ABUBAKAR TAFAWA BALEWA UNIVERSITY LIBRARY COMPLEX: TOWARDS EFFECTIVE PLANNING FOR COMFORT.

BY

SULEIMAN ABUBAKAR
B.SC. (HONS) ABU

BEING A THESIS WORK SUBMITTED TO THE POSTGRADUATE SCHOOL, IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF MASTERS OF SCIENCE (M.SC.) IN ARCHITECTURE.

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

OCTOBER, 1997

D E C L A R A T I O N

I, Suleiman Abubakar solemnly declare that this Thesis is the outcome of my research work. All sources of information have been duly acknowledged.

(SULEIMAN ABUBAKAR)

C E R T I F I C A T I O N

This Thesis entitled **Abubakar Tafawa Balewa University (ATBU) Library Complex** by **Suleiman Abubakar** meets the regulation governing the award of the Decree of Masters of Science (M.Sc.) in Architecture of AHMADU BELLO UNIVERSITY, ZARIA, and is hereby approved for its contribution to knowledge and literary presentation.

Chairman Supervisory Committee	DEC. 1997 **Date**
Member Supervisory Committee	9 DECEMBER 1997 **Date**
Head of Department	1 Date
Dean, Postgraduate School	28/4/99 Date

D E D I C A T I O N

To my parents, **Mallama Habiba Suleiman** and **Mallam Suleiman O.**, also to **Mallam Abdullahi Suleiman** who went naked so that I may go to school.

A C K N O W L E D G E M E N T

Firstly, my greatest regards goes to Almighty Allah whose mercy covered me from birth to this level of my career.

I am grateful to my Supevisor in person of Mr. Adewolu and other members of staff in the department for their support.

Particularly, I am indebted to my parents, Mallama Habiba and Mallam Suleiman whose collective efforts saw me to this level of my academic pursuit. Abdullahi Suleiman, is an elder brother of substance. His contributions are by all standards unique. May Allah bless you all (ameen).

My special thanks goes to the following people for their contributions which came in various ways: Ahmed Mohammed, Sylvester Onoja, Anthony Ogboji & Alh. Ibrahim Akoh.

Haruna, Ibrahim and Yusuf are all special brothers who stood by me during periods of hardship. I pray Allah for us to succeed (ameen).

I greatly appreciate the cordial relationship enjoyed from my class-mates whose few names are only mentioned here: Kabir Babama'aji, Jackson Okpale, Oduniyi Alaba, Opaluwa Hassan, Dennis Odeje, Samuel Idris Bawa and Obatomi Olukayode.

Finally, I would like to extend my regards to all who have contributed to the success of this work. May Allah reward you accordingly.

A B S T R A C T

The wind of change is blowing accross the globe in all spheres of human disciplines. This change is towards increasing demand for comfort. Hence, the University library which is the heart of the process of education must not bo loft out in this increasing conciousness for comfort.

This thesis is therefore, centered principally, around the comfort needs of readers within the prevailing climatic conditions of the site.

The first chapter proposes and defines the problem. This chapter also unfolds the research instrument used.

Chapter two looks at historical developments of library architecture and operational requirements of the library. The third chapter examines some existing libraries with particular emphasis on comfort levels.

Chapter four, which is the research chapter, analysis comfort parameters with a view to ascertaining basic problem and solutions. The result of this study is to guide the author towards making a successful design proposal.

Chapter five examined the project site critically to know the prevailing conditions. Chapter six which is the design proposal, reports the application of the principles studied in previous chapters.

Chapter seven concludes the research with recommend-ations. What is hoped is that, the research work would be useful to students, scholars and the society at large.

TABLE OF CONTENTS

Title page		Page
Declaration		i
Certification		iii
Dedication		iv
Acknowledgement		v
Abstract		vi
Table Content		vii
List of Figures		ix
List of Plates		x
CHAPTER ONE INTRODUCTION		
1.1	Problem Statement	1
1.2	Motivations	2
1.3	aims and Objectives	3
1.4	Scope of study	3
1.5	Constraints and limitations	3
1.6	methodology of study	4
CHAPTER TWO : LIBRARY IN CONTEXT		
2.1	Objectives of library	5
2.2	Types of Liberaries	6
2.3	Historical Developments	8
2.4	Historical Developments of library in Nigeria	12
2.5	Library Requirements	12
2.5.1	Functional Requirements	12
2.5.2	Structural Requirements	2.5.2
2.5.3	Technological requirements	2.5.3
2.6	Thesis Position	

CHAPTER THREE: CASE STUDIES

3.1 kenneth Dike Library, University of Ibadan Nigeria 29

3.1.1 Building Design Features 29

3.1.2 Merits 32

3.1.3 Demerits 32

3.2 University of Lagos Library 33

3.2.1 Building Design features 33

3.2.2 Merits 35

3.2.3 Demerits 36

3.3 Kashim Ibrahim Library, Ahmadu Bello University Zaria 50

3.3.1 Building Design Features 50

3.3.2 Merits 51

3.3.3 Demerits 52

3.4 Cranfield's New Library, University of Cranfield U.K 57

3.4.1 Building structure 57

3.4.2 Merits 58

3.4.3 Demerits 59

CHAPTER FOUR : COMFORT CONSIDERATION

4.1 Thermal Balance.

4.1.1 Air Temperature 63

4.1.2 Air Velocity 66

4.1.3 Solar Radiation 77

4.1.4 Relative Himidity 79

4.1.5 Nature of Clothing 80

4.1.5 Activity level 80

4.2 Planning requirements 84

4.2.1 Library Security 84

4.2.2 Fire Hazards 84

4.2.3 Maintenance 87

4.3	Visual Comfort	88
4.3.1	Glare control in Design	89
4.4	Environmental standard (Noise Distraction)	90
4.4.1	Control of Accoustic Distractions	91
CHAPTER FIVE: STUDY AREA		
5.1	The Project site	97
5.1.1	Site Selection Criteria	97
5 2	Site Characteristic (Climate)	98
5.2.1	Rainfall	98
5.2.2	Temperature	98
5.2.3	Humidity	99
5.2.4	Wind and Dust	99
5.2.5	Sunshine Hours and solar Radiation.	100
5.2.6	Vegetation	100
CHAPTER SIX: DESIGN REPORT		
6.1	Site Concept	107
6.2	Form Development	107
6.3	Choice of Structure	107
6.4	Design Response to Comfort	108
6.5	Schedule of Accommodation	113
CHAPTER SEVEN: CONCLUSION		
7.1	Conclusion	117
7.2	Recommendations	118

BIBLIOGRAPHY

LIST OF FIGURES

		Page
Figure 2.1:	Relationship between various Functional Units of An Academic Library	16
Figure 2.2:	Process of Material Routes	17
Figure 3.1	5 University of Ibadan Library plans	37-41
Figures3.6 -	11 University of Lagos Library Plans	43-47
Figures3.12-	15 Kashim Ibrahin Library Plans (ABU)	53-56
Figures3.16-	Cranfield New Library, U.K. Plans	60
Figures4.1 -	Comfort Parameters	62
Figure 4.2 -	Thermal Balance	65
Figure 4.3 -	Impact of Air Pressure on Plans	66
Figure 4.3b-	Impacts of Position of Openings	67
Figure 4.4 -	Effects of shading devices	70
Figure 4.5 -	Height Consideration	71
Figure 4.6 -	Hieght Effects on wing Velocity	73
Figure 4.7 -	Air Temperature Velocity: Control Measures	74
Figure 4.8 -	" " "	75
Figure 4.9 -	Internal Arrangements	76
Figure 4.10-	Building Orientation	81
Figure 4.10b	Theermal Insulation Materials	82
Figure 4.10c	Thermal Control Measure	83
Figure 4.11-	Solution against Clare	92
Figure 4.12-	Use of Different Materials for sound control	93
Figure 4.13-	Impact Sound Control	96
Figure 5.1 -	Site Master Plan	101
Figure 5.2 -	Rain Fall Grave	102
Figure 5.3 -	Temperature	103
Figure 5.4 -	Humidity	104
Figure 5.5 -	Prevailing Wind Direction	105
Figure 5.6 -	Sunshine Hours	106

LIST OF PLATES

Plate 34 University of Ibadan Library View 48

Plate 35 University of Lagos Library View 49

CHAPTER ONE

I N T R O D U C T I O N

That education stimulates human development culturally, politically, socially, economically and intellectually calls for serious consideration and concern. If any nation must move forward then, the various organs and institutions responsible for educating her people such as the home, the school and the society must be well organised and equipped with the basic instruments of performance. The University library, a bibliographical nerve centre of the University, is not only an essential instrument of formal and informal education but also an area of the curriculum.

1.1 PROBLEM STATEMENT

The past two daces have witnessed an unprecedented growth in the number of our tertiary institutions. Since the motive of creating these institutions is to accelerate technological development among others, then, the need for library facilities to support their traditional role of learning, teaching, research and consultancy activities can not be over emphasized.

Abubakar Tafawa Balewa University Bauchi (ATBU), is in the categogry of these universities. Her book collections are housed in a temporary accommodation too small to house the ever growing student enrolment and book collections. Besides, the university authority is considering a proposal to move to their permanent site.

In view of the reasons advanced one may be tempted to say that there is an obvious need for the erection of a modern library complex. The library will be designed to

function as a repository for large organised records and as research data bank. It is hoped to enhance an environment that would be conducive for technological advancement and communication development in the country.

The effective performance of a library is usually affected by comfort conditions. Bauchi, the project site happens to be in a Savanna Zone which is characterised by harsh climatic conditions which would require the introduction of a well-designed landscape elements to ensure that the university environment is conducive for learning. This calls for a careful planning particularly in the design of a library.

This thesis is an attempt to analyse comfort parameters and evolve a satisfactory or workable solution.

1.2 MOTIVATIONS

The instrument that established the University (ATBU) stipulates that it is to accelerate the tednological development of the nation. This goal can hardly be accomplished without library facilities. This is to say the need for a library was a motivating factor.

The feeling that the library should not be left behind in the increasing demand for comfort in all spheres of life was another motivating factor.

The author's long-standing interest in contributing to knowledge acquisition geared at enhancing research and innovation for effective development was also a contributing factor.

1.3 AIMS AND OBJECTIVES

The aims and objectives of the project include the following:

- To achieve a flexible, functional and aesthetically pleasing library design that is responsive to users needs and requirements.
- To stimulate intellectual development through the provision of a healthy and inspiring library environment.
- To evolve a library proposal that is durable and economical.
- To contribute towards governments programmes aimed at alleviating mass literacy through inculcating the habit of reading for relaxation.

1.4 SCOPE OF STUDY

This study will seek to identify principally, comfort parameters, general design principles and their subsequent applications in library design. Given the increasing rate of change experienced in area of size and complexity of library services, the research hopes to evolve a proposal that is adaptable to changing needs.

1.5 CONSTRAINTS AND LIMITATIONS

- Lack of resources, both financial and material, posses a major constraint;
- Difficulty in obtaining information materials and where available, the cost was unbearable;
- The noncompromising attitudes of some public officers at responding to data collection needs of students.

Bureaucratic proceedings involved in acquiring information and documents from concerned institutions and organisations.

1.6 Methodology of Study

The Author adopted applied research technique which seek findings for immediate application. The instruments used are as follows:

INTERVIEW: Some university librarians were interviewed to ascertain the nature and extent of their services, problems and prospects. Users survey was equally carried out to ascertain their level of content with existing services and comfort levels. Their views in both cases were noted.

CASE STUDIES: Case studies were carried out to ascertain design merits and inadequacies with particular refereence to comfort levels. Identified merits could be inculcated in the new scheme or avoided; while the manifested inadequacies are to be addressed. Visits to existing libraries were made to enable the researcher to appreciate the spatial relationship between the various functional components.

LITERATURE REVIEW: Literature review of works of past researchers on library planning is desirable as it will familiarise the author with the subject under consideration.

CHAPTER TWO

LIBRARY IN CONTEXT

A library is generally defined as a reservoir of written, printed or recorded materials organised and maintained for human consumption in the form of reading, studying and consultation. These collections include records, tapes, video, discs, films, phonographs, micro-films and computer programs.

2.1 OBJECTIVE OF LIBRARY

The primary functions of a library is that of education, entertainment and information. Therefore, for a university library to effectively meet the study needs of students its role must be well defined to accomplish the four fold task:

- To collect the most up-to-date information to complement the instructional program of the university; and the efficient and rapid information retrieval on demand.
- To provide assistance in developing the reading habit, hereby acquiring knowledge through the independent use of books.
- To acquaint library users with the contents of the library, thereby arosing in them a desire to read and stimulating them to read for culture and for pleasure.
- To increase knowledge of the basic reference tools to aid research-work.

2.2 TYPES OF LIBRARIES

The knowledge of various types of libraries enables the designer to appreciate their distinctive objectives and requirements.

Acadamic Library:- The need for keeping printed records of teachers' lectures following the development of printing marked the beginning of the great university libraries.

The university library is characterised by many users seeking the same book at the same time. This calls for generous circulation spaces and entrance. Furniture and lighting requirements may differ from other library types.

Public Libraries:- Public libraries are exclusively conceived to promote literacy level of the community, provide wide range of readings for all ages and centres for community information services. The size of the area covered is a variable that dictates the services to be offered by this kind of library. Example is the Samaru Public Library.

National Libraries:- This is the largest of all libraries in book-stock and reader seating. National libraries strive principally to collect and preserve published materials - national bibliography-though, they try to be as internal as possible. Most national libraries receive by legal right one free copy of each book and periodical printed in the country. A collection of foreign publications and facilities to aid research activities is part of their objectives.

Special Libraries:- Special libraries unlike the public or university libraries, are built around a special subject interest established by special group of users to cater for their needs. They are perhaps the most positive libraries of all, in that they are least inclined to sit and wait for their clientele to approach them.

They are more concerned with investigation of information and communicating such information to specialist consumers.

School Library:- At one extreme will be the primary school library, which house a few books, at the other extreme will be the library in a senior school with a large pre-university group. This library house comparatively small stock of books thus presenting few storage problems.

Private Libraries:- Individuals with interest in the library field collect materials and own their libraries. The contents of the library depends completely on the areas of interest of the owner. However, private libraries lend themselves to public consumption. Example is Folger Shakespeare Library in Washinton D.C. (1932).

Subscription Libraries:- Partly, it is the combination of the characteristic of public and private libraries to cater for colleges and academic institutions. The practice is old and not finding itself in contemporary practice. With the most famous example being Athem-a cum in 1807.

2.3 HISTORICAL DEVELOPMENTS

A study of the historical process of the library and challenges together with solutions found in the course of research and development will be worth discussing. These developments will be discussed in stages:

Ancient World:- Evidences of earliest form of library was the archive (record room) containing developed literature. The clay tablets are discovered in temples or palaces of kings. Examples are found in the temple of Nippur in Babylonian and Tell-el-Amarna in Egypt.

Library architecture of this period cannot be fully distinguished as it was an integral part of the temple architecture.

Classical Period:- the classical world marked the origin of the idea of book collecting or libraries. The people of this time look at libraries as centre of reading and general interaction. This development portrayed it as the first institutional library credited to Aristole, who founded and organised peripatic school in Greece.

Essentially, library buildings were usually decorated with symbolic sculpture, murals and paintings. Books were stored in cupboards and shelves against the walls and galleries.

Medieval Period: (9th - 15thC):- This refers to the era when monastries flourished and christain writings gained prominence. Moreso, the practice was found essential to spiritual faith.

Library plan here consist basically one room well-lighted by window. Contained Armarium (book cupboard) appropriately placed to serve its purpose.

The later medieval libraries witnessed the chained book stall system designed to provide well-lit work space. This is done to avoid book stealing - being a common phenomenon of the time. Characterised by small readers, it is equally important to note here that Medieval library architecture was merged to the church architecture hence it is not independent. Libraries were oriented towards the east. Perhaps, to catch morning light and drying out of damp on library collections.

Renaissance Period:- (16th - 18 Century):-
This is the period of reawakening of thought. All these awakenings were fostered by social and economic conditions culminating into the birth of universities.

Also at time of renaissance came the invention of printing, which meant that more books will be produced.

The classical practice of housing library collections in large halls with large un-interrupted space was retained, perhaps as a reminder of the old system.

Chaining of books was abandoned. Books could now be taken away from the shelves for reading; adoption of wall shelving to store more books; and the main floor area could equally be left empty for exhibition. The Austrian National Library in Vienna (1726) and Trinity College Library, Cambridge provides good examples. Building forms in these examples are rectangle and square.

Nineteenth Century:- This period saw architectural form taking its shape. Two major innovations were made in this period to meet the growing needs and aspirations of users.

Book-Stacks:- Henry Labrouste in the library of Ste-Genivieve between 1845 to 1850 in Paris incorporated the idea of separate room for books. His was the first library to be designed as an individual building. Anthony Panizzi in a similar development discovered the cast iron book stack in 1854 to meet the radical growth in the need for books against the renaissance practice of storing books in multi-tiered galleries along walls, in a high ceiling room.

Reading Rooms:- The same Anthony Pannazi designed a circular and centrally located reading room, for 450 readers. In this arrangement, readers are surrounded by bookstacks with an advantage of open-access to stacks. Example is the British Museum reading room in 1854. Emphasis in this period was more on functionalism.

Contemporary Period:- The cold forbidding monumental libraries - University of Michigan - of yesterday with its inflexible structure no longer fitted changing needs. Such buildings cannot be remodelled economically. Consequent a break with the system was inevitable, if the architect must find an answer to the changing library functions and needs. Modular construction, an application of modern technology and materials was the answer.

Modular planning entails a system where the basic floor area is divided into equal rectangles defined by structural columns at the corners which are the only weight bearing elements within the building.

Theoritically, no function assumes a fixed status except the structural elements and service cores (Ducts, stairways, etc.) so that the use made of an area can be modified.

Information explosion resulting from intensive research activities have rendered traditional methods of acquiring, storing and retrieval ineficient. Newer method of recording and retrieving information such as microfilm, roll film, microfitche, audio-visual media, and disc exist. Non-book materials - tape recording of oral history interview have been discovered. In addition are improved environmental changes like ventilation and lighting.

Emphasis in contemporary library practice is on improved user's services, leading to the computerisation of its activities.

I foresee an academic library in Nigeria of the future accommodating less reader space as services may be brought to the house hold. Automation has helped too by making it possible for readers in one library to consult the catalog of others by means of computer networks. It is no longer news to be told that practices of the near future may totally eliminate the use of books as book contents could be comfortably stored in floppy disc of computers. The process is already been experimented in the advance countries like U.K. The consequence of this development being the abandonment of the use of stacks originally meant for storing. How soon this will come to pass cannot be fully ascertained.

Modular design still responds to these changes as it permits flexibility capable of adapting to functional ations.

It must be however, noted that economical considerations and social forces exerts tremendous forces in adapting to these changes.

2.4 HISTORICAL DEVELOPMENT OF LIBRARY IN NIGERIA

Nigeria has no defined library history for it was a practice left behind by the Colonial masters. In fact it is an imported idea. However, its practice can be traced to the colonial days in Ibadan University library in 1954. From this, other academic libraries drew some inspirations and guidance.

As usual, other forms of libraries generated and took their developmental origin from this point with the greatest progress made in public libraries. Many of them are struggling for survival.

Developmental progress is however, hampered by shortages of finance and inflation.

2.5 LIBRARY REQUIREMENTS

Principally, we have three requirements of the library, and they include:-

(i) Functional Requirements;

(ii) Structural Requirements; and

(iii) Technological Requirements.

2.5.1 **Functional Requirements:-** A proper study of the theoriti spatial relationships of the functional components of the library will provide a useful guide in the design process. This situation can be best understood when one clearly defines the activities that take place in the various

sections of the library. Three major activities exist in a library - users activities, staff activities and materials (both book and non-book materials).

USER ACTIVITIES - Users activities include the search for information, reference, reading,research work, material borrowing, exhibitions, purchase of library materials, attending lectures, seminars, drama, film shows or symposium, e.t.c.

STAFF ACTIVITIES:- The organisational pattern of book progress through the various processes from delivery to shelving and of the various services required before it is made available to users. Such activities include acquisition, despatch/delivery, accession, cataloging and classification.

MATERIALS:- This covers library resources which might either be in printed graphics or non-graphics form. Non-graphics materials are audio-visuals consisting of micro-forms, microfilms, tapes, records, disc, etc. Because they are very sensitive to weather conditions, they are often stored in the audio-visual section in safe envelops, files or catalog cabinets.

The printed graphics refer to books, periodicals, documents newspapers, etc. These materials are stored in shelves according to their subject matter to facilitate easy accessibility and reference with a view to ensuring their security.

In an academic library, there is a common organisational pattern arising from the major activities. Each of these activities mentioned above have been designated a specific activity space within the library. These spaces are related to each other depending on function and readers convenience.

A proper relationship between these three activities can be established through zoning of interrelated functions to enhance performance.

The underlisted are often zoned on the ground floor to enhance efficiency:

- Vestibule, Reader7s store;
- Entrance lobby and control desk, information centre,
- Exhibition,
- Circulation services,
- Toilets and stairways,
- Public catalog,
- Periodical indexes;

all the above are users activities. The vestibule leads the reader to lobby or could drop belongings in store. From lobby to circulation, enquiries/access to issue desk, catalog, referencing, toilets and stairways for vertical movements of humans and books/non-books.

Technical activities involving acquisition, despatch/ delivery, accession, cataloging, classifications and bindery should be located close to staff and separate from readers to enhance functionality, proper control and security.

Figure I is an expression in a sketch form, the functional relationship between the various areas.

Functional Routes linked for Readers and Materials

While appreciating that readers,library staff and materials are functionally interrelated, a definition of circulation patterns will avoid conflict of responsibility so as to enhance accessibility and operational

simplicity. See figure 2 for graphical explanations.

Effective and careful planning would enhance design exceptional comfort which is the author's design target as a major contribution in the scheme.

2.5.2 **Structural Requirements:-** The relationship between the afforelisted library activities have a marked effect on physical layout and structural layout which are in turn dependent on the underlisted factors.

FLEXIBILITY:- In view of the tremendous increase in the change of library needs, either because of professional developments or growth in readership and rise in the standards of physical comfort, no building, however wisely laid out today, will likely remain unchanged years ahead. Hence buildings should be kept as free of fixed elements as possible. Flexibility therefore can be defined as the ability to alter an original design to meet or suit a new situation at practically no cost.

This calls for the followings:

- minimum installation of permanent partitions;
- equipping library with movable furniture and stack to facilitate rearrangements in size or location to meet changing conditions.
- Avoiding built-in features, such as closets and window seats.
- Packaging in one area, all fixed functions such as elevators, toilets, etc.
- Allowance for general service space within the ceiling to enhance mechanical and electrical flexibility.

Figure 2-1

• RELATIONSHIP BETWEEN VARIOUS FUNCTIONAL UNITS OF AN ACADEMIC LIBRARY.

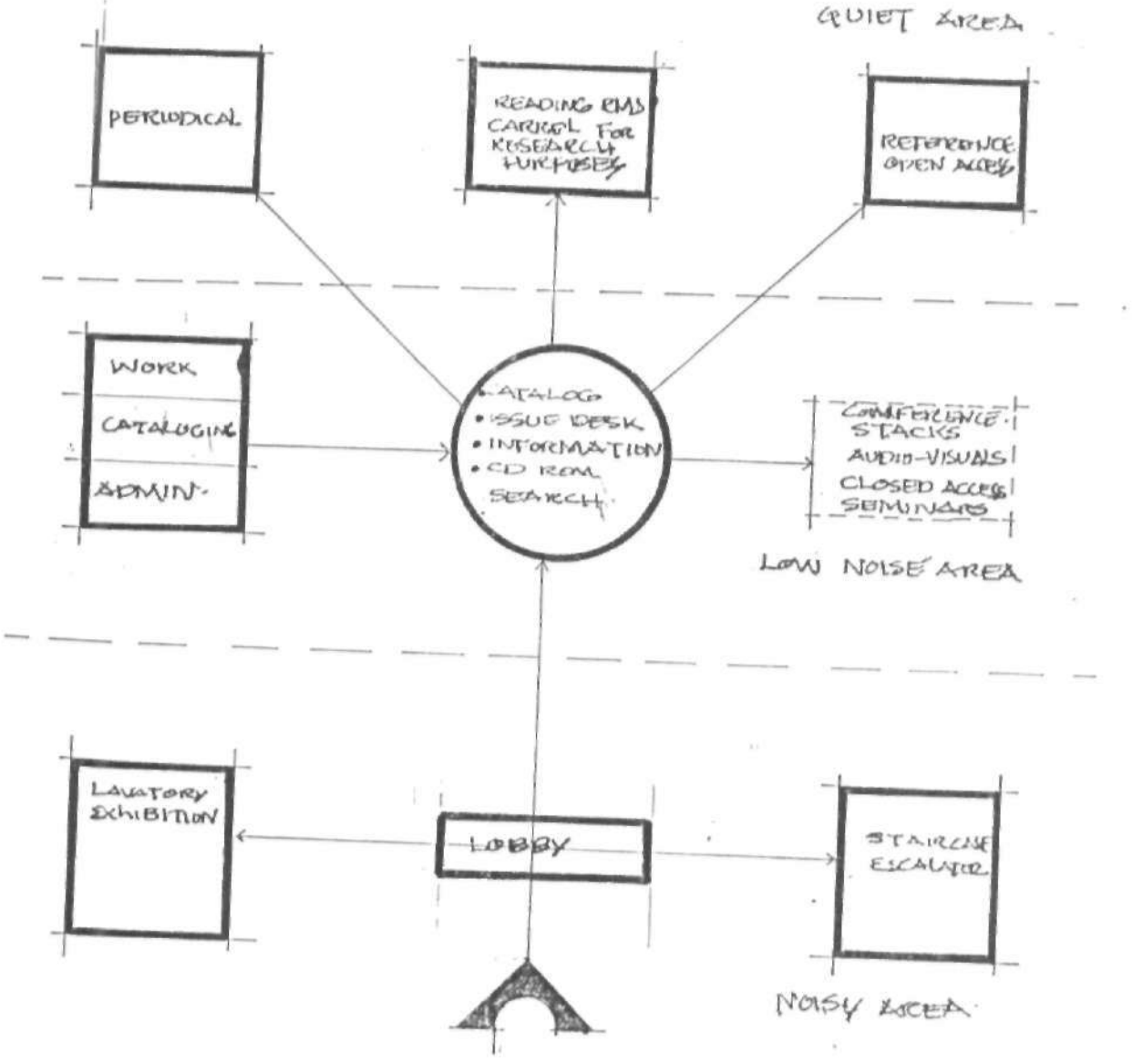
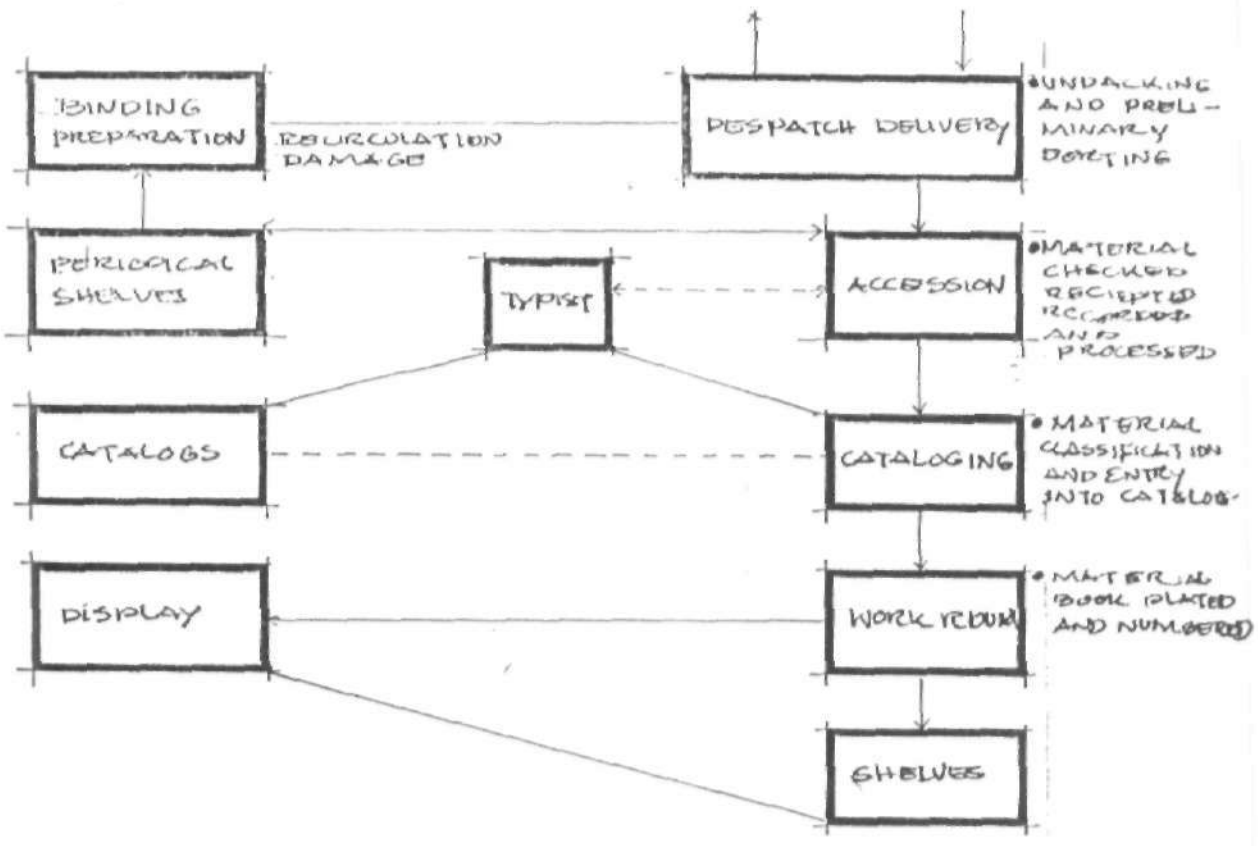
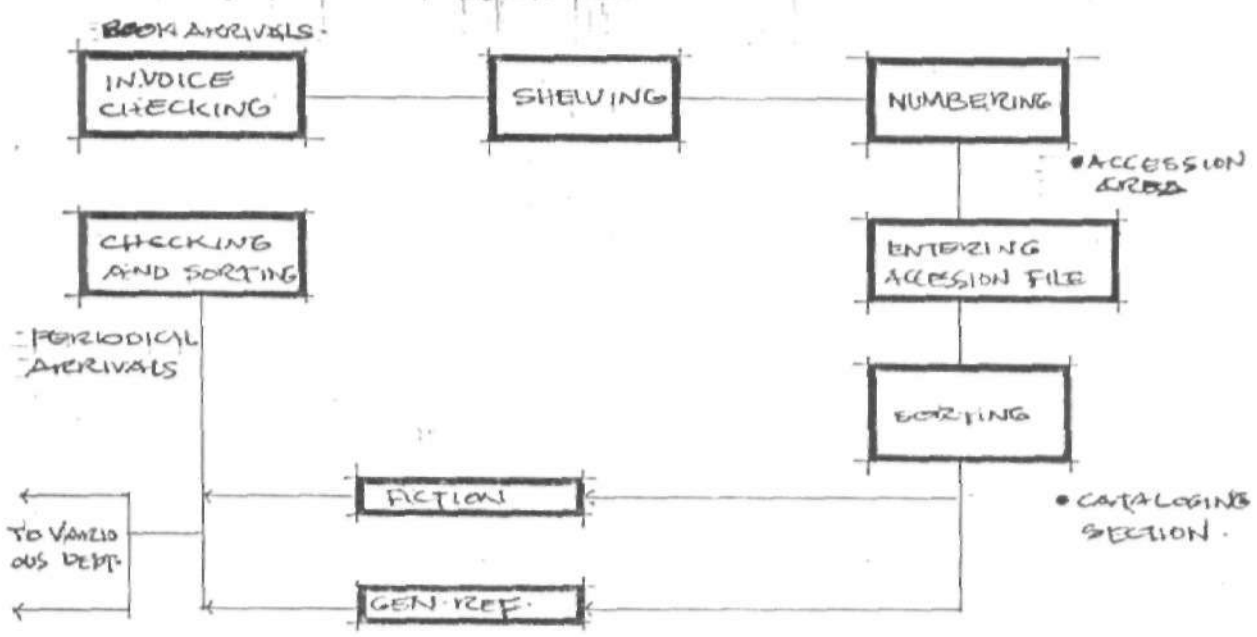


Figure 2.2

• PROGRESS OF MATERIALS ROUTES.



• MATERIALS INTAKE THROUGH PROCESSING SECTIONS.



A space of 900mm was found suitable for this purpose. Provision of vertical duct to facilitate vertical connenctions of wires and air-conditioning system.

EXPANSION:- Architects must realise that space needs will grow. Hence the structure should be designed such that it would be sufficiently elastic to permit expansion without injuring its architectural beauty or diminishing its economical administration. Expansion could be either as a result of increased student enrolment, size of collection or a change in the curriculum. Expansion could be vertical or horizontal. In horizontal expansion, allowance is made on the adjourning ground while in vertical expansion, allowance is made for upward development. While in the former, addition can be done with minimum destruction of existing structure and minimum disturbance on library users, vertical addition has many disadvantages such as: impact noise on users as expansion continues, water penetration through roof during construction spoils book collections.

Application of modular planning to the design of the building structure, elements and internal spaces permits future addition with little disruption of internal activities.

Completed drawings should if possible, indicate clearly the plans and possibilities for its expansion.

Modular Planning:

Modular planning is essentialy a method of planning that makes all dimensions multiples of a basic dimension (known as a module). In modular buildings, all spaces, except for all fixed facilities such as elevators and toilets, etc. are interchangeable.

Flexibility of the modular system is its major virtue - since spaces created in this structure can be used for almost any purpose without expensive alterations which very often involves heavy expenditure. No wonder it has stamped its feet in the libraries and other buildings.

Apart from this, the modular system of planning lend itself to the followings:

- Substantial economics resulting from regularity of structural arrangement and lower overall building height;
- Apart from its economic advantages, the plan of modular libraries makes easy the task of cost estimate;
- Then too, modular construction opens up the possibility of prefabrication - in which case component parts can be mass-produced in the factory under high standard of performance test;
- Its standardised components permit programming of erection time thus leading to appreciable saving in time.
- Easily amenable to high standards of architectural aesthetics and comforms with modern technological sophistication.

Modular planning is however, not without short-comings. No bay size is ideal for all purposes - that is, the module suitable for an office accommodation may not equally suit book-stack dimension. This way, some kind of compromise may have to be made which in the long run may result in less satisfying buildings. Acoustic problems arising from light partition elements not being adequate barrier to sound transmission. Complications may also arise in

determining appropriate floor to ceiling heights. Example is the distance requirement of floor-ceiling height for readers may be unsuitable for bookstacks.

In spite of these demerits, the modular system of planning is here to stay. It however requires careful planning to accomplish satisfactory results.

Air-Conditioners (A.C):

Air-conditioning plant installation in libraries have structural consequences. This calls for strict structural considerations as carelessness may result in undue vibrations which might subsequently lead to the collapse of the entire building.

Air-condition itself is an artificial means of enhancing or conditioning the temperature, humidity, air velocity, ventilation and accoustical level to comfortable limit.

A call for A.C became evident following the near impossibility of achieving a moderate temperature, humidity, air movement and accoustical level naturally all year round.

2.5.3 **Technological Requirements:-** Identifying the new technology in information management, and assessing their impacts on design is of paramount importance to the architect. Increasing emphasis on user's comfort requires that adequate consideration be given new technologies in library functions and library buildings which envelope the operations.

AUTOMATION:- when a computer is used to support a library function, that is, when a computer performs some of the basic processing operations in a function such as acquiring, cataloging and circulating materials or providing access

to information - a computer-based or automated library function results.

Automated system could be referred to as "human-machine system". This is because staff and computer share responsibilities for performing work.

OPAC (on-line public access catalog): REsearch findings have revealed that one of the most important developments in library catalogs is OPAC. It provides speedy on-line access to all library holdings through a computer terminal. On line catalogs serving a single institution or a group of institutions are now an operational reality.

- It has great appeal for users and libraries;
- It substantially reduces the cost of maintaining a card catalog;
- It can be well integrated with other technical service files, streamline and permit reorganisation of the work done in technical service department.
- Easy to locate books.

AUTOMATED CIRCULATION:- The computerised circulation system require the insertion of the punched book card and the borrower's I.D. card into the computer at the same time. The I.D. card carries the student picture, name, registration number, course of study and date of graduation. The transaction is recorded into the computer memory ontapes. This system aids automatic processing of call-ins, renewals, reserves, overdues, calculation of fines, preparation of fine notices and notification of missing items. With the ultimate result being simplified and speedy circulation procedures; accurate and up-to-date statistic concerning use of library materials.

THE CD-ROM (Compact Disc Read only Memory):- It is a new information technology. It is an information support of tremendous storage capacity which can be easily manipulated, transported and can tolerate heavy manipulation and climatic conditions.

CD-ROM technology has the potential to facilitate greatly the process of identifying and obtaining such literature. Catalog can be put in CD-ROM for consumption by users. In addition, compact disc stores book contents and reference materials.

It must be however,noted that one can only read the information on the disc. It is not possible even by accident to change any information on the disc.

AUTOMATED ACQUISITION SYSTEM:- This is introduced as a best way to curb the problems imposed by a higher rate of acquisitions. By means of the computer display terminal,

- slip orders are produced and sent to vendors,
- maintaining file of material on order,
- receiving , invoicing and processing information
- claims for items not received are easily produced.

This way, extensive manual files and other manual jobs are eliminated.

INTERNATIONAL INFORMATION HIGHWAY (THE INTERNET): the internet can best be described as a network of computer networks. JANET (joint academic network) used in U.K. to access the internet. It is linked to universities and government establishments, etc.

The Internet is a source of information. Probably the largeest intellectual resource in the world. The computer

on the Internet contain GIGABYTES of available information. This informationhave been published so that anyone, anywhere around the Internet can use.

INTERNET INFORMATION SERVICES:- Users can gain access to internet via the servers. Such servers include:- the wide area information server (WAIS) and most recently, the world wide Web (WWW) which probably offers the best information service on the Internet. Using the gateways they provide access to virtually everything.

ELECTRONIC MAIL (E-mail):- Simplistically, electronic mail is a tool that enables people to send text to each other using computers. they serve both locally and internationally. In local cases, computers in the same building or locality can be used to exchange mails between people.

International cases: Computers and people scattered across the globe use the E-mail to pass on news and other information, to discusss topics and for collaborative writing and document exchange. There is no doubting the fact that E-mail is an extremely useful instrument for handling and diseminating information.

MICROPHOTOGRAPHY: A micro-image is a unit of information such as a page of a text or a drawing, too small to be read by the unaided eye. Micro-image through various programs can be used for the preservation of documents. Microforms assumes various shapes; cards, film, fitche, etc. This new technology that have gained wide applications in library preservation shall be briefly outlined as below:

Microfilm:- serve as a medium for compressing information, transporting it into another area, and reproducing it in

hard-copy form. The major problem here is that it is not flexible.

Microcard:- An opague card with photographic images arranged inrows. Periodical literature and scholarly material could be made available inthis format.

Microfiche:- it is a rectangular sheet of film on which are placed multiple micro-images arranged in rows with an eye of readable index at the top of the card. It is flexible.

Applicable in area of preserving physically deteriorating materials and compressing bulky text, newspapers, journals, etc. It is however not without its shortcomings as it becomes bad and toxic with time which is injurious to health.

Audior-Visuals:- In the times past, printed page, was the major carrier of information, but today, tapes, discs, slides, graphics, etc are valuable carriers of information. Copying machines are equally available for copying tapes and cassettes.

Automated slide shows are developed to teach students the use of library. When these projectors are combined with self-instructional manual, they constitute a crude sort of teaching machine.

Book Transportation:- Various mechanical efforts like the conveyor belt and the Randtriever exist for book transportation and retrieval. Randtriever receives books from the shelves and returns them with minimum human effort. Example is found in Rotterdam.

Security Devices:- stealing of library resources is as old as the history of libraries. Manual exit controls is not very effective. Modern electronic charging and exit checking systems are more efficient and effective if properly utilised.

Both systems requires patrons to charge out a book in the usual way. During this process, the electronic control is released. The patron leaves the library through a barrier. The barrier which is connected to the charging desk via an electric wire, shut automatically if the patron is carrying improperly charged book. It can only be released by an attendant at the charging desk.

The electronic exit control barrier can be placed immediately inside the exterior doors of the library.

Close Circuit Television:- Uses cameras (various) - can be used to monitor student activities in various units of the library. Through this, these vices such as mutilation and hiding of books in wrong shelves can be arrested.

Modern storage facilities not only preserve our library materials but also compress bulky materials to a reduced size leading to space savings and convenience.

The opportunities offered by the internet is amazing. You can lay your hand on any information, anywhere, anytime in the world if you are on the internet. The electronic mail is another major area of advantage. With E-mail, you can send your message to any part of the world with ease under twenty-four hours.

In fact, to neglect the potentials of electronic communication is tantamount to pushing aside golden opportunities to forestall stronger links with students and to become much more actively involved in their learning.

A critical issue which needs to be addressed here is the large amount of library users relative to the cost of purchasing computers for their use. Lack of qualified personnel to handle the technical intricacies involved in the use of these machineries call for concern. Equally important is the poor nature of economy, especially in developing countries.

Impacts on Design:

Impacts of modern technology on library building design are in areas of space allocation and machine requirements.

Space Allocations:- Library buildings in the future will undoubtedly get smaller as we sharpen our thinking on how far we can rely on systems which deliver documents on paper or electronic form. However, the emphasis here is both on space reduction, and a flexible plan that can adapt to these changes easily.

Allowance must be made for all categories of equipment such as the following:-

- computer machines made up of central processing unit (CPU) and the peripheral of in-put and out-put devices, that is the hardware and soft-ware.
- communication centre (internet and E-mail) to facilitate internal and external information exchange.
- Xerox and other copying machines.
- Electronic typewriters.
- Electric door locks.
- Fire alarm system.
- Elevator and conveyor belts (if to be used);
- Microfilm cameras.

- Microfilm, microcard, micro-print readers and even printers.
- Photographic laboratory for film treatment and other media.
- Music and language listening facilities of various kinds.

Machine Requirements

Requirements for the various machines can be categorised into two: environmental and electrical:-

Environmental Requirements:- Computer and other machineries require air conditioning to reduce dust, and also to regulate the temperature and humidity. Accoustic treatment is desirable to counter or absorb the noise generated from the operation.

Electrical: More machines means more electric power needs. Hence the provision for the availability of power in any reasonable amount is desirable. The building should be designed such that the conduits and cables can be installed as they are needed.

Provision of under-floor conduits could carry almost any specific system. Ample ceiling space required to receive ducts for horizontal distribution; vertical mechanical ducts is desirable for both electrical and air-conditioning.

2.6 Thesis Position

Information technology (IT) adds a new dimension to established university library programs in just the same way that all developments in the communication field have added to the cummulative total without replacing one another.

If we are going to have excellence in education, a proposal of traditional bookstock plus the IT is desirable.

As for actual or complete computerisation of the library, the general finding have revealed that we are as yet sufficiently impressed with the economy, utility and availability of this service. Hence full commitment cannot be made.

The only thing we can think of is changes so the building should be physically as completely flexible as possible.

CHAPTER THREE

CASE STUDIES

3.1 Kenneth Dike Library: University of Ibadan, Nigeria

ARCHITECTS: MAXWELL FRY & JANE DREW

CLIENT: IBADAN UNIVERSITY

LOCATION: The library is strategically located at the centre of the Campus, thus, guaranteeing easy access from all spheres of the university.

3.1.1. Building Design Features:

The Library is a combination of old and extension building:

OLD BUILDING: it is a slender rectangular building standing on six floors with an area of 4,283.5m². The basement houses toilets, other services and technical issues. On the ground floor, the entrance leads into the lobby, catalog display, information/enquiries, exhibition and general reference collections. Located on the first and second floors are areas for book-stacks and readers in various disciplines. The university librarian and other secretarial staff are accommodated on the third floor to the western end. On the eastern end of the same floor is earmarked for bookstacks and readers.

Offices for the deputy librarian as well as general administrative staff are located on the fourth floor. Map rooms with provisions for readers, carrels and other collections are also located on this floor.

Least I forget, the service lift is not operational for the period covered by this study. Simplicity was the major virtue of the design as the layout is simple to follow.

Structure:

The building have the columns and beams as the primary structural elements with the sandcrete block wall enclosing the structure. Walls are of normal cement/sand rendering finished in paint.

Flexibility:

The ability of the structure to adapt to internal rearrangements is simply interesting. It is not hard to conceive this seeming flexibility as the fixed elements such as staircase, lift and lavatories are centrall grouped, thus dividing the building into two halves. The rest of the floor areas are little interrupted by structural members.

Library Comfort:

The building was designed to provide without air-condition. This zeal dictated the slender, long rectangular shape of the building. Cross-ventilation was achieved through the provision of openings on both longer sides of the library. Running varendahs the full lengths of the building help to keep the sun off the main structure.

Funiture:

Furniture are essentially made of metal skeleton and wooden platform. the stack on the other hand is made of steel. To facilitate flexibility, the aforesaid furniture were designed to be movable.

Modern Technology in Use:

Two major factors that influence the change of trend from manual to technological, are comfort and savings in space and time of users including staff alike.

- the on line public access catalog (OPAC) is to replace the card catalog currently, it is at programming stage;
- The CD-ROM SEARCH - this refers to compact disc read only memory. A technology which is fast dorminating the world of reference searching.
- The Electronic Mail (E-Mail) - A tool that enables people to send text locally and internationally as discussed in the previous chapter.

The New Building:

A larger extension of 5,212.57m² areas was added at right angles to the old structure in 1969 February. A research library, as it is commonly referred to, is mainly to serve research and post-graduate students.

Composition here is not too different as it maintains the imposing structure of the old building.

Plant room, hoist motor room,serial/journal and toilets arethe main features of the basement. On the ground and first floors are located bookstack areas, microfilm reading room, research librarian, and other secretarial staff. Sky-light was admitted into the reading room of the first floor through the maroon coloured ceilings prepared from a dirt-resistant ground-glass compound known as fantax

Comfort:

Unlike its predecessor, it was designed to be centrally air-conditioned for books preservation and human comfort. Though not functional for the period covered by this study. A situation which may of course, not be unconnected with complex technical and financial problems associated with the use of cental A.C. system.

Finishing

The outer wall is covered with a form of quartz, known as Nigerian marble from Lokoja. This way, maintenance needs (like painting) are kept to the minimum. The inside is finished in panel of sterculin, a timber from Sapele.

On the whole, the library occupies 9497m² areas, housing ½ million volumes and seating 1,250 readers.

3·1·2

Merits:

Accessible to user because it is centrally located.

- Effective natural ventilation and lighting achieved by keeping building narrow, with openings on bothsides. Another concious effort, was the running of verrendahs the full length of the building which keep the sun off to enhance thermal comfort.
- Flexibility, as earlier identified is an important virtue of the building. The librarian was most impressed that the design proved extremely satisfactorily efficient and adaptable to alterations and general re-arrangements at little or no practical cost.

3·1·3

Demerits:

The conspicous external steps has proved to be one of design shortcomings, as it is unattractive.

A further negative effect of the steps is that, it does not permit the physically handicapped to access thelibrary stock.

- The elevation of the building is not aesthetically appealing. The completely screned facade with mosquito netting is simply monotonous and boring.
- The absence of a stand-by generator means that the anticipated automated system will run the risk of inconveniencies anddisruption of having the system down for as much as NEPA fails to supply power. Too bad!

Summary:- There is no doubting the fact that the design was successful at utilising environmental conditions and design elements to achieve comfort in the building. Effective utilisation of its resources will surely enrich the educational experiences of students and staff beyond expectation. See sketches in figures 1 - 5 and plate 1 for illustrations.

3.2 University of Lagos Library

CLIENT: LAGOS UNIVERSITY

OCCUPANCY DATE: The building was completed and occupied in July, 1965.

LOCATION: The library building which is located behind the University Senate building is surrounded by facilities and student hostels. By and large, it is centrally located for easy access.

3.2.1 Building Design Features

The building stood on four floors. The basement provides area for the lift machine and the machine room.

The key features of the ground floor are; entrance vestibule, control counter, electronic gate, circulation, cataloging an computer application unit. Other services on this floor are the Ghandi Library, store, administrative offices and work rooms.

Toilets are located centrally beside the stair-case which conveys books and passengers to the first floor. The main area of this floor is designated for the university librarian, his deputy and other secretarial and administrative staff. Provision for book-stacks and readers are made for divisional library.

The upper floor areas are earmarked to serve readers, faculty members with book-stacks. Another special feature is the carels. The building form is simply the block type without courtyards with tiny strips of openings on most sides.

Structure

Frame construction of beams and columns was the adopted structure. It is enclosed by external walls. The building was finished with farefaced concrete.

Flexibility

Notably visible is the concious effort on the side of the designer to achieve flexibility. The library tend to avoid as much as possible permanent partitions and fixed elements. To this end, the area denoted for services core such as staircase, lift, toilet were zoned in one area.

Library Comfort

Unlike its Ibadan counterpart, it was designed to be centrally air-conditioned - which calls for deep planning.

Ventilation and thermal comfort is purely mechanical. In this wise, the user's comfort is threatened and a collapse of the system becomes eminent with NEPA failure and voltage flunctuation. Lighting in the library is dependent on the bank of oppressive artificial alternative.

Funiture

In the same way with Ibadan case, seats were of metal skeleton, with a wooden platform finished in foam to enhance comfort. The stack are the movable steel type. Hence they can be removed and easily replaced.

Modern Technology in Use

The library's automation has attained a reasonable level. The on line public access catalog is also in use.
Another special feature of their technology is the electronic gate. A security device which raises alarm if an improperly charged book is to be taken away. Anticipated is the close circuit television to scan library users at various points to ascertain defaulters.

Finishing

Purely fair-faced concrete finish and painting used of recent.

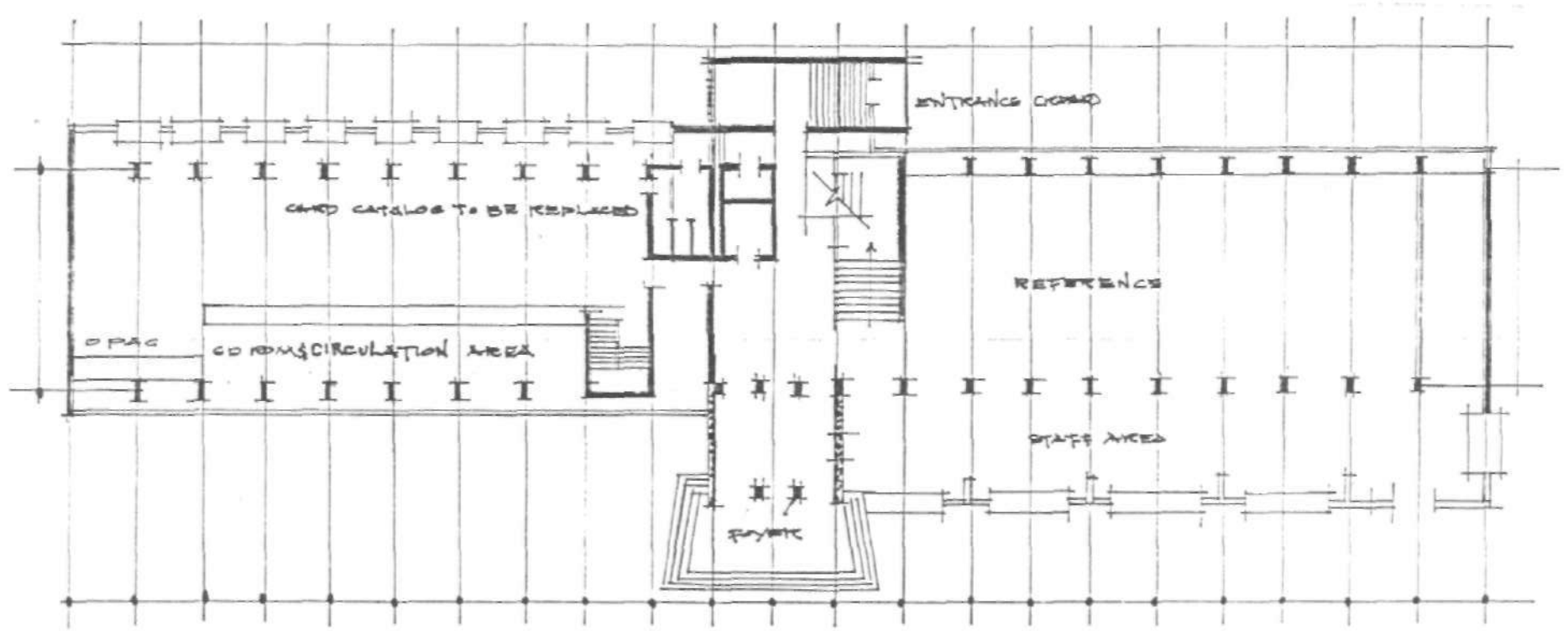
3.2.2
Merit

The fair-faced concrete finish reduces maintenance task to a minimal level.

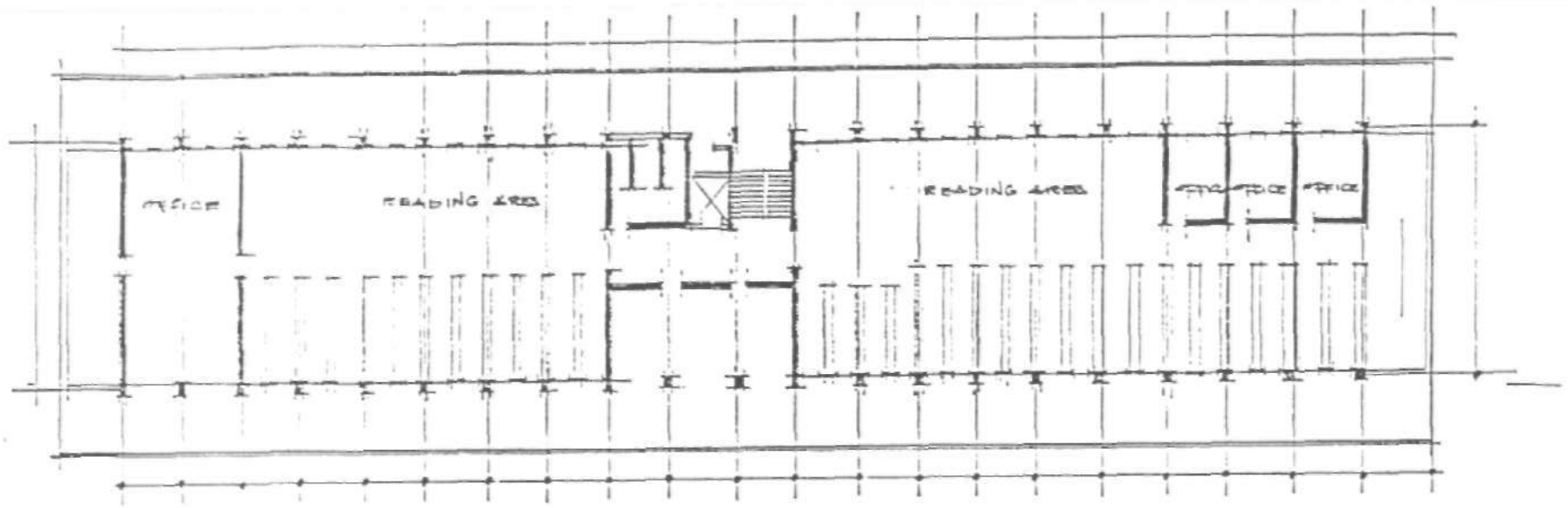
- Modular system permits flexibility;
- Circulation pattern fairly good;
- Security in the library greatly emphasized.

3·2·3·
Demerits

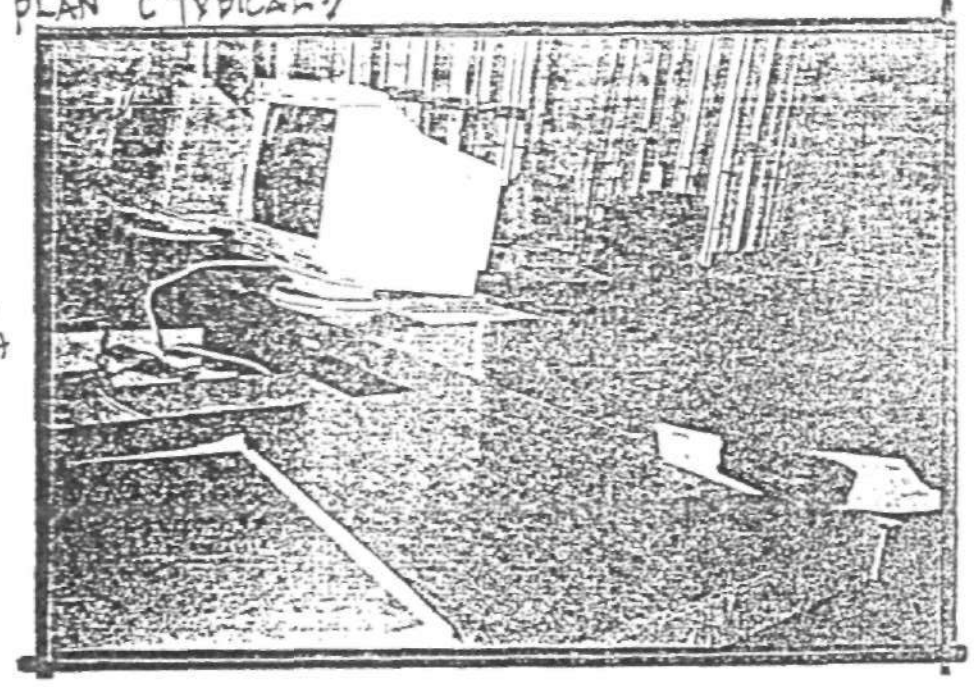
- Its narrow projected windows surrounded by fins hardly let in air in spite of the location of the building by the lagoon. This way, natural ventilation becomes a major problem.
- The design of the building to be centrally air-conditioned dictated deep planning approach. However, since the central air-conditioner broke down in late 1970, a permanent solution has yet to be found to the effective cooling of the building.
- Again, thedeep planning requires greater dependence on artificial lighting which is completely unreliable in Nigerian context.
- The flat concrete roof posses a major constraint as the building ages, leakages are experienced. Figure 6 - 11 and plate 2 give a panoramic view of the building since it is not possible to describe every aspect of the building.



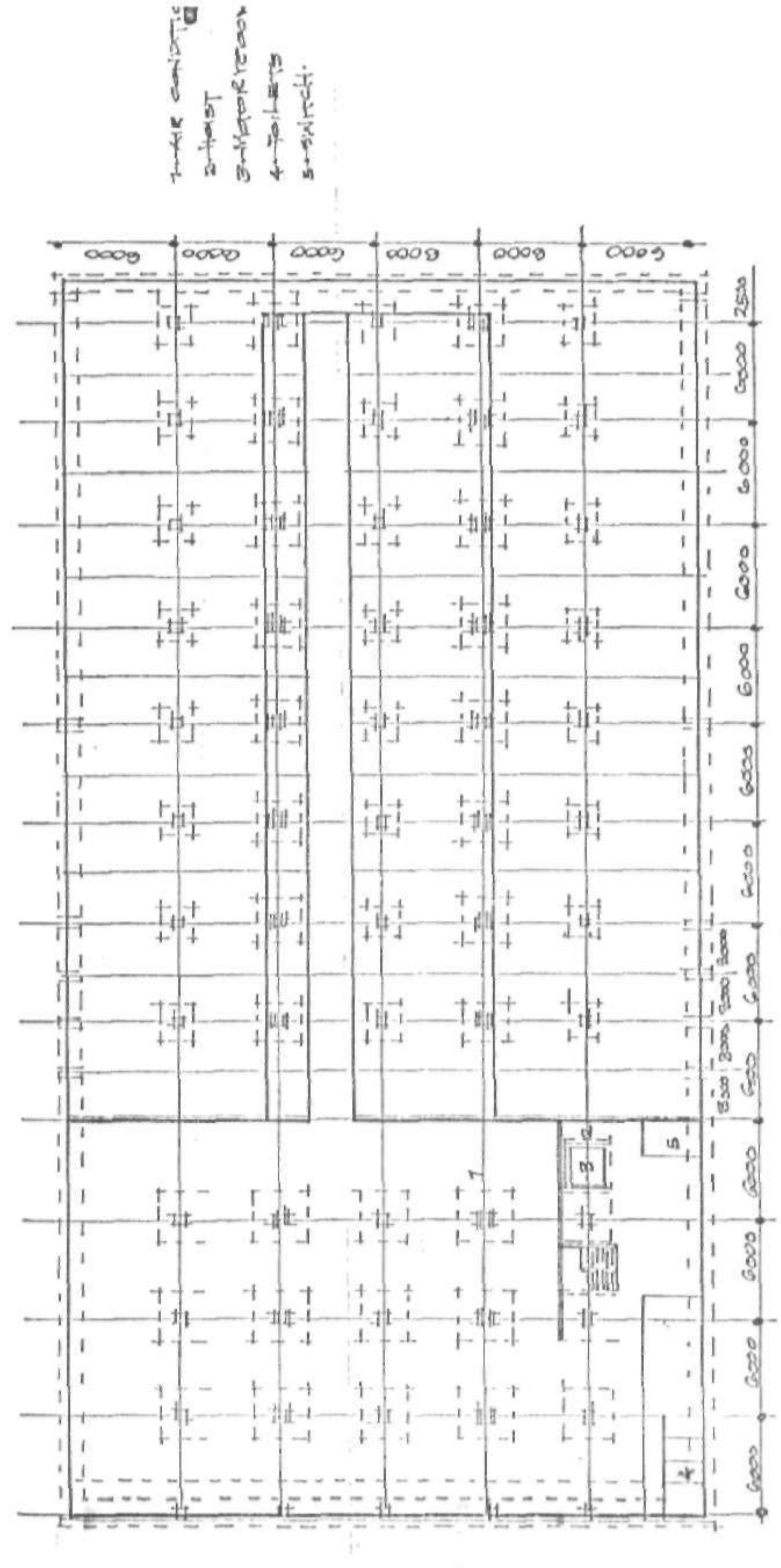
● GROUND FLOOR PLAN



⑤ FIRST FLOOR PLAN (TYPICAL)



○ COMPUTERISED CATALAG AND CD ROM SEARCH



BASEMENT PLAN (EXTENSION.)

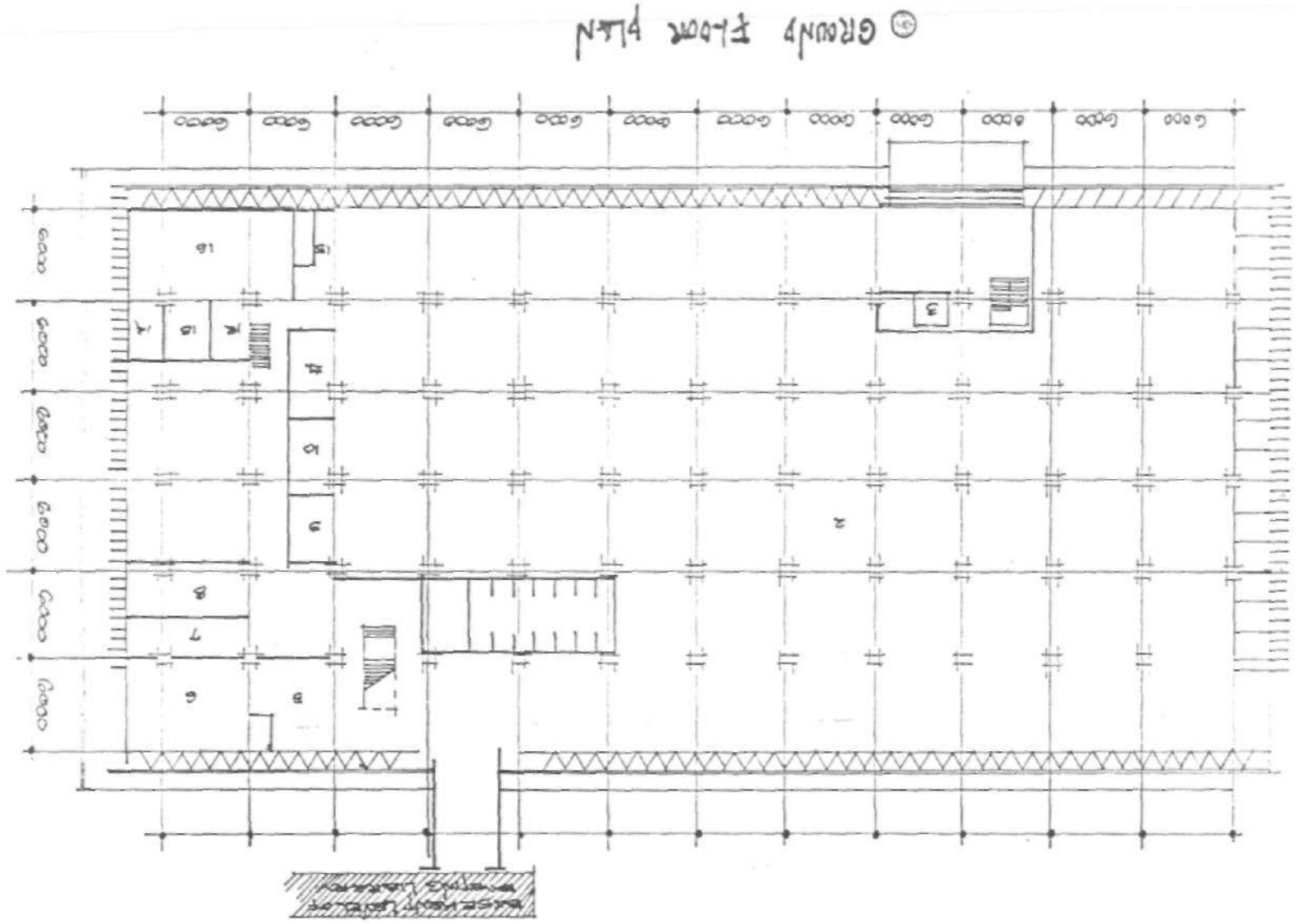
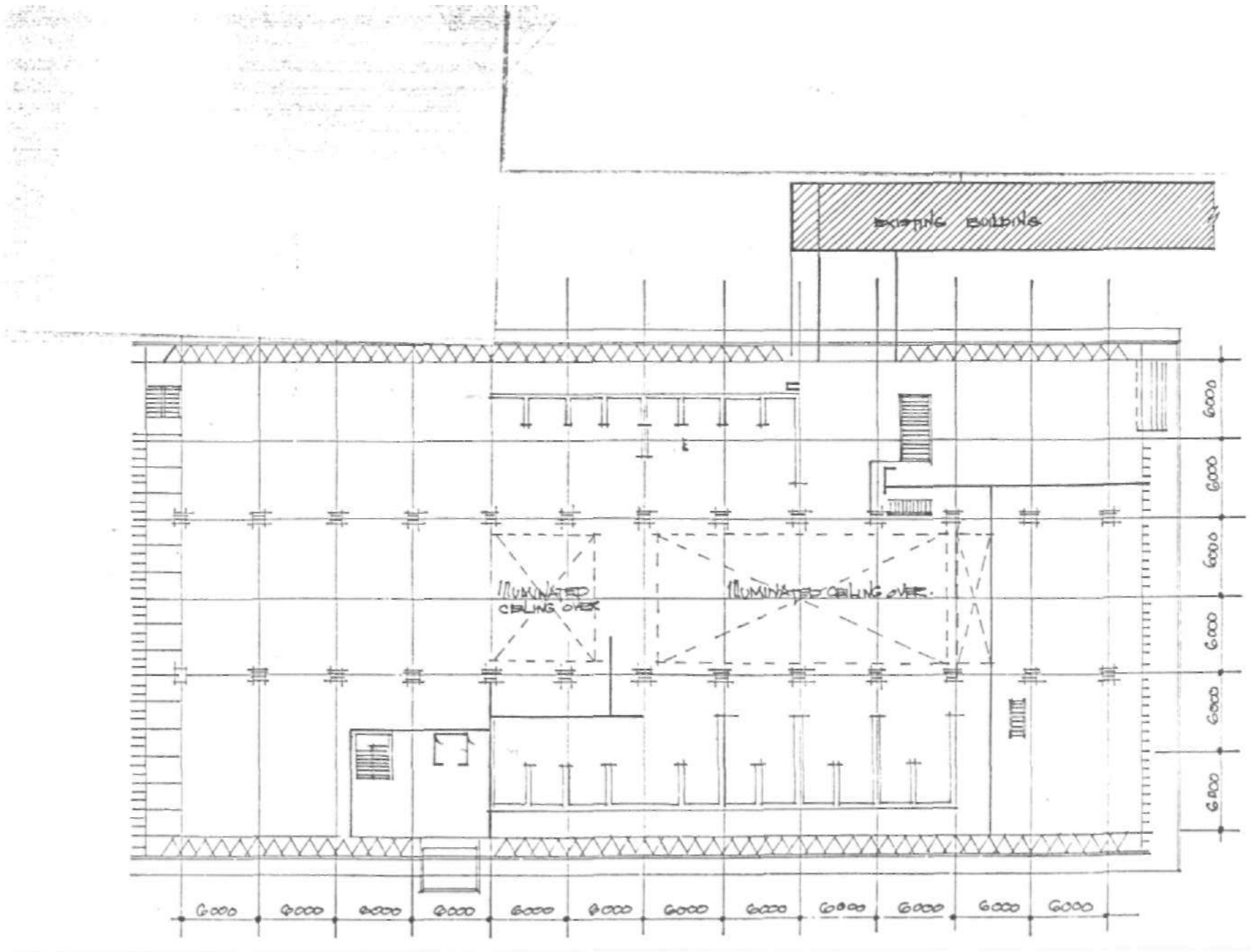
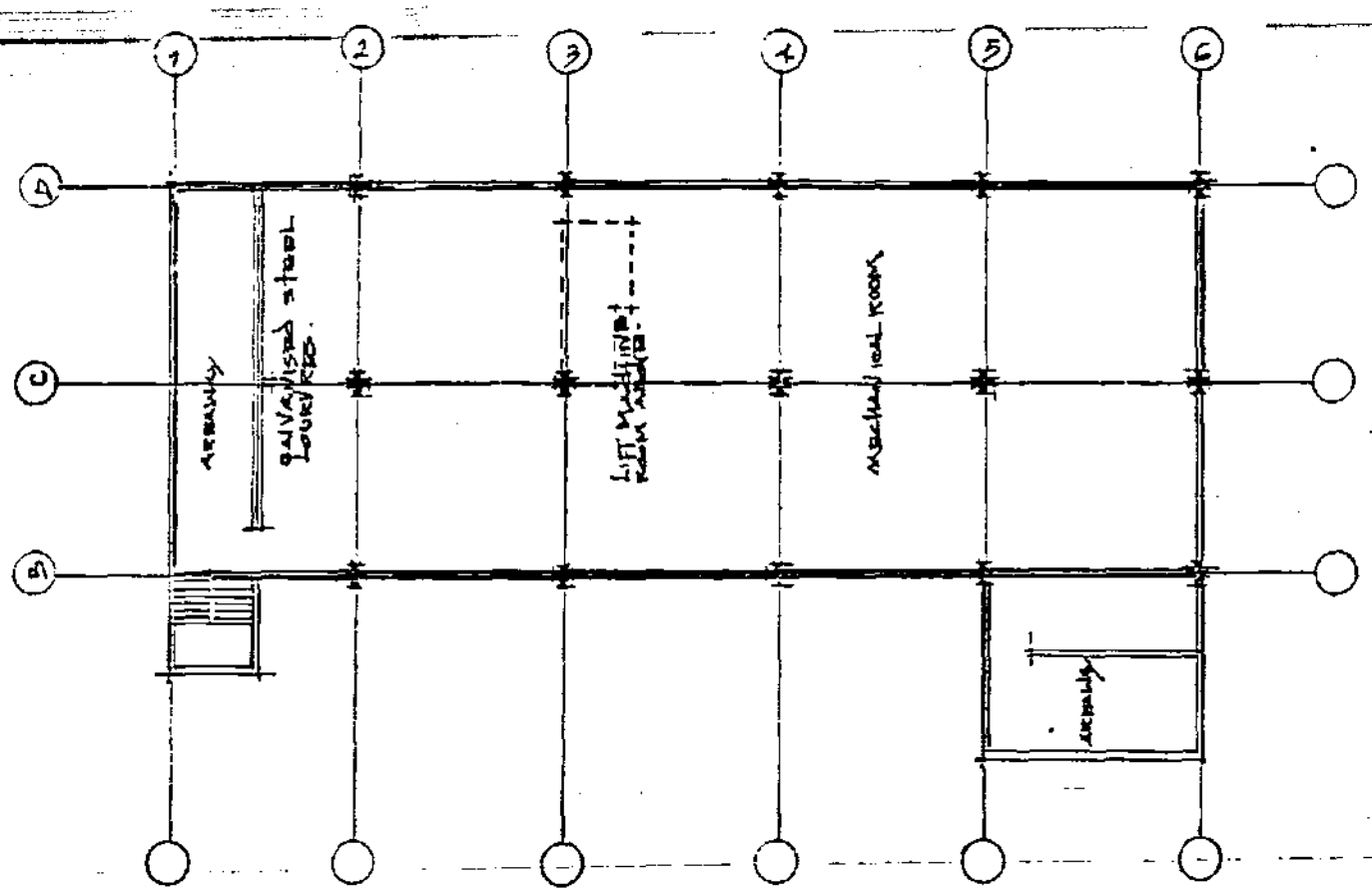

① Ground floor plan
1 : Cafeteria
2 : Bank
3 : Office 1
4 : Shop
5 : Common room
6 : Lobby
7 : Security office
8 : Library
9 : Office 2
10 : Office 3
11 : Staircase
12 : Office 4
13 : Office 5
14 : Meeting room
15 : Laboratory
16 : Open room

Fig. 3-4



© FIRST FLOOR plan.



⊕ BASEMENT PLAN

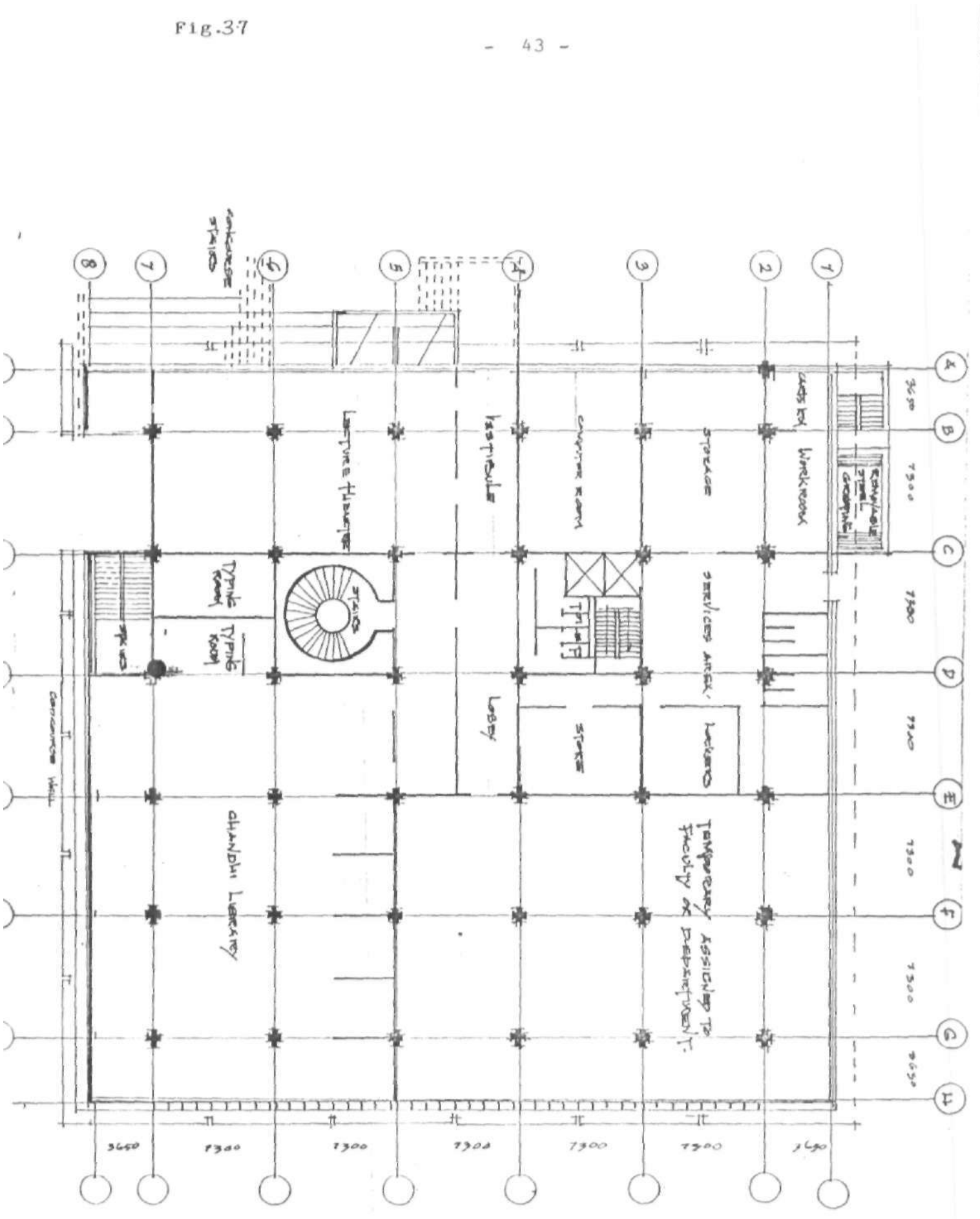
MERITS :

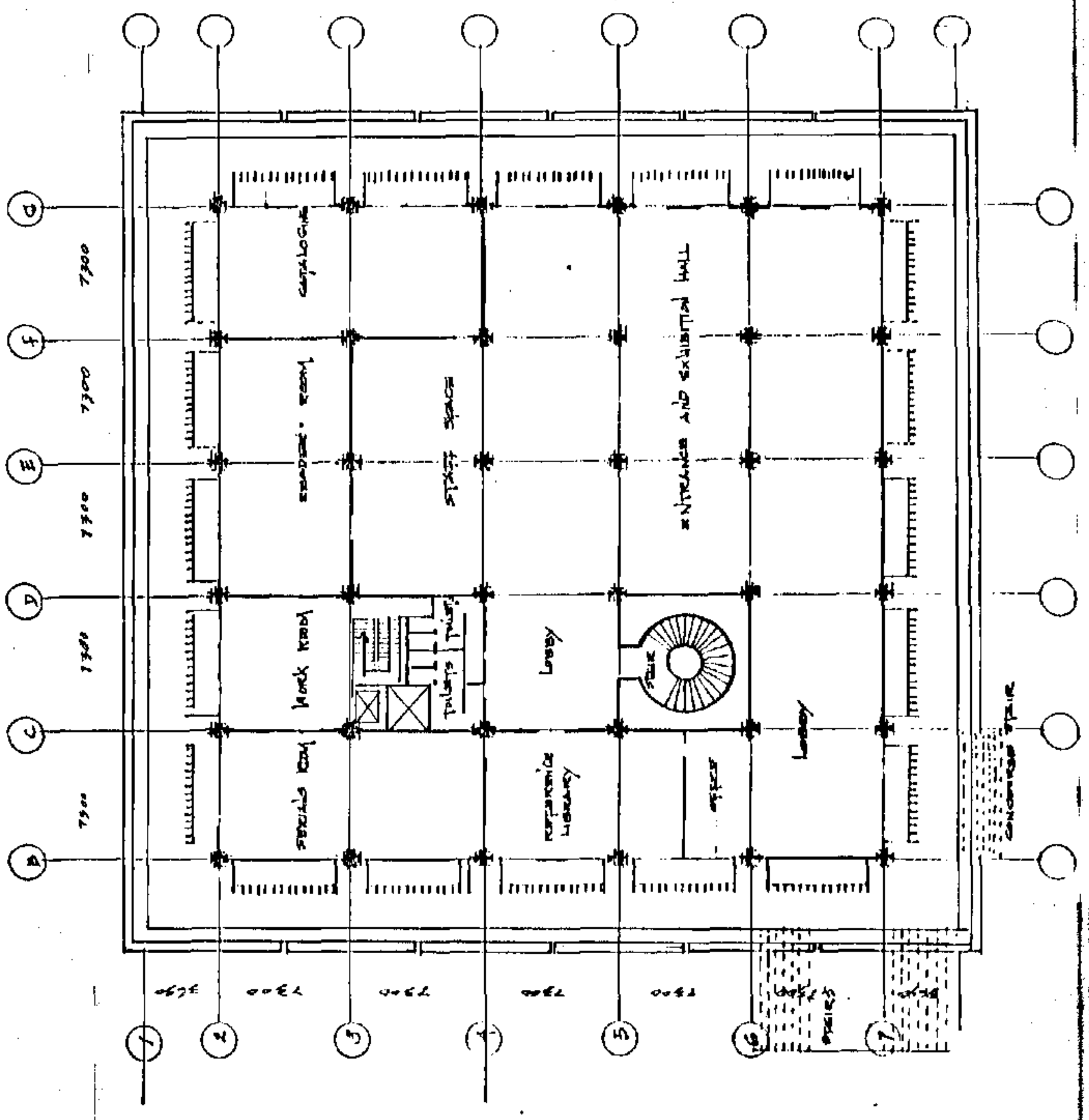
- CONSIDERATION FOR EXPANSION IN THE DESIGN.
- MODULAR APPROACH WHICH PERMITS ADAPTATION TO CHANGING REQUIREMENTS.
- FLEXIBILITY ENHANCED BY ABSENCE OF MANY PERMANENT ELEMENTS
- ECONOMY OF DESIGN THROUGH COMPACT DESIGN

Fig.3.6

- 42 -

Fig.37


Workroom
Lecture theatre
Lobby
Storage
Computer room
Services area
Lecture
Store
Temporary assistant to Faculty of Architecture
Typing room
Typing room
Store
Store
Lecture
Lobby
Chandigarh Library
3650
7300
7300
7300
7300
7300
3650
7500
7500
7500
7500
3650



FIRST FLOOR PLAN.

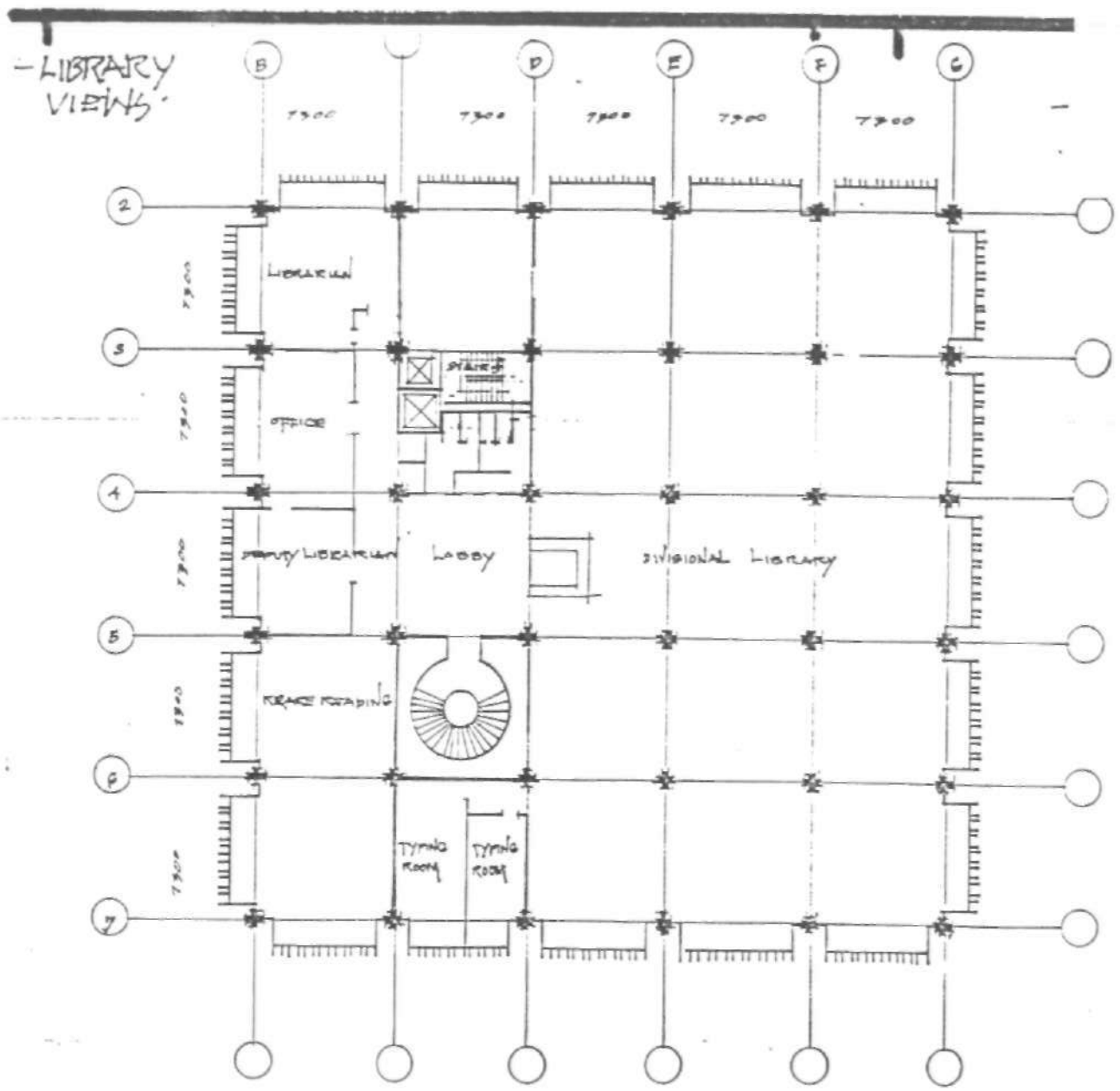
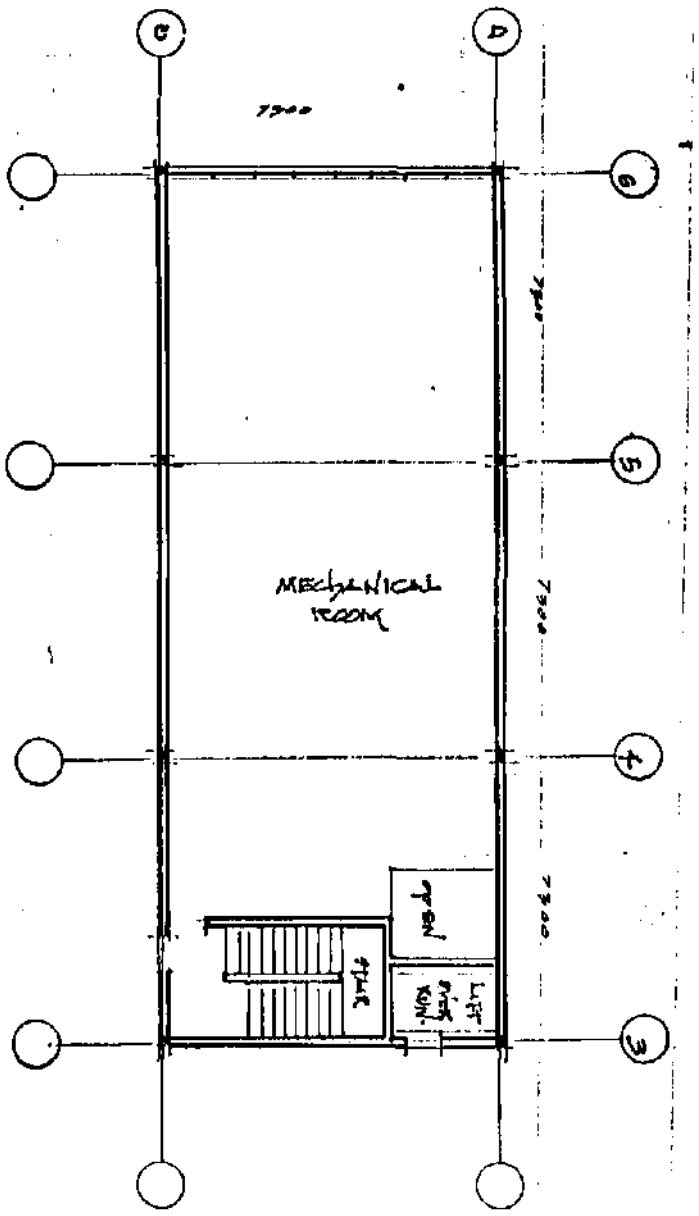


Fig.39

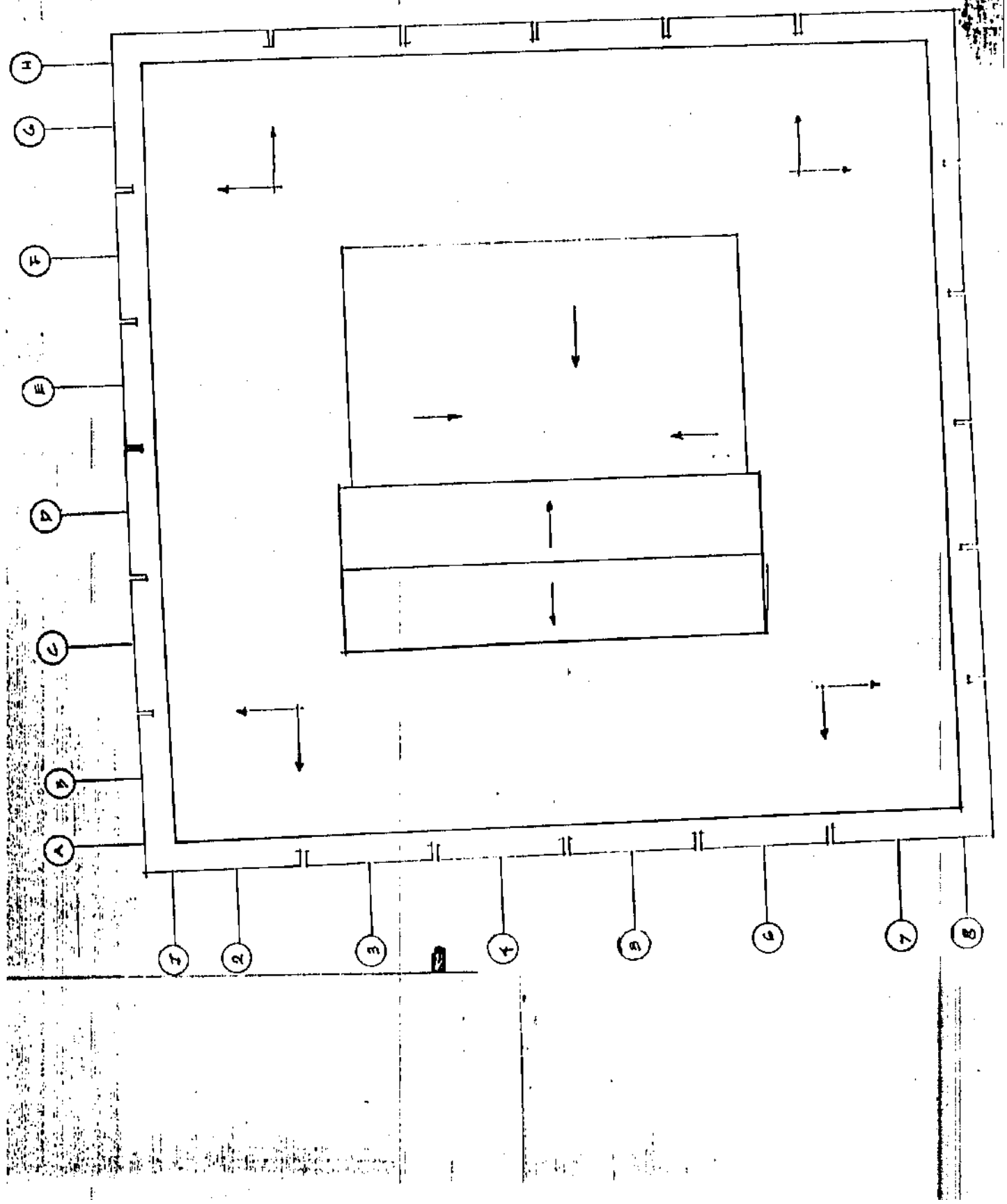
© SECOND FLOOR PLAN.

Fig.3.10



● PENTHOUSE.

Fig.3·11





A VIEW OF UNIVERSITY OF IBADAN LIBRARY. PLATE 31.



A VIEW OF UNIVERSITY OF LAGOS LIBRARY.
PLATE 3.2.

3.3 Kashim Ibrahim's Library, Ahmadu Bello University Zaria (ABU)

ARCHITECTS: Egbor and Associates

CLIENT: Ahmadu Bello University

LOCATION: By location, it is bounded to theeast by biochemistry department. On the Western end is architecture department andcomputer department/centre is to the southern border. Finally, it is bounded northwards by Ribadu/ Allexander Hall. Inthis wise, it can be easily conceived that the library is freely accessible to users.

3.3.1. Building Design Features

A two storey building designed to house 170,000 book volumes, 2,000 microfilm items, and 34,000 bound volumes of periodicals. On the whole, it is supposed to house 500,000 volumes and seat 2,000 readers.

Principally, the ground floor contains the entrance, exit point, lobby, exhibition, serials, reference and public catalog. Other features include administrative offices and work rooms. The first floor is mainly designated for book stacks and readers in various dsciplines. Office of the librarian, his deputy as well as general office for library administration are also located on this floor.

Other features include the careis and audio-visual. On the final floor is located the reserved books area, documents division and Africana. The western end of this floor houses the stack and readers in science and technology. Seminar rooms are provided also on this floor.

Structure

The structure is reinforced concrete frame with sand-crete external block walls and internal temporary partitions.

Flexibility

The Modular planning adopted enhance response to changing library needs.

Thermal Comfort

The building was designed to depend on mechanical ventilation which entails the use of air-conditioning machine. This approach dictated deep planning. But with the unreliable nature of power supply in Nigeria, this system is not effective.

Furniture

Furniture are not the fixed type. Basically, they are made of circular and box hollow metal pipes as skeletons. A platform of wood finished with foam is connected to the skeletons. The stacks are equally of steel and of course movable thus, permitting internal rearrangements.

Finishing

External walls are finished in paints after being rendered with cement/sand; the main columns, are finished with wood pannels. On the other hand, the projecting lobby's entrance and canopy are of the taroleen finish.

3.3.2
Merits

- Circulation pattern is to some extent well articulated;
- A better elevational composition;
- The building is able to officer substantial functional relationships of the various units;

- Both vertical and horizontal shading devices were applied to keep the sun and rainstorm off the main structure.

3.3.3
Demerits

- Deep planning approach does not permit effective natural lighting and ventilation. In this wise, human comfort and book preservation is threatened in events of power failure;
- Building structure not well resolved as vibrations are experienced when the central air-conditioning plant is on. It is in the face of this constraint that the A.C. plant is not used. This is by all standards an economic waste.
- Offensive odour often generated from the toilet located near exhibition hall is not only unpleasant but discouraging.
- Building security not well articulated as books could be thrown out through the window. In fact, the author witnessed such ugly scene once.

For better appreciation of design approach and building elements, see Figures 12 - 15 for illustrative sketches.

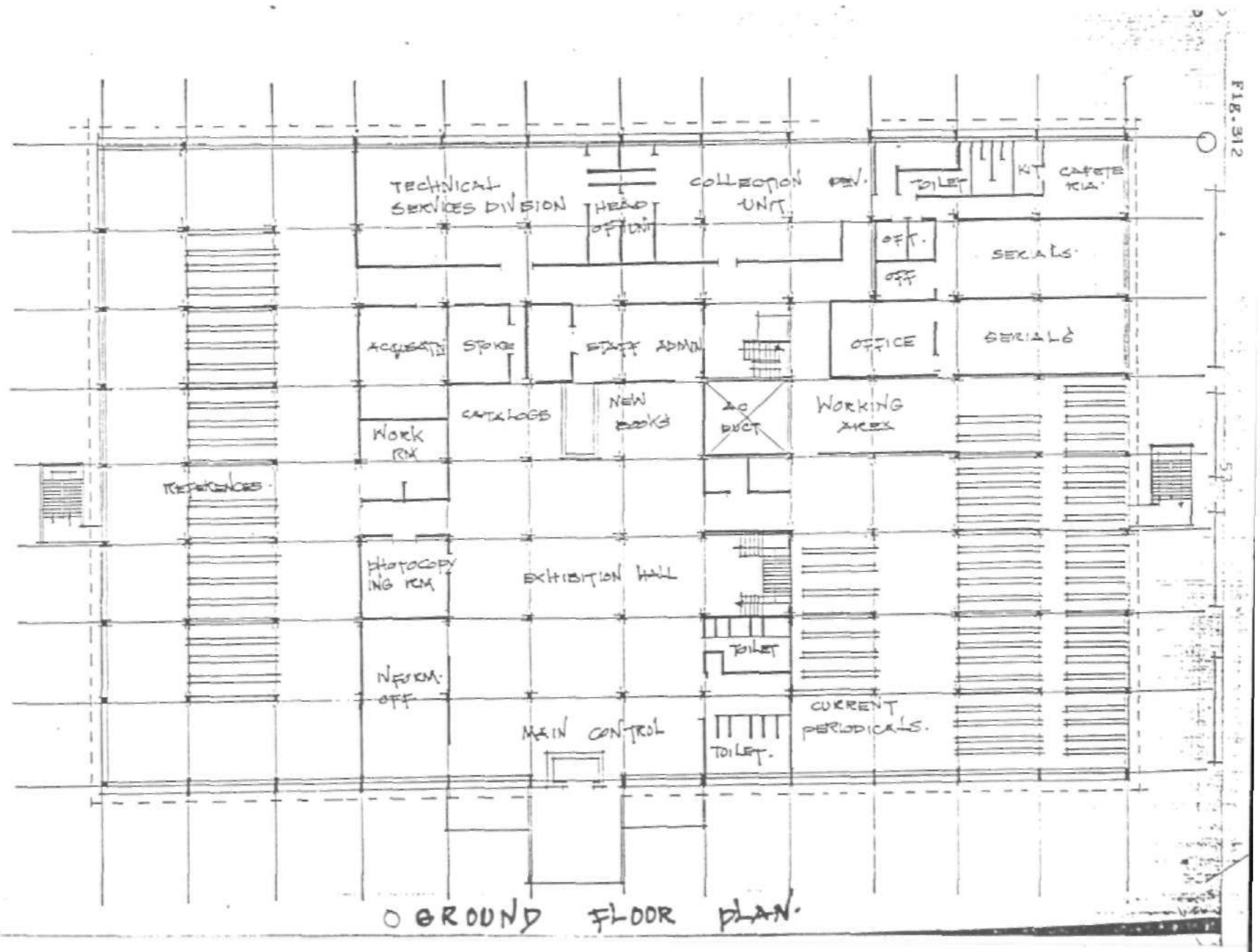
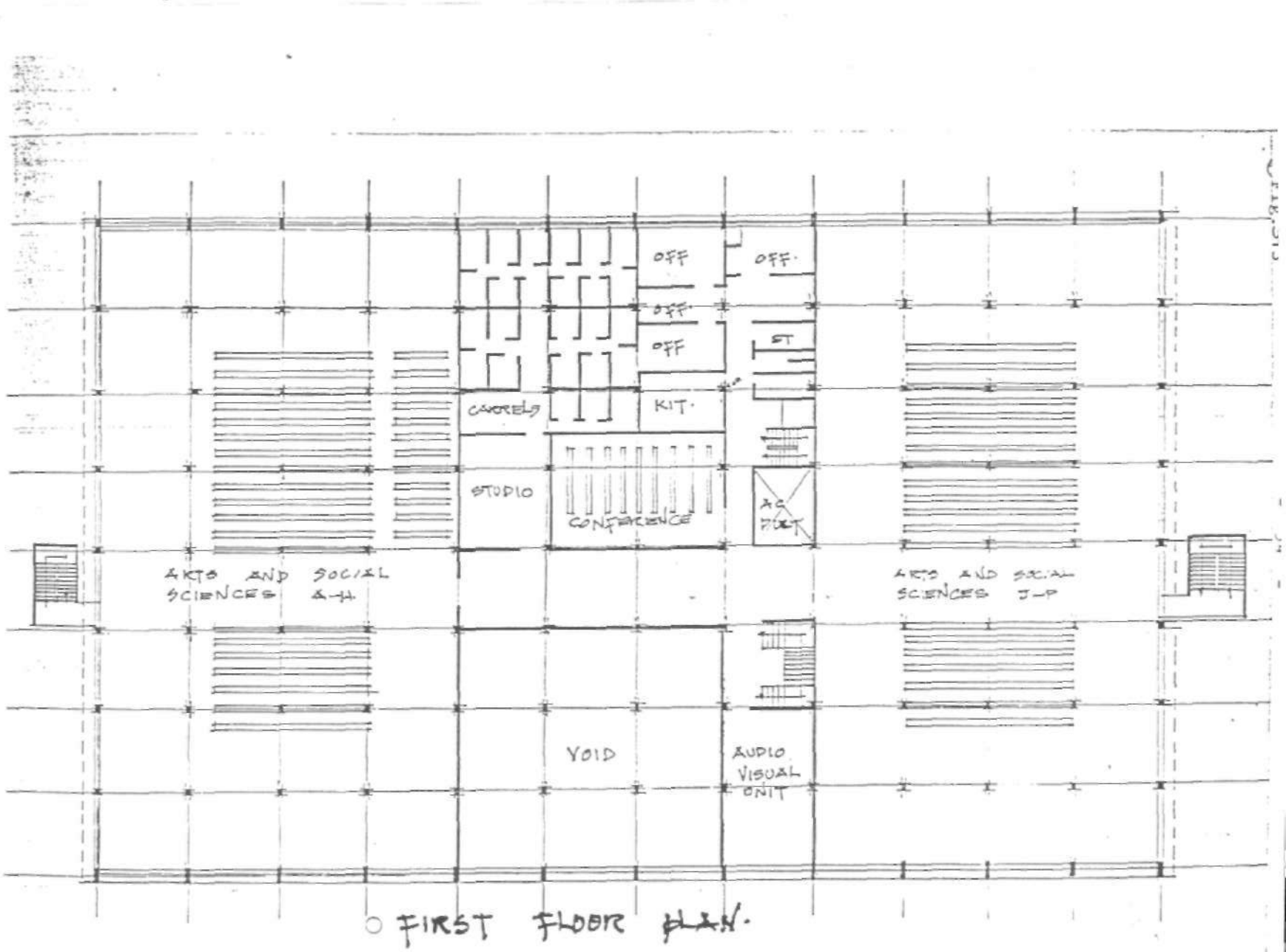
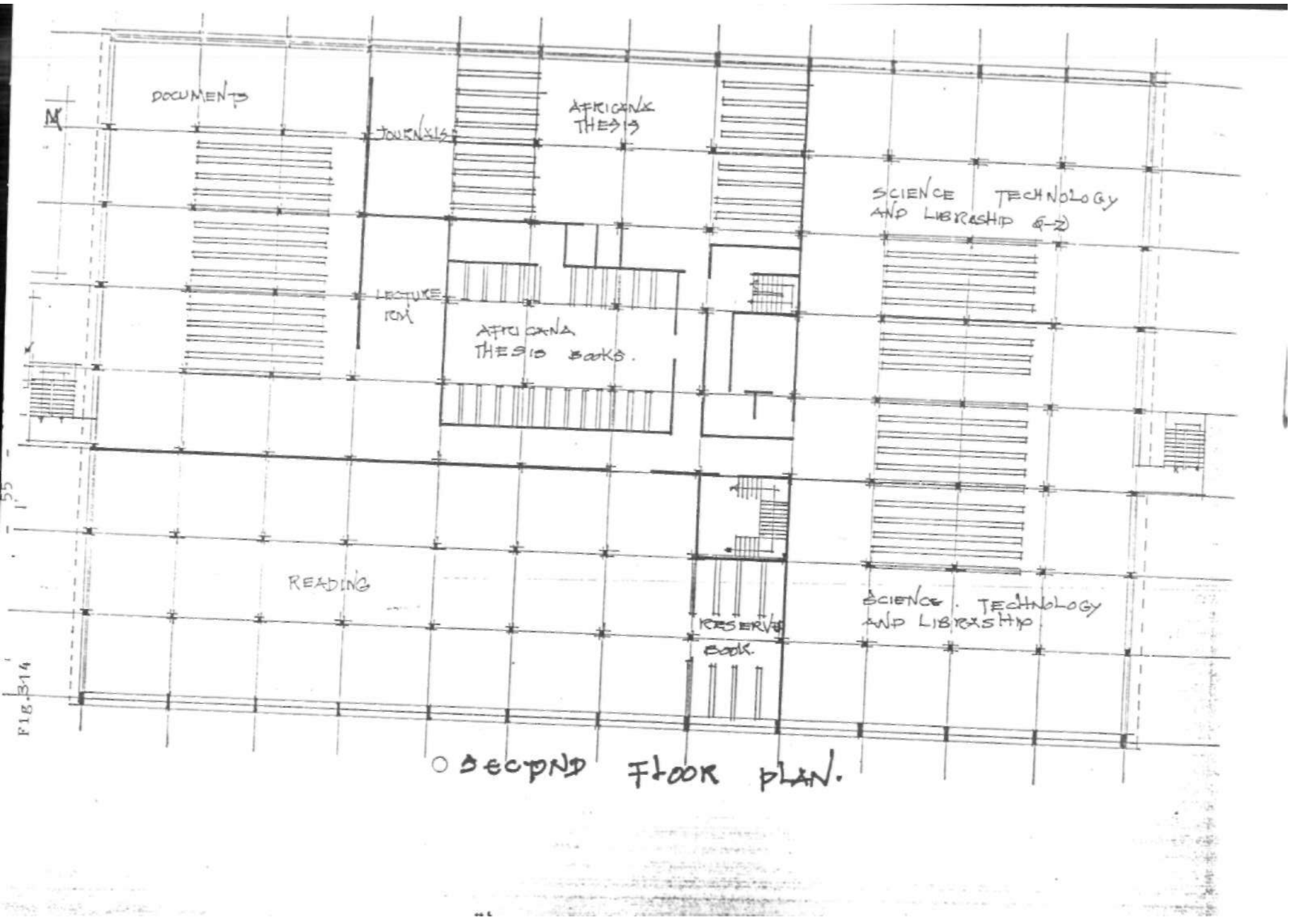

TECHNICAL SERVICES DIVISION
HEAD OFFICE
COLLECTION UNIT
DEV.
TOILET
KIT
CAFETERIA
OFF.
OFF
SERIALS
ACQUISITIONS
STORE
STAFF ADMIN
OFFICE
SERIALS
CATALOGS
NEW BOOKS
AC DUCT
WORKING AREA
WORK RM
REFERENCES
PHOTOCOPYING RM
EXHIBITION HALL
TOILET
NEWSM. OFF.
MAIN CONTROL
TOILET.
CURRENT PERIODICALS.
GROUND FLOOR PLAN.

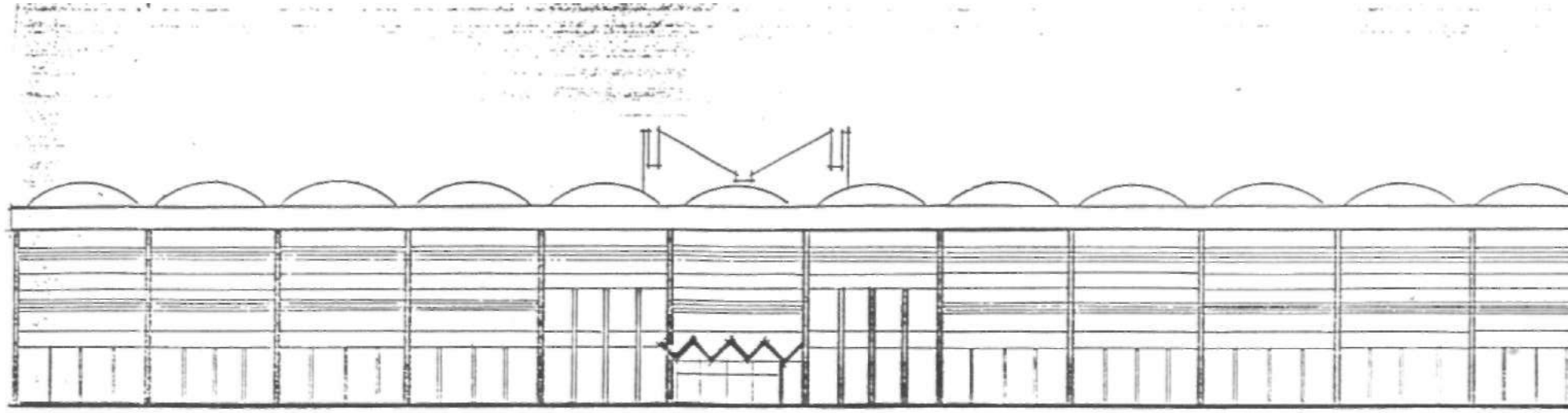
Fig. 312



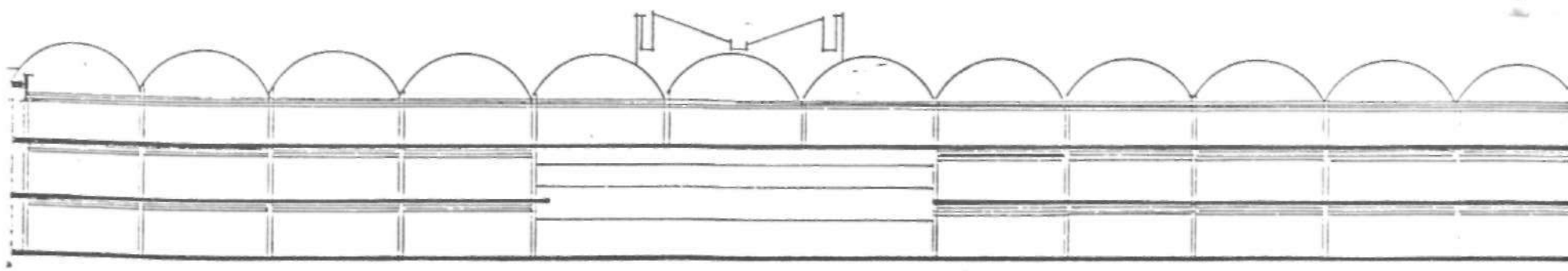
FIRST FLOOR PLAN.



○ SECOND FLOOR PLAN.



○ APPROACH FACADE.



○ LONGIPUDINAL SECTION

3.4 Cranfield's New Library, university of Cranfield, u. k

ARCHITECTS: SIR NORMAN FOSTER & PARTNERS

LOCATION: CRANFIELD UNIVERSITY CAMPUS, U.K.

OCCUPANCY DATE: 1993

Design

The design consist of four floors, the ground floor houses four lecture rooms, including a 180 seater tiered auditorium fully equipped with a sophisticated A. V. structure. Other areas provided on the ground floor include: research report and desertation collections on open access, aerospace research archive fully air-conditioned.

A glass staircase leads users up to the first floor which contains information areas, book issue desk and 3 group project areas.

Periodicals, group project areas seating six to eight people used by MBA students who use the case method and always conduct a group project. One of the provisions on this floor is the seminar rooms for small "handson" group work using data bases.

Approximately, a third floor is dedicated to the library, and this area can only be reached from the first and second floors.

4·4·1

Building Structure

The building consist of four parallel steel-framed bays each capped with a vaulted roof, projecting foward on the south entrance to provide a canopy over a sheltered paved area. The external walls of the library are double glazed clear glass and E-coated for low emminsivity and

and energy conservation.

The data communication wiring infrastructure within the building was designed to meet current and future needs of an advanced library. Cables exist for about three hundred devices. Attached to the networks, are dump terminals, PCs, workstations, server systems and output devices. The PCs are such that users gain access, easily and intuitively to electronically-held information both on and off campus.

Furniture

Furniture design was undertaken by the architect himself and the structural engineer. The shelving consist of steel frames with extruded light aluminium permitting shelves finished in silver to blend with the general decor of the building. the furniture for the library has white, grey and silver as dorminant colours, softened by the greens of the floor covering, the many colours of the books and of course, the people working in the library.

Lighting

Lighting concept implores maximum advantage of environmental conditions to achieve abundant glare-free natural lighting complemented by fluorescent lamps.

3.4.2.

Merits

- Good temperature and air quality in the main body of library was excellently achieved through the combination of natural and artificial means;
- Generally, the louvres and overhanging roof worked well in eliminating glare;
- The openness of facilities, the high degree of visibility and accessibility of staff and the restful, tranquil

nature of the colour schemes, are simply fascinating.

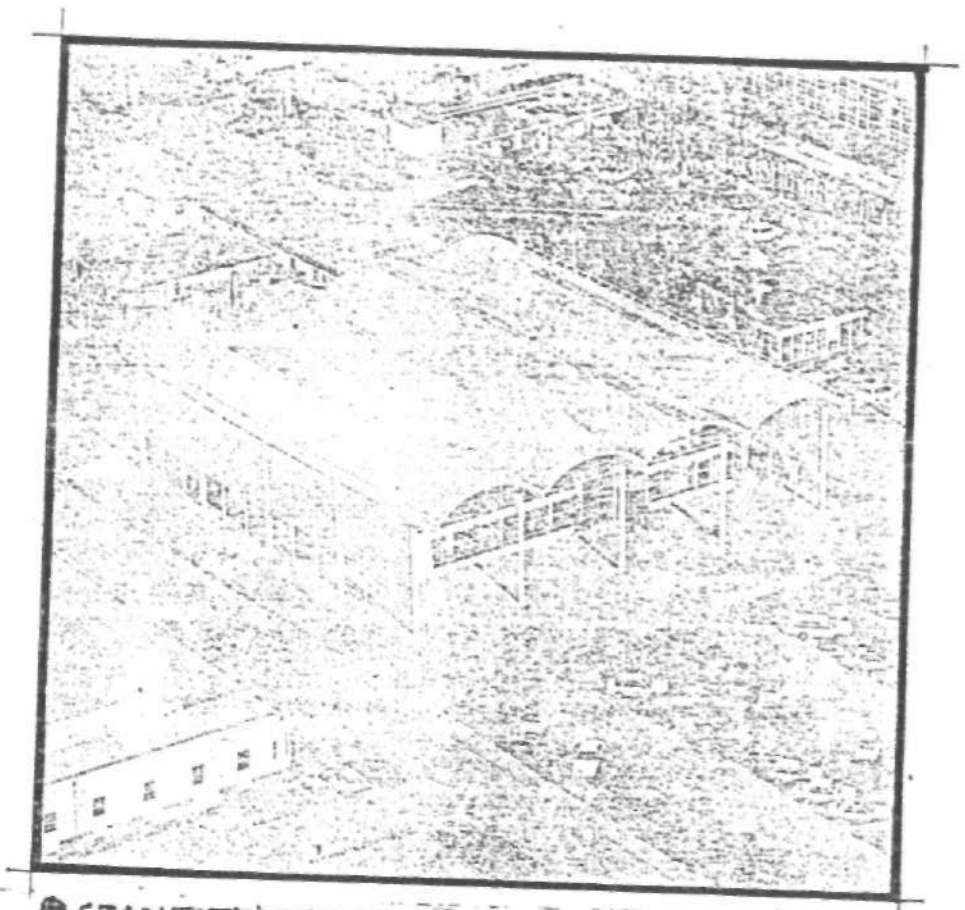
- The use of abundant glare-free natural light was a bold attempt in the right direction against the trend of dorminant artificial lighting.

3.4.3
Demerits

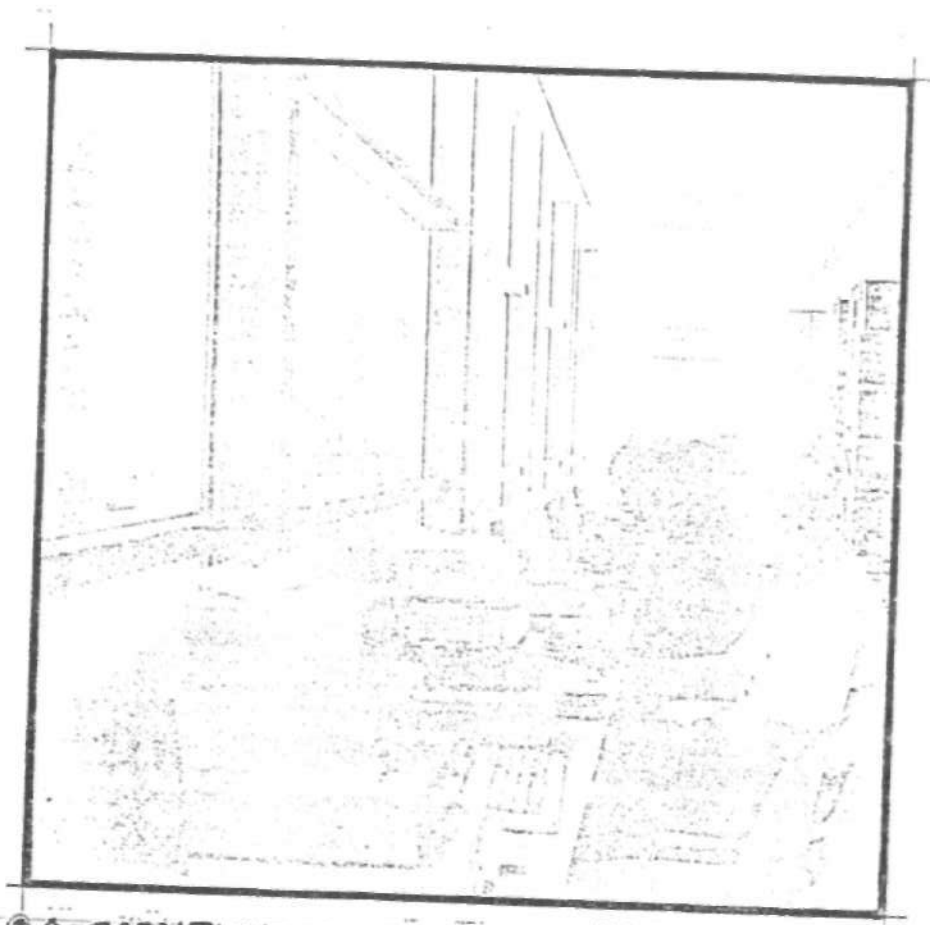
- Noise leakage from the lecture room and auditorium is an intermittent problem.
- Storage facilities for inter-library loan not adequate;
- Heavy large external doors requires bollards to avoid them being caught by wind and damaging the glass.

Conclusion

The inference drawn from the preceeding discussion is simply that, every piece of the building is simply beautiful, every proportion is effortlessly right and every tone is an essay in tasteful grey restraint. Figure 16 is a photographic illustration.



(a) CRANFIELD UNIVERSITY LIBRARY WITH ITS IMPOSING VAULTED ROOF STRUCTURE



(b) A SCENERY OF STUDENTS MAKING USE OF COMPUTERS IN THE LIBRARY.

FIG. 3.16.

CHAPTER FOUR

COMFORT CONSIDERATIONS

Comfort in libraries can be defined as the provision of conditions or atmosphere that strengthen, encourage, aid and support learning and research activities satisfactorily. In fact, it is a condition of content and restfulness.

Considering the afforementioned reasons, the case for comfort in library design cannot be under-estimated. Frankly speaking, a healthy and inspiring atmosphere for users, staff and library materials cannot be compromised.

Comfort in its entirety is a function of four basic variables; they are:-

Thermal Balance:- Thermal balance encompasses radiation, air temperature, humidity and air movement.

Planning:- This entails basic fundamental requirements of the library, which are traffic flow, ease of access to materials and functional co-ordination just to mention a few.

Visual Comfort:- This refers to design response to visual task of users and staff in carrying such activities as searching for materials, reading, studying and official responsibilities. Glare control becomes a fundamental task in this regard.

Accoustics:- Basically, accoustics entails noise nuisance control in libraries. Figure 1 presents a sketch representation of the comfort variables.

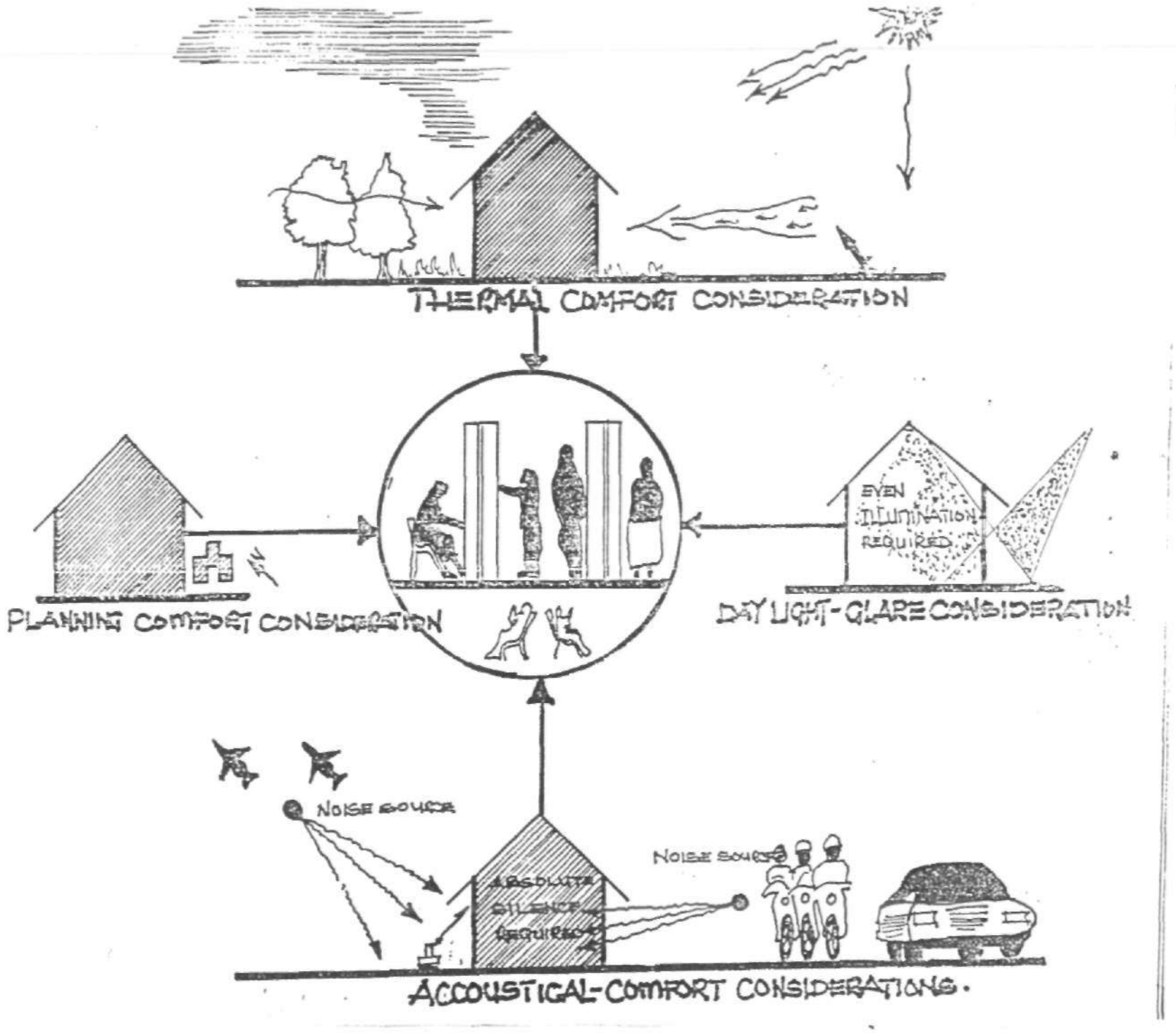

THERMAL COMFORT CONSIDERATION
EVEN ILLUMINATION REQUIRED
PLANNING COMFORT CONSIDERATION
DAY LIGHT-GLARE CONSIDERATION
NOISE SOURCE
NOISE SOURCE
ABSOLUTE SILENCE REQUIRED
ACCOUSTICAL-COMFORT CONSIDERATIONS.

FIG-41

4.1 THERMAL BALANCE

It is essential to establish the limits within which people are likely to be thermally comfortable. To maintain a constant deep body temperature and thermally neutral range, the total heat gain must be equal to the total heat loss. This way, the climatic strain or stress on the body thermoregulatory mechanism is tolerable. See figure 2.

Six inter-related factors are the major determinants of thermal balance between the body's state of equilibrium and the environment. They are:-

- Air temperature;
- Air velocity;
- Solar radiation;
- Relative humidity;
- Nature of Clothing; and
- Activity level.

4.1.1 Air Temperature: constant body temperature is dependent on the surrounding air temperature which determines the direction of heat gain/loss between the human body and the environment. Heat transfer (loss/gain) in the body can be through conduction, convection, radiation, evaporation and metabolism.

Heat transfer by conduction is a result of vibrating molecules coming into contact with adjoining molecules and thus setting them vibrating faster, hence they become hot.

On the other hand, heat transfer by convection refers to heat transmission within a gas or fluid caused by the movement of particles which becomes less dense when heated and rise thus setting up a current or circulation. Heat is

said to be transmitted by radiation when it passes from one point to another without raising the temperature of the medium through which it travels. Evaporation is the escape of molecules (liquid) into the atmosphere under a particular temperature.

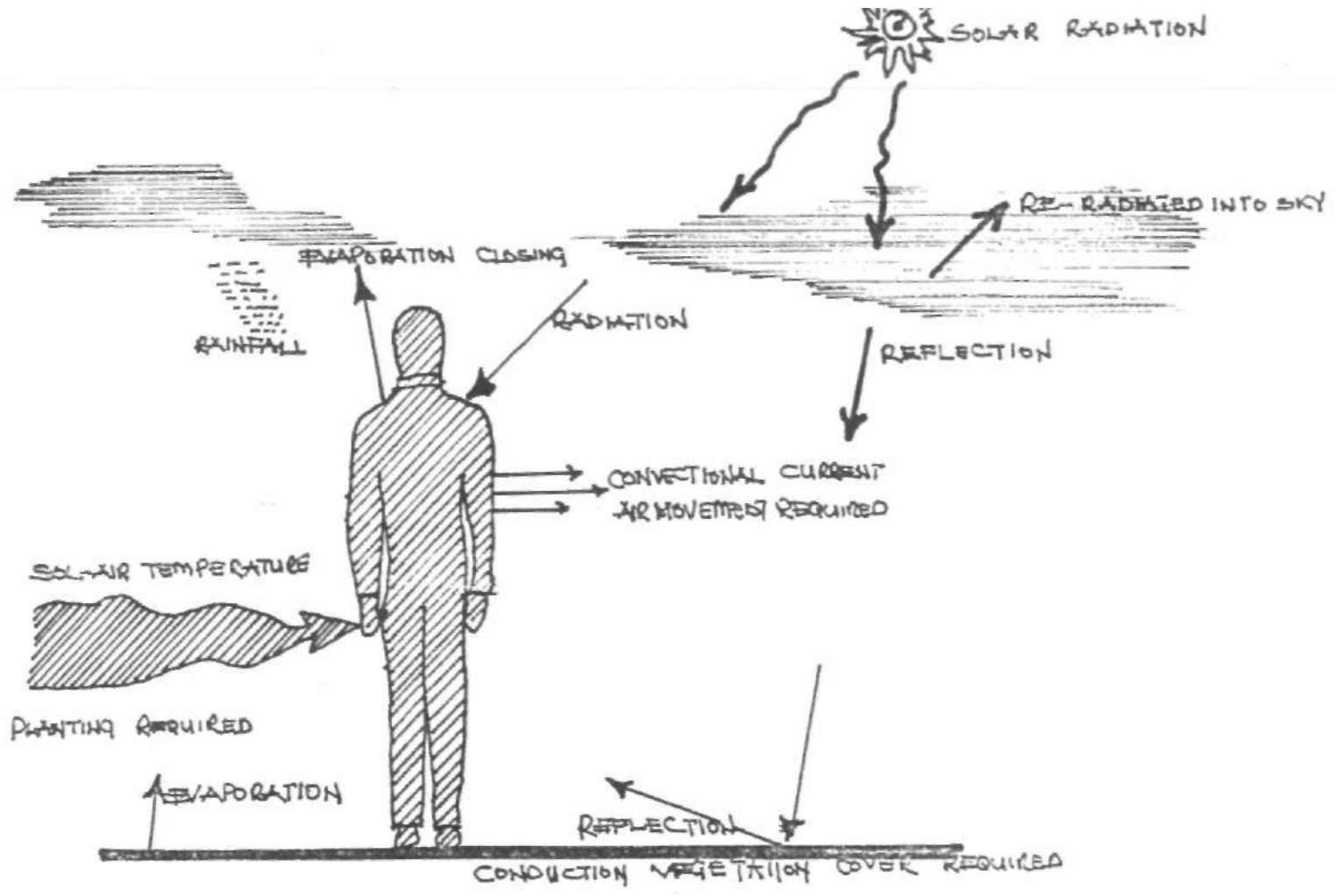
Finally, metabolism is a process which requires the conversion of food stuff into living matter and organism.

In a building, all the above five methods of head transfer can take place since the heat will be conducted through the fabric of the building and dissipated on the external surface by convection and/or radiation. Through the metabolic activities - breathing, digestion, blood circulation (i.e BASA metabolism) and muscle activity (Muscular Metabolism) - of the building occupants. Heat loss can equally result from evaporation.

Therefore to maintain a comfortable and healthy internal temperature, certain mechanism have to be set in motion to control heat exchange.

The external building fabric must be constructed of a combination of materials which will provide an adequate barrier to the transfer of heat. Other head transfer mechanism are; evaporation resulting from sweating either as a result of solar radiation or high activity rate provides comfort, shivering, a situ ation where heat loss by other means cannot be controlled by the body. Thermal insulation will reduce condensation and draughts, lower fuel cost among others.

Since the air temperature is dependent on convention, turbulence, eddies and wave radiation emitted by the surface, the nature of the ground requires special emphasis.



HEAT EXCHANGE BETWEEN BODY AND ENVIRONMENT.
HOT-ARID CONDITION

Fig A-2

Information on possible determining factors influencing ground temperature at the site is necessary. Comfort can be achieved between 16° and 28° C. The architect can through design, super impose some influence on the micro-climate and hence the comfort level within the environment.

4.12 Air Velocity:- The speed which the air moves in replacement or transfer is termed its velocity. Wind on the other hand is the movement of air which is the main cause of ventilation. And ventilation can be achieved naturally through air movement induced by wind pressure, and difference in air pressure of two bodies of air, at different temperatures (stack effect). For instance, if the outside room temperature is lower than the inside temperature, then cold air will enter through the lower inlet and warm air escapes via the upper outlet.

It therefore follows that the architect must pay special emphasis on design factors that affect air flow through buildings. These factors are:-

- Number and size of openings;
- Position of openings and opening components;
- Air flow around buildings is also determined by height and shape, approach topography, exposure of the building andthe proximity of surronding structures.
- Better design of openings enhances natural ventilation. Generally air velocity increases with size of openings. Increase in size of outlet to size of inlet is preferable.

- Position of opening: location of inlets on the windward pressure side and the outlet on the leeward suction side is advisable. Such air flow will cause het loss or gain depending on the outside temperature. Figure 3 is a schematic representation of the influence position of openings exert on plan and sections.
- Opening components: Opening components are outlined as louvres and venetian blinds, variously hinged windows, curtains, screens, sashes, vertical components shading and horizontal components (canopies). See figure 4 for illustrations.
- shapre, height and orientation:- wind pressure on buildings vary depending on their shape, exposure or method of construction. Pressure is experienced on the winward face of buildings while suction may result from the negative effect of wind pressure deflected over the roof and around the sides of the building - (both low and high). See figure 5. Exposure of the building, its height in relation to other buildings and the proximity of surrounding structures also affect wind flow patterns. While a free standing structure oriented across wind flow direction experiences less suction, two structures arranged in similar direction will experience stronger suction. Eddy is said to be experienced when air is forced to move in an opposite direction on encountering an object on its path. When a short and a tall buildings are both arranged in the windward face, vortex is experienced on both sides of the tall building and

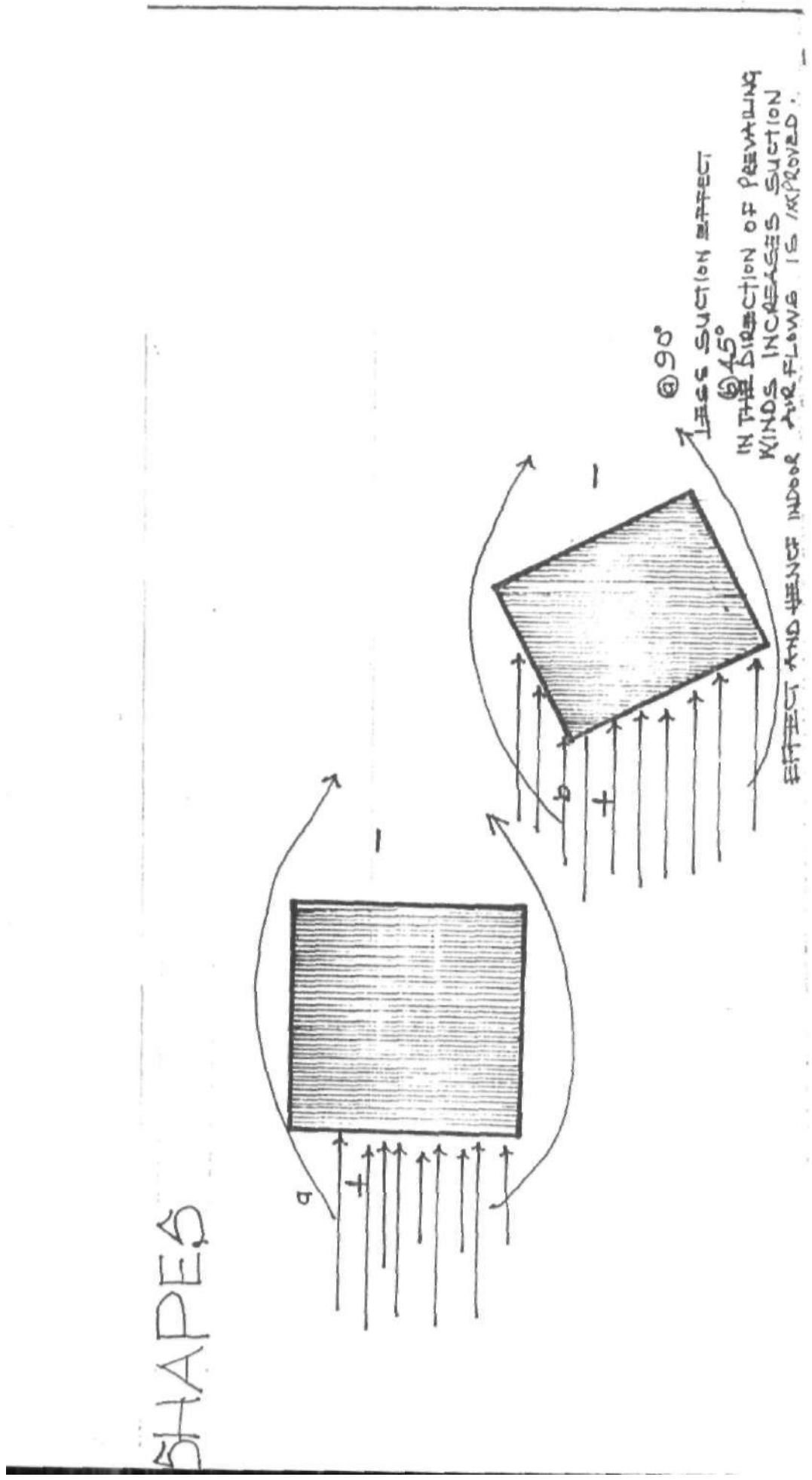
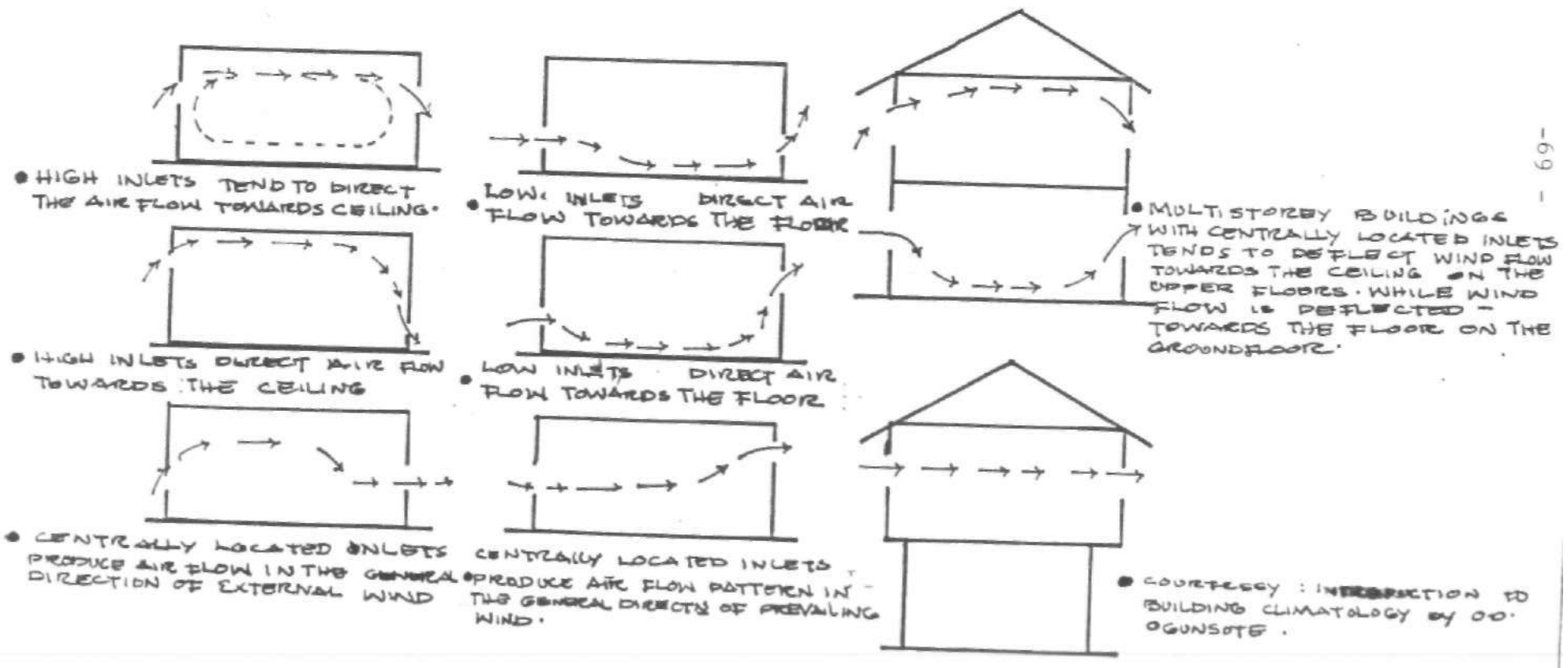

@90°
@45°
EFFECT AND HEIGHT OF INDOOR AIR FLOWS IS IMPROVED.
IN THE DIRECTION OF PREVAILING KINDS INCREASES SUCTION
LESS SUCTION EFFECT
• IN PLAN, THE AIR VELOCITY DISTRIBUTION IS AFFECTED BY RELATIVE POSITION OF INLET AND OUTLET FOR A GIVE WIND DIRECTION.
SHAPES
+
-
a

Fig 43(B)

OPENING POSITION

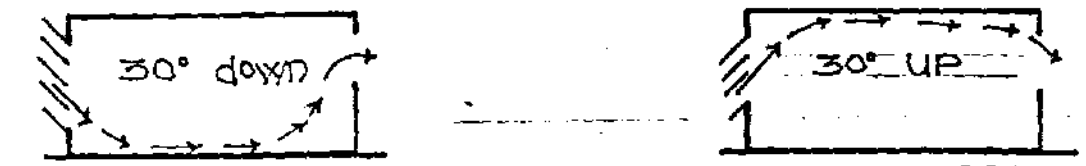


• IN SECTION POSITION OF OPENING (OUTLET) HAS LITTLE INFLUENCE ON AIR FLOW PATTERNS.

COMPONENTS



EFFECT OF CANOPIES



VENTIAN BLIND. EFFECT OF LOUVRES 300mm LOUVRES



EFFECT OF SASHES

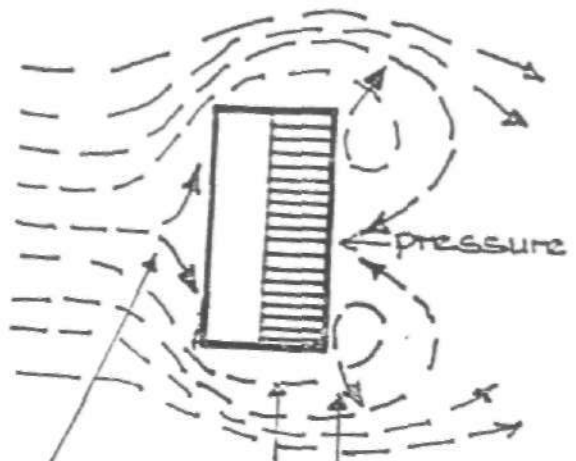


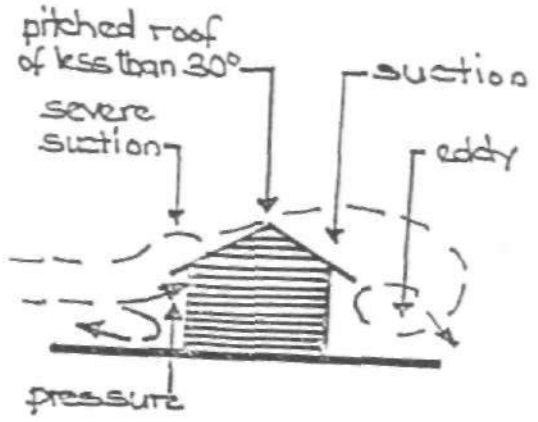
EFFECT OF SHADING DEVICES AND SHUTTERS

COURTESY : INTRODUCTION TO BUILDING CLIMATOLOGY : BY Dr. OGUNSOTE.

fig.44

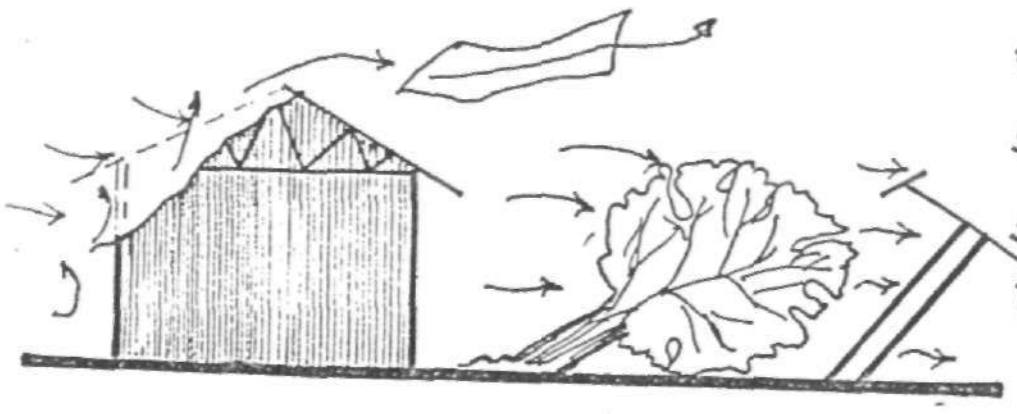
AIR VELOCITY: HEIGHT CONSIDERATION





Notes: roofs over 25° pitch usually develop positive pressure on windward slope with suction over ridge and on lee slope. wind in direction of ridge will create areas of suction along all windward edges.

FIG. 45



THESE STRONG WINDS PULLS DOWN ROOF STRUCTURES EASILY, AT TIMES THE WHOLE STRUCTURE MAY COLLAPSE + SURROUNDING TREES, SERVICE POLES AND CABLES.

suction over its roof. On the other hand, wind pressure is exerted on the face of the shorter building, creating suction over its roof and vortex in between the two buildings. See Fig. 6.

The underlisted design solutions can be applied to subdue the negative effects of wind pressure on building structures:

- To enhance proper ventilation, buildings should not be placed in the wind shadow of other buildings. Hence buildings should be placed at least six times their height apart, given a reasonable land mass. See Fig. 7.
- Use of materials of high density can provide adequate resistance to wind pressure.
- Adequate anchorage of the light weight coverings to the structural frame is recommended to overcome uplift or suction on roofs.
- Stiffeness should be fitted between structural members where unacceptable pressures anticipated.
- Wind breaks in form of walls and tree belts may serve to curtail the excesses of wind pressure which is a nuisance to staff and library users alike. See fig.8 Therefore the architect must carefully plan his site layout to suppress the tremendous destructive tendencies of the wind, in the context of library building works.
- Good internal arrangements may help too. See Fig. 9.
- Mechanical aids may often be employed to play complementary roles when the air movement induced by wind

EIGHT EFFECTS ON WIND VELOCITY

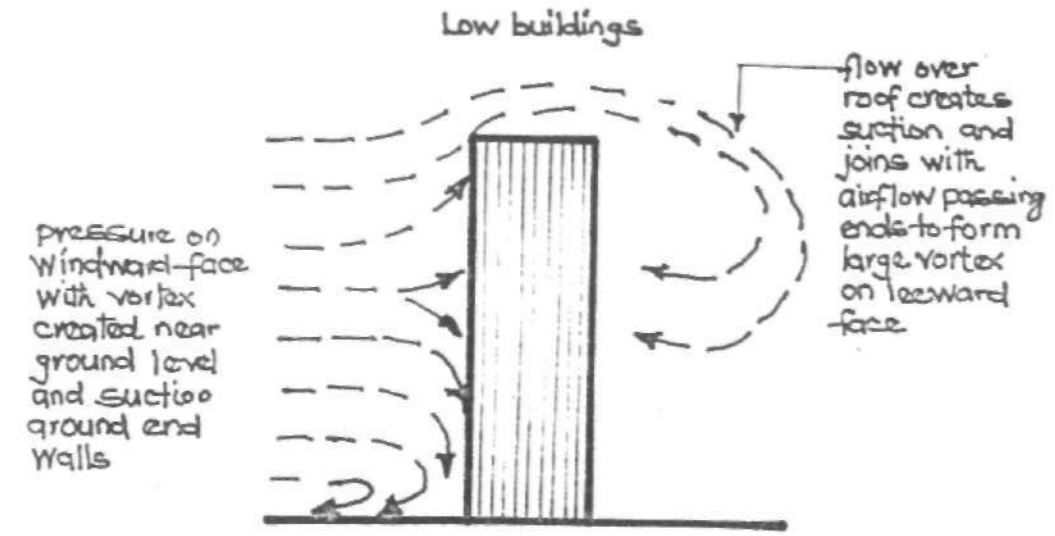


FIG 46

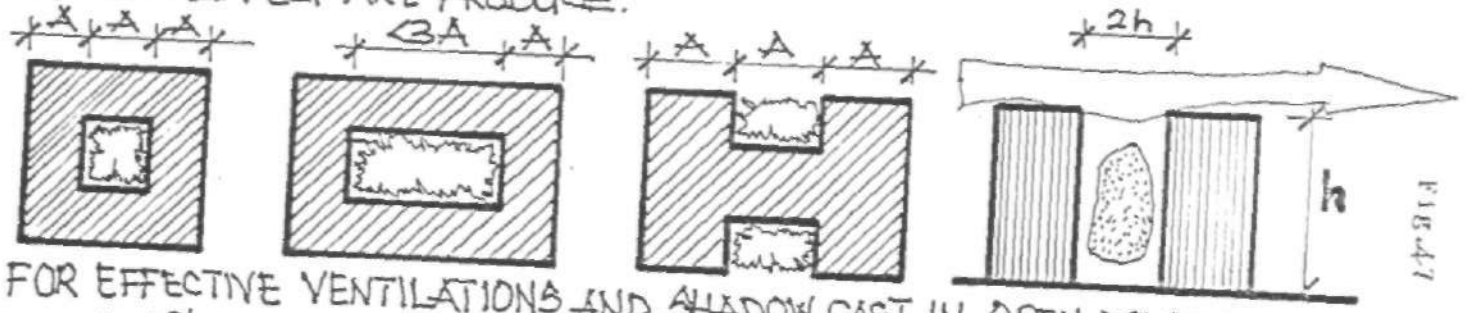
TYPICAL WIND PRESSURE AROUND BUILDINGS

• COURTESY : CONSTRUCTIONAL TECHNOLOGY BY R. CHUDLEY.

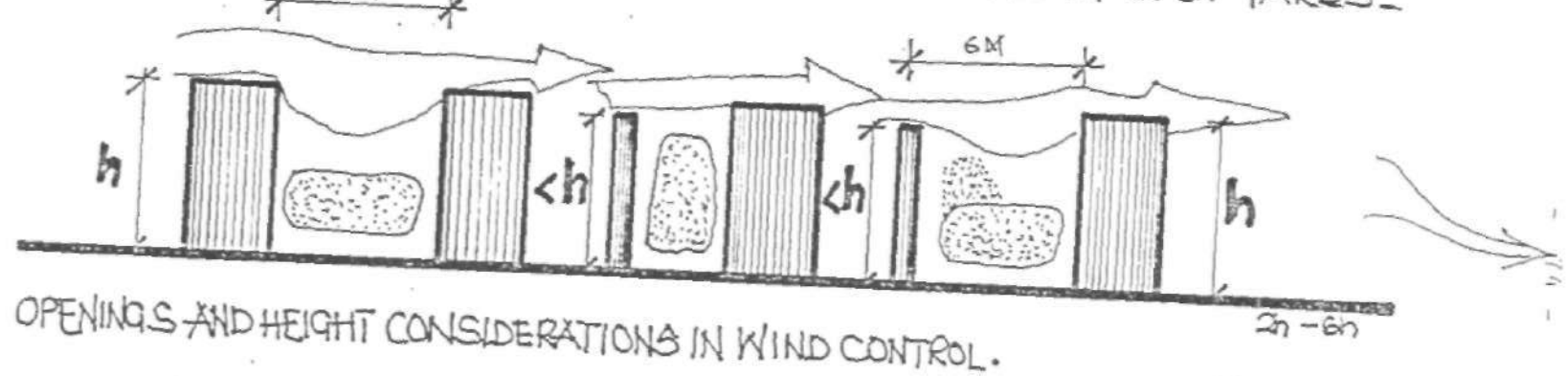
AIR TEMPERATURE VELOCITY: CONTROL MEASURES

BUILDING SHAPES AND NEIBOURHOOD FOR EFFECTIVE OPEN YARDS VENTILATIONS.

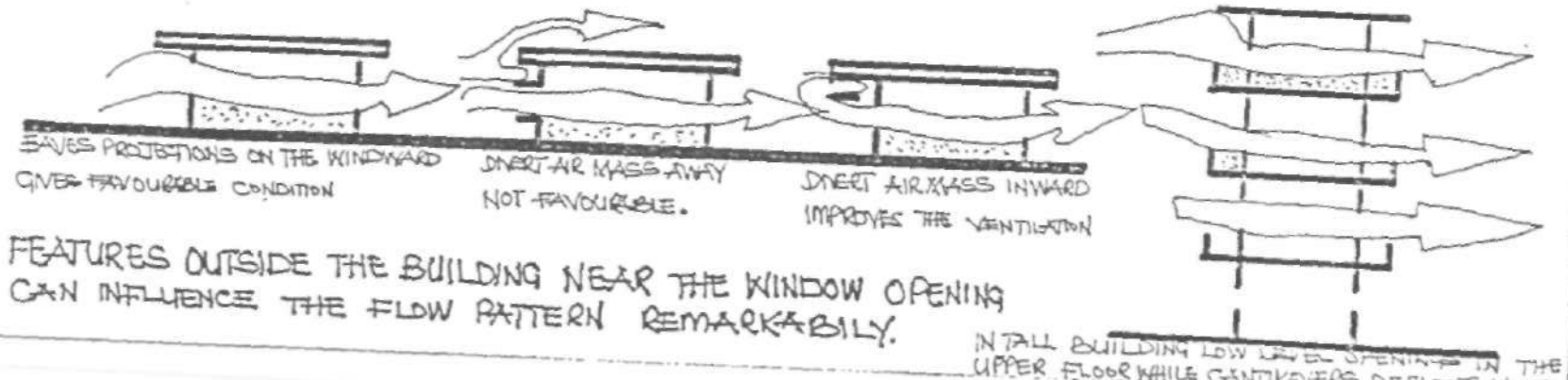
DIFFERENT WIND EFFECT ARE PRODUCE.



SPACING FOR EFFECTIVE VENTILATIONS AND SHADOW CAST IN OPEN YARDS.

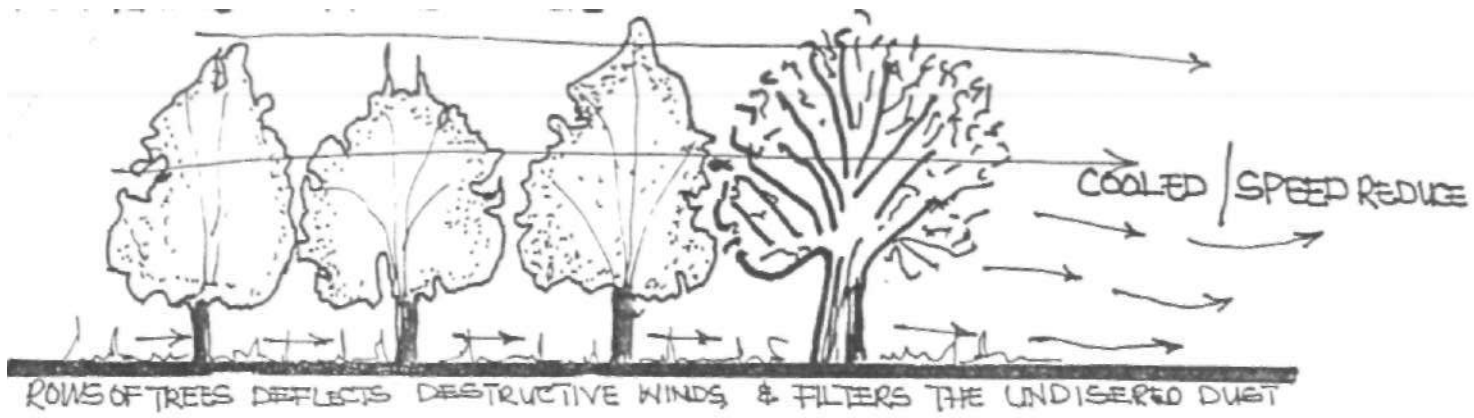


OPENINGS AND HEIGHT CONSIDERATIONS IN WIND CONTROL.

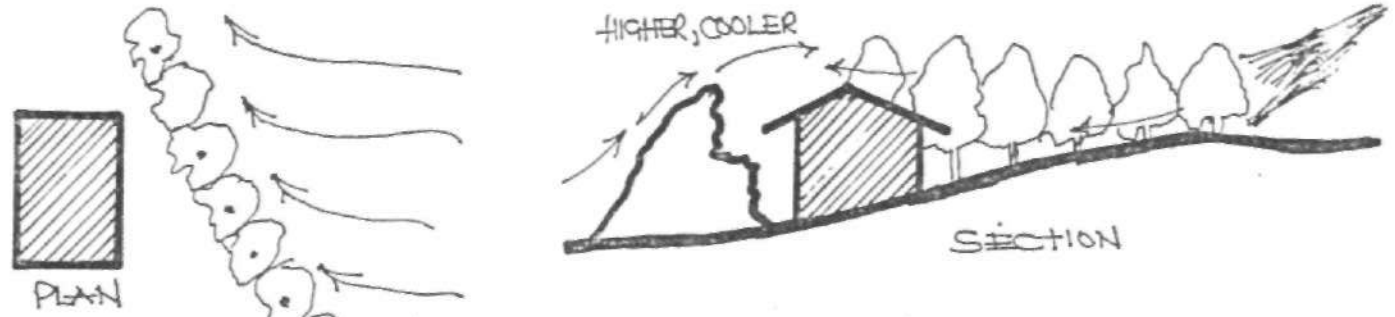


FEATURES OUTSIDE THE BUILDING NEAR THE WINDOW OPENING CAN INFLUENCE THE FLOW PATTERN REMARKABLY.

IN TALL BUILDING LOW LEVEL OPENINGS IN THE UPPER FLOOR WHILE CANTILEVERS DEFLECT WINDS



ROWS OF TREES DEFLECTS DESTRUCTIVE WINDS & FILTERS THE UNDISERED DUST

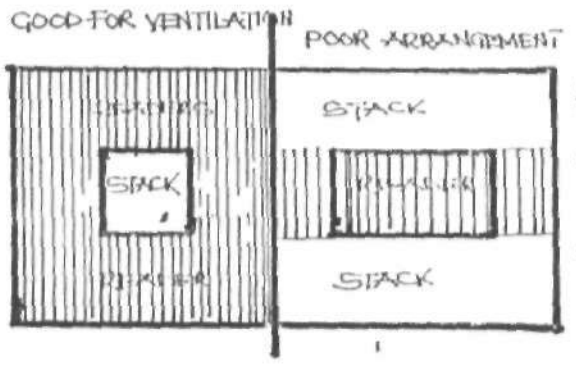


DIAGONAL SHELTER TO THE DIRECTION OF PREVAILING WINDS DEFLECTS STORM DUST WIND

F 1648

Fig 4-9

INTERNAL ARRANGEMENT



FUNCTIONS MUST BE ARRANGE TO ENSURE PROPERLY VENTILATED SPACE AND SUFFICIENT TRAFFIC FLOW - PLANNING COMFORT.

FOR A COMFORTABLE ENVIRONMENT, DESIGN MUST BE FREE OF THE MENANCE OF AIR TEMPERATURE AND AIR MOVEMENTS. SITE NEED TO BE ANALYSE AND THEN BE TREATED INACCORDANCE WITH THE PREVAILING WINDS CHARACTERISTICS AND THE EXISTING SITE SITUATIONS.

pressure and stack effect is insufficient particularly for book preservation and users/staff comfort. Examples are air conditioners and fans.

A C. basically is an artificial means of providing an environment of correct temperature, humidity, air movement, air cleanliness, ventilation and accoustical level. Anything less is a compromise and is not termed air-conditioning. It must however be emphasized that planning to explore merits of the best natural possibilities cannot be overstressed.

- Approach topography: wind velocity increases with height above the ground as frictional effects becomes weaker depending on the physical nature of the ground.

4.1.3 Solar Radiation:- Radiation emitted from the sum is a major source of energy on earth. Radiation can be experienced to and from surfaces within an enclosure. Excess solar radiation brings thermal discomfort. This calls for the carefu l examination of factors affecting global radiation, analyse them and deduce their impacts on the earth surface which accommodates the building with the aim of achieving thermal balance. These factors are enumerated below:

- Solar altitude;
- Earth's rotation
- Sun movement;
- Nature of ground surface;and
- Topography.

Solar Altitude:- A knowledge of the sun altitude and azimuth is essential for the prediction of solar intensity - radiation at a particular position.

Earth's Rotation:- Rotation of the earth about its north-south axis account for days and nights. Direct solar radiation is eminent during the day as against the night.

Sun Movement:- Movement of the sun between the tropic of cancer (TC) (23.5°N) and the tropic of capricon (TC) (23.5°S) affects solar intensity distribution at various times.

The tilt of the earth axis towards the sun in June is accountable for maximum intensity of solar radiation in the northern hemisphere (summer) experiencing longer days and shorter nights. Reverse is however the case in winter solstice, as the sourthern hemisphere receives maximum solar radiation (summer) with the northern hemisphere experiencing winter.

The above determine the length of the day and the climate of the season. The angle of inclination of the earth axis (north-south) to the plane of the orbit give rise to seasons.

Natute of Ground Surface:- nature of ground paved/bare ground surface, grass covered surfacess - is responsible for solar response in terms of absorption, reflectance, and emmittance. Understanding of these parameters can service a useful guide to the architect in his thermal design.

Topography:- atmospheric temperature decreases with altitude, hence position of physical features such as rocks, hills, valleys in relation to the site affects the distribution of solar radiation, air temperature, precipitation, winds and vegetation. Proper topographical analysis may be useful for thermal design.

Summary:- Experts have predicted that with increased atmospheric pollutions, the ozone layer which shields the earth from direct ultra-violet rays of the sun stand the risk of being thinner in the next fifty years. The implication of this, is that, the earth will be more exposed to direct impact on preservation of library materials, users psychology or reasoning, and staff comfort alike. The message here is only a call for the effective employment of natural and artificial alternatives to regu late the intensity of solar radiation. This can be done through proper zoning, orientation and insulation. The use of sun screens and water bodies may also help in this regard. See fig. 10.

4.14 Relative Humidity (RH): Relative humidity plays a vital role in the provision of comfort for library inhabitants and books. Relative Humidity is simply the amount of water vapour the air can hold at a given temperature.

$$RH = \frac{\text{amount of water vapour in the air}}{\text{amount of water vapour for air to be saturated at the same termperature}} \times 100$$

Atmospheric humidity varies with time. This is not unconnected with evaporation of exposed water body, water content of ground surface, precipitation, and plant transpiration among other. While low humidity accompanied with dryness

is potentially harmful to paper and bindings, high humidity will cause mould growth. The design task here requires the stricking of a compromise between the two extreme conditions. Experts are of the view that the life-spand of present day books can be increased by considerable proportion when relative humidity is between 50-65%. Relative humidity has other negative impacts on the behaviour of many building materials and their rate of deterioration. Possibilities of condensation on the surface or within the building fabric cannot be ruled out. Sweating becomes more effective in cooling down the body at low humidity when the air becomes very dry. Air velocity plays an important role at increasing rate of evaporation in this regard.

Attainment of comfort level can always be achieved through humidity changes and by planting trees, grass and locationof water bodies.

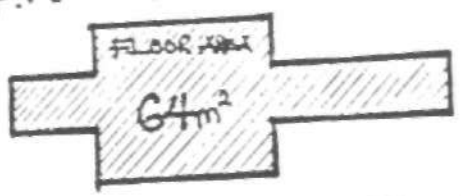
4·1·5 Nature of Clothing:- Effect of air movement is dependent on the amount and permeability of the clothing. Clothing is measured in CLO unira. 0.5 to 1-0 CLO range on intrinsic clothing is recommended for thermal comfort where;

0.5 CLO = a pair of short for men and a cotton dress for women;

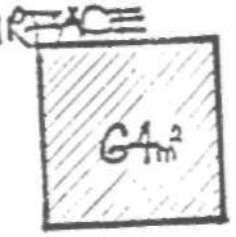
1-0 CLO = Bussiness suit, shirt and underwear.

4·1·6 Activity Level: physical activities such as sitting, standing, walking, dancing, running facilitates heat production which is evaporated to provide cooling effect. This is dependent on wind velocity and air-temperature.

2. WALLS MATERIAL CONTROL:
A. WALLS SURFACES FACING EAST AND WEST FACADES HAS TO BE MINISED & ALSO THE TOTAL EXPOSED SURFACE



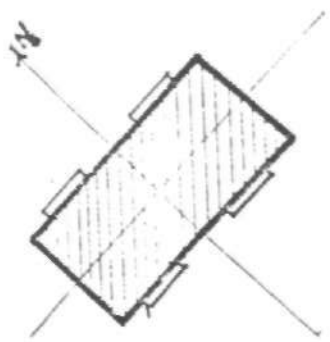
COMPLEX SHAPES GIVES GREATER WALL SURFACES (PERIMETER RUN)





SIMPLE SHAPES GIVES LESS WALL SURFACES



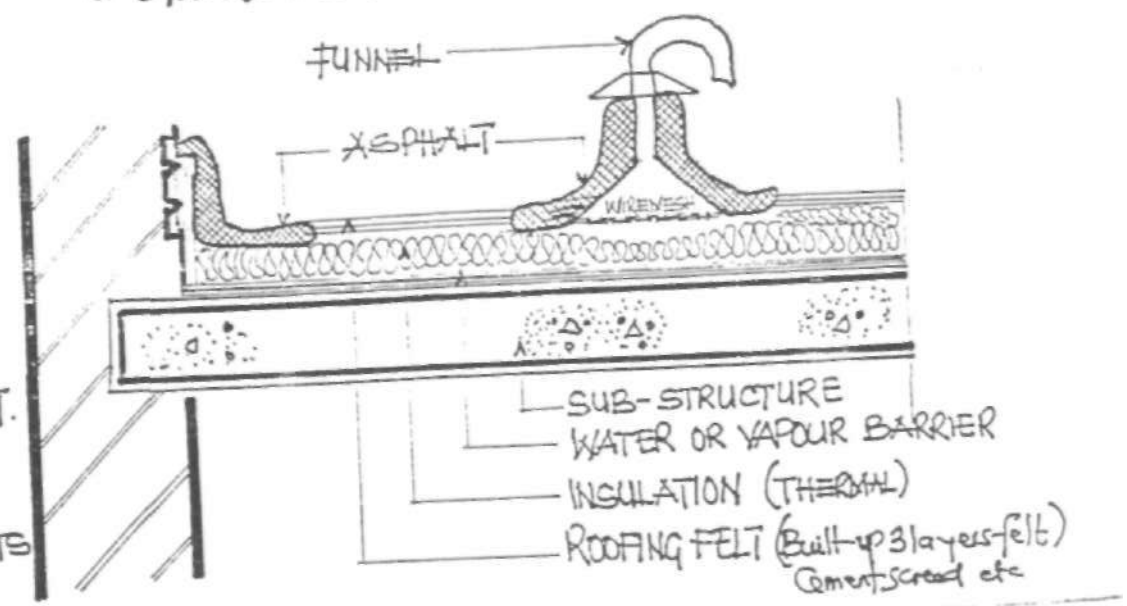


B. SHORTER WALLS TO BE SOLID SHADED AND BE FACING EAST WEST

Fig 4.10 (a)

- **THERMAL INSULATION MATERIALS IN ROOFS:** APART FROM THE PROPERTY OF ROOFING MATERIALS, A NUMBER OF INSULATING MATERIAL ARE TO CONTROL INTERIOR TEMPERATURES. THESE INCLUDES:
  1. ALUMINIUM FOIL
  2. HARD GLASS WOOL
  3. CORK INSULATION
  4. ANAZOTE
  5. POLYSTYRENES
  6. OTHER MINERAL WOOLS AND FOAMS

- USE OF INSULATION MATERIALS IN CONCRETE ROOFINGS PROTECTS THE SUB-STRUCTURE FROM HEAT. UP AND HENCE THE INTERIOR AT EXPANSION JOINST: IT PROTECTS HEAT FROM ENTERING THE BLDG.



DIFFERENT FORM OF PLANTINGS USE TO ARTICULATE SPACE, COOLS HOT MOVING AIR, AND FILTERS POLLUTED AIR

- WATER BODY USE TO GENERATE COOL MICRO CLIMATIC EFFECT FOR OUTSIDE READING AND LEISURE. IT COULD BE AN INTERIOR LEISURE POOL DESIGN TO REDUCE ENVIRONMENTAL

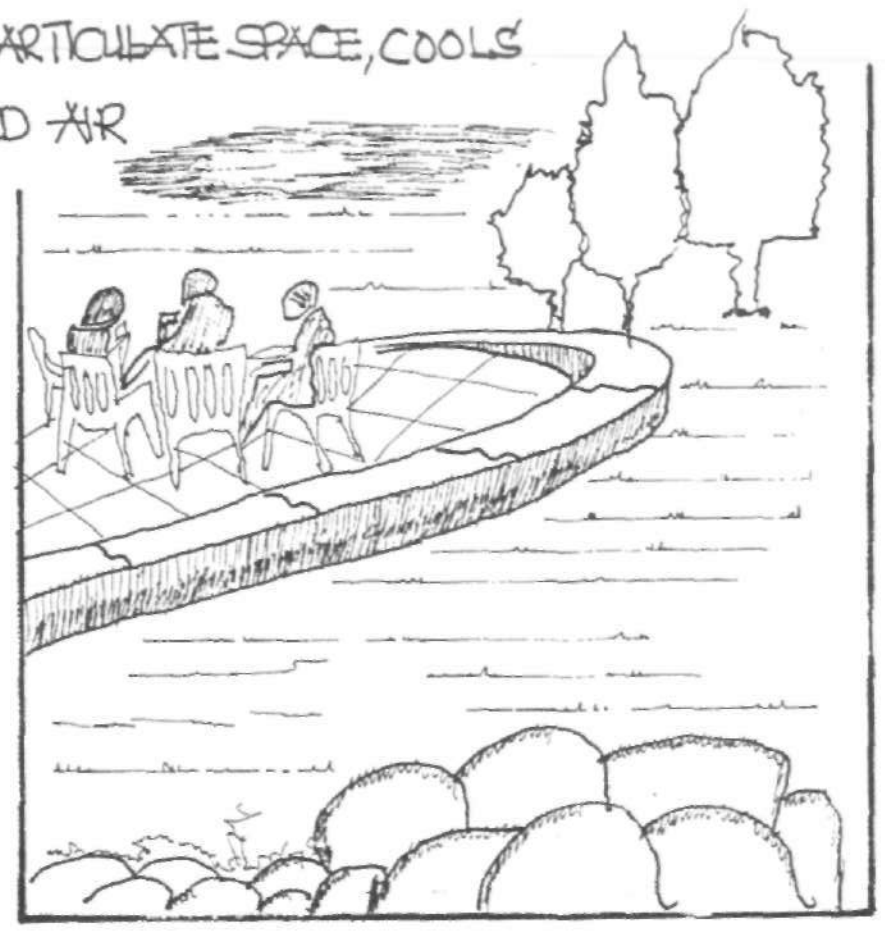


Fig.4l0 (c)

4.2 PLANNING REQUIREMENTS

Planning a library requires increased emphasis on functional co-ordination in areas of convenience, efficiency, traffic circulation, proximity to library materials, escape route, simplicity of operation and economy of maintenance enhance human comfort.

4.2.1 Library Security:- Many libraries have lost their valuable resources to the menance of theft, a practice which is as old as library history. Theft hazards is often in terms of mutilation and vandalism.

MUTILATION refers to the cutting out of book pages by students for the sake of using it at their own convenience.

VANDALISM is the destruction of books by students. The author7s experience have shown that some students destroy books just for the sake of being destructive.

While it must be appreciated that the above vices are serious hazards which are difficult to prevent, certain design mechinaries must be set in motion to curb its excesses.

Such design mechinaries include; provision of accommodation for clear coping machines operated at subsidized cost, proper functional classification and provision of check counters at various units. Yet another method is by the use of modern automatic security device such as the the electronic gate and closed circuit television (CCT).

4.2.2 Fire:- Fire hazards in libraries is dangerous to human lives and library resources. This calls for measures to prevent it, and perhaps, delay its spread in events of out-break pending total suppression.

Causes of Fire

major causes of fire in libraries are: defective and over heated fire plants, wiring used for mechanical and electrical installations plus appliances, careless smoking by staff and students, indiscriminate use of matches, storage of combustible materials near heater, act of God- which could be lightning, earth-quakes, etc.

Each of these factors have contributed singularly or collectively to cause a number of library fires. Positive measures are required if the trend is not to continue.

PREVENTIVE APPROACH

- Heating installation should be designed and installed to avoid over-heating which might cause fire;
- Fire resistive construction, more commonly called fire-proof construction, usually of reinforced concrete or steel and mansory with steel structural members in cased in concrete, or other fire-resistant material. A concrete thickness of about 1½ inches is recommended as minimum cover for reinforcement in structural elements. This is because moisture can penetrate through concrete (steel) of poor quality or inadequate thickness, causing corrosion of concrete inevitable.
- Compartment planning, whereby a building is divided into fire areas by the use of fire walls and fire doors. The essence is to limit the spread of fire to a predetermined area.

SUPPRESIVE APPROACH

- Installation of automatic sprinkler actuated by the rise in temperature aids fire suppression. Metcalf[1] however believe that water damage from sprinklers is greater than the risk of fire in most areas in a properly designed modern library building, if construction and house-keeping are up to standard.
- Selection of non-easily combustible furniture and interior finish will delay fire spread.
- installationof automatic detector and alarm system in underside of ceilings, air-conditioning ducts, etc and connected to local fire personnel. This will enhance proper operation and maintenance.
- Protective devices - self closing fire door cut off air circulation, ducts and first aid fire fighting equipments in suitable location are essential.

MANAGERIAL APPROACH

- Against the danger of fire out-break resulting from smoking, readers and staff discipline is essential. Smoking must not be allowed in the library. Where it must be allowed, provision must be made for it.
- Effective supervision on periodic basis to ascertain unsafe fire conditions, such as defective electrical wiring and mechanical installations.

OCCUPANTS EVACUATION

- Emergency access/exits within an average distance of 25 - 30m for evacuation of building occupants in cases of fire outbreak is a matter of special significance. But even in the best of systems, with the best of care, and

even satisfactory construction, accidents may happen, hence the question of fire detectives, alarm, and extinguishers must be given proper attention.

4.2.3 Maintenance: The poor state of existence of our library buildings makes case for strong emphasis on maintenance. The built environment depects physically the complex economic and social factors which give structure and life to the community. Therefore, dilapidated and unhealthy buildings in a decaying environment reduces effeciency.

Maintenance itself is a work undertaken in order to maintain, keep, restore or improve every facility, that is, every part of the building, its services and surrounding to a correctly accepted standard and to substain the utility.

Given the amountof money involved in erecting a library building, the preservation of value and utility of these buildings is therefore essential to the economic well-being of not only the university but also the country at large. This calls for appropriate measures:

- Thoroughness at design stage to ensure a properly sound structural syste m will avoid failure;
- Choice of appropriate and durable materials for the various building elements.
- A foundation should be properly designed and built with good materials to avert unsightly cracks and collapse of buildings.
- Construction method and finishings specified determines how long a building remains before maintenance can be done. Fair-faced concrete finishes can stand the test of time. Construction method could be wet or dry, whichever is chosen must be carefully supervised to enhance

quality workmanship.

- Janitorial personnel, accommodation for brooms, mops and other equipment aid the maintenance work. Other requirements include a janitor's closet with running water and sink.
- Maintenance awareness campaign is necessary for users and building owners alike for proper appreciation of maintenance virtues.

4.3 VISUAL COMFORT

Since the major task in the library is seeing to read, provision of adequate lighting (both natural and artificial) is desirable for eye comfort.

Good lighting includes consideration of the following factors; steady source, sufficient intensity to illuminate without glare and the elimination of shadows on reading and work surfaces.

Natural lighting can be achieved through fenestration. Windows in reading room should be as high as possible towards the ceiling to enhance greater distribution of light entering the room. While northern exposure is good as a design measure, the architect must beware that natural lighting is not essential in the stack area since it causes deterioration of papers, and bindings.

Nowadays, artificial lighting system involves a little more than just lamps and fixtures. The colour of ceilings, walls, floors and desk-tops, all contribute in some measure to redistribute light around the room and provide an atmosphere conducive to eye comfort. Recommended minimum

illumination level for libraries is 70 foot-candles.

For visual comfort, the reflection factors of different parts of the library are approximately thus:

Ceiling	-	70 to 90%
Walls	-	50 to 70%
Furniture	-	35 to 50%
Floors	-	20 to 50%

It therefore, follows that reflected light, which is above the normal field of vision should be used to advantage in library lighting.

On the concluding note, lighting concept for the building based on the utilisation of abundant glare-free natural light supplemented by low brightness from artificial lighting employing fluorescent lamps, is desirable for the tropics.

4.3.1.
GLARE CONTROL IN DESIGN

Glare by definition, is a condition of vision caused by high intensity of light, and by spatial or temperal contrast in lighting. Direct solar radiation admitted through windows and reflected sun-light are both causes of glare.

Since light falling on an object can be reflected, absorbed or transmitted, it then follows that, the reflectance absorbance and transmittance properties of building materials and finishes must be considered at design stage.

Good landscaping of environment andthe avoidance of undulating surfaces are both design approaches to reduce glare from the ground surface. On the other hand, glare caused by reflections coming from nearby buildings can be

supplanted through the use of good non-reflective surfaces or paints and creation of buffer zones to shield direct reflective rays. See Fig 11.

On the whole, venetian blinds, curtains, and internal vertical pivot louvre blinds can be wisely applied where there is great deal of glare.

4.4 ENVIRONMENTAL STANDARD (NOISE DISTRACTION)

Noise refers to undesired sound which may have any of the following effects on man in the context of a library.

- Damage hearing;
- Interferes with the ability to absorb what is being read and general concentration of mind;
- Annoyance.

Given the nature of activity within the library, noise and other distractions becomes fundamental problems in the planning of traffic and circulation patterns.

SOURCES OF ACCOUSTIC DISTRACTIONS

(a) External noise generated from motor traffic, low flying aircraft, and even railway lines;

(b) Internal or air-borne noise often arise from conversation, typewritters or radio which sets the structure vibrating when the sound waves are emmitted from these sources;

(c) Impact noise generated as a result of direct contact with the floor or other elements. The sources are dropping/falling books, footfalls resulting from movement of humans, pulsating equipment, and hammering on wall.

(d) Background noise is the resultant noise effect of the above discussed sources. It reduces speech, intelligibility and general concentration. Coughing, fluorescent lighting, air-conditioning plant, etc are all sources of background noise.

4.41 CONTROL OF ACCOUSTIC DISTRACTIONS

- External Control:-

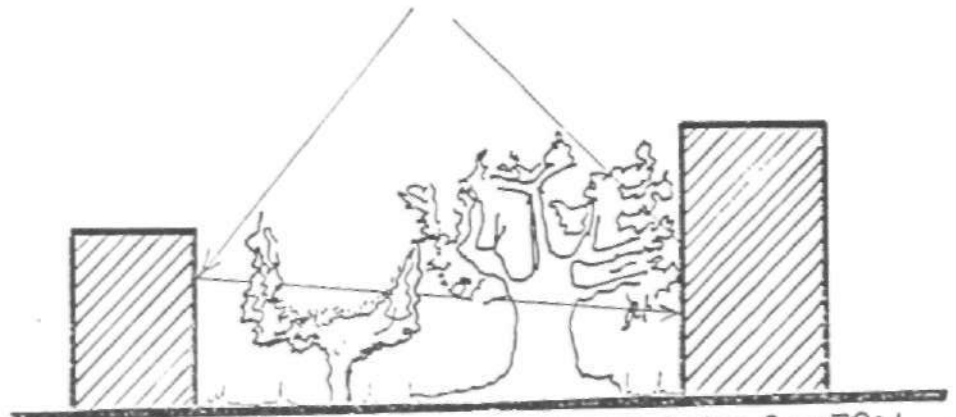
(i) Isolation of the source from the receiver. This can be achieved through screening which can be in form of walls, hedges or other barriers. For better results, such screens orhedges be positioned nearest the source.

(ii) Proper site planning can help suppress external noise to some bearable level - with adequate consideration given to the neighbouring land use, location of the library site,a quiet library environment can be conveniently achieved.

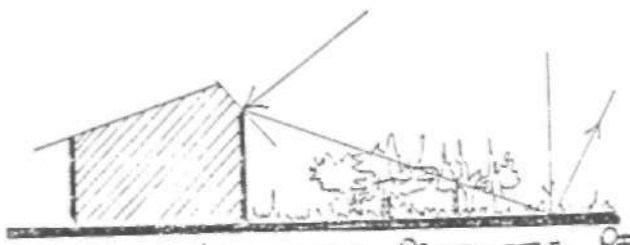
(iii) The functional layout of libraries should be such that noise sensitive areas like the reading room be separated from the noisy areas of the entrance, circulation, staircase and exhibition.

(iv) Insulation; noise reduction can be achieved through proper construction and accoustic treatment of external elements that envelop the building. Another solution may be to increase the thickness of the enclosing structure. See fig. 12.

> POSITIONS, SPECIFICATION OF DIMENSION AND ORIENTATION OF WINDOWS DESIGNS PROVIDES GOOD DAYLIGHT DISTRIBUTION AND GLARE
:TROL.



REES SHADES THE SURROUNDING AND CONTROL
REFLECTIONS (Glare) FROM NEARBY BLDGS/GR SURFACE



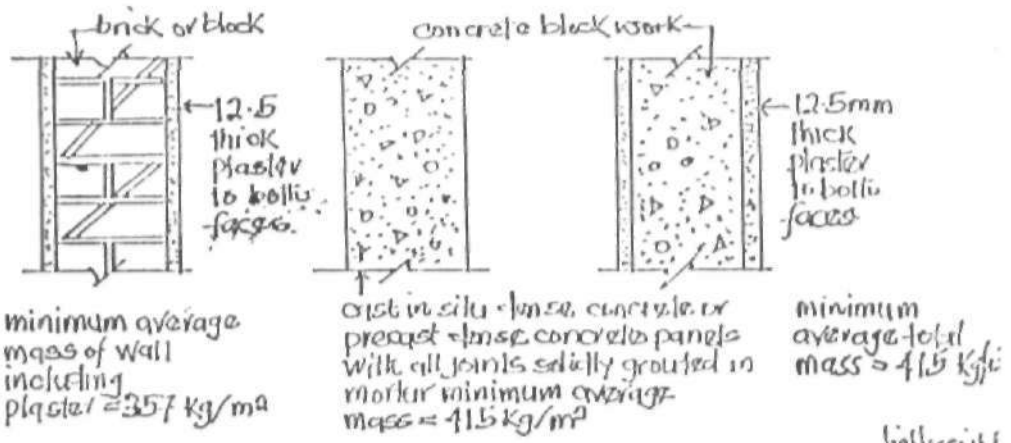
HEDGES/GRASSES PROTECTS REFLECTIONS DUE TO GROUND SURFACE.

❸ THUS FOR GOOD VISUAL COMFORT IN LIBRARY DESIGN, WINDOWS SHOULD BE LOCATED NOT ONLY FOR VENTILATION BUT ALSO FOR LIGHTING AND GLARE CONTROL AS IT DETERMINE THE POSITIONING OF MAJOR FUNCTIONS RELATIVE TO EXTERNAL WALLS.

FIG. 4.11

Fig.412

USE OF DIFFERENT MATERIALS FOR SOUND CONTROL: WALLS, COLUMNS & BEAMS



Internal Noise Control

(i) Noise emitted at a source can be reduced using suchdevices as mufflers and mounting machinery on resilient pads. Paying particular attention to accoustic requirements of machineries such as air-conditioners, photocopiers, typewriters, is yet another step in the right direction. See Figure 13.

(ii) Application of sound absorbing materials on critical surfaces of internal elements like ceiling and walls can help diminish noise caused by conversation and pedestrian movement among others. Examples of absorbents are; membrane absorbents, porous absorbents, perforated panel absorbents and resonators. It is worthy of note that porous absorbents are effective at suppresing reverbrant noise of high frequency.

(iii) Insulation; the amount of sound transmitted within an enclosure can be reduced to a reasonable degree bysound insulation. This requires that noisy machineries, be installed in well insulated enclosure. Air tight and noise insulating construction of partitions and other internal elements may also assist in this regard.

(iv) The design of the library building can effectively suppress noise transmission through spatial internal segregation of noisy zones (stairs, lift, corridors) from quiet reading zones.

IMPACT NOISE CONTROL

Floor coverings of cork, rubber, or asphalt tile, also serves to deaden noise generated from contact with floor.

BACKGROUND NOISE CONTROL

Since background noise encompasses the various noise sources, several remedial measures discussed above can be applied to check it.

CONCLUSION

Below are recommended accoustic standards for the various library units.

- Quiet Areas (Reading Areas) - 30 - 35 dB
- Low Noise Areas (Services Areas) 45 - 50 dB
  Work rooms)
- Noisy Areas (Stairs, corridor
  Entrance & Exhibition) 50 - 60 dB

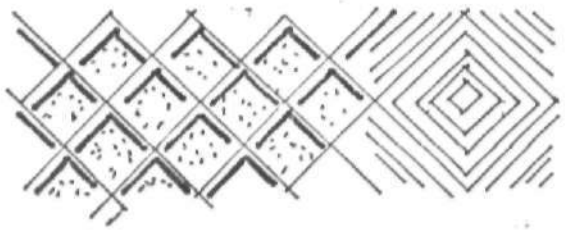
Comfort Zone: having analysed the various comfort parameters it is generally accepted that comfort zone lies between 22°C and 27°C corrected effective temperature with air velocity of 0.15M's to 1.5m's at between 50 -65 percent relative humidity.

Fig.413

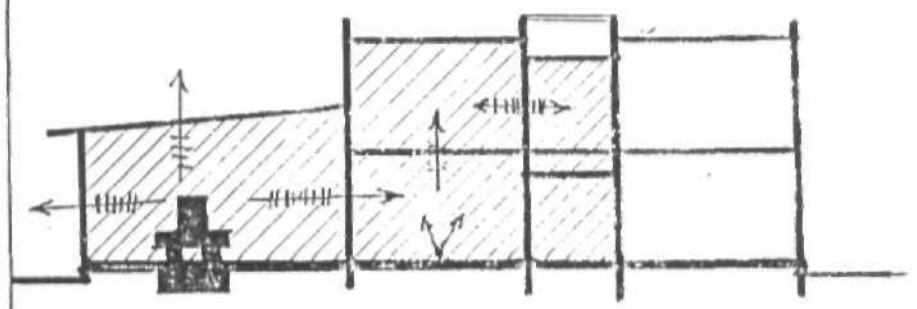
E-FLOORS

USE OF RECILLANT COVER, RUBBER TILES OR CARPETS TO REDUCE TRAFFIC NOISE

USE VIBRATING INSULATION MOUNTING FOR HEAVY INSTALLATIONS AND USE FLEXIBLE CONNECTIONS FOR ALL JOINSTS. PREFERRABLY USE SEPERATE FOUNDATION FOR MECHANICAL INSTALLATIONS.



SOFTTILES CARPETS AS SOUND ABSORBERS



SEPERATE FOOTINGS FOR VIBRATING BODIES.

ALSO USE CONSTRUCTION TECHNIQUES AND MATERIALS FOR TRANSMISION CONTROL IN UPPER FLOORS.

CHAPTER FIVE

STUDY AREA

INTRODUCTION

This chapter hopes to examine the project town and other physical factors that will affect the architectural character of the proposed design.

BAUCHI TOWN: Bauchi city itself lies approximately 9° 49' east and 10° 17' north with an altitude of about 609.3 metres.

5.1 THE PROJECT SITE

The permanent site of the University in Gubi is where the project is located. The proposed library is located within the academic core behind the proposed senate building of the university as shown on the master plan. see Fig. 1.

SITE SELECTION CRITERIA

The underlisted criteria favoured the choice of site.

- Possibility of expansion: the land area is big enough to house the library and other facilities. In which case, possibility for future expansion is visible.
- Better environmental condition: hazards of noise generated from automobile is minimal thus making it suitable for the project.
- Accessibility: the central location of the proposed site makes it easily accessible from all parts of

the campus such as the faculties, student hostel and staff quarters.

Topography: the site is relativel flat which makes it suitable for a library location.

5.2 SITE CHARACTERISTICS

CLIMATE (MACRO)

Basically Bauchi has two predominant climatic characters, namely: the dry and wet seasons. The dry lasts from November to March, while the wet season predominates from April to October. The seasons are engendered by the tropical maritime air-mass and the tropical continental air-mass which blow in from the southwest and northeast respectively.

Micro Climate: climate on its micro level influence, positively by the imposing topography of the land which is best suited for the project.

5.2.1 RAINFALL

The project site which lies on the side of the plateau has mean annual rainfall of 1075mm. With the highest rainfall experienced in August and the least in October. Possible design influences will be on roofing anchorage to wll, efficient roof and site drainage, problems of decay and surface bleeding. All these points influence the choice of material finish and quality of workmanship among others. See Fig 2.

5.2.2 TEMPERATURE

Average temperature daily is 32° C maximum and 19° C minimum. On a monthly scale it is 36.7°C maximum

and 28.7°C minimum. Heat is experienced mostly between middle of April to middle of May with temperature as high as 36°C maximum and 23° C minimum. From the temperature graph, thermal discomfort is obvious through the year with variations of up to 13°C on the average.

The above conditions calls for designs which take advantage of natural cross-ventilation to enhance thermal comfort. Colling istallations as supplements might be necessary. Possible effects of heat on roof, windows, finishes and joints are areas of possible consideration. See Fig. 3.

5.2.3 HUMIDITY

From fig. 4 it can be seen that the months that fall within the comfortable RH range of (30 -70%) are few. They are May, June and October.

Here the designers may consider or pay emphasis on thermal insultation, ventilation cooling plant design, and buiilding material porosity and moisture conductivity. See Figure 4.

5.2.4 WINDS AND DUST

There are two trades winds that characterise the climate of Bauchi, namely; the north-east and south-west made winds. the former predominates from November to April while the later from May to September with an average annual occurrence of 79 cases.

The north-east trades wind with its destructive tendencies is capable of blowing off roofs and a major carrier of dust particles which affects the health and

visbility of the eye.

Generally, the winds alleviate the extremes of high temperature and solar radiation. the cool south-west trade wind on other hand is moisture ladden to facilitate human comfort.

Generally the winds alleviate the extremes of high temperature and solar radiation with good design. This can be achieved through proper fenestration,orientation and layout of buildings. External surface finish, and proper roof anchorage are possible areas of consideration. See Fig. 5 for prevailing wind direction in a year.

5.2.5 SUNSHINE HOURS AND SOLAR RADIATION

Sunshine hours in Bauchi is averagely 8 hours daily. Highest sunshine period is 9 hours daily in November and December and lowest in July and August with 6 hours averagely. See Fig. 6.

Solar radiation is highest in March and November with 17knm^{-2} and lowest in July -14knm^{-2}.

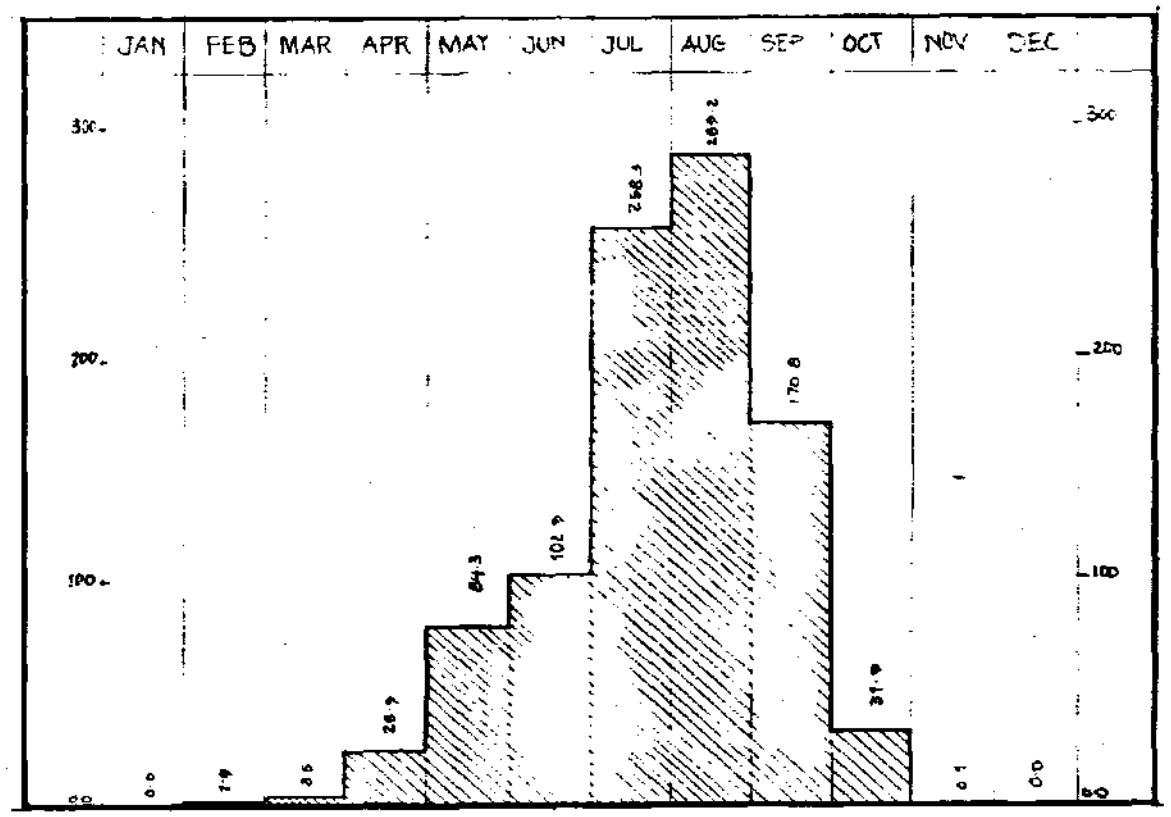
Design influences will be on nature of finishes, roof and wall material, thermal comfort, shading device depth and material, general site planning and building orientation.

5.2.6 VEGETATION

At macro level, the vegetation of the site is that of the open savanna woods which is characterised by large grass land dotted by tropical trees and shrubs.

Fig. 1

Fig.5.2

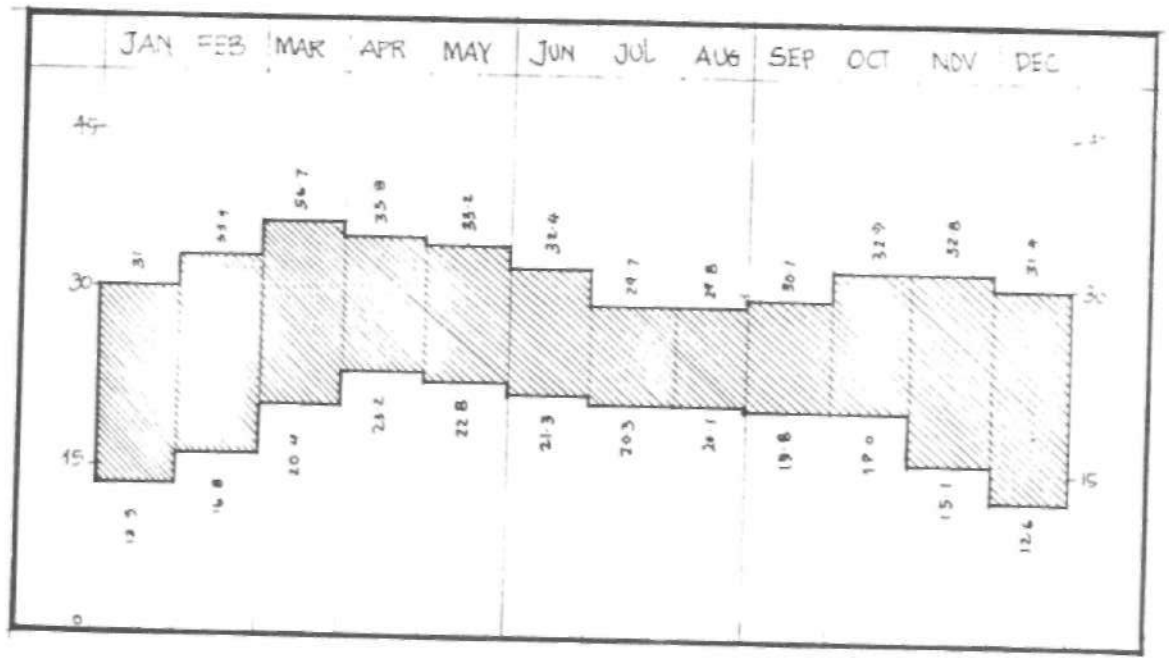


Average Monthly Rainfall (mm)

RAINY SEASON OCCURS BETWEEN APR-OCT YEARLY

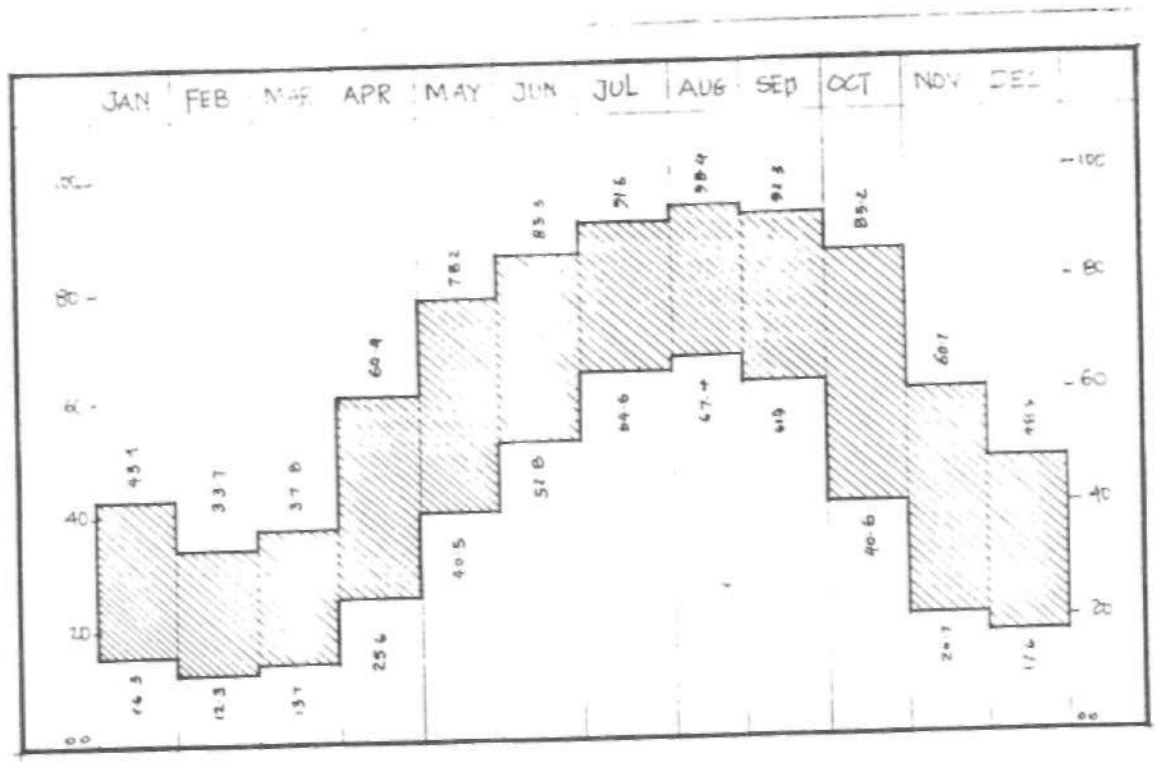
HIGH INTENSITY OF RAINFALL OCCURS BETWEEN JULY-SEPTEMBER

RAINFALL IS CHARACTERISED BY STRONG WINDS



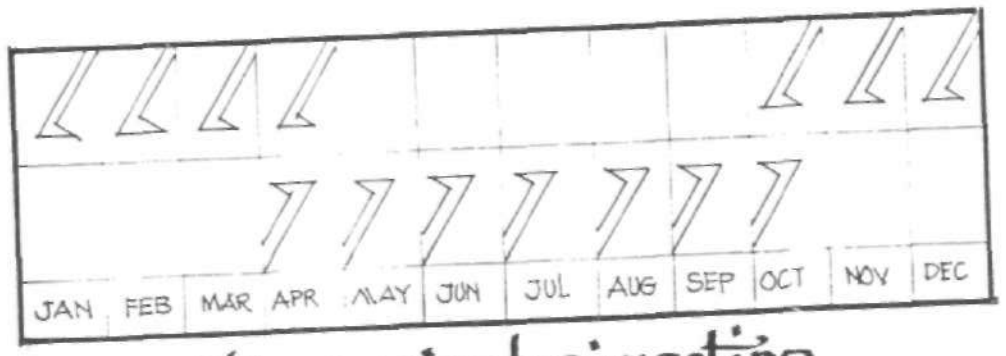
Temperature (Average monthly max and min in °C)

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

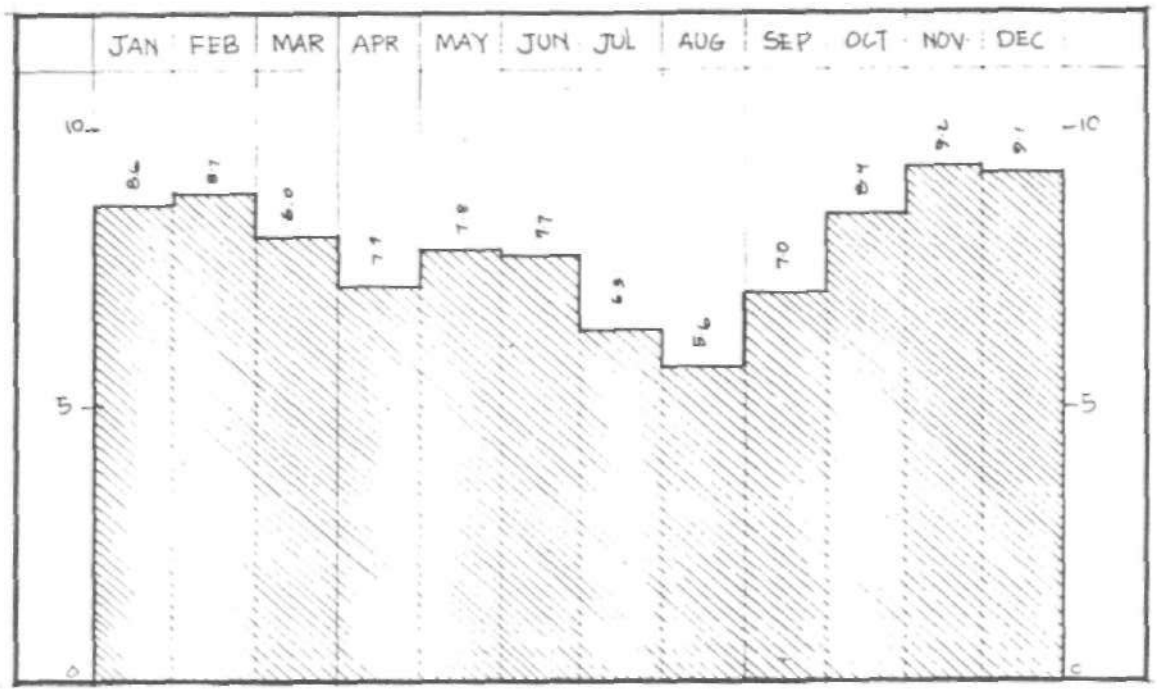


Relative Humidity

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



prevailing wind direction



Sun Shine Hours (Daily Mean Hours)

During the DJF season (NOV-MAR) the monthly variation in the amount of sun shine follows a trend of an increase over the JFM. The least value of sunshine hours is noted in Aug.

CHAPTER SIX

DESIGN REPORT

This Chapter explains the author's systematic approach to the analysed problems and his design proposals.

6.1 SITE CONCEPT

In developing the site concept, major activities which will take place in the library as earlier identified are zoned accordingly. Such zoning has been affected by noise, security, accessibility and other related variables. Quiet areas like reading room which requires concentration were isolated from the noisy areas of entrance, circulation, staircase, and exhibition among others. See Fig. 1. A rough idea of library functions and their inter-relationship informed zoning to enhance easy accessibility to materials while avoiding points of conflicts. See Fig. 2.

6.2 FORM DEVELOPMENT

Having analysed the site concepts, the author adopted The combination of circular and rectangular forms for the following reasons:

- structural simplicity;
- Space economy;
- easy expansion and proper circulation efficiency;
- Aesthetic reasons;
- ventilation purposes - See fig. 3.

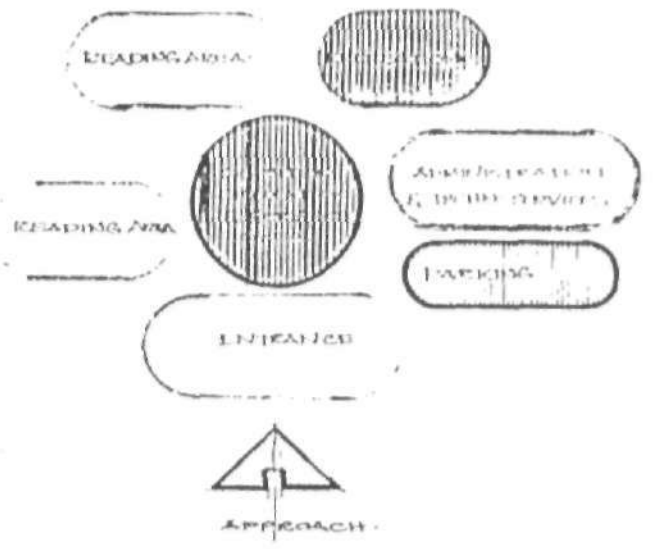
6.3 CHOICE OF STRUCTURE

The column and beam structural approach was chosen to

ZONING CONCEPT.

ZONING AFFECTED BY NOISE & SECU.

ZONING HERE TAKE INTO CONSIDERATION NATURE OF ACTIVITIES THAT TAKES PLACE IN A LIBRARY. ZONING AFFECTED BY NOISE IDENTIFIES NOISY AREAS, LESS NOISY AREAS & QUIET AREAS. QUIET AREAS LIKE READING ROOMS WHICH REQUIRES CONCENTRATION ARE ISOLATED FROM NOISY AREAS OF CIRCULATION, ENTRANCE, STAIRCASE AND EXHIBITION LOW NOISY AREAS ON THE OTHER HAND ARE ZONED AWAY FROM HEAVY NOISE AREAS INTERMEDIATE FOR

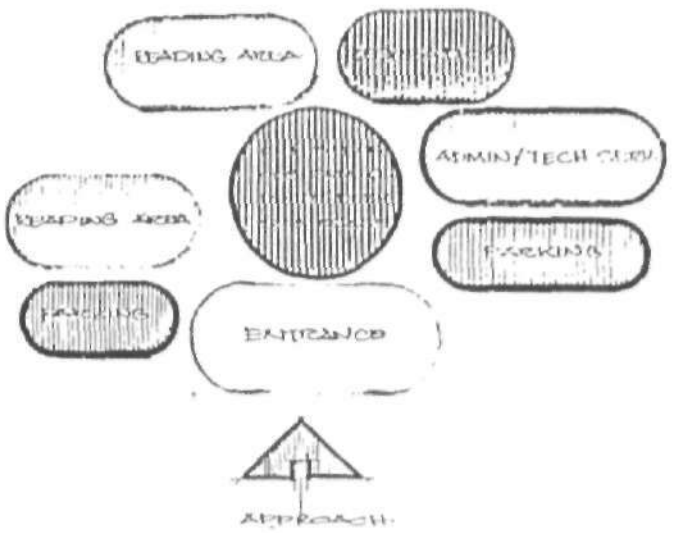


ZONING AFFECTED BY ACCESSIBILITY.

A ROUGH IDEA OF THE LIBRARY FUNCTIONS AND THEIR INTERRELATIONSHIPS INFORMED ZONING TO ENHANCE EASY ACCESSIBILITY TO MATERIALS WHILE AVOIDING POINTS OF CONFLICTS OR REDUCING POINTS OF CONFLICTS TO THE MINIMAL.

A CENTRAL CIRCULATION IS BEING ADVOCATED TO MEET THE ABOVE NEED.

PARKING LOCATED AT THE ENTRANCE TO FACILITATE EXTERNAL ACCESS.

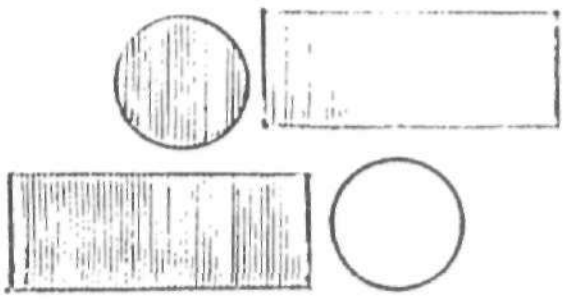


CONCEPTS

FORM DEV. CONCEPT

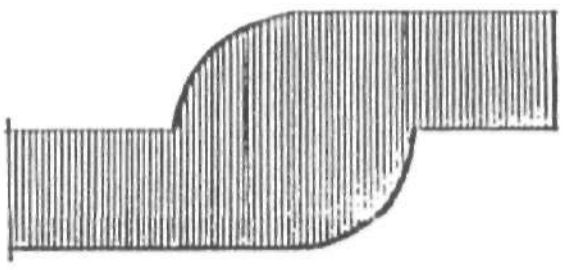
CHOICE OF FORM.

FIRST STAGE IDENTIFICATION OF FORM TO USE. THE CIRCULAR & RECTANGULAR FORM WERE CONSIDERED.
THIS IS DONE BEARING IN MIND COMPARTMENTALISATION, CONTEXT FUNCTIONALITY, VENTILATION LIGHTING AND COMFORT PARAMETERS AS BASIC FUNDAMENTAL CRITERIA.



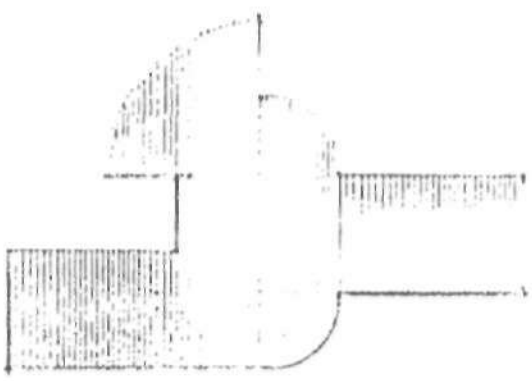
FUSION OF FORMS.

OVERLAPPING RECTANGULAR FORMS JOINED BY ARC. THE APPROACH HERE IS TO ARTICULATE THE UNDERLISTED.
ORIENTATION: PLACING LONG FACADE ON NORTH AND SOUTH AXIS. SHORT FACADES ON THE EAST AND WEST AXIS.
POSSIBILITY FOR EXPANSION FLEXIBILITY AND FUNCTIONALITY.



FINAL FORM.

LOOSE FORM CONFIGURATION TO TAKE ADVANTAGE OF ENVIRONMENTAL CONDITIONS IN AREAS OF VENTILATION & LIGHTING. OTHER REASONS ARE; STRUCTURAL SIMPLICITY, SPACE ECONOMY, EXPANSION, PROPER CIRCULATION EFFICIENCY, AESTHICS AND FUNCTIONALITY. THIS PUT TOGETHER ENHANCES COMFORT IN LIBRARIES FOR LEARNING.



ensure durability, flexibility, and fluidity of space.

6.4 DESIGN RESPONSE TO COMFORT

The author here, explored merits of available natural possibilities to enhance comfort. This approach basically incorporated major problems analysed which is that of harsh climatic conditions.

CLIMATIC CONTROL

The two main climatic concerns in hot-humid zones is the avoidance of penetration of excessive solar radiation into buildings and the encouragement of evaporation of moisture by breezes.

As a result, the whole library has been planned with loosely scattered building units. Carefully mixed into the shade of landscaped environment in order to allow for free air movement.

LANDSCAPING

Landscaping the library is not only an essential but a necessity. Grassing the environment and planting of trees with water bodies have been utilised to exert some positive influence on the micro-climate. Grass surfaces dorminated the external library environment since natural growth tends to stabilise temperature and minimize extremes in them. Paved surfaces, on the other hand tend to exaggerate it. Hence, paved surfaces exposed to sun, were shaded by planting of trees and shrubs.

BUILDING ORIENTATION

The building has been largely oriented along the north-south, and as near it as possible. This is in line with the

understanding that windows in these directions receive the least radiation. Openings were avoided as much as possible on eastern and western facade to minimise solar heat gains. And where openings could not be avoided, shading devices were applied.

VENTILATION

Rather than bear the expense of providing central air-conditioning, which experience has shown to be very difficult to maintain technically and financially, the building was designed to take advantage of natural ventilation. This was possible by orienting openings largely towards the breeze prevailing during the warm-humid season to utilise its cooling effect. Little openings towards the sun was adopted to improve in-door comfort during cold season. Ona general note, reasonably large openings were allowed in opposite walls.

The effect of the above is that, the building is reasonably well-ventilated and cool enough for studying over a long period. Notwithstanding, the design is flexible to permit installation of split unit AC or fans in offices and reading rooms so as to provide extra comfort for users and equally enhance library material preservation.

DUST AND SAND CONTROL

A study of the site revealed that north-easterly winds carry dust and sand particles over the site. To over come this nuisance, the library environment was judiciously landscaped with trees and shrubs having leaves and viscous surfaces which catch the dust and

filter the air.

WIND CONTROL

Wind breaks in form of tree belts was employed to curtail the distructive tendencies of harmattan wind between November and March. However, trees and grass were also planted near the building to allow heavier cool air to flow in side since the building has generous openings.

LIGHTING

Lighting concept employed here is that of abundant glare-free natural lighting supplemented by artificial fluorescent light. This was possible through generous openings.

GLARE CONTROL

Openings were recessed by 1.2m to avoid direct sun-ray from entering the building, keep out the rain and provide shade. All reflective surfaces like walk-ways exposed to the sun are shaded by trees and shrubs.

NOISE CONTROL

Trees are densely planted to form barriers which reduce the level of air-borne noise. Besides, it satisfies the instructive need for aesthetics. Other areas will be discussed under use of materials and finishes.

CIRCULATION CONCEPT AND INTERNAL ARRANGEMENT

It was always intended that the library would become a focal point for the campus and this concept was extended to the design of circulation pattern of the library. It was centrally located in the building, thus, distributing people into the various compactments with minimal conflict. Internal arrangements kept readers by the windows. Hence it is possible for them to rest their eyes on the green

rolling landscape and other universally buildings around.

OTHER REQUIREMENTS

Flexibility:- For structural and space flexibility needs, modular design approach was adopted. This way we have minimum permanent structures, in which case, no function assumes a fixed space occupation except fixed core elements like toilet, staircase, etc. The result is that internal rearrangements of functional components of the library is fully guarranteed at little or no practical cost. Details had already been discussed in chapter two. To this end, open offices, free space dorminate the interior.

EXPANSION

The long imposing struct ure made it possible for the library to grow on both eastern and western ends.

COMPARTMENTALISATION

This Design approach was considered by the author to prevent fire spread. Use of fire resisting doors which are self closing and minimize openings at property boundaries, emergency staircases to facilitate evacuation of library occupants in events of fire. Fire hydrant was located in near the toilet to be used as aid in event of fire out-break.

SECURITY

The arrangement of the stacks between the reading spaces psychologically discourages mutilation and vandalism since a culprit can be seen by other readers at opposite ends of the stacks. Mosquito netting (iron) of openings was completely recommended to minimize the tendencies of pilfering library materials through the windows, use of

control desk to check incoming and out-going library users, an electronic gate which raises alarm if an improperly charged book is to be taken out of the library is to supplement the manual control system. The use of close circuit television to monitor activities in various library units was yet another solution provided.

MATERIALS AND FINISHES

Floor finishes: This consist of concrete paving in outdoor reading/recreational areas. Terazzo finishing along the main circulations including the exhibition area. Polyvinyl floor tiles are specified for interior of offices while reading areas are finished with padded floor tiles for accoustic reasons.

All circulation routes round the site is of concrete paving.

Walls:- mainly of concrete block walls for external walls and certain internal areas. Temporary partition of aluminium and timber was adopted. Internal walls of seminar rooms and conference rooms are finished with accoustic tiles to help deaden noise generated from discussion and those of machineries in printing and binding divisions.

ROOF

Roof material is longspan aluminium roofing sheet laid on steel lattice beam double pitched to gently throw off water. All expose concrete surfaces on the roof are finished with asphalt tanking.

CEILING

Ceiling structure is the suspended type with accoustic ceiling ties laid to help absorb noise.

Basically, simplicity is the major virtue of the design as it is devoid of complications.

6.5 SCHEDULE OF ACCOMMODATION

The appropriate space required for users, bookstacks and library staff was estabished based on figures obtained on student/staff population, international standards, Clients brief an and assumptions based on recommeded practice.

CLIENT BRIEF

The brief requested the architect to prepare drawings for a a library building in line with what was projected to be ultimate size of the university. Minute details such as objectives of the University, and Library organisational structure, Planning facts and figures, structural considerations. fenstrations, and communication were given in a ten page brief submitted to the author. While appreciating the unigue contribution of the brief, it must however be emphasized that it was too ambitions.

The University with its present student population of about 4,000 is projected to have total enrolment of about ten thousand students (10,000). Using a percentage of 18 of student population, than space for readers = $\frac{16}{} = \frac{10,000}{} = 1,800$.

Teaching staff at the ratio of one ten students will number 1000, and 25% seating will be 125 seats. The administrative staff under this guideline will require 125 seats thus, a total seating capacit of 1925 is envisaged.

READER SPACE: standard acceptable dimension of an individual table is 600 x 900mm with additional allowance, a reader occupies 1.25m². Micro reading room (carrells) for serious work or research requires 3.0m².

SHELVING SPACE: A collection of 300,000 volumes is being planned for the first twenty-fives at a shelving space specification of;

Area	Books	Area	Journals
Open access-4.65m²	1,000 volumes	9.35m²	1,000 volumes
Closed access-4.03m²	1,000 volumes	8.06m²	1,000 volumes

Or at fifteen volumes per foot.

Below is a break-down of the areas in the proposed library building:

Functions	GROND FLOOR	Area (m²)
Entrance Porch/Drop off		177m²
Vestibule		18m²
Luggage Room		36m²
Control Counter		18m²
Circulation Area		264m²
Public Catalog		85m²
Serial/Journals		350m²
Reference		340m²
Loan Desk		85m²
Photocopying Room		72m²
Staircases, lift, toilets and duct		168m²

Function	GROUND FLOOR	Area (m^2)
	Technical Services	
Acquisitions		36m^2
Despatch/Delivery		72m^2
Accesssion		36m^2
Cataloging		72m^2
Classification		72m^2
Awaiting Shelving/Circulation		36m^2
Parking Space		1340.5m^2
Out-door Reading/Recreation		450m^2
	FIRST FLOOR	
Readers		754m^2
Stack		383m^2
Staff Area		36m^2
Circulation		180m^2
Staircase, lift, toilets and ducts		168m^2
	Staff Area	
Workspace		144m^2
Bindery		144m^2
Printing		72m^2
	SECOND FLOOR	
Readers		882m^2
Micro-reproduction		185m^2
Stacks		324m^2
Staircase, lift, toilets and ducts		168m^2
	LIBRARY ADMINISTRATION	
University Librarian		72m^2
Special Assistant to University Librarian		26m^2
Secretarial Staff		72m^2

Function	SECOND FLOOR	area(m²)
Deputy librarian		36m²
Accounts Office		72m²
Workspace		72m²
	THIRD FLOOR	
Readers		915m²
Reserved Unit Stack		260m²
Audio-Visual/Store		272.8m²
Circulation		156m²
Staircase, lift, toilets and Ducts		168m²
	STAFF AREA	
Computer Central Processing Unit (CPU)		144m²
The Internet, E-Mail and Close Circuit T.V.		72m²
Staff Common Area		72m²
Head, Computer Services' Unit		36m²
	FOURTH FLOOR	
	PG/Staff Division	
Carrels		206m²
Readers		432m²
Rare Books		113m²
Stack Area		129m²
Circulation		39m²
Staircase, lift, toilets, ducts		72m²
	FIFTH FLOOR	
Staircase, lift, lift machine room		72m²
		10,676.3

CHAPTER SEVEN

7. 1 CONLUSION

The sphere of communication and information has developed permanently as one of the largest and long lasting unfulfilled human needs. Installed in such an idea I cannot see libraries otherthan in their rightful priority of essential structures of society. they are the surest way of trasfering and promoting the continuity of knowledge. In fact, they are well placed to give to local communities and to humanity in general, a sense of well-being and security of heritage, and a surety that the density of information available answers their needs, behaviours and human expectations with maximum adequacy.

With only these few important points, the reality and the development of libraries must be listed among the priorities of our society. However, present dimensions are linked to quantity and quality of knowledge. This calls for a complete entry into competitive territory of knowledge and a renewed approach to library issues.

Given the above, in the face of economic constraints, the author attempts to explore this scheme with view of contributing to societal development. A study of prevailing situations, trends of library development, its new roles and societal problems were carefully carried out. A further analysis of conditions under which effective learning and reading can take place was done and suggestions were designed to give satisfactory results. The work does not portray itself as a perfect solution to the defined

problems, rather it is an attempt towards solving the problem.

Future architects are therefore enjoined to research in this direction so as to evolve varying alternatives in library design.

7.2 RECOMMENDATIONS

Research have shown that libraries in Nigeria are faced with a common problem. Among these problems are the follow-ings:-

- Decline in the investment inacademic libraries as Universities reduced the proportion of their overall budget over the past few years.
- The astronomical rise in the cost of serials, 400% of the last 15 years, leading to widespread cancel-lation of serial titles;
- The cancellation of expensive and unique titles forcing libraries to loose their richness in diversity and move towards more homogenous collections, as they seek merely to satisfy securing or core collection items;

For human societies, the future must not be a territory of chaos - hence it must be built with clarity and determination. The following recommendations are therefore put forth to better the future of our libraries.

- Architects must strive to design with climate so as to reduce cooling cost since declining economies and high inflationary situations are a major handicap.

- Finishing must be such that it requires little maintenance;
- On the policy levels, University policies and management of intellectual property ought to be thought.
- Efforts must be made to improve the image of libraries and libriarianship in Nigeria.
- University libraries in Nigeria should take advantage of the "Twinning" arrangements being proposed by some University libraries in the United States and Canada.
- University libraries in Nigeria must go beyond their traditional roles and move into commercial ventures such as providing consultancy services. This will substantiate efforts by the governemnt which solely finance the libraries in Nigeria.

B I B L I O G R A P H Y

1. BIDDLE, F. STANTON "Planning in the University Library" (London; Greenwood Press, 1992) p.3

2. CONBIN, JOHN "Implementing the Automated Library System" (Encanto; ORYX Press, 1988) p.1

3. NEUFENT,F. "Architects Data, Second International English ED. 1980. Granada Pub. London.

4. MAHMUD K. & NWAFOR B. W. "Tropical Library Architecture" ABU Zaria Semina Proceedings, 1980.

5. METCALF, K.D. "Planning academic and Research Library Buildings" McGraw Hill Book Company, New York, 1965.

6. National Universities Commission, (NUC) Standard Guides for Universities

7. NOLAN L. & WILLIS N. M. "Libraries Designed for Users" A planning Handbook, Hamden Connection, 1980

7. OLGYAY V. "Design with Climate" Princeton University Press, 1963.

OLIVER J. E. "Climate and Man's Environment" John Wiley and Son; Inc. New York, 1973.

9. OGUNSOTE,O . "Introduction to Building Climatology" ABU, University Press, 1991

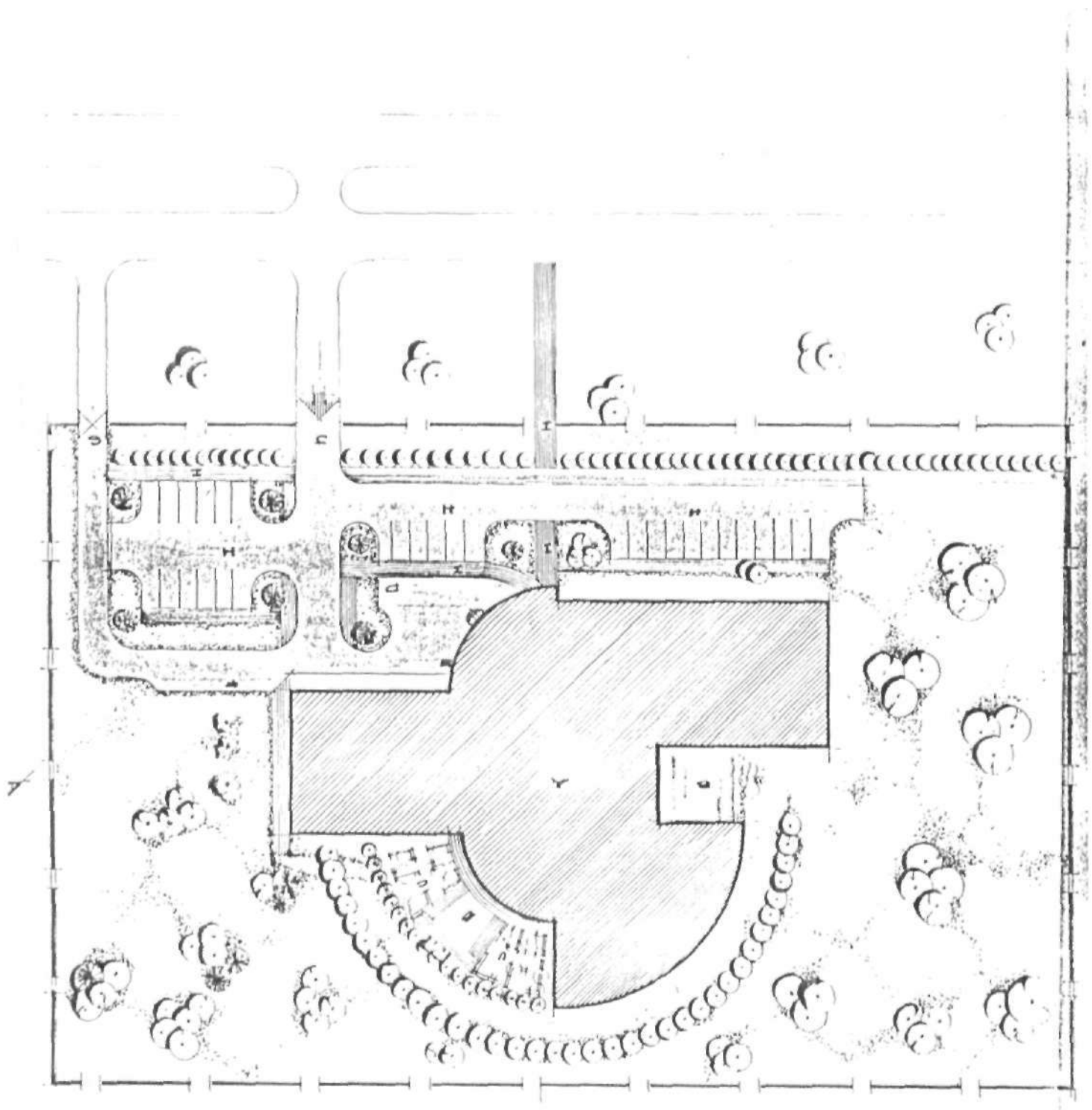
10 PALMER, P. RICHARD "Case Studies in Library Computer System" (New York and London R. R. Bowker Company, 1973) P. xiii.

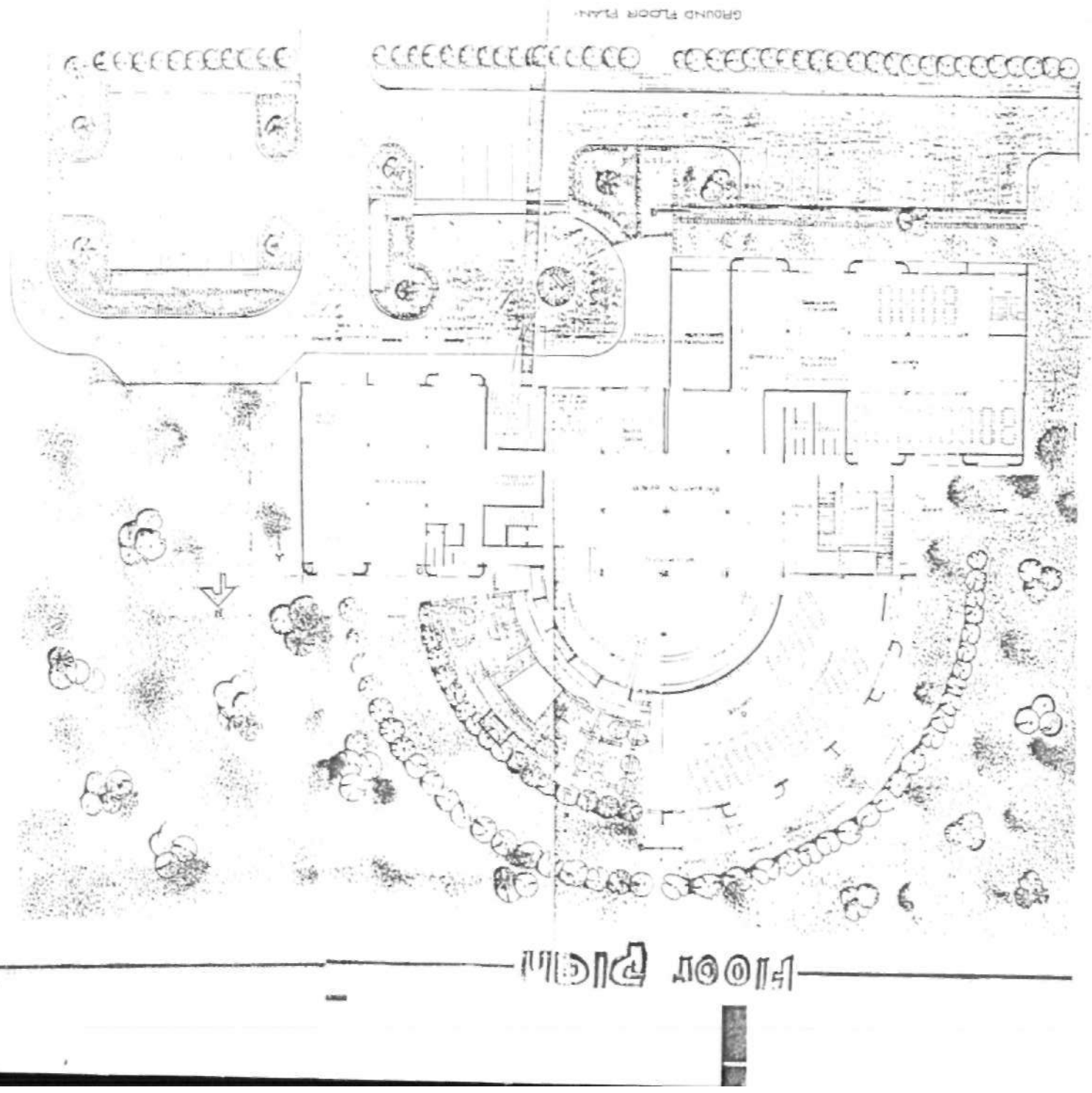
BIBLIOGRAPHY CONT.

11. REEKIE,R.F. "Design in the Built Environment"
Edward Arnold Publishers, London, 1972.

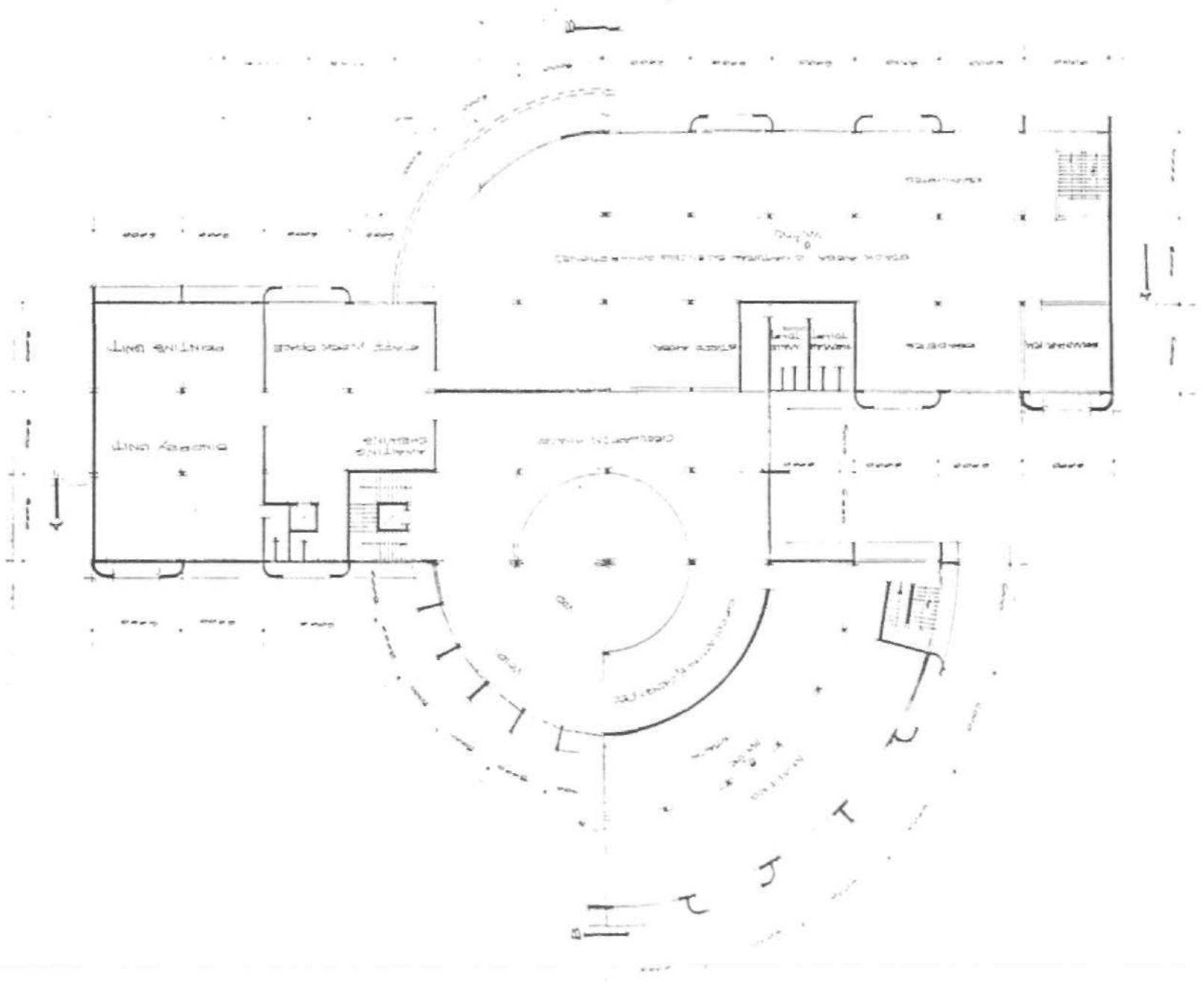
USMAN M. "State Library Complex Maiduguri"
ABU, 1989(An unpublished Thesis Submitted to Department of Architecture)

Site Plan

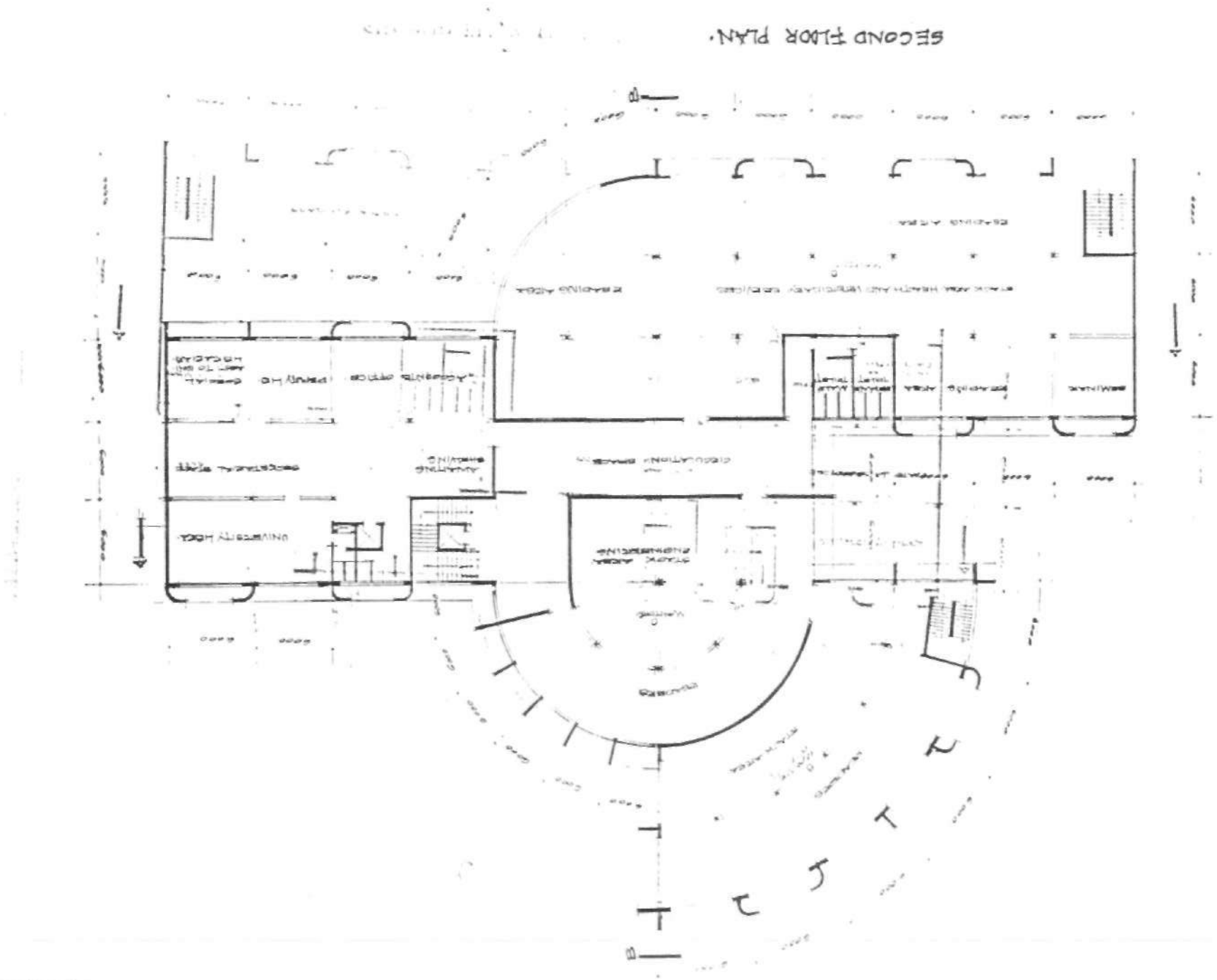

A Library building
B Fountain
C Outdoor Reading Terrace
D Parking Space
E Deep Off
F Book Van Parking
G Book Van EXIT only
H Public Parking Space
I Pedestrian Access
J Main Vehicular Access

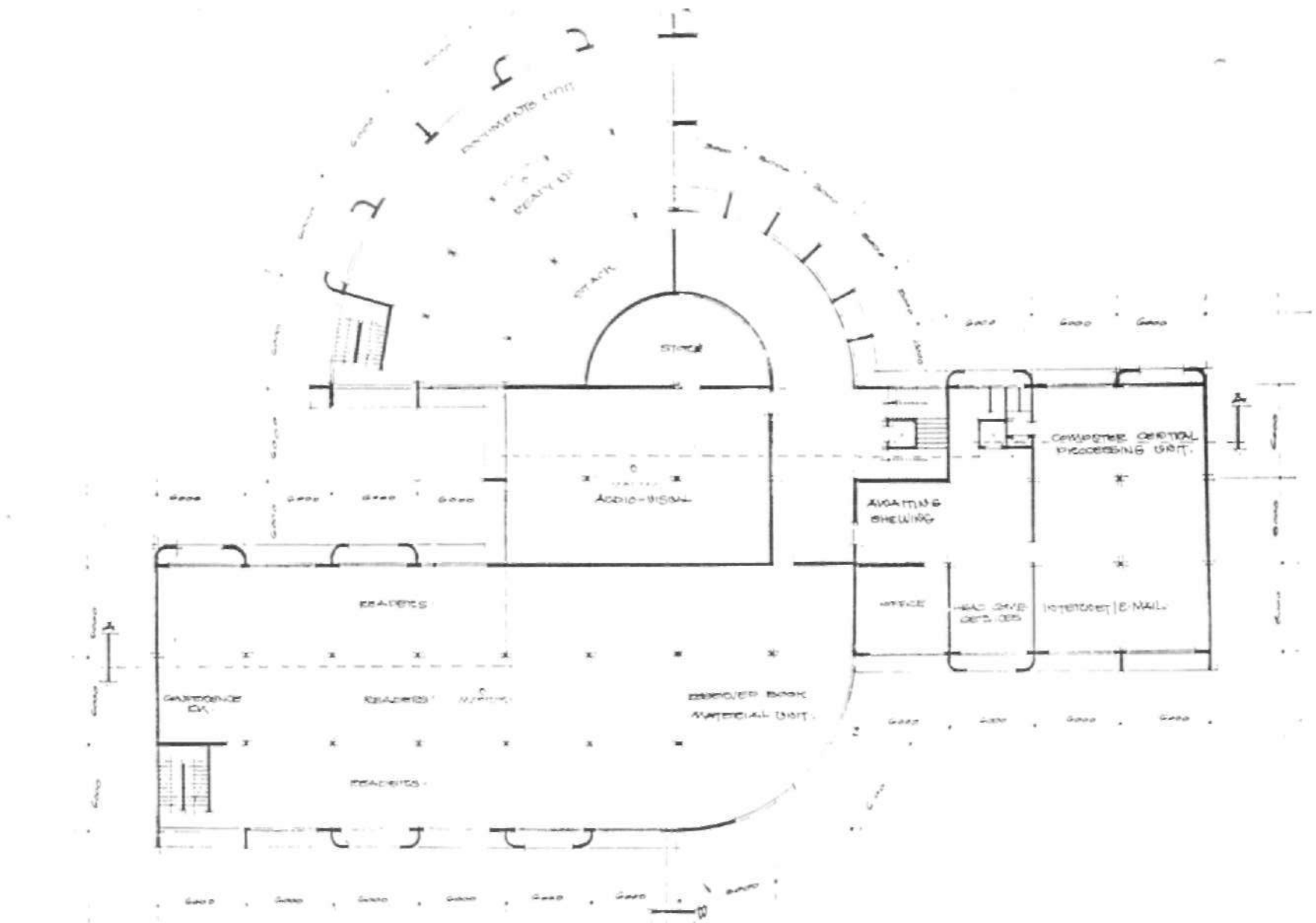

GROUND FLOOR PLAN

FIRST FLOOR PLAN.

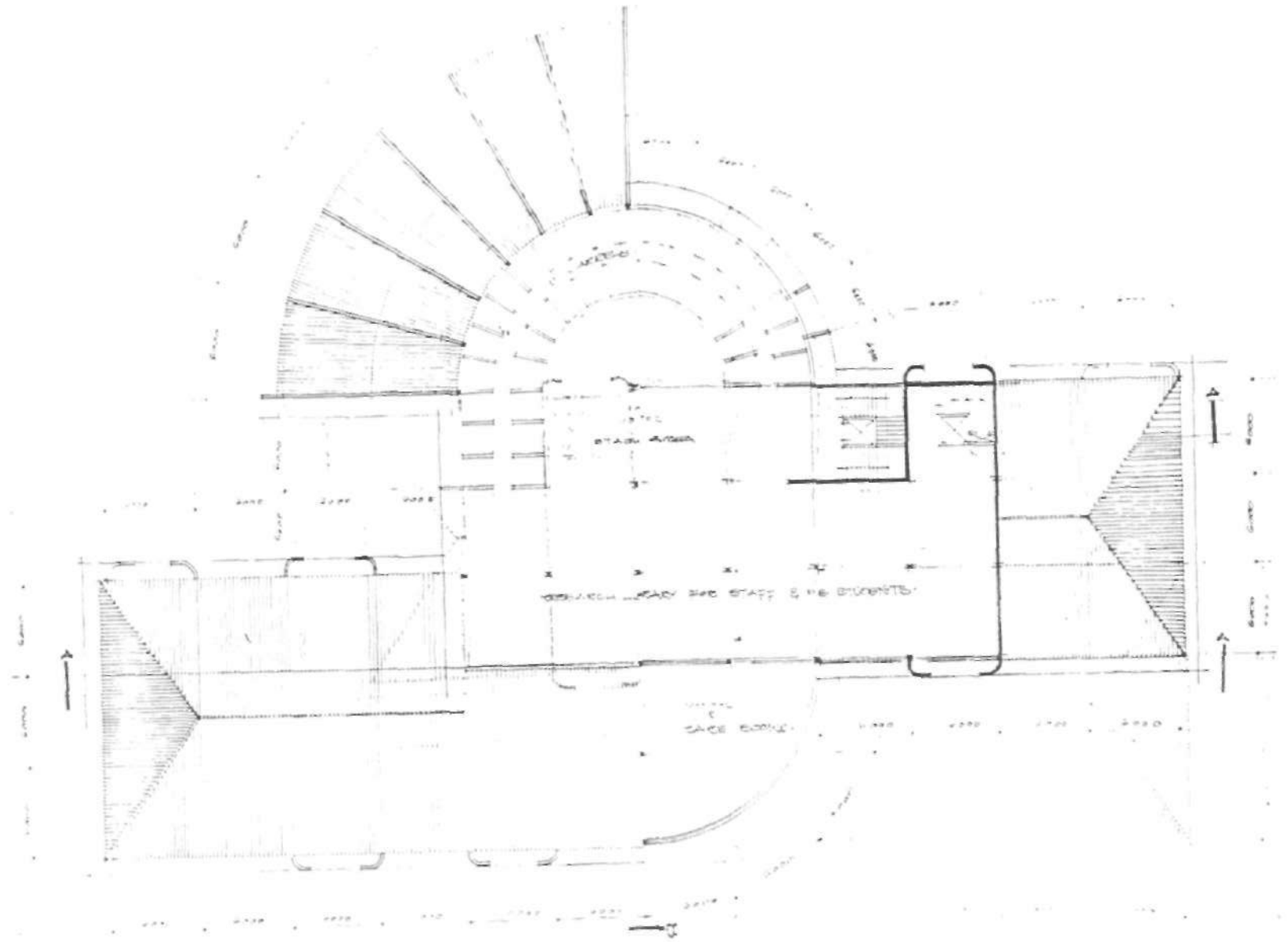


SECOND FLOOR PLAN.

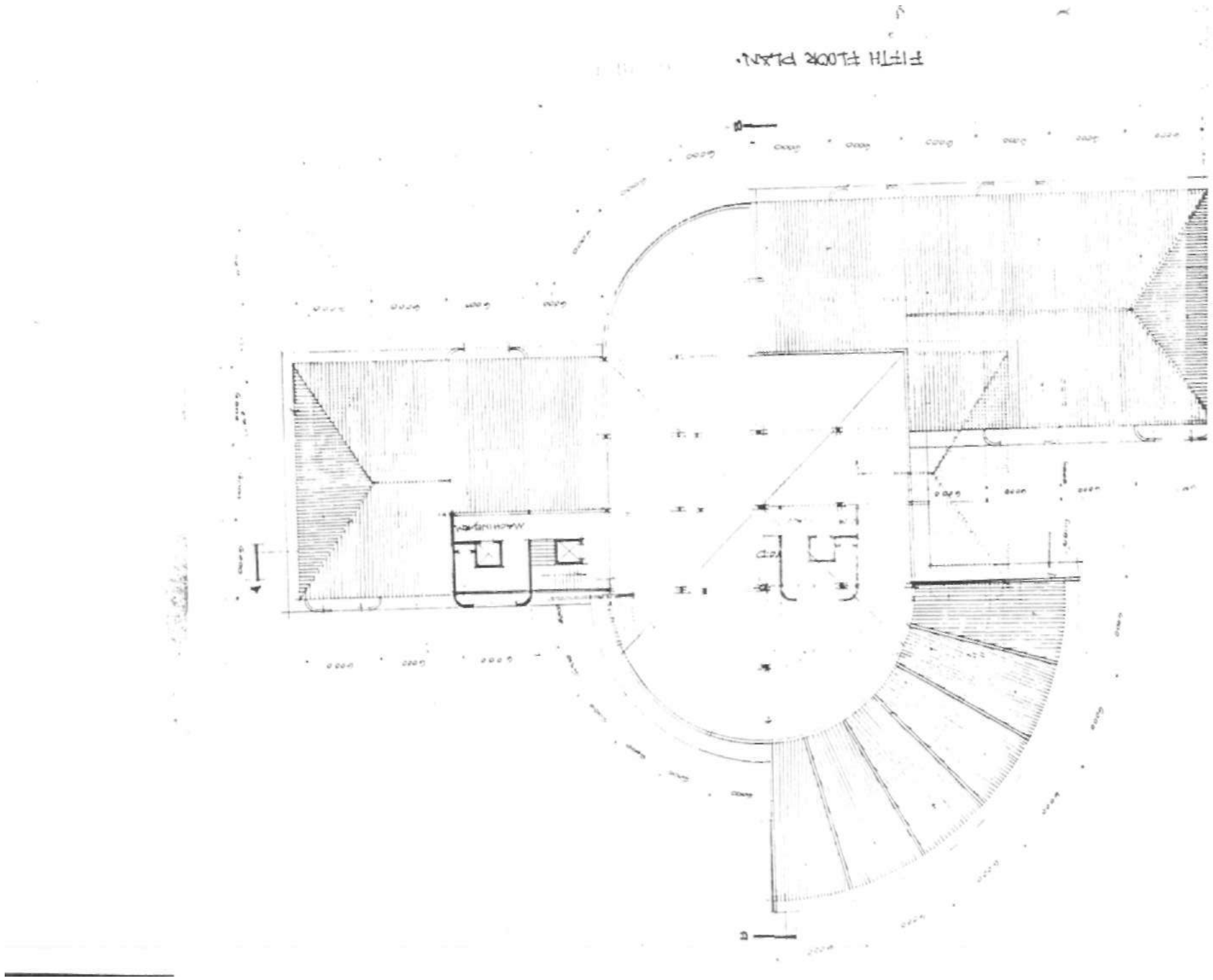


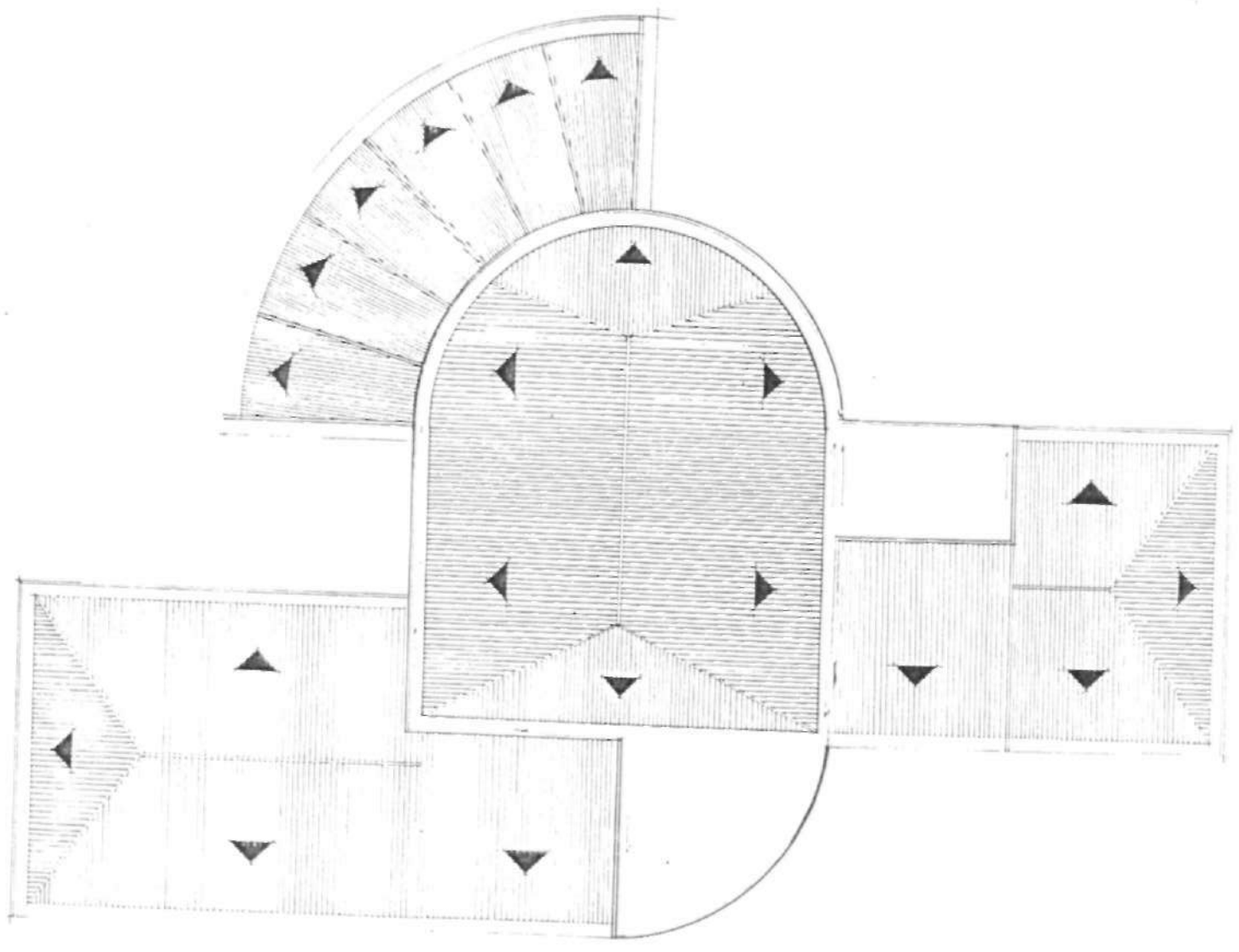


THIRD FLOOR PLAN.



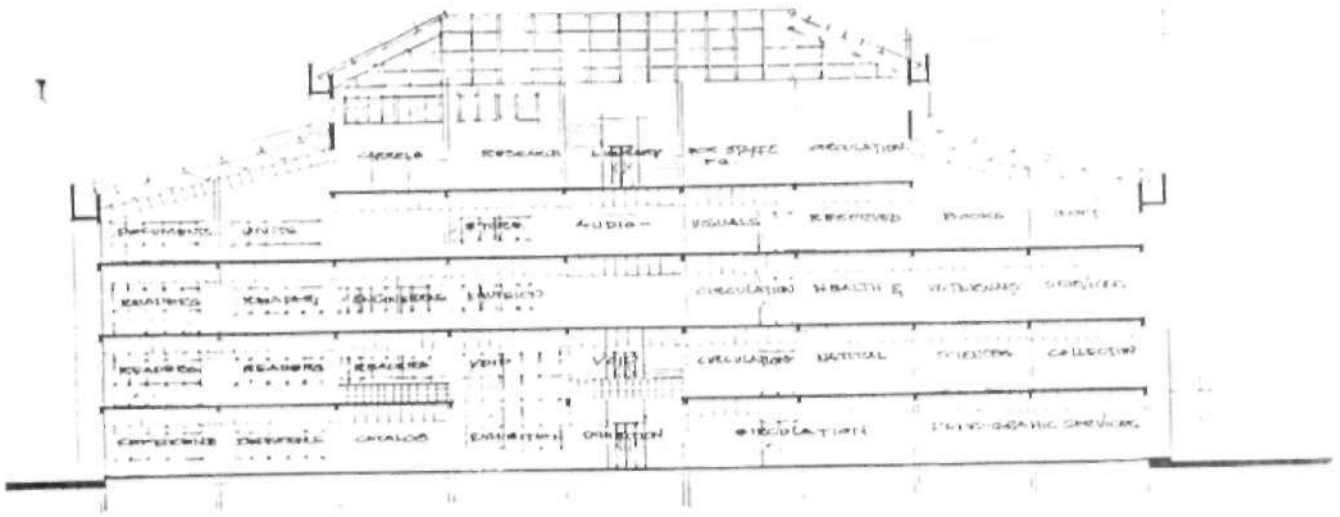
FOURTH FLOOR PLAN


FIFTH FLOOR PLAN.

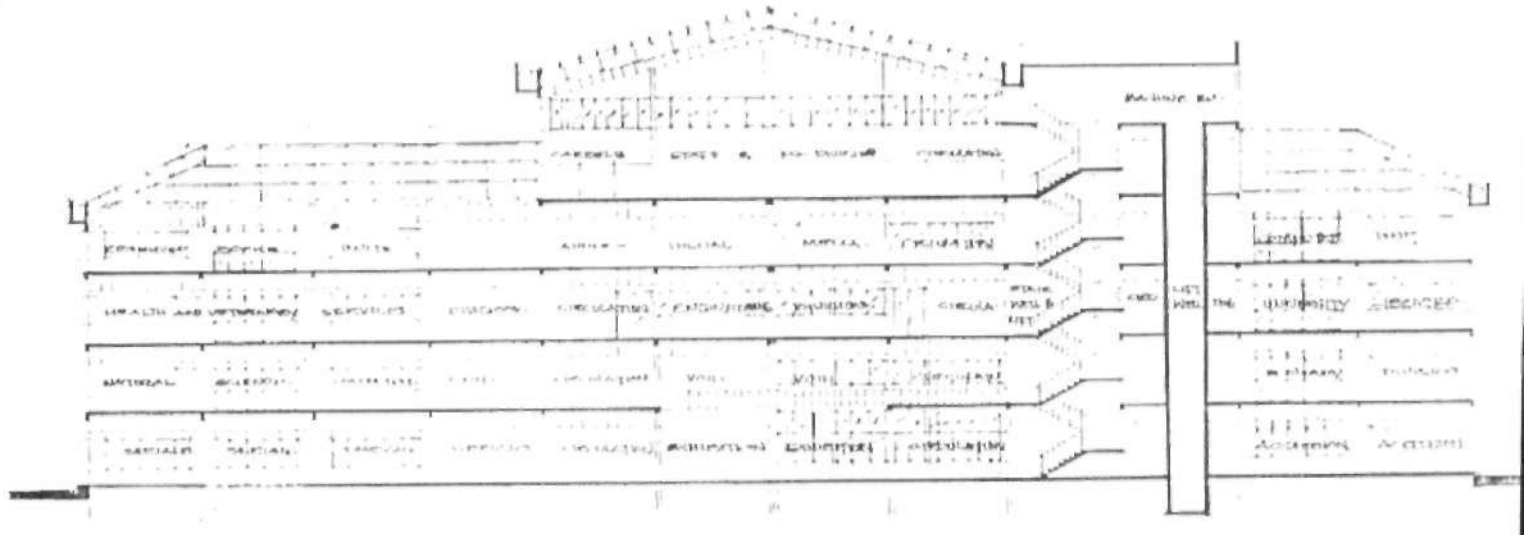


ROOF PLAN.

Sections

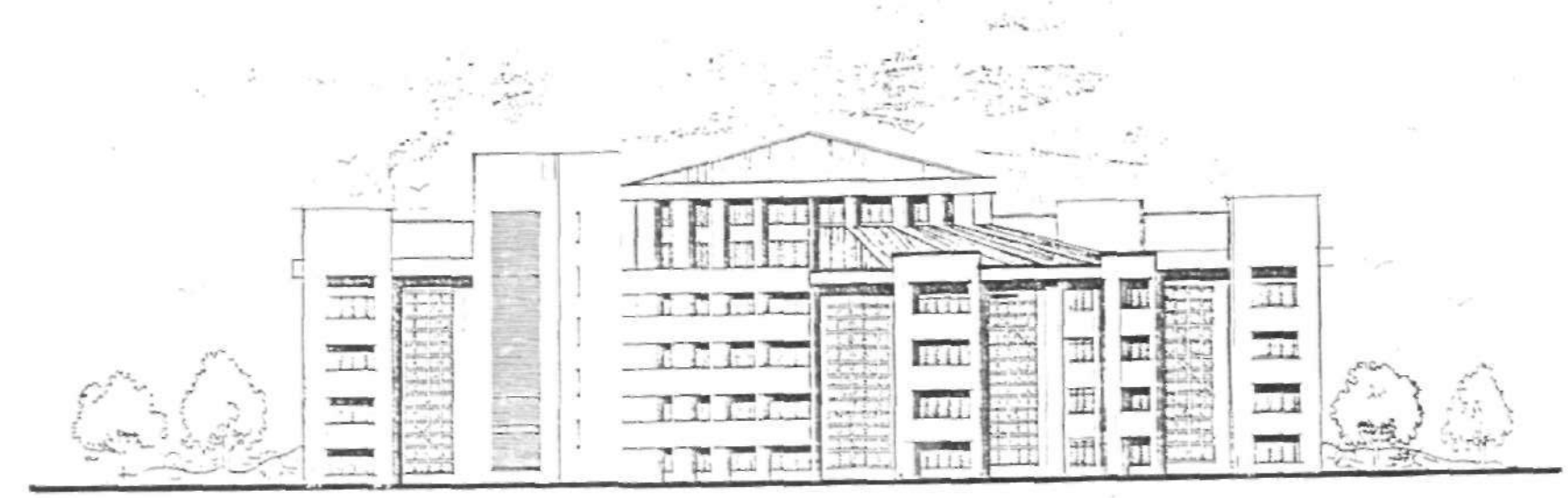


SECTION B-B·

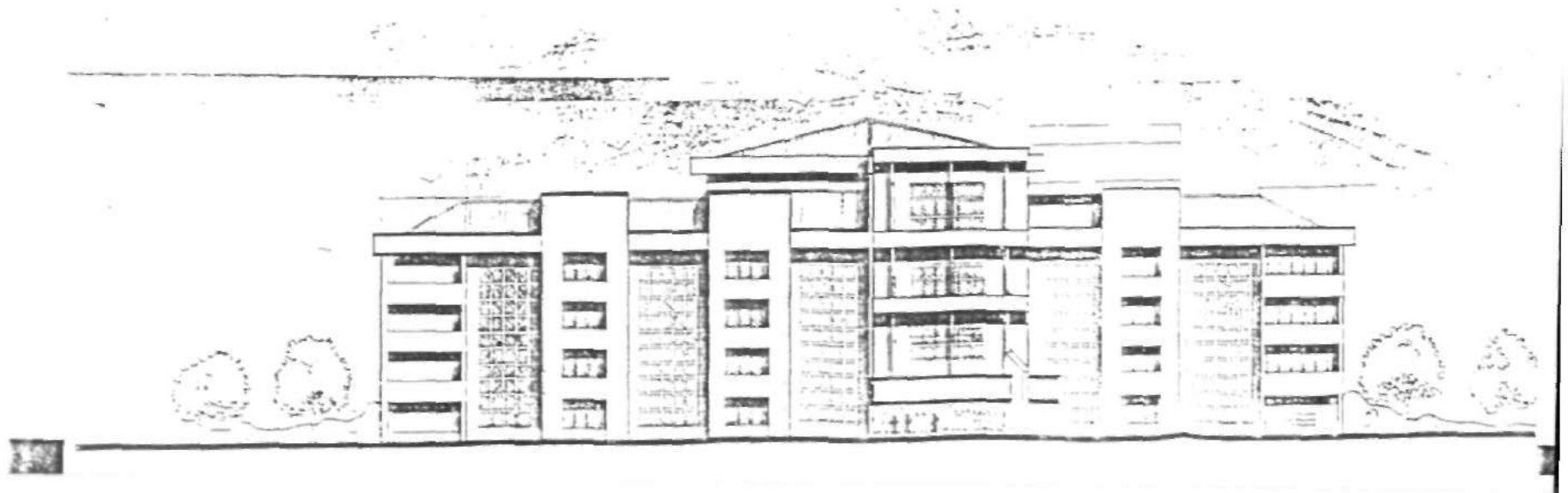


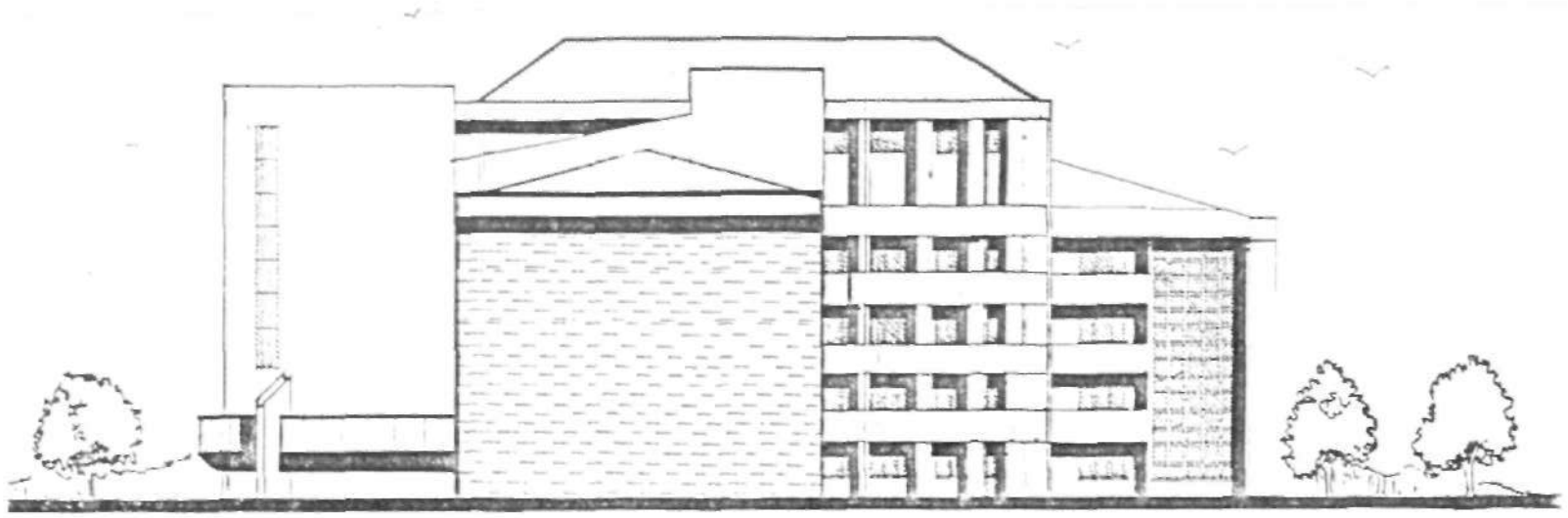
SECTION A-A·

Elevations

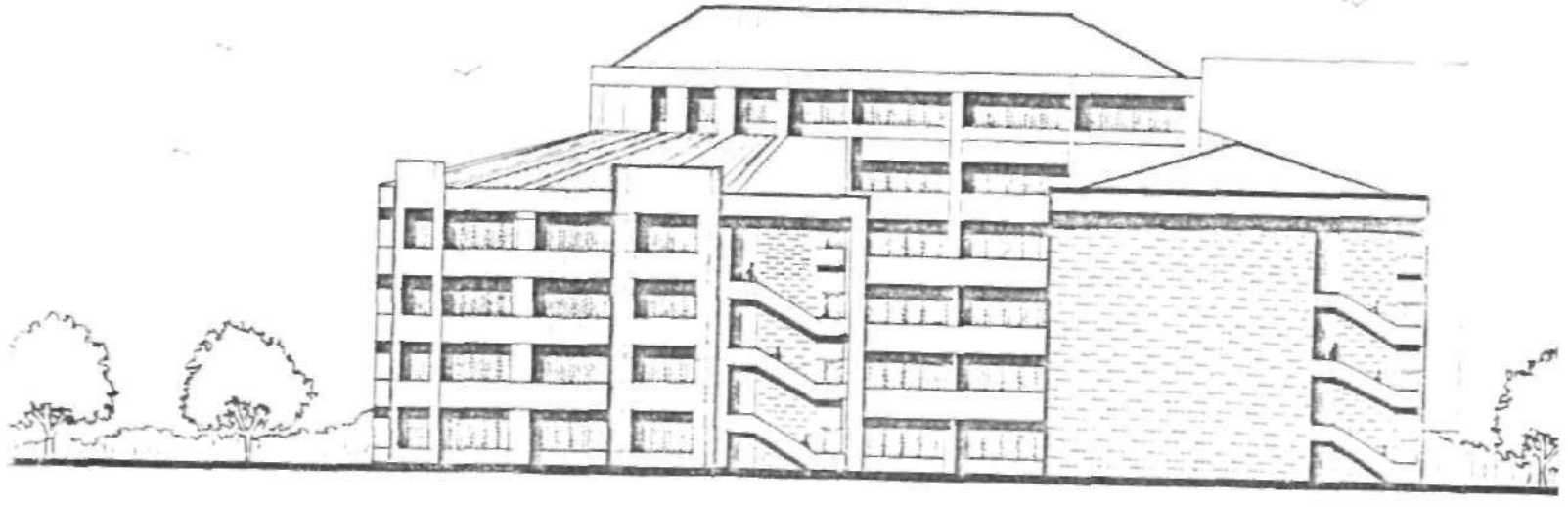


REAR FACADE





EAST FACADE



WEST FACADE.

