

**DESIGN PROPOSAL FOR BIBLIOTHEQUE UNIVERSITAIRE ABDOU
MOUMOUNI NIAMEY, NIGER REPUBLIC WITH EMPHASIS ON
VENTILATION IN LIBRARY BUILDINGS**

BY

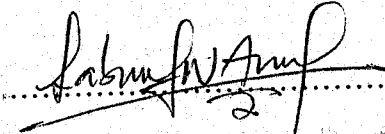
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M.TECH / SET / 890 / 2001 / 2002**

**A THESIS SUBMITTED TO THE DEPARTMENT OF ARCHITECTURE,
POSTGRADUATE SCHOOL,
FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA
IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE AWARD OF M.TECH DEGREE IN ARCHITECTURE**

AUGUST 2003

DECLARATION

I, MOHAMADOU NABINGI ABDOURAHAMANE, hereby declare that this thesis titled: **DESIGN PROPOSAL FOR BIBLIOTHEQUE UNIVERSITAIRE ABDOU MOUMOUNI NIAMEY, NIGER REPUBLIC, WITH EMPHASIS ON VENTILATION IN LIBRARY BUILDINGS** is an original product of my research work under the supervision of Arc R.E OLAGUNJU MNIA.

 DATE 22-10-2003
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M.TECH / S.E.T / 890 / 2001 / 2002

CERTIFICATION

This is to certify that thesis titled: **DESIGN PROPOSAL FOR BIBLIOTHEQUE UNIVERSITAIRE ABDOU MOUMOUNI NIAMEY, NIGER REPUBLIC WITH EMPHASIS ON VENTILATION IN LIBRARY BUILDINGS** is an original work undertaken by: **MOHAMADOU NABINGI ABDOURAHAMANE** of the Department of Architecture, Postgraduate School, Federal University of Technology, Minna in partial fulfilment of the requirements for the award of M.TECH Degree in architecture and is approved for its contribution to knowledge and literary presentation.

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DEDICATION

Madame, chaque fois que j'aurai la chance, je crierai haut et fort votre soutien incessant et inlassable. Sachez madame que je m'efforce d'être un fils digne de vous. A vous mère je dedie ce travail exclusivement. Que Dieu vous soutienne comme vous m'avez soutenu.

AKNOWLEDGEMENT

To Almighty God I first acknowledge this work for him to have sustained me and allowed me to reach at this level of study.

This thesis would not have been possible without the constant support of my family. To the entire members I say thank you.

If you go through this work and find it interesting, therefore the efforts of my supervisor ARC R.E OLAGUNJU MNIA, my project coordinator ARC ANUNOBI MNIA and my other lecturers of the department of architecture have not been in vain. They have imparted this knowledge to me. For all these I'm Grateful.

Throughout this work many people have been helpful in one way or the other, directly or indirectly. They are:

My fellow Niger Republic students in F.U.T. in general and in particular my room mates O. Zodi and M. Djibrilla for their comprehension and patience, Ganiu and Boube for allowing to use their computers, room 118 sheraton members for their constant assistance, Abdoulrazac for his tea supply.

My classmates in general; in particular the studio rats like Wale, Bala, Famoshe, Nat, Tunde, for their advices on my design work; Aliyu, IG, Zannu, Tukur, Pat, Samuel, Slowman, for other types of supports.

My friends Abdoulaye, kristova, Aime, Yacouba, Moumouni, Dantata, Kabirou, fatouma, Aissa for their endless encouragement and support.

My thanks also go to the authorities of the University Abdou Moumouni for their assistance during my research work in the University.

I must not forget to appreciate the effort of Mr. Rabo's family, Mr. Salou's family, Mr. Ibro's family and aunty Aminatou; they have all been so concerned about my studies.

ABSTRACT

The library assembles information from countless sources and places it at the command of the individual user. It sustains individual freedom of inquiry and opinion. At the same time it supports vastly expanded educational systems. It is an indispensable means to the preservation and revival of learning. (Dan Lacy,1981). Library is a very necessary instrument in a university system.

This thesis work is on a university library, and it is organized in eight chapters. The chapter one is the general introduction highlighting the work. In chapter two, the literature review, research work done on existing writings on libraries is dealt with. The area of research – ventilation in library buildings - is specified in chapter three. Case studies on existing university libraries are carried out in chapter four. In chapter five, data collected on the location town and the university are analyzed, followed by the analysis of the site to be used in chapter six. In chapter seven, some design data on university library buildings are stated, and then the design proposal and construction method made. In chapter eight the services are explained. Finally some recommendations are made and the conclusion is drawn.

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DEFINITION OF TERMS

Library: A place in which literary and artistic materials, as books and periodicals, are kept for readings, reference or borrowing.

Stacks: The section of a library where most of the books are arranged on shelves.

Carrel: A nook in a library for private study.

Books alcoves: A recess, a nook created with book shelves in a library.

Catalogue room: A room or space in the library where catalogues that is aiding for reference especially an alphabetized listing in a printed work that gives the pages or subjects are mentioned.

CHAPTER ONE

INTRODUCTION

1.1. PREAMBLE.

Library is an institution that assembles information from different sources and makes them available to the individual user. More than any instrument of society, it opens to public use the treasury embodied in books. "Books speak not only from one man to another or from one culture to another, but from one generation or one age to another. They provide the union of understanding that links generations, makes it possible to share human experience down through time and casts our vision of life forward into a future we shall not see". (Dan Lacy, 1981). Library plays an important role in the collection, preservation and dissemination of knowledge.

There are different types of libraries today, out of which the university library is one. Ever since university first emerged out of the teaching efforts of Europe's medieval churches, books have been central to the university enterprises. These two institutions – university and library – cannot be dissociated. They have one strong thing in common, provision of knowledge. Indeed Allan M. Cater said "Library is the heart of the university; no other single non-human factor is so closely related to the quality of graduate education. A few universities with poor library resources have achieved considerable strength in several departments. But institutions strong in all areas invariably have major research libraries". In these few words he clearly delineates the importance of the university library and its character.

University libraries have many characteristics in terms of goals and objectives, collection size and growth, cooperative activities, uses of technology, physical facilities,

services, and organizations. Their collection supports the undergraduate teaching program, the advanced instruction of graduate students, and research by member of the faculty and research staff.

But the modern university library is not simply a warehouse for the storage of books. Its combination of collections, staff and physical facilities makes it a complex instrument for the active promotion of teaching and research. No other single agency is so deeply involved in the academic activities of all members of the university community (Norman, 1981). Historically most universities grow out of colleges or other higher institutions, and as an institution expands in size and complexity especially in terms of the addition of graduates and professional programs so does its library. The university Abdou Moumouni was established in 1973 out of the college of higher studies established in 1971, and since then it has not stopped growing in terms of graduates and professional programs. But a certain number of supporting facilities out of which the library system, have not been following. This thesis work is a response to this crucial problem. It intends to propose a new central library building for the university, taking in cognition, the technological development of these recent years and the new developments in university library system.

1.2. MOTIVATION

As said above, since its establishment in 1973, the university Abdou Moumouni has not stopped growing in terms of study programs, but the library system has not been following. It is true there is a central library, but it is now not more than a faculty library

as the building size and collection content is limited. There are some other libraries for departments or faculties, but they are just given the name of library, as they are not more than books warehouses. So it cannot be denied that there is a library system in the university, but it is just that it is outdated and no longer responding to the actual needs. In fact Norman D. Stevens said, "The nature and size of the university library mirror the nature and size of the university and bear a direct relationship to the teaching, research and service needs of its faculty and students". All these points have led to the choice of this topic. There is a strong belief that a new building for the central library is highly needed and will be welcomed by the university community.

1.3 AIM AND OBJECTIVES

1.3.1. AIM OF THE STUDY

The aim of this thesis is to produce a standard, modern central university library, which will support the programs of the university. It will also enhance the quality of graduate and will provide an avenue for research by providing collection and services at national or even international level.

1.3.2. OBJECTIVES OF THE STUDY

The objectives of this study are:

- i. To produce an architectural design of the library which will match with its environment
- ii. To provide standard working areas which will ease activities in the library

- iii. To produce a design that will rightly integrate the diverse activities to be taken place in the library.
- iv. To provide an avenue where the recent technological development will match with the traditional role of library.
- v. To produce a design where ventilation is enhanced both naturally and artificially for the comfort requirements of the users.

1.4. SCOPE AND LIMITATION

1.4.1. SCOPE OF THE STUDY

Today, mainly at times in a university, network of libraries is found. They vary in size, volume content and services offer in relation to the required need. There are central library, faculty library, department library, and research library among others. Each one on its way plays a specific role, but all together they work to enhance the general quality of services required.

This thesis work is about a central library. It will be playing the role of coordinator in the university library network system. It will house the library administration. It will provide enough reading space for the overall existing faculties. But emphasis will be for the human and social science studies. It will also provide research area, reference sections and provision will be made for manuscript collection. It is also to satisfy not only the needs of the parent institution but also the national and international researchers. The scope of this project covers the following major functions:

- i. Main services
- ii. Administrative services.

- iii. General services.
- iv. Technical services.

Main service

This is the branch that will house all the library stock and provide conducive environment to users. They comprise the following elements.

- i. Entrance hall
- ii. Control and enquiring
- iii. Reader's storage areas
- iv. Exhibition hall
- v. Security and control
- vi. Lending and receiving counters
- vii. Catalogues
- viii. Browning area
- ix. Newspaper and periodical reading areas
- x. Audiovisual
- xi. General reading areas
- xii. Bibliographical
- xiii. Reserve section
- xiv. Special reference section
- xv. Photocopy s' areas

Administration

The major role of an administrative arm of any organization is to formulate, coordinate, control, and implement policies which will enable the organization to reap the purposes or rewards of its establishment. The need of an administrative arm, more so in a network system of libraries, is therefore not overemphasized. It will comprise the following elements:

- i. Offices for library officer
- ii. Staff area
- iii. Lavatories

General services

There is a need to incorporate certain services which will compliment the main functions in the area of information dissemination as a micro commercial set-up to assist students and research workers in area related to research. These services units shall comprise the following elements:

- i. Typing and photocopy
- ii. Lavatories
- iii. Snack selling areas

Technical services

This department will be responsible for maintaining and up-grading the quality of the library stock. It shall also be capable of generating revenue through printing and publishing of research work and other documents as well as from technical services

offered to students, faculty and research workers. The department shall therefore comprise the following:

- i. Bindery unit
- ii. Acquisition
- iii. Book processing area with storage facilities
- iv. Collection and development

1.4.2 LIMITATION

Research work is all about seeking for something. Seeking does not imply automatic and complete findings. In one-way or the other shortcomings occur. During some case studies, visits of the facilities were allowed, but some parts of the buildings were considered reserved areas and access to them was not allowed. During the interview, some questions were answered but some were considered so sensitive and were not answered. The internet system was time consuming and money dependent. The findings of the right information are many at time a matter a marathon process. Therefore all these will reflect on the work and the shortcomings are regretted.

1.5. RESEARCH METHODOLOGY

The following procedures were adopted in order to establish a base from which the projects aim and objectives could be realized. These include:

- i. Acquisition and analysis of data and information obtained through library service
- ii. Case studies on similar existing project
- iii. Personal enquiries and interview with relevant bodies and organizations

- iv. Data collection from the internet on similar institutions

1.6 IMPORTANCE OF THE STUDY

The importance of a central library in a university cannot be overemphasized. It plays an important role in the overall study schemes. It supports the undergraduate and graduates programs. It provides research and reference services.

Beyond the university community the library will provide services to the larger society. It will be a center for research for national and international researchers. It will serve for the collection of records and manuscripts on the country and others. It can serve as national archives center. And finally in this era of globalization it will be an important source of information center both for education and leisure.

CHAPTER TWO

2. LITERATURE REVIEW

The library is older than the book as we know it, older than paper, older than print. It extends back to the scroll, papyrus, and clay tablets that appear near the dawn of writing, back to ancient Mesopotamian and Egyptian civilizations.

Through all the centuries of its existence the library has had three main functions namely, to collect, to preserve and to make available. In each of these, the library is an essential instrument for making real the great inherent potentialities of the book and its predecessors, (Dan Lacy, 1981).

A library enhances the power of individual book. A certain number of books brought together in a library will make it serve a function different from and far greater than that served by the same amount of books in different places. Indeed a reader entering a commendable library is given power over knowledge. He can pursue a study of his choice to its depth. He can travel to whatever place at whatever time he wills. Library is the essential instrument for giving reality to the potential of books for immortality, (Dan Lacy, 1981).

2.1. HISTORICAL DEVELOPMENT OF LIBRARY

The formation of a library, as distinct from a collection of archives, presupposes the existence of a literature, whether it is preserved on clay tablets, papyrus, parchment or paper. In the earliest days of recorded civilization in Mesopotamia the material used for writing was wet clay. These tablets, baked hard have survived in great numbers to the present day. Temples and princely houses have yielded the greatest finds. In Egypt, every

temple had its library and school. There, papyrus was used. Traces of temple libraries are preserved at Karnack, Dendera and Idfu.

As time progressed, developments were made and these changes influenced the establishment of libraries in the old days. Virtually during each prominent era and empire of the history, evolutions were made in the library system. A thorough review of the history will be extensive. Therefore only important facts will be mentioned.

It was reported that Pisitatus, tyrant of Athens (Greece) in the 6th century B.C established the first library. But the first truly extensive library in Greece was founded and arranged by Aristotle (384 – 322 BC). After Greece, Egypt had a prominent library, Alexandra. It was established by Ptolemy and greatly augmented by his son Ptolemy II. Parchment came into use in the library of perfume founded by Attalids in the Hellenistic age. During the Roman Empire many developments were made in the library evolution. Public libraries were a common feature in ancient towns of Italy and provinces. In the same era, during the Carolingian revival, old cathedral libraries were revived and new ones founded throughout the empire of the Franks.

The 12th century was marked by the revival in learning. It saw the rise of cathedral schools, a new learning in Latin, translation of scientific and philosophical works from the Arabic, and many other learning activities which were fostered by contemporary economic and social conditions. All these combined together, caused an awakening that lead to the birth of universities. Scriptoria and libraries endeavored to keep with varying degrees of success.

The Muslim world also has its public and private libraries during this period. Muslim governors and princes throughout the vast Arab empire, from Baghdad to

Cordou, patronized science and learning, founded libraries, and fostered production of books. It is from the Muslims that came in the 13th century, by way of Constantinople and Spain the knowledge of paper that has proved vital to the spread of renaissance.

During renaissance period, the book trade expanded rapidly in Western Europe. Italy was the center. This led to the creation of many libraries and to the refurbishment of existing ones. The Vatican library though founded in the 14th century was static until in 1447 that Giovanni Tortelli of Arezzo librarian of Pope Nicholas V gave it a new life.

The mid- 15th century brought the perfection of printing from movable type, and the shift to the modern conception of the library ensued. It is not difficult to learn from actual physical remains and from references record something of the appointments of the libraries. Books were shelved sometimes by size, sometimes by subjects, and the catalogues were drawn up accordingly. On the tail edges of surviving volumes, shelf marks indicate that they were often laid flat upon the shelves or set up on their side edges. Identifying labels were affixed either to the cover or to the spine. Chains gave protection from thieves when necessary. Foxtails were employed for dusting, and aromatic herbs were used for fumigating, (Dorothy. M, 1981).

2.2 DEVELOPMENT OF LIBRARY IN AFRICA

The winds of change that have swept across Africa since the close of World War II have accelerated considerably the pace of library development in this vast and varied continent. Political independence has been accompanied by planned efforts aimed at economic and social development to raise living standards. The rapid expansion of education has been a key factor in the process. However many problems remain that

directly affect library development. Public and private funds for all purposes were scarce, and needs were acute in many key sectors such as health, housing, and transportation. Most African countries still have largely illiterate adult populations. There are innumerable local languages. Book production is extremely limited in most countries. Most imported books are expensive, and for many purposes, they are unsuitable, both in content and in language. Because Africa is not a homogenous entity, library development can best be considered, according to regional division of the continent:

- i. The Arab states of Northern Africa: These countries share a common language, with an intensive literature. They have centuries-old library legacy, which sometimes impedes effort at modernizations.
- ii. French-speaking middle Africa, comprising the 17 countries colonized by France and Belgium: The educated elite uses French, but most of the population speaks local languages. Here continental European library traditions are clearly reflected.
- iii. English-speaking middle Africa, including the former British territories plus Liberia and Ethiopia: Here too, local languages are widely used. British and American library influences are predominant.
- iv. Southern Africa: Angola and Mozambique have little library development. Zimbabwe is somewhat more advanced. By world standards South Africa provides full-scale library services of high quality.

Virtually all types of library can be found in Africa. Some countries house all the types and some a few numbers of the types. The Arab countries, South Africa, Ghana, and Nigeria are the leading countries in library development.

Some notable libraries in Africa are:

- i. Egyptian national library (Dar – el –Kutub) with its vast collection of papyrus and Arabic manuscripts
- ii. Al-Azhar University in Cairo
- iii. National library of Algeria with more than 800,000 volumes including important raw material on North Africa
- iv. National library of Tunisia
- v. General library and Archives of Morocco with more than 208,000 volumes and rich collection of Arab historical documents
- vi. University of Ibadan library and Ahmadu Bello University library in Nigeria
- vii. University of Ghana library
- viii. University of Dakar Senegal
- ix. South Africa national library
- x. South African state library

2.3. DEVELOPMENT OF LIBRARY IN NIGER REPUBLIC

Niger Republic got its independence in 1960. And right then, the government laid down plans for the economic and social growth of the country. Out of these plans, the education system was well considered. The aim was to raise the learning standard throughout the country. Actions were taken, schools were built, teachers' schools established, educational programs drawn, and books were made available. But a library system was not developed. Many problems hindered its development. Funds for all purposes were scarce and needs were acute in many key sectors such as food, health

transportation and housing. Beyond that, there were no production of books and the imported ones were expensive.

An attempt to library development started in the late seventies. The boom of the uranium has made funds available and the new regime in place (1974) started implementing a new policy towards the youth. Yearly, successively, major town were endowed with youth centers. And these centers were housing libraries out of the different services offered, though some libraries are not more than warehouses. The national Archives was also up-graded, it serves as a national documentation records and bibliographical center.

French cooperation has helped in library development in Niger republic. Through it, two cultural centers were established in two major towns. Niamey and Zinder, and these centers offer library services, which are up to modern standard. It also helped in the establishment of a library in Maradi. The cooperation between French and Niger towns has also helped in the matter. It has made some small towns to acquire school library or town library. The American cultural center too has a library.

The universities and the higher institutions have libraries caring for their programs, even though it is not all that meet up with the modern requirement of library. Private libraries also exist; they are many at times established by commercial or industrial companies as part of their recreation centers.

It can be seen that library system is in existence in the country, but there is not a clearly stated policy towards its development. In fact there is not even a national library.

2.4. DIFFERENT TYPES OF LIBRARIES

According to use, location and services rendered, libraries can be classified into the following:

- i. Institutional libraries.
- ii. Public libraries
- iii. Special libraries
- iv. Private libraries.

The purpose and function of each are almost the same, but the number and types of volumes vary significantly with the users. These libraries are further subdivided into smaller units in order to meet the need and aspiration of different categories of users.

2.4.1 INSTITUTIONAL LIBRARIES

Institutional libraries serve educational institutions and the services offered by them cut across the various departments that harbor bibliographical apparatuses, books, journals, newspapers, manuscripts, films, records, and other documents necessary for the attainment of the educational objective of the institution. These libraries also have tremendous influence on the way the institution develops academically.

Institutional libraries include:

- i. University library
- ii. Polytechnic library
- iii. Primary, Nursery school library

2.4.2 PUBLIC LIBRARIES

These libraries though offer academic services, deal with the public of all walks of life. Their size varies considerably depending on the size of the community they serve, and they mainly offer lending services to public.

These libraries include:

- i. Central library for towns and cities
- ii. National library
- iii. Branch library

2.4.3 SPECIAL LIBRARIES

This type of library has limited collections in related subject to a particular area of interest. It is least inclined to "sit and wait" for their users to approach them. They do not acquire only source materials but produce them by scanning and extracting the exact material that will suit the users' requirements. They serve as information centers for their parent institutions and because of their dynamic approach to library services their planning is also more flexible in concept.

These libraries include:

- i. Government libraries, e.g. prison and hospital libraries
- ii. Corporate libraries
- iii. Commercial and industrial firms libraries

2.4.4 PRIVATE LIBRARIES

These are libraries for individual use normally incorporated in homes and offices where access to it is restricted only to their owners. This type of libraries range from private clubs, to subscription committees, they serve members or owners according to their own needs and funds available.

2.5. UNIVERSITY LIBRARY

2.5.1 OBJECTIVE

The nature and size of the university library mirror the nature and size of the university. The basic objective of the university library is to support the program of the university in which it is part. But in many cases strong university libraries are also research libraries providing services at national and even international level.

The collections and services of the contemporary university library must take a number of factors into account. These include the requirements of the undergraduate teaching programs, the advanced study and research needs of graduate students, teaching and research by the faculty, the needs of local and on site users not affiliated with the institution, and involvement in national, international network of bibliographic information and collections that are vital elements in preserving the records of human society.

2.5.2 COLLECTION

Its size, above all which distinguishes the university library. At least 100 universities libraries in the United States and Canada have collections of more than one

million volumes. And they receive about 20,000 current serial titles and add almost 55,000 volumes annually. Each expends about \$1.7 million annually for materials. At least 80 of these universities have collections of microforms that are beyond one million units of material not readily available in printed form. It can be seen that strong universities libraries ought to have a very wide collection. Since most universities offer instruction and support research in almost all academic disciplines and many applied professional fields, their libraries must attempt to provide reasonable thorough coverage. The growth of international interest, and corresponding changes within universities has brought with it a need for university to collect materials from all parts of the world. To support teaching and research, the typical university library attempts, as far as its resources permit, to collect and make available materials of all kinds from countries throughout a substantial part of the world.

2.5.3 COOPERATIVE ACTIVITIES

“It has long been recognized that no university library, no matter how large, can acquire every item that might be needed by its faculties and students. Consequently, cooperative arrangements, especially for the sharing of resources, are necessary”. (Norman, 1981) since the early 1970's a wide variety of forces- the information explosion, new formats, rapidly escalating cost of material, an overall decline in financial support, the serious problems created by paper deterioration, and the availability of computer systems- has given new impetus to cooperation, among university libraries. It is a system widely used by developed countries in the western world.

The system include cooperation attention to the acquisition of materials and sharing of resources, preservation, and provision of solution to other problems peculiar to major university libraries, whose massive collection acquired over time have become difficult to maintain and control. Network systems were established for the effective running of the cooperation activities. These networks provide usually on line, machine-readable bibliographic database to its members.

It is high time for African university libraries to come into this type of cooperation system. It will surely reduce the serious burden of lack of materials.

2.5.4 LIBRARY AUTOMATION

Some library services have called for the use of computer technology for effective operations. In fact universities with a network of libraries, with some located in different geographical location have led to the widespread use of automation that began in 1930's, accelerated in the 1960's and finally became effective in the 1970's. Many libraries use one or more turnkey systems, which may not be integrated with each other. In these a commercial vendor makes available the ware and software necessary to operate, for example a circulation system. Some university libraries will develop their own comprehensive, integrated on-line system to enhance access.

As the complexities and cost of maintaining the records for the enormous university collection continue to escalate attention is being placed on the development on-line, public access catalogue to replace the card catalogue.

Today with the Internet era, automation has made a step ahead. Libraries throughout the world are offering on-line services on the net. The major requirement for

Even such major buildings are no longer adequate to meet all needs. In some large universities the sheer size of such building and the demands on them have led to the creation of a library designed to provide a smaller core collection (100,000 volumes or so) of books in heavy demands, with services specially designed for undergraduate.

Faced with the problems, of increasingly large collections, which contain much little-used materials, as well as rising cost that begins to severely limit the construction of major new buildings, some university libraries have built less elaborate structures. These may be located on less valuable land at the edge of campus, or even off campus and they provide compact storage for little-used materials and release pressure on overcrowded central facility.

2.5.6. SERVICE AND STAFFING

The modern university library provides different services. Attractive physical facilities and strong collections, which are complemented by highly, trained professional staff assisted by an extensive support staff. They provide guidance to the complexities of a large building, a large collection and attendant services. Many universities have also developed programs of bibliographic instruction.

The enormous growth of the use of technology of all kinds within the university libraries has led to the development of specialized public services. For example, on-line data-base searching of indexes and abstracts prepared by vendors are designed to facilitate access to materials.

2.5.7 ADMINISTRATION AND MANAGEMENT

The effective operation of a university library is a complex task requiring a large well-trained staff with diverse specialties. The director of university libraries or university librarian is the chief administrative officer, he reports directly to the president or academic vice president. Internally, most university libraries are divided into at least two traditional units - public services and technical services -. Assistant or associate directors, who, in turn is supported by a cadre of department heads, head each unit. The latter serve as manager of the day-to-day operations. The university librarian is responsible for the overall direction of the university library. He works closely with the administrative and managerial staff and often with a library advisory committee.

CHAPTER THREE

AREA OF RESEARCH

VENTILATION IN LIBRARY BUILDINGS

3.1 INTRODUCTION

Olumsimbi (1991) defines ventilation as the replacement of used inside air by outside air and he specified that it has three major functions which are: supply of fresh air, body cooling and structural cooling or heating. Different methods can be used to achieve the movement of air through buildings, basically stack effect; wind pressure and mechanical means are used. The factors that affect airflow through buildings are external features and factors, number and size of openings, position of openings and openings components. The shape, height, orientation and planning of buildings determine the airflow around buildings. Ventilation can be predicted by mathematical formulae or with the aid of models.

These general aspects of ventilation will be analyzed and those that can be applied to library buildings for their effective use will be listed out

3.2 BASIC CONCEPT IN VENTILATION

- a. Ventilation is the replacement of used inside air by outside air, and it has three major functions – supply of fresh air, body cooling and structural cooling or heating, (see table 3.1).
 - i. The supply of fresh air by replacing used internal air by external air is required in all buildings. It removes carbon dioxide, odours, vapours, gases from tobacco and smoke

- ii. Comfort cooling is the use of air movement for body cooling. This is achieved through the evaporation of sweat from the skin and increased heat loss from the skin by forced convection. This is usually known as air movement, and the cooling effect is achieved by air velocity and not by low temperature
 - iii. For ventilation to be used for structural cooling or heating there must be a significant temperature difference between inside and outside air. To cool the building, the outside air temperature must be lower, and to heat a building, the external air temperature must be higher than the internal air temperature
- b. Natural ventilation is ventilation achieved naturally by stack effect and wind pressure without any mechanical aid
 - c. Cross ventilation is achieved by placing openings on opposite walls
 - d. Air movement refers to the circulation of air within a space and is not necessarily associated with ventilation
 - e. Infiltration is uncontrolled airflow into or through a building especially via gaps in doors and windows
 - f. Ventilation is measured in air changes per hour.

Function	Fresh air	Body cooling	Structural cooling
Required	In all occupied buildings	In warm humid conditions	In hot dry conditions
Suitable building	All buildings	Single banked buildings	High internal heat capacity
Adequacy of method			
Stack effect	Adequate	Not adequate	Adequate
Wind pressure	Adequate	Good if available	Adequate
Mechanical	Not necessary	May be desirable	Not necessary
Required change per hour	1	100	10

Table 3.1: Ventilation function and requirements

Source: Introduction to building climatology (Olumsimbi, 1991)

3.3 TYPES OF VENTILATIONS

Basically, there are two types of ventilations, natural and artificial ventilation.

- i. Natural ventilation: stack effect methods, and wind pressure method.
- ii. Artificial ventilation: use of mechanical means.

3.3.1 NATURAL VENTILATION

3.3.1.1 STACK EFFECT METHOD

The stack effect method refers to the movements of air as a result of differences in air pressure of two bodies of air at different temperatures. Thus when there is a significant difference in the temperature of air within and outside a building possessing appropriate air inlets and outlets, air movement results, (Olumsimbi, 1991). When the temperature outside the building is lower than that of inside, then cold air will enter through the lower inlets and warm air will rise and exit through upper outlets, (see fig.3.1.a).

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

$$V = K \times A_i \times \sqrt{h \times dt} \quad (\text{m}^3/\text{sec}/\text{m}^2)$$

Where V = rate of ventilation

dt = temperature difference

t_i = internal air temperature

t_o = external air temperature

A_i = area of inlet

K = correction factor ($K = 0.117$ for $A_o = A_i$)

h = difference in height between inlet and outlet

A_o = area of outlet

A_o / A_i	K
5	0.161
4	0.160
3	0.156
2	0.147
1	0.117
0.75	0.098
0.50	0.074
0.25	0.040

Where A_o = area of outlet

A_i = area of inlet

Table 3.2: Correction factors for ventilation in relation to inlet and outlet size

Source: Introduction to building climatology (Olumsimbi 1991)

Stack effect usually produces some air movements even for small differences in temperature and height. In warm humid area, stack effect cannot be relied upon for the

provision of adequate cooling by air movement, even with large windows. This is because of the low difference in temperature between the inside and the outside. In the hot dry climates, stack effect can provide structural cooling at night times, especially during the hot season.

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

3.3.1.2 WIND PRESSURE

Olumsimbi (1991) states that wind pressure is the major force responsible for airflow through buildings. The air produced by stack effect is often of little pressure and insufficient for body cooling, so wind pressure and stack effect often act together to create air movement within buildings.

Usually one of the aims of a designer is to maximize wind pressure for air movement in buildings, especially in warm humid climates. But in the hot climates, where the wind is dusty, cold, and unwelcome and also where the wind is so strong that it causes destruction – tearing roofs of buildings – the maximization of wind pressure is not optimum.

When the wind strikes a building it is slowed down, but at the same time it exerts a pressure on the building. The pressure exerted is directly proportional to the square of the wind velocity. The slowing down of the air forms a relatively stagnant air mass on the windward face of the building. Then the wind is deflected above and around this mass. It however travels some distances before it regains its original direction due to its tendency

to maintain a straight path (momentum). Stagnant air masses are thus formed on the other surfaces of the building, although at reduced pressure, resulting in suction. The combined effect of pressure on the windward side and suction on the leeward side is to encourage airflow through the building, and this is possible only if there is an inlet on the windward side and an outlet on the leeward side, (see fig. 3.1.b, fig. 3.1.c). (Olumsimbi 1991)

3.3.2 MECHANICAL VENTILATION

Mechanical ventilation is used generally to guaranty general comfort requirement in buildings. It is achieved with the use of mechanical aids and these often provide:

- i. Air movement
- ii. Humidification or dehumidification
- iii. Cooling
- iv. Heating

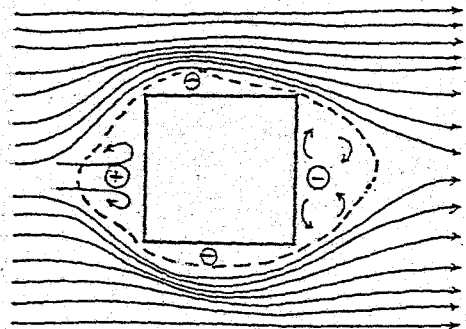
These mechanical aids are fans, evaporative coolers, air conditioners and heaters.

3.3.2.1 FANS

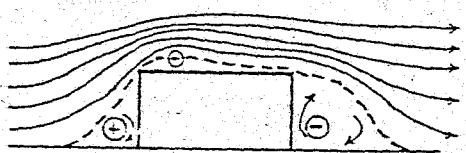
Electric fans are very useful in providing necessary air movement for body cooling, especially in the warm humid climates. Types of electric fans include ceiling fans, wall mounted fans, standing fans, table fans, and extract fans. Extract fans cannot be used for body cooling since they suck and do not blow air; they may however be used to assist the stack effect and remove odours and vapours, (Olumsimbi, 1991)

3.3.2.2 EVAPORATIVE COOLERS

These coolers work on the principle that water absorbs heat from the atmosphere when evaporating. This lowers the room temperature, and at the same time the



Plan



Section

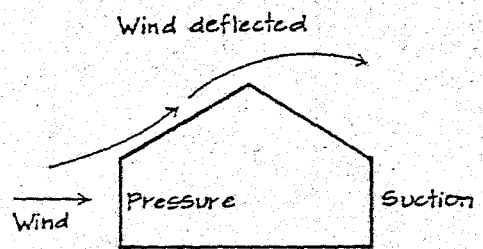
- ⊕ = pressure
- ⊖ = suction

where P = wind pressure (N/m^2)
 v = wind velocity (m/s)

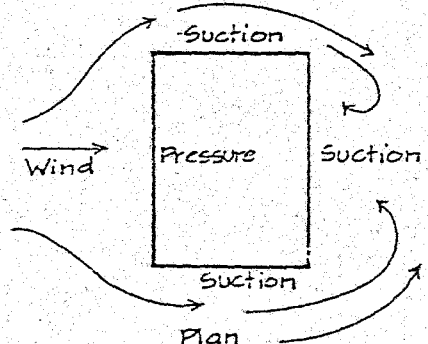
$$P = 0.612v^2$$

Figure 3.1.6
 Wind pressure on buildings

Fig. 3.1

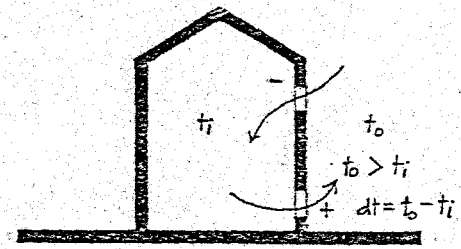
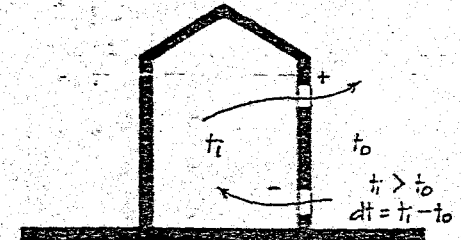


Section



Plan

Wind pressure and suction on a building



$$V = K \times A_i \times \sqrt{h} \times dt \quad (m^3/sec/m^2)$$

- where
- V = rate of ventilation
 - dt = temperature difference
 - t_i = internal air temperature
 - t_o = external air temperature
 - A_i = area of inlet
 - K = correction factor ($K=0.117$ for $A_o = A_i$)
 - h = difference in height between inlet and outlet
 - A_o = area of outlet

Figure 3.1.a
 Ventilation by stack effect

evaporated water increases the relative humidity of the air, causing humidification. Therefore evaporative coolers are used for both cooling and humidification, especially in hot dry climates.

The winds scoop and the desert cooler are two types of evaporative coolers. The wind scoop catches the wind with the aid of properly oriented shafts projecting above roof level. The wind is channeled through charcoal constantly wetted by earthenware pots. The desert cooler has an electric fan blowing air through a wet fabric kept damp by a small pump feeding on a reservoir, (see fig. 3.2). (Olumsimbi 1991)

3.3.2.3 AIR CONDITIONERS

Air conditioners provide both cooling and humidification and are sometimes the best solution in difficult climates –hot dry tropics- especially for offices and public buildings. Their major disadvantages are cost of acquisition and maintenance. The use or otherwise of air conditioning should be decided early in design since this will affect the size of openings, (Olumsimbi, 1991). Air conditioners may be large plants, small units or split units.

a. REFRIGERATING PLANT

The most commonly used systems for air conditioning are as follow:

- i. **Air to refrigerant to air:** In this system, room air is cooled by contact with cool refrigerant, which then becomes warm. The warm refrigerant is then cooled by contact with outside air. This is the manner in which self-contained window units and most other package units operate, (see plate 3.1. a).

Fig 3.2: The wind scoop and desert cooler

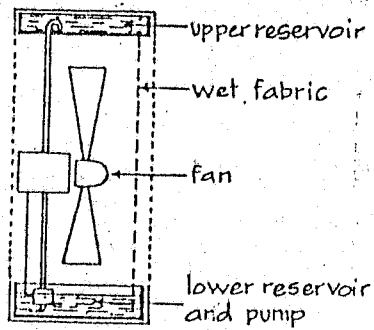
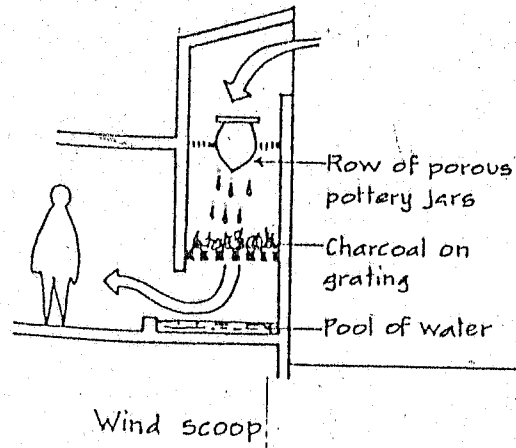


Figure 3.2
The wind scoop and desert cooler

- ii. **Air to refrigerant to water:** Where air cooled condensers are not feasible and cheap water is not available, then a cooling tower must be used. This will take the water that has removed the heat from the hot refrigerant and allow it to give up its heat to the outdoor air. This type of system is practical for commercial installations up to about 150 tons, (see plate. 3.1.b). (Alfred Greenberg, 1982)
- iii. **Air to water to water to air:** Although five complete heat-transfer operations are required, this cycle has produced the most economical results for large systems to date, (see plate 3.1.c).

b. **COMPRESSORS**

The types of refrigeration compressors are:

- i. Reciprocating
- ii. Centrifugal
- iii. Absorption
- iv. Screw

For unit up to 100 tons of refrigerant capacity, reciprocating or absorption unit are used. In the tonnage from 100 to about 1,000, centrifugal, screw and absorption machines are usually used.

All types of compressors are available in open or hermetically sealed models. In general hermetic units are used in the lower tonnages, and are electrically driven. Open-type compressors can be driven by electric motors, steam turbines, gas engines or any other motor or engine drive. Open-type machines are made in capacities of over 6,000 tons, whereas hermetics stop at about 1,700 tons. (Alfred Greenberg, 1982)

c. MECHANICAL EQUIPMENT ROOM

In the refrigeration plant room there is generally other equipments, such as chilled water pumps, condenser water pumps, and an air-ventilation system. In larger buildings a refrigerant receiver tank and a pump down compressor may be required. In some instances, air handling, plumbing, and electrical system for moving equipments may be advantageous. Provision should be made for replacing equipments without interfering with the operation of the building, through areaways, (see plate. 3.1. d).

d. AIR DISTRIBUTION

Wherever a refrigerating plant is used, a system for an effective distribution of air is needed. It will help distribute the air in the different parts of the building in relation to the air requirement of each space, thus maintaining an appropriate temperature and comfort level within these places. Air-distribution systems include the following types:

- i. Low velocity, single duct (conventional)
- ii. Low velocity with zone control
- iii. Fan coils
- iv. Air water induction
- v. High velocity, single duct (with and without reheat)
- vi. High velocity dual ducts
- vii. Self contained and modular units, including heat pumps
- viii. Roof top units.

The components for each of the above systems are similar (see plate. 3.1.e). Many variations in arrangement and location of components are possible.

Air-distribution systems usually call for ductwork. The layout of ductwork should be carefully designed to provide for smooth airflow, minimize motor power losses, keep fan and system noise to a minimum and keep space headroom as high as possible. All ductwork should be constructed with no air leakage permitted in order to assure optimum results with minimum energy use, (see plate. 3.1. f).

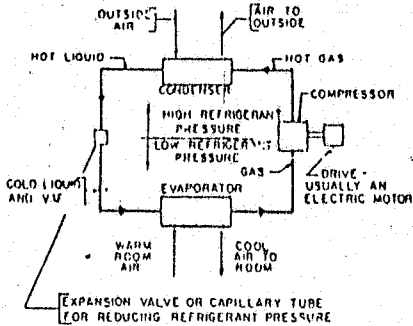
(Alfred Greenberg, 1982)

3.3.2.4 HEATERS

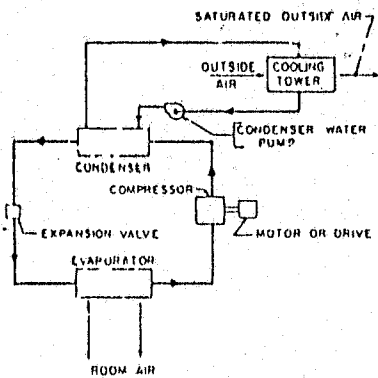
Heaters are usually unnecessary in hot dry climate. However they can create additional comfort during the cold harmatan period, especially when combined with humidification. Small portable units are often adequate and built-in heating systems unnecessary.

3.3.3 NEED FOR COOLING AND HEATING SYSTEM

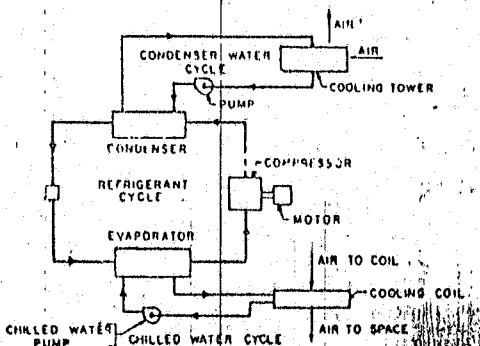
The need for cooling and heating systems is usually determined by comfort conditions (humidity and temperature) and the duration of that condition, (Olumsimbi, 1991). The cost of installing these systems is however usually high and therefore not affordable to public even when the climatic conditions justify their use. In such cases, flexible use of space, outdoor living and sleeping as well as adequate clothing are common alternatives, (see table 3.3). But in some buildings such as office buildings, hospitals, libraries, notwithstanding the cost, these systems, particularly the cooling ones are required.



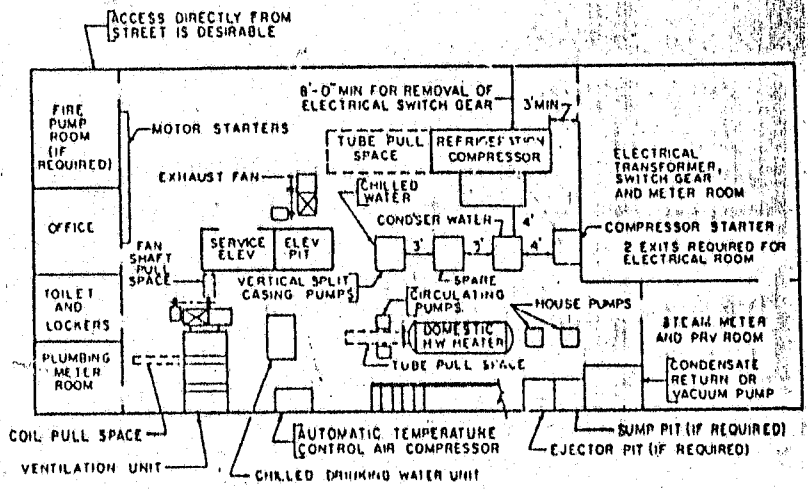
a. Air to refrigerant to air system



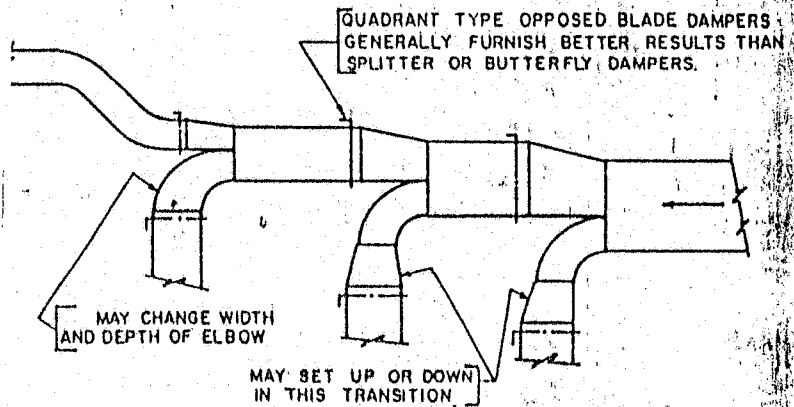
c. Air to refrigerant to water to air system



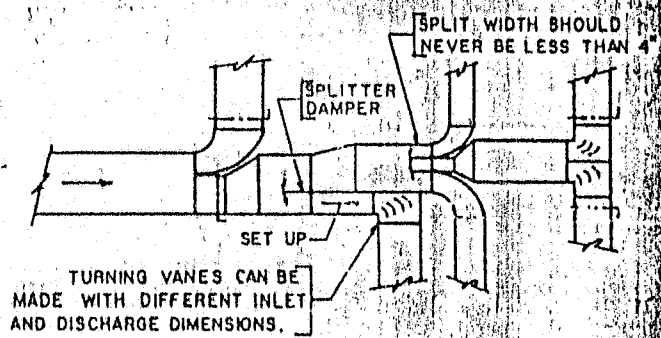
e. Air to water to refrigerant to water to air system



b. Typical mechanical equipment room layout showing heating, ventilating, air-conditioning, electrical, and plumbing requirements



d. GOOD, BUT REQUIRES MOST CEILING SPACE



f. SATISFACTORY, MORE ECONOMICAL OF SPACE

Ductwork details

Plate 3.1: Air conditioners systems
Source: Time saver standard of architecture design

3.4 FACTORS AFFECTING VENTILATION IN BUILDINGS

The factors affecting airflow in buildings according to Olumsimbi are:

- i. External features and factors
- ii. Number and size of openings
- iii. Position of openings
- iv. Openings components

3.4.1 EXTERNAL FEATURES AND FACTORS

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

3.4.2 NUMBER AND SIZE OF OPENINGS

For effective cross ventilation there must be at least two openings, an inlet and outlet on opposite or at least adjacent walls of an enclosure, (Olumsimbi, 1991). Furthermore, there should be no full partition separating the inlet from the outlet. In a case where there is only one opening, the air movement within the room remains negligible even for high external speeds. In fact, comfort conditions worsen at higher wind speed due to pressure build up, (see table 3.4).

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

- i. Increase in size of inlet and outlet
- ii. Increase in size of outlet with respect to inlet.

3.4.3 POSITION OF OPENINGS

The position of outlets on the leeward side and that of inlets on the windward side has a marked effect on the pattern of airflow within an enclosure. This influence can be observed both in plan and section.

In plan, the air velocity distribution is affected by the relative position of inlet and outlet for a given wind direction. The incoming air stream takes the shortest course of least resistance to the outlet. Thus openings located diagonally will cause airflow through center of the room. When openings are situated directly opposite to each other on one side of opposite wall or close together on adjacent walls, the larger portion of the room will remain unventilated, (Olumsimbi, 1991)

In section, the position of the outlet has little effect on air flow patterns. The inlet can be low, high or central. Low inlets tend to direct the airflow towards the floor, while high inlets direct the airflow towards the ceiling. Centrally placed inlets produce airflow in the general direction of the external wind. For multistorey buildings, with centrally placed inlets, the wind flow is deflected towards the floor on the ground floor while it is deflected towards the ceiling on upper floors, (see fig.3.3).

System	Criteria	Duration (month)	Requirement
Fans	High temperature and humidity	Never 1 2 > 3	Not required Desirable Highly desirable Desirable; need for cross ventilation
Evaporative coolers	High temperature Humidity < 25%	Never 1 2 > 3	Not required Luxury Highly desirable Desirable
Air conditioners	Temperature > 35° C or Temperature > 30° C Humidity > 70%	Never 1 2 > 3	Not required Luxury Desirable Highly desirable
Heaters	Day temperature < 16° C and diurnal range < 10° C or day temp. < 18° C and diurnal range > 10° C	Never 1 2 > 3	Luxury Desirable Highly desirable Permanent heating required

Table 3.3: Need for cooling and heating aids

Source: Introduction to building climatology (Olumsimbi, 1991)

Wind direction	Outlet size	Inlet size		
		1/3	2/3	3/3
Perpendicular	1/3	36	34	32
	2/3	39	37	36
	3/3	44	35	47
	None	13	13	16
Oblique	1/3	42	43	42
	2/3	40	57	62
	3/3	44	59	65
	None	12	15	23

Table 3.4.: Effect of window size and wind direction on average air velocities in buildings

Source: Introduction to building climatology (Olumsimbi, 1991)

3.4.4 OPENINGS COMPONENTS

Opening components affect the velocity and pattern of airflow, (fig. 3.4). These components include:

- a. **Canopies** (horizontal shading devices): they direct airflow towards the ceiling, but this can be reversed towards the floor by leaving a gap between the canopy and the openings.
- b. **Louvres and Venetian blinds**: they direct the airflow upwards or downwards according to their angle of inclination.
- c. **Sashes**: they deflect the airflow upwards, but reversible pivot sashes can deflect it downwards.
- d. **Variouly hung windows**: top hung outward opening windows deflect air towards the ceiling. Side hung windows deflect air towards the hinged sides when open outwards and vice-versa. Roller shutters deflect wind downwards when partially open.
- e. **Mosquito screens and curtains**: they reduce the airflow to a very large extent. Mosquito screens, depending on material and perforation, may reduce airflow by 30% to 70%. For nylon screens, reduction is about 35%. This should be considered when calculating openings size for effective ventilation, (Olumsimbi, 1991)

3.5 AIRFLOW AROUND BUILDINGS

The wind flow around a building plays an important role in determining the airflow pattern within buildings. The shape, height, orientation and planning of the building will affect airflow around it.

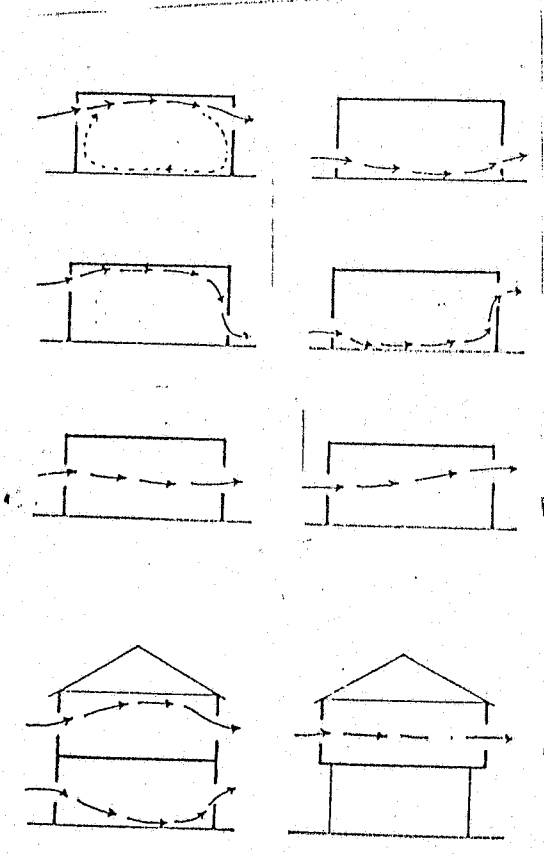
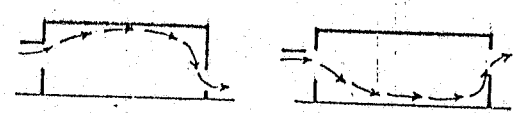
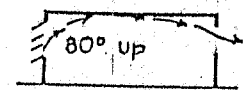
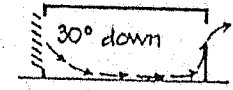


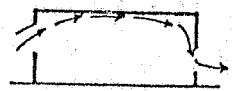
Figure 3.3
Effect of opening position in section on
air flow through buildings



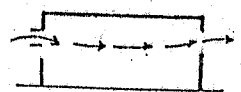
Effect of canopies



Venetian blind 30° down
300mm louvres 80° up
Effect of louvres



Effect of sashes



Effect of shading devices and
shutters

Figure 3.4
Effect of window components on air
flow pattern

3.5.1 WIND PRESSURE AND SUCTION

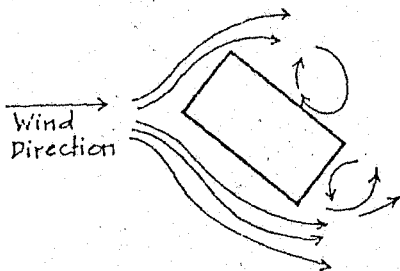
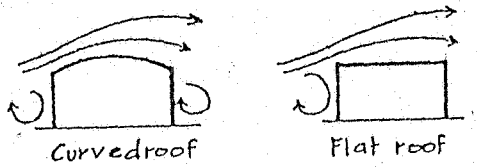
The wind creates a pressure on the windward side of the building and suction on the leeward side. This creates air movement within the building in the general direction of the wind. The wind is deflected over the roof and around the sides of the building, creating suction. For wind acting at an angle to a rectangular building, pressure is experienced on the two windward sides while suction is experienced on the other two. Suction and pressure on an L shaped building follow the same principles, (see fig. 3.5.i), (Olumsimbi, 1991)

3.5.2 EFFECT OF OTHER BUILDINGS

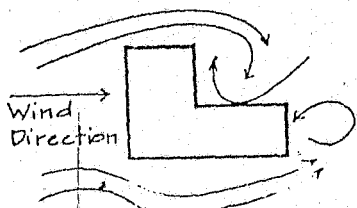
The proximity and height of neighbouring buildings also affect wind flow patterns. For two buildings arranged across the direction of wind flow, the wind is channeled between them, creating stronger suction than freestanding buildings, (see fig.3.5.ii). When the buildings are arranged in the direction of wind flow, the second building experiences suction from all sides. When the second building is taller a wind pressure may be experienced on upper floors. There may occur a wind flow under the second building in the pressure of open spaces, (Olumsimbi, 1991)

3.5.3 THE WIND SHADOW EFFECT

The wind, on meeting a building in its path, creates pressure on the windward part, and suction on the leeward side. The area where this suction is effective represents the wind shadow of the building. In the wind shadow, the direction of airflow is opposite to that of the wind direction. Buildings placed in the wind shadow of others buildings will



Plan Rectangular building
Wind acting on corner



Plan L-shaped building

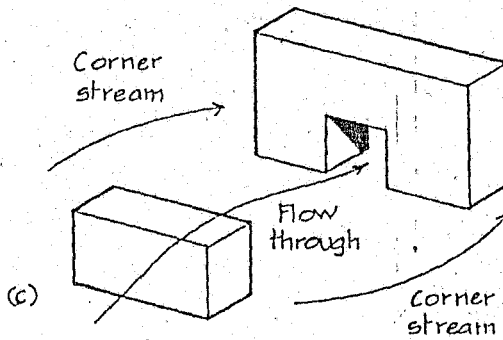
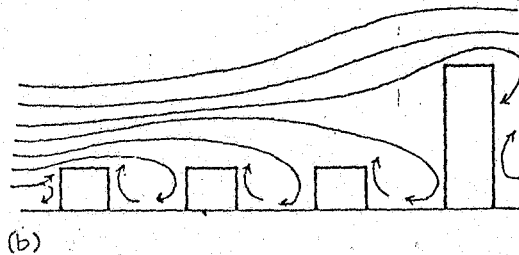
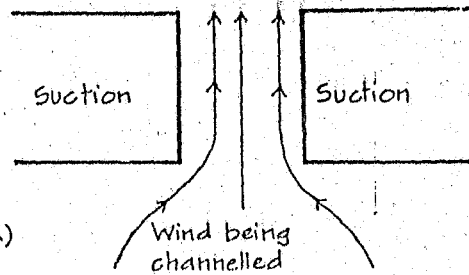


Figure 3.5
Wind flow round buildings

Effect of neighbouring buildings on windflow
(a) channelling of wind. (b) interaction of low and high-rise buildings. (c) wind flow around buildings

suffer from poor ventilation. Buildings are spaced at least six times their height to avoid this effect. Staggering has also been found to be effective.

The wind shadow effect should however not be overemphasized in designs. Land is expensive, and such spacing is uneconomical in large cities. The spacing required may also be reduced when air velocities are high or where cross ventilation is not essential for comfort. In critical cases staggering, low building heights, well design openings or finally mechanical aids may provide workable solution, (Olumsimbi, 1991).

3.6 PREDICTION OF VENTILATION

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

3.6.1 PREDICTION OF VENTILATION WITH MATHEMATICAL FORMULAE

There are many formulae for the prediction of airflow through and around buildings. But their development is limited here, because they are the premise of air-conditioning and services engineers

3.6.1.1 PRESSURE DUE TO WIND

The pressure due to wind flow is given as the product of a constant (0.613) and the square of the wind velocity. It is measured in Pascal. The IHVE guide gives some standard values of wind velocities. These are guides only and it should be remembered that wind velocity increases with height. These values are:

- i. Open country 9m/s

suffer from poor ventilation. Buildings are spaced at least six times their height to avoid this effect. Staggering has also been found to be effective.

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- i. Open country 9m/s

- ii. Suburban areas 5.5m/s
- iii. City center 3m/s

$$P = 0.612 V^2$$

Where P= wind pressure (Pascal)

V= wind velocity

(Olumsimbi, 1991)

3.6.1.2 AIRFLOW THROUGH OPENINGS

There are two equation used to determine the rate of airflow through an openings. The first gives this in terms of the pressure difference and the second in terms of the air velocity.

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

$$V = 0.827A\sqrt{pd}$$

Where V= rate of airflow (m³/s)

A= area of opening (m²)

pd= pressure difference across the opening (Pascal)

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

$$V = EA v$$

Where V= rate of airflow (m³/s)

E= effectiveness

A= area of opening (m²)

v= wind velocity (m/s)

3.6.1.3 RATE OF HEAT GAIN OR LOSS

The rate of heat gain or loss through structural ventilation is given by the product of the ventilation rate, the difference in temperature between internal and external air, the volumetric specific heat of air and correction factor. The volumetric specific heat of air is: 1220 J/m³ deg C at 20°C and 1180 J/m³ deg C at 30°C.

$$Q = VTKC$$

Where Q= rate heat loss or gain (W)

V= ventilation rate (m³/s)

T= temperature difference- internal and external- (°C)

K= correction factor

C= volumetric specific heat of air (J/m³ deg C)

3.6.2 PREDICTION OF AIRFLOW WITH THE AID OF MODELS

Mathematical formulae are incapable of absolutely predicting airflow through and around buildings. The most reliable are measurement taken in actual buildings. But this is of limited value, the building being already built. Another method is to construct a model of the proposed building and evaluate it in a wind simulator. There are two types of wind simulators: the open-jet wind simulator and the wind tunnel. Smoke generators are used to show the pattern of wind flow and miniature instruments measure wind velocity and pressure, (Olumsimbi, 1991).

3.7 VENTILATION STANDARD

According to Olumsimbi (1991) ventilation is required to provide fresh air, body cooling and structural cooling or heating. This can be achieved by stack effect, by wind pressure or use of mechanical aids. When mechanical aids are used, the choice of the appropriate aid depends on the severity of climatic conditions. Minimum ventilation rate must provide adequate fresh air and the need for this varies with the occupation density and purpose of the enclosure.

3.8 VENTILATION IN LIBRARIES

There are various types of libraries, but in general they consist of stack areas, working and offices areas, reading areas, rare book vaults, small study rooms, and computer workstations - Internet and Online services -. These various spaces call for various types of tasks. And thus the ventilation requirements differ from one space to another. This result in a complex ventilation requirement, that natural ventilation alone cannot efficiently satisfy.

In general natural and artificial ventilation are used together to achieve adequate ventilation in libraries. Based on the first type of ventilation, the following aspects are considered:

- a. Good orientation of the building with respect to true north
- b. Good location on site; as much as possible wind path related to the building should not be obstructed
- c. Openings size are determined in relation to air velocity

- d. Openings should be well positioned to achieve cross ventilation (where required) and good stack effect (if possible use of court yard)
- e. Openings are protected to control, sun entrance in the buildings so as to reduce possibility of thermal discomfort.

Based on artificial ventilation the following aspects are considered:

- a. The stack areas (usually interior spaces) have a relatively low lighting intensity and low ratio of people to floor area, so the air conditioning load is not heavy. However sufficient air must be circulated to maintain uniform temperatures through out the stack. Generally four to six changes per hour are required.

If the book stacks are adjacent to an exterior wall, then a perimeter air conditioning should be design to act as a buffer, in order to maintain constant environmental conditions. Do not use air-conditioning system that contains water or steam or water piping in areas where leakage can cause damage.
- b. Office areas are treated in the same manner as those in the office buildings. The work areas however may use special binding glues and other materials that require a special separate exhaust system to eliminate odors.
- c. Reading rooms have a fluctuating people load, which may be high; lighting intensities are high, and these rooms are generally at the perimeter of the building. Therefore the air-conditioning load is variable, and individual room or zone control is desirable. The reading room will generally require from eight to twelve air changes per hour for proper condition. The noise level should be maintained at NC- 30 to 35, a level less than NC- 30 will tend to accentuate background noises such as page rustling, foot shuffling, chair moving.

- d. Small study rooms (4.50 m² to 9.00 m²) are usually located at the exterior walls of the building. The lighting and people loads are relatively low and can be considered constant. When the rooms are located above grade and the exterior wall has glass, the glass presents the largest load. Therefore a simple design expedient is to put all the rooms on each façade on one zone and control the air conditions from an outdoor thermostat. If the rooms are below grade or contain no exterior glass, the air condition may be controlled from a preset, adjustable thermostat located on the zone of discharge duct.
- e. Many libraries, especially universities libraries operate up to 16 hours a day and may run the air-conditioning equipment for about 5000 hours a year. Such constant usage requires the selection of heavy-duty, long life equipment needing little maintenance.
- f. All books area and especially the perimeter and roof areas should be on night thermostat and humidistat control to maintain reasonably constant environmental conditions at all times.
- g. Library vault often require closer temperature and humidity control than the general book areas. Hence it is desirable to furnish a separate refrigeration compressor and air-handling system for the vaults.
- h. The location of the mechanical equipment rooms should be as remote as possible from the reading areas in order to minimize noise and vibration. (Alfred Greenberg, 1982}

CHAPTER FOUR

CASE STUDIES

4.1 INTRODUCTION

So far, the previous chapters have given much information on university libraries. They have stated the different types of these libraries, specified the services they offer, highlighted their organization, and described their buildings typology and discussed on some matters to be considered during their design. Indeed an appreciable knowledge on university libraries is achieved, but all these informations are not fully enough for an effective design of a university library. Existing examples are necessary to complement the study. Therefore three case studies have been carried out, they are:

- i. University of Delaware library,
- ii. University of Idaho library,
- iii. Federal university of technology Minna library.

4.2 UNIVERSITY OF DELAWARE, MORRIS LIBRARY

4.2.1 BACKGROUND

Morris library is the main library of the University of Delaware, which has four other libraries; branch libraries. The mission of the library is to gather, organize, preserve, and provide access to information resources necessary for the university to achieve its educational, research, and service goals. Beyond these, the library is expected to improved and expand access to information in all forms, using innovative technology, and also being the primary library in the state and the only one having a comprehensive

and broadly based collection, to assist in meeting the needs of library users in the state of Delaware.

4.2.2 LOCATION

The Morris library is located in the main campus of the University of Delaware in the town of Newark, which is situated in the northwest corner of the state of Delaware of the united State of America, (See plate 4.1).

4.2.3 FACTS ABOUT THE LIBRARY AND SERVICES OFFERED

- a. **Description:** the library is a six-acre, four floor building with seating for over 3,000 users, (see plates 4.2, 4.3, 4.4 and 4.5)
- b. **Hours of service:** 100 hours per week
- c. **Collection type:** Books, periodicals, microforms, government publications, databases, maps, manuscripts, media, and electronic resources
- d. **Collection size:**

Books and bound periodicals:	over	2, 500, 000
Microforms:	over	3, 300,000
Current serials:	over	13,000
Journals and Newspaper in Databases list:	over	30,000
Linear Feet of Manuscripts and archives:	over	3,700
Other resources:	over	570,000
Databases:	over	190
- e. **Use statistics: (2001/2002):**

Items loaned:	over	400,000
Items used in building:	over	380,000
Individual entering the library:	over	800,000
Interlibrary loan:	over	29,000

Reference question answered: over 140,000

Hits on library website: over 39,000

f. **Other services offered:**

- i. More than 200 computer workstations accessible to users
- ii. More than 175 laptops connections for university users to connect personal laptops
- iii. Special purpose space for computer-based systems
- iv. Graduate carrels
- v. Periodical reading room
- vi. Self-service photocopiers
- vii. Microforms reader/printers including a digital microform workstation
- viii. A large reserve reading room
- ix. Small research studies which faculty may reserve
- x. Special equipment and areas to assist users with disabilities
- xi. Media viewing room
- xii. Special collection area including an exhibition gallery and reading room with a controlled environmental system for rare materials
- xiii. Electronic services
- xiv. Internet services
- xv. Safety phones

(Source: internet,)

4.2.4 OBSERVATIONS

a. MERITS

- i. Adequate collection and modern services for information collection
- ii. Emergency exit
- iii. Enough staircases and good circulation planning
- iv. Provision of atrium
- v. Provision of services for users with disabilities
- vi. Good location on campus.

b. DEMERITS

- i. Ventilation and lighting basically artificially based.

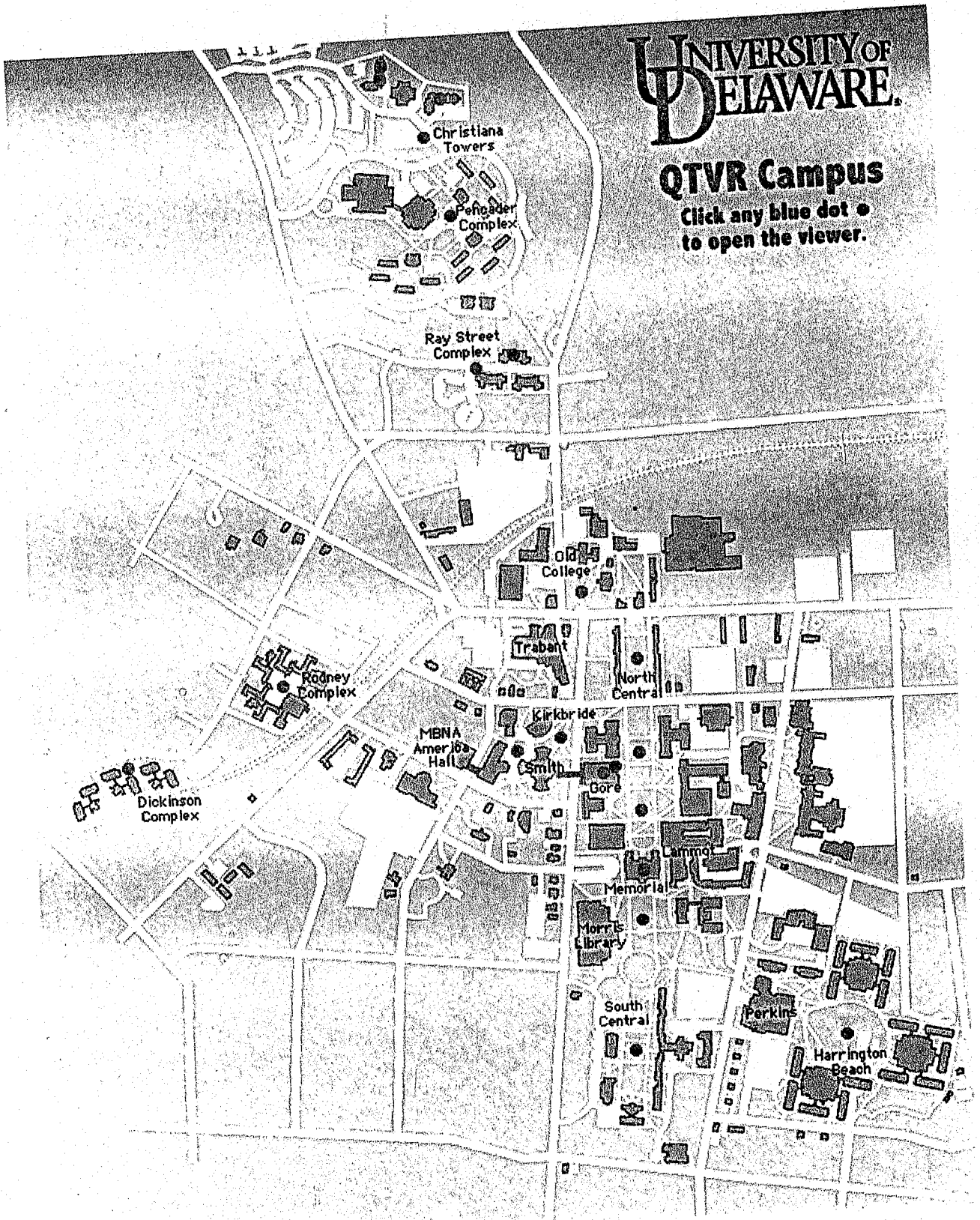
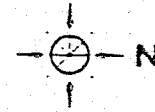


Plate 4.1: location map of the university of delaware campus newark town,
Delaware state, U.S.A

Morris Library Lower Level



South College Avenue

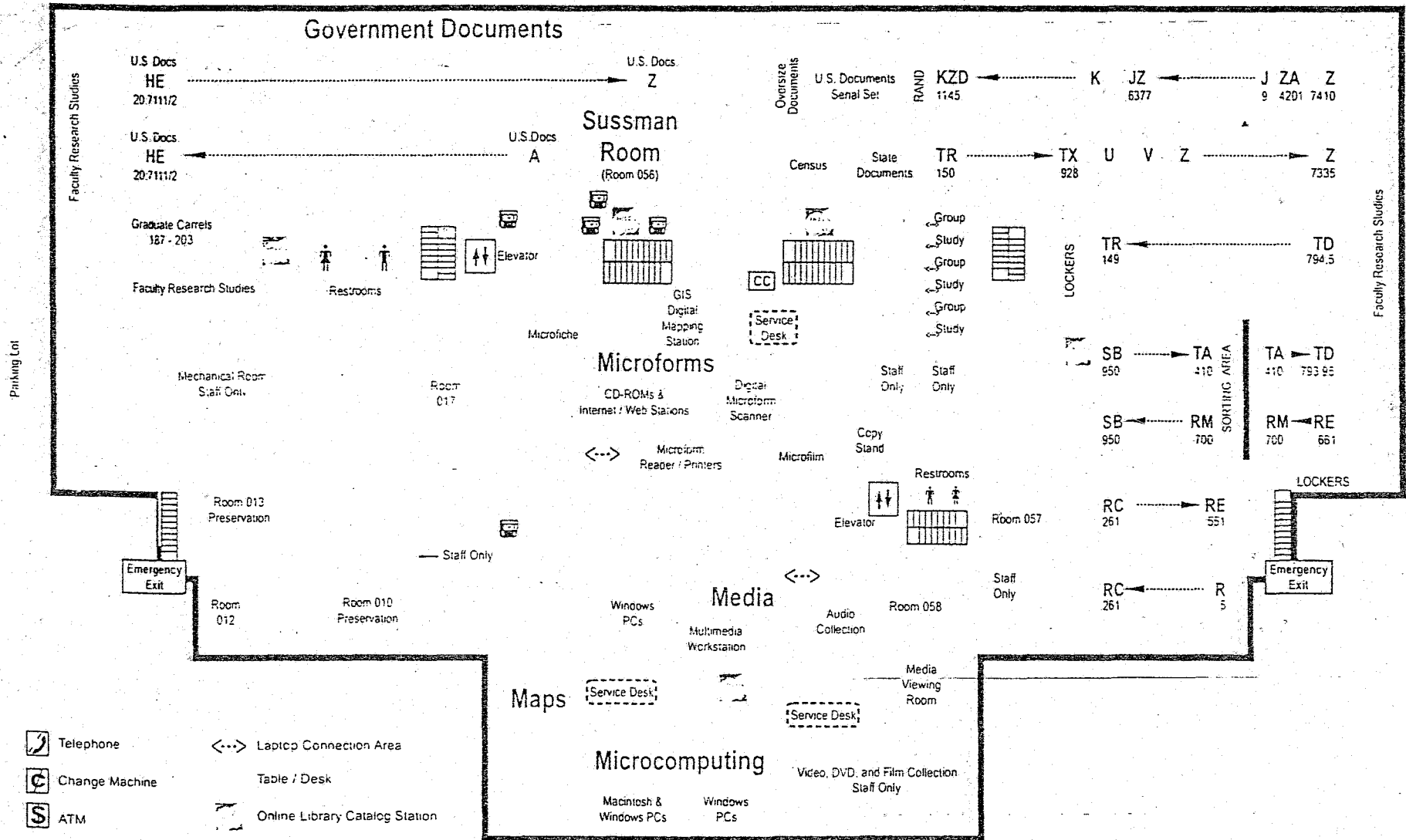


Plate 4.2

- Telephone
- Change Machine
- ATM
- Copy Card Dispenser
- Elevator
- Copy Machine
- Laptop Connection Area
- Table / Desk
- Online Library Catalog Station
- Stairs
- Restrooms
- Baby Changing Station

All Group Study Rooms Have Ethernet Connections For Laptops

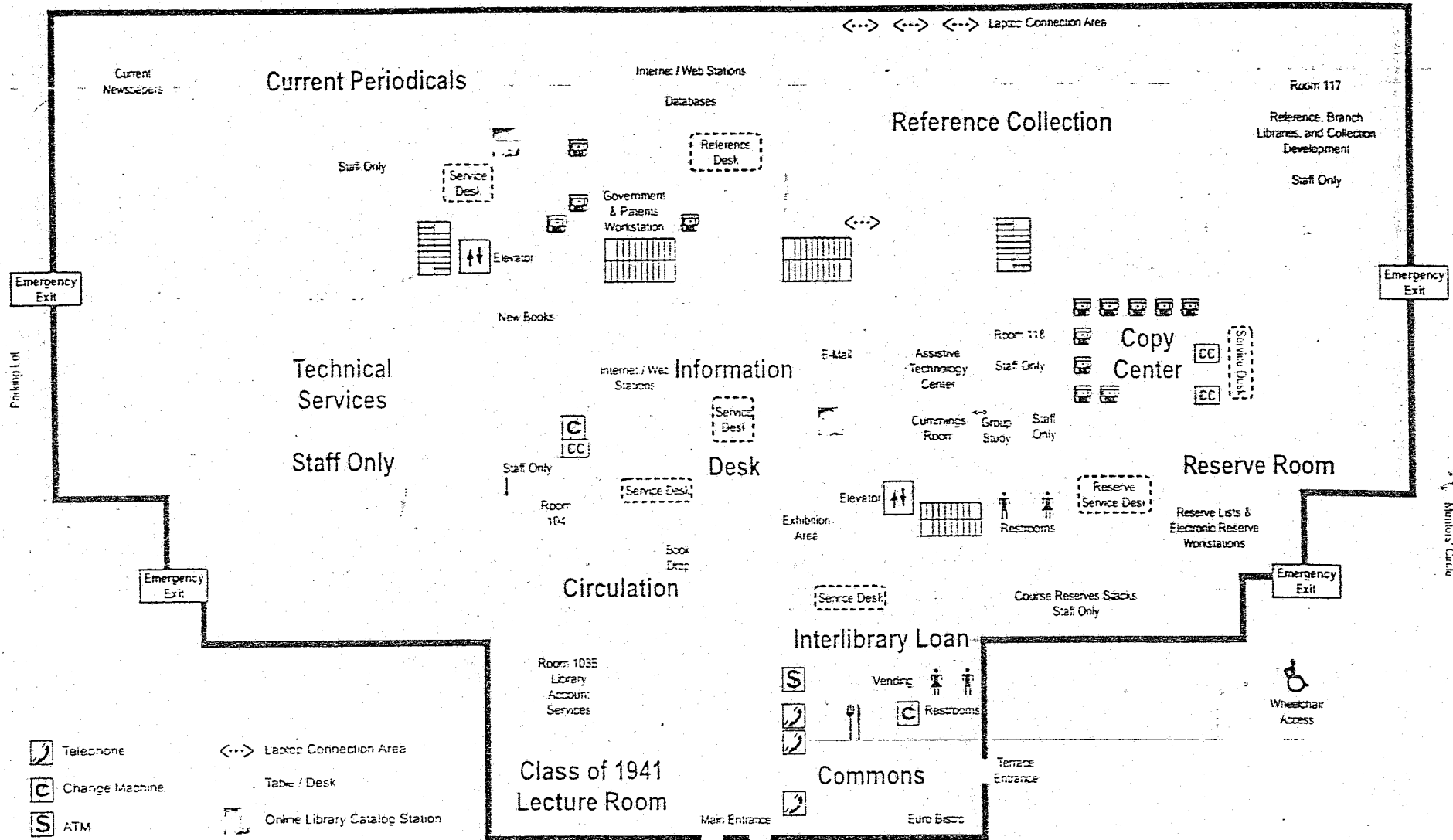


Morris Library First Floor



57

South College Avenue



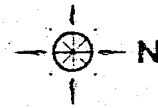
- Telephone
- Change Machine
- ATM
- Copy Card Dispenser
- Elevator
- Copy Machine
- Laptop Connection Area
- Table / Desk
- Online Library Catalog Station
- Stacks
- Restrooms
- Baby Changing Station

All Group Study Rooms Have Ethernet Connections For Laptops

Plate 4.3

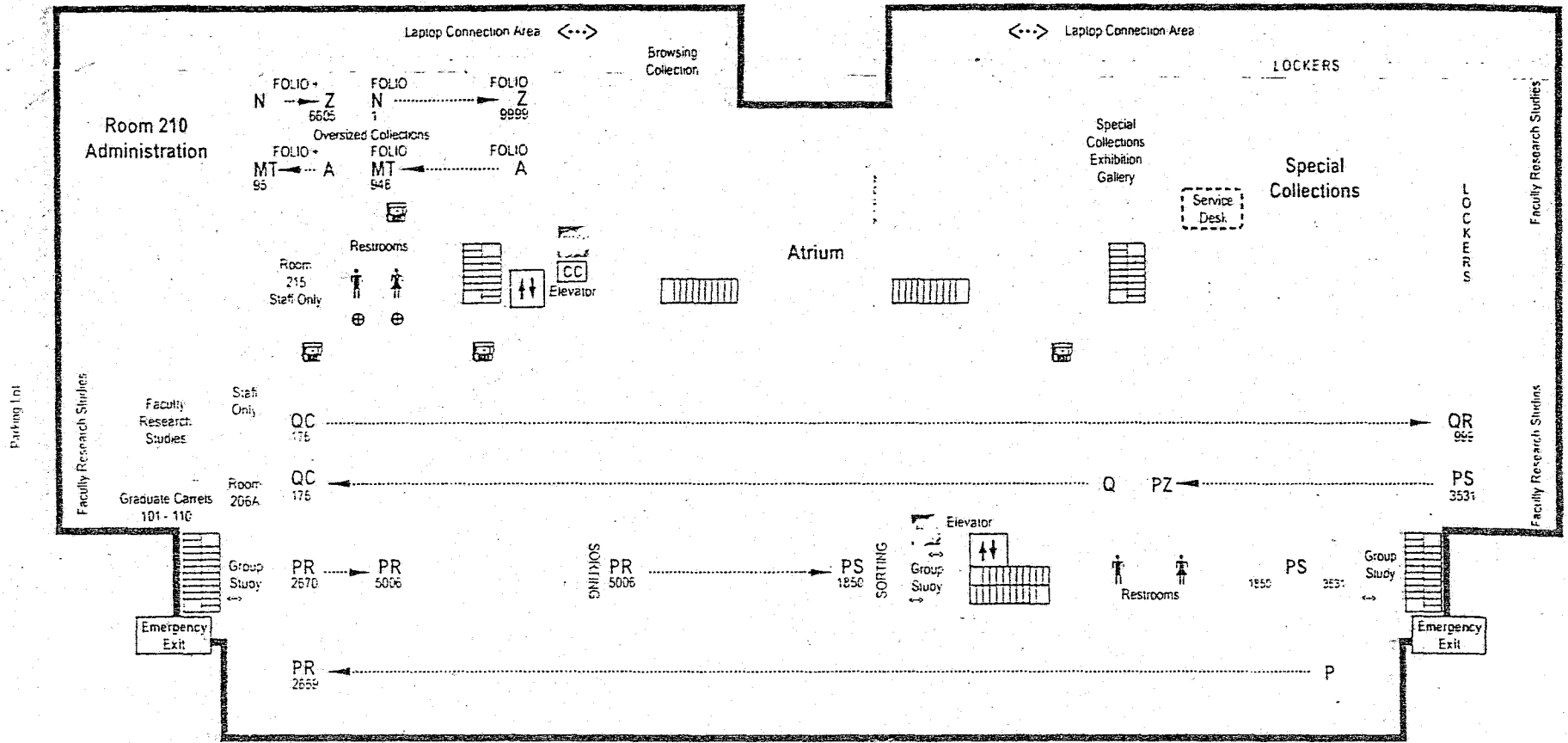


Morris Library Second Floor



58

South College Avenue



- Telephone
- Change Machine
- ATM
- Copy Card Dispenser
- Elevator
- Copy Machine
- Laptop Connection Area
- Table / Desk
- Online Library Catalog Station
- Stairs
- Restrooms
- Baby Changing Station

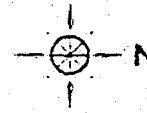
All Group Study Rooms Have Ethernet Connections For Laptops

Rev. 4/02

Plate 4.4



Morris Library Third Floor



South College Avenue

59

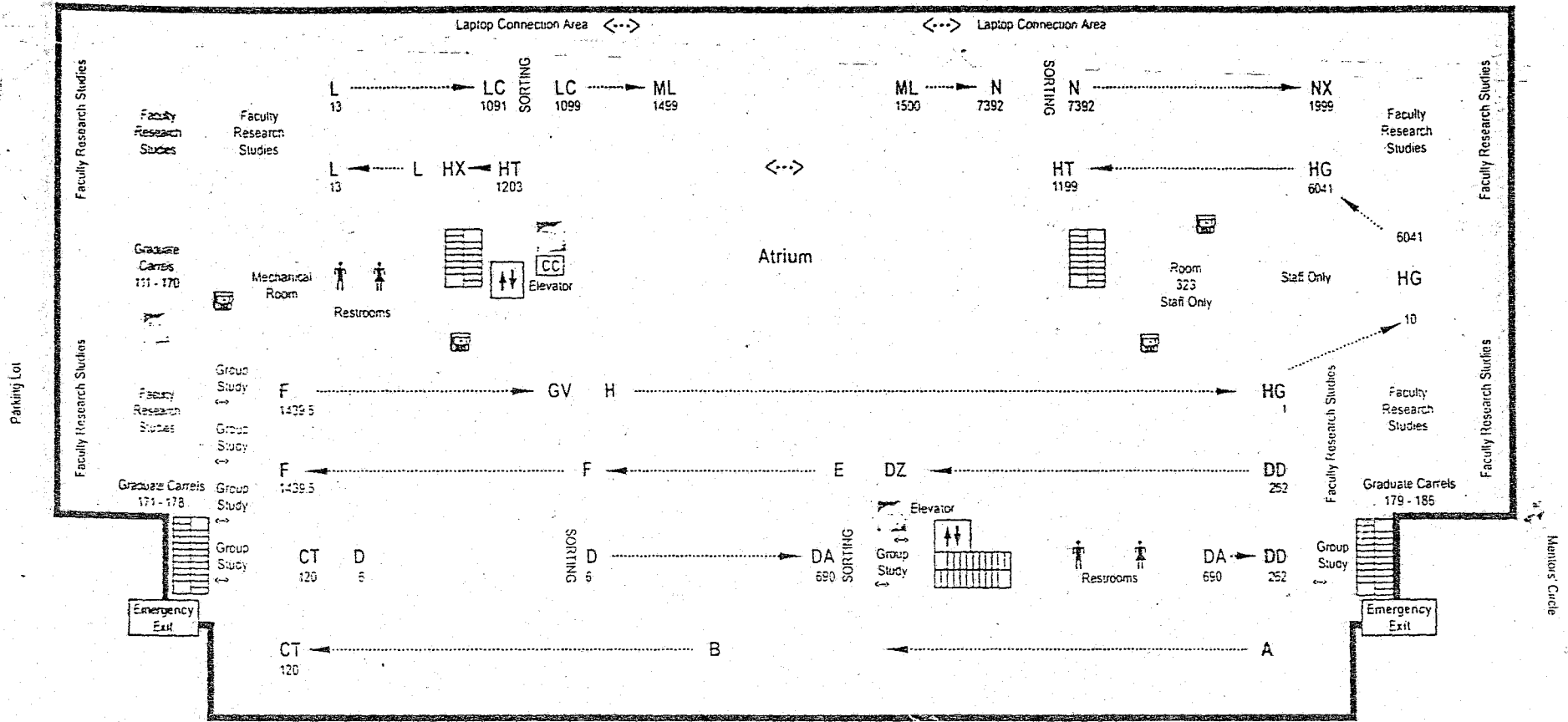


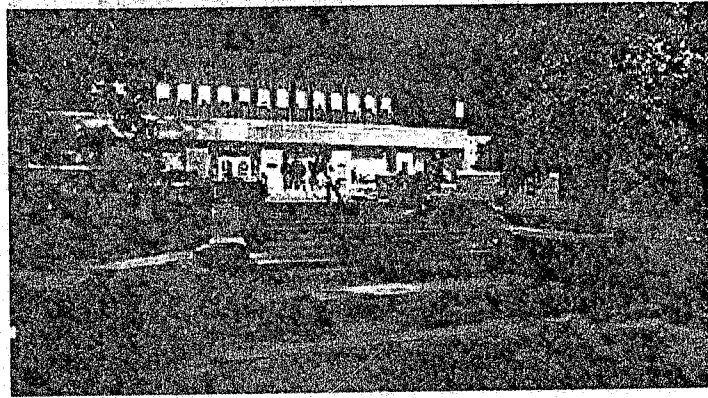
Plate 4.5

- Telephone
- Change Machine
- ATM
- Copy Card Dispenser
- Elevator
- Copy Machine
- Laptop Connection Area
- Table / Desk
- Online Library Catalog Station
- Stairs
- Restrooms
- Baby Changing Station

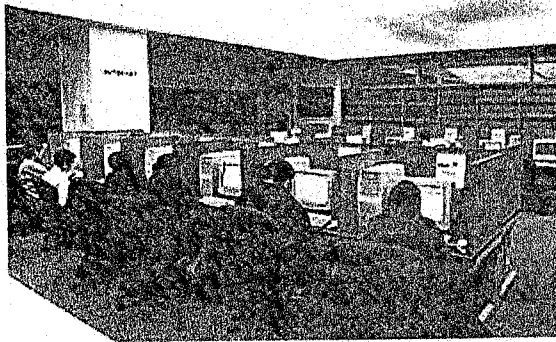
All Group Study Rooms Have Ethernet Connections For Laptops

Rev. 4/02

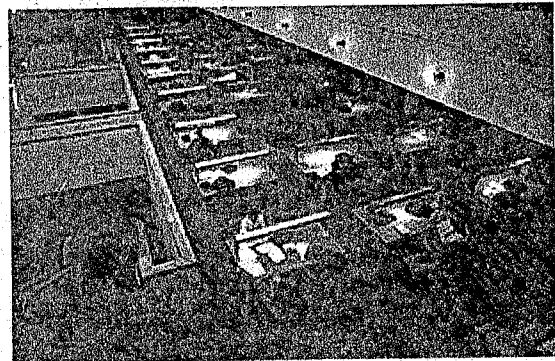




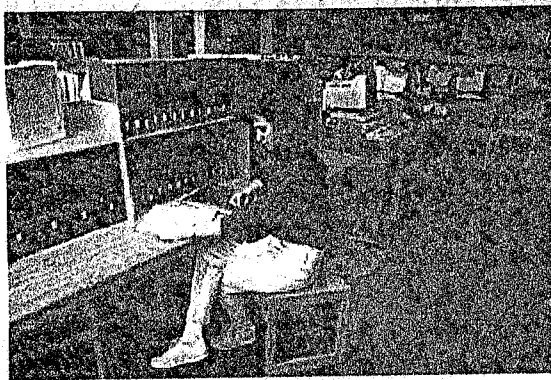
a. perspective view of the Morris library at night



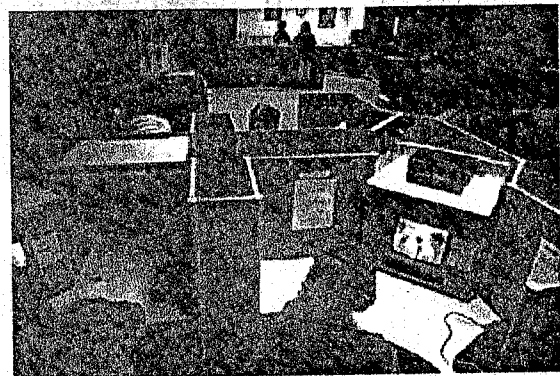
b. internet and on-line section



c. reading area



d. reference section



e. audiovisual section

Plate 4.6: views of morris library, University of Delaware

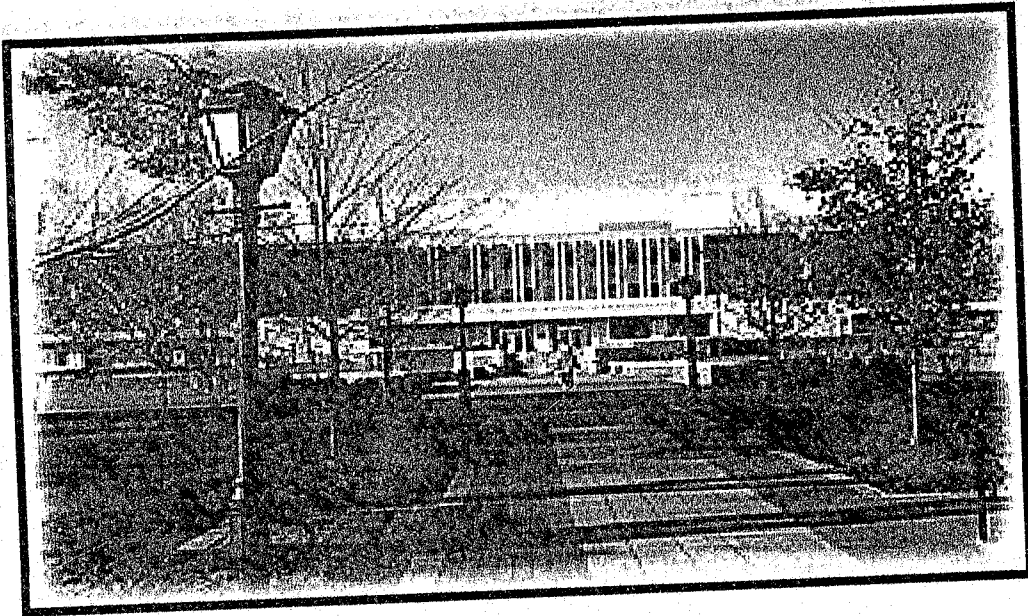


Plate: 4.7 a front view of morris library, university of delaware

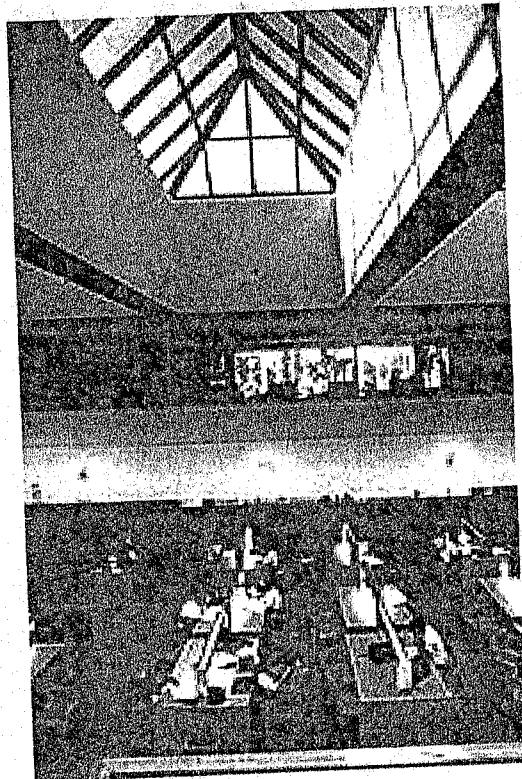


Plate:4.8 a view of the atrium of the library (source of natural lighting)

4.3 UNIVERSITY OF IDAHO LIBRARY

4.3.1 BACKGROUND

The university of Idaho building was first constructed in 1959, to relieve the space restriction in the administration building where the library was formally located. In 1991 the library was extended with about five acres, so that it will fulfill its mission of making information readily affordable and access to it easy.

4.3.2 LOCATION

The library is located on the campus in Idaho town, state of Idaho in United State of America, (see plate 4.9).

4.3.3 FACT ABOUT IDAHO LIBRARY AND SERVICES OFFERED

- a. **Description:** the building with its four floors covers an area of more than six acres; (see plate 4.10, 4.11, 4.12, 4.13, 4.14, 4.15).
- b. **Collection type:** Books, government documents, maps databases. The collection emphasizes more on basic sciences, agriculture, forestry, mining and geology. Documents on humanities and social science are also available.
- c. **Collection size:** more than one million books and 1.4 million government documents.
- d. **Other services offered:**
 - i. Audiovisual area
 - ii. Interlibrary loan
 - iii. Periodical service center
 - iv. Journals and magazine reading area
 - v. Copy center for photocopy

- vi. Microfilm and Microfiche
- vii. On-line services
- viii. Graduate carrels
- ix. Group study room
- x. General reading area
- xi. Internet services
- xii. Conference room
- xiii. Computer workstations

4.3.4 OBSERVATIONS

a. Merits

- i. Adequate collection size
- ii. Good circulation and adequate size of building
- iii. Internet and modern technology outfits of information availability
- iv. Good location on campus

b. Demerits

- i. Ventilation and lighting basically based on artificial source
- ii. Limited emergency exits

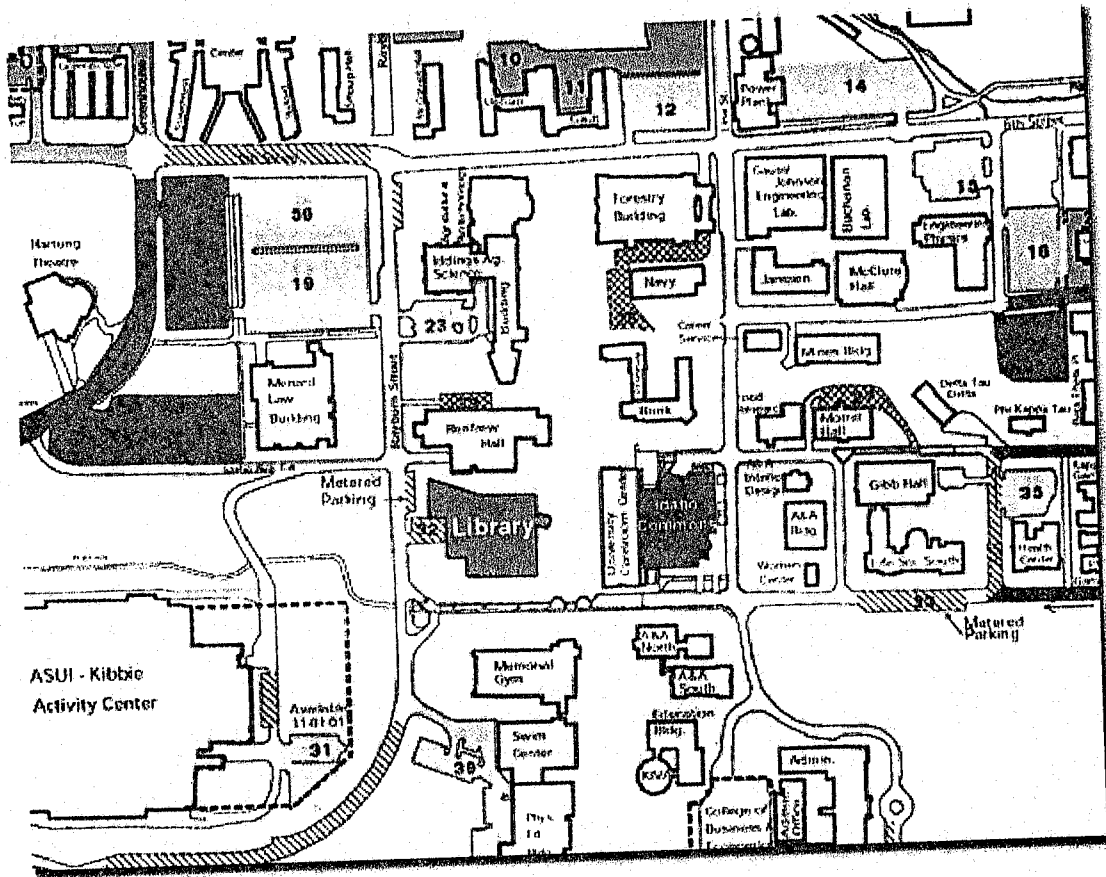
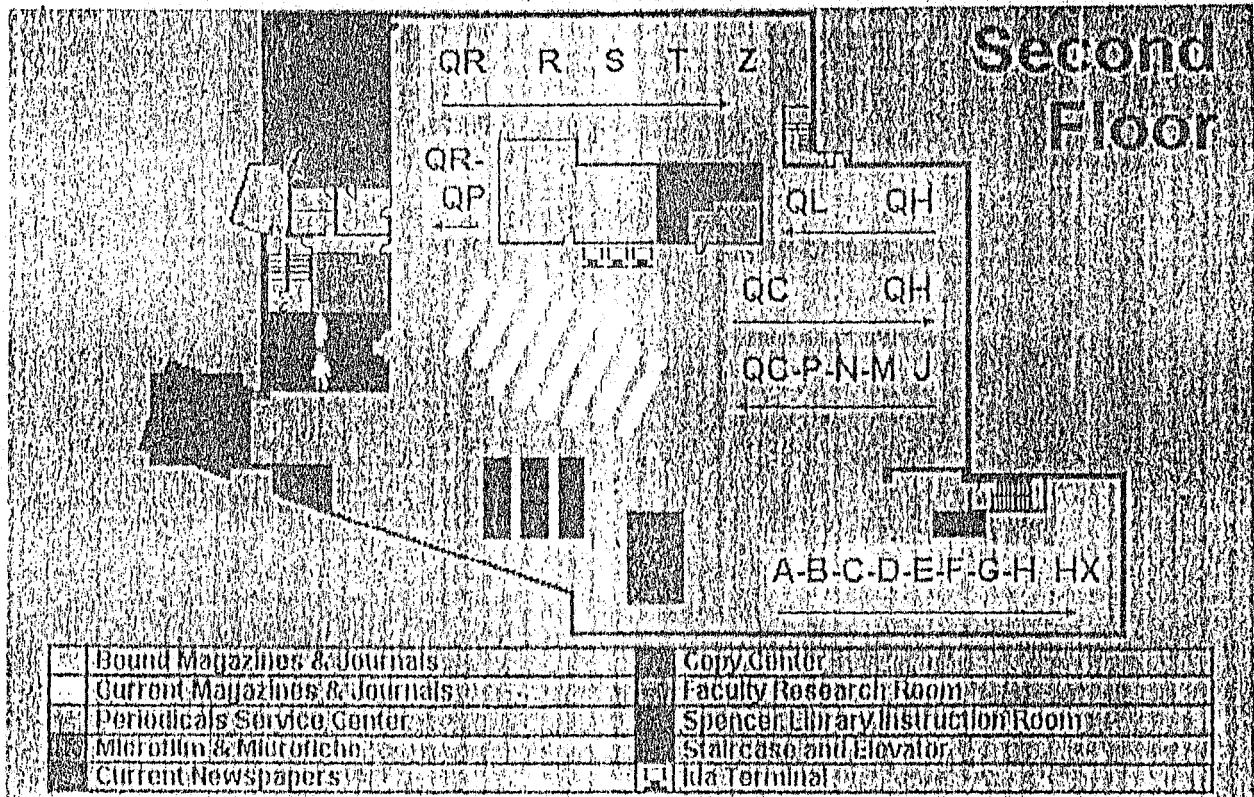


Plate: 4.9 location map of university of Idaho campus, (location of the library),

Idaho town, Idaho State, U.S.A

plate 4.11

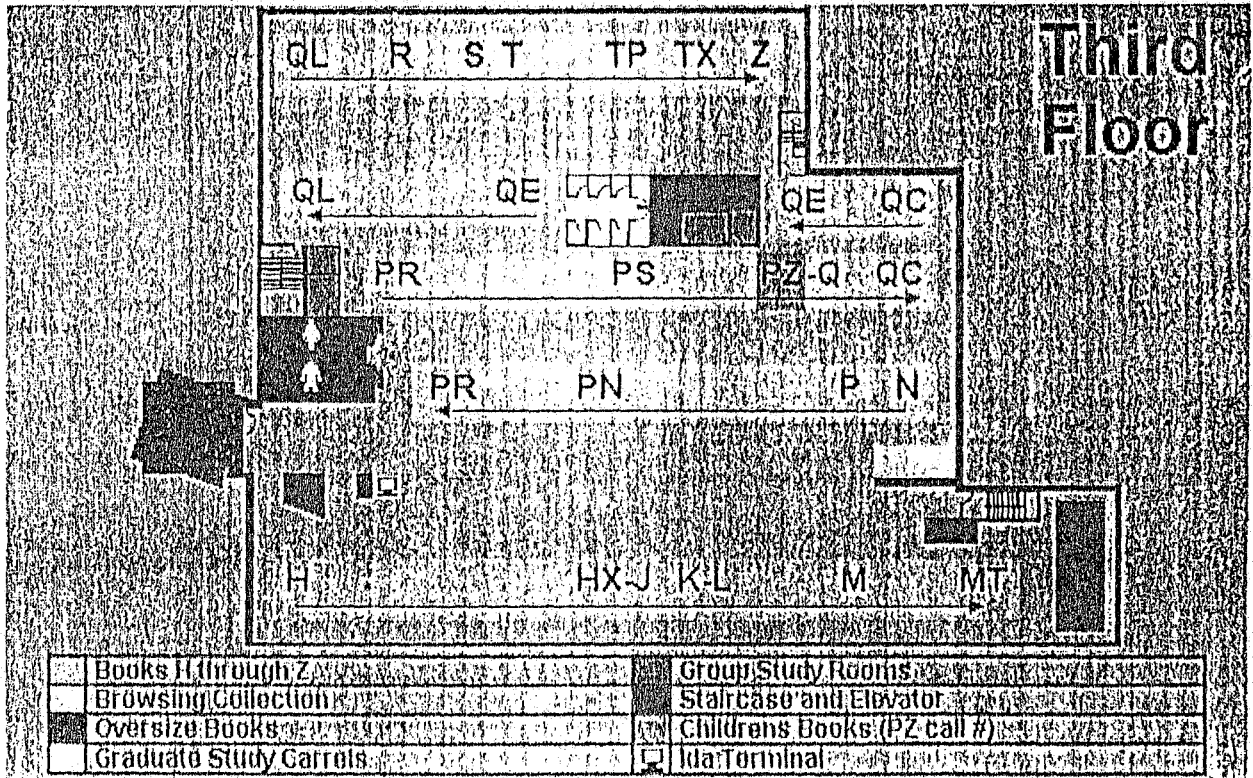
MAPS: First | Second | Third | Fourth



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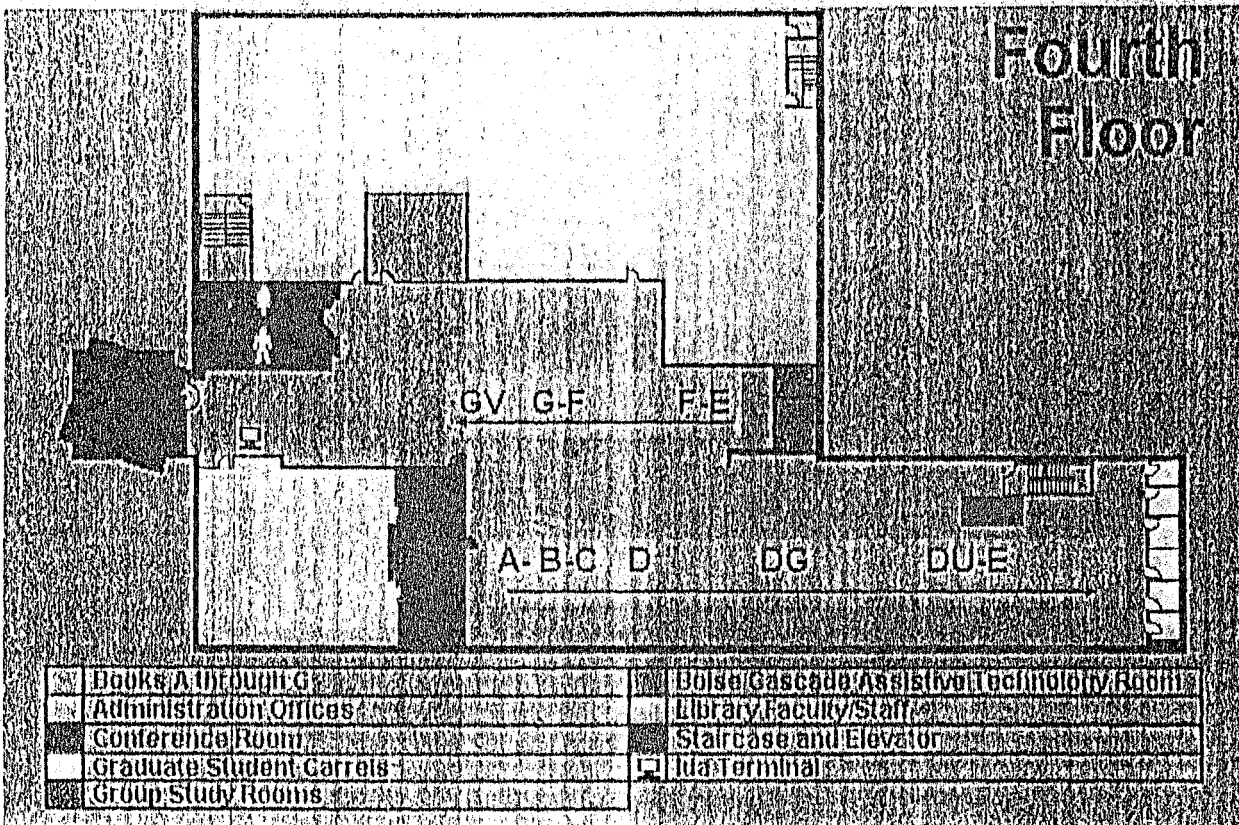
late 4.12

MAPS: First | Second | Third | Fourth



late 4.13

MAPS: First | Second | Third | Fourth



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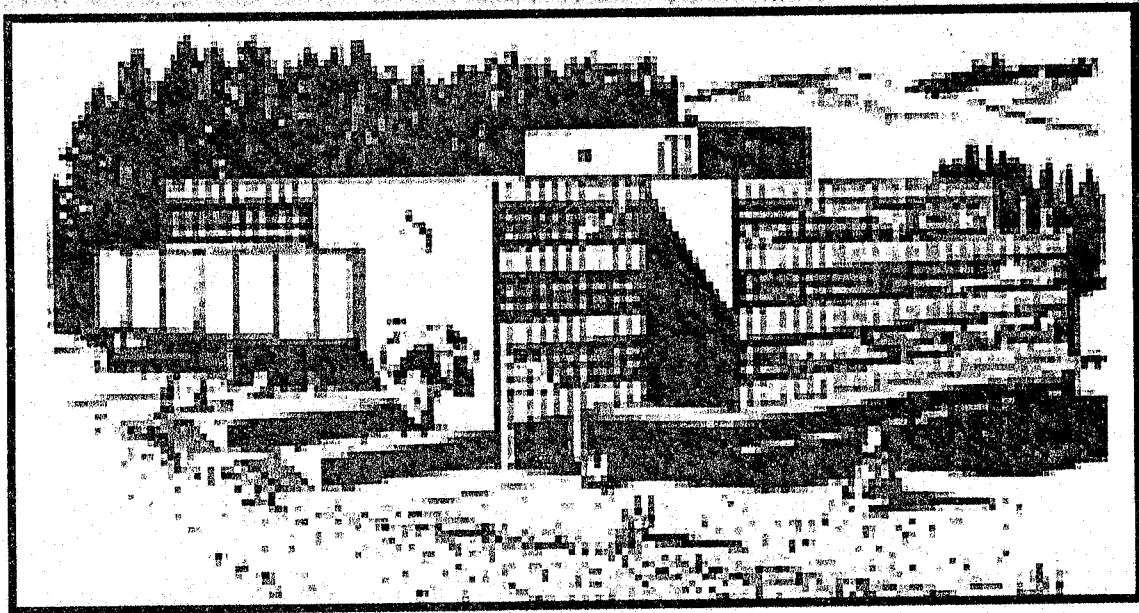


Plate: 4.14 perspective view of university of Idaho library building

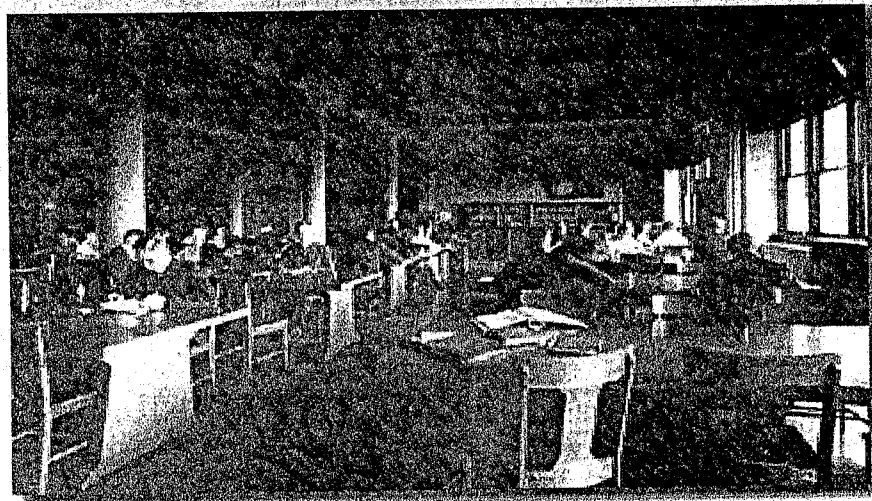


Plate: 4.15 inner view of university of Idaho library building

4.4 FEDERAL UNIVERSITY OF MINNA LIBRARY

4.4.1 BACKGROUND

The library gathers, organizes, preserves, and provides access to the information resources necessary for the university to achieve its educational, research, and service goal.

4.4.2 LOCATION

The library is located on the Boss Campus of the university in Minna town, Niger State of Nigeria.

4.4.3 FACTS ABOUT THE LIBRARY AND SERVICES OFFERED

- a. **Description:** It is a two floors building. It has a courtyard and it has two accesses, one for public and the other for staff members. It has three major reading areas, one for science students, the other for engineering – both at the ground floor – and the last part is basically for reference materials and graduates students – first floor -. It provides 350 seats for the reading areas. There is also provision for offices for the technical crew, (see plate 4.16, 4.17, 4.18, 4.19).
- b. **Collection type:** Books, Government documents, journals, Serials, Maps.
- c. **Collection size:** About - 35,000 books;
- 3,000 journals and magazines.
- d. **Facts about the library and services offered:**
 - i. Reading areas,
 - ii. Reference section,
 - iii. Serial and periodical areas,
 - iv. Binding unit,

The circulation in a library is very important; it should be solved in relation with the quietness needed therein but also with the traffic flow of the users. Even though users should be restricted to one entrance, emergency exits should be considered for in case of any accident.

Technical services of the library should not compete with the public areas but rather be designed in such a way to serve effectively for their purposes without infringing on the public areas' activities. In fact the different spaces of the library should be planned and organized in such a way different activities can be carried out with less conflict or disturbance. The case studies have showed that libraries today have become complex entities, as the sources of information are diverse and wide. A library ought not be seen as a book storage center only, but as a "multimedia center" where reading materials – books- audiovisual, internet and online services are provided. Therefore care should be taken in the design to integrate all this different functions for an effective use of the building.

The case studies have also proven the necessity of a good location for the library on the campus, so that it will be easily accessible to the university community and then fulfill its mission of information provider. The library should also be design so as to make provision for the new development in information technology but also provide room for an adequate storage of writing materials and finally provide pleasant places for reading and research work. It has also been noticed, that artificial ventilation is used to complement the natural one for the comfort of the users in all the libraries studied.

**PICTURES OF F.U.T MINNA LIBRARY BOSSO CAMPUS, MINNA, NIGER
STATE, NIGERIA**

Plate 4.16: front view

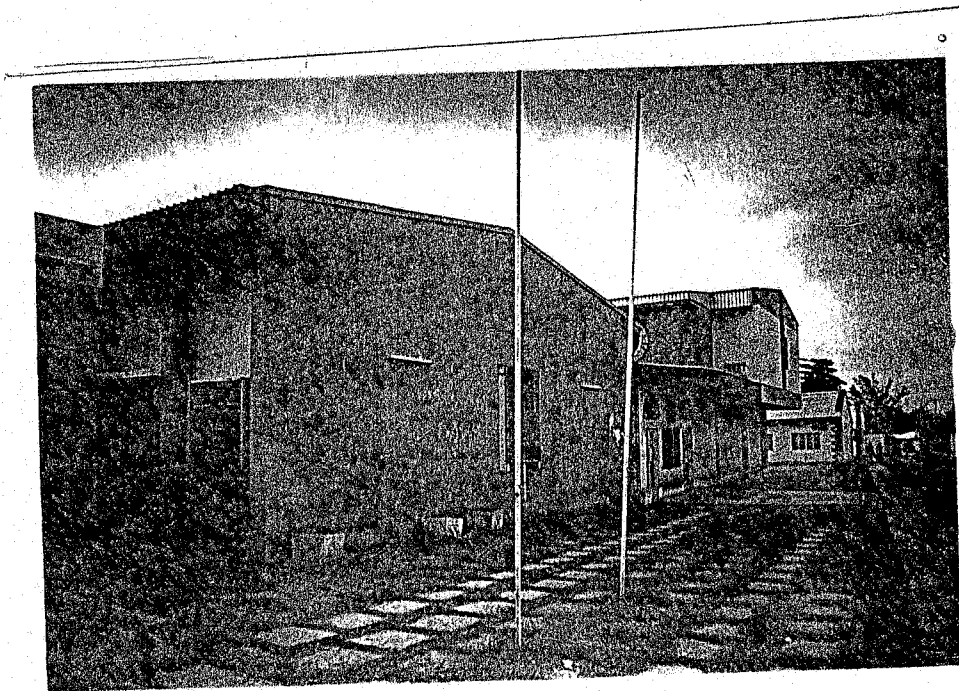
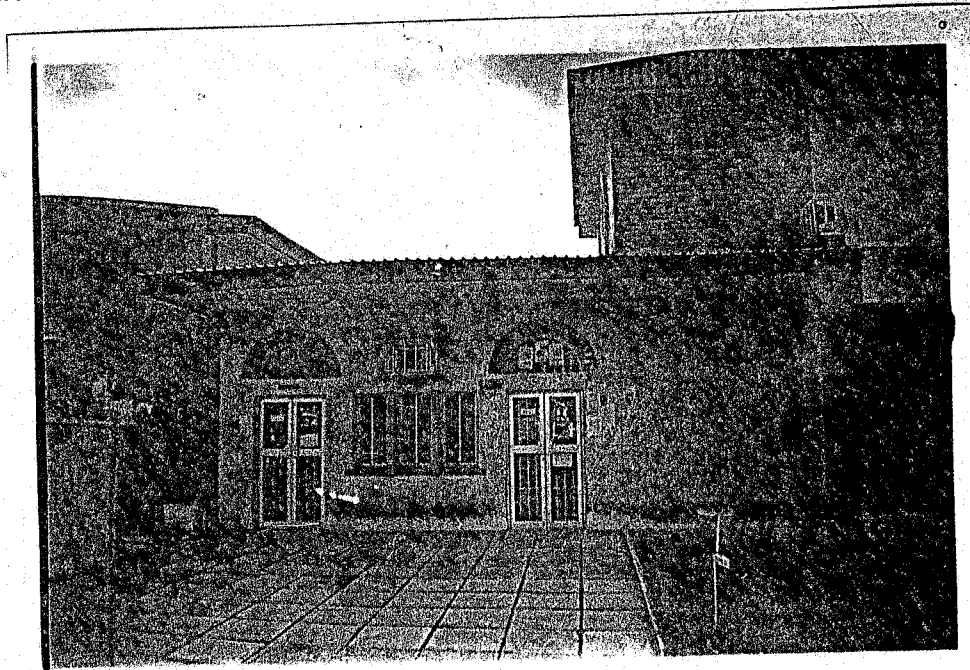


Plate 4.17: perspective view front side

Plate 4.18 perspective view staff entrance side

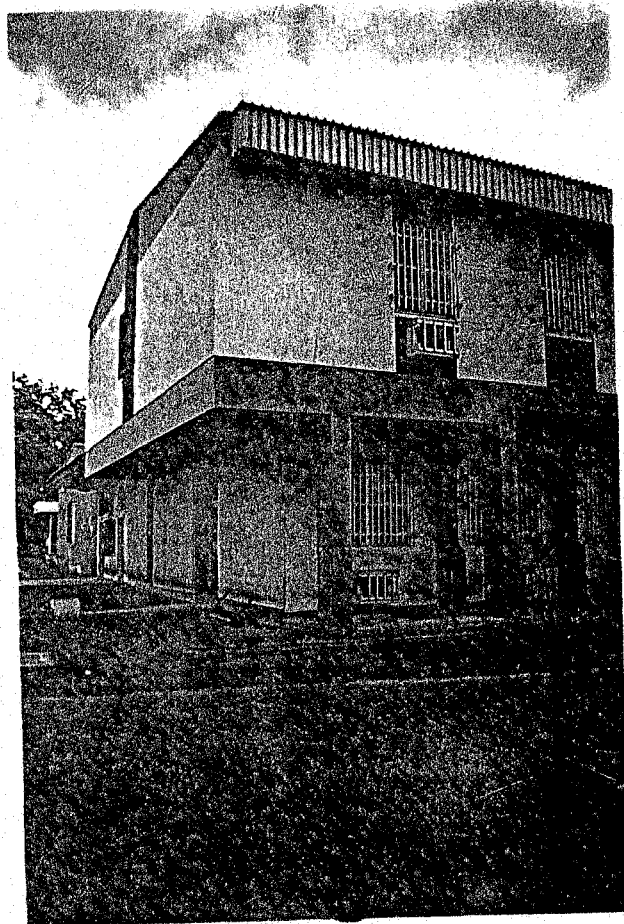


Plate 4.19: left side view

CHAPTER FIVE

DATA COLLECTION

5.1. PHYSICAL AND SOCIO-CULTURAL BACKGROUND

5.1.1 NIGER REPUBLIC

Niger is a West Africa country; it lies at latitude 16° north and longitude 8° east. It is bounded at the north by Algeria and Libya, at the south by Nigeria and Benin, at the east by Chad and finally at the west by Burkina Faso and Mali. It is a landlocked country, having a land mass area of 1.267 million square kilometers. Its terrain is made up of desert plains and dunes – northern four-fifth is desert-, flat to rolling plains –southern one fifth is savannah-, and hills in the north. The greater part of the country has a mean elevation of 360m above sea level; the lowest area is the river Niger area at 200m above sea level. This area is also the most wooded of the country, and the river is the only important running water.

Niger is one of the hottest country in the world; its climate is basically a tropical hot dry one, which is influenced by the desert in the north.

Economically, the country is regarded as a poor nation, whose economy centers on subsistence agriculture, animal husbandry, re-exports trade and increasingly less on uranium, because of declining world demand.

Education wise, the literacy level is quite low, just about 15.3% of the population of age 15 and over can read and write (2002 estimate). There are only two universities in the country and some few tertiary institutions.

Niger republic has a population of 10,639,744 (2002 estimate) spread among eight ethnic groups. The country is divided in seven departments (states) and a capital

district town, Niamey that is the location town of the University Abdou Moumouni, site of this study.

5.1.2 NIAMEY TOWN

5.1.2.1 GEOGRAPHICAL LOCATION

Niamey is located in the southwestern part of the country. It lies at latitude 12° 21' north and longitude 3°37 east. It is the capital district town of Republic of Niger, and it is divided in three communes I, II and III. The town is divided into by the River Niger and it is bounded Dosso and Tillabery states respectively at east and west, north and south. (See map)

5.1.2.2. EXISTING LAND USE AND FUTURE TRENDS

The present town covers about 270 km²; the town runs from "Koiratgui" in the north to "Banga Bana" in the south a distance of about 30km. It also runs from "Aéroport" in the east to "Koubia" in the west a distance of 40km. Much of the development along this stretch is between 50 to 150m off of the main road.

There is only one bridge linking the two part of the town, across river Niger passing through the town. A series of hills delineate the southern fringe compelling the definition of the town. The sitting of the airport and the Kori of Ouallam (water valley) at the eastern fringe plays a similar role as the hills in the south, thus eliminating all possibilities of further growth on this side.

The town has expanded with the recent large scale land allocation to the northwest and northeast. In the near future the majority of the growth of Niamey will be along these two sides.

5.1.2.3 SOCIO CULTURE SETTING

Basically, Niamey is a Zarma town. But Niamey being the capital of the country, it is everybody's town. The area was of old a center of conflict between Semites and Hamites of the north and the Negroid groups of south.

The first European contact was 1890 when the Scotsman Mango Park explored the River Niger. The French came in 1890's but did not establish a colony. At that time they were only small villages around the River Niger.

Then in 1921 the colony was established and Niger became a French over sea's territory in 1946. It became a self-governing state within the French community in 1958. In 1960 Niger Republic gained full independence, with Niamey as capital. But, before Zinder was the capital and Niamey was just the second "Fort Arme" (Army Barracks), until 1927 when the capital was transferred to Niamey due to some problems.

5.1.2.4 CLIMATIC SETTING

The climate of Niger Republic is influenced mainly by two winds systems. One is the rain bearing southwest monsoon, which blows from the ocean, the other is the dry dusty northeast trade or harmattan, which comes from the Sahara desert.

The climate is hot and dry. No where in this tropical steppe and desert land is the amount of rainfall very great and the northern half of the country receives less than 100mm a year. The total rainfall decreases from south to north and the climate becomes hotter and drier.

Niamey falls in the southern climatic conditions. The presence of the national institute of meteorology makes climate records ready available such as rainfall, temperature, humidity and wind.

5.1.2.4.1 RAINFALL

Rains, usually starts in May and cessation begins in October, there may be variation of 20 days in either case. Thus the length of the raining season is 100 – 120 days. Total rainfall is a bout 600-700mm with the dry season from November to May contributing only 0 – 20mm while rainfall in May – October is 580 – 670mm. The month of highest rainfall is August with a value of 180mm to 220mm. Between May and August, monthly values average 40– 220mm, and decline sharply afterwards to 0– 20mm in October.

The months of May and October are the beginning and cessation of rains respectively, which are usually associated with lightning and thunder. After July, squally thunderstorms become infrequent but when they occur they could be very violent causing flash floods and destruction.

Annee	Jan	Fev	Mar	Avr	Mai	Jui	Jui	Aou	Sep	Oct	Nov	Dec	Total
1998	0.0	0.0	0.0	8.6	3.4	109.6	113.9	220.5	80.1	12.2	0.0	0.0	548.3
1999	0.0	0.0	2.0	1.7	54.0	62.5	95.1	91.1	56.5	48.6	0.0	0.0	411.6
2000	0.0	0.0	0.0	32.7	26.8	89.1	176.7	281.9	207.8	1.6	0.0	0.0	816.6
2001	0.0	0.0	0.0	4.8	27.8	44.9	219.2	150.6	188.7	5.8	0.0	0.0	641.8
2002	0.0	0.0	0.0	9.4	5.4	82.5	165.0	144.9	50.2	0.0	0.0	0.0	458.4
Moy	0.0	0.0	0.4	11.44	23.5	77.7	154.2	177.8	116.7	13.6	0.0	0.0	575.3

Table 5.1: Pluviometrie (mm) for Niamey aeroport

Rainfall table from 1998 to 2002

Source: Direction nationale de la meteorology

5.1.2.4.2 TEMPÉRATURE

Mean daily air temperature varies from early morning low values of 28⁰c to a maximum of about 40⁰c in the afternoon. Thus a diurnal temperature variation of 12⁰c is observed from March to September.

Daytime highest temperature is also seasonal with the months of April and May having the highest values, 41.7⁰c and 40.8⁰c respectively.

<i>Annee</i>	<i>Jan</i>	<i>Fev</i>	<i>Mar</i>	<i>Avr</i>	<i>Mai</i>	<i>Jui</i>	<i>Jui</i>	<i>Aou</i>	<i>Sep</i>	<i>Oct</i>	<i>Nov</i>	<i>Dec</i>	<i>Moy</i>
1998	35.2	37.2	39.6	41.0	41.0	36.5	35.5	32.7	34.1	37.6	35.0	34.7	36.7
1999	34.3	32.6	36.6	40.6	39.2	37.3	35.1	35.0	36.1	38.9	38.1	33.9	36.5
2000	32.8	37.1	37.1	42.5	40.9	37.5	34.3	31.8	33.4	37.8	37.4	34.0	36.4
2001	33.0	34.9	41.1	41.6	41.1	39.8	34.3	31.6	33.5	37.1	37.0	33.1	36.5
2002	34.7	32.2	38.0	42.9	41.8	38.3	33.7	33.0	36.1	37.6	37.3	32.8	36.5
<i>Moy</i>	<i>34.0</i>	<i>34.8</i>	<i>38.5</i>	<i>41.7</i>	<i>40.8</i>	<i>37.9</i>	<i>34.6</i>	<i>32.8</i>	<i>34.6</i>	<i>37.8</i>	<i>37.0</i>	<i>33.7</i>	<i>36.5</i>

Table 5.2: Temperature maximum (°c) pour Niamey aeroport

<i>Annee</i>	<i>Jan</i>	<i>Fev</i>	<i>Mar</i>	<i>Avr</i>	<i>Mai</i>	<i>Jui</i>	<i>Jui</i>	<i>Aou</i>	<i>Sep</i>	<i>Oct</i>	<i>Nov</i>	<i>Dec</i>	<i>Moy</i>
1998	17.4	20.3	24.4	26.7	28.5	26.1	25.1	23.5	23.9	24.6	18.5	17.0	23.0
1999	17.7	18.5	24.0	27.0	27.7	26.0	25.0	25.1	25.3	26.7	22.3	17.1	23.5
2000	16.7	20.7	22.1	28.5	29.2	26.6	24.7	23.4	23.6	26.5	20.7	17.8	23.4
2001	17.2	19.4	24.5	27.5	28.7	28.0	24.4	23.3	23.5	23.9	20.4	16.5	23.1
2002	19.4	16.0	21.6	27.4	29.3	26.1	24.2	23.7	25.3	25.0	19.4	16.5	22.8
<i>Moy</i>	<i>17.7</i>	<i>19.0</i>	<i>23.2</i>	<i>27.4</i>	<i>28.7</i>	<i>26.6</i>	<i>24.7</i>	<i>23.8</i>	<i>24.3</i>	<i>25.3</i>	<i>20.3</i>	<i>17.0</i>	<i>23.2</i>

Table 5.3 : Temperature minimum (°c) pour Niamey aeroport

<i>Annee</i>	<i>Jan</i>	<i>Fev</i>	<i>Mar</i>	<i>Avr</i>	<i>Mai</i>	<i>Jui</i>	<i>Jui</i>	<i>Aou</i>	<i>Sep</i>	<i>Oct</i>	<i>Nov</i>	<i>Dec</i>	<i>Moy</i>
1998	26.3	28.8	32.0	33.9	34.7	31.4	30.3	28.1	29.0	31.1	26.8	25.9	29.9
1999	26.0	25.6	30.3	33.8	33.5	31.7	30.1	30.1	30.7	32.8	30.2	25.5	30.0
2000	24.8	28.9	29.6	35.5	35.1	32.1	29.5	27.6	28.5	32.2	29.1	25.9	29.9
2001	25.1	27.2	32.8	34.6	34.9	33.9	29.4	27.5	28.5	30.5	28.7	24.9	29.8
2002	26.9	24.2	29.9	34.8	34.8	35.2	28.8	28.2	30.4	31.3	28.3	24.6	29.6
<i>Moy</i>	25.8	26.9	30.9	34.5	34.7	32.2	29.6	28.3	29.4	31.6	28.6	25.4	29.8

Table 5.4 : Temperature moyenne (°C) pour Niamey aeroport

Source: Direction nationale de la meteorology

5.1.2.4.3 EFFECTIVE TEMPERATURE

Effective temperature may be defined as a measure of physiological comfort or discomfort due to low/high temperature and relative humidity. It is a stress factor, which may be attributed to effective heating power of the ambient air under relatively calm (wind) conditions. It is therefore the key to estimating a simplified index of comfort for any given environment.

The effective heating that human body is subjected to in Niamey and its environs is maximum during the dry season when the relative humidity is low and, minimum during the raining season when the relative humidity is high.

<i>Annee</i>	<i>Jan</i>	<i>Fev</i>	<i>Mar</i>	<i>Avr</i>	<i>Mai</i>	<i>Jui</i>	<i>Jui</i>	<i>Aou</i>	<i>Sep</i>	<i>Oct</i>	<i>Nov</i>	<i>Dec</i>	<i>Moy</i>
1998	24	21	16	26	39	58	61	74	70	46	27	23	40
1999	20	15	25	28	48	56	63	65	65	49	27	22	40
2000	20	17	14	27	47	56	66	76	74	52	31	29	42
2001	27	20	19	29	41	45	67	77	73	51	32	26	42
2002	39	33	26	46	56	56	69	90	83	68	44	37	57
<i>Moy</i>	<i>26</i>	<i>21</i>	<i>20</i>	<i>31</i>	<i>46</i>	<i>58</i>	<i>69</i>	<i>76</i>	<i>73</i>	<i>54</i>	<i>32</i>	<i>27</i>	<i>44</i>

Table 5.5: Humidity relative, moyenne ($^{\circ}$ C) pour Niamey aeroport

Mean relative humidity

Source: Direction nationale de la meteorology

5.1.2.4.4 WIND

Winds are predominantly blowing from northeast during the dry season, while in the raining season it is from southwest. Mean wind speed during the wet season is 1 – 3m/sec but during the dry season it could be persistently high at 3 – 6m /sec from the northeast. Night times are usually calm. In the raining season, winds are generally frequent with a speed of not more than 3m/sec.

<i>Annee</i>	<i>Jan</i>	<i>Fev</i>	<i>Mar</i>	<i>Avr</i>	<i>Mai</i>	<i>Jui</i>	<i>Jui</i>	<i>Aou</i>	<i>Sep</i>	<i>Oct</i>	<i>Nov</i>	<i>Dec</i>	<i>Moy</i>
1998	2.8	2.9	3.0	2.3	3.5	3.3	4.1	3.0	2.8	2.6	3.2	2.7	3.0
1999	3.4	5.8	4.0	3.0	3.6	3.7	4.3	3.9	3.7	3.5	3.3	3.9	3.8
2000	4.6	4.4	4.4	3.5	3.7	4.2	3.9	3.2	3.3	2.9	2.0	2.3	3.5
2001	3.3	3.9	3.7	3.7	4.0	4.1	3.8	2.8	3.1	2.9	2.6	4.2	3.5
2002	4.4	5.3	4.9	3.1	4.3	5.9	3.9	3.0	3.3	2.8	2.0	3.4	3.9
<i>Moy</i>	<i>3.7</i>	<i>4.5</i>	<i>4.0</i>	<i>3.1</i>	<i>3.8</i>	<i>4.2</i>	<i>4.0</i>	<i>3.2</i>	<i>3.2</i>	<i>2.9</i>	<i>2.6</i>	<i>3.3</i>	<i>3.6</i>

Table 5.6: Vent moyen observe a 10 meters (m/s) pour Niamey aeroport

Mean of wind observed at 10 (m/s)

Source: Direction nationale de la meteorology

5.1.2.5 VEGETATION

The type of vegetation prevailing all over the country is divided into four broad zones. These are: saharienne zone, north – sahelienne zone, south – sahelienne zone and soudanienne zone. Niamey town is located in south – sahelienne zone of the country. This is one of the broadest vegetation zone in Niger. The grasses have durable roots, which remain underground after the tops have been burnt away after a dry season fire, and sprout again with the onset of the rains the following season. However, vegetation type in Niamey at places located in the vicinity of the riverbanks possesses the characteristics of that of fresh – water swamp – belt. And also some man-made forest can be seen on the boundaries of the town, otherwise the trees are sparse and shrubs dominate the vegetation.

5.1.2.6 GEOLOGY AND TOPOGRAPHY

The formation nature of soils in a particular place depends mainly on three factors. These are the nature of the parent rock, the vegetation and the climate. The soil particles vary in grain size and are therefore grouped according to the size of their component grains. The groups are: -

- a. Sandy soils – coarse, porous and easy to work.
- b. Clayey soils – fine grained and retentive of moisture but are difficult to till. When they dry up in the dry season they contract, harden and develop cracks. They swell when they absorb moisture.
- c. Loam is a mixture of sandy and clayey soils usually with small quantity of fine soils called silt in them.

The soils in Niger Republic can be broadly grouped into four zones and they are:

- i. Northern zone of sandy soils
- ii. Interior zone of laterite soils
- iii. Southern belt of savanna soils
- iv. Zone of alluvial soils

Niamey falls within the zone of alluvial soils along the course of the River Niger.

The soil is sandy, tight hued and often sterile.

The topography of the town generally slopes gently toward the River Niger whose bed is 200m above sea level. The Niger River forms a major drainage channel for all surface runoff water in the town. The water is conveyed from the interior of the town to the river through natural and covered drainage channels, which are designed to serve this purpose.

5.1.2.7 DEMOGRAPHIC DATA

The population of Niger Republic was about 4,994, 000 in 1978 it reaches 8,500, 000 from the last census in 1996. But a census was conducted in 2000, results are not yet available, but the population is estimated to be about 10,639,744 people in 2002.

About 75% of the populations were Negro (Hausa, Djerma, Songhai, Tubu, and Kanuri) and the remainder Berber (Tuareg, Fulani and Arab). These two groups are geographically and culturally separate, but share Muslim religion. French is the official language.

The Hausa is the largest group, forming more than 40% of the country's total population, and they are living in the central southern to the east southern part of the country. The second principal group is the Djerma – Songhai, they too are farming people and live in southwest. The third group is the Tuareg and others occupying respectively the north and east of the country, they are more or less nomadic people. Notice should be made of the fact that Fulani being cattle rears and nomadic by nature are scattered all over the southern bands of the country.

The population of Niger republic is very young, with a higher birth rate of 52 birds for 1,000 habitants. At the independence (1960), Niamey town had a population of about 30,000. But in twelve years that is from 1960 to 1972 the population passed from 33, 816 to 108, 000 as shown in figures below.

Year	1905	1910	1926	1930	1940	1945	1956	1960	1966	1975	1977	1988	1995	1997	2000
Pop	1800	3000	3146	4642	8152	8078	11,790	33,816	56,388	135,388	242,873	399,846	500,000	700,000	930,000

Table 5.7: Niamey's demographic evolution (1905 – 2000)

Source: service des "Recensements General de la population 1996"

(Statistics, General population census 1996)

5.1.2.8 ECONOMY AND COMMERCE

The economy is based almost entirely on agriculture even though only about 5% of the land is suitable for farming. The chief crops are millet and sorghum for local consumption, and peanuts for commercial use. Much food must be imported. Cropland is in the south near the Nigerian border in the steppe land. There is nomadic herding. The cattle's, sheep's, goats, camels, donkeys raised are impressive in number. They are part of the goods exported.

Among all other important minerals, uranium and charcoal are the only mined minerals. Industrial mining of gold is expected to start soon. And serious exploration works are going on for the exploitation of petroleum.

5.1.2.9 TRANSPORTATION AND TRAFFIC FLOW

Niamey has a good road network well spread all over the town. This makes circulation flow easy and convenient. The road network is made of some principal dual carriageways running from one side of the town to the other, and minor roads and streets. Niamey's urban development is closely monitored. In each new development the road network is not tampered with. The roads are usually wide enough to allow for both vehicular and pedestrian traffic.

A main road, the "boulevard de l'universite", serves the area where the site is to be located "University Abdou Moumouni main campus".

5.2. DATA ON UNIVERSITY ABDOU MOUMOUNI

5.2.1 BACKGROUND.

In 1971 a teaching college was established in Niamey, it became University of Niamey in 1973. It was given the name of Universite Abdou Moumouni in 1992 in memory of late renowned professor Abdou Moumouni.

When the university started operating it had only three schools namely:

- a. Ecole de pedagogie – school of education
- b. Ecole des sciences – school of science
- c. Ecole des lettres – school of Art.

And then the students' strength was just 107. But for the session 2001-2002 the students were estimated to be over 7000 and the number of faculties on site have increased.

5.2.2 THE UNIVERSITY TODAY

The university today has five faculties, four institutes, a college and a center. It is spread over three sites, the mini campus, the main campus and the administration - senate- site. The mini campus is on the left side of the town with respect to the river and the two other sites are on the other side.

The strength of student as stated above is estimated at 7000 for the 2001-2002 sessions. It is a number that is in constant increase, although programmes for facilities developments are put in place.

5.2.2.1 BUILDING FACILITIES

This will be fully discussed in the following chapter, but it should be noted that the main campus houses the majority of the building facilities of the university.

5.2.2.2 THE UNIVERSITY IN FIGURES

The university has:

Five (5) faculties and some twenty departments. The faculties will be listed below, and for the department see tables of student strength:

- a. Faculté de science – faculty of science
- b. Faculté d' agronomie – faculty of agronomy

- c. Faculté des sciences de la sante – faculty of medicine
- d. Faculté des lettres et sciences humaines – faculty of human sciences
- e. Faculté des sciences économiques et juridiques – faculty of law and economy.

A high school, which is:

Ecole normal superieur – college of education

Three institutes and one centre, they are:

- a. Institut de recherche en science humaine (IRSH) - institute of research on human science.
- b. Institut de radio isotope – institute of radio isotope
- c. Institut des techniques agricoles (ITA)- institute of agricultural technology
- d. Centre regional d' excellence specialise en agronomie– centre of excellence specialized in regional agronomy.

Some of the institutes are purely research oriented, some offer courses.

Hostels, thirteen (13) hostels are available on the main campus and their capacity is over 2000 bunks. The boys have eleven of the buildings while the girls have only two.

Libraries, six in number and documentation centre.

Each faculty and the high school has one. But these places have only the name of library as they do not fully render library services, their collection contents is limited and all operate on the base of consultation of document therein in the library – no borrowing services – (summary table 5.8)

Library of	No of seats	Collection size	Service offered
FSES	80	N.A	Consultation therein and photocopy
FLSH	90	N.A	Consultation therein and photocopy
F. Agro	50	N.A	Consultation therein and photocopy
F.S.S	80	N.A	Consultation therein and photocopy
FS	80	N.A	Consultation therein and photocopy
ENS	50	N.A	Consultation therein and photocopy
Documentation of FSES	15	N.A	Consultation therein and photocopy

Table 5.8: services rendered by the libraries in the University

Source: compiled table

Note: the documents are not exposed within free reach; rather a needed book has to be asked from the library operator.

Student strength: 7067 for the 2001-2002 session. The following tables give breakdowns of students in the different faculties and departments for the last sessions.

UNIVERSITE ABDOU MOUMOUNI
 SERVICE CENTRAL DE LA SCOLARITE
 STATISTIQUES DES INSCRIPTIONS ACADEMIQUE 2001-2002

FACULTE DES SCIENCES DE LA SANTE (FSS)

Sections	Effectifs		Total	% Filles
	Garçons	Filles		
EM.1	273	122	395	31%
EM.2	152	80	232	34%
EM.3	67	23	90	26%
EM.4	91	27	118	23%
EM.5	38	22	60	37%
EM.6	65	19	84	23%
EM.7	41	14	55	25%
EM.8	34	15	49	31%
Total:	761	322	1083	30%
Aide-chir.1	4	0	4	0%
Aide-chir.2	5	2	7	29%
Aide-chir.3	8	1	9	11%
Radio.1	1	0	1	0%
Radio.2	6	2	8	25%
Radio.3	2	0	2	0%
Aide-Anest.1	0	0	0	0%
Aide-Anest.2	6	8	14	57%
Aide-Anest.3	3	6	9	67%
DES chir.1	3	0	3	0%
DES chir.2	1	0	1	0%
DES chir.3	1	0	1	0%
DES gynéco.1	6	1	7	14%
DES gynéco.2	2	0	2	0%
DES gynéco.3	1	0	1	0%
DES gynéco.4	1	0	1	0%
Total:	50	20	70	29%

FACULTE D' AGRONOMIE (FA)

Sections	Effectifs		Total	% Filles
	Garçons	Filles		
ITA.1	68	11	79	14%
ITA.2	43	13	56	23%
ITA.3	25	4	29	14%
ITA.4	44	9	53	17%
Agro.3	19	1	20	5%
Agro.4	28	3	31	10%
3e cycle crésa	15	3	18	17%
Total:	242	44	286	15%

FACULTE DES SCIENCES (FS)

Sections	Effectifs		Total	% Filles
	Garçons	Filles		
Agro.1	308	33	341	10%
CBG.1	166	16	182	9%
MP.1	127	3	130	2%
PC.1	84	2	86	2%
Agro.2	65	5	70	7%
CBG.2	12	0	12	0%
MP.2	15	0	15	0%
PC.2	32	4	36	11%
BG.2	6	1	7	14%
Licence Maths	10	1	11	9%
Licence Chimie	10	0	10	0%
Licence Physique	10	0	10	0%
Licence SVT	4	0	4	0%
Maîtrise Maths	9	0	9	0%
Maîtrise Chimie	9	0	9	0%
Maîtrise Physique	8	0	8	0%
Maîtrise SVT	2	1	3	33%
Total:	877	66	943	7%

FACULTE DES SCIENCES ECONOMIQUES ET JURIDIQUES

Département d' Economie

Sections	Effectifs		Total	% Filles
	Garçons	Filles		
ECO.1	408	73	481	15%
ECO.2	211	23	234	10%
Licence	104	8	112	7%
Maîtrise	49	11	60	18%
Total:	772	115	887	13%

Département de Droit

Sections	Effectifs		Total	% Filles
	Garçons	Filles		
Capacité.1				
Capacité.2				
Droit.1	332	128	560	23%
Droit.2	113	31	144	22%
Licence	69	19	88	22%
Maîtrise	70	16	86	19%
Total:	584	194	878	22%

FACULTE DES LETTRES ET SCIENCES HUMAINES (FLSH)

Departement d' Anglais

Sections	Effectifs		Total	% Filles
	Garçons	Filles		
Anglais.1	54	22	76	29%
Anglais.2	47	14	61	23%
Licence	73	23	96	24%
Maîtrise	53	11	64	17%
Total:	227	70	297	24%

Departement de Géographie

Sections	Effectifs		Total	% Filles
	Garçons	Filles		
Géo.1	294	42	336	13%
Géo.2	98	14	112	13%
Licence	78	5	83	6%
Maîtrise	59	2	61	3%
Total:	529	63	592	11%

Departement d' Histoire

Sections	Effectifs		Total	% Filles
	Garçons	Filles		
Hist.1	36	6	42	14%
Hist.2	36	3	39	8%
Licence	24	6	30	20%
Maîtrise	28	1	29	3%
Total:	124	16	140	11%

Departement de Philosophie

Sections	Effectifs		Total	% Filles
	Garçons	Filles		
Philo.1	67	4	71	6%
Philo.2	28	3	31	10%
Licence	41	1	42	2%
Maîtrise	39	1	40	3%
Total:	175	9	184	5%

Departement de Sociologie

Sections	Effectifs		Total	% Filles
	Garçons	Filles		
Socio.1	304	64	368	17%
Socio.2	158	49	207	24%
Licence	239	55	294	19%
Maîtrise	51	3	54	6%
Total:	752	171	923	19%

Departement de Psychologie

Sections	Effectifs		Total	% Filles
	Garçons	Filles		
Psycho.1	103	17	120	14%
Psycho.2	65	12	77	16%
Licence	4	4	29	14%
Maîtrise	2	0	2	0%
Total:	174	33	228	14%

Departement de Lettres Modernes

Sections	Effectifs		Total	% Filles
	Garçons	Filles		
Let mod.1	40	8	48	17%
Let mod.2	34	6	40	15%
Licence	52	9	61	15%
Maîtrise	17	0	17	0%
Total:	143	23	166	14%

Departement de Linguistique

Sections	Effectifs		Total	% Filles
	Garçons	Filles		
Ling.1	47	11	58	19%
Ling.2	27	6	33	18%
Licence	23	10	33	30%
Maîtrise	12	3	15	20%
Total:	109	30	139	22%

ECOLE NORMALE SUPERIEURE (ENS)

Sections	Effectifs		Total	% Filles
	Garçons	Filles		
C/ Alpha	9	1	10	10%
I / Alpha	2	0	2	0%
C/ ECB1 (II)	52	7	59	12%
C/ ECB1 (I)	24	2	26	8%
CAPES	8	1	9	11%
CPES	12	1	13	8%
I / ECB1	5	0	5	0%
Tech Labo1	14	0	14	0%
Total:	126	12	138	9%

RECAPITULATIF
FACULTE DES SCIENCES DE LA SANTE (FSS)

Sections	Effectifs		Total	% Filles
	Garçons	Filles		
Etudes médicales	761	322	1083	30%
Aides Chirurgies	17	3	20	15%
Anesthésie	9	14	23	61%
Radiologie	9	2	11	18%
DES Chirurgie	4	0	4	0%
DES Gynécologie	10	1	11	9%
Total:	810	342	1152	30%

FACULTE D' AGRONOMIE (FA)

Sections	Effectifs		Total	% Filles
	Garçons	Filles		
ITA	80	37	117	32%
AGRO	47	4	51	8%
CRESA	15	3	18	17%
Total:	142	44	186	24%

FACULTE DES SCIENCES (FS)

Sections	Effectifs		Total	% Filles
	Garçons	Filles		
AGRO	373	38	411	9%
CBG	178	16	194	8%
MP	142	3	145	2%
PC	116	6	122	5%
BG	6	1	7	14%
MATHS	19	1	20	5%
PHYSIQUE	18	0	18	0%
CHIMIE	19	0	19	0%
SVT	6	1	7	14%
Total:	877	66	943	7%

FACULTE DES SCIENCES ECONOMIQUES

ET JURIDIQUES (FSEJ)

Sections	Effectifs		Total	% Filles
	Garçons	Filles		
ECONOMIE	772	115	887	13%
DROIT	584	194	778	25%
Total:	1356	309	1665	19%

FACULTE DES LETTRES ET SCIENCES HUMAINES (FLSH)

Sections	Effectifs		Total	% Filles
	Garçons	Filles		
ANGLAIS	227	70	297	24%
LET.MOD	143	23	166	14%
SOCIO	752	171	923	19%
PYSCHO	174	33	207	16%
PHILO	175	9	184	5%
HISTOIRE	124	16	140	11%
GEO	529	63	592	11%
LINGUSTIQUE	109	30	139	22%
Total:	2233	415	2648	16%

ECOLE NORMALE SUPERIEURE (ENS)

Sections	Effectifs		Total	% Filles
	Garçons	Filles		
ALPHA	11	1	12	8%
C/ECB	81	9	90	10%
CAPES/ CPES	20	2	22	9%
Tech Labo	14	0	14	0%
Total:	126	12	138	9%

SITUATION GENERALE

Facultes	Effectifs		Total	% Filles
	Garçons	Filles		
FA	247	44	291	15%
FS	892	66	958	7%
FSS	818	335	1153	29%
FSEJ	1458	308	1766	17%
FLSH	2327	428	2755	16%
ENS	131	13	144	9%
Total:	5873	1194	7067	17%

Tables 5.9: students' strength in the university in function of faculties and departments

5.3 DEDUCTIONS

The data so far gathered will in so many ways affect the project at hand. Some will verify the choice of the area and others will influence the design of the structures.

The location of the university in Niamey makes the town the area of this project. The climate of the town with its harsh conditions in some part of the year makes it necessary to consider some design conditions to be implemented:

- i. The ventilation should be properly taken care of
- ii. Landscape should be enhanced through planting of trees. The trees should also serve as sun barriers, but also as wind barriers
- iii. Use of parapet should be considered to counter the action of the wind on roof
- iv. The nature of the soil call for goods foundation system
- v. The good road network will make access to site easy

CHAPTER SIX

SITE ANALYSIS

6.1 INTRODUCTION

Niamey the town where the site of the project is located has been analyzed in the preceding chapter. And many characteristics such as climate, temperature, and rainfall among others have been treated. Therefore in this chapter the detailed information concerning the site is going to be given.

6.2. LOCATION OF THE SITE

The site to be used for this design proposal is an earmarked place for the central library building on the main campus of the university. This campus is located in "Nogare" commune III of Niamey town. It is on the right bank side of the River Niger and it is along the "boulevard de l' université". The place earmarked for the library on the campus site is after EMIG (higher school of mining and geology) slightly facing the faculty of medicine, see site diagram, plate 6.1.

6.3 CRITERIA FOR SITE SELECTION

As said above in 6.2, there is a place earmarked for the central library of the university in the site layout of the main campus, therefore that same place is retained for this design.

The place is located further on site, at some distance of the hostels, but a trackable distance. It looks somehow isolated in relation to the existing facilities on site, but the future trend of development of the university is towards that side. The place is easily

accessible as it is along the major road of the campus serving its major facilities. It is fulfilling the requirement of being accessible to the university community.

In library location, the sources of noise are important factors to be considered. For the proposed site, EMIG, an independent school is playing a role of buffer with respect to the other activities on site. Concerning the road, there is enough space which will allow to locate the building at a comfortable distance away from it so that, the noise generated there will have less impact.

These above factors have made the place earmarked for the library convenient as site for this proposed design.

6.4 SITE CHARACTERISTICS

The site is almost flat in nature with a very gentle slope south north in the direction of the river. The soil type is alluvial agricultural soil with highly compressed literate subsoil. The climate of the area like wise Niamey town is influenced by the seasonal winds blowing from the northeast during the dry season bringing harmattan and dust from the desert and the southwest winds bringing the rains from the ocean. The raining season lasts for almost six months with great variation of rainfall throughout the months. During that period, the relative humidity is high. During the dry season the relative humidity is low especially in May and April and then the temperature is too high. On the average the sun is intense at 10Am and 4Pm and comfort should therefore be maximized in relation to the angle of inclination of the sun. Palm trees dominate the vegetation on the site.

6.5. ACCESS TO SITE

The access to the university main campus is quite easy, just after the Kennedy bridge that links the two parts of the town across the river, the "boulevard de l' universite" starts and passes in front of the university. From it another road is taped and carried in the university, that it crosses from one end to the other and it serves all the facilities on site. Like the others, the access road to the proposed library will be connected to that major road.

6.6. UTILITIES

The main campus housing already some facilities such as the hostels, lecture theatres, classrooms, laboratories and offices, has the basic necessary utilities. So, power lines, telephone lines and water supply are available. All of these are running along the major and minor roads, therefore the basic utilities are within easy reach from the proposed location place of the library.

6.7. EXISTING FEATURES

As said earlier, the main campus has some facilities that are already erected thereupon. They are basically:

- a. Faculty of science
- b. Faculty of medicine
- c. Faculty of agronomy
- d. Faculty of social science
- e. Institute of Radio isothope

- f. High school of education
- g. Centre of excellence specialized in regional agronomy
- h. Student affairs block
- i. Students' hostels
- j. Social centre with clinic
- k. Central mosque
- l. Students union government building
- m. Restaurant (old and new)
- n. Game field both indoor and outdoor
- o. EMIG (high school of mining and geology), an independent school has been sited on the campus.

The faculties are made up of their classrooms, lecture theatres, offices for lecturers and administration, laboratories for experiences and research and libraries. Though the libraries are just having the name, they are more of bookstores, (see chapter five.)

The faculty of medicine, apart from the basic learning facilities houses a teaching hospital and a maternity. The faculty of agronomy has in addition to the basic facilities stalls where animals are kept for research and studies purpose.

6.8. SCENERY, MAN MADE FEATURES

Apart from the buildings, some landscape elements can be noticed on the campus.

These are:

- a. The monument place of late Professor Abdou Moumouni with its statue in the student hostels area.

b. Fountains with monuments or decorated walls in each faculty

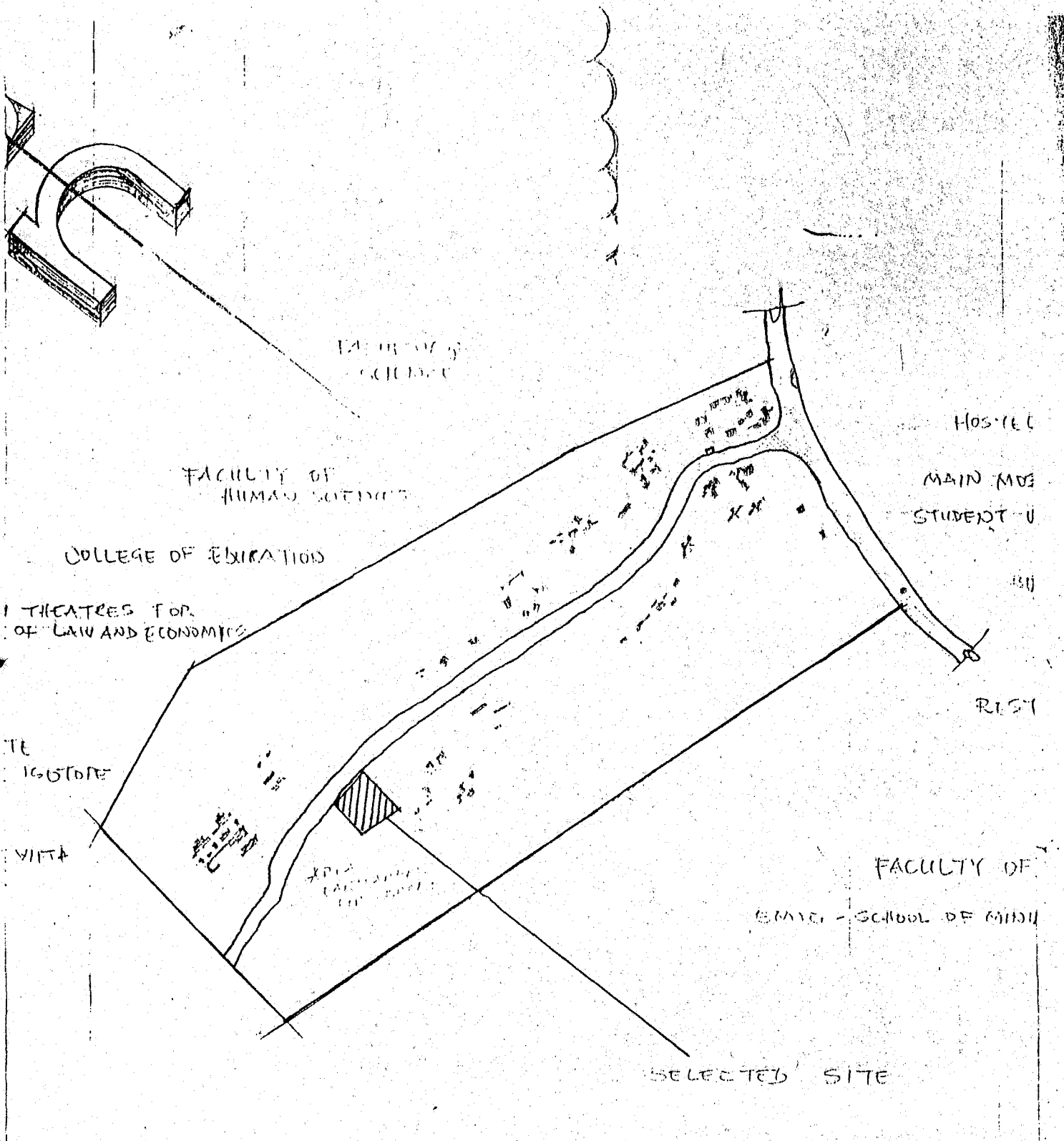
c. Green landscape in the students' hostels and the students' affairs offices area

As far as scenery, the river rolling some distance away could be seen from the second and above floors of the hostels and other buildings, it gives in the morning and evening period wonderful images of sun rises and sets on the water. The abundance of palm trees in areas not yet utilized is also source of natural scenery.

6.9 ENVIRONMENTAL PROBLEMS

Nothing worth to be mentioned as environmental problem was noticed on the site particularly the area reserved for the library. It is true that the site being in the vicinity of the river is liable to be influenced by this one with respect to its soil type - soil stratification -, topography -slope towards the river-, natural water channels. The last two aspects as said earlier are not noticeable on the site and for the first one; the structures on site and their state with respect to their age predict a fairly good bearing soil.

Plate 6.1 Site diagram



CHAPTER SEVEN

DESIGN REPORT

7.1. DESIGN BRIEF

As stated in chapter one, this thesis intends to propose a central library for the university Abdou Moumouni of Niamey, Niger Republic. It has been discovered that the university since its inception in 1973 is growing both students and programmes wise, but some supporting facilities are not following the pace, such as the library system. Therefore, this thesis is to propose a solution to this crucial problem. A university needs a library, and not any kind of library, for it to successfully fulfil its mission of knowledge provider. That is why this proposal shall take in consideration:

- a. The real needs of the university (students' strength and types of programmes run on campus).
- b. The need of proposing a modern university library, taking in cognition the technological development of these recent years and the new development in university library system.
- c. The necessity of providing comfortable study area; comfort both in relation to space planning, adequate ventilation and lighting and enough book storage area.
- d. The new development in university library calls for an administrative arm that will coordinate the network of libraries existing on campus. And the right location for such institution is the central library.
- e. The fact that, though the proposed library will basically support the university programmes, it shall also be a centre for research even for non-university community.

7.2. DESIGN FACTOTRS

Three main elements, materials, readers and staff, are related in varying ways in a library depending on organization policy.

- a. **Entrance:** libraries entrance should declare the building function, and be welcoming. Lobby should reduce entry of noise or draughts. Adequate control is needed to prevent high losses of books and other material through exit; some

libraries have to use turnstiles or electronic detectors. Entrance should lead to control, guide area with display en route.

- b. **Control area:** it should be close to or within sight of building entrance, and with space to absorb congestion at peak hours, but located to allow maximum visibility for supervision. It serves for registration of new readers issuing and receiving loan books, dealing with reservation and fines- see plate 7.1.
- c. **Guide area:** card index, book sheaves, computer printout books are the guiding devices about materials available in the library, it is usually located near control or enquiry desk, en route to all departments served. It is also close to catalogue work area. If index card available allow 122m² covering 36000 vol.
- d. **Enquiry desk:** located near catalogue guide and bibliographies, it can help to share supervision with control.
- e. **Materials:** books are, and will continue to be primary material in libraries. But space may also be required for newspapers and periodicals, discs, tapes and music scores, microfilms, maps and pictures, Internet on line, audiovisual and may be more to add in future, therefore flexibility of layout is necessary.
- f. **Shelving units:** most widely used type is metal shelving; individually adjustable, single sided (along wall) double sided (island).

Shelf dimensions.

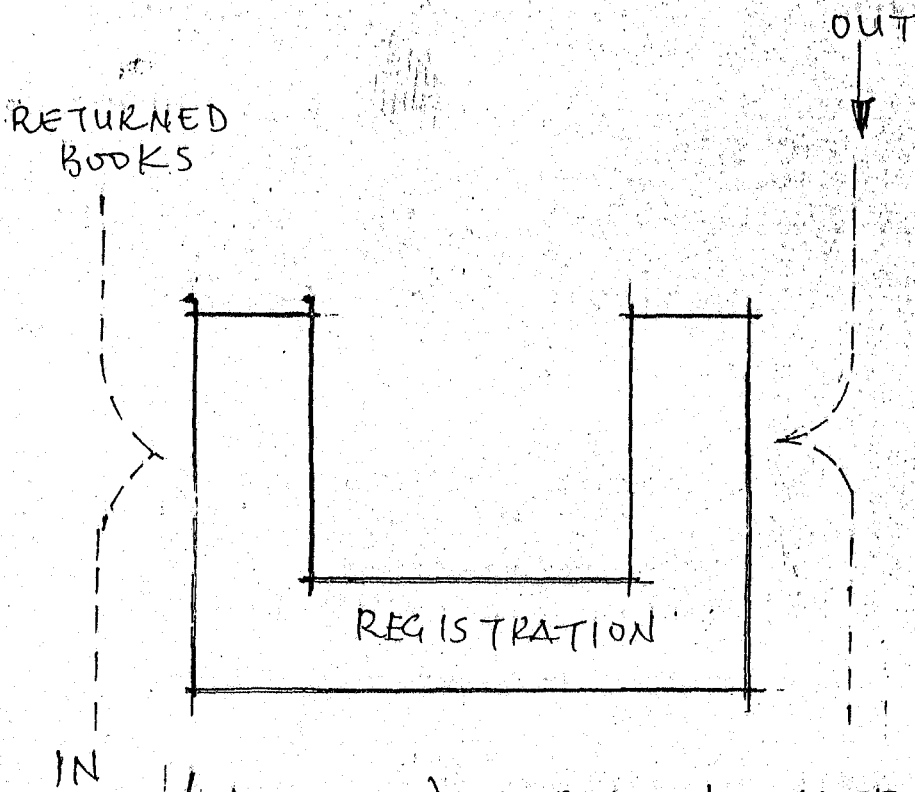
Area	Unit height(m)
Children	1.5
Loan	2.0
Book stack	2.3

Table 7.1: shelf-unit heights

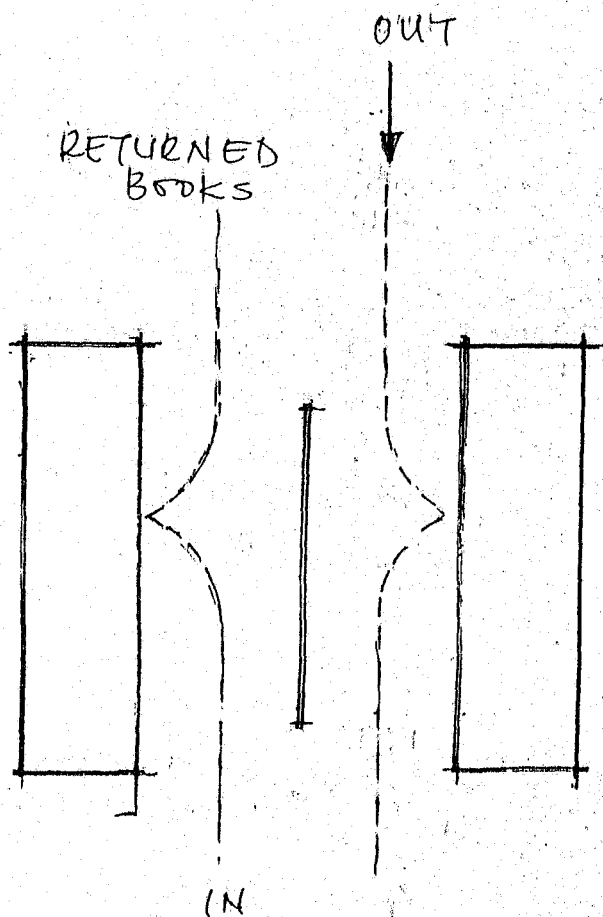
Source: archidata

Fig.7.1 Types of control area

Source: Archidata



ISLAND CONTROL; 1 STAFF AT OFF PEAK



LARGE LIBRARY CAN ADJOIN OTHER WORK AREA - MIN 2 STAFF AT ALL TIMES

Book type	Shelf depth (m)
Children book	0.2-0.3
Fiction, literature, history, politics, economic, law	0.2
Scientific, medical technical	0.3

Table 7.2: shelf depth

Source: archidata

- **Width:** of shelf unit generally 0.9m
- **Main routes:** in open access area 180m clear width, and minor routes 1.20m.

g. **Book stacks:** optimum length of shelving 6 units (5400mm) to maximum 8 units (7200mm) but 4 units (3600mm) where accessible only from one end.

Centre of islands where open stack are 1280-1520mm (gives about 164 vol/m²), and where closed stack centres are 1060-1280 (gives m200-215 vol/m²). The choice between these limits depends on selection of shelf depths and aisles width.

Derivation from stack centre figures will give choice of economic structural grid dimension at centre 5400, 6000, 6850, 7310, 7620, 7710 and 8350. Subdivision of these figures will relate windows, roof lights, fixed elements, ventilation and lighting. Optimum column sizes should be contained within 450x450 less finishes and tolerances, clear ceiling height approximately 2400. (Dimensions in mm), (source archidata).

h. **Reading and study:** the basic aim in the arrangement and design of seat in reading area is to give sufficient privacy for mental concentration (to students), yet open enough to allow to know if the space is occupied or not misused. Standard seat accommodation is a worktable of 900x600/ reader who should sit facing low screen possibly with built in light. Student should have 2.32m², which includes circulation space, screened on 3 sides (open carrel); research worker 3.00m² or more screened on 4 sides (enclose carrel). In university libraries either large reading room separated from books stacks are

used or more commonly reading areas round perimeter of stack areas, with further seating within stacks are used.

i. Work areas:

- a. Unpacking and despatch, accessions and cataloguing, binding and repairs, photocopy and typing
- b. Offices
- c. Staffs rest room, lockers, and lavatories

j. Ancillaries:

- d. Study room for reference materials
- e. Typing and photocopy room
- f. Projection for slides, cine film, microfilm
- g. Exhibition space, chair storage, room for grouping meeting
- h. Telephones
- i. Lavatories
- j. Internet online.

(Source archidata)

k. Flexibility: the larger the library the greater the need for the need for freedom and future change with inter changeability of major stack areas, reading areas, staff area. Fixed elements should be grouped. Best if floors can carry stack loading anywhere.

l. Floor areas: both the number of floor in a library and the area of each floor may be important functionally and aesthetically. Decision in regard to them may properly be influenced by the site surroundings, the slope of the ground, and the value of the property, see table 7.3.

Grown building area in sq ft	Size of collection in volumes	Minimum percentage of gross area on central services level.
Under 20,000	Under 100,000	40-50
20,000-45,000	100,000-250,000	$33^{1/3}$ -40
40,000 – 80,00	210,000 - 500,000	21 – $33^{1/3}$
71,000 – 100,000	500,000 - 1,000 000	20,30
135,000	1,000 000	$16^{2/3}$ – 21

Table 7.3: suggested formulas for percentage of gross square footage functionally desirable on the central service level. (Main control point, circulation and reference service, reference and bibliographical collections, the public catalogue and acquisition and catalogue departments)

Source: Time saver standard of building types

m. **Accommodation for readers:** Seating accommodation for readers and the service to readers are the largest space consumers in most libraries. The required areas depend on:

- i. The number of accommodation required.
- ii. The types of accommodations and the percentage of each.
- iii. Dimension of the working surface for each type of accommodation.
- iv. Average square footage required for each type of accommodation
- v. Additional space required for each service to readers.

Type of institution	Percentage
Superior residential coeducational liberal arts college in rural small town	50-60
Superior residential liberal arts college for men or women in rural area or small town.	45-50
Superior residential liberal arts college in small city	40-41
Superior residential university	31-40
Typical residential university	21-30
Typical commuting university.	20-21

Table 7.4: formulae for percentage of student for whom selecting accommodations are suggested.

Source: Time saver.

7.3 SPACE REQUIREMENT

	m ²
Ground floor	
Entrance (control desk)	165
Exhibition hall	100
Courtyard	96
Newspaper, serials and periodicals	338.8
Internet online and audiovisual	338.8
Catalogues and bibliographies	76.96
Central staircase (2 in nos)	64.4
Escape route (3 staircases, one for each wing)	60.9
Ladies convenience (2, one on each wing)	42.24
Men convenience (2, one for each wing)	42.24
Administration wing	
Binding unit	60
Acquisition despatch and cataloguing	60
Male staff rest room	35.96
Female staff rest room	29.76
Male staff convenience	13.5
Ladies staff convenience	9
Audiovisual unit	62
Staircase	30
Reception	29.76
Waiting area	29.76
Sub total without corridor	1537.72

First floor	m²
Faculty of medicine	
Reading area (photocopy-service desk)	162.5
Stack area (with catalogue place)	133.24
Group study area (2 in nos)	112.85
Men conveniences	42.24
Ladies conveniences	42.24
Escape route	24.78
Staircase (central)	32.2
Faculty of science	
Reading area (photocopy and service desk)	162.34
Stack area (catalogue)	133.24
Group study area (2 in nos)	112.85
Men convenience	42.2
Ladies convenience	42.2
Escape route	24.78
Staircase (central)	32.2
Administration	
Conference room	71
Librarian office	29.76
Secretary	29.76
Public relation officer	29.76
Head cataloguing	29.76

Head acquisition	29.76
Head circulation and personnel officer	35.96
Men conveniences	13.5
Ladies conveniences	9
Staircase	30
Escape route	20.3
Void	96
Sub total without corridor	1537.72

Second floor **m²**

Faculty of human and social science (2 wings)

Reading areas (photocopy and service desk)	325
Stack area (with catalogue)	230.74
Maps unit	62
Group study area (2 in nos)	112.85
Men conveniences (2, one in each wing)	84.48
Escape route (2, one on each wing)	84.8
Staircase (central)	32.2

Faculty of economics and law

Reading area (photocopy, and service desk)	162.5
Stack area (with catalogue)	133.24
Group study area (2 in nos)	112.85
Men conveniences	42.24

Ladies conveniences	42.24
Escape route	24.78
Staircase central	32.2
Void	96
Sub total without corridors	1626.62

Third floor

m²

Graduates and lecturers section

Reading area (photocopy and service desk)	162.34
Stack area (catalogue)	133.24
Men convenience	42.2
Ladies convenience	42.2
Escape route	24.78
Staircase (central)	32.2

Faculty of agronomy and college of education section

Reading area (photocopy, and service desk)	162.5
Stack area (with catalogue)	133.24
Group study area (2 in nos)	112.85
Men conveniences	42.24
Ladies conveniences	42.24
Escape route	24.78
Staircase central	32.2

Reference, rare book vault, government document section

Reading area (photocopy, and service desk)	162.5
Stack area (with catalogue)	133.24
Rare book exhibition vault	112.85
Men conveniences	42.24
Ladies conveniences	42.24
Escape route	24.78
Void	96
Subtotal without corridor	1626.62
Total floor area without corridors	6328.68

7.4 DESIGN CONCEPTS AND PHILOSOPHY

The method used in this design is basically the analogical method; the focal concept is based on an open book. Whenever we talk of a library one of the first image which comes to ones mind is a book open in front of a reader. The three parts of the book that is the two open sides and the central part formed by the hard cover of the book are represented in three wings forming the actual shape of the library. The round shape of the reader s' shoulders seen in background are used to derive the entrance lobby.

The other methods have also found their ways in these designs particularly the iconic method. For harmony between the project and the other building on site, tiles are used to achieve abstract design and face the sides' elevations.

7.5 DESIGN PROPOSAL

This proposal is to satisfy the onset aims and objectives of this thesis. Hence it is to propose a building that will provide comfortable reading places, enough book storage area, enhance in many ways knowledge acquirement for the university community in particular and the general public in general. Therefore the proposal provides the following facilities:

- i. Administration offices
- ii. Reading area.
- iii. Stack area.
- iv. Reference section, rare book vault and government documents.
- v. Exhibition area.
- vi. Library supporting facilities.

All these are gathered in one single unit, which is going to be discussed below. Apart from this two sit-outs are provided on site where people can relax after lengthy hours of work.

7.5.1 SITE PLAN

The proposed site of this project as seen in chapter six is on the main campus of the university and is by the major road serving the university. The site is planned in such a way to limit noisy activities right by the roadsides. So the public parking is located close to it. But a service way is provided which will link the road and the staff parking area, which is placed nearby to staff entrance both for easy access and mainly for service purpose. The potential noise to be generated by this link is to be taken care of by trees.

The building is sited further down on the site at quite some distance from the road and hence reducing the impact of the noise generated there. The longer side of the building is on North-South direction therefore reducing the impact of the sun on the building and enhancing the comfort therein. This position allows the building to successfully take benefit of the different trade winds, and the fact that no neighbouring building is in both wind paths allows the building to be adequately exposed to natural ventilation. The sit-outs are positioned at some distance from the library, but easily accessible, and each is on one side of the main building.

Landscape elements are used for both the beauty of the site and for other specific purposes. Trees are used for sound isolation, sun protection, wind breaking and dust protection; also seats will be provided underneath for outside reading areas. Hard surfaces are used for parking areas and circulation ways.

7.5.2 THE PROPOSED LIBRARY BUILDING

The purpose library building is three-floor storey building with an area of more than 6500 m² with a capacity of 2000 seats and a book storage capacity of over 750,000 volumes. It has a cross shape derived from the concept. This shape allows it to take full advantage of the wind stream and therefore maximize natural ventilation therein. Though mechanical ventilation in the form of single air conditioner unit is proposed to assist in maintaining the temperature comfort in the building, all round the shape a corridor is provided with supporting structure to serve for sun shading device. This structure will help to serve for sun protection and reduce the heat load built up from the glass used in windows and doors. A courtyard is also provided to enhance the ventilation in the building.

Each part of the cross constitutes a wing and a circular entrance is provided. The entrance lobby is quite big and allow for easy circulation. These wings are arranged for the different activities. The sharing of these wings in relation to the different faculties and college of the university is function of the students' strength of these faculties and college. And also the allocation of space is done following a hierarchy of noise sustainable activities. Therefore newspapers, magazines, internet online and audiovisual activities are on the ground floor as they can entertain a certain degree of noise. From the first floor to the second floor reading areas and stack areas for the different faculties are arranged. The last floor host the reference section, rare book vault, government documents section, graduate students and lecturers' research area and the last wing is for faculty reading area.

The administration and supporting facilities section has basically:

- i. Services – binding unit, acquisition despatch and cataloguing unit- staff resting room, audiovisual section, reception and waiting in ground floor.
- ii. Administration offices in first floor and conference room.

Note that the administration section has its one entrance but it is accessible from the other part of the library.

An individual faculty wing is made up stack area and reading area. Provision is made for photocopy machines place - the idea is based on coins self photocopy machines-, catalogue and group study area.

The different floor arrangement is already detailed in space requirement. The vertical circulation is centralized and two staircases are taking care of the library

activities area. The administration has its own. Escape staircases are also provided at the edge of each wing.

The sit-outs are made up of rental shops, conveniences and the real sit-out areas which are covered and where seats can be arranged.

7.6 MATERIALS AND CONSTRUCTION

In any architectural design, the uses of appropriate building material are always an ideal situation, which helps in the construction of the building, and allows an easy and appropriate maintenance in the future.

The architect is therefore expected to make recommendations as well as write specifications, which should comply with the architectural requirements of functionality, aesthetics, economic as well as climatic conditions and all other factors of the site with reference to the materials to be used.

Materials for each element of the structure have to be analysed, from foundation to walls, floors, and roofs and finishing. The durability of the materials should equally be given out most importance as well as their structural capabilities bearing in mind the method and techniques of construction and fixation.

7.6.1 SITE CLEARANCE

This is the preliminary stage of the construction and it involves the removal of grass, scrub, trees that are not wanted and also the removal of matter of topsoil to reduced level from vegetative.

7.6.2 FOUNDATION

The foundation is the base of an erection of a building. It is the part of the building in the subsoil to which it transmit the loads (life, dead and imposed) received from, the other component of the building. It should be properly designed in relation to the loads to be transmitted and the nature of subsoil. Different types of foundation exist among which strip foundation, which is used in this project due to the adequate resistance of the bearing soil.

The materials to be use include Portland cement, sand, gravels and reinforcement, which are mixed together for reinforce concrete. Damp proof materials shall also be recommended.

7.6.3 FLOOR

The floor of a structure is the lowest horizontal space in a room on which all the walls are raised. It usually consists of load bearing elements such as slab girders, beam and space enclosing members. The floors of the library building consist of reinforced concrete floor slabs. The reading area and circulation area shall be finished with carpet.

7.6.4 WALLS

Walls are vertical elements, though some could be slanting depending on function and aesthetics. They could be load bearing or non-load bearing. They are used to enclose and divide space in buildings. They could be concrete walls, bricks and curtain walls. In this project all walls are non-structural as the construction is based on frame

construction that is column and beams. The interior side of the walls are finished with quiet paint colours.

7.6.5 CEILINGS

They are the top horizontal surfaces seen in a room. They are made up of different materials and in different ways. In this design the concrete slab of the upper floors form the ceilings of the down one but they will be treated with sound absorbent materials.

7.6.6 ROOFS

They protect the building from the elements of weather (rain, sun and wind) they are made up of trusses and roof covering. In this project steel trusses are used because of the long spans to be covered and also to resist wind effect. Long aluminium roofing sheets are used for covering.

Walkways and toilets area are covered with concrete. They serve for collecting rainwater and conveyed them to gutter. Roof gutters apart from draining rainwater also serve for roof protection against strong wind. They also play the role of sun-shading devices.

7.6.7 WINDOWS

Traditionally the window was considered an opening or the wall. With the increasing use of glass, however, window now often form the entire wall. Most metal window manufacturers now offer complete curtain wall system.

Window or window wall perform several distinct functions out of which:

- i. Admission of light in the interior
- ii. Provision of natural ventilation
- iii. Permit vision in or out of the building.
- iv. Serve sometimes as an emergency escape route.

Windows are elements of architectural composition and are extremely important in the total aesthetic effect created by a building. In this design windows are playing an important role of ventilation; they are placed in such a way that cross ventilation can easily be achieved in the reading and stack areas of the library.

7.6.8 DOORS

Doors provide entranceways in buildings; they are also used for the escape routes. Different types of doors exist and their size depends on the traffics to be handled. They are:

- i. Single swing door (for offices, store, lavatories)
- ii. Revolving doors (double type use for entrance and corridors escape routes)
- iii. Sliding doors
- iv. Industrial types of doors

CHAPTER EIGHT

BUILDING SERVICES

Services are provided in a building for the convenience and comfort of the users, they therefore help for the effective use of the building space. They also enhance the safety in building. These services are electricity, water supply, telecommunication, drainage and sewage disposal, refuse disposal fire safety and maintenance. Note that, for the fact of this project site being on the university s' domain, all this service facilities are within easy reach as they are already available.

8.1 LIGHTING

Lighting in library is generally done with fluorescent tubes particularly in the reading area but additional tungsten lighting to indicate changes of function or environment is used and it adds sparkles and interest. Emergency lighting is also required in the escape route. Natural lighting is also achieved through the atrium and the windows, which are large enough. Note that the light in the reading areas differs with that of the other areas, See table 7.4.

Area	Lighting
Control/enquiry.	600
Reading table (lending)	400
Reading table (reference)	600
Book stack vertical surface	100
Cataloguing and work room	400

Table 7.4 artificial lighting in lux

Source: Archidata

8.2 AIR CONDITIONING

Because the thermal comfort in the library is of optimum importance, air conditioners should be provided so as to maintain a constant stable temperature and enhance the natural ventilation. Single unit air conditioners are recommended for this project. This should not be regarded as over designing for ventilation as provision has been made for enough natural ventilation, because at certain period of the year the natural air is so hot that in itself it will be discomfort for buildings users (see temperature table in chapter five), this is where the air conditioning system will be effective. Sun shading devices have been provided to avoid direct entry of sunlight and minimize solar heat gain in the building.

Note also that it is not only for people that the air conditioning is necessary but even for rare and valuable collection. And also that in dry season Niamey weather is too hot see chapter five.

8.3 TELECOMMUNICATION

Telephone lines are needed in the library building both for the normal communication and security telephone outfit and also for the internet on line connection purpose. The library must have an independent server that will allow internet service to be effectively run. It is necessary at this point to inform that an internet system is already on campus as a "virtual university" is available and it provides internet services, therefore erecting internet services in the library won't be a hard task.

8.4 WATER SUPPLY, WASTE WATER DRAINAGE

As said early due to the location of the site, water supply and wastewater drainage is already available; the library building is just to be connected to the existing network. A duct system is provided in the design where pipes for water supply and wastewater and rainwater will be drained. The conveniences are on the edges of the wings and will allow easy maintenance work.

8.5 FIRE SAFETY

Fire safety involves fire prevention and means of fighting fire. As fire prevention, the majority of materials used in the library building are fire resistant material such as the steel shelf; the building is basically of concrete and steel. The atrium with its skylight roof may serve as fire explosion vent. In case of fire outbreak sprinklers have been provided in the work areas and carbon dioxide extinguishers in the stack and reading area, because water may spoil the books, which are valuable items. Escape routes are provided for each wing for the safety of the people in the building.

8.6 ACOUSTICS

All the reading areas need quietness, and to achieve this quietness, the circulation in the building is centralised, the real reading areas for the faculties are located at the high floors and carpet is specified for the floor finish so as to reduce circulation noise. The building on site is located at some distance from the road so that it will be less exposed to the noise produce there and trees are planted to control the noise generated there.

8.7 SECURITY

The security on this site will be subject of the security network of the university. The site won't be fenced as an easy and direct access is required but public and staff parking is provided where users can park their vehicles. The internal security will be the privilege of library staff and they will be helped with the provision of security camera system and other electronic devices. A security room is provided for security staff and for monitoring.

GENERAL APPRAISALS

Functionality should not be the only criteria of building design, but rather the combination of aesthetic and utility. A beautiful building, with a pleasant environment is surely a convenient place for the intending activity to be performed therein. It is often said that a library, which offers good services, is highly used. Therefore it is an open challenge for modern architects to combine or rather integrate aesthetic in utility.

This is what has been tried in this project bearing in mind not only this condition, but also the necessity for having this project in harmony with its surrounding environment. Thus architectural features of the area are integrated in this design.

RECOMMENDATIONS

The main essence of a library in a university is for it to be used extensively. But the architectural design alone can not guarantee such attendance therefore some other points need to be considered, they are:

- i. The quality of the students' body and faculty; the higher the quality, the greater the library use.
- ii. The library facilities provided; the more satisfactory the seating accommodations and the services provided, the greater the use.
- iii. The quality of the collection; superior collection increase use.
- iv. The emphasis placed by the faculty on the library and non-textbook reading.
- v. The institution policy in regard to use by persons other than those connected with it.
- vi. The percentage of graduate students and the field in which they work.

Therefore it is not only the building provision, which matters but also the furnishing both, seats wise, books collection, and other library services provided.

Another point of concern is the African mentality of non-maintenance that makes valuable project to be left to decay. It is necessary that proper maintenance be carried out from time to time to maintain the building in its best shape and allow it to continue carrying its function effectively.

It will be interesting if the site of the library is fully exploited by providing outside reading areas arranged following some landscape rules. But the point of concern here is that observation has shown sign of non existence of landscape or is it of improper care of landscape elements, in fact the actual campus looks so barren green and walkways wise.

CONCLUSION

In this era of globalisation, a university institution needs to be effectively equipped to be part of the technology development evolution and render its traditional services of knowledge provider in a successful way. This will go a long way in the contribution of the university in housing country development, as up to date graduate will be produced. So one of the instruments of this achievement will be a standard modern library. With the new development in the library system this will be like a door for the university on the outside world, it will keep the mother institution at pace with the world in all the new developments in all the fields of study. So the importance of a library in the university system cannot be overemphasised. This thesis work was on a university library. The main of the design was to produce a modern library with

provision for all the development in library system. The comfort of users was also a great concern in all the ways, such as provision for enough reading spaces, enough book storage areas, provision for facilities for the supporting services of the library and adequate ventilation and lighting provision.

The design worked with the real situation on ground so the student strength was used in determined the necessary space requirements, and the design was done in such a way it can be in harmony withy the other existing facilities on campus.

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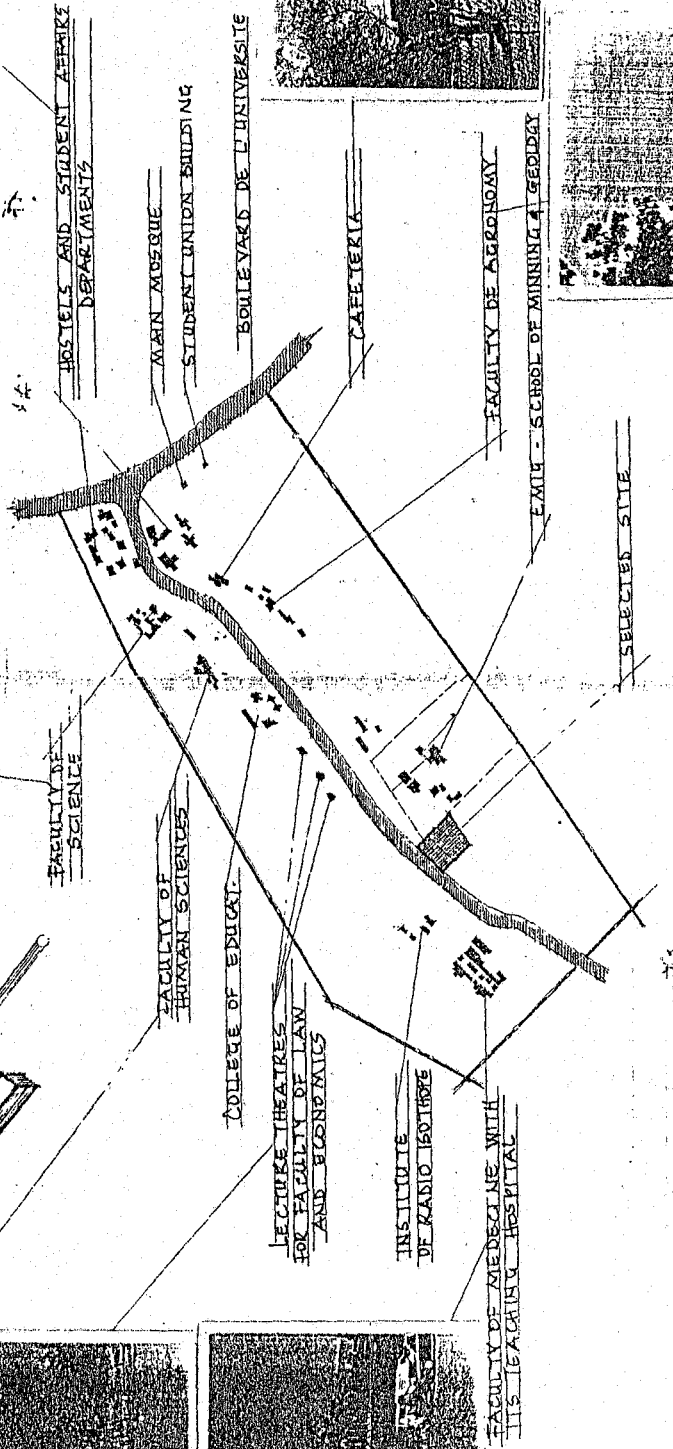
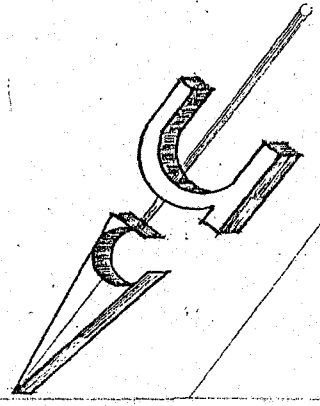
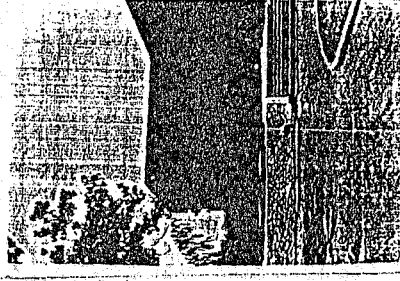
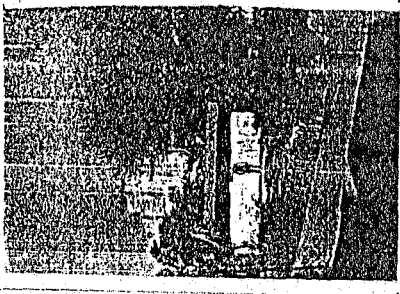
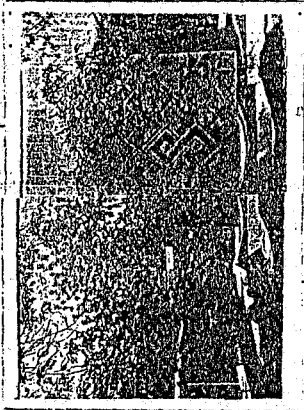
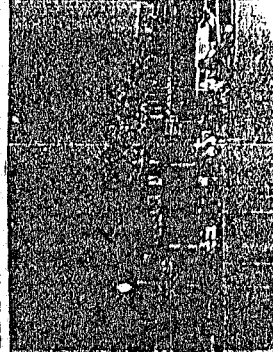
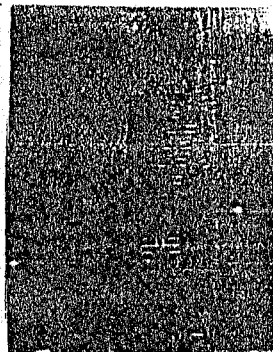
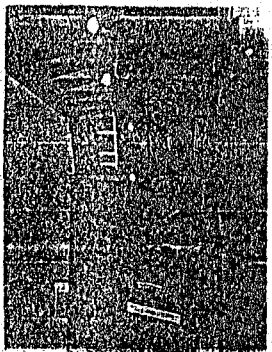
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APPENDICES

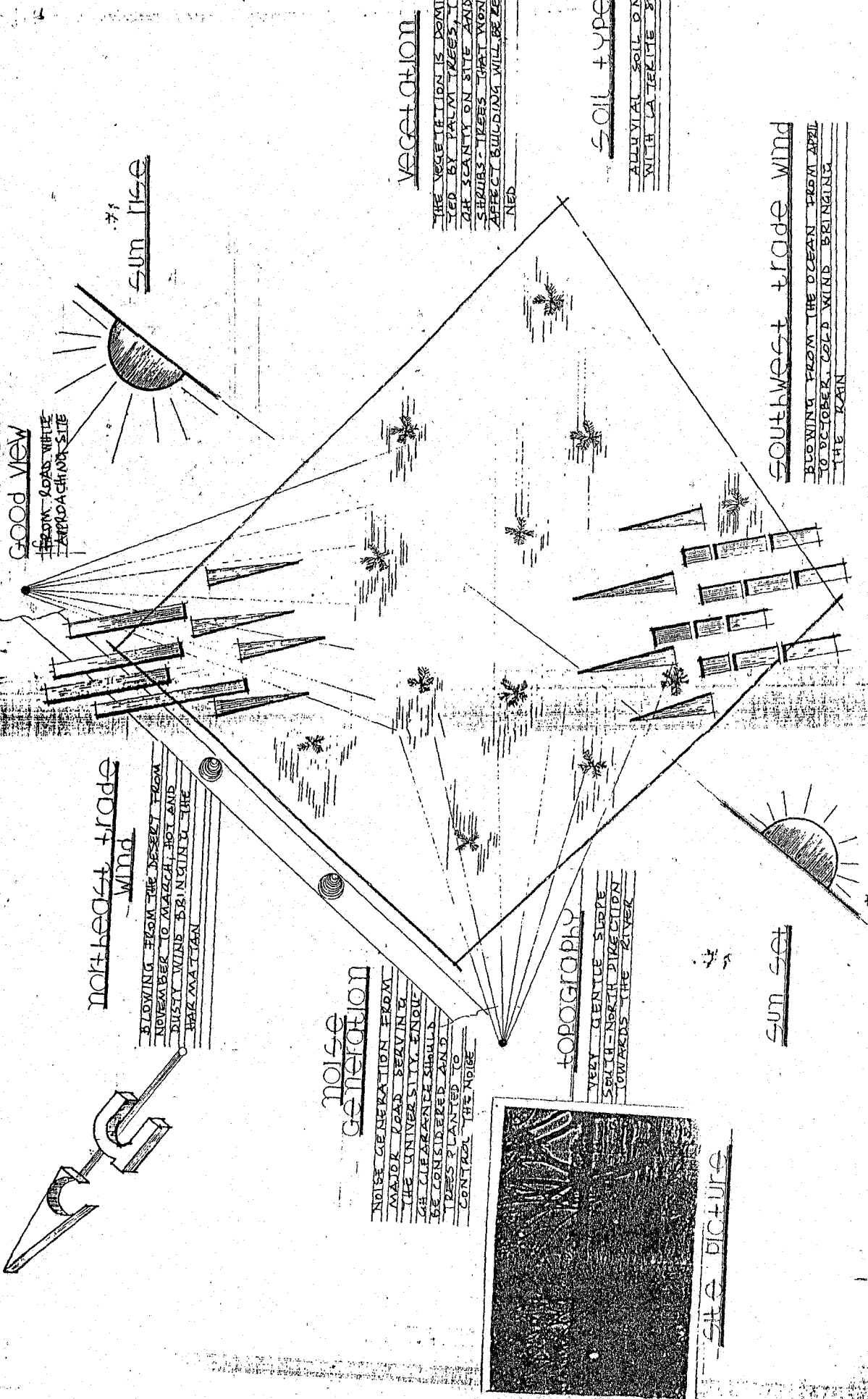
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SITE LOCATION



UNIVERSITY main campus site

Design proposal for Bibliothèque Universitaire



GOOD VIEW
FROM ROAD WHILE
APPROACHING SITE

SUN RISE

SOUTH WEST TRADE WIND

BLOWING FROM THE DESERT FROM
NOVEMBER TO MARCH, HOT AND
DUSTY WIND BRINGING THE
HARMATIAN

noise generation

NOISE GENERATION FROM
MAJOR ROAD SERVING
THE UNIVERSITY. ENOUGH
OR CLEARANCE SHOULD
BE CONSIDERED AND
TREES PLANTED TO
CONTROL THE NOISE

TOPOGRAPHY

VERY GENTLE SLOPE
SOUTH-NORTH DIRECTION
TOWARDS THE RIVER

SUN SET

VEGETATION

THE VEGETATION IS DOMI-
NATED BY PALM TREES, I-
OR SCANTY ON SITE AND
SHRUBS. TREES THAT WON
AFFECT BUILDING WILL BE
NEEDED

SOIL TYPE

ALLUVIAL SOIL ON
WITH LA TERTIARY

SOUTHWEST TRADE WIND

BLOWING FROM THE OCEAN FROM APRIL
TO OCTOBER. COOL WIND BRINGING
THE RAIN

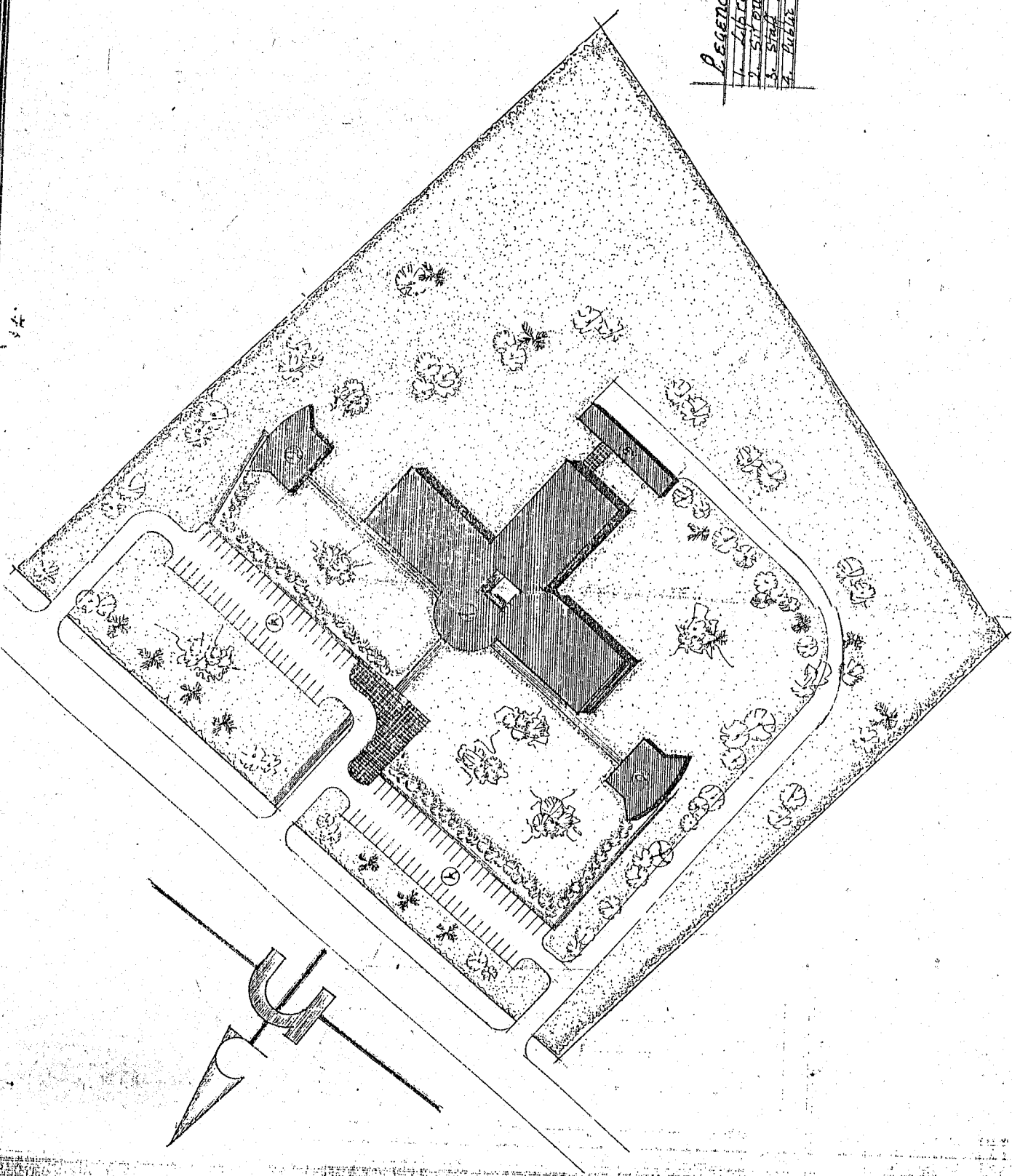


SITE PICTURE

Design proposal for **Bibliothèque Universitaire Abdou Moumouni**
Niger
Niger

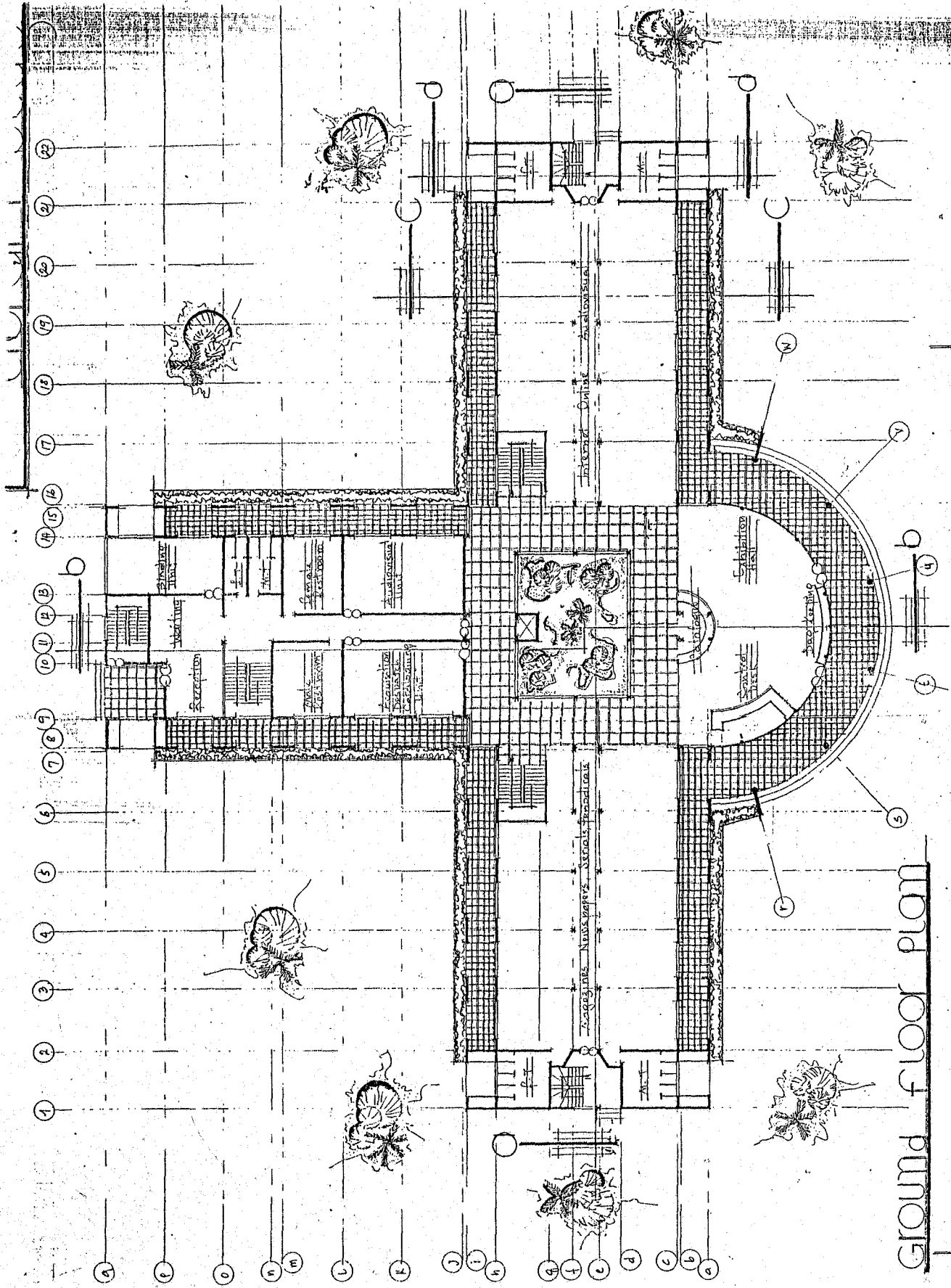
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Reg No	M: 2001/02/01/001/01	Scale	
Dept	Architecture	Supervisor	A

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- Legend*
- 1. Library Building
 - 2. Site
 - 3. Staff Parking
 - 4. Public Parking

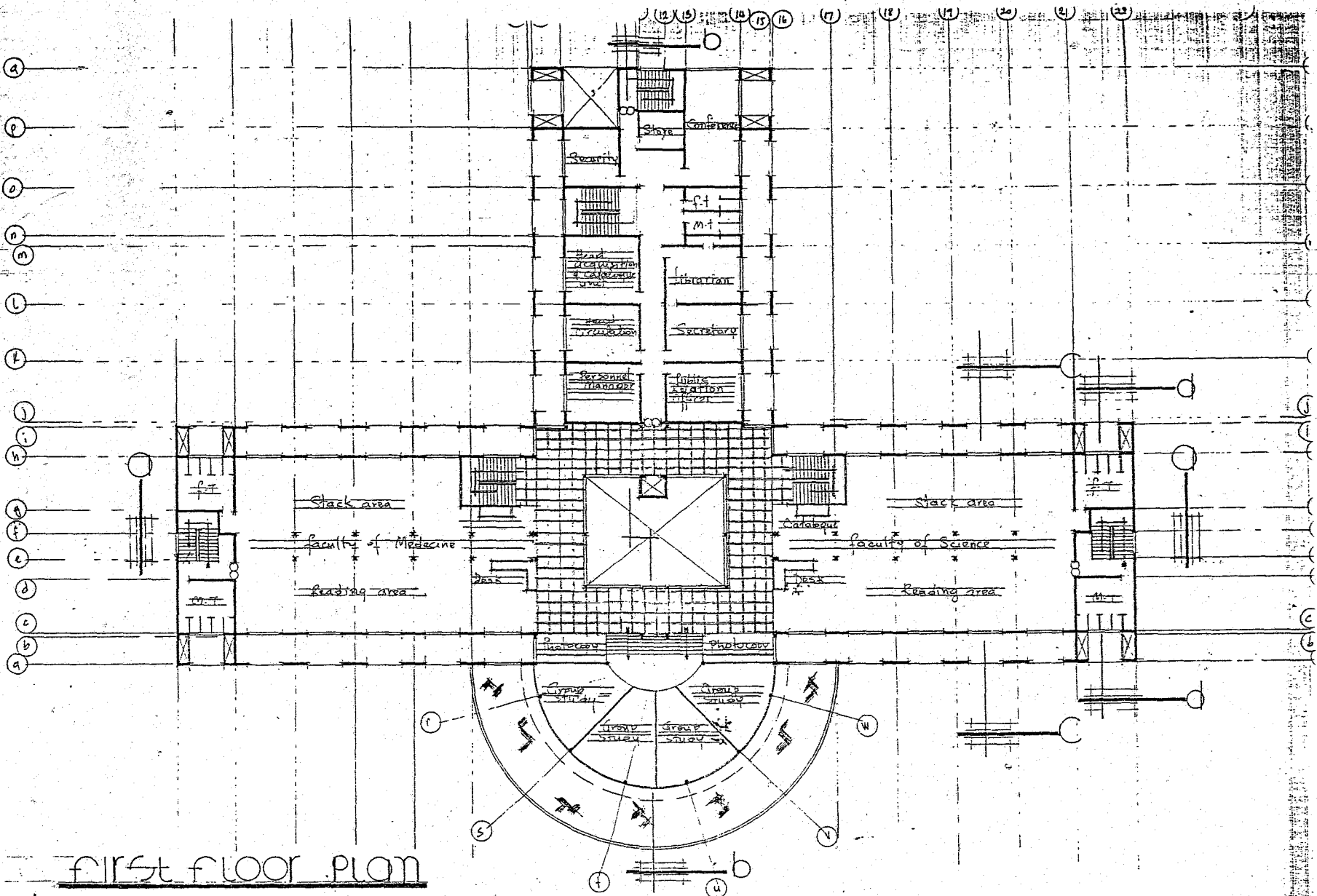
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GROUND FLOOR PLAN

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 Niamey, Niger Republic.

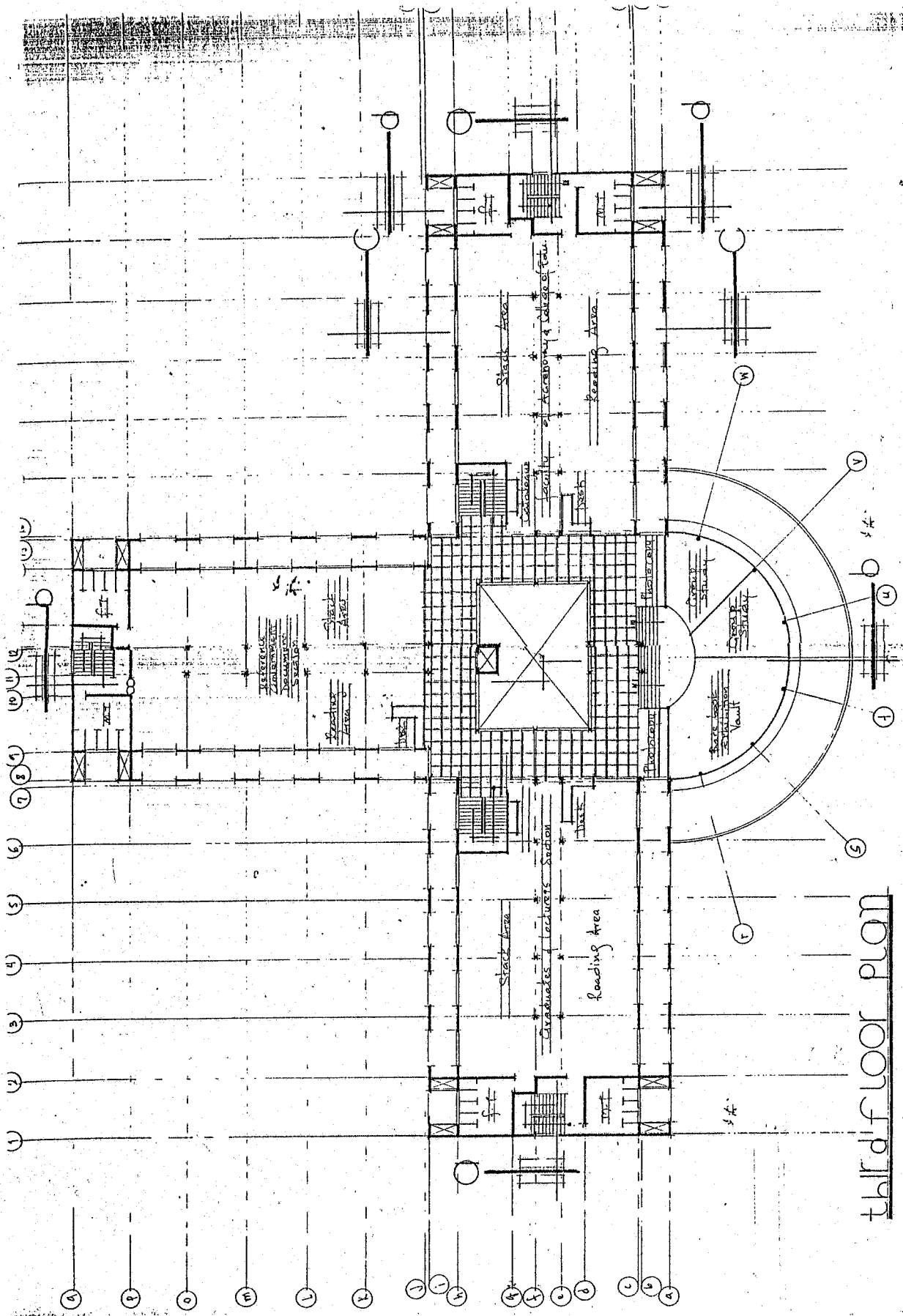
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Reg N°	AT-TECH/SET/010/01/02	Scale	
Dept	Architecture	System	



FIRST FLOOR PLAN

Design proposal for Bibliothèque Universitaire Abdou Moumouni
 Niamey, Niger Republic,
 with emphasis on ventilation in library

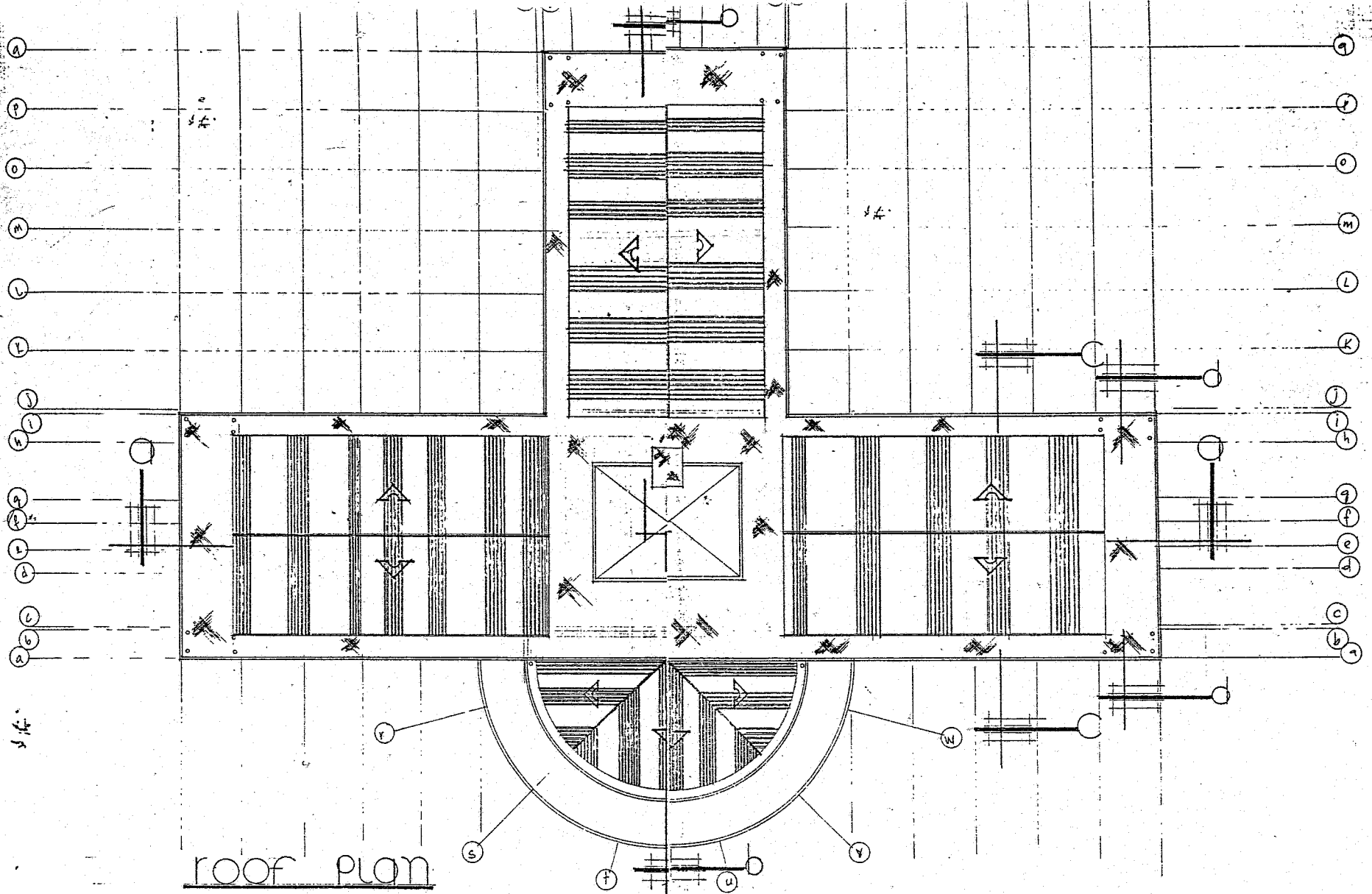
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3rd FLOOR PLAN

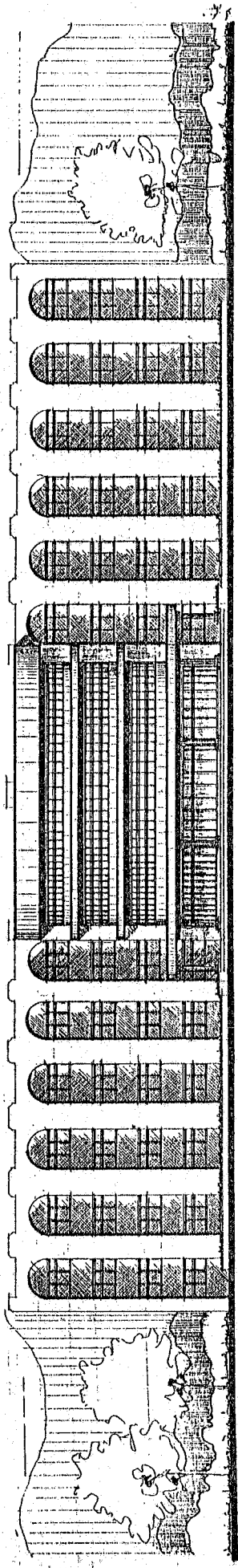
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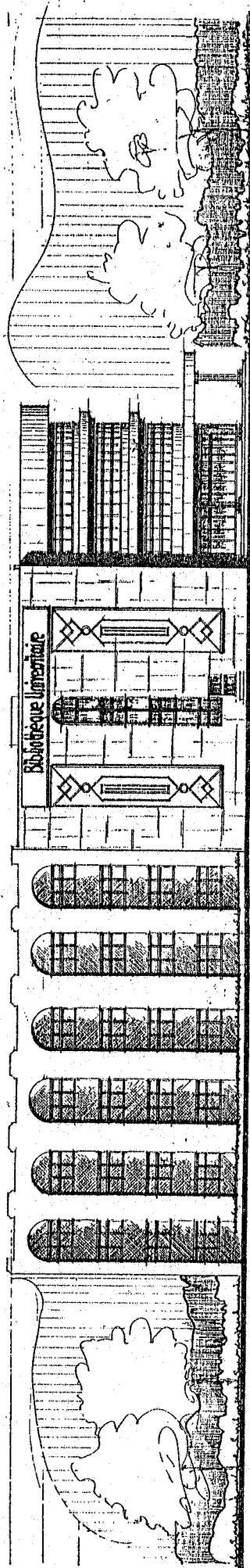


Design proposal for Bibliothèque Universitaire Abdou Moumouni
 Niamey, Niger Republic,
 with emphasis on ventilation in library building

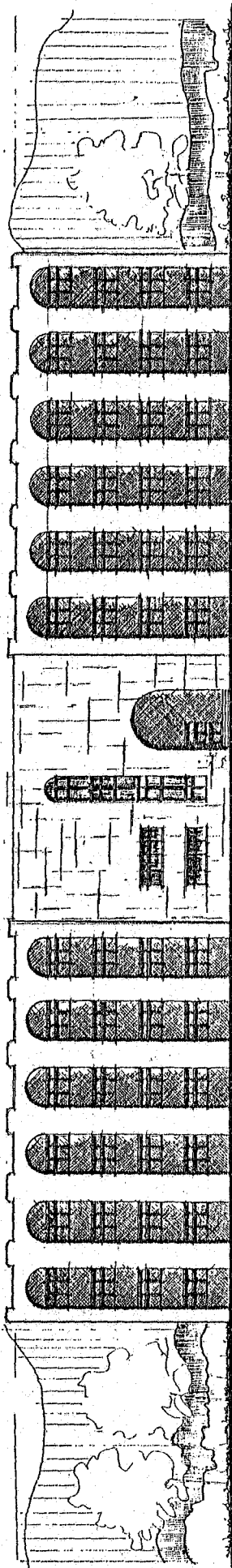
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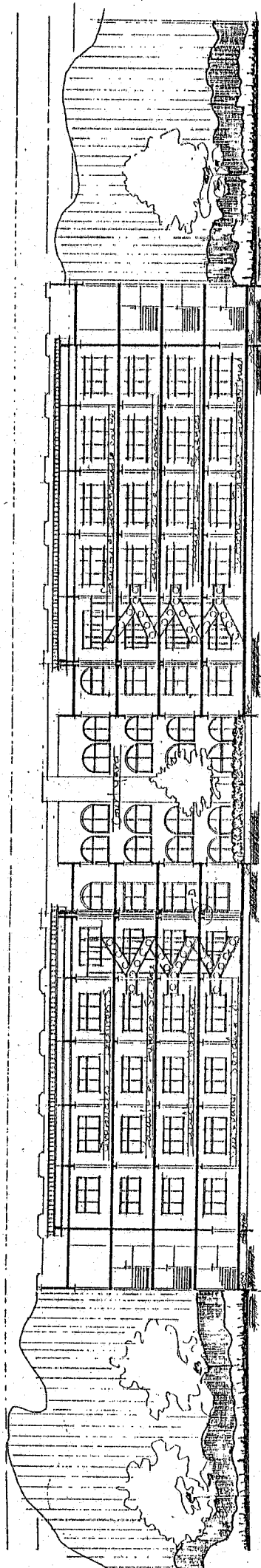
front view



Left Side View

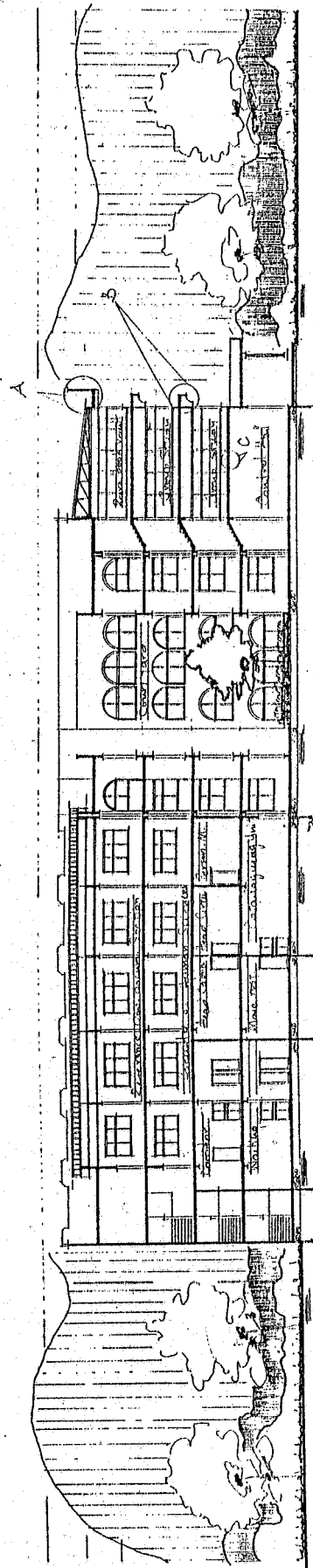


REAR VIEW



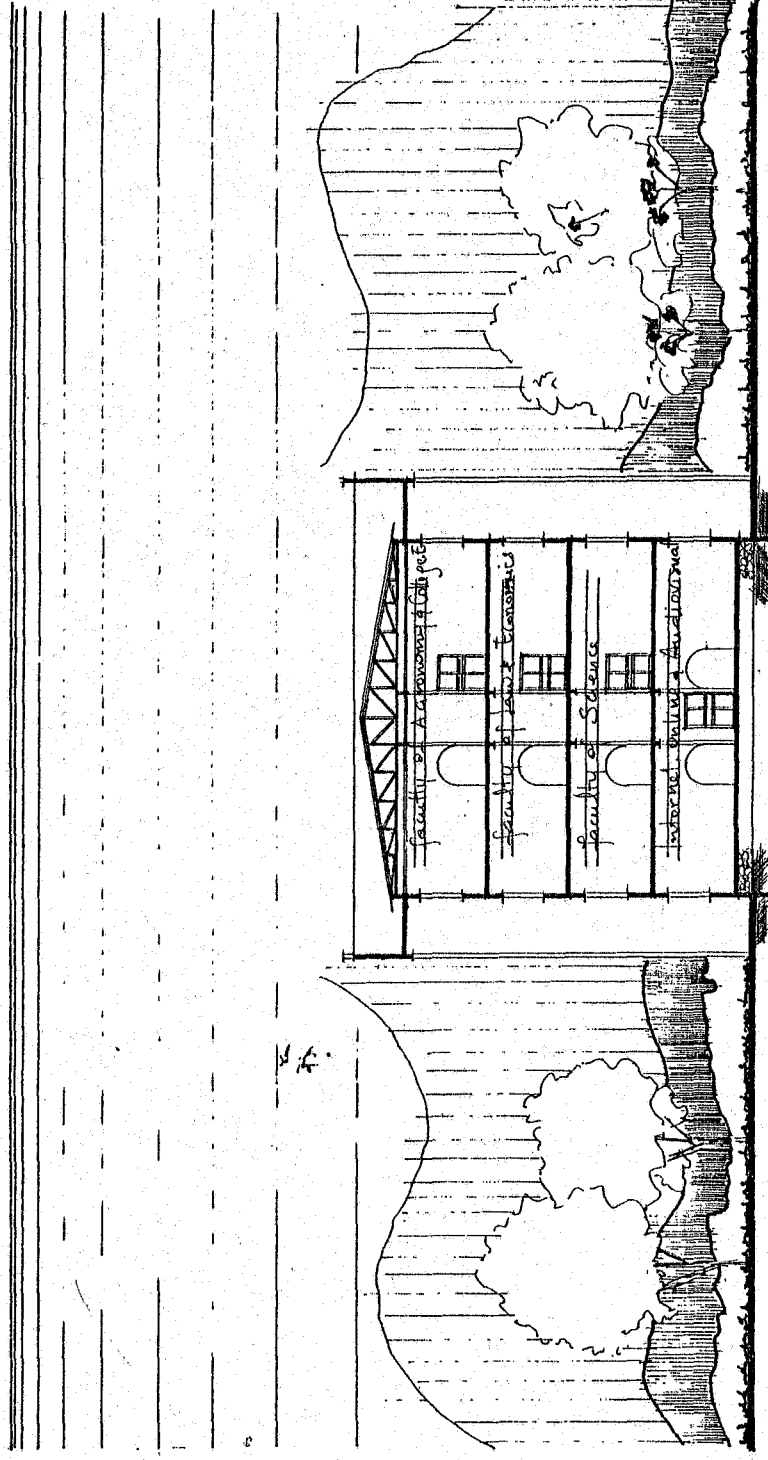
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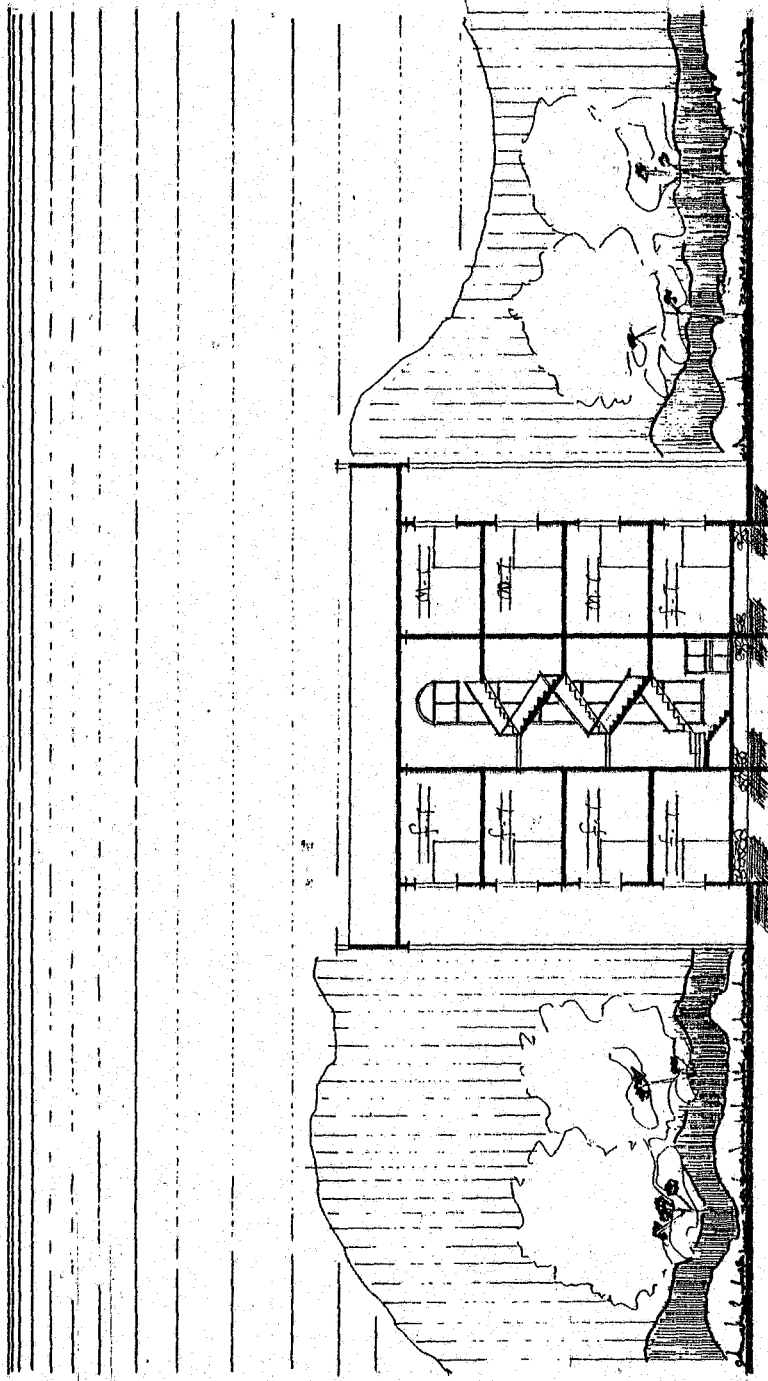
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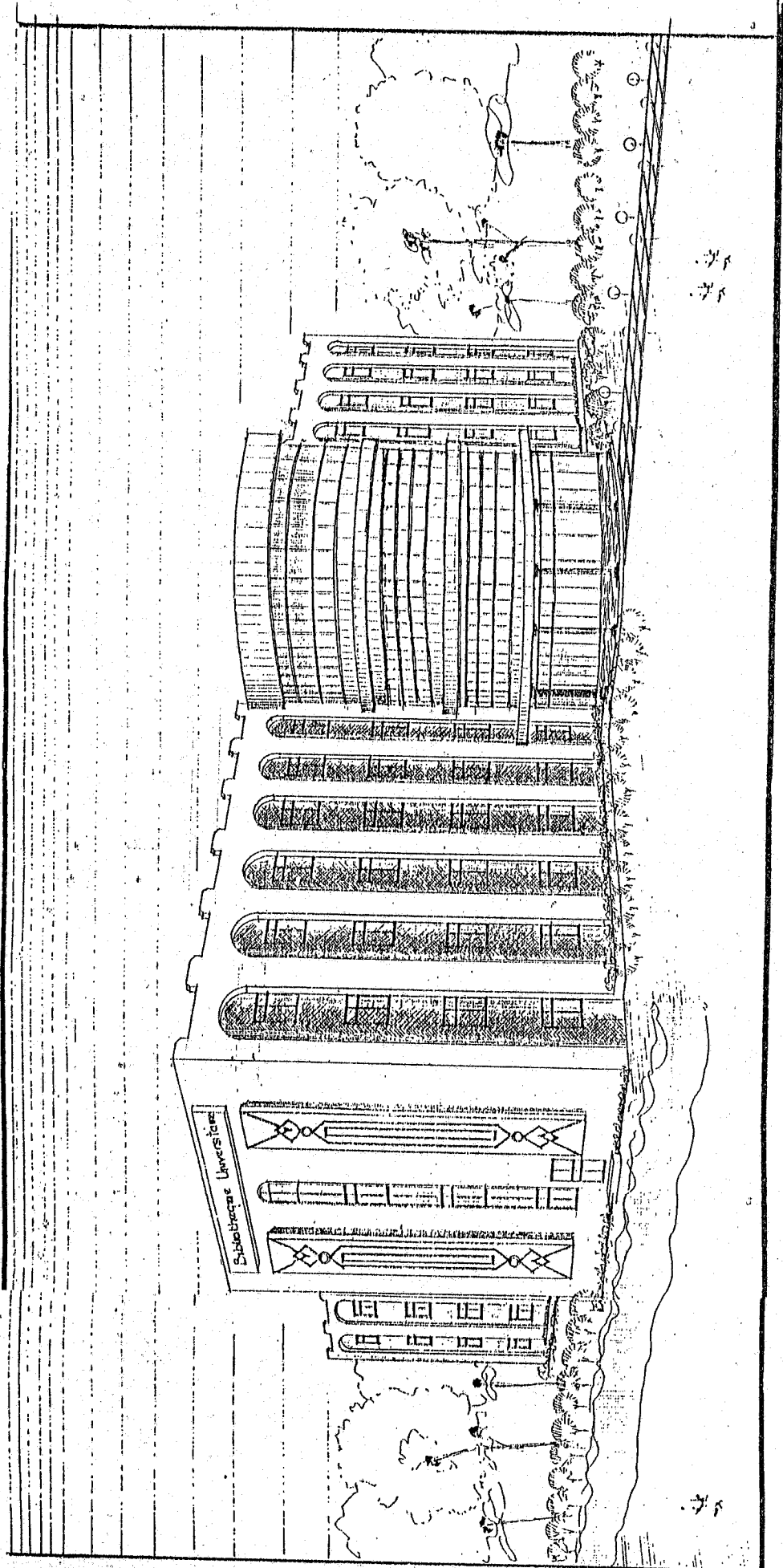
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SECTION dd



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