STO
STAFF ENT.
X
X
Y
Y


37
STD
STAFF LOBBY
SERIAL
READING COLLECTION
VOID
STUDENTS LOBBY
CONC DECK AS CANOPY BELOW
READING COLLECTION
CHIEF LIB
ASST LIB
COMMITTEE
OFF
OFF
WC
WC
D. CHIEF LIB.
ADMIN. OFFS.
OFF
SEMINAR
STAFF LOBBY
CHIEF OFF.
STATION STORE
RESERVE BOOKS UNIT
VOID
STUDENTS LOBBY
DOCUMENTS
READING COLLECTION



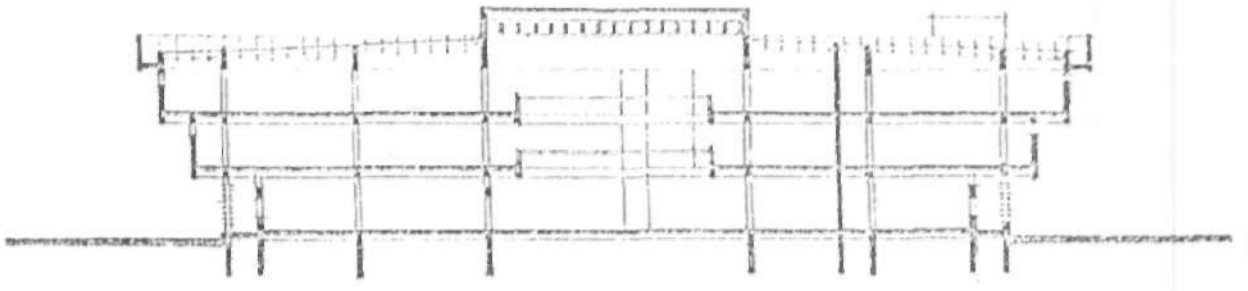
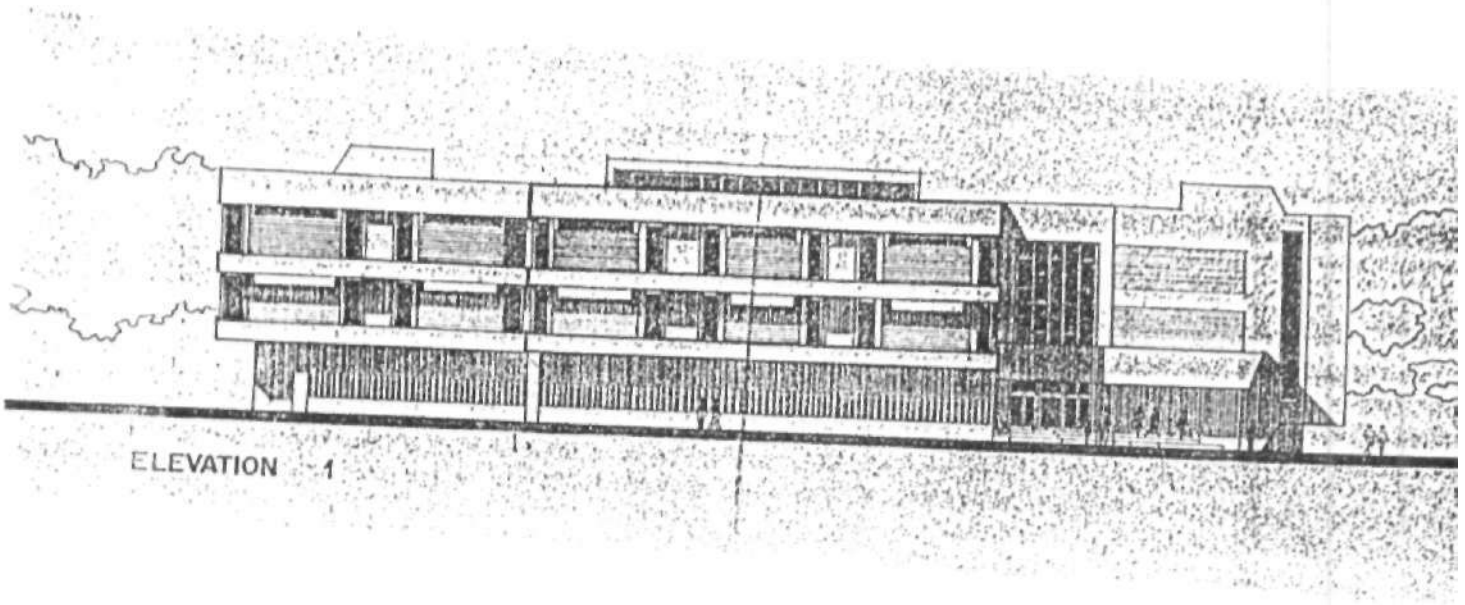


Fig 3.6 Section X-X and Y-Y.



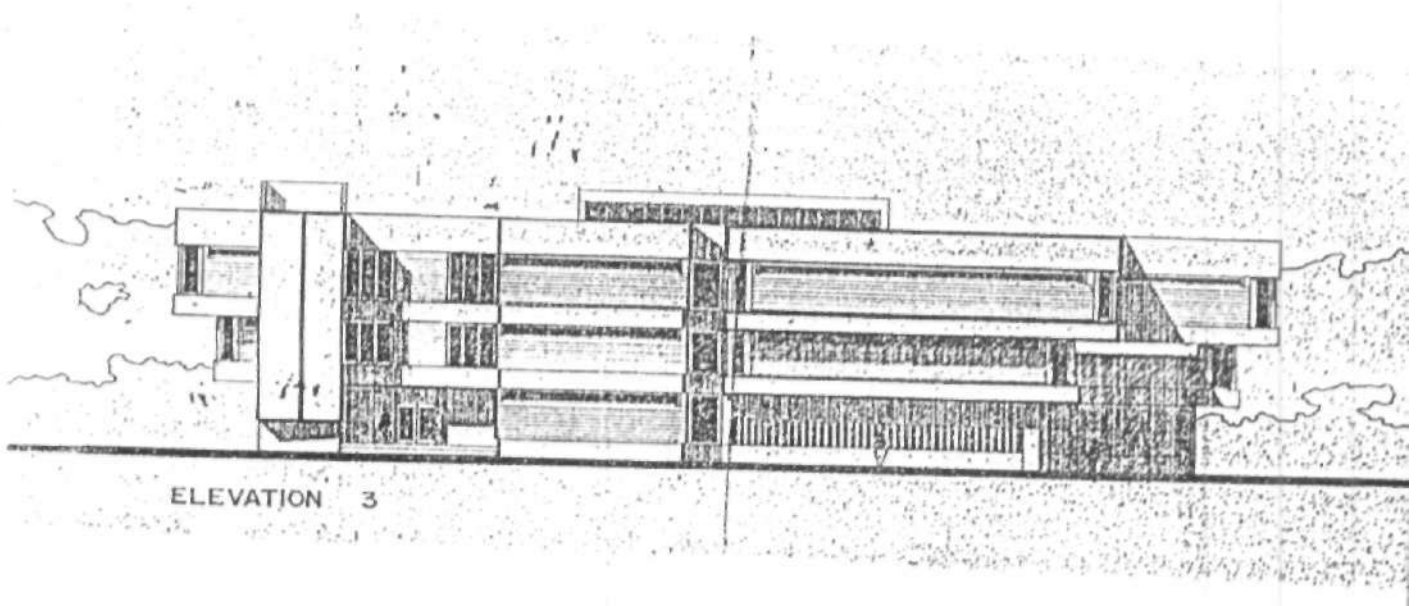


Fig 3.7 Elevations.

3.3 KASHIM IBRAHIM LIBRARY A.B.U. ZARIA

Historical Background: Zaria is one of the towns in Kaduna State. The state has many tertiary institutional libraries but Kashim Ibrahim Library in Ahmadu Bello University Zaria has its genesis dates backs to the early 1950s when the Nigerian College of Arts, Science and Technology was created with headquarters at Zaria and branches_ at Ibadan and Enugu. Some libraries were built for the College in many places before the present Kashim Ibrahim library was built and finally commissioned in 1976 by Alhaji Sir Kashim Ibrahim. The library was built to accommodate 500,000 volumes of books and 2,000 readers.

The library is at the central core of the main campus of the university. It is surrounded by hostels, senate building some faculties and the likes.

Client/Users: The client of Kashin Ibrahim library Ahmadu Bello University was formerly the Northern State (AREWA) but it has been taken over by the Federal government of Nigeria. The users are the students, staff and other students from other tertiary institutions.

Site Location: Kashim Ibrahim Library is located in the main campus of the University. It is surrounded by Ribadu

hostel, Biological Sciences, Senate building, Iya Abubakar Computer centre, Faculty of environmental Design and Faculty of Engineering.

The site has a relative slope from Ribadu hostel to Iya Abubakar computer centre.

KASHIM IBRAHIM LIBRARY

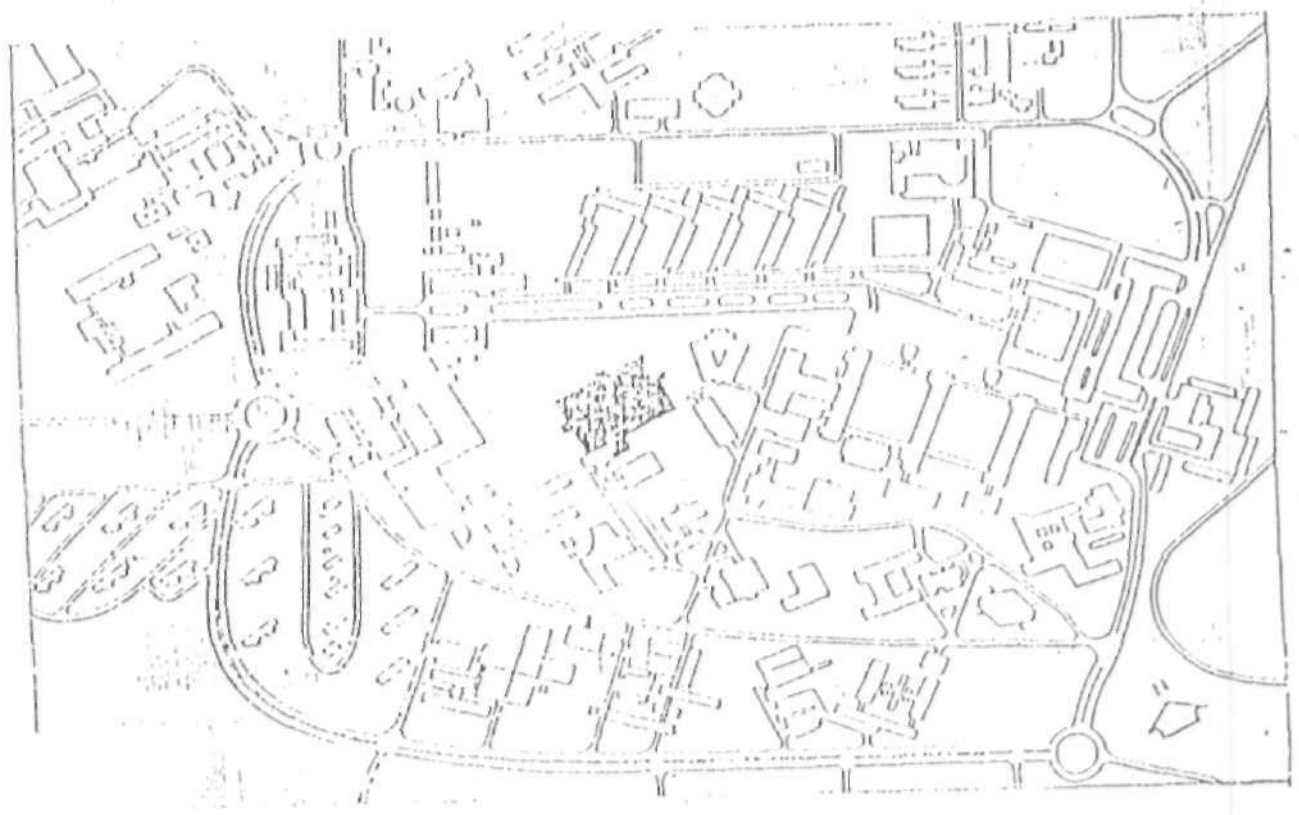


Fig 3.8 Site Layout of the Library.

General Description: It is rectangular three floors building with the entrance over looking Ribadu hostel. On the ground floor accommodates the entrance for readers and staff respectively, control, exhibition, catalogues circulation desk, new books display technical service area at far end. To the right and left are the serials and reference sections respectively, toilets are housed on the ground floor.

On the first floor are the Arts and Social Science collection with seating and stacks to the left and right, Audio-visual unit, carrels, sitting room and administrative offices.

The second floor accommodates the science and technology collections reserved books, documents, and the Africana section. The central air conditioning plant is on the rooftop.

Design/Planning concept: In the design of the rectangular shaped building, allowance had not been made for comfortable lighting and ventilation. Fin walls and horizontal shading devices are employed to protect the glazed sides from glare. The building is deep planning. There are three escape staircases and one service staircase with a lift to convey books to different floors.

Structure, Construction Materials: The building is of frame structure with the bay modules of six-metre grid, the floor slabs are of terrazzo type. The walls are normal sandscreed rendering and painted. The roof members are of barrel vault with aluminum sheets and suspended ceiling.

Furniture Design/Arrangement: The furniture are designed of wood steel and foam/cushion. The tables are made of wood and steel, the chairs made of steel and cushion and stack shelves are of steel. They are comfortable when seated on.

Design Appraisal:

Merits:

i. The library is centrally sited.

ii. Proper co-ordination of units.

iii. Good circulation for staff, users and materials.

iv. Good structural grid system that enhance flexibility in space usage.

v. Adequate provision of sum shading devices.

Demerits:

i. Heavy dependence on artificial lighting and ventilation and the central air conditioning plant on the rooftop are not functioning.

ii. No provision made for group discussion and as a result

readers are commonly seen discussing along corridors.

iii. Audio-visual unit highly inadequate.

iv. Toilet facilities not distributed on the whole floors.



Plate 4. Perspective View of Kashim Ibrahim Library, A.B.U. Zaria.

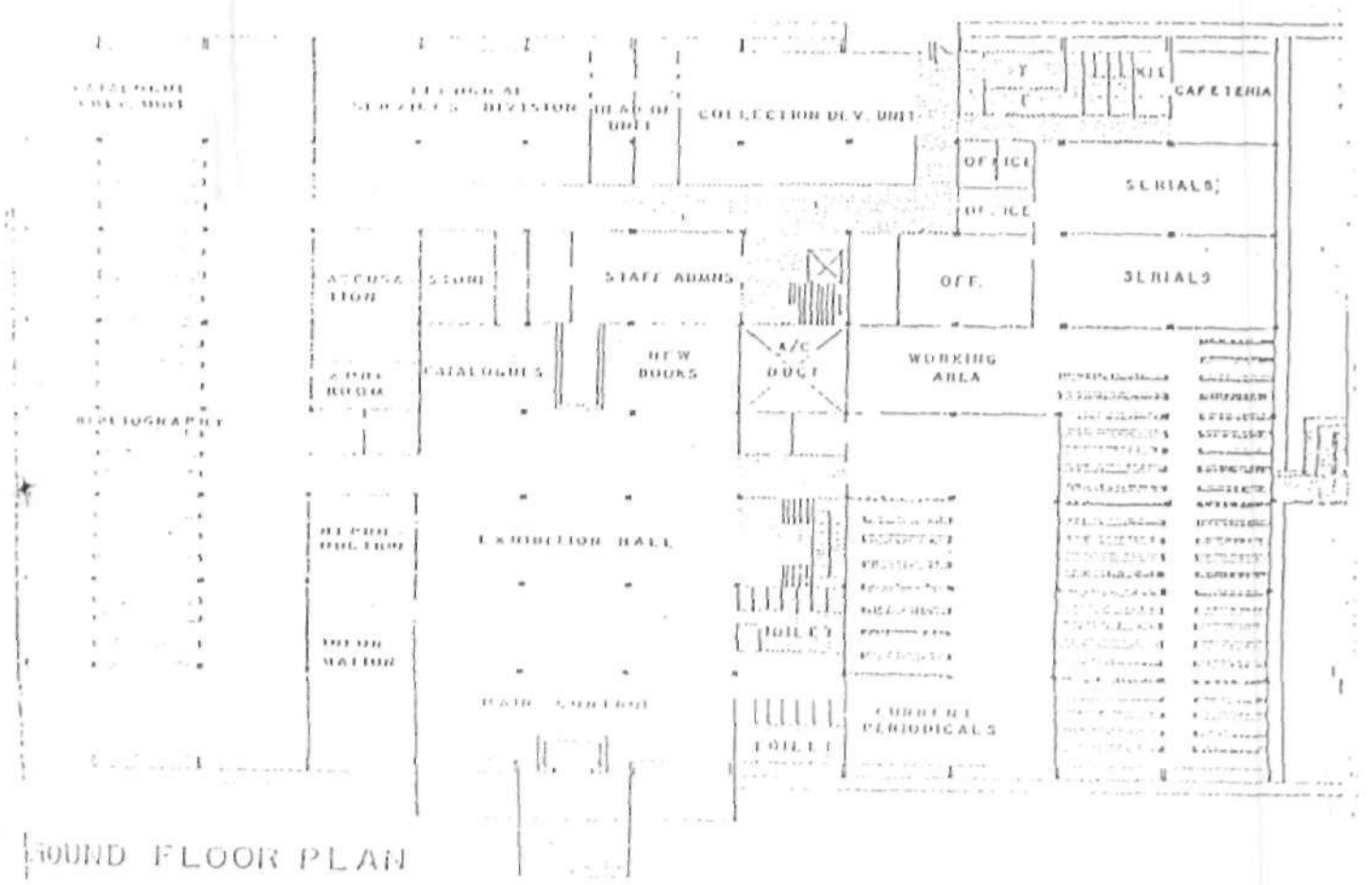
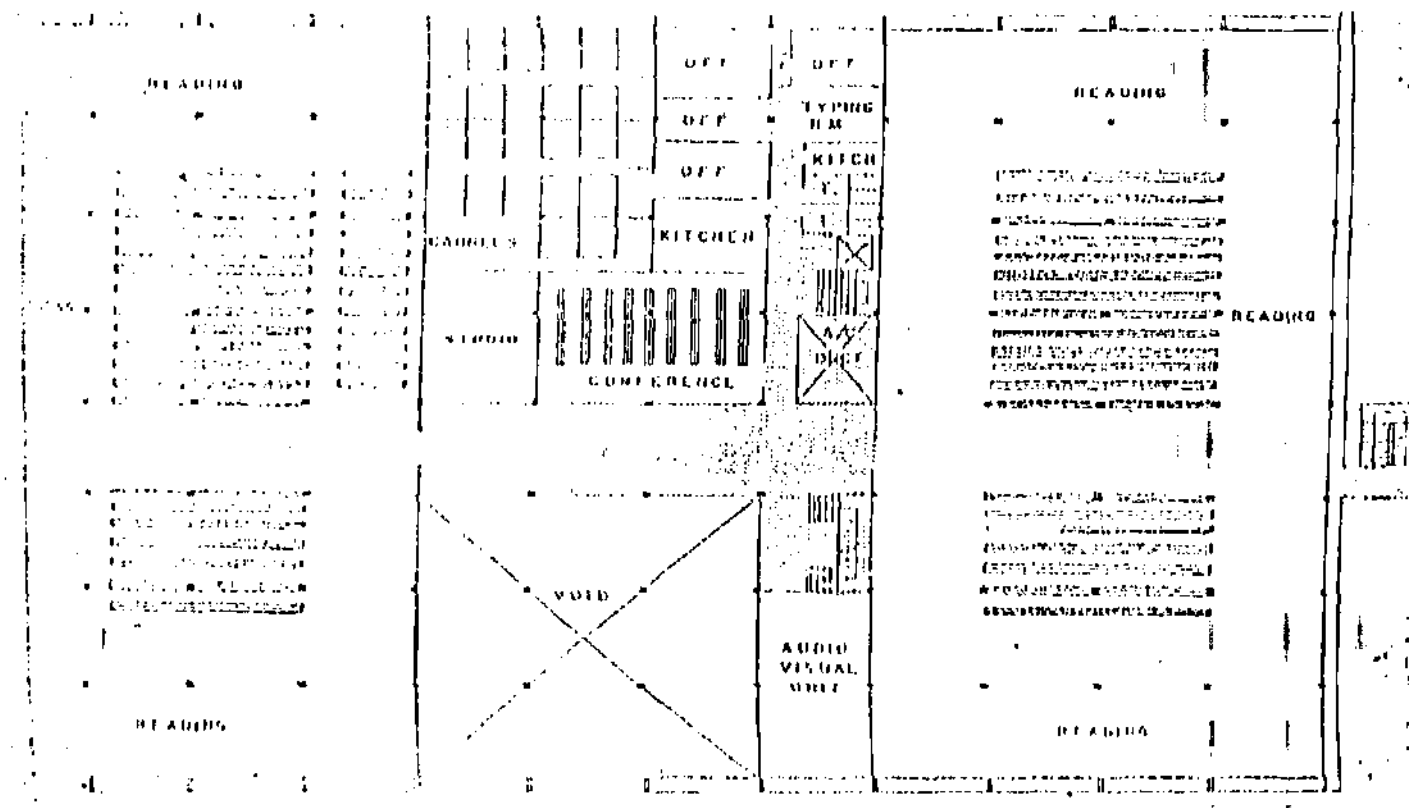


Fig 3.9 Ground Floor Plan.



FLOOR PLAN

Fig 3.10 First Floor Plan.

KASHIM IBRAHIM LIBRARY

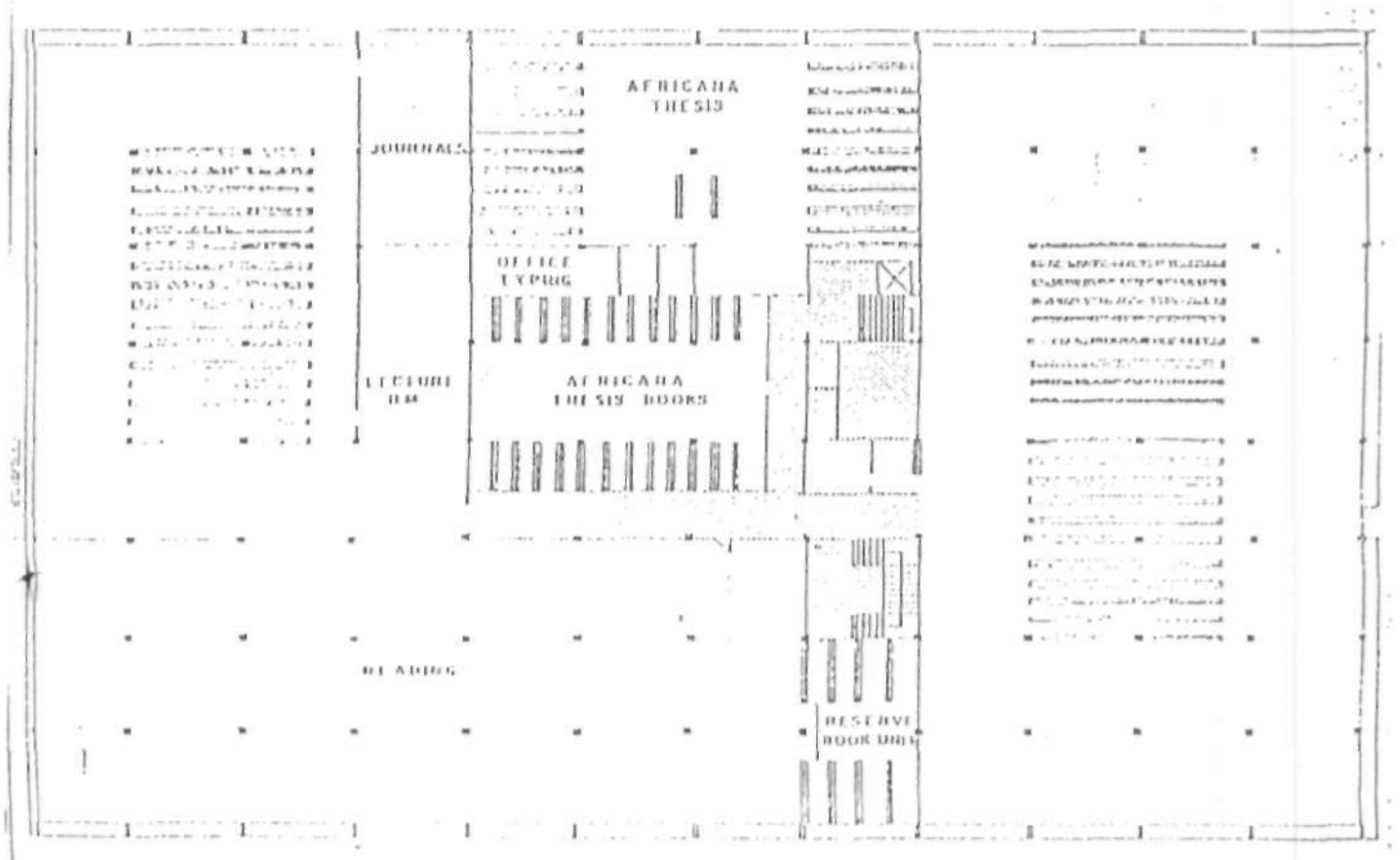
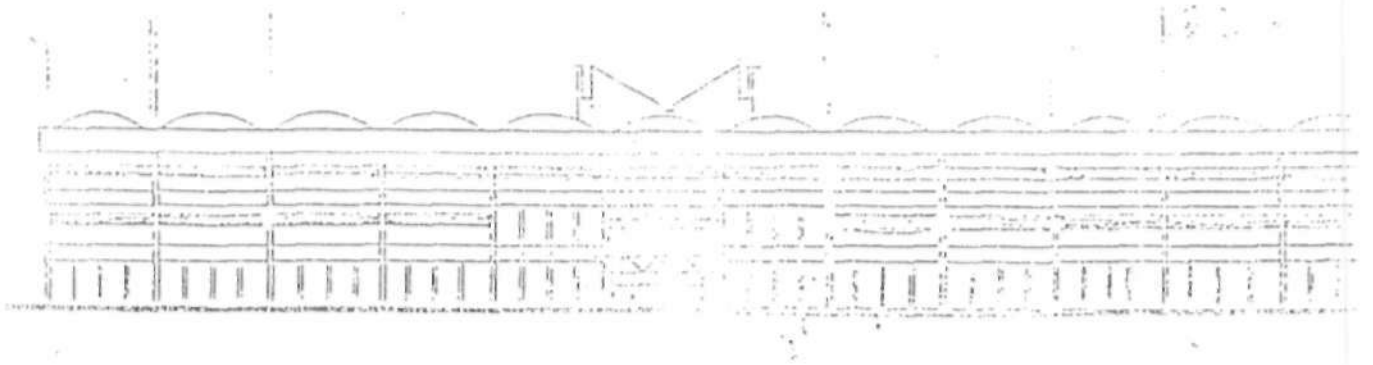


Fig 3.11 Second Floor Plan.



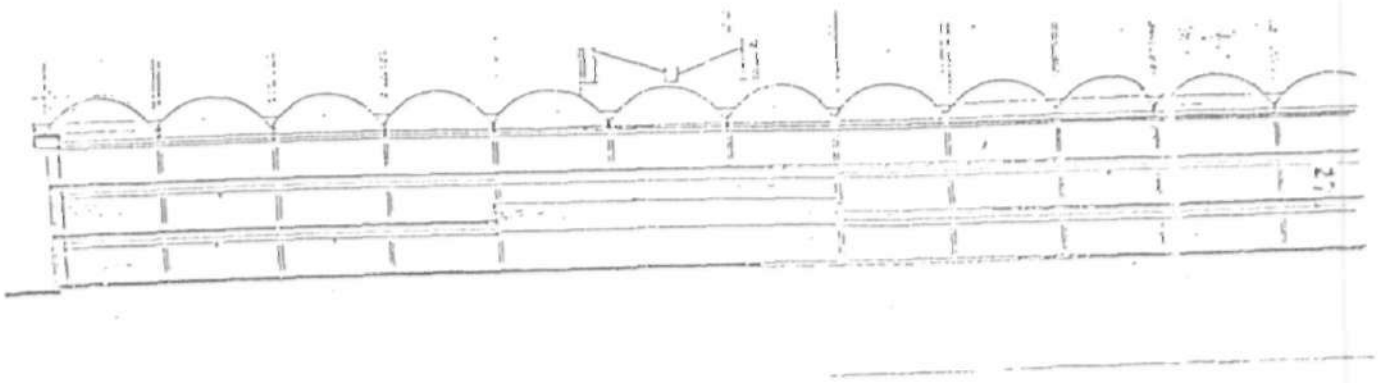


Fig 3.12 Approach and Rear Elevations.

3.4 CENTRAL LIBRARY, FEDERAL POLYTECHNIC AUCHI

Historical Background: Auchi one of the major towns in Edo State with central library located in the campus of the Polytechnic. The present building was not meant for library it was a classroom but converted to library. This was renovated and an extension was made to accommodate books, students and staff. The library is located on the convocation ground. The extension was made in 1993.

Cleint/Users: The client is the state library board and the users are students of tertiary institutions and staff of the polytechnic.

Site/Location: The central library is located in the polytechnic campus at convocation square ground. The site is relatively flat and of tropical vegetation.

General Description: The building is a rectangular shape structure with an extension of a rectangular shape. It has a beautify entrance and is a bungalow. On entering the building is the control catalogue/circulation desk stacks, reading areas, serials, reference archives offices, cataloguing and registration desk.

Design/Planning Concept: There are some places with fins, while the roof is made of parapet, the spaces are made open

to allow for enough lighting into the stack area.

Structure, Construction Materials: The building is a bungalow with standing columns spacing in the reading area. The walls are made of blocks with plaster rendering and painted. The roof members are timbers with aluminum roofing sheets falling into a parapet round the roof as fascia. The window and doors frames are made of aluminum materials.

Furniture Design/Arrangement: The furniture had been designed of timber and comfortably enough for reading. The stacks too had been made of timber and also designed and arranged to allow in light into the bays.

Design Appraisals:

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Merits:

i. Good natural lighting and ventilation at reading areas.

ii. Good structural grid system at the reading areas.

iii. The entrance

Demerits:

i. There is no good circulation.

ii. Toilet facilities are not well distributed.

iii. There was no future projection consideration of the students' population.



Plate 5 Showing Entrance Gate to Federal Polytechnic Auchi.

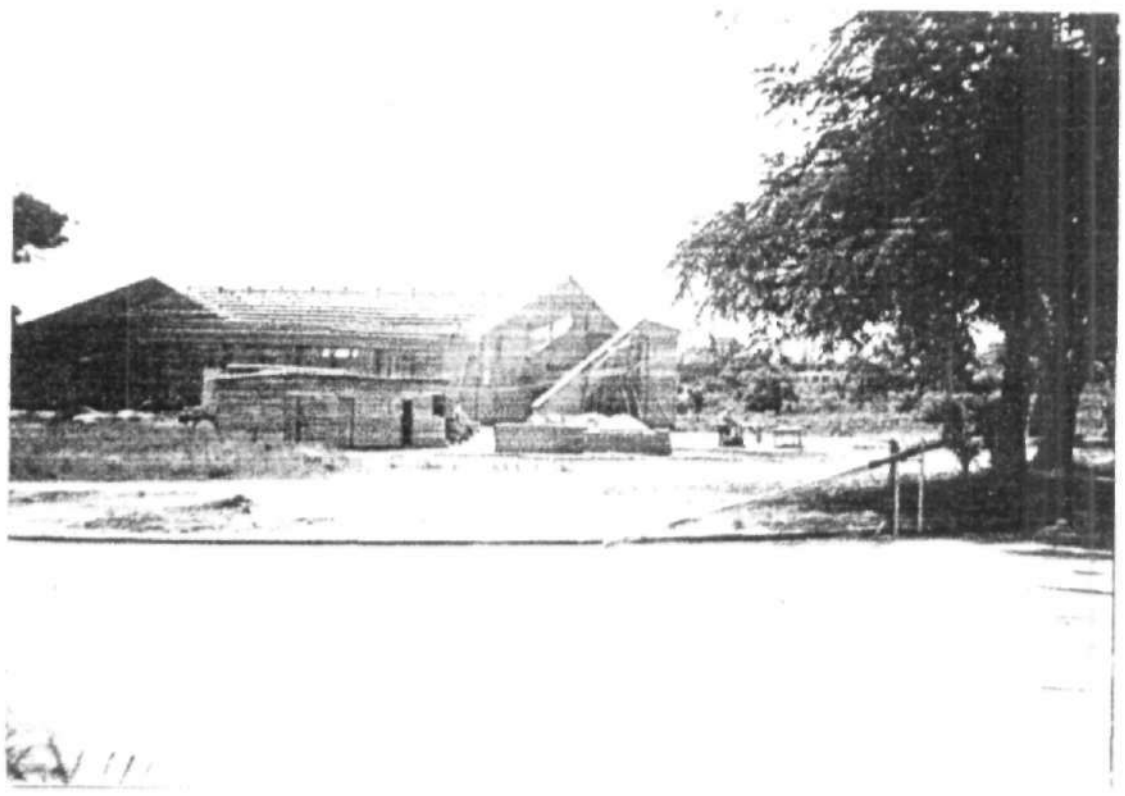


Plate 6 Showing Road to Hostels and uncompleted Auditorium.



Plate 7 Showing the Main Service Road to the Site.

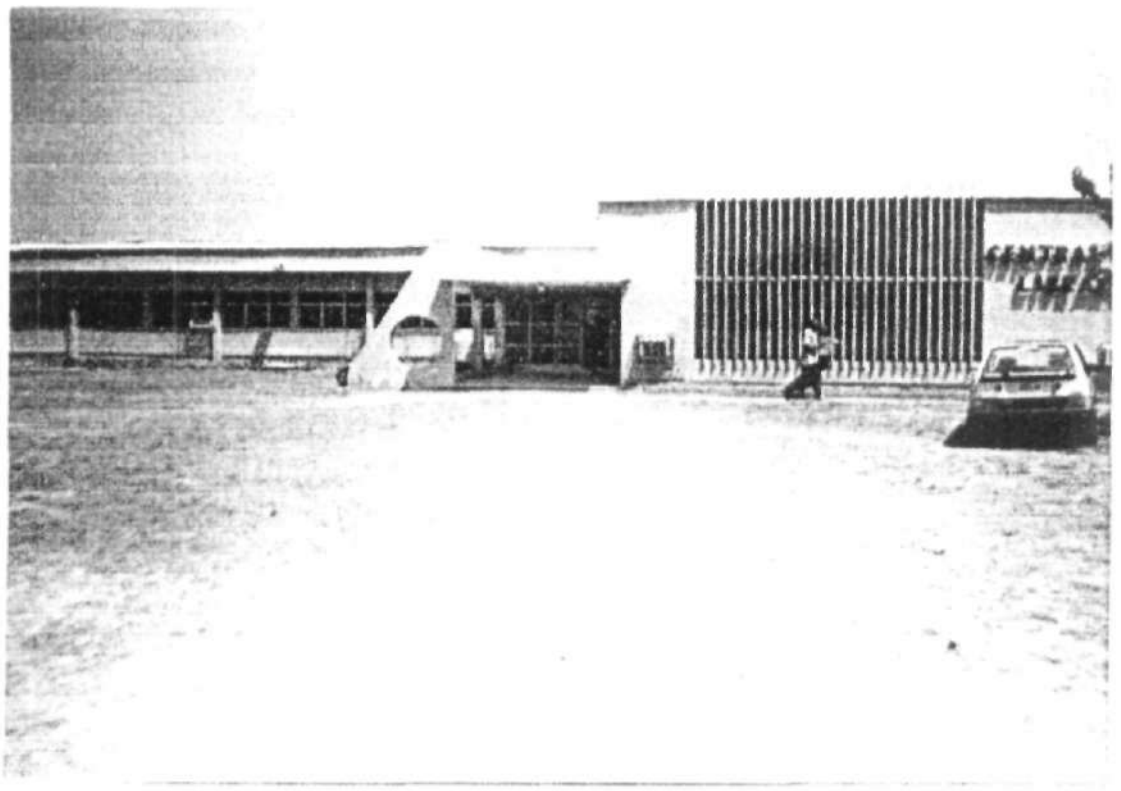
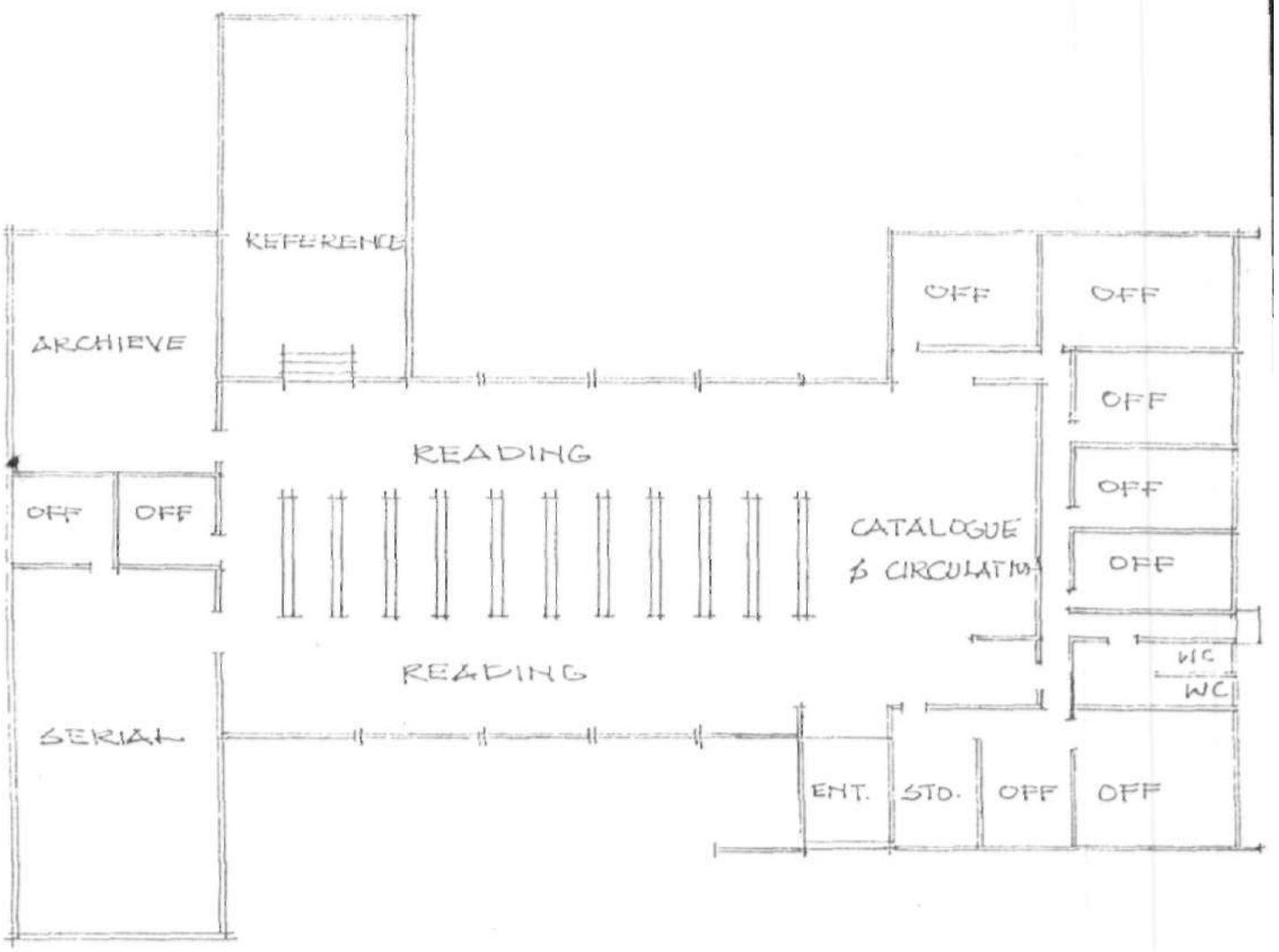


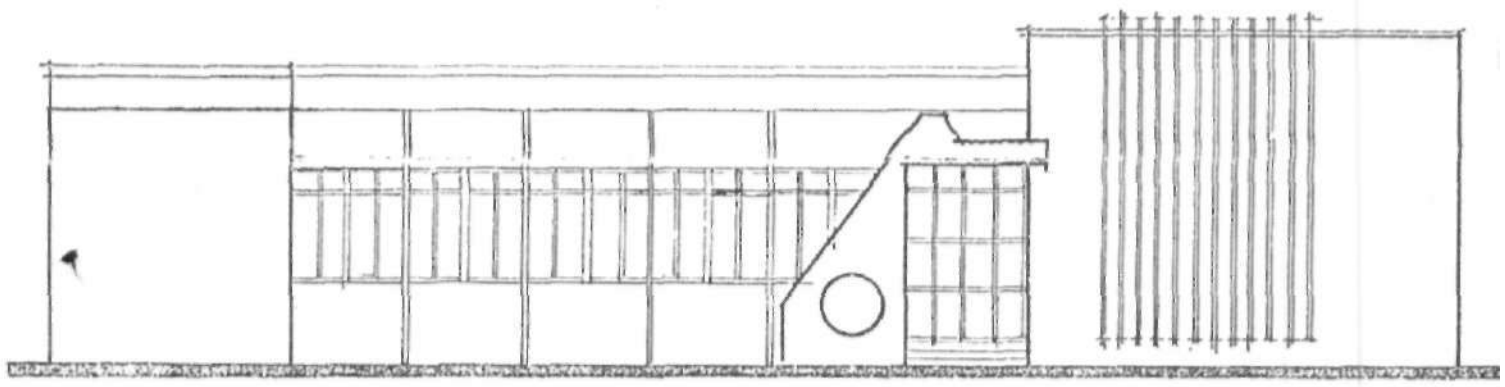
Plate 8 Showing the Main Approach Elevation to the Library.



Plate 9 Showing the Perspective of the Library.



GROUND FLOOR PLAN



APPROACH ELEVATION

CHAPTER FOUR

4.0 NATURAL LIGHTING AND VENTILATION

4.1 INTRODUCTION

Knowing fully well that library involves deep planning the author will look at the intricacies involved in Day lighting, artificial lighting and ventilation in library design and possible solutions.

Lighting involves several basic concepts including reflectance, absorbance and transmittance. Daylighting should prevent excessive heat gains and glare. Prediction of daylight can be done mathematically or in the laboratory. The design sky is the ninetieth or eighty-fifth percentile illumination level while the daylight factor is made up of three components; the direct sky component, the externally reflected component and the internally reflect component. Systematic design of artificial lighting should consider the lighting problem, the method of lighting, the illumination value required, types of fittings, types of lamps, number and placing of fittings as well as maintenance. Lighting standards relate to design sky.

Ventilation is the replacement of used inside air by outside air and it has three major functions: Supply of

ABDULLAH IBRAHIM LIBRARY

fresh air, body cooling and structural cooling or heating. Air movement through buildings can be induced by the stack effect, wind pressure or mechanical means such as fans, evaporative coolers, air conditioners and heaters. The factors that affect airflow through buildings are external features and factors, number and size of openings, position of openings and opening components. Airflow around buildings is determined by the shape, height, orientation, and planning of buildings. Ventilation is predicted by mathematical formulae or with the aid of models. Minimum ventilation standards provide for supply of fresh air, body cooling and structural cooling.

4.2 LIBRARY LIGHTING

Library lighting is complicated and sometimes controversial matter, whether approached as architectural or engineering problem, a question of aesthetics, or a way of serving the library readers. The architect considers natural lighting when designing while the engineer looks at the artificial lighting to give both the aesthetic of the exterior and the interior of the building.

4.2.1 Basic Concepts in Lighting

Light is electromagnetic radiation with wavelength between 380 and 780 manometers. The colour of perceived

light is determined by its wavelength. Light falling on an object can be reflected, absorbed or transmitted, depending on the following properties of the object:

Reflectance (r)

Absorbance (a)

Transmittance (t)

Since light falling on any object can only be reflected, absorbed or transmitted,

r + a + t = 1

Colour of Light: The colour of light is determined by its wavelength. The light from the sun is white coloured light can be produced by additive or subtractive processes. The properties of colour are:

Blue - concept of colour

Value or pureness - light or dark

Chrome or brightness - colourfulness or intensity.

Reflectance: Parallel rays of light remain parallel after reflection from a plane mirror. This is called specular reflection. In case of a matte surface however, the giving rise to diffusion. The colour of the light after reflection is determined by the absorbance of the surface.

Absorbance: Certain surfaces absorb selected wavelength of light falling on them. This results in a difference in colour between the incident and reflected light.

Transmission: Transparent materials transmit a large part of the light incident upon them while opaque materials do not allow the passage of light. Translucent materials transmit a small part of the light falling on them, scattering the light and creating diffuse light. The transmission factor is the ratio of the light transmitted by a body to the incident light.

Intensity: The intensity of a light source is measured in candelas (cd). One candela is the intensity of $1/60cm^2$ uniformity emitting black body radiator at the melting point temperature of platinum.

Flux: This refers to the flow of light and it is measured in lumen (lm). One lumen is the flow of light emitted by a 1-candela point source, within a quit solid angle.

Illumination: This is the amount of flux falling on a unit area and the unit of measurement is the lux (lm/m^2).

Luminance: Is the measure of brightness of a surface and is defined as the luminous intensity of any surface in a given direction per unit of projected area of the surface viewed from that direction. It is measured in candelas per square metre (cd/m^2).

4.2.2 Day Lighting

The provision of daylight is very important in architectural design. This is achieved through appropriate design of windows and openings. The origin of daylight within an architectural space may be one or more of the following:

i. Direct sunlight

ii. Externally or internally reflected light

iii. Diffused sunlight

In the Nigerian climate the design of windows should guarantee lighting but excessive lighting should be avoided in order to prevent:

i. Heat gain

ii. Glare

Heat gains are caused by solar radiation raising internal temperatures (green house effect) while glare may result from strong contrasts in light level or from high absolute level of light.

Glare: Glare is a condition of vision caused by spatial or temporal contrasts in lighting or high levels of light. It is most commonly associated with direct sunlight entering a window (direct glare) but it can also be caused by sunlight reflected from external surfaces (indirect glare). Direct glare can be prevented by providing sun-shading devices designed with the aid of a direct solar radiation over lay and a sun-path diagram. We can distinguish two types of glare disability glare and discomfort glare.

Disability Glare: Is a glare that makes vision impossible due to extreme constraints, as when there is an area of indistinct vision around a bright light. It does not necessary cause discomfort and is rarely a problem in design.

Discomfort Glare: Is a glare which causes discomfort, as distinct from reduction in vision caused by distractingly bright surfaces or sources of light. Discomfort glare should be avoided in building design.

In the Nigerian climate, high luminance skies and reflection from the ground and nearby buildings cause glare. To prevent glare, externally reflected light should be avoided and light should be reflected from ceilings

using high level windows. Alternatively vertical strip windows can be provided in room corners as these reflect light of internal walls. When sun-shading devices are used, their surfaces should be non-reflective to prevent glare. A common solution to reflectance from the ground is the use of plants and flowers to cover the reflective surface. Changing the colour of external reflective surfaces to a darker colour will also prevent glare.

The method of prevention of glare should take into account the prevalence of either clear or overcast sky conditions. Clear sky conditions exist in hot dry climates where there is little cloud cover. The highest luminance is from the ground and sunlit walls opposite windows. In this case windows should be exposed the blue sky rather than the horizon.

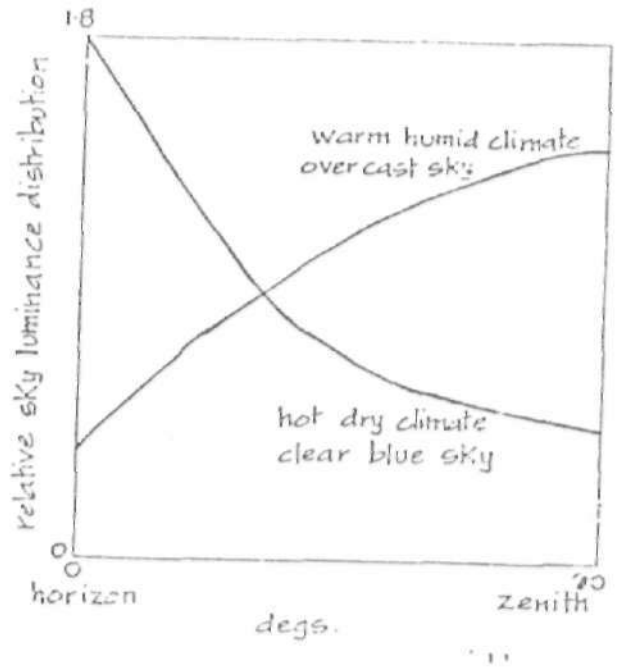


Fig 4.1. Relative Light Distribution from a Blue Sky and an Overcast Sky.

The opposite situation is found in warm humid climates where heavy cloud cover and overcast sky conditions exist. Here the darkest part of the sky is found near the horizon. The view should be directed towards the horizon and glare prevented by horizontal overhangs. In composite climates both of these conditions may be found. Screens are usually used as they prevent glare both clear and overcast skies.

Prediction Techniques: The prediction of daylight may be done through the use of mathematical formulae or in the laboratory. Laboratory studies are carried out in the artificial sky that simulates the illumination obtained from the sky. Daylight requirements may be calculated under clear sky or overcast conditions. Daylight prediction techniques under clear sky conditions will not be discussed here due to their relative complexity. The British Research Establishment developed the daylight prediction technique discussed below and it uses the concept of the design sky to establish the daylight factor.

The Design Sky: The design sky illumination value is usually established for each location and it is the out

door illumination level that is exceeded 90% or 85% of the time. This is the ninetieth or eighty-fifth percentile illumination level and it is usually obtained from analysis of long-term illumination records. This concept is very useful in design as it makes it possible to determine the daylight factor or the required illumination level indoors from the following equation:

$$DF = \frac{E_i \times 100\%}{E_o}$$

Where

DF = daylight factor

Ei = required illumination level

Eo = design sky illumination.

The ninetieth or eighty-fifth percent tiles are usually employed to avoid uneconomical and excessive lighting most of the time. This is done at the expense of having to little light some of the time. The design sky illumination levels decrease with latitude and Nairobi for example has 18,000 lux while London has 5,000 Lux.

The Daylight Factor (DF): The daylight factor method is used to calculate the intensity of daylight received on a surface inside a building from an overcast sky. It indicates the ratio of daylight falling on the surface as a proportion of the total daylight that would fall on the same surface from an unobstructed sky. The daylight factor

has three components that relate to the possible light paths to the surface:

i. The direct sky component (DSC)

ii. The externally reflected component (ERC)

iii. The internally reflected component (IRC)

The direct sky component is the proportion of light that falls on the surface directly from the sky. Window size and position in relation to the surface thickness of window frame members, quality of glass and its cleanliness as well as external obstructions affects it.

The externally reflected component is the proportion of light from the sky that is reflected off external surfaces to fall directly on the surface. It is determined by the area and reflectance of external surfaces visible from the surface under consideration.

The internally reflected component is the proportion of light from the sky that is reflected off the internal surfaces of the room before falling on the surface. It depends on the size of the room, ratio of window area to total wall area and reflectance of indoor surfaces.

The daylight factor is also dependent on the glazing factor, the framing factor and the maintenance factor of the glass. The glazing factor is a correction factors the glazing other than single clear glass glazing. The framing factor makes a correction for the use of mosquito screens

and security bars and is the ratio of the glass area to the total window area. The maintenance factor is correction factors the state of cleanliness of the glass.

The following equation is used to calculate the daylight factor:

DF = (SC + ERC + IRC + M) x GF x FF x MF

Where

DF = daylight factor

SC = direct sky component

ERC = externally reflected component

IRC = internally reflected component

M = Maintenance factor for internal surfaces

GF = glazing factor

FF = framing factor

MF = maintenance factor of glass

The direct sky component is determined with the aid of a pepper pot diagram or a daylight factor protractor.

4.2.3 Artificial Lighting

Until about the turn of the century the sun was the chief source of light in most libraries and the need for making full use of sunlight was a more important consideration in library architecture than almost any other single factor. The development of the incandescent electric light bulb finally provided a reasonably

satisfactory artificial method of lighting, although the quality and intensity of early incandescent lighting would seem completely inadequate today and the cost of electric current was relatively very high. Primitive though the fixtures were by the end of the nineteenth century, libraries could be lighted with electricity, readers could be admitted after the sun had set, and evening hours of opening were possible throughout the year.

Artificial lighting is a necessity in buildings, not only in the night, but also in the daytime. Artificial lighting should however only be used to supplement daylight. Nevertheless, there are cases where only either daylight or artificial light (factories) may be provided. The level of daylight provided in buildings is usually enough for general lighting but inadequate for several tasks, especially those involving small details. The amount of artificial light provided is often related to the wealth of the country with lower levels for poorer countries. This is dictated by the cost of lighting.

In the Nigerian situation it is wise to rely on daylight and use artificial lighting only as a supplement. Rooms for nighttime use should however be provided with adequate artificial lighting.

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Lighting Design: The design of artificial lighting, like

architectural design, is a complex process and not only may several solutions be appropriate for the same problem but the same solution may be obtained using different methods. A systematic approach to lighting design is however needed. Every design should determine the following:

i. The lighting problem
ii. The method of lighting
iii. Illumination value required
iv. Types of fittings
v. Types of lamps
vi. Number and placing of fittings
vii. Maintenance

The Lighting Problem: The general lighting problem relates to the function and the structure of the area to be lit. The designer should acquaint himself with the uses and spatial geometry of the space, the users, the obstructions and other conditions. The special lighting problem relates to the special tasks to be performed and the degree of precision required.

Methods of Artificial Lighting: We can differentiate four methods of lighting. General lighting is the illumination of an area in such a way that light reaches every part of it from a number of different directions, with the

resultant illumination on a given horizontal plane over the whole area not varying greatly from point to point. Angle lighting is lighting which reaches the working plane predominantly at a preferred angle, whether in a concentrated beam as from a spotlight, or over a wide angle as from a parabolic angle reflector. Localized lighting provides high illumination over the working plane and an appreciable area around it as well as fair general illumination between work places. Local lighting is the illumination of a very small area by a lighting fitting usually placed very close to the area and giving practically no light outside the immediate confines of the area.

Illumination Value Required: The amount of illumination required for a task depends on the following:

The size of the detail to be seen, the contrast between the object of vision and its immediate background, the reflection factor of the object, the motion of the object and the duration of the task. The level of illumination provided should not cause glare.

Types of Fitting: There are several factors that influence the choice of fittings. The light distribution of the lamp will determine whether the lighting will be direct, general or indirect. The brightness of fittings should be such

that disability glare is avoided. The light output ratio or luminous efficiency is a measure of the amount of light emitted by the lamp and absorbed by the fitting. The mechanical characteristics of the fitting should ensure easy installation, long life and easy maintenance.

Types of Lamps: The choice of lamps depends on the spectral composition of light, source brightness, source area and economic factors. The spectral composition of daylight is taken as a standard and the light produced should be as natural as possible, except for special effects. The area and brightness of the source is determined so as to avoid glare. The economic factors relate to the procurement costs, running costs and maintenance costs.

Number and Placing of Fittings: This is determined by the available mounting height and the illumination required. The mounting height determines the maximum spacing permissible for uniform lighting. The shape of the room determines the arrangement of fittings.

Maintenance: The installation of fitting should enable flexibility of control and easy access for maintenance. The choice and installation of lamps and fittings should aim at keeping maintenance cost low. They should be

protected from dust.

4.2.4 Lighting Standards

The daylight factor required providing adequate illumination depends on how much light is available from the sky. This in turn depends on the thickness of cloud cover and the position of the sun in the sky. The amount of light available reduces with increase in latitude, thus the level of illumination changes from place to place. A standard level of illumination known as the design sky is however usually assumed for different regions or countries. The design sky represents a level of illumination that is exceeded about 90% of the time. The design sky for Nigeria may be assumed to be about 15,000 Lux.

In summary, having looked at both the natural day lighting and artificial lighting we now observed that there is no need of talking about cost of maintenance, replacement of fitting, paying for electricity in day lighting but they are necessary for some aspect of the library. The library should not solely depend on the artificial lighting.

4.3 VENTILATION

Ventilation is an important necessity in the designing of library buildings because of the deep planning and buildings generally. In this thesis write up the author shall go into the basic concepts in ventilation, airflow through buildings, airflow around buildings, prediction of ventilation and ventilation standard.

4.3.1 Basic Concepts in Ventilation

Ventilation is the replacement of used inside air by outside air. Cross ventilation is achieved by placing openings in opposite walls of an enclosure. Natural ventilation is ventilation achieved without mechanical aids, but by stack effect and wind pressure. Comfort cooling is the use of air movement for body cooling. Air movement refers to the circulation of air within a space and is not necessarily associated with ventilation. Infiltration is uncontrolled airflow into or through a building especially via gaps in doors and windows. Ventilation is measured in air changes per hour. Ventilation has three major functions - those of supply of fresh air, body cooling/heating.

The supply of fresh air by replacing used internal air is required in all occupied buildings. This removes carbon

dioxide, odours, and vapours, gases from cooking and tobacco smoke. A minimum rate of ventilation is established according to the usage of the space. Body cooling by ventilation is achieved through the evaporation of sweat from the skin and increased heat loss from the skin by forced convection. This is usually known as air movement. The cooling effect is achieved by air velocity and not by low temperature.

Ventilation may also be used for structural cooling or heating. This is dependent on a significant temperature difference between inside and outside air. To cool the building, the temperature of external air must be lower. The cool air from outside is drawn into the warm interior where it lowers the air temperature and cools the building. The reverse is the case when external air is used to heat the building interior.

Function	Fresh Air	Body Cooling	Structural Cooling
Required	in all occupied buildings	in warm humid conditions	in hot dry conditions
Suitable building	All buildings	Single banked building	High internal heat capacity
Adequacy of method stack effect	Adequate	Not adequate	Adequate
wind pressure	Adequate	good if available	Adequate
Mechanical	Not necessary	may be desirable	not necessary
Required changed per hour	1	100	10

Table 4.1 Ventilation Function and Requirements.

4.3.2 Air Flow Through Buildings

Ventilation in buildings can be achieved through:

i. The stack effect due to difference in temperature between the air within and outside the building.

ii. Air movement induced by wind pressure.

iii. Mechanical means

The Stack Effect: The stack effect refers to the movement of air as a result of differences in air pressure of two bodies of air of different temperatures. Thus when there is a significant difference in the temperature of air within and outside a building possessing appropriate air inlets and outlets, air movement results. If for example the temperature outside the building is lower than that inside, then cold air will enter through the lower inlet and warm air will rise and exit through the upper outlet.

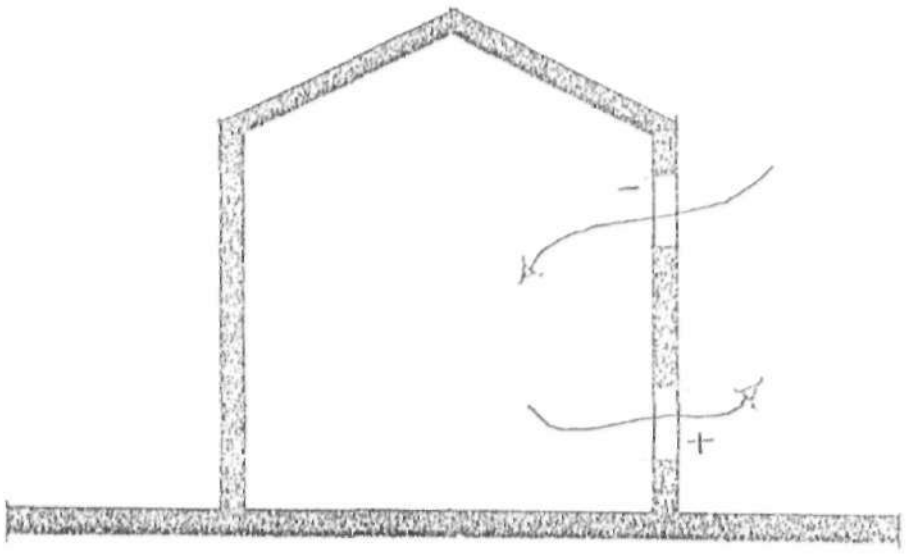


Fig 4.2. Ventilation by Stack Effect.

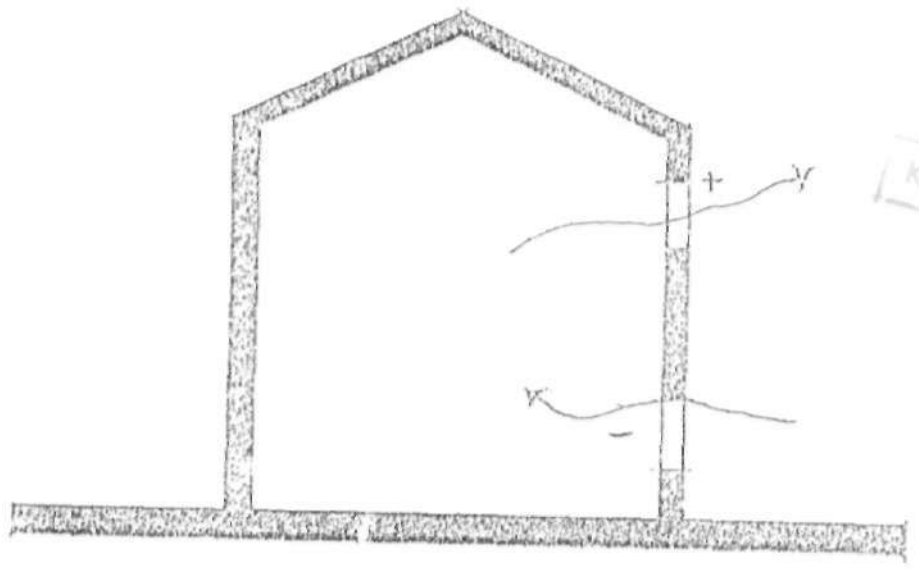


Fig 4.3. Ventilation by Stack Effect.

The rate of ventilation achieved is directly proportional to the area of the inlet, and the square root of the difference in temperature between inside and outside air, and the difference in height between the inlet and outlet. The rate of ventilation is also affected by the ratio of the area to of outlet to area of inlet. This ratio determines the correction factor. Ventilation rate increases the ratio of the area of the outlet to that of the inlet.

Stack effect usually produces some air movement even for small differences in temperature and height. In warm

humid conditions, such as in Lagos, stack effect cannot be relied upon to provide adequate cooling by air movement even with large windows. This is due to the low difference in temperature between the inside and the outside. In hot dry climates, stack effect can provide structural cooling at nighttime, especially during the hot season.

The cooling produced by stack effect can be increased by better design of openings. Inlets should be on the windward side of buildings with outlets on the leeward side. The difference in height between inlet and outlet should be maximized window areas should be large, with bigger outlets.

Air Flow Through Buildings Induced By Wind Pressure: Wind pressure is the major force responsible for air flow through buildings. The air movement produced by stack effect is often of little magnitude and insufficient for body cooling. Wind pressure and stack effect often act together to create air movement within buildings. The use of mechanical aids is usually employed only if the air movement induced by wind pressure and stack effect is sufficient. The aim of design is usually to maximize wind pressure for air movement, especially in the warm humid climate in the southern part of the country. The

exception to this rule includes situations where the wind is dusty, cold and unwelcome, such as is experience during the harmattan. There are also cases where the wind is so strong that it causes destruction, tearing roofs off buildings for example in Sokoto.

When the wind strikes a building it is slowed down but at the same time it erects a pressure on the building. The pressure exerted is directly proportional to the square of the wind velocity.

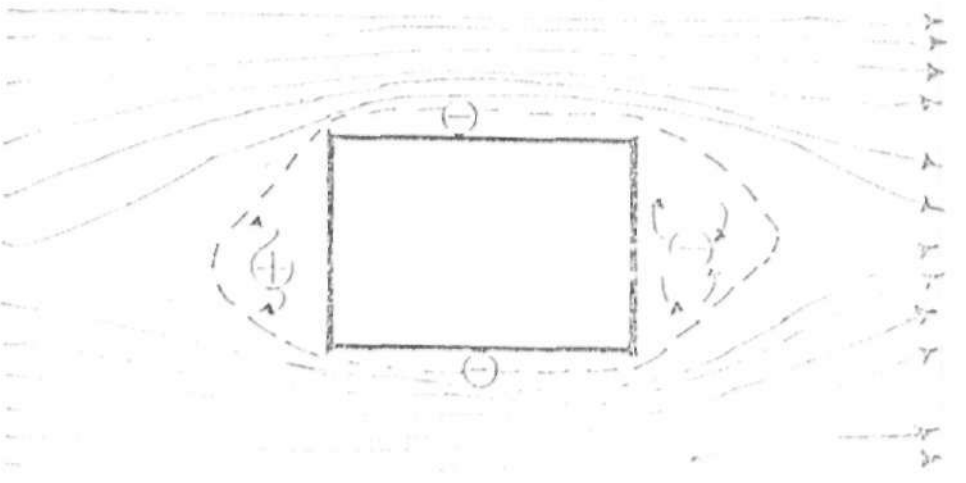


Fig 4.4 Plan

\+ = Pressure

\- = Suction

Where P = Wind Pressure (N/M^2)

V = Wind Velocity (M/S)

$$P = 0.612\ V^2$$

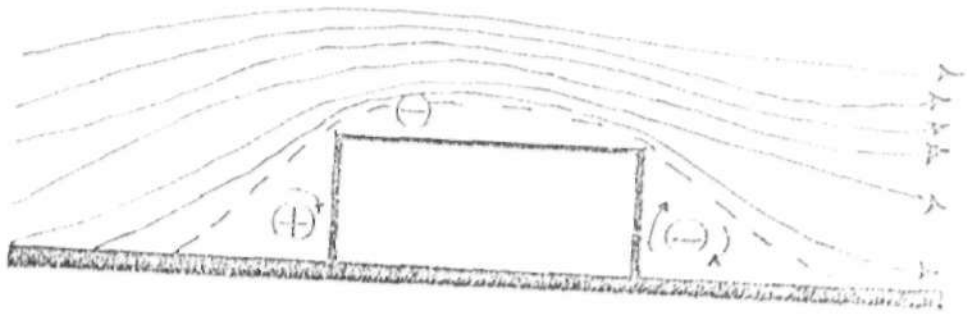


Fig 4.5 Wind Pressure on Buildings

The use of mechanical aids for ventilation is usually combined with general comfort requirements. These aids are includes:

i. Air movement

ii. Humidification or dehumification

iii. Cooling

iv. Heating

These mechanical aids are fans, evaporative coolers, air conditioners and heaters.

Fan: Electric fans are very useful in providing necessary air movement for body cooling, especially in the warm humid climates in the southern part of the country. There are different types of fan use but extract fans cannot be used for body cooling since they such and do not blow air, they may however be used to assist the stack effect and remove odours and vapours.

Evaporative Coolers: These are used for both cooling and humidification, especially in hot dry climates, similar to the hot dry season (April) experienced in the northern part of Nigeria. These coolers work on the principle that water absorbs heat from the atmosphere when evaporating. This lowers the room temperature. At the same time the evaporated water increases the relative humidity of the air, causing humidification.

Air Conditioners: Air conditioners provides both cooling

and humidification and are sometimes the best solution in difficult climates especially for offices and public buildings. Their major drawback is cost of acquisition and maintenance. Air conditioners may be large plants, small units or split units. The use or otherwise of air conditioning should be decided early in design since this will affect the size of openings.

Heaters: Heaters are usually unnecessary in the Nigeria climate. However they can create additional comfort during the cold harmattan period, especially when combined with humidification. Of small portable units are often adequate and built-in heating systems unnecessary.

Need For Heating and Cooling Systems: comfort conditions (humidity and temperature) and the duration usually determine these conditions. The cost of installing these systems is however usually high and many families remain without them, even when the climatic conditions justify their installation. In such cases, flexible use of space, outdoor living and sleeping as well as clothing are common alternatives.

Factors Affecting airflow Through Buildings: Factors affecting air through buildings are:

i. External features and factors

ii. Number and size of openings

iii. Position of openings

iv. Opening components

External Features and Factors: External features and factors affect the airflow in buildings. The wind speed and direction as well as dust content combined with the building shape and orientation are very important. Dusty winds should be avoided or filtered by vegetation. Building orientation should take maximum advantage of wind direction. External features such as barriers and vegetation also play an important role as they may create wind shadows and channel airflow. The situation of the building with respect to other buildings should ensure adequate spacing to avoid wind shadows and achieve air movement.

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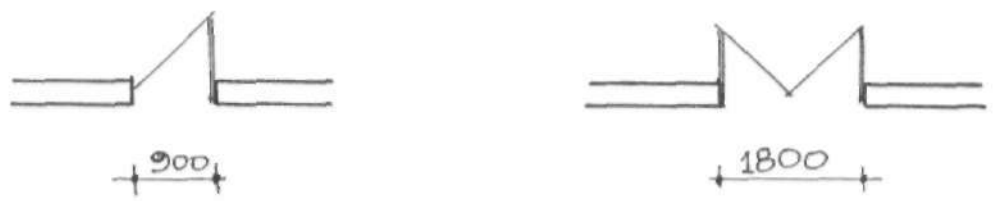
Number and size of Openings: For effective cross ventilation there must be at least two openings, an inlet and an outlet, on opposite, or at least adjacent walls of an enclosure. Furthermore, there should be no full partition separating the inlet from the outlet. In a case where there is only one opening the air movement within the room remains negligible even for high external

winds speeds. In fact, comfort conditions worsen at higher wind speeds due to pressure build up.

The area of both inlet and outlet, combined with the relative position of inlet and outlet as well as the wind direction has a marked effect on the rate of airflow. Generally, the average air velocity increases with:

i. Increase in size of inlet and outlet

ii. Increase in size of outlet with respect to the inlet.



DOOR SIZES



WINDOW SIZES

Position Of Openings: The position of outlet (on the leeward side) and that of inlets (on the windward side) has a marked effect on the pattern of air flow within an enclosure. This influence can be observed both in plan and section.

In plan, the air velocity distribution is affected by the relative position of inlet and outlet for a given wind direction. The incoming air stream takes the shortest course of least resistance to the outlet. Thus openings located diagonally will cause airflow through the centre of the room. When openings are situated directly opposite each other on one side of opposite walls or close together on adjacent walls the larger portion of thereon will remain unventilated.

In section, the position of the outlet has little effect on airflow patterns. The inlet can be low, high or central. Low inlets to direct airflow towards the floor while high inlets direct the airflow towards the ceiling. Centrally placed inlets produce airflow in the general direction of the external wind. For multi storey buildings, with centrally placed inlets, the wind flow is deflected towards the floor on the ground floor while it is deflected towards the ceiling on upper floors.

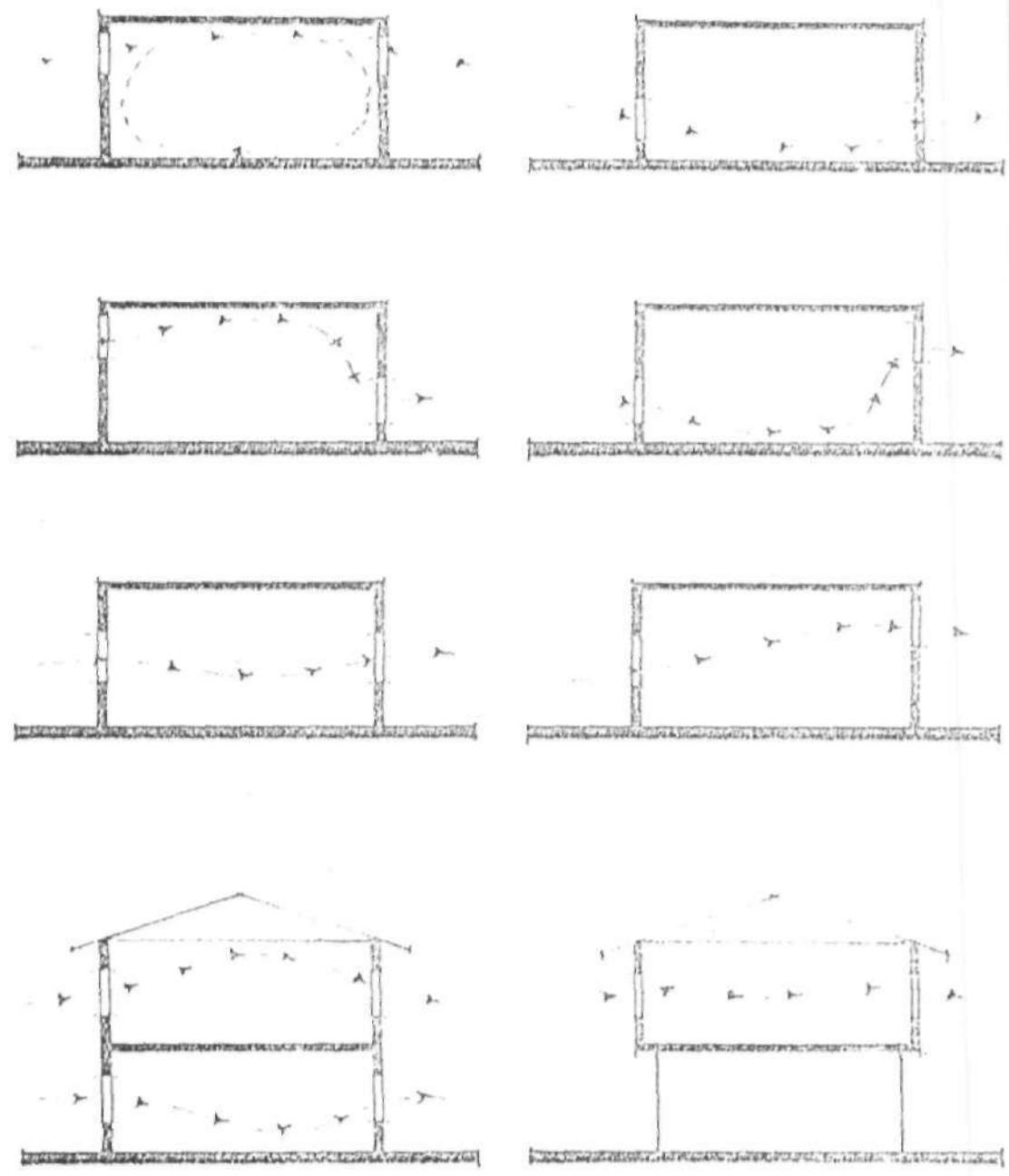


Fig 4.7. Effect of Opening in Section on Airflow through Buildings

Opening Components: Opening components are very important in determining the velocity and pattern of airflow. These components include:

i. Canopies (horizontal shading devices)

ii. Louvres and venetian blinds

iii. Sashes

iv. Variously hung windows

v. Mosquito screens

vi. Curtains

Canopies direct the airflow towards the ceiling but this can be reversed towards the floor by leaving a gap between the canopy and the opening. Louvres and venetian blind direct the air -flow upwards or downwards according to their angle of inclination. Sashes deflect the airflow upwards but reversible pivot sashes can deflect it downwards. Top hung outwards but reversible pivot sashes can deflect it downwards. Top hung outward opening windows deflect air towards the ceiling. Side hung windows deflect air towards the hunged side when open outwards and vice-versa. Roller shutters deflect wind downwards when partially open. Mosquito screens and curtains reduce air- flow to a very large extent. Mosquito screens, depending on material and perforation may reduce airflow by 30% to 70%. For nylon screens, reduction is about 35%. This should be kept in mind when

calculating size of openings for effective ventilation.

4.3.3 Air Flow Around Buildings

The wind flow around a building plays an important role in determing the airflow pattern within the building. Data concerning wind speed and direction are gathered during site analysis. The wind data are usually taken at 3 hourly intervals at a height of 10 metres above ground level. The shape, height, orientation and planning of the building will affect airflow around it.

Wind Pressure and Suction: The wind creates a pressure on the windward side of the building and suction of the leeward side. This creates air movement within the building in the general direction of the wind. The wind is deflected over the roof and around the sides of the building, creating suction. For wind acting at an angle to a rectangular building, pressure is experienced on the two windward sides while suction is experienced on the other two. Suction and pressure on an L-shape building follow the same principles.

Effect Of Other Buildings: The proximity and height of neighbouring buildings also affect wind flow patterns. For two buildings arranged across the direction of wind

flow, the wind is channeled between them, creating stronger suction than for free standing buildings. When the buildings are arranged in the direction of wind flow, the second building experiences suction from all sides. When the second building is taller a wind pressure may be experienced on upper floors. There may occur a wind flow under the second butching in the presence of open spaces.

The Wind Shadow Effect: The wind on meeting a building in its path creates pressure on the wind ward part and suction on the leeward side. The area where this suction is effective represents the wind shadow of the building. In the wind shadow, the direction of airflow is opposite to that of the wind direction. Buildings placed in the wind shadow of other buildings will suffer from poor ventilation, except in special cases. Buildings are spaced at least six times their height to avoid this effect. Staggering has also been found to be effective. The wind shadow should however not be overemphasized in designs.

4.3.4 Prediction of Ventilation

There are two basic methods used for the prediction of airflow through and around buildings. The first involves the use of mathematical formulae while the second makes use of models.

Prediction Of Ventilation By Mathematical Formulae:

There are many formulae for the prediction of airflow through and around buildings. Many of these are beyond the scope of an introductory text.

Pressure Due To Wind flow: The pressure due to wind flow is given as the product of a constant (0.613) and the square of the wind velocity. It is measured in Pascal.

$$P = 0.612v^2$$

Where P = wind pressure (Pascal)

V = wind velocity (m/s)

The IHVE guide gives some standard values of wind velocities. Wind velocity increases with height and the values are:

Open country 9m/s

Suburban areas 5.5m/s

City centres 3m/s

Air Flow through Openings: There are two equations used to determine the rate of airflow through an opening. The first gives this in terms of the pressure difference and the second in terms of the air velocity

i. The rate of airflow (v) is the product of a constant (0.827). The area of the opening and the pressure difference across the opening.

$$V = 0.827\ A\ /Pd$$

Where V = rate of air flow (m^3/s)

A = area of opening m^2

Pd = pressure difference across the opening (Pascal).

ii. The rate of airflow (v) is the product of the effectiveness of the opening, the area of the opening and the wind velocity. The effectiveness of the opening has a value between 0.5 and 0.6. For winds blowing at an angle of 45 degrees to the opening, the rate of airflow should be reduced by 50%.

$$V = EAV$$

Where V = rate of air flow (m^3/s)

E = *effectiveness of openings*

A = area of opening (m^2)

V = wind velocity (m/s)

Rate Of Heat Gain Or Loss: The rate of heat gain or loss through structural ventilation is given by the product of the ventilation rate, the difference in temperature between internal and external air, the volumetric specific heat of air and a correction factor. The volumetric specific heat of air is 1220 $J/m^3\ ^oC$ at 20°C and 1180 J/m^3 at 30°C.

$$Q = V + KC$$

where Q = rate of heat loss or gain (w)

V = Ventilation rate (m^3/s)

t = temperature difference internal and external air deg C

K = correction factor

c = volumetric specific heat of air ($J/m^3\ ^oC$).

Prediction Of Air Flow With The Aid Of Models:

Mathematical formulae are incapable of absolutely predicting air flow through and around buildings. The most reliable are measurements taken in actual buildings. This can however be done only after the building has

been constructed, and as such is of limited value in evaluating a proposed design. The favoured method is to construct a model of the proposed building and evaluate it in a wind simulator.

There are two types of wind simulators: the open jet wind simulator and the wind turned. Smoke generators are used to show the pattern of wind flow and miniature instruments measure wind velocity and pressure.

4.3.5 Ventilation Standards

Ventilation is required to provide fresh air, body cooling and structural cooling. This can be achieved by stack effect, by wind pressure or mechanically.

Form of cooling	Conditions Temp °C Rel. Humidity	Notes
Evaporative	35 - 37 below 35%	Below 35°
Cooling	37 - 40 below 25%	Thermal capacity will reduce maximum temperatures.
Air	35-3.75 30-60% 37.5- 40 20 -50% 40 - 42.5 0-45% 42.5 - 45 0-40%	Humidification required when relative humidity is below 10 - 15%
Air cooling and dehumidification	31 - 33 above 85% 33 - 35 above 70% 35- 37.5 above60% 37.5- 40 above50% 40 - 45 above 40%	Below 31oC air movement can be used.

Table 4.2. Showing the conditions under which each type of ventilation is required and the method by which it may be achieved.

When mechanical aids are used, the choice of the appropriate aid depends on the severity of the climatic conditions. Minimum ventilation rates must provide adequate fresh air and the need for this varies with the occupation density and purpose of the enclosure.

4.4 COMFORT ANALYSIS

In designing a library complex building or buildings generally comfortability is the out watch. Comfort in building designs can be categorised into four sections, each attempting to satisfy a system of conditions between the users and environment. These factors are:

i. Thermal that involves heat, air temperature, relative humidity, and air movement.

ii. Visual that involves enough windows on all sides of the building, adequate lighting is admitted into the building and especially into the reading rooms.

iii. Acoustic involves science of sound. Noise is any unwanted sound that is to be eliminated in designing a library by providing acoustic materials where necessary.

iv. Planning involves proper co-ordination of the various functions in the building. Circulation has to be taken care of to admit non-conflict of staff and users. Adequate natural lighting and ventilation should be considered when designing.

All these are design essential requirement for designing a comfortable library environment. Where the user, the materials and the structure have to be taken into account and their effects and response to climatic conditions fully integrated.

4.5 THERMAL COMFORT

The aim of design with climate is to maintain comfort with in buildings. Therefore, thermal comfort can be defined as a thermally neutral range in which the climatic strain or stress on the body's thermo-regulatory mechanism is minimal and the whole environment can be judge as neither too cold nor too warm for any learning or recreational activity. The maintenance of such a thermal balance between the body's state of equilibrium and environment depends on the combined effects of four contributing parameters namely: air temperature, mean radiant temperature humidity and air velocity.

Air Temperature: This is the dry bulb temperature and it is very important factor affecting thermal comfort. When temperatures are low, people feel cold and when they are high people feel hot. Comfort can approximately be achieved between (16 - 28)°C. The body can through radiation connection, conduction and evaporation exchange

heat with the surrounding a bit to attaining a comfort level.

Mean Radiant Temperature: The main source of energy on the Earth is the sun. This energy comes in form of electromagnetic radiation and this can either be positive or negative to human comfort depending on the nature of activity. This can also be referred to radiation to and from surfaces within an enclosure measured with the globe thermometer. The mean radiant temperature is calculated from the globe temperature using the air temperature and velocity. Comfort can be achieved if the globe temperature is between 16 and 28°C and if the difference between the mean radiant temperature and the dry bulb temperature is less than 5°C.

Relative Humidity: At any given temperature, the air can contain only a certain amount of water vapour. When the air cannot contain any more moisture, it is said to have reached its saturation point. The amount of moisture that the air can hold before it reaches its saturation point increases with temperature. Therefore relative humidity is the measure of the degree of saturation of the air at any dry bulb temperature. Thus, relative humidity vapour

$$\frac{\text{Water vapor} \times 100}{\text{Saturated vapour at the same temperature rate.}}$$

Therefore, when there is low humidity the air is

very dry and sweating is more effective in cooling down the body. However, when the humidity is high the air is damp and clammy swearing is no longer very effective in cooling down the body. Thermal comfort can be achieved when the relative humidity is between 20 and 90%.

Air Velocity: Air movement is very effective in increasing heat loss from the body at tight temperature when sweating occurs. The air movement enhances the evaporation of sweat from the body thereby cooling down the body.

Air velocity of up to o0.1 metre per second may lead to a feeling of stuffiness indoors, air velocities of 0.1 to 1.0 m/s are comfortable indoors when air movement is required but above the level there is discomfort. Outdoors wind speeds of up to 2.0m/s can help achieve comfort, especially when the humidity is high. Wind speeds of over 5.0m/s lead to considerable discomfort.

CHAPTER FIVE

5.0 DATA COLLECTION AND SITE ANALYSIS

This aspect deals with site location, site selection criteria, feasibility studies, planning implication of climate on site, social demographic structure, present and projected population and population projected of potential users.

5.1 SITE LOCATION

The federal polytechnic Auchi as the site of this thesis is located in Auchi town, a rapidly developing urban centre and the administrative headquarters of the Estako West local government Area of Edo State. It is a distance of only one hundred and thirty kilometres (130km) from Benin City, the state capital. The campus occupies about 224 hectares and is situated on a stretch of undulating land along the west edge of the town.



Fig 5.i Federal Polytechnic Location Map.

5.2 SITE SELECTION CRITERIA

The site of this thesis has already been mapped out in the master plan of the school. However, the following

could be observed.

i. The site is situated at the heart of the school to serve the users

ii. The site is accessible from the major road that links the entrance gate to service road.

iii. Utility of some services such as telephone and electric poles and pipe born water are already existing on site.

iv. The length and breadth of the site can be able to accommodate the proposed complex or project.

5.3 SITE EVALUATION AND FEASIBILITY STUDIES

This is what the site entails presently and the evaluation of it. In this way the author shall look at the location, adequacy of the site, soil and drainage, access and utilities of the site

5.3.1 Location

The site is centrally located at the heart of the campus. It is along the service road that is along the entrance gate. The north with administrative block surrounds it, by the south with gulley and hostels, by the east with school auditorium and by west with a clinic and commercial centre.

The proposed project will be well sited centrally to

avoid noise from the service road and other places.

5.3.2 Adequacy Of Site

The site area is 60,000m^2 that are enough for a library complex of such an institution or for an academic environment. The area will be able to accommodate the project, parking spaces, circulation routes, landscaping elements and for future expansion.

5.3.3 Access

The site will be access through the service road whereby vehicles and pedestrian users will easily have their way in.

KASHIM IB

5.3.4 Soil and Drainage

The soil on the site is a red soil like literate soil and of a good bearing capacity to withstand any structure. The gradient slopes to the south where we have the gulley. This will allow drainage by gravity towards the gulley. The whole channel of water will be directed to south.

5.3.5 Utilities

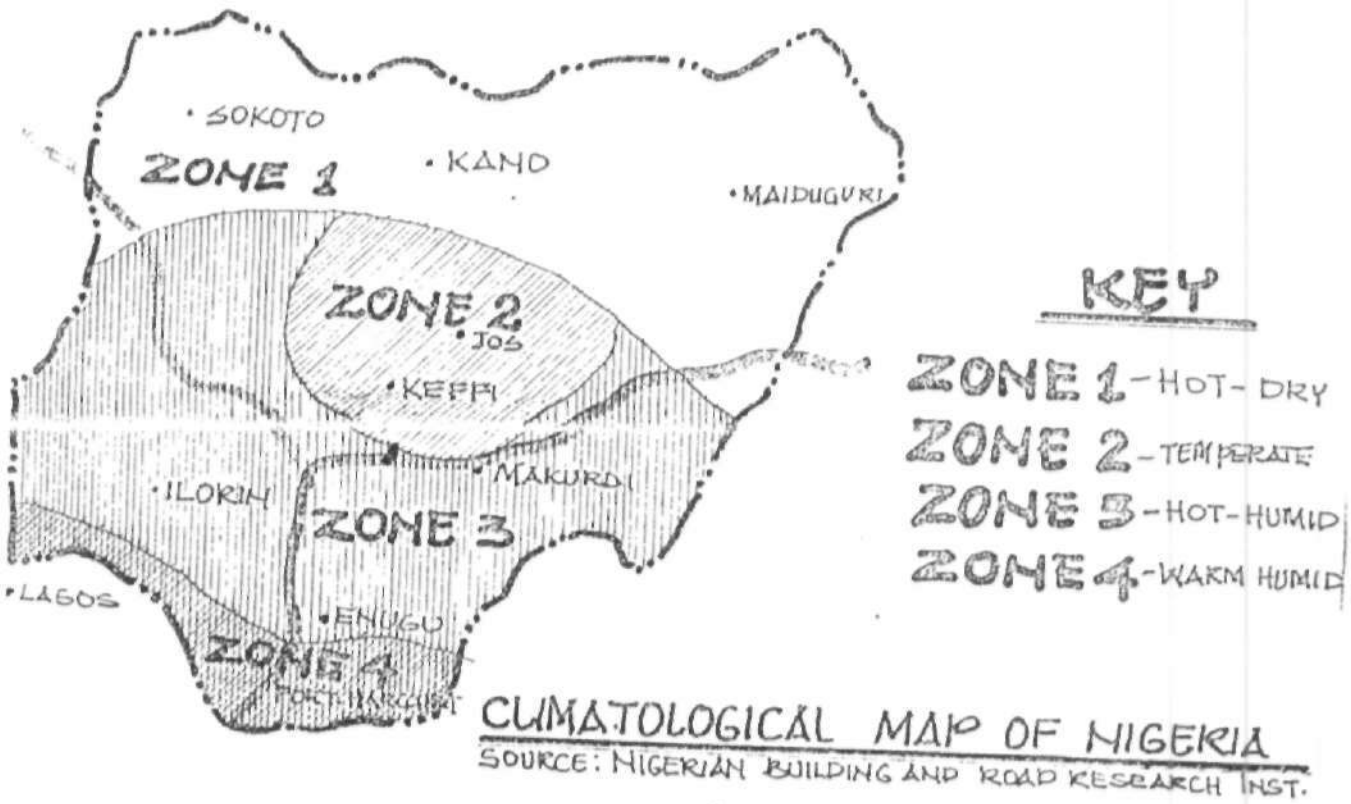
There are some services that are naturally necessary for human living and which are already existing in the institution. These facilities will be extended to the services of the library complex. Such services like pipe born water, transformer of 1100/450v, telephone cables. All these will improve the services of air conditioning, artificial lighting, communication and water in the library.

5.4 PLANNING IMPLICATION OF CLIMATE ON SITE

Nigeria has two main seasons: the wet and dry seasons. The wet season starts from March to October while the dry season starts from November to February.

Nigeria is divided into four climatic zones for building design purposes. The zoning is based on the climatic data collected over a period of forty years. This include:

i. Hot dry climate
ii. Temperate climate
iii. Hot-humid climate
iv. Warmhumid climate



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Fig 5.2 Map of Nigeria Showing the Zones of the States

Edo State falls into hot warm humid climate zones, the climatic factors are Rainfall, Temperature, Relative humidity, wind, Radiation, and sunshine.

Auchi as the site of this thesis falls in the hot humid: climatic zones of the state.

Rainfall: This starts from early March to ending of October. The state has an average annual rainfall of about 197mm and it is characterised by wind, thunderstorm, and lightening

Months	Jan.	Feb.	March	April	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
Means	66	25.6	63.1	288.6	206	249	507.5	358.3	273.7	286.3	36.2	60.2

Table 5.1

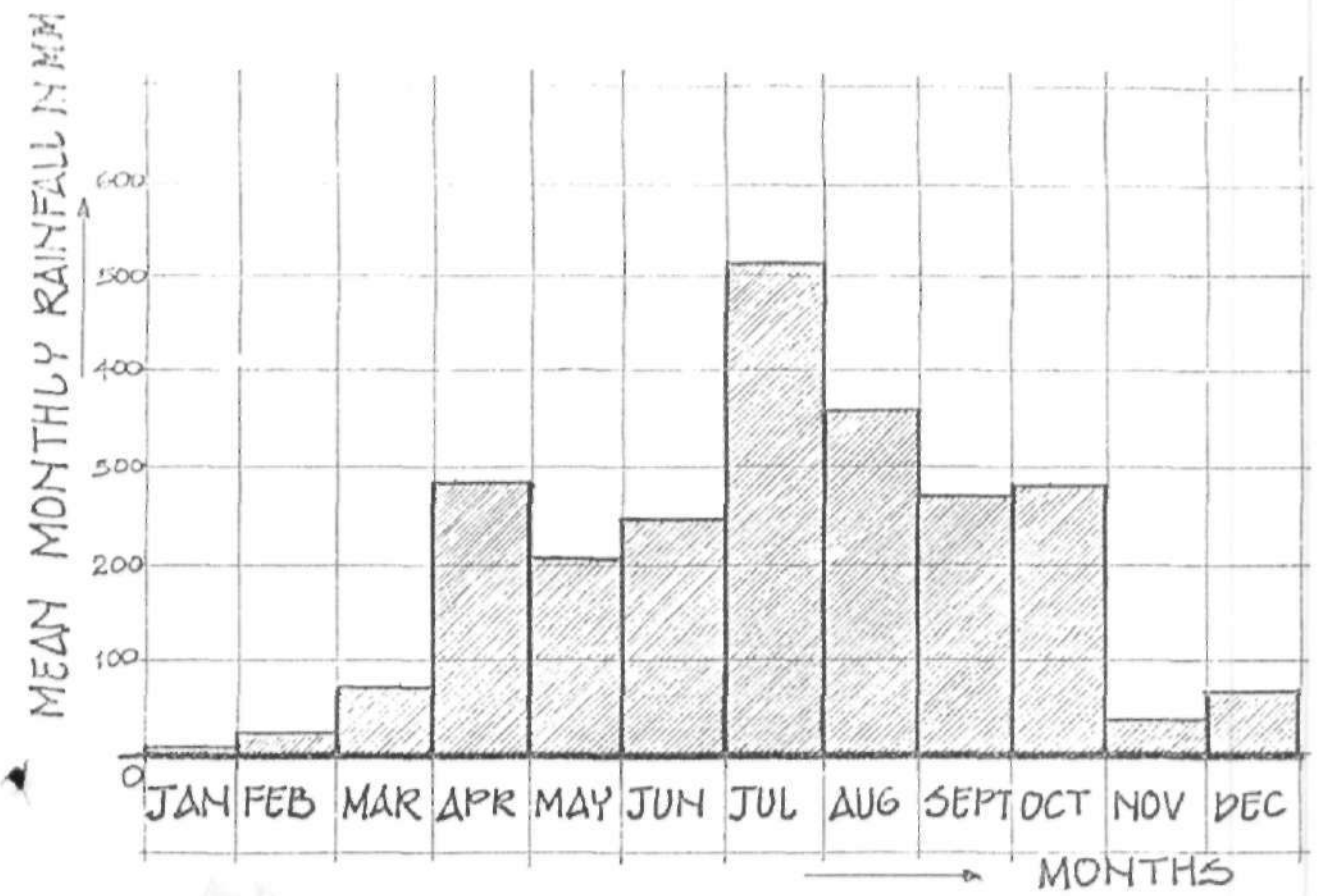


Fig. 5.3 Rainfall Bar chart.

Temperature: The temperature is moderate and is under normal body temperature. Heat is not lost by radiation.

Average minimum annual temperature is 22.5oC, while the average maximum annual temperature is 27.8°C.

Max. Min. Temperature

Months	Jan.	Feb.	March	April	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
Max.	26.5	34.7	28.6	26.3	25.6	29.9	28.0	28.3	29.4	24.4	25.9	24.2
Min.	17.9	19.1	24.4	23.9	25.6	23.2	22.5	22.5	22.6	22.6	23.1	22.3

Table 5.2

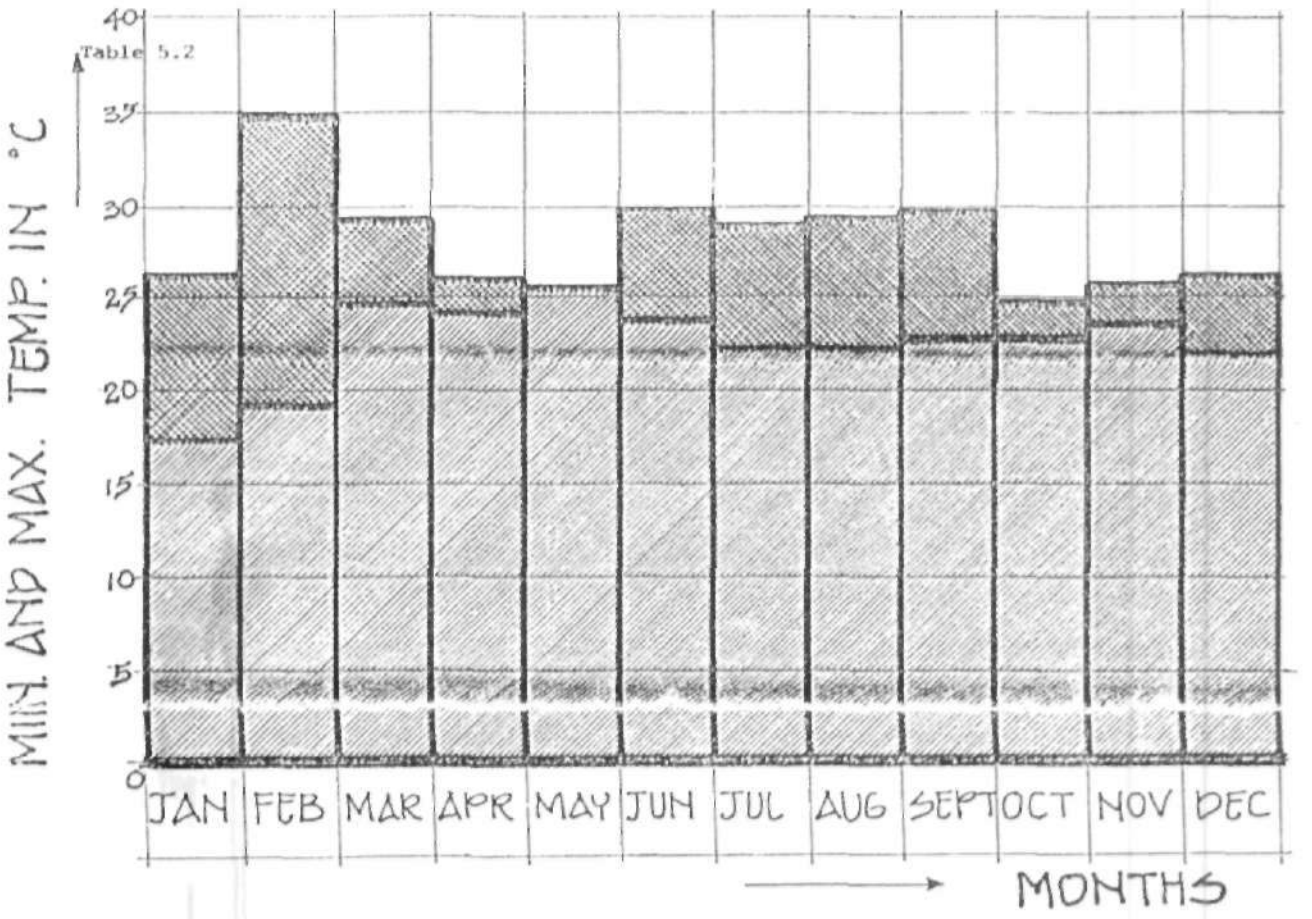


Fig 5.4 Temperature Bar chart

Relative Humidity: Edo State is characterised by high humidity of about 66% - 82% annually. The moisture content of the air is accompanied by high temperature making the weather uncomfortable.

Months	Jan.	Feb.	March	April	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
Max.	55.4	77.7	80.2	82.2	83.6	87.0	92.0	92.0	89.2	86.6	82.4	95.6
Min.	34.6	52.8	56.0	67.0	71.0	75.6	85.2	86.0	80.6	72.6	64.8	51.2

Table 5.3

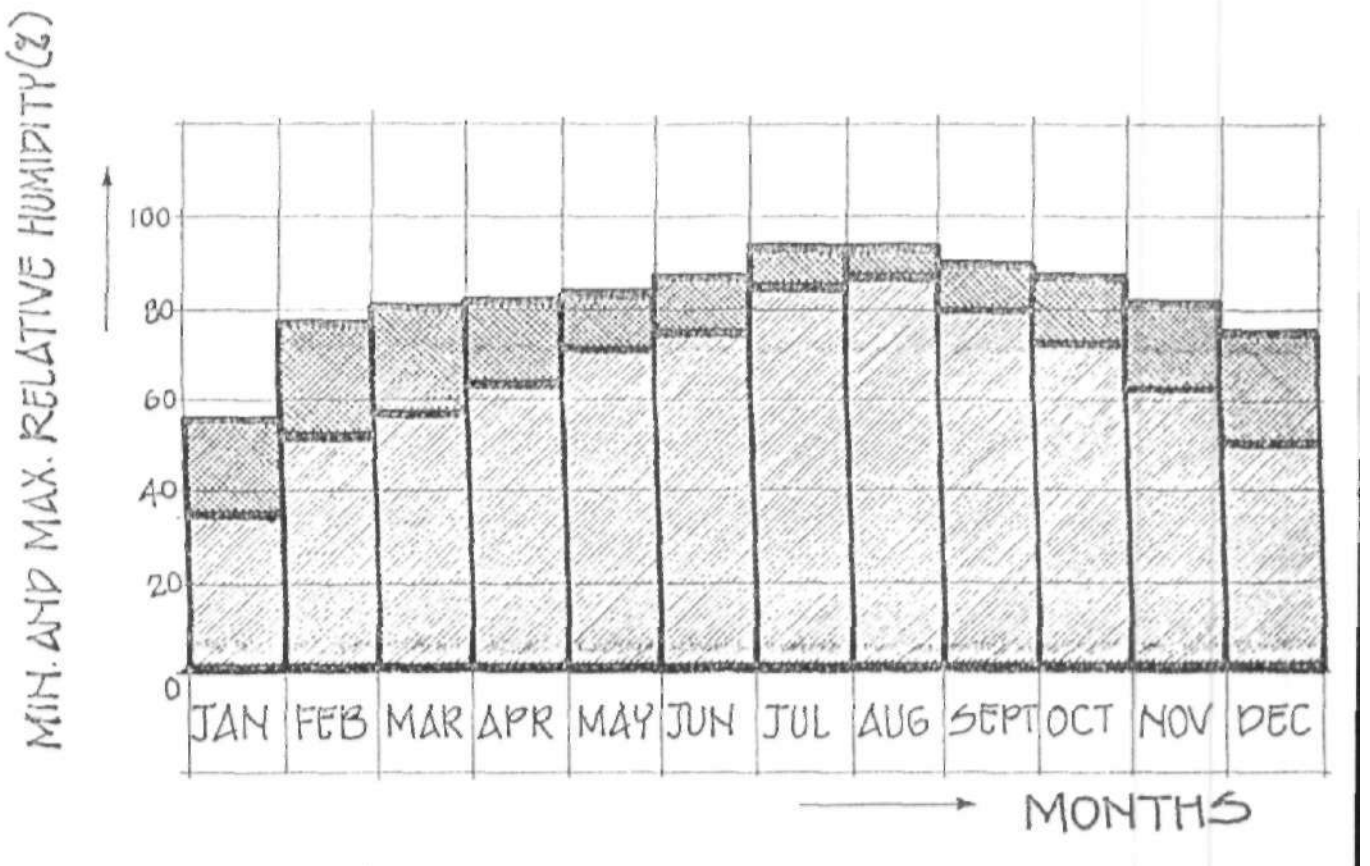


Fig 5.5 Relative Humidity Bar chart.

Wind Direction: There are two main prevailing winds namely, the Southwest and the Northeast trade winds. The Southwest trade wind comes from the Atlantic ocean brings rain in the months of March - October, while the Northeast trade wind from Sahara brings dust known as harmattan. This is experienced between November and February.

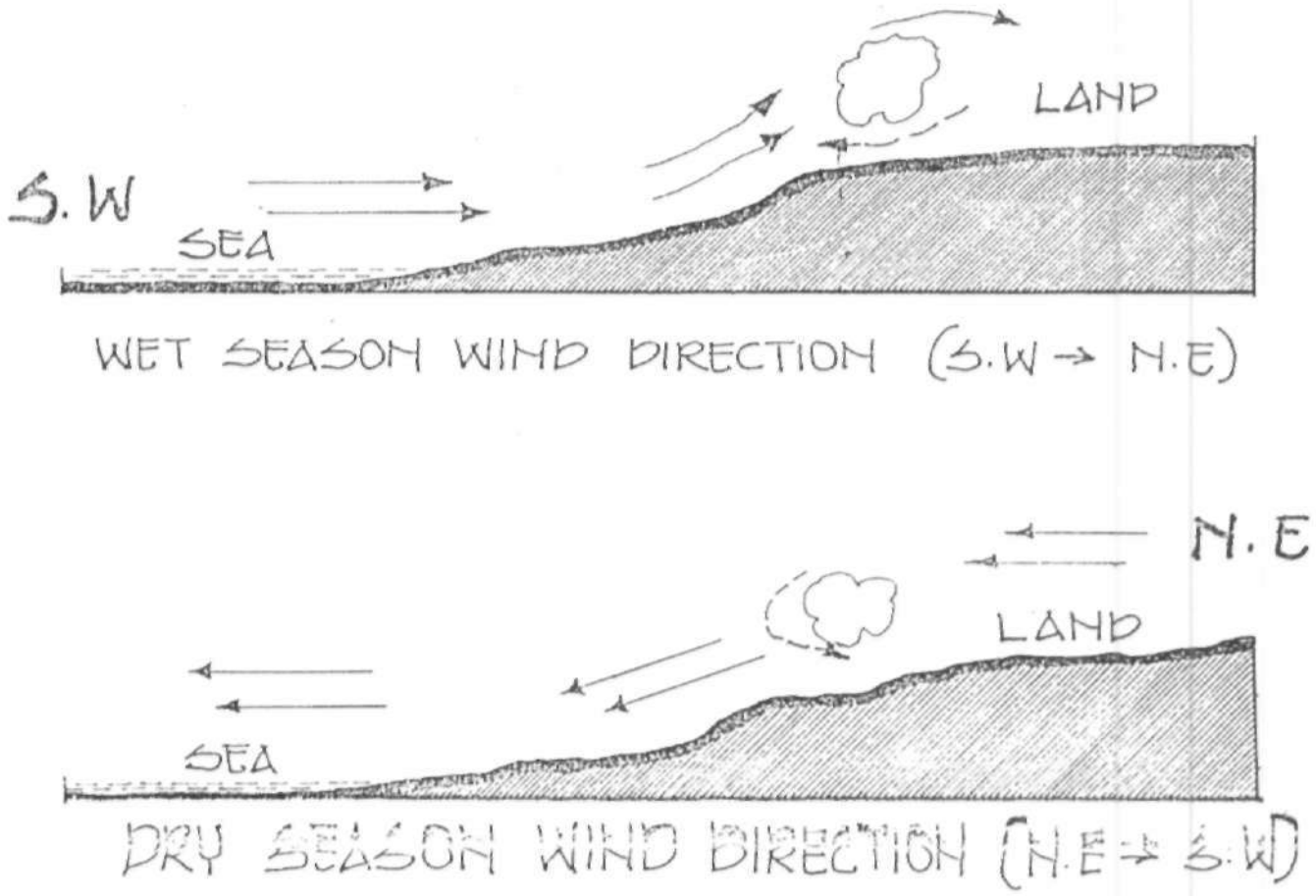


Fig 5.6 Showing Wind Direction.

Radiation Cover: This is the solar heat or energy that comes or absorbs by the earth surface or atmosphere. The annual radiation cover is 10.55nm of the Edo State. To maintain the thermal balance of the earth, the equivalent amount of the radiation absorbed is lost back to the outer space. Without the regulatory system the temperature of the Earth received at a point on the Earth's surface thereby varies with the path of the solar radiation through the atmosphere.

Months	Jan.	Feb.	March	April	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
Rad.	8.9	12.2	12.4	12.0	11.7	10	8.5	7.5	8.8	10.5	11.8	12.3

Table 5.4

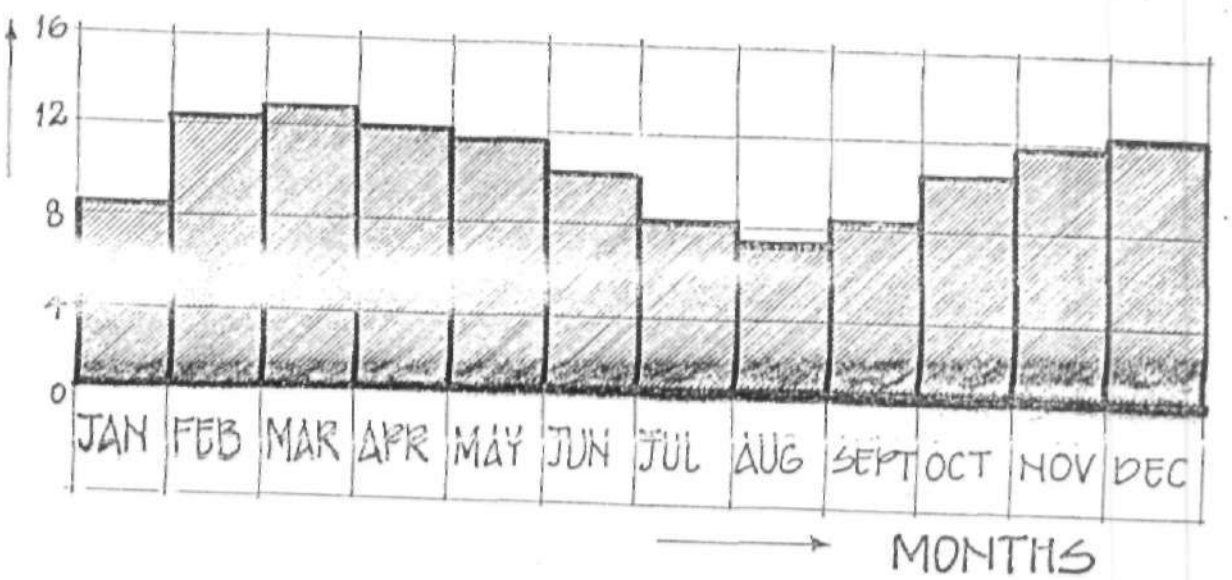


Fig 5.7 Radiation Cover Barchart.

Sunshine Hours: Edo state is exposed to about 52.92 sunshine hours annually. The amount of sunshine hours ranges from 49.2 - 55.6 hours.

Months	Jan.	Feb.	March	April	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
Hours	4.6	5.0	5.1	5.8	5.6	3.8	2.1	1.9	3	4.8	6.1	5.4

Table 5.5.

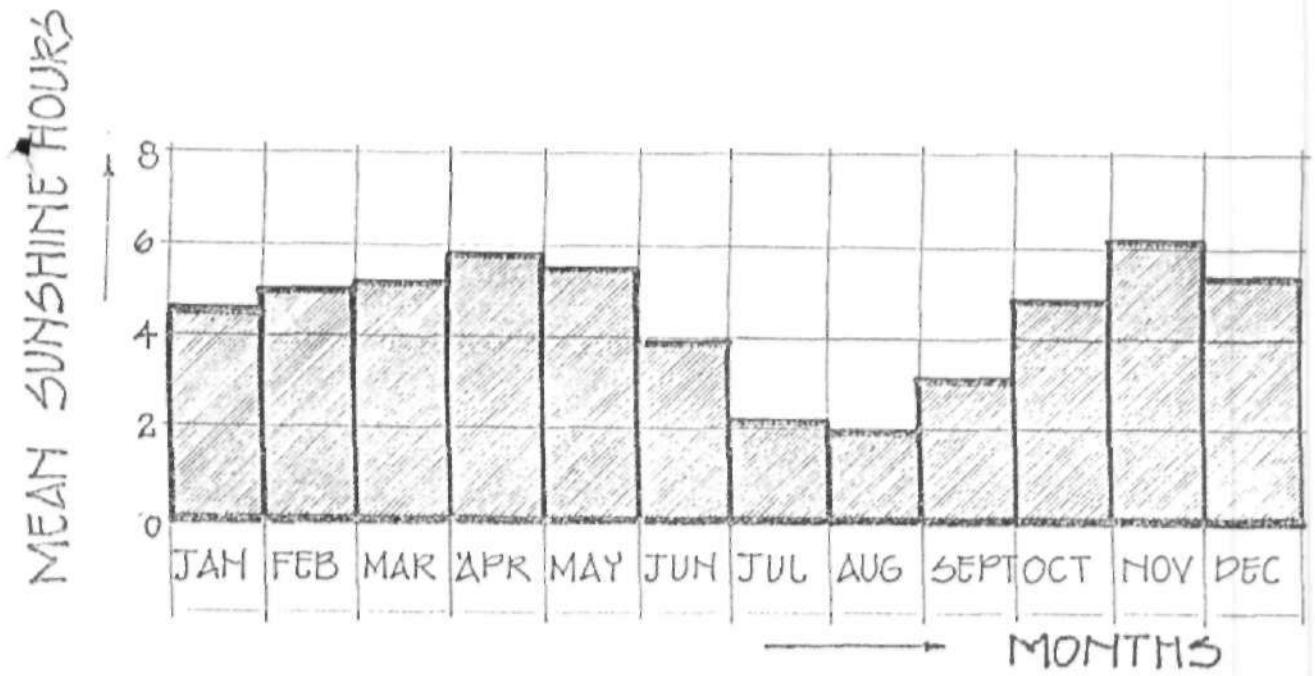


Fig 5.8 Sunshine Hours Bar chart.

Inferences: Inferences as applicable in the process of planning is given as follows:

i. **Orientation and form**: North-South direction with cognizance to prevailing breeze during humid periods and radiation required during cold months is desirable. Courtyard-base design concept and not having too deep planning concept is recommendable.

ii. **Openings**: Openings on with adequate protections against rain penetration direct sunlight penetration. 40% - 65% walls openings with adequate overhangs, deep verandah and woods is recommendable.

iii. **Air movement**; Single banking with adequate openings is suitable. Openings made adequate are to ensure comfortable airflow during humid periods.

iv. **Roofing and Ceiling Timber/steel**: Training is desirable. It could be accompanied with parapet/concrete roof gutter with proper drainage channeling.

Reflective roof cover such as long span aluminum roofing sheet or ceramic roof tiles/asbestos roof material are suitable.

5.5 SOCIO-DEMOGRAPHIC STRUCTURES

The author is able to provide adequate and successful facilities in his proposal, the demographic structure pattern of the institution must be known. This should involve the population at present and projected with a specified period the age and sex structure.

5.5.1 Present and Projected Population

Designing an academic library for an institution it is an interest to know the population growth of the institution before now and the projected growth. The demographic population of the institution tells us the number of students whom the design is meant for and projected students.

The statistic of the students' enrollment from 1989 to 1999 about 10-year's statistic is tabulated below:

FULL TIME STUDENTS

Year	OND	HND	P.G.D	Total
1,989	3,435	984	703	5,032
1,990	3,396	1,354	693	5,443
1,991	4,547	1,738	732	7,017
1,992	4,383	1,398	678	6,459
1,993	5,075	1,531	739	7,345
1,994	5,384	1,843	834	8,061
1,995	5,267	1,908	769	7,944
1,996	5,438	2,231	675	8,344
1,997	5,734	2,053	878	8,665
1,998	5,856	2,436	781	9,073
1,999	5,795	2,502	701	8,998

Table 5.6

From the population statistics of the school the population increases by 5%. The proposed library complex will be design to cater for users within a period of 25 years.

To be able to project the population within the next 25 years from 1999, the following UNSECO standard growth formula will be used

$$p_n/p_o = (1 + r)^n$$

$$n \log(1+r) = \log (p_n/p_o) \quad \ldots\ldots\ldots \quad 5.1$$

Where

P_n = Population at the end of the $_n$th years

Po = Population at base years

r = annual growth rate

n = number of years (difference in years)

using equation 5.1 therefore, the population of the federal polytechnic Auchi within 25 years can be computed thus:

P_n = ?

P_o = 8998 (1999 data, with a growth rate of 5%)

r = 5%

n = 25 years

log (P_n/8,998) = 25 log (1 + 0.05)

log (P_n/8998) = 25 log 1.05

log (P_n/8998) = 25 x 0.02119

= 0.5297

P_n/8998 = anti log (0.5297)

P_n = 3.39 x 8998 = 30,470

P_n = 30,470 persons

The total estimated population for the end of 25 years is 30,470 persons.

CHAPTER SIX

6.0 MODULAR SYSTEM AND ACCOMMODATION

6.1 INTRODUCTION

Modular system is gradually gaining a lot of use in the design of a library. With its revolutionary approach and an expansive outlook, it is really a better system. Initially, there were skeptical acceptance but with modern development modular system has broken new grounds in the arrangement of space, functions and accommodation of a library, with examples of modern and large libraries scattered all over the world using modular system for their functions.

6.2 WHAT A MODULAR SYSTEM IS AND WHY IS IT DESIRABLE

Modular system is an innovative system of design of a library that employs the use of columns as the main supportive structure of a building. Theoretically, the only immovable thing in a building is the column and then other structures within are readily movable. Modular building is made of identical bays that are rectangular shaped with a furnishing into different functions based on

the desirability of the building designed.

With reference to a library; a modular system consists of a building of identical bays any one which may be furnished as a reading area filled with ranges of shelving or divided into partition with as office diverse combination of this arrangement could be used.

The unique feature of a modular system is design flexibility radical use of spacing with immovable column as the skeleton of the building. It is a building consisting largely of spaces that can be used for almost any purpose without extensive alteration to save high expenses occurring from changing space required.

The modular system or some adaptation of it is now a standard practice building design most especially in facilities such as a library.

There are salient features of the modular system, which have made it preferable and desirable in constructing of a library building. They are highlighted as follows.

i. Simplicity with cost estimation with more accurate results.

ii. Radical use of spacing which is readily amenable to any otherwise intended purpose from the initially arrangement.

iii. Considerable reduction in cost implication as duration of time needed on the site because the materials used

are readily available in suitable sizes avoiding the cumbers approach by cutting, patching and wasting materials in an attempt to get forms from raw materials.

iv. Increase use of prefabricated materials encourage with its affordable advantages

v. Efficient supervision of the work done at a period in time is positively enhanced with detectable results of the finished products done in the factory instead of field construction.

However, like all innovations there were certain attendant pitfalls with modular systems like ever changing column spacing which may be a cumbersome and tiresome exercise, another complication is that of possibility of reflect determine by distance between floors.

Modular building has some encountered serious acoustical problems because of
Immovable partitions and books cases that are inimical inadequate barriers to sound.

Consequently with its often desirable virtues which placed this system at an advantage over its demerits, it is still the favourable choice in the building a highly functional, space and circulation controllable unit as a library.

6.3 THE MODULE SIZE AND BOOK STACKS

This deals with certain decision to be made by the architect as per the bay size for book stacking but the different difficulty envisage have been stated as follows.

i. The size and shape of the supporting column which in -turn affected by:

(a) Technical requirements based on the loads to be carried where are the columns are load bearing, the heavier the weight the larger the columns

(b) The types of construction they must be made up of steel rather than a reinforced concrete to keep them down to preferable stack installation

(c) The choice of services provided and the shape of the columns employed.

ii. Arrangement for housing services which affect the overall architect of the arrangement.

iii. The length of the stack section - the length of a standard stack section is 900mm in centre giving the shelves approximately in length with used for space required.

iv. The length of ranges the following should be considered

(a) Range of length should vary with circumstances

(b) The ranges longer than those that have considered standard are possible particularly in large installation where light is important

(c) Long ranges may increase total stack capacity up to 10% or more

(d) Other things being equal, the longer the range or the heavier the use the wide the stack.

v. The depth of shelving and width of the stack aisles - the distance between columns should be exact multiple of the distance from the center of one range to the center of the next and this is determined by two factors.

(a) The optimum depth from the front to back of each range and

(b) Optimum width of aisles. Many stack layouts have been unsatisfactory and uneconomical because these requirements have been neglected in column spacing and book stacking.

vi. The width of the main subsidiary and subsidiary cross in a multitier stack it is possible for the aisles of any width desired, so long as the standard stacking layout is used.

vii. The direction in which stacks own - if complete flexibility for the planning of ranges is to be obtained, columns must be square or circulated with

adjustable ranges without rearranging the lighting fixture.

viii. The ceiling height the clear height of stack level between the finished floor and the ceiling is a bay size problem corrected with cubic footage in building. It has its advantage in extra height that makes more spaces available for multiple seating accommodation.

ix. Lighting - The preferable lighting is fluorescent light during a sizeable proportion of the library hours. This allows for proper determination in size of a stack back in relations to ceiling heights.

It is noteworthy, to say that none of these factors above should be singly considered but must be assessed based as an interplay of factors all forming a common point of reference on column spacing, no one column space is suitable for all library stacks.

6.4 THE MODULE SIZES AND OTHER ACCOMMODATIONS

With main reference to the book stacking there are points for consideration, these are spaces for purposes other than concentrated book storage, though rarely such spaces seriously is affected by column spacing. Certain inconveniences arise if the selected are larger in both

direction than the bay size required a development which may need columns and numerous identical small units that ought to fit evenly into the module, if valuable space is not to be wasted.

The area so large that columns may affect them if the wrong bay size is selected might include the following:

i. Large reading area for varieties of use reference collections, current periodicals reserve books, public documents, divisional reading maps, large special subject rooms and night study areas.

ii. Public areas around services desks and catalogue room.

iii. The processing rooms.

iv. Classrooms and auditorium with audiovisual rooms.

v. Non assignable space for lobbies mechanical areas and stairwells. Small area that might cause difficulty because two or more of them fit in between column should not be forgotten.

However, this problem is assessed by these methods of planning. Larger areas unbroken by columns, they can be appraised as follows:

i. Place the room on top floor with no weight but the roof supported by special trusses overhead, interior column than can be ignored.

ii. Make the room high enough so that heavier beam can be used in the ceiling with mezzanines but it would

necessarily require high room else where on the same floor.

iii. Make the column spacing narrower in one direction and so make possible wider spacing in the other

iv. Hang the upper part of the building from heavy roof beam

v. Heavy pre-cast concrete methods, which permit large spans, are employed.

If a small Bay size is used in a reading area and columns protrude into it, they may interfere with seating arrangement, particularly if long tables are used. With more need for more frequency of movement, there should be inequity in connection with layout, ordinarily, this can be overcome most difficulties without undue loss of valuable space footage with emphasis on using adequate equipment arrangement principles.

In two public area of a Library, complication may arise, firstly in large service desk - many educational institutions of higher learning have circulation desk longer than the distance between columns. The size may be inconvenient if the column comes just in fronts or behind the desk as visions may be obstructed - a rarely satisfactory alternative is a column dividing a desk into two. However, a more preferable method is:

i. Place the desk far enough in front or behind the

column lines so then neither staff or reader are bothered by it.

ii. Planning of services in such a way that space between columns will be long enough for any desk required.

iii. Plan a curved L shaped desk which will be in one bay, not in two, this provide the required extra length. If the method is impossible with heavy workload ceiling for a longer desk, break the desk work assignment into two. Secondly, the card catalogue room is another public space that may cause trouble, but again a little ingenuity will generally made suitable any bay size to be adopted with doubtable results. In very large, it may be desirable to have an entrance lobby so large that a column will fall into it, but this ordinarily should not cause problem. So also the large staff area such as catalogue department room.

Stairwell should be considered, but the complication that may arise should not be neglected. For certain small area it is proper to give some attention to:

i. Walled in area for office studies and enclosed carrels.

ii. Reading alcoves combine shelving and readers accommodations and

iii. Individual seating both for staff and readers.

Other attendant problems are areas adjacent to the outside walls and the wall have windows, size must to a greater or lesser extent conform with the facade pattern with optimum use for windows, but if columns must be used complications may arise which can be rectified.

In conclusion, appropriate recommended tables for sizes should be contacted for adequate spacing when modular size is considered vis-a-vis the accommodation area.

6.5 ACCOMMODATION FOR WHOM AND HOW MANY

Colleges and higher institutional libraries have demands for accommodation for five distinct groups of users namely

i. The undergraduates
ii. The graduates
iii. Faculty members
iv. Visiting scholars
v. Others include the general public.

These groups differ widely in the use they make of a library in order of the number of seats of that ought to be provided in a new library building, provident estimation needs to be carried out of each group separately and a sum total appraised.

Undergraduates: In must higher institution, undergraduates

are more numerous than the other groups. Based in available statistics of admissions and surreys, undergraduates represent the largest part of user of academic libraries.

No definitive formula can be proposed to determine the percentage of the undergraduate whom the library should be designed for, though differences occurs from institutions to the others. If however, follows a basic pattern, there is always unprecedented increase in number of undergraduate gaining admission into the university and other higher institution with direct consequences on greater number of them patronising the library. Despite all uncertainties, some estimates must be made for such upsurge before plans for a new library are prepared, if the institution expects to provide a building large enough to cater for them.

Intimating users relevance, a study of circumstances should be made in advance for each respective institution and a definite projections made for this, if now behaves on the designing architect, to provide allowances for future growth in number without complications.

Graduate Students: They are the next most common users of a higher institution library though they are in smaller number when compared to the undergraduates. They however, have more use for library than undergraduates do in terms

of much wider scope of learning methodology.

To estimate their number is also difficult, due to relevance and diverse forms of graduate students to the part times students, professional and research students who have much independence from classroom but use the library for most of their study materials.

And as such separate or more expansive consideration made for them with each graduate school having imputes even though they must be provided with their own special departmental library. An important point is that; graduate students make heavier use of library than undergraduates and other things being equal require more space for each student accommodated.

It is proposed that, twenty percent more spaces seat should be probably be provided than for the undergraduates.

The designing architect must adequately consult experience library expert before design.

Faculty: They are mostly research professionals but with a standard and adequately stocked departmental and faculty libraries, less load in terms of patronage if central library is expected from this group.

However, the needs for faculty members differ for the two previous groups and estimating the square footage that should be provided for them is even more difficult than the

other groups.

Instead of seating members of the faculty in the public arrears, provision for their use of library can be in three ways:; in a special faculty reading room, in faculty studies or in a type of a cubicle or carrel provided by the library for its graduate students. There is a then dividing line, in the case of teaching fellows, the facilities ordinarily should agree to assign the graduate students and professional section together.

Visiting scholars too are considered amongst the faculty group though they form a comparatively negligible factor in a great majority of institutions. It is suggested that accommodation suitable for graduate students will be appropriate to the visiting scholars in most institutions and square footage can be figured on the same formula used for that group.

Others Including The General Public: Visitors and people who are not scholars can be ignored in seating estimation, they, however, need more than a cursory look, they are often integral part of the whole set-up, infact, their number is not necessarily unimportant.

Ordinarily, location of a higher institution with a standard library, naturally attracts students from poorer schools with different intended sections provided into a

library like the serial section, Internet centers with diverse functions. It is strongly imperative to give them an elaborate consideration.

The 2.25m^2 of space for each to be accommodated at each peak load, which was proposed for the undergraduate, should be suitable for this group.

In the long run, the decision of how and which way the estimation is to be made depends on the architect local conditions, with imputes from the school authority.

6.6 TYPES OF AREAS FOR READERS

There are different types of area for reader in different institution of higher learning. It is impossible of exact design to fill all need of the user's purpose, however, certain areas of use can never be ignored in a design of a library. They are as follows:

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6.6.1 Reference Rooms

Placed at the entrance level where space is at a premium, close to the man entrance lobby in proximity to the processing department.

6.6.2 Bibliography Collection

Similar to what obtained in reference rooms, but are mostly located close and adjacent to each other and to the

public catalogue entrance lobby.

6.6.3 Current Periodical and News Paper

Most library now encourage the use of this section, but with varying numbers based on the different user purpose.

6.6.4 Reserve Books, Rare Books and Special Collection and Archives

Are most relatively close in function, they are place close to each other and partitioned mostly with functional reference.

6.6.5 New Book Area

It is customary to place them in a prominent position generally adjacent to the entrance lobby in order to them to allegation of those interested and make them easily available. Small seating arrangement could be provided in such area.

6.6.6 Public Documents and Maps

These are areas of less patronage due to their close function, limited number of special reading area is provided the number to be provided for depends almost altogether on the service pattern adopted.

6.6.7 Restaurant/Smoking Room

Until fairly recently, it was rarely allowed, and a point of obvious disagreement it however, being promoted in certain European libraries. This is detached from the main library but within the complex. This ease students or library users from going as far as to the central cafeteria before eating.

6.6.8 Conversation, Conference or Noisy Study Rooms

It is suggested that every library should have one or in some case a considerable number of these rooms - two to six rooms at most. The wall adjoining other should be well catered for acoustically, if they are located close to the reading room.

6.6.9 Seating Accommodation for Study

Rather than for library use, these are more relaxed areas for quick perusal, it is closely related to a browsing room, but with more comfortability.

6.6.10 Seminar Rooms

Most colleges and universities have standard seminar

room dully appropriate for pare academic exercise and discussion, it is suggested that these rooms do not have books they are simply small classrooms.

The desirable of providing multiple facilities for, a library is a dynamic role, and a library should be able to cater for any person entering, in diverse mode of ways.

6.7 TYPES OF SEATING ARRANGEMENTS AND ACCOMMODATIONS

The types of seating of arrangements for library are numerous, with different arrays of possibilities. They are closely related to layouts, and type of functions and equipment's used.

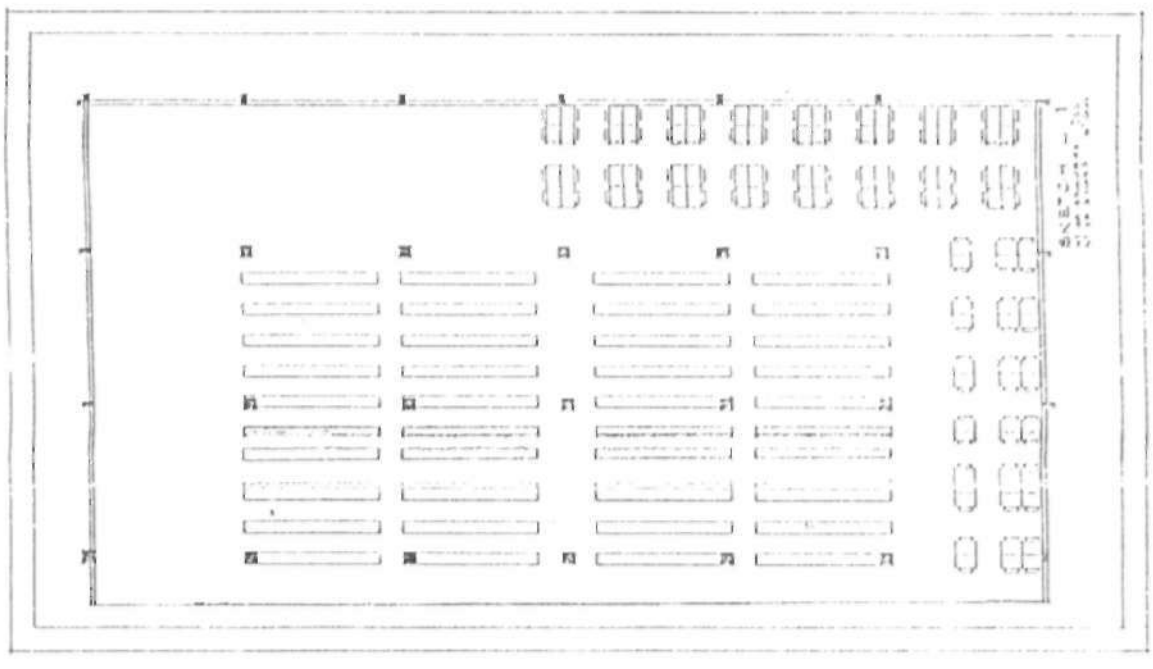
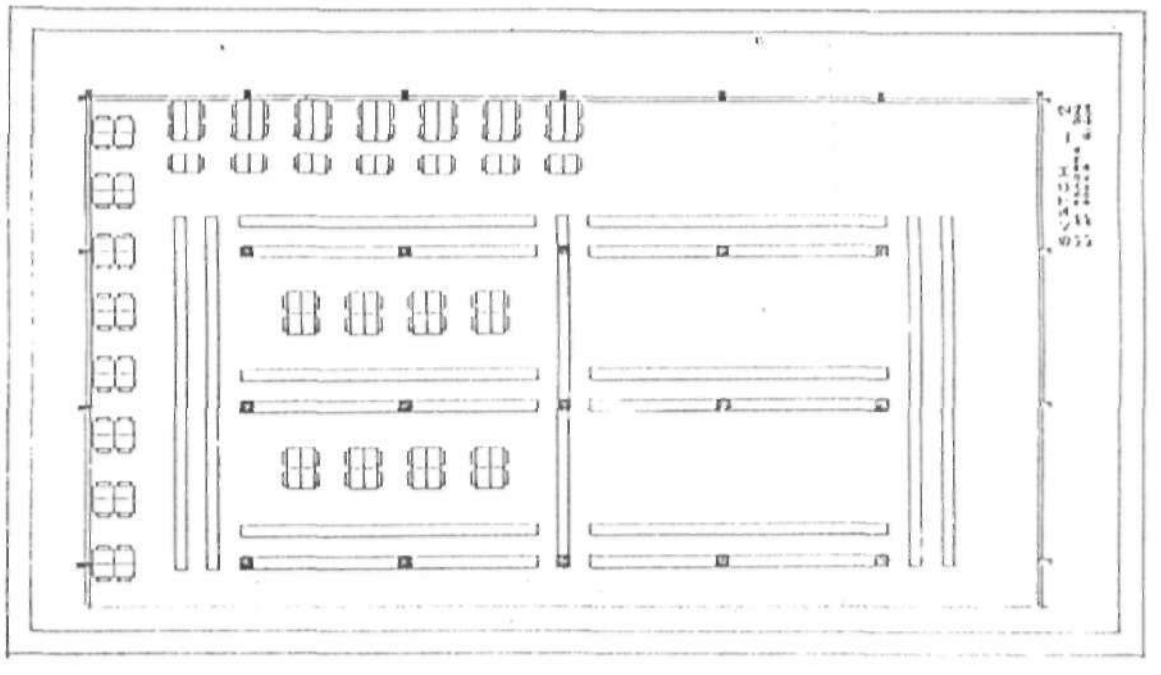


Fig 6.1



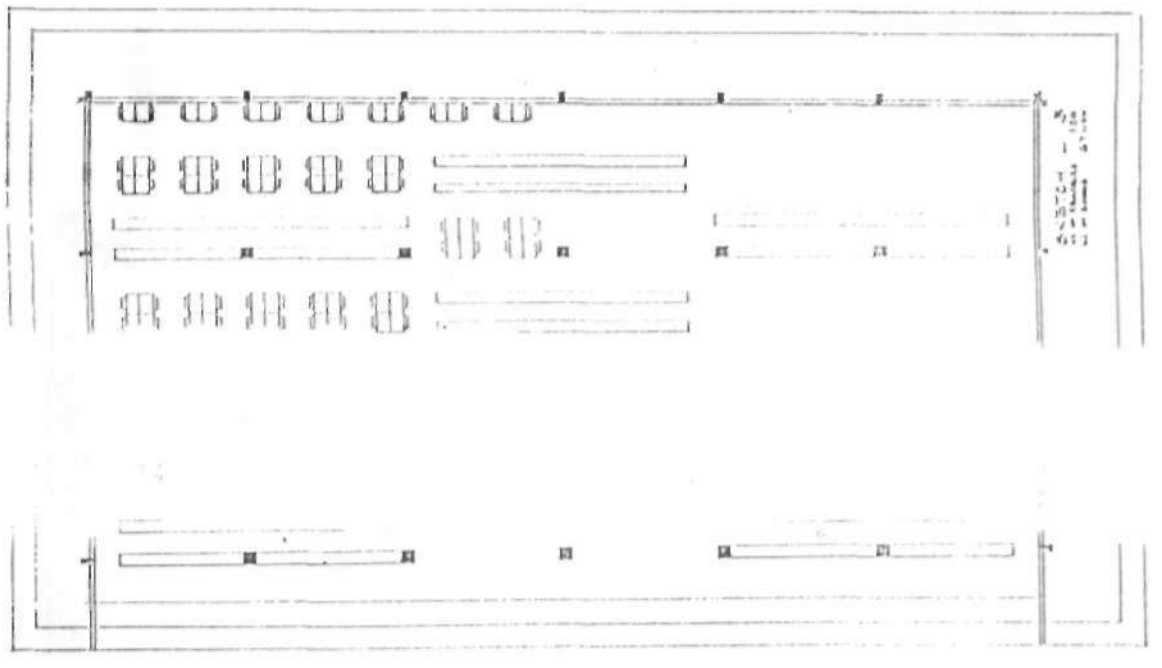
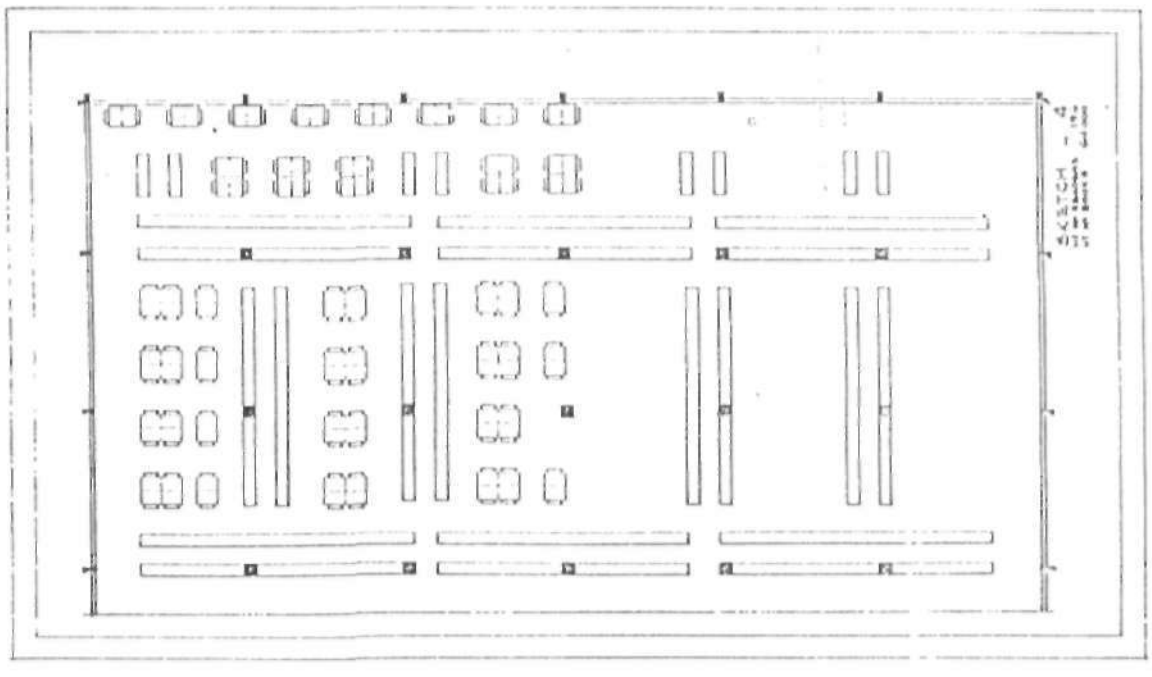


Fig 6.2



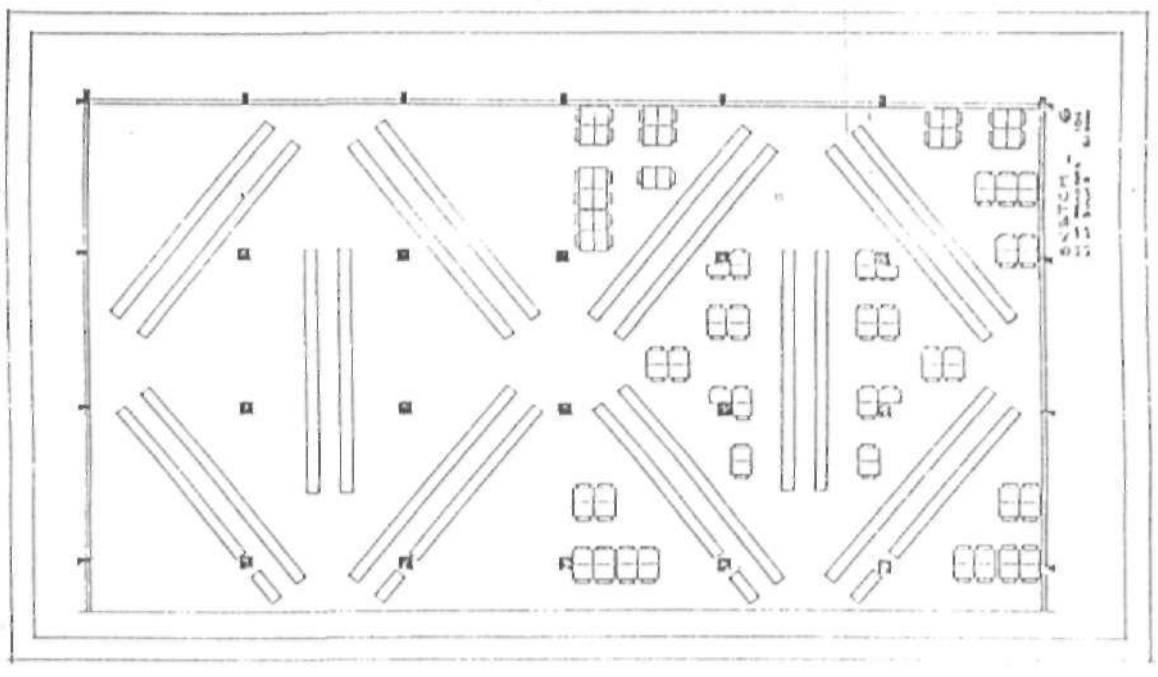


Fig 6.3

Standard Library Reading Room Tables: Most commonly practicable seating arrangement in libraries was at reading room tables. Generally a fairly large reading room consist of table accommodation from four to twelve or even more reader. This arrangement was very unsatisfactory when table for multiple seating are provided in academic reading room, but due consideration should be given to greater spacing between table to reduce the expected congestion and loss of privacy.

Slanting Room Table: This is Closely related to the aforementioned type, but different because the tops slant downwards toward the reader. The table makes it easier to read a volume that lies on table without learning forward and also helps to prevent the glare that too often reflect from the table into the reader's eyes. A limited number of tables of this kind can be useful, as at least, some readers prefer to work with books standing slightly towards them.

Tables For Two Or Six Even More In Reading Alcoves:

Tables resembling those described above may be placed in alcoves with books and shelving may be placed in alcoves with books and shelving on atleast two sides, a third

side often being an outside wall with a windows and fourth opening into a large reading or stack area. Third type of arrangement has the advantage of placing the readers close to the books and a maximum privacy and quiet is better achieved. This is more applicable in graduate and visiting scholars' section of a library.

Individual Accommodation In A reading Room/Stack Area:

These employ the use of a table placed with aisle on the each side so that each table was at least 0.6m from the adjacent one. Tables so placed take somewhat more space than the other arrangement particularly if adequate aisles are provided with greater modernity. The use of individual tables of the open carrel types in reading rooms or stack area has increased so rapid that these now supply or chunk of seating capacity in an academic library. If however, not always because of poor space utilization and of confusion and disturbance arising when a reader moves about from a seat. This problem could be solved with a modification of this type of the architect so discreet.

A Table Arm Chair: They mostly relevance in the classrooms, but if they must be used in library great caution is employed so as not create confusion and irregular traffic pattern and its attendant decorative adequacies.

Lounge Or Semi Lounge Chairs Without A Table Or A Table Arm: Also called semi lounge chairs they are often made too large, common in browsing areas and periodical and newspaper school where note taking is mostly not done. They can be used successfully in pair or even in chairs in all one unit if they are not likely to be used, small unattached table will tend to be used as footstools.

Carrel-Type Table: In this type of arrangement preference is given to individual seating on the periphery of a book stack preferably adjacent to the outside aisle or even at the end of a blind aisle along an inside or outside wall. If tables are next to a window for each can be incorporated into the arrangement they have most importance and proper feature and layout are employed with no distinction between stack and reading rooms carrels.

6.8 SPACE FOR THE STAFF AND FOR OTHER PURPOSES

Adequate accommodation for the library staff are essential for effective services spaces for four major staff group are available.

Administrative Personnel: The sizes of the group depend largely upon the size of the total library operation based in their function. Most important is the chief librarian he should adequate quarters for his office work and also for meeting with members of his staff and the public. The space assigned to him will depend on the work required and the ability of the office to cater for them, as a conference of various kinds, a room for that purpose. There may also be boardroom for small meetings and staff conferences. In larger libraries, there will be one or more assistant librarians engaged in general administrative works their office will not be as large as the librarians.

Provision is also made of sectional spaces, with waiting rooms, reception rooms, and spaces for fitting cases and supply cupboards. Business manager in administrative assistant librarians and spaces provided for his staff.

In large libraries separate toilets rooms facilities are sometimes provided for the administrative staffs

either collectively or separately depending on the hierarchy and privacy.

Public Service: They include those responsible for reference and circulation works, supervision of the public and page or messenger services done from one or more desks with areas of considerable spaces. Private offices will be needed for the head of these departments, for other members of the staff the space required will depend largely upon the amount of equipment. It is noteworthy that a larger service staff, tend to increase yearly preferably a space should available close to the circulation desk for machinery changing equipment which may be needed later. This equipment is expected to be noisy and acoustic problem.

Processing Staff: They include those for shopping or receiving, order and acquisition works for various kinds, gift handling and exchanges descriptive and subject cataloquing, classification work with serials, preparation for shelves and for binding.

Typing And clerical Staff: The shipping and receiving room should ordinarily be a room by itself. Providing not only for the members of the staff but for shelving

materials, that is arriving or leaving with table spaces for sorting and packing. In large libraries, a loading dock is provided the entrance should be covered so that a truck can back up to it and be unloaded in bad weather.

Order and acquisition section with specialisation division to five groups selection, ordering checking in acquisition, billing and gift and exchange work a large space is considered for such section.

Spacing for a catalogue department is also large it includes professional member for subject heading work, classification and descriptive cataloguing and also clerical assistance filers and typist. Bindery section is also considered along with this part of the library though it has separate room.

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Maintenance Staff: They will need a space which their member can use a base for keeping supplies, brooms maps, vacuum cleaners and other equipment as well as supplies such as toilets towels separate rest rooms and lounge are provided.

Staff Rest Room and Lounge Accommodation: The staff should be provided with a rest room lounge and kitchenette. There could be a cot for staff in cases of emergency, inadequate toilet facilities for both sexes,

separate from public ones.

Other space users are those required by:

i. Architectural spaces which is non assignable space - air collection, readers and staff, spaces for walls, stairwells and vestibule, corridors and toilets.

ii. Spaces for other public facilities sometimes included in libraries but not ordinarily used for seating accommodation of readers for book storage and staff quarters like - exhibition, auditoriums, audio visuals, photographic laboratories carpenters and others.

CHAPTER SEVEN

7.0 DESIGN REPORT

7.1 DESIGN PROPOSAL

Federal Polytechnic Library Complex Auchi (Toward achieving natural lighting and ventilation in Libraries), is a proposal for the Polytechnic. This will definitely cater for academicians/students who intent to acquire knowledge across the country. This will serve as a centre for academic excellence within and across the country.

7.2 SCOPE

This proposal intents to provide adequate comfort to users, books and staff. This proposal will also look at the facilities, the technical section, administrative offices, exhibition, reading areas, restaurant/snacksbar, audio-visual, computer/Internet, seminar/conference halls, adequate toilets facilities at each floor, parking spaces, stair cases, discussion/common room and the rest of other facilities.

7.3 DESIGN BRIEF

The brief was compiled after many case studies carried out in several higher institutions. The brief is divided

into technical section, administrative offices, reading/stack areas and other facilities that will make the library comfortable for users and provide business venture.

7.4 DESIGN CRITERIA

Considerations have been looked at in various ways in the process of articulation the design proposal in order to ensure a functional and successful design.

7.4.1 FIRE

Fire prevention and control in buildings is very important. Library involves books that can easily catch fire, and therefore, adequate provision for fire extinguishers and water hydrants shall be strategically located. Sources of fire includes electrical fittings, bush burning around site, kitchen etc., staircases are placed in strategic places and two escape staircases are also placed for an easy access.

7.4.2 Security

Effort to magnetise all books for security sake has been considered immediately a book is taken without being demagnetised will be noticed in the lending unit or control unit. Mutilation and theft of books is the outwatch of the proposed library complex.

7.4.3 Exhibition Hall

The hall provided is mainly for exhibition of individual, group and governmental works, arts monument, journals and books and so on. It is located on the ground floor for easy accessibility. This is detached from the building to control traffic but enclose within the complex, and easily accessible.

7.5 ESTIMATED SPACE NEEDS IN LIBRARIES

Spaces needed can be divided into three categories: stack pace, reader space and service space.

The stack space or collection space is usually planned large enough to have every bookshelf only three-quarters filled. A standard figure for space need is $0.09m^2$ for each book. There is a space economy, however, and this figure varies with the total number of volumes collected as follows:

Up to 150,000 books = $0.009m^2$/book

Additional 150,000 books = $0.0081m^2$/book

Additional 300,000 books = $0.0072m^2$/book

All other additional books = $0.0063m^2$/book

For materials other than books space requirements are determined by using the following equivalence date:

15 classified pamphlets = 1 book

15 music scores = 1 book

6 records = 1 book

4 microfilm cassettes = 1 book

9 maps = 1 book

Reading Space: This requirement depends on the type of library, since research work takes up much more space than general reading. In a college library then the number of square metre needed per station varies with the status of the reader as follows:

Undergraduate and intermediate graduate student = $0.675m^2$

Advance graduate student and faculty with low research level = $1.35m^2$

Faculty with high research level = $2.7m^2$

As a rule of thumb, the total number of reading stations should be 25% of the total number of students.

Service Space: This is usually estimated as a percentage of reading space and 25%, which includes space for offices, reference desks the general catalogue and archives, is considered standard. Based on the data given above the space for a College library could be estimated as follows:

Stack Space:

150,000 books x 0.009 = 1,350m^2

100,000 books x 0.0081 = 810m^2

100,000 classified pamphlets x 0.00054 = 54m^2

Total = 2,214m^2

Reading Space:

2,000 under graduates x 0.675 = 1,350m^2

1,000 graduates x 1.35 = 1,350m^2

100 faculty members x 2.7 = 270m^2

Total = 2,970m^2

Service Space:

Reading space x 25%

= 2,970 x 0.25 = 742,5m^2

Service space = 742.5

Total net area needed

= Stack space + reading

Space + service space

= (2,214 + 2,970 + 742.5)m^2

= 5926.5m^2

Total gross building area

(70% efficiency) = $\frac{5926.5 \times 100}{70}$

Total gross building area = 8466.4m^2

7.6 SCHEDULE OF ACCOMMODATION

The space requirements and figures obtained are all based on population figures of the school, resources and international standards for the library designs.

Presently, the school has a population of 8998 as full time students. With this population it has been 5% increment in population. Therefore, projection of 25 years will give a population of 38,618.

The breakdown of the areas to be used as a guideline in the design is as follows:

GROUND FLOOR

S/No	Description	Area Required m^2
1	Parking Spaces	108
2	Entrance porch	120
3	Reference/reading	684
4	Reserved books	60
5	Librarian	24
6	Control	9
7	Information Unit	45

8	Telephone cubicles	24
9	Photocopying/computer centre	108
10	Bookshop	216
11	Common/discussion room	324
12	Store	45
13	Stair case	30
14	Loan/lending unit	66
15	Catalogue	43
16	Registration	54
17	Archive	108
18	Audit/account	54
19	Store	15
20	Dark Room	12
21	Office	15
22	Microfilm/microfiche	72
23	Reprographic laboratory	108
24	Store	54
25	Stair case	30
26	Browsing	216
27	Janitor	18
28	Toilets	36
29	Book Preservation	30
30	Cataloguing	138
31	Processing	36

32	Binding/Serial preparation	30
33	Binding/printing	204
34	Office	12
35	Acquisition	216
36	Waste	12
37	Exhibition	288
38	Restaurant	240
39	Kitchen/store	24
40	Stair case	24
41	Courtyard	1,728
42	Electrical service	8
43	OPAC	3
44	Processing Tool Room	216
45	Store	36

Total Area on the Ground Floor = 5,746m^2

FIRST FLOOR

S/No.	Description	Area Required m^2
1	Serials / Periodicals	432

2	Close Stack	288
3	Control	9
4	Librarian	30
5	stair case	30
6	Electrical services	8
7	OPAC	3
8	Janitor	18
9	Toilets	36
10	Control	9
11	Librarian	30
12	Business studies	648
13	Control	9
14	Librarian	24
15	Engineering/Voc. & Technology	744
16	Stair case	30
17	Discussion room	162
18	Control	9
19	Librarian	24
20	Environmental Studies/Art & Design	744
21	Snacks/smoke room	234

Total Area of the First Floor = 3,491m^2

SECOND FLOOR

S/No.	Description	Area Required m^2
1	Audio-visual	252
2	Internet/Computer	432
3	Control	9
4	Librarian	24
5	Africana	72
6	Document/Culture	60
7	Reading	540
8	Discussion room	162
9	Staircase	30
10	Control	9
11	Librarian	24
12	Reserved Unit	168
13	Reading	288
14	Carrels	216
15	General office	108
16	Secretary/waiting	28
17	Deputy librarian	72
18	Chief Librarian	99
19	Secretary/waiting	42
20	Toilets	15

21	Deputy librarian Technical services	30
22	Office	30
23	Stationary store	24
24	Two tea rooms	10
25	Staff training	108
26	Committee Room	108
27	Electrical Services	8
28	OPAC	3

Total Area of the Second Floor = 2,863m^2

THIRD FLOOR

S/No.	Description	Area Required m^2
1	Conference	336
2	Tea Room	18
3	Store	12
4	Seminar/Lecture	300
5	Office	54
6	Tea room	18
7	Toilets	36
8	Janitor	18
9	Electrical services	8
10	OPAC	3

Total Area of the Third Floor = $803m^2$

Due to the growing population of the students and estimated project population of the school, the author has come out with an approximate volume of books and number of readers within the 25 years. The library complex will be able to accommodate 700,000 volumes of books and provide seating accommodation for at least 3,000 readers.

7.7 DESIGN CONCEPTS

The concept involves the site, zoning, building and form.

7.7.1 Site Concept

The concept is based in the function of library services, accessibility, landscaping, orientation, and view of site.

i. **Effects Of Library Services On Site Concept**: Library services are places where valuable information are essentially gathered for the social, economical, cultural, political and intellectual development of human race. The concept involves the idea of gathering and spreading out for development of services of library.

ii. **Effect Of Accessibility**: Two roads have been tapped from the service road to achieve successive traffic pattern control of vehicles pedestrian and materials to minimise traffic conflict.

iii. **Effect Of Landscaping**: The use of landscaping elements are very important to achieve human comfort within various activities on site/environment. This can also serve as checking the noise, excessive wind, pleasant visual view, control glare vehicular/pedestrian movements and shade.

iv. **Effect Of Orientation**: The reading areas of the library is orientated towards the east-west axis to catch the morning sunlight and the warmth from it to dry up the damp of the night on parchments and papyrus. This is to achieve a reasonable degree of

comfort from solar radiation. With this enough southwestern trade wind is observed in the building.

v. **Effect Of The View Of Site**: The site is surrounded by service and other tertiary roads gully auditorium and other topographical features will stimulate the view of the site.

7.7.2 Zoning Concept

This is in terms of noise level and services provided on the building.

i. **Zoning Based On Noise Level**: The activities are classified into noisy, less noisy and quiet zones. Where a larger activity takes place without regards for quietness is a noisy area but where a bit regards for quietness and less population is termed less noisy zone. While the areas with maximum respect for quietness with all seriousness is termed as quick zone.

ii. **Zoning Based On Building Services**: This is referred to the facilities of the building, the main staircases and escape ones service life machine are well located. Water tank and split unit air

conditioners are to be used. The location of the toilets should be such that it will facilitate easy piping to the septic tank and soakaway pit or channel to the gulley.

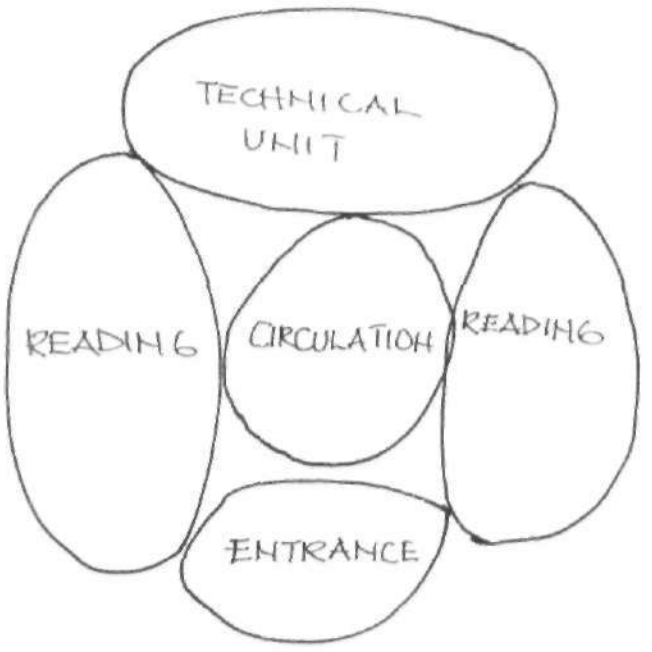


Fig 7.1 Showing Design Zoning Concept.

7.7.3 Building concept

This is seen in terms of user comfort, flexibility and expansion.

i. **Building Concept Based On Users Comfort**: The library will consider all aspect of comfort enough natural lighting and cross ventilation would be considered as the site is in the hot humid zone. Acoustics would be considered in reading sections and audiovisual.
Efforts would be geared at avoiding glare with landscaping and sun shading devices.

ii. **Building Concept Based On Flexibility**: The library building is flexible due to the nature of its service. Fixed partition and built-in fixtures would be avoided.

iii. **Building Concept Based On Expansion**: Academic library grow constantly due to increase in population of students. Hence efforts at providing for future expansion has been considered. However, horizontal expansion has been considered.

7.8 FORM CONCEPT

This form concept develops from a Stripdex stand in Libraries use as subject index. The concept involves freedom and energy consciousness.

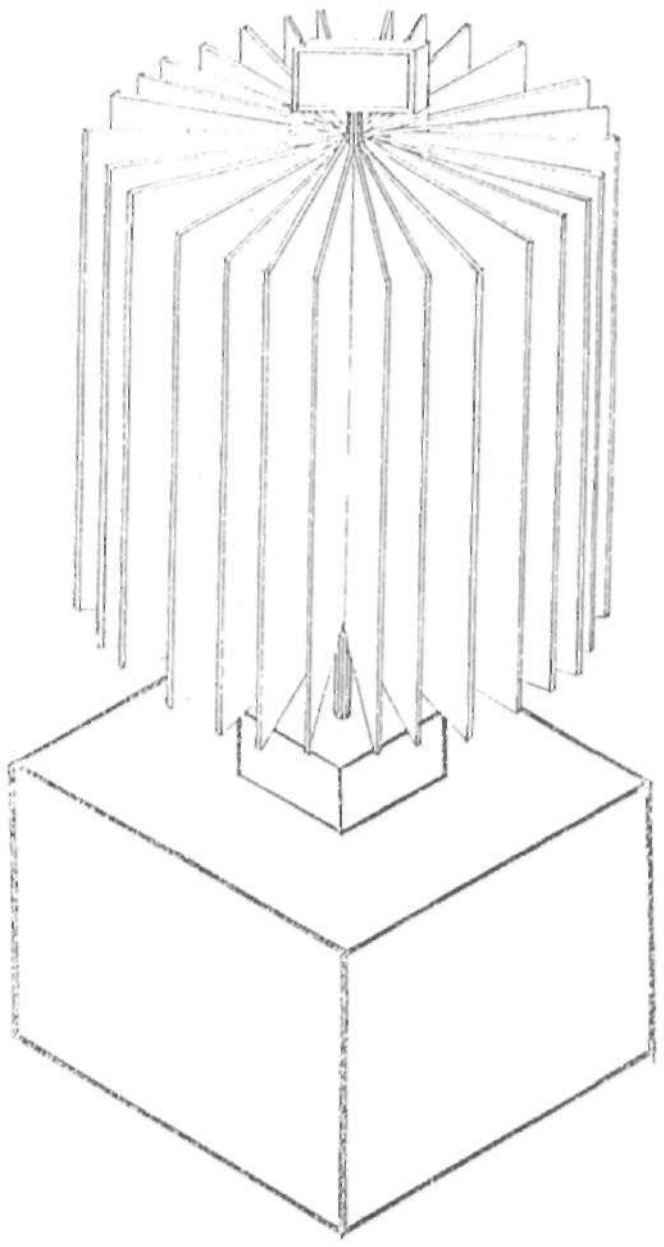


Fig 7.2 Shows Stripdex Stand.

CONCEPT DEVELOPMENT

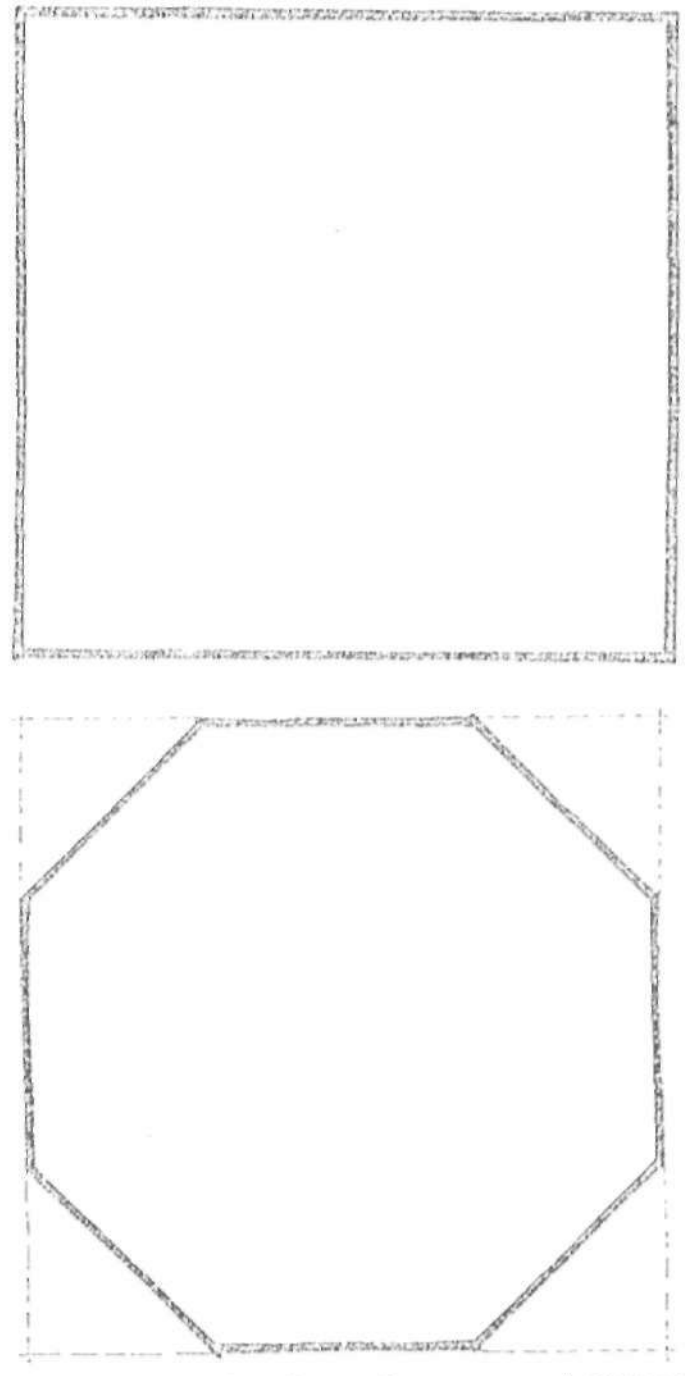


Fig 7.3 Shows a Geometric form Square and Octagon as a basic element.

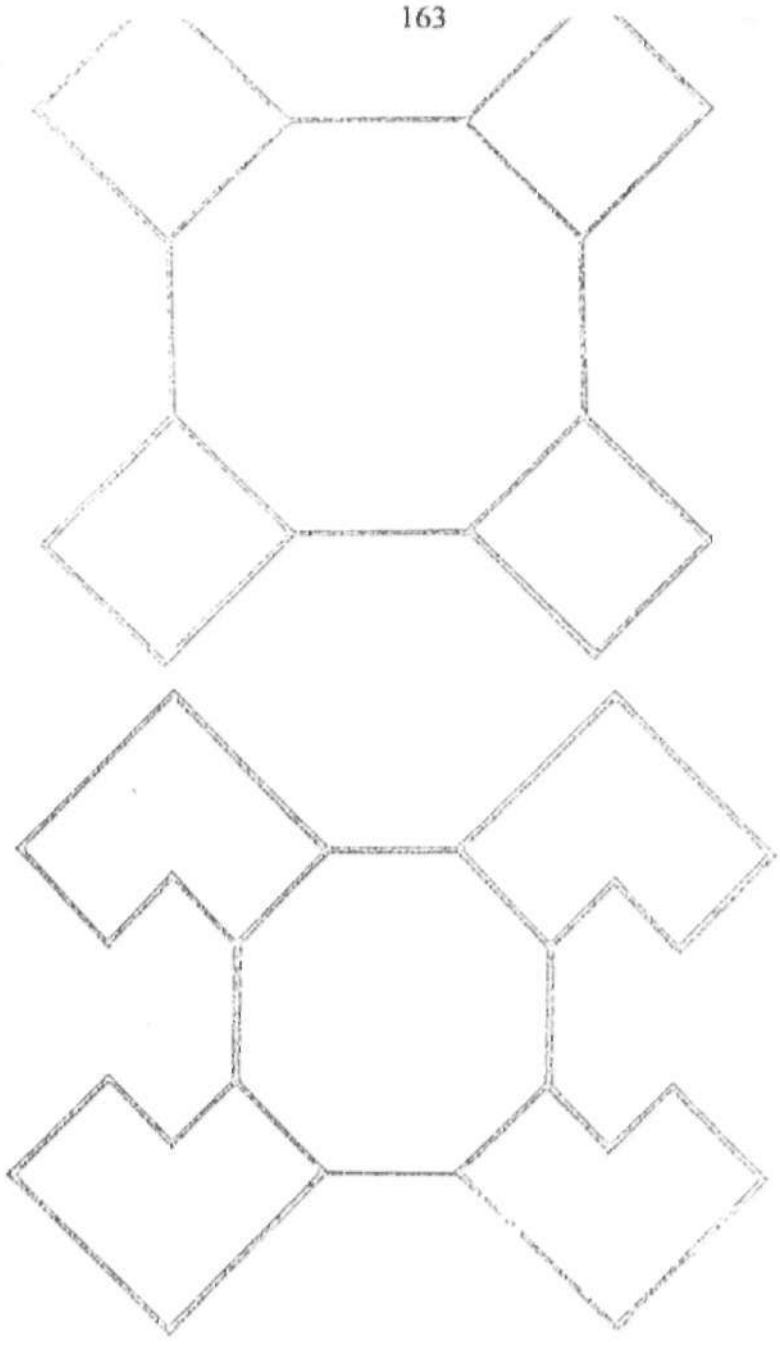


Fig 7.4 Shows evolution of the hindlimbs and forelimbs as wings.

7.8.1 Freedom

The form emerges out of the fact that knowledge when acquired, elevates and free man from illiteracy and taken to a greater height. From the core evolved the wings in different directions signifying freedom from illiteracy.

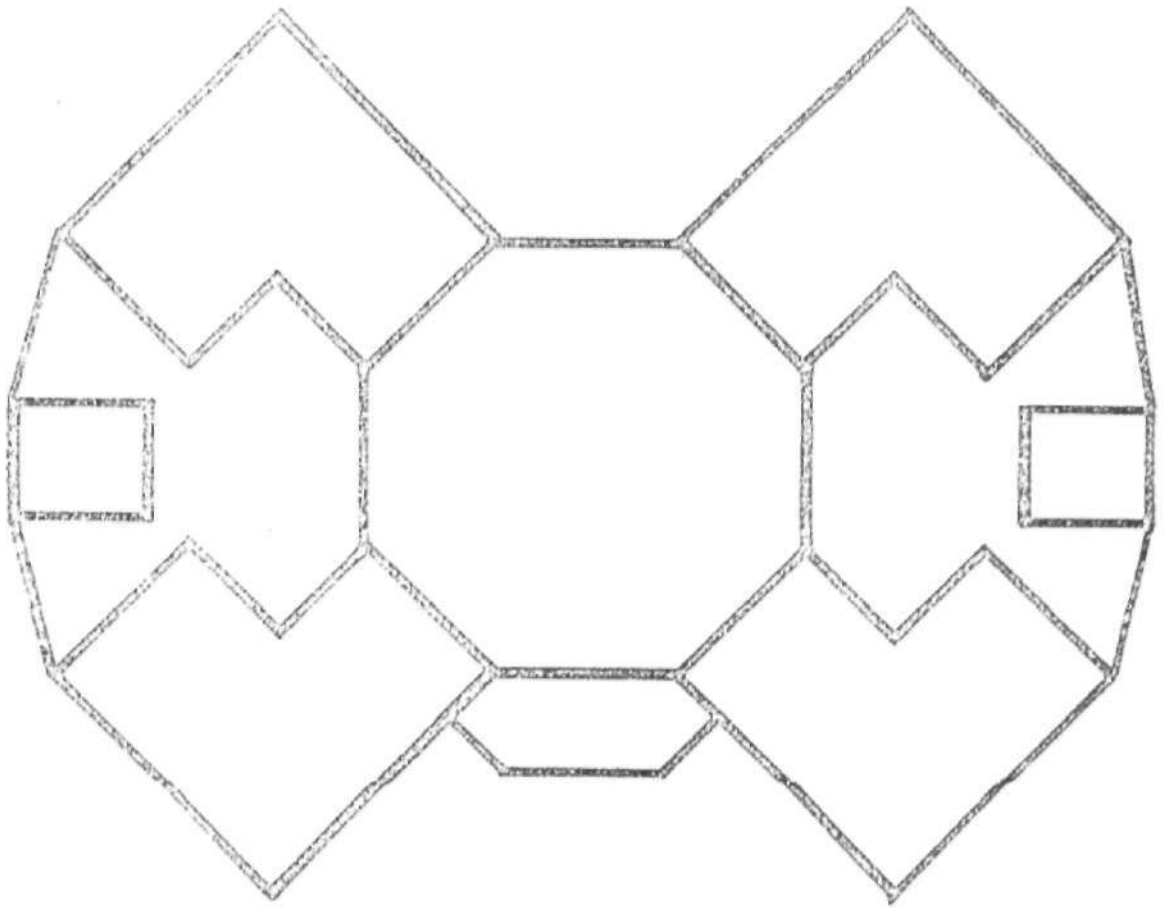


Fig 7.5 Shows the revolving of subject index stand.

7.8.2 Energy Consciousness

When a tortoise is in danger it goes into its shell but when there is no danger it brings out its forelimbs and hindlimbs as a way of freedom. With the spreading out of hindlimbs and forelimbs is to admit natural lighting and cross ventilation through the building and totally elimination of mechanical energy and air conditioning in the design. The idea of it all is the stripdex stand used as subject index at catalogue unit in libraries.

7.9 SITE PLANNING

The site is planned in such a way that it follows the gradient of the topography. The slope is 0.5m gradient towards the south of the gulley. The rain water collection are channeled or drained to the gulley while the wastes from the building are connected to septic tank and soakaway pit behind the building where the toilet facilities are. The building is positioned away from the service road to avoid vehicular noise. The parking spaces have been done in such a way that they conform to the structure. Pedestrian way is really looked at to avoid conflict with on coming vehicles. Although the library complex is position in the heart of the campus.

7.9.1 Services

Toilet facilities are restricted to one wing of the whole complex for easy piping. The piping is done on a straight route down to the ground that invariably goes into the inspection chambers of the septic tank and pass to soakaway.

All the electrical cables are channeled to electrical room where all electrical services are done. There is also a service duct for conveyance of computer Internet cables to every floor.

A provision has been made for hanging split units air conditioning. The lift motors are located on top of the building called the machine room in case of services.

7.9.2 Restaurant/Smoke Bar

The restaurant/smoke bar caters for the library users. It is on the ground floor also detached from the main library building but within the complex and can easily accessible within.

7.9.3 Browsing

When entering the hall of the building there is a step down browsing area where new arrival books, journals, papers and other materials are exhibited.

7.10 Functional Relationship between Areas and Their Arrangement

The functional relationship between various areas in a library could be best understood when one clearly defines the activities that take place in each section, while the routes of such activities provide proper guidelines for better arrangements.

In an academic/research library, some activities like, the users activities, the staff activities and material preservation are to be looked at.

7.10.1 Users Activities

These can be seen as the purpose and nature of the users and hence the functionality of the library users activities which include the search for information in the reading, reference, research works, exhibition, browsing, lectures/seminars purchase of library materials, restaurant snacks bar, common/discussion room, etcetera. When these are properly integrated, a user might be attracted to use more than one activity.

7.10.2 Staff Activities

These cover the overall management of the library system from the administrative policies, its

implementation, staff welfare maintenance, directing and assisting the users in all aspect of the library services, storage, technical services etcetera.

7.10.3 Materials Preservation

In this aspect acquiring, distribution storage and maintenance of library materials in printed graphics or non-graphics form. The latter are often referred to as audio-visuals consisting of microfilms and microfiches. They are stored in safe envelopes, files or boxes in catalogue cabinets because they are very sensitive to weather conditions.

Printed graphical materials like books, newspapers, periodicals, and documents are stored in shelves according to their subject matter for easy accessibility and reference. The stacking are carried out in a manner that would provide easy accessibility and security of the materials.

7.11 Relationship between Staff Users and Material Route

These provide the required function of a good library in terms of traffic routes and easy accessibility. Effective and careful planning would provide the expected convenience that is one of the

authors design target as a major contribution in the scheme

8.0 CONCLUSION

A critical analysis of prevailing situations, modern trends of library development, its new academic roles and the societal problems were under taken and solutions proffered to the problems identified. This was to give the library complex the congenial environment required of any communication, information or recreational centre.

A library is a place of storing valuable information and acquiring knowledge for the development of any nation. It can therefore, concluded that with the global advancement in technology, the computer/internet age of communication has made it possible to store and retrieve information in many different forms.

The term digital library and virtual library have become popular in recent times. These terms are now used to refer to the vast collections of information to which people gain access over the internet, cable television, telecommunication or some other type of remote electronic connection.

The role of architecture in the over all development

of mankind in terms of educational development need not be over emphasised. Architecture provides not only the framework for such activities, but also provide the attracting potentials and incentives to the average users.

When designing an academic library, the architect should be conscious of employing an approach that provides facilities that improve or are in line with the educational objectives of the institution. He should also endeavour to provide a functional environment that is conducive for users activities, preservation of collections and is complimentary to the environs. This thesis has sought to achieve effective natural lighting and ventilation in libraries. It is hoped that the extrapolations made will serve as a reference source for related projects in the future.

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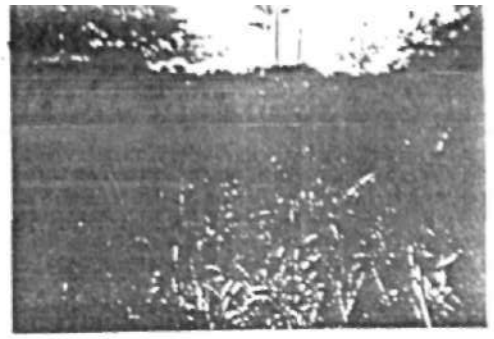
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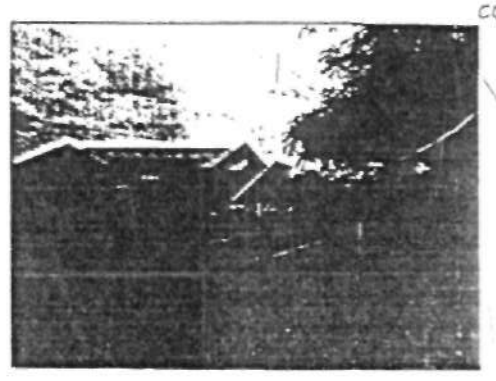
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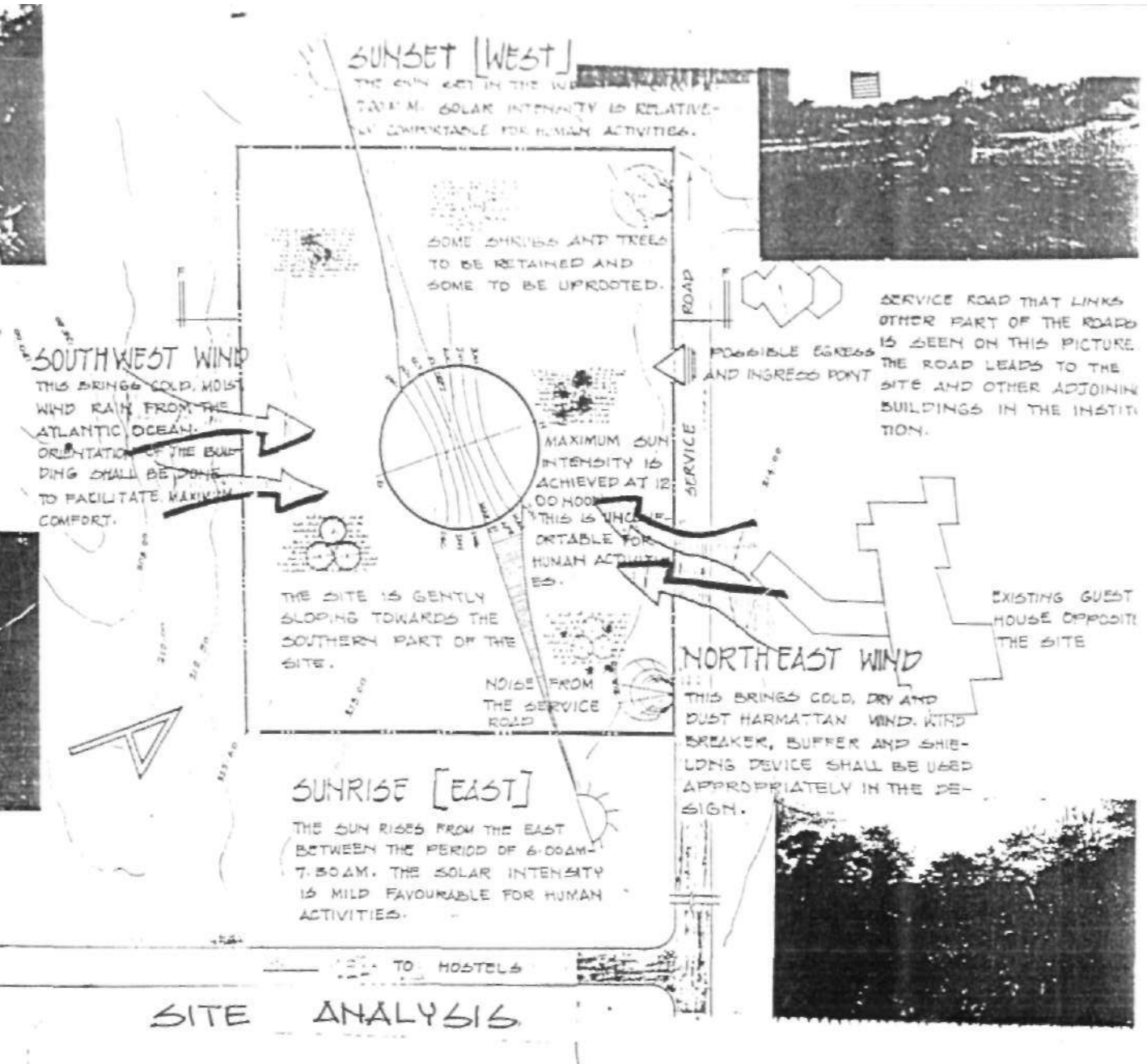
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A VIEW SHOWING THE SITE, HOSTELS AND OTHER BUILDINGS BEHIND. THE SITE IS UNDULATING AND GENTLE SLOPING TO A DITCH.



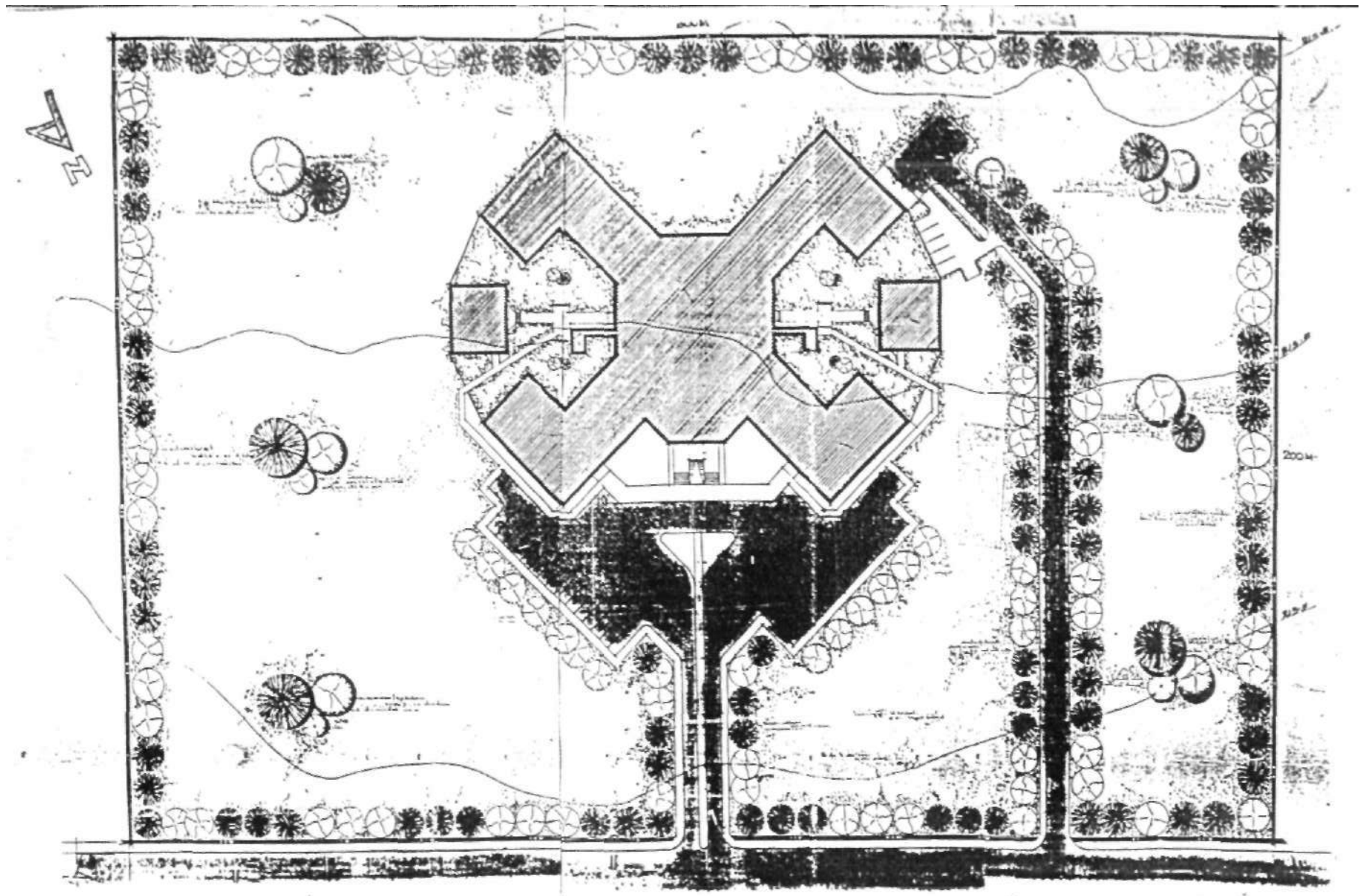
A VIEW SHOWING A ROAD GOING TO THE HOSTELS AND AUDITORIUM UNDER CONSTRUCTION.



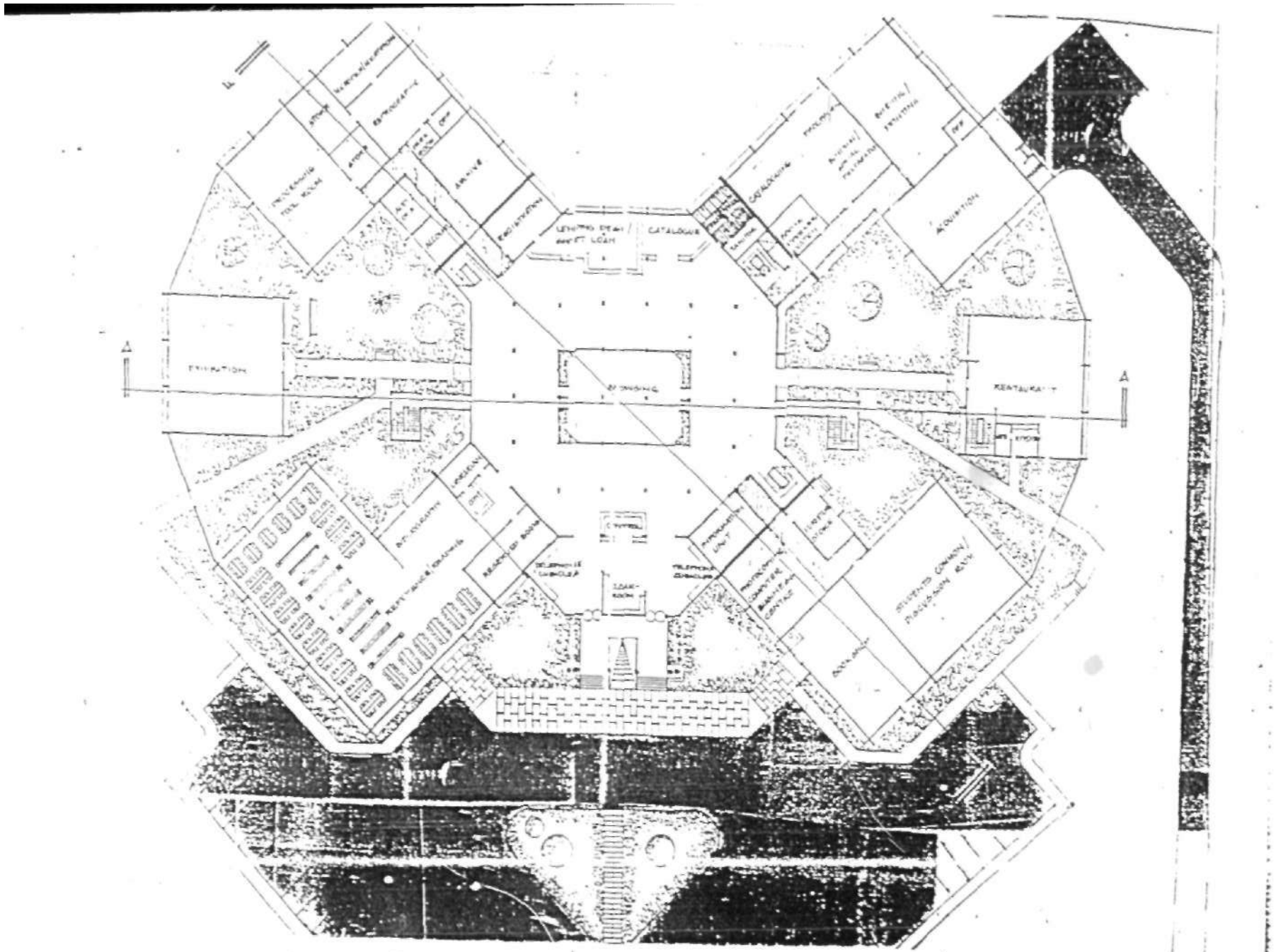
SERVICE ROAD THAT LINKS OTHER PART OF THE ROADS IS SEEN ON THIS PICTURE. THE ROAD LEADS TO THE SITE AND OTHER ADJOINING BUILDINGS IN THE INSTITUTION.

EXISTING GUEST HOUSE OPPOSITE THE SITE

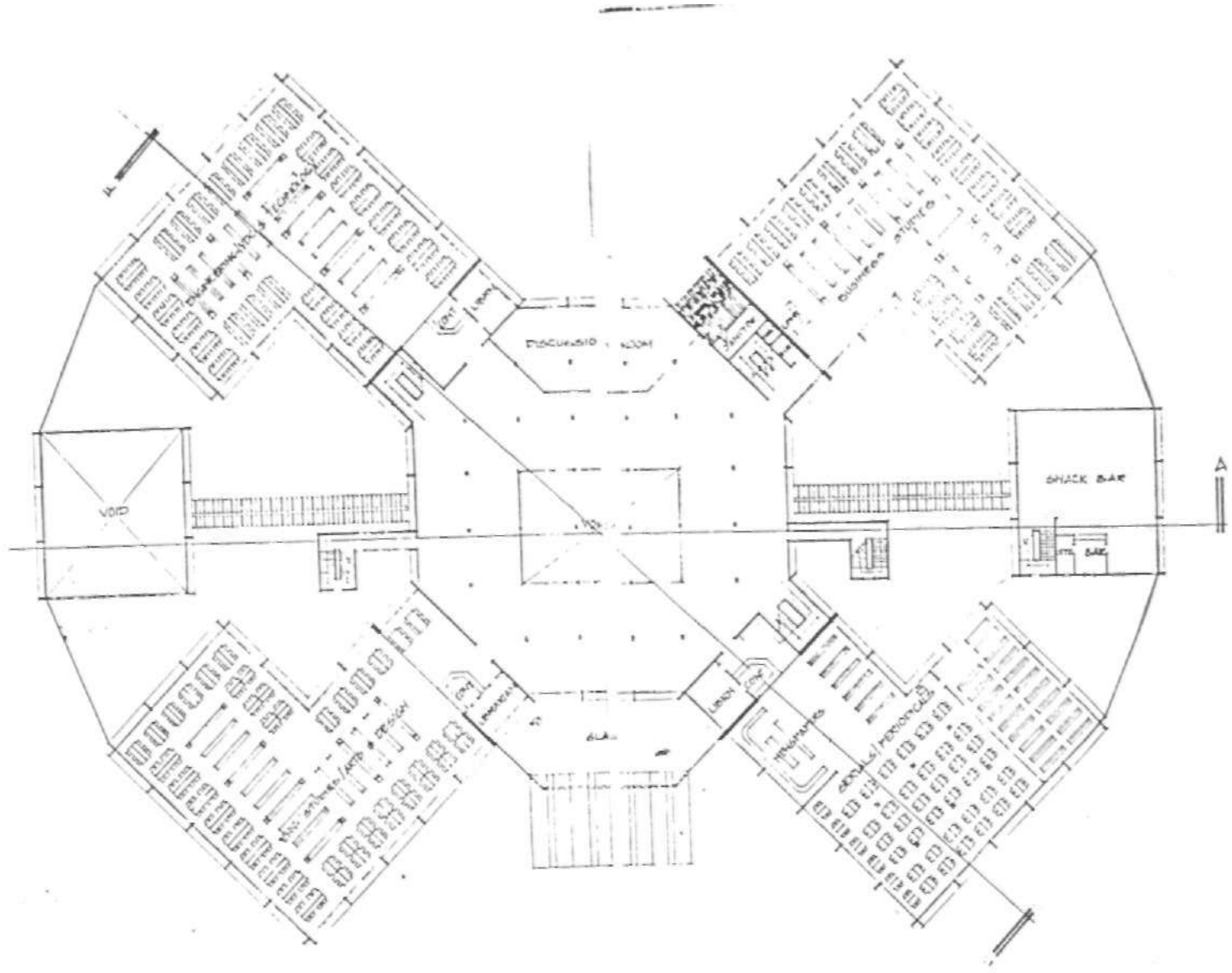
SITE ANALYSIS



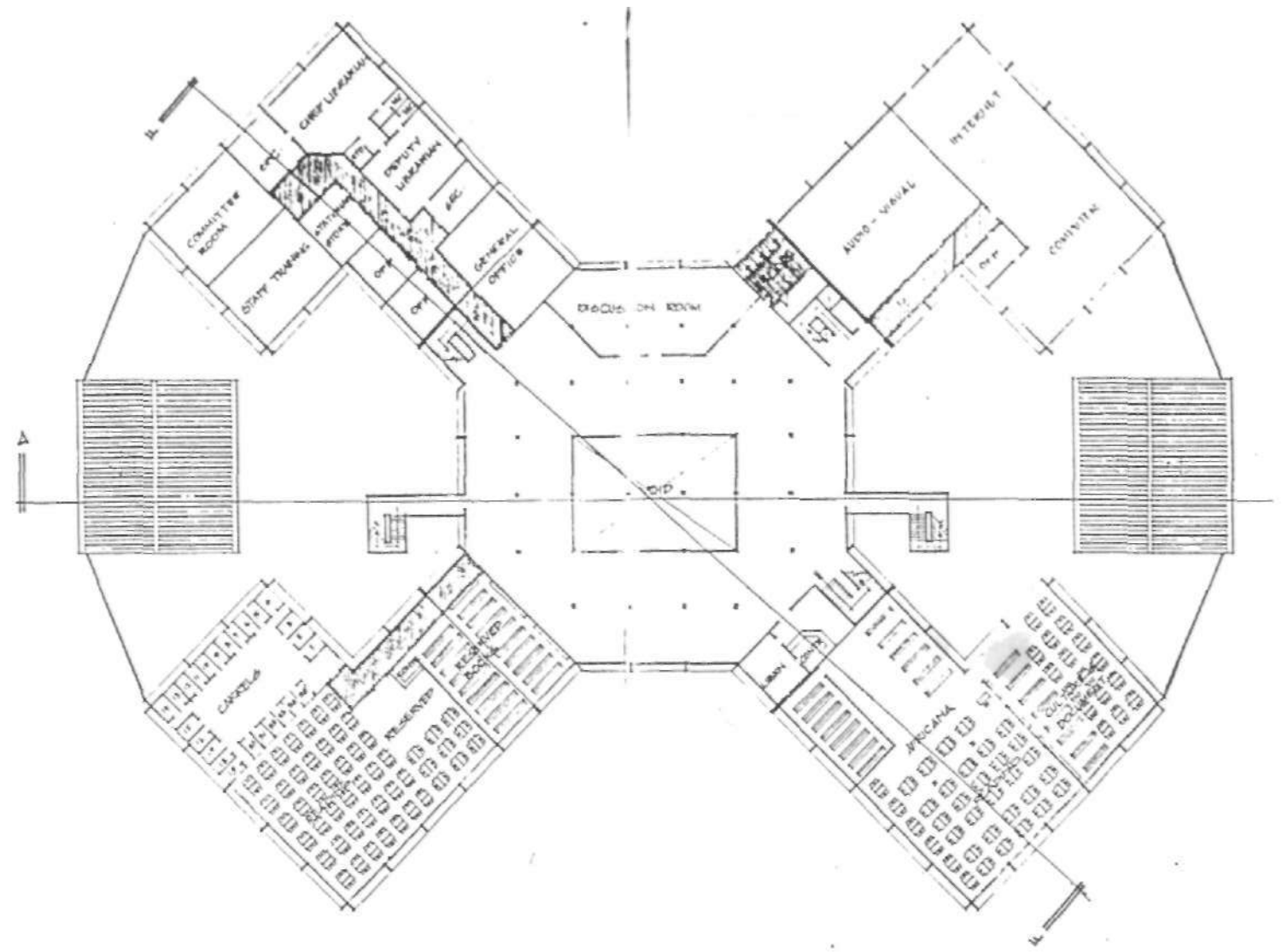
SITE PLAN



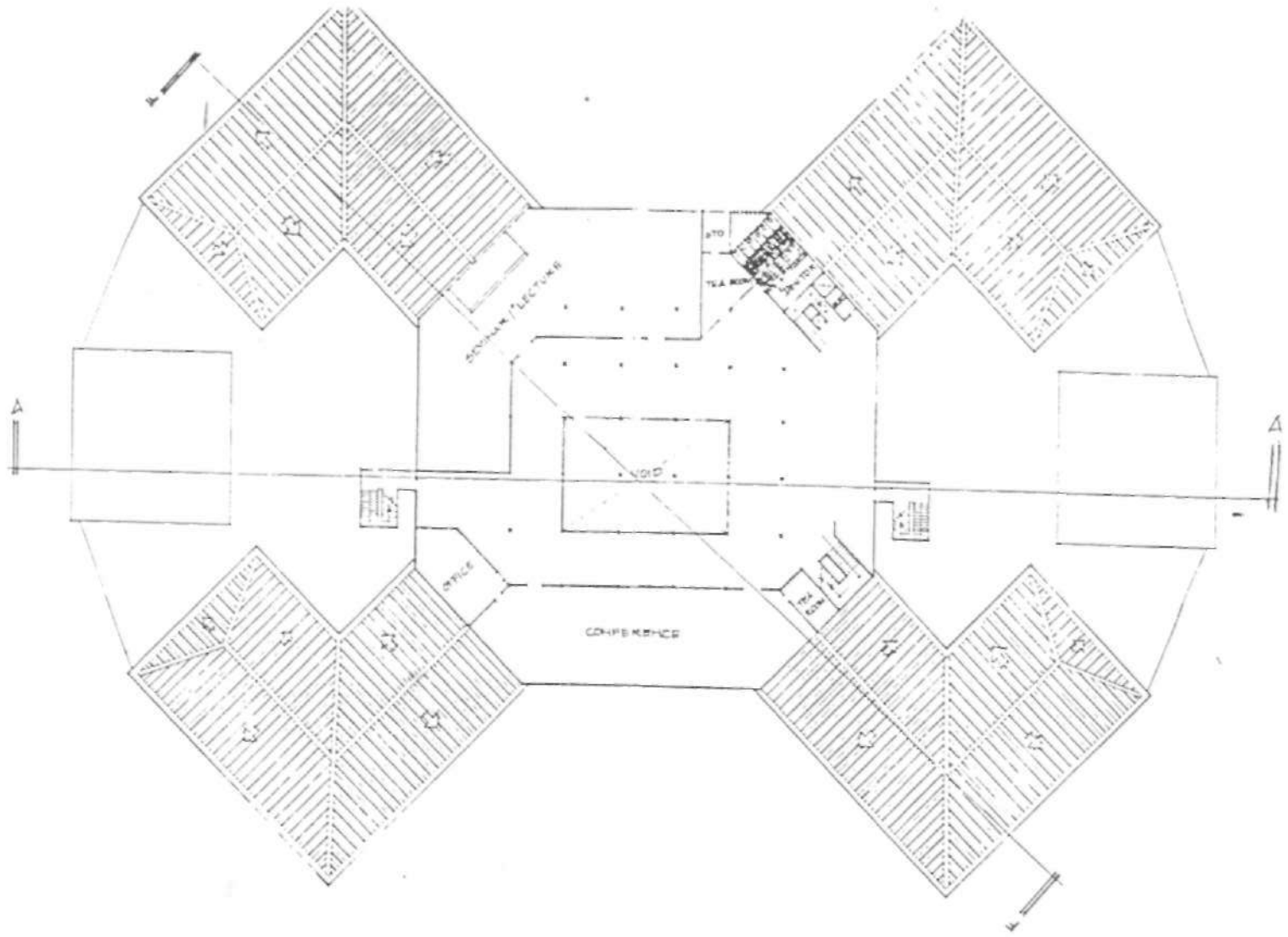
GROUND FLOOR PLAN



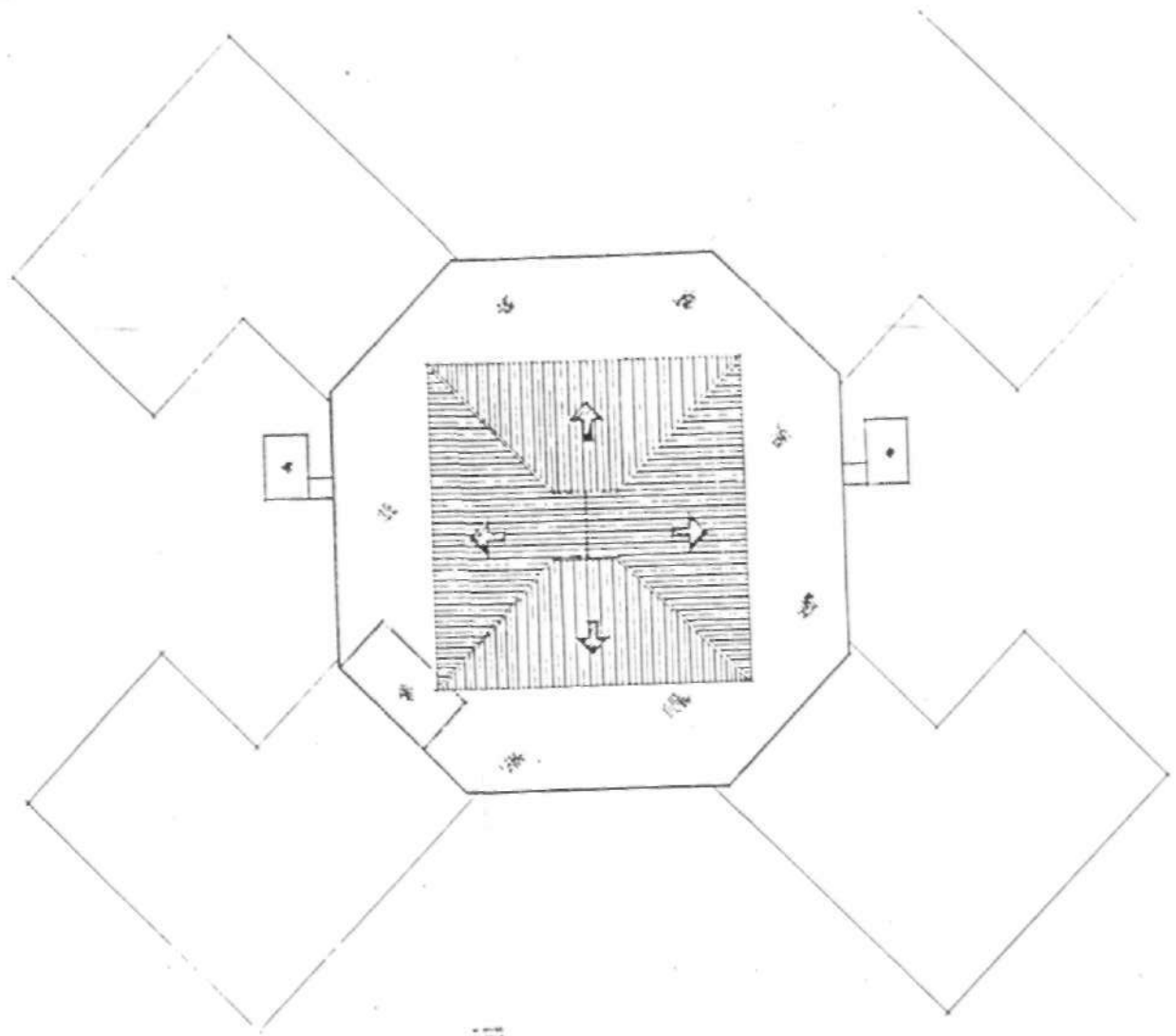
FIRST FLOOR PLAN



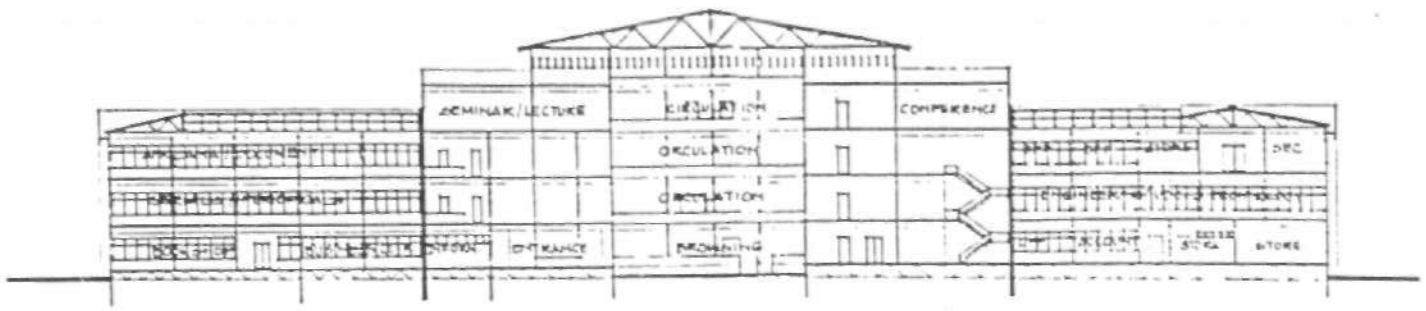
SECOND FLOOR PLAN



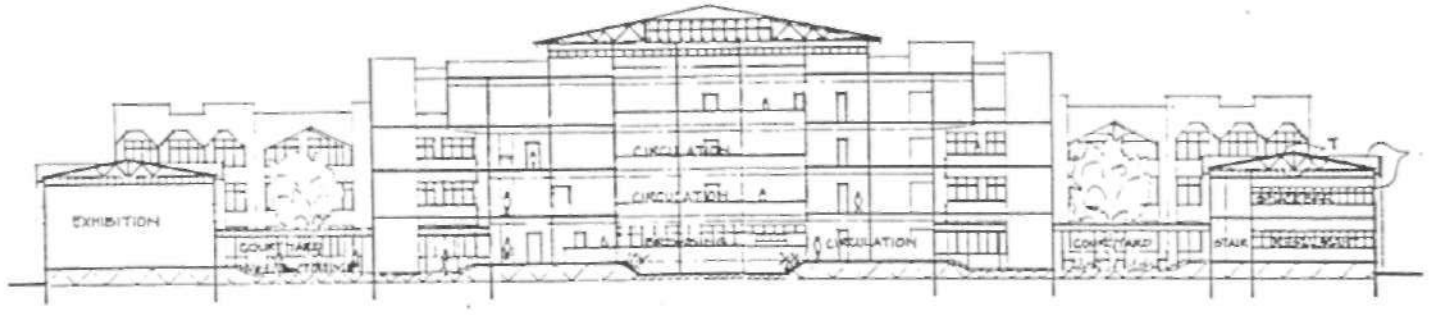
THIRD FLOOR PLAN



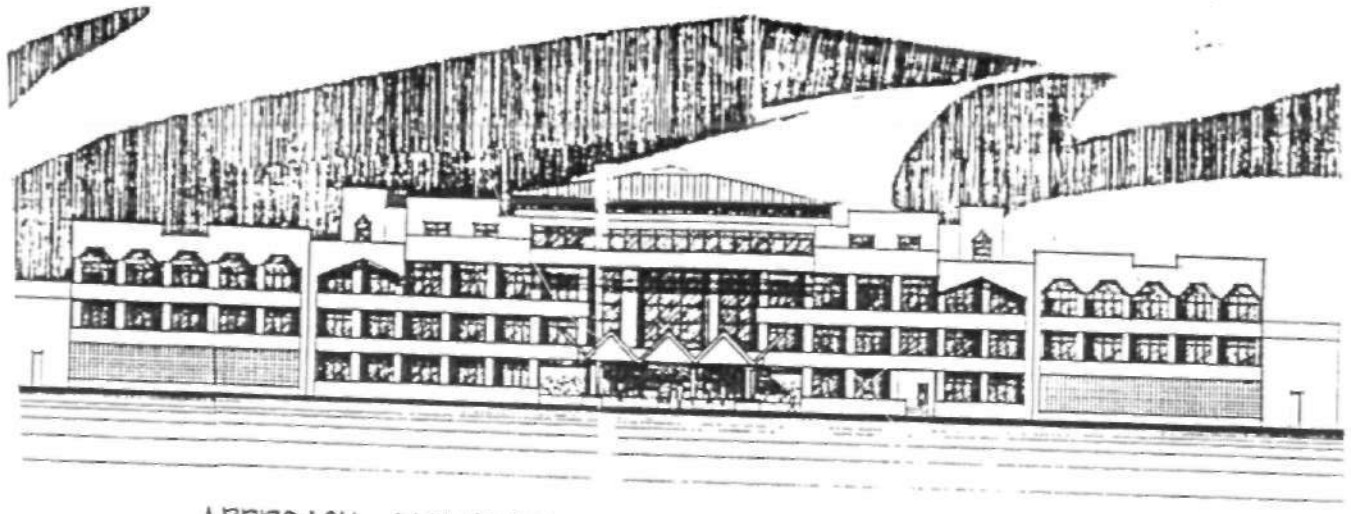
ROOF PLAN



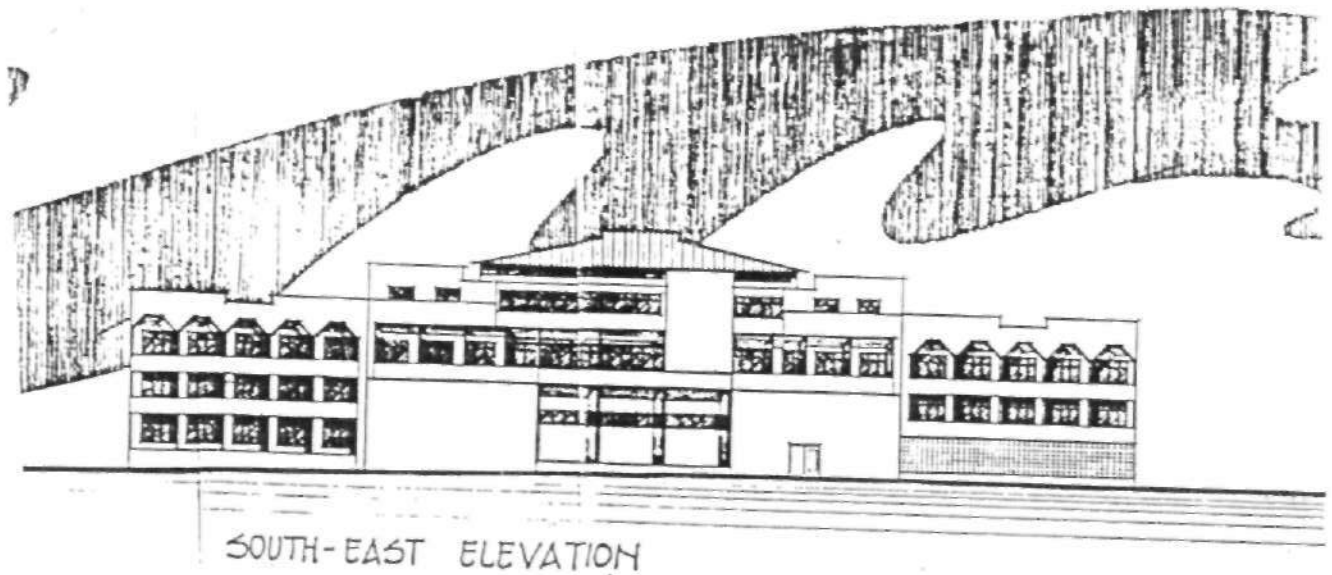
SECTION F-F



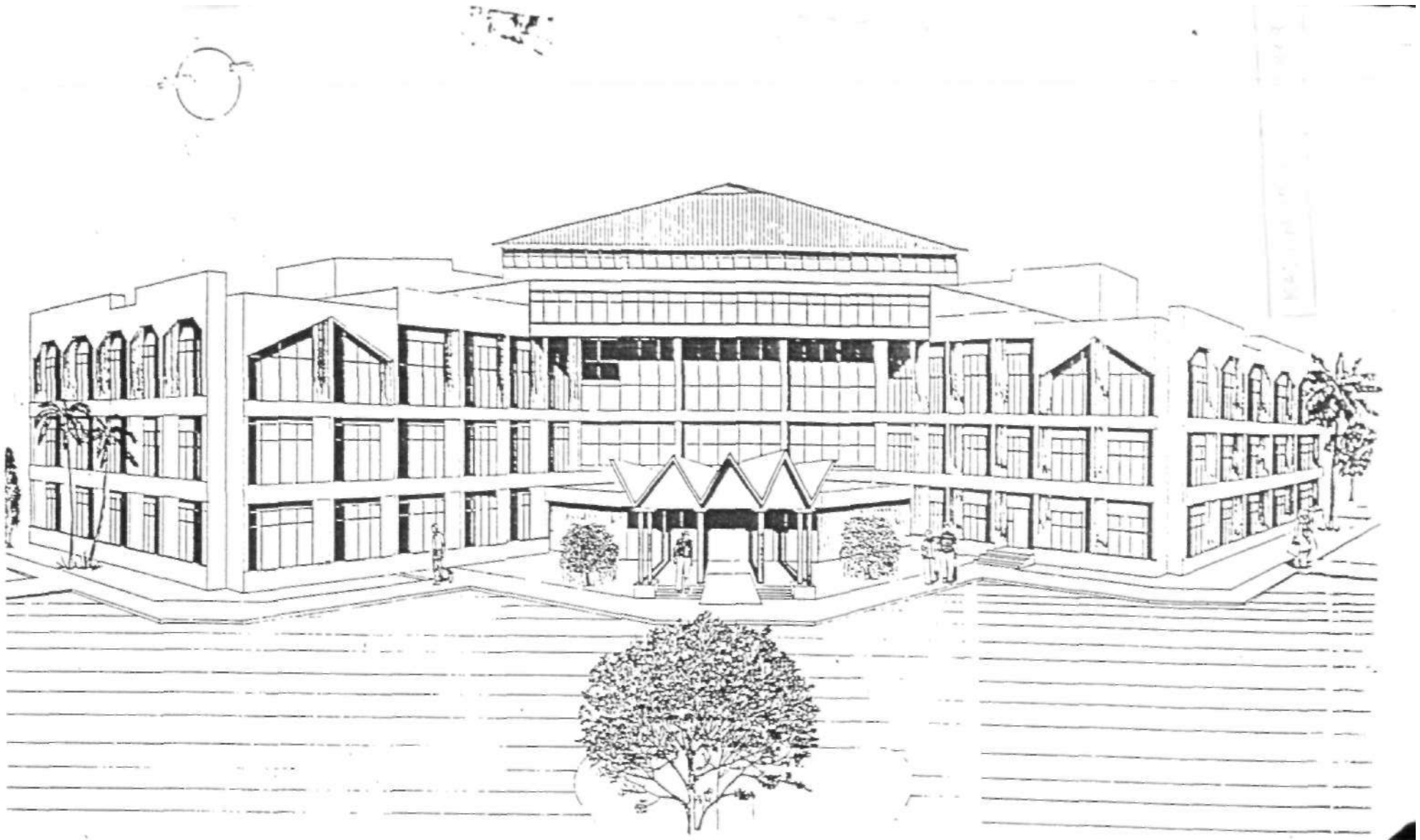
SECTION A-A



APPROACH ELEVATION



SOUTH-EAST ELEVATION



EXTERIOR PERSPECTIVE