DESIGN PROPOSAL FOR NIGER DELTA DEVELOPMENT COMMISSION HEADQUARTERS IN PORT-HARCOURT, WITH EMPHASIS ON WATER CONTROL IN BUILDINGS.

BY

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SUBMITTED TO THE DEPARTMENT OF ARCHITECTURE SCHOOL OF POST-GRADUATE STUDIES, FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA, IN PARTIAL FULFILLMENT FOR THE AWARD OF M.TECH DEGREE IN ARCHITECTURE.

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CERTIFICATION

This thesis titled **DESIGN PROPOSAL FOR NIGER DELTA DEVELOPMENT COMMISSION HEADQUARTERS IN PORT HARCOURT WITH EMPHASIS ON WATER CONTROL IN BUILDINGS** by *EKWEGHARIRI L. CHUKWUEMEKA,* meets the regulation governing the award of the degree of Master Of Technology in Architecture of Federal University of Technology, Minna, and is approved by the Senate of the University for its contribution to knowledge and literary presentation.

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DECLARATION

I EKWEGHARIRI LASBREY CHUKWUEMEKA hereby declare that this thesis titled design proposal for Niger Delta Development Commission Headquarters in Port Harcourt with emphasis on water control in building, is a product of meticulous research work which has no bearing to any work carried out by any person or group of persons that had been presented and accepted for higher degree

EKWEGHARIRI L.C.
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DEDICATION

To all those who have struggled

For better living conditions

In the Niger Delta

To my family,

For their undying support

To my friends,

For their futuristic thought

Their hard work and

Understanding

To my enemies,

Because sometimes

They make me

Doggedly pursue

Success

ACKNOWLEDGMENT

With utmost sincerity of appreciation, I do say a hearty thanks to the unseen hands with the greatest impact in the success of this project. God, your grace has really been sufficient.

To my friends, your encouragement still baffles me. It will be an unforgivable thing to do, not to say thank you, unconditional friends.

To all those that I came across in the course of this project who really gave one assistance or the other. I pray that the good God will richly be helpful to you in time of need.

To my family, the Ekweghairis and the Ihemes, every day I do not cease to acknowledge the daily roles you played, you are playing and you will still play.

To my enemies because I know some of them did help facilitate the accomplishment of this feat. You will wonder why call them enemies. I call them enemies because they are thought to be friends because they hide under umbrella of friendship to perpetrate evil that can run a man down.

ABSTRACT

Quest is one thing, finding what have motivated this quest is another. The people of Niger Delta and her well-wishers have sought and found this development commission. This came to reality following the repeal of the Oil Mineral Producing Areas Commission decree 1998, and among other things, establishment of a new commission with a reorganized management and administrative structure

It has been well-articulated research on the Niger Delta with a desire to providing a unique structure to facilitate the high performance of the commission. The structures special research consideration has been devoted to control of water in buildings

The research methods used have been analytic and descriptive. This informed the carrying out of case studies and consultation of books and people. Knowledge acquired from this research have facilitated a better approach to the design

The design proper was built up based on the suffering of the people and their doggedness to succeed. The approach view of the complex have been conceptualized to reflect the sufferings of the people. Services provided in the complex are such that will hinder rapid deterioration of buildings and enhance efficiency of workers

It is desired that the construction of state offices is also carried out fast for better coordination of activities within the area and serve the purpose of deterring the escalation of man's inhumanity to man.

TABLE OF CONTENTS

CHAPTER THREE

CHAPTER FOUR

CHAPTER FIVE

CHAPTER SIX

CHAPTER SEVEN

CHAPTER EIGHT

CHAPTER NINE

CHAPTER ONE

1.0 INTRODUCTION

Thoughtfully, the desire to have a reasonable degree of compensation for the oil rich Niger Delta region of Nigeria has been a long struggle, dating as far back as the discovery of oil in this region. It is saddening that with this generation old struggle, not much has been done to comfort the sober hearts of these people. It has been said, that not much has been done even with the setting up of the Niger Delta Development Commission (NDDC). This expression of fear is not out of place for the people, considering what happened to the Oil Minerals Producing Area Development Commission (OMPADEC) and her predecessors. Those factors that inhibited the success of those ones, will they not also come to play here? So many questions will be asked, but be not dismayed by the trend of events. On the optimistic side, it is believed that with the thoroughness of the committee, which saw to the birth of this body, a lot has been considered to make sure that the failure of its predecessors does not repeat itself.

The choice of this project is born out of the deepest regards for the daily struggle of the oppressed people of the Niger Delta. It is frustrating enough for the thoughtful minds of those who do appreciate what it means to have money in your house and not be able to spend it. The dynamism of corruption must be checked to forge positively ahead. MOSOP (Movement for the Survival of Ogoni People) readily comes to mind. The likes of Ken Saro-Wiwa and the Ogoni 8's struggle, has paid off well.

It is obvious that expectations are high, regarding what the structure will likely look like. Of paramount consideration is the desire to propose a structure with architectural uniqueness and in furtherance, the future needs of the would-be occupants. Also, to be considered is the desire to re-orientate the minds of the people of the Niger Delta.

1.1 AIM AND OBJECTIVES:

AIM: The desire to have a developmental body instituted for the oil rich Niger Delta, is one thing, while the proposal of an efficient office complex is of unique importance. Of paramount importance, in this project, is to make a proposal of a Niger Delta Development Commission Headquarters to be sited in Port Harcourt, Rivers State (popularly called treasure base of the nation.)

OBJECTIVES

1. Provision of basic office facilities to encourage office processes.
2. Reduce to the barest minimum, the difficulties encountered by the people in making their contributions.
3. Creation of a conducive environment for the people-government relationship.
4. Reducing the crisis so rampant in the Niger delta, that leads to numerous deaths everywhere.

1.2 RESEARCH METHODOLOGY

The most basic, popular, and cost effective techniques in architectural research are observation and questioning. These two techniques can be used

in a wide range of studies from rigorous, large-scale experiments to brief exploratory research.

Research in Architectural Practice

In this research work, considerations have been to the major techniques of architectural research and these considerations have been based on:

Human Needs: It is important to note that the ultimate goal of planning and design is the accommodation of human needs. As described by Robert Bechtel; "There is no such thing as the design of space and spaces: behaviour not space is enclosed by architecture. The needs of the would-be users have been thoroughly considered.

Primary Domains

There are primary areas where research is needed to improve architectural design. For example, in this case, what has been considered include ethnic and income mixes, control of water, open general offices and expansion possibilities. All involve the interrelated components of the person-environment system.

Research for design

This involves the search for design concepts, principles, and ideas. A design principle is a research-based guideline. It is a statement of characteristics that the built environment should have in order to respond to the design problems.

Research in design may take the form of building topology studies. This has been given paramount consideration in this work. This involves the systematic collection and generation of prototypical floor plans, basic spatial configuration or images of building type in question. From this, surveying of the hypothesized design options available were carried out.

1.3 SCOPE AND LIMITATIONS OF STUDY

In this project proposal, provision shall be made for:

1. A main office complex (Administrative unit)
2. Restaurant facilities
3. Training institute
4. Library facilities
5. Gate (Security) house
6. Conference centre.

LIMITATIONS

Some difficulties were encountered in the course of carrying out this project. They include:

a. The far distance of site from the base of research processes. It was really difficult and expensive having to go to Port Harcourt, more especially when it is not the home base.

b. Getting current information as regards the research was somewhat expensive because of the lack of current information on that in the libraries close by.

1.4 IMPORTANCE OF STUDY

The struggle for the passage of the act establishing the commission known as the Niger Delta Development Commission by the National Assembly of the Federal Republic of Nigeria will be trivialized if the provision of a headquarters is not proposed fast. The proposal of this headquarters is basically to provide for the day to day running of activities in an office complex that will be structurally stable, aesthetically inviting and environmentally friendly. The fact is appreciated that they are already operating from somewhere, but it will be unwise to delay any further because there is no way it can be said that they are operating comfortably in the presently rented office complex. We in the construction industry do overwhelmingly appreciate the fact that it is most advantageous to own one than to rent one.

It is of great importance to even have something standing as the headquarters building of Niger Delta Development Commission, because the citizens need to be reassured of the authenticity of whatever is on paper.

The need to create an environment for better discussions with the various oil mineral and gas prospecting and producing companies on all matters, has been put into consideration.

To create an environment for better surveillance in order to ascertain measures which are necessary to facilitate the physical development of the area is of great importance.

To execute the developmental works in the area is also of great importance.

CHAPTER TWO

LITERATURE REVIEW

2.0 THE NIGER DELTA

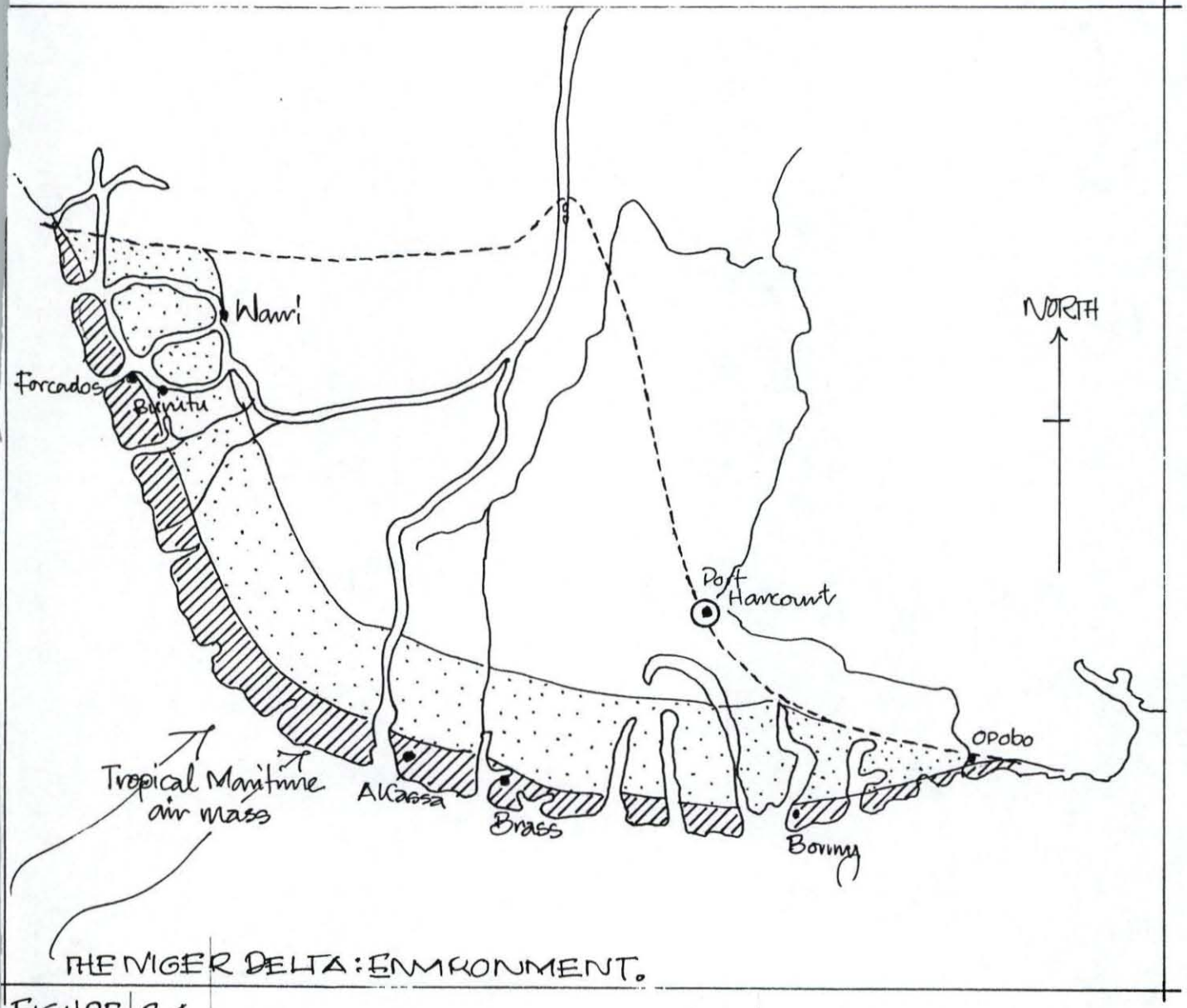
The name Niger Delta is misleading here. It is misleading because it does not really define the area or rather the lands which make up the Niger Delta as described by the House of Assembly in the act establishing the commission. The fundamental constituent lands which make up the Niger Delta can be stated as:

1. The Niger Delta
2. The Eastern Coastal Lowlands
3. The Lower Niger and the Western Coastal Lowlands.

2.1 THE NIGER DELTA AREA

The Niger Delta is a fan-shaped wetland which covers most of Yenagoa, Degema and parts of the Port Harcourt areas of Rivers State, and the Southern part of Delta State. The land area is about 70,000 square kilometers. The maze of intercommunicating channels, which dissect the area, open to the Atlantic by several mouths. These discharge millions of tonnes of sediments annually into the sea.

The physical units stand out clearly in the delta region (see figure 2.1). there is a clearly visible narrow belt of saline beaches, piled up by the sea waves; then an inner belt of saline swamps, underlain by mud and clay and impregnated with brackish water on which mangrove trees grow. Finally, there is an interior, rhomboid-shaped zone of fresh-water swamp where water, transported by the river and spread by its distributaries, nourishes raffia palms and other fresh water plants.



THE NIGER DELTA: ENVIRONMENT.

FIGURE 2.1.

---- Boundary on the Delta region

Fresh water swamp

Salt water swamp

Sandy beaches

→ Winds

The southward bulge of the land, which squarely intercepts the southwest wind, its proximity to the sea, and the constant evaporation from the marshes have combined to make this area the rainiest in Nigeria. Warri has an annual rainfall of 377 centimeters. Rainfall is mainly convectional and frontal. The ecosystem is particularly sensitive to changes in quality, such as salinity or pollution and to changes in hydrology of the region which is determined by the Atlantic Ocean and the flood region of the River Niger.

The People and Their Way of Life

The delta has a fair share of the ethnicity so prevailing in Nigeria. It has been diagnosed that this sub-region is dominated by the Ijaw people and a few Igbos in the north and east, with an inclusive inhabitation by the Urhobo and Itsekiris in the west. They have about 1600 long settled communities. Their mainstay are subsistence farming, fishing, boat-building and net-making.

The best way to view the delta region is by flying over it. A better view of the settlements is gotten, which are few and far between. The fishermen's houses are huddled together at the sides of the creeks, and their boats are moored at the water front. Figure 2.2 shows such houses in detail. On close observation it can be noticed that bamboo, raffia leaves and sticks are the only articles found in the locality with which people can build their houses. They are erected on stilts in order to keep the floor above the level of the water. There is so much water around causing people to shop and visit their friends in canoes! It is obvious that under such conditions, this area can only hold a few people. However, in recent times, with the advent of construction industry know-how and the struggle by the people to have development

around them, economic activities, mostly in the oil industry, have brought significant immigration of people to the area. The population is about seven million. The upland areas, particularly the urban centers are densely populated. The swamps display an array of scattered settlements taking advantage of higher ground. Presently, the oil and gas industry drives the economy of this region and to some extent social activities in the area. Around here, we have some important cities as shown in the figure.

2.1.1. **The Eastern Coastal Lowlands**

Environment

Considering the definition given to the Niger Delta in the Act, this part also belongs to the Niger Delta. Immediately south of the scarplands, lies this area, and it is joined to the lower Niger and Western Coastal Lowlands by the narrow corridor of the Niger Valley. Predominantly, this area of disposition and an almost featureless land slopping gently from about 180 meters as its northern margin to near sea level at the coastal fringes.

From the north, a marked entry is observed, by gradation from the rugged topography found in the scarplands to a gentler surface characteristic of the region. There is an approximate coincidence of transition with the change from the cretaceous sediments of the scarplands to the tertiary sand and clays of the Coastal Lowlands.

Rainfall has averages over 230 centimeters and increases steadily southwards as the coast is approached. Aba has 231 centimeters per annum, Port Harcourt 249 centimeters and Calabar 305 centimeters. Vegetation is denser here than in the scarplands. The most important vegetation here is the palm bush, but fresh-water swamps are found along the watercourses.

The People and their Way of Life

The Igbos, Ibibio, and Efik peoples are the major inhabitants of this area. It is one of the most densely populated parts of Nigeria. Densities of about 250 per square kilometers are usual, and a density of over 400 per square meter is observed in Owerri and other districts.

Rural settlements are closely packed here than in any other parts of Nigeria, and the village continues to be the main unit of settlement. The structural nature of the compounds is basically, the same as elsewhere, but thatch roofing material are been replaced by raffia palm leaves.

Rural Economy

This has great similarity to the other sub-regions. There is a dominance of crop farming and petty trading over every other pursuit. Three particular aspects of the economy are noteworthy.

First, this region is the heartland of oil palm belt. Some out of the many oil mills scattered all over the region have been closed down.

Second, an additional cash crop here is the coconut. They are grown along the obviously sandy coastal strip between Opobo and Calabar.

Third, the population is very dense; the land has been farmed out and thus reduced drastically its production capacity, not even enough for its inhabitants. There is great dependence of food mainly rice and yams from the Cross River Plains and elsewhere.

Figure 2.3 shows a typical farm found in this physical region.

Towns and Industries

Port Harcourt: One of the towns in this area is of considerable commercial and industrial activity. It is the most important in this region, inclusively, it is the capital of Rivers State.

This city's importance is directly related to its development of route center. Its rail, air, road and sea connections with the interior and exterior of the country. The availability of oil wells and its proximity to oil wells as well as its position as a transshipment point and commercial center.

By far the most important industrial undertaking around Port Harcourt is mineral oil and gas. There exists refineries in this part of the region.

Owerri: It is an old government station whose strength and life had been sapped by its offsprings – Aba, Umuahia and Port Harcourt. Previously, they were all under Owerri province. Port Harcourt and later Umuahia provinces were carved out of Owerri.

ABA: This is located at a cross roads and is on a railway line. As a result, has developed gradually into a commercial town with a large market, and many shops and banks. Its industries basically include; soap factories, a brewery, textile factories, tyre treading workshops and drugs factory.

Calabar: It is situated 77 kilometers up the Calabar River. A bridge connects it to Oron.

Calabar was a notorious slave port in the eighteenth century and later the headquarters of the Oil Rivers Protectorate from 1883 – 1906. (Iloeje, 1980) much of its commercial importance was lost to Port Harcourt and its administrative prestige to Enugu. Now it is the capital of Cross River.

It manufactures boats, processes rubber and export palm produce, cocoa, timber and rubber.

Umuahia: Presently the capital of Abia is gradually developing a new industrial outlook with the help of its ceramic industry and Independence Brewery.

Uyo and Ikot Ekpene: Uyo is presently the capital of Akwa Ibom State. Both are centers of craft industries.

Akwette: Located a few kilometers South of Aba, is not really an urban settlement, but it is noteworthy because of it weaves a famous local fabric known throughout Nigeria, popularly known as the Akwette cloth.

2.1.2 The Lower Niger and Western Coastal Lowlands

Environment:

This region lies south of the Plateau of Yoruba land (figure 2.4). it covers the greater part of former Bendel State, rural area of Lagos State and the Southern part of Ondo and Ogun States. Ondo is the Yoruba State in this region which, basically, by definition of the Niger Delta in the House, belongs. The uniformity of sedimentary cover, similarity of high temperatures, high humidity and dense vegetation cover are the bases of the region's unity and geographical personality.

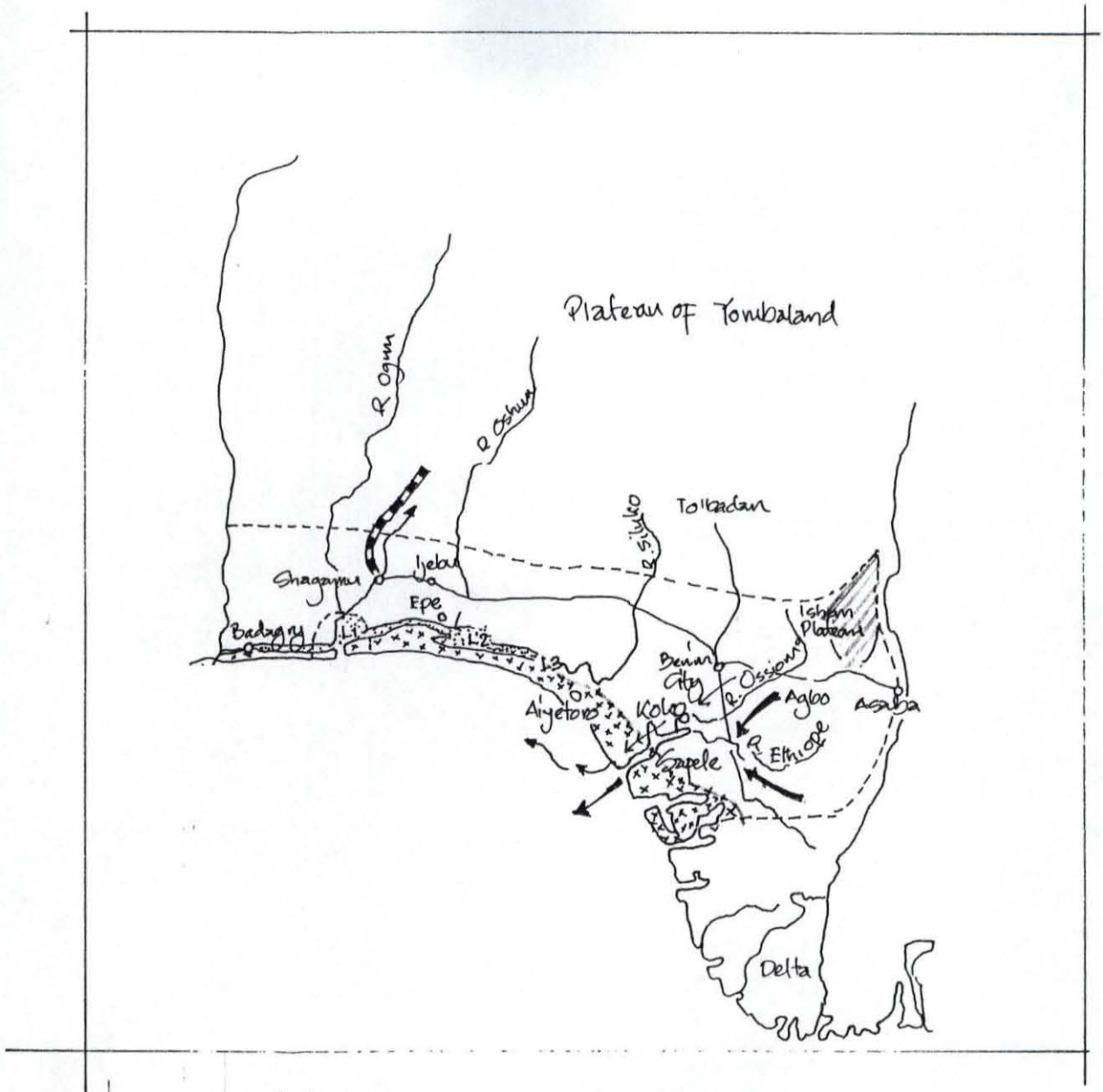


FIGURE 2.4. THE LOWER NIGER AND WESTERN COASTAL LOWLANDS

The relief of this area can be classed into 3 major groups.

1. The low narrow sandy beaches of the coastal margin which are lined with coconut palms.
2. The sheltered Lagoons and Creeks behind which are mangrove swamps, and
3. An extensive area of low flat-dropped sandstone and limestone hills in the interior.

The People and their Way of Life

The western sector of this region is inhabited by Yoruba people. The Urhobo, Itsekiri and Western Igbo peoples live in the eastern part, and the population is fairly evenly spread out.

Figure 2.5 shows a road side settlement located at the Benin road in Edo State. Practically, most settlements face the main road and are lined up by its side. This type of settlement is called an elongated settlement or ribbon development.

The walls of the houses are made reddish brown mud, recent ones are built of concrete. The roofs components are either thatched with a mixture of raffia palm mats and leaves of other trees. Advance in technology introduced the use of galvanized iron (Zinc) or aluminium sheets.

The compound farms or gardens are usually close by and mainly behind the rows of houses. Behind these exist the farmlands and furthest away from the village compound but accessible through the roads are rubber plantations and forestlands.

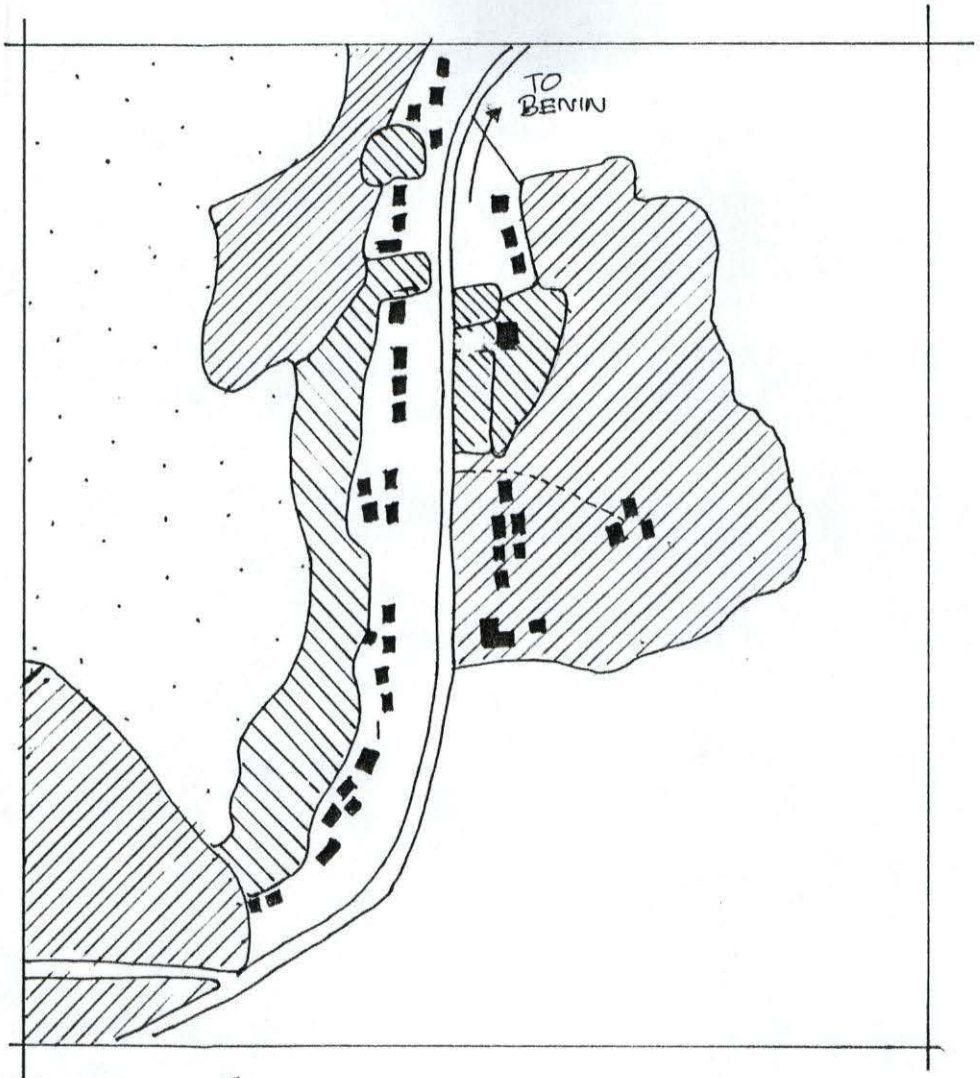


FIGURE 2.5

HOUSES AND COMPOUND

COMPOUND FARMS

FARMLANDS

RUBBER PLANTATIONS

FORESTS

A ROADSIDE SETTLEMENT IN THE BENDEL STATE, NOW EDO STATE ON THE BENIN ROAD.

SEE HOW THE HOUSES ARE LOCATED AT THE SIDES OF THE ROAD. THE FOREST AND FARMS ARE BEHIND THE HOUSES.

Economy

The economy of this region revolves round trees crops production. Tree crops and where they are found are shown in figure 2.6. These include; kola, oil palm and rubber.

Timber has a higher degree of supplies from Benin, Ijebu and Ondo areas. The timber is either exported, sawn in planks or used in the plywood industry.

Coconuts are grown for copra on the sandy beaches. There are plantations around Badagry. The copra is exported, extracted oil from it is being used for making of margarine, while the remaining pulp makes excellent biscuits or cattle food. There is also fishing activities along the coast and in the Lagoons and creeks. The major catches are the saw fish, tarpon and shark. In this region, plantains, yams and cassava are food crops.

Towns and Industries

On a closer study of figure 2.4, it will be observed that the major towns are dispersed along two arteries of communication.

1. The Asaba – Lagos road, opened in 1964, which connects Asaba, Agbor, Benin, Ikene, Sapele, Ode, Shagamu; and
2. The navigable waterway between Sapele and Badagry.

Asaba: Considered as relic port on the Niger, once a headquarters of many government departments, and a Royal Niger Company station. It had retarded growth until recently when it was made the capital of the oil rich Delta, when compared with its counterpart, Onitsha, on the other side of the Niger.

Benin City: Popularly known for its history. It was the capital of Benin Kingdom, which in its heydays stretched from the Republic of Benin in the west to the Niger Delta in the east.

Shagamu: It is the chief kola collecting and evacuating center in Nigeria. The Hausa community here, now over 8000, engage principally in the trade of sales of yams, rice, onions, beans and fish. They settled in Sabo founded in 1942 and located across the Eniwuru stream to the south.

Sapele: Situated on the Benin River. Sapele is synonymous with plywood in Nigeria. It is also a commercial port whose hinterland is the whole of former Bendel State. It is the main timber port of Nigeria. Cocoa, rubber and palm oil are some of its other exports.

Koko: Also an inland port like Sapele, is 80 kilometers from the sea up Benin River. There are sawmills, a flourishing timber trade and bulk oil storage tanks.

Badagry: Obviously a relic of a former prosperous port. It was a famous slave port, and when slavery was abolished most of Badagry's importance was lost. Later, it became a missionary center but Lagos struck it a final blow in a war in 1851, when the city was destroyed by fire.

That was considered the reason its population of 12500 in 1800 fell to only 1000 by 1852. this figure showed a limited revival as a result of the new roads, a new market and new coconut and oil palm plantations which have been introduced to the town.

Aiyetoro: A peculiar town in Ondo State. It was founded by a group of people who styled themselves 'the Holy Apostles' in 1947. They live a communal life and their main occupations are fishing and related industries such as net and boat making.

2.2 THE MINERAL OIL

The mineral oil is believed to be a secretion from dead marine organisms. It collects with gas and water in huge underground basins called fields. The gas stays on top of the oil in an oil field and the oil on top of the water as shown in figure 2.7. These fields are the areas the prospectors go out to look for.

In oil prospecting, many techniques are used. The methods include testing and sampling the underground rocks with complicated instruments. On tracing the oil, a hole, called an oil well, is dug with a drilling rig to reach the level of the oil (figure 2.8). This oil is then pumped out to the surface or allowed to flow up by pressure. A system of valves is put up to control this flow through pipelines into surface tanks. This system of valves is called a 'Christmas tree' (figure 2.9).

The historical landscape of the oil industry in Nigeria has undergone a series of changes since exploration started in 1937.

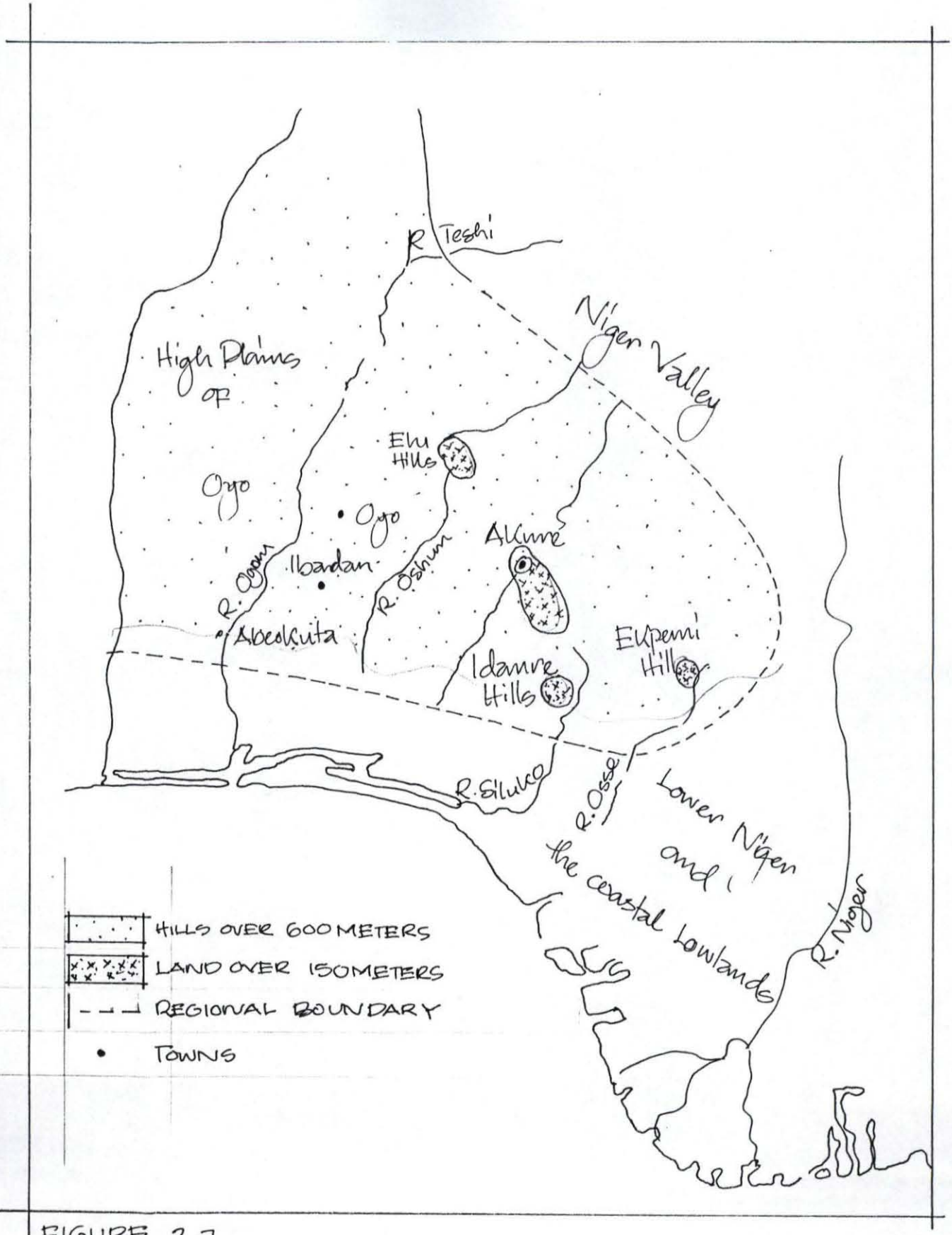


FIGURE 2.7

THE PLATEAU OF YORUBALAND: RELIEF AND DRAINAGE.

SEE HOW THE RIVERS RUN AWAY IN DIFFERENT DIRECTIONS FROM THE PLATEAU

On inception, prospecting started in the coastal lowlands around Owerri in Imo State by Shell British Petroleum Company (then known as Shell D'Arcy). There was a halt caused by the 2nd World War, but prospecting did continue after that. Amazingly, instead of finding oil in the lowlands, it was in the delta area at Oloibiri that the first oil was struck in 1956.

The striking of this oil prompted the movement of Shell's headquarters to Port Harcourt, adjusted the center of its operations to the delta region and there was discovery of field after field in quick succession – Afan, Imo River, Akata, Bornu, Owaza, Egbema, and Ughelli, to mention a few. The 'oil rush' saw the participation of many more companies – Gulf Oil Company, SAFRAP and MOBIL, TEXACO, and others. A refinery was built in Port Harcourt. Export of crude oil was through the Bonny terminal.

The 1967 – 70 civil war, known in so many quarters as the Biafran War, brought about decentralization of operations. As the oil industry in the Eastern Region became exposed to the hazards of war, the oil companies moved to Lagos. Prospecting had to be relocated and it was moved to the then Bendel State and later started on Cross River State. There was also a new birth in April 1971. The Nigeria National Oil Corporation was formed with powers to acquire concessions and prospect for oil.

Recent developments are aimed at increasing the oil refining capacity of the nation, developing chemical industries, and improving the distribution of transport of both crude and refined oil. Also the flaring of gases has been of great concern to the government. The building of Liquefied Natural Gas plant at Bonny estimated at $3.8 billion is also a step in reducing gas flaring.

First, the Nigeria National Oil Company and the Ministry of Petroleum Resources were merged in April 1977 into the Nigerian National Petroleum Corporation with wider power to operate the oil industry in the country. With increasing local demand for petrol and allied products, the 60,000 barrels-per-day Port Harcourt refinery was billed for expansion. A ₦500 million refinery, with a capacity of 100,000 barrels-per-day was built at Warri and commissioned in September 1978. It was built by an Italian State Oil Company but 100% government owned. Another refinery at Kaduna also 100% owned by the Nigerian government, with 100,000 barrel-per-day capacity is been built by a Japanese Company. In addition to local extension of pipelines in the producing areas, a giant pipeline has been constructed from Warri to Kaduna. It is possible that another pipeline will be built from the North to bring crude oil from the Chad and Niger oil fields. The 1976 petrol shortages in the country not only accelerated efforts in the lines mentioned, but led to the commissioning in March 1977 of the construction of 17 super storage depots throughout the country.

Production and reserves also fluctuated over the period 1956 to 2001. From zero before 1956, production rose to 26 million tones in 1966. The Civil War brought it down to less than 8 million tones in 1968. Actually, production stopped in early 1967 and picked up slowly in early 1968. The history of production in the 70s is best observed in Table 1 (figure 2.9). From a level of 50 million tones in 1970, which in itself is a sharp rise from the 1968 level of 8 million tones, it shot up by leaps and in 1974, an increase of over 120%. 1975 showed a slump to 88.4 million tones, but a recovery since then nearly brought production up to the 1974 level for in 1976 a total of 102.7 million tones was produced and in 1977, 105.3 miilion.

2.3 THE ACT

NIGER-DELTA DEVELOPMENT COMMISSION (ESTABLISHMENT, E.T.C) ACT, 2000

ARRANGEMENT OF SECTIONS

2.3.1 Part I – Establishment, e.t.c., The Niger Delta Development Commission And The Governing Board.

1. Establishment of the Niger-Delta Development Commission, e.t.c.
2. Establishment of the Governing Board of the Commission.
3. Tenure of office of the Board members.
4. Rotation of office of Chairman of the Commission.
5. Cessation of membership of the Board, e.t.c.
6. Allowances of members.

2.3.2 Part II – Functions And Powers Of The Commission, E.T.C.

7. Functions and powers of the commission.
8. Powers of the Board.

2.3.3 Part III – Structure of the Commission

9. Establishment of Directorates.
10. Establishment of the Management Committee.
11. Establishment of the Niger – Delta Development Advisory Committee.

2.3.4 Part IV – Staff

12. Appointment of Managing Director, e.t.c.
13. Service in the Commission to be pensionable.

2.3.5 Part V – Financial Provisions

14. Fund of the commission.
15. Expenditure.
16. Gifts to the commission.
17. Powers to borrow.
18. Annual estimates and expenditure.
19. Quarterly report.
20. Annual report.

2.3.6 Part VI – Miscellaneous

21. Establishment of Monitoring Committee.
22. Offices and premises of the Commission.
23. Directives by the President, Commander-in-Chief of the Armed Forces.
24. Limitations of suit against the Commission, e.t.c.
25. Service of documents.
26. Restriction on execution against property of the commission.
27. Indemnity of officers.
28. Repeal of 1998 No. 41, and savings provision, e.t.c.
29. Regulations.
30. Interpretation
31. Citation.

This act being an instrument of law has followed the rudimental format in analyzing this.

This act was provided to repeal the Oil Mineral Producing Areas Commission, Decree 1998, and among other things, establish a new commission with a re-organised management and administrative structure for more effectiveness; and for the use of the sums received from the allocation of the Federation account for tackling ecological problems which arise from the exploration of oil minerals in the Niger-Delta Area and for connected purposes.

2000 ACT, NO. 6

The commencement of the debate was on the 12th July 2000. it was enacted by the National Assembly of the Federal Republic of Nigeria.

2.3.1 Part I: Establishment, e.t.c. of the Niger-Delta Development Commission And The Governing Board

1. There is hereby established a body to be known as Niger-Delta Development Commission (in this Act referred to as "the Commission").
2. The Commission -

a. Shall be a body corporate with perpetual succession and a common seal;

b. May sue and be sued in its corporate name.

3. The Commission shall have its head office in Port Harcourt, Rivers State and shall establish an office in each Member State of the Commission.

1. There is hereby established for the Commission a governing Board (in this Act referred to as "The Board"), which shall consist of –

a. A Chairman

b. One person who shall be an indigene of an oil producing area to represent each of the following State, that is –

i. Abia State;

ii. Akwa Ibom State;

iii. Bayelsa State;

iv. Cross River State;

v. Delta State;

vi. Edo State;

vii. Imo State;

viii. Ondo State;

ix. Rivers State;

c. Three persons to represent non oil mineral producing States provided that such membership should be drawn from the remaining geo-political zones which are not represented in the Commission.

d. One representative of oil producing companies in the Niger- Delta nominated by the oil producing companies;

e. One person to represent the Federal Ministry of Finance;

f. One person to represent the Federal Ministry of Environment;

g. The Managing Director of the Commission; and

h. Two Executive Directors.

2. The Chairman and other members of the Board shall be appointed by the President, Commander-in-Chief of the Armed Forces, subject to the confirmation of the Senate, in consultation with the House of Representatives and

b. Be persons of integrity and ability.

3. The members of the board referred to in paragraphs (1) – (f) of subsection (1) of this section shall be part-time members.

4. The supplementary provisions set out in the schedule to this Act shall effect with respect to the proceedings of the Board and the other matters contained therein.

3.

1. Subject to the provisions of section 4 of this Act, a member of the Board, other than an ex-officio member, shall hold office for a term of 4 years at the first instance and may be reappointed for a further term of 4 years and more.

2. The resignation, of a member of the Board other than ex-officio member may be by notice, in writing under his hand addresses to the President, Commander-in-Chief of the Armed Forces, which resignation shall take effect only upon receipt by the President, Commander-in-Chief of the Armed Forces of the Federal Republic of Nigeria.

4. The office of the Chairman shall rotate amongst the member States of the Commission in alphabetical order.

5. 1. Notwithstanding the provisions of section 3 of this Act, a person shall cease to hold office as a member of the Board if –

a. he becomes bankrupt, suspend payment or compounds with his creditors

b. he is convicted of a felony or any offence involving dishonesty or fraud;

c. he becomes of unsound mind, or incapable of carrying out his duties;

d. he is guilty of serious misconduct in relation to his duties,

e. in the case of a person possessed of professional qualifications, he is disqualified or suspended, other than at his own request, from practicing his profession in any part of the world by an order of a competent authority;

f. he resigns his appointment by a letter addresses to the President, Commander-in-Chief of the Armed Forces;

g. Where a vacancy occurs in the membership of the Board, it shall be filled by the appointment of a successor to hold office for the remainder of the term of office of his predecessor, so however, that the successor shall represent the same interest and shall be appointed by the President, Commander-in-Chief of the Armed Forces subject to the confirmation of the Senate, in consultation with the House of Representatives.

6. There shall be paid to every member of the Board such remunerations, allowances and expenses as the Federal Government may, from time to time, direct.

2.3.1 Part II – Functions and Powers of the Commission e.t.c.

7. 1. The Commission shall –

a. formulate policies and guidelines for the development of the Niger-Delta area;

b. conceive, plan and implement, in accordance with set rules and regulations, projects and programmes for the sustainable development of the Niger-Delta in the field of transportation including roads, jetties and waterways, health, education, employment, industrialization,

agriculture and fisheries, housing and urban development, water supply, electricity and telecommunications;

c. cause the Niger-Delta area to be surveyed in order to ascertain measures which are necessary to promote its physical and socioeconomic development;

d. prepare master plans and schemes designed to promote the physical development of the Niger-Delta area and the estimates of the costs of implementing such master plans and schemes;

e. implement all the measures approved for the development of the Niger-Delta area by the Federal Government and the member States of the Commission;

f. identify factors inhibiting the development of the Niger-Delta area and assist the member States in the formulation of policies to ensure sound and efficient management of the resources of the Niger-Delta area;

g. assess and report on any project being funded or carried out in the Niger-Delta area by oil and gas producing companies and any other company including non-governmental organizations and ensure that funds, released for such projects are properly utilized;

h. deal with ecological and environmental problems that arise from the exploration of oil mineral in the Niger-Delta area and advise the Federal Government and the member States on the prevention and control of oil spillages, gas flaring and environmental pollution;

g. dialogue with the various oil mineral and gas prospecting and producing companies on all matters of pollution prevention and control; and

h. carry out such other works and perform such other function which in the opinion of the Commission are required for the sustainable development of Niger-Delta area and its people.

2. In exercising its functions and power under this section, the commission shall have regard to the varied and specific contributions of each member State of the Commission to the total national production of oil and gas.

3. The Commission shall be subject to the direction, control or supervision in th performance of its functions under this Act by the President, Commander-in-Chief of the Armed Forces of the Federal Republic of Nigeria.

8. The Board shall have power to -

a. manage and supervise affairs of the Commission;

b. make rules and regulations for carrying out the functions of the Commission;

c. enter and inspect premises, projects and such places as may be necessary for the purposes of carrying out its functions under this Act;

d. pay the staff of the Commission such remunerations and allowances as appropriate;

e. enter into such contracts as may be necessary or expedient for the discharge of its functions and ensure the efficient performance of the functions of the Commission; and

f. do such other things as are necessary and expedient for the discharge of the functions of the Commission.

2.3.3 Part III – Structures of the Commission

9. 1. There shall be established in the head office of the Commission, the following directorates –

a. the Directorate of Administration and Human Resources;

b. the Directorate of Community and Rural Development;

c. the Directorate of Utilities Infrastructural Development and Water ways;

d. the Directorate of Environmental Protection and Control;

e. the Directorate of Finance and Supply;

f. the Directorate of Agriculture and Fisheries;

g. the Directorate of Planning, Research, Statistics and Management Information system;

h. the Directorate of Legal Services;

i. the Directorate of Education, Health and Social Services;

j. the Directorate of Commercial and Industrial Development and

k. the Directorate of Projects Monitoring and Supervision.

2. With the approval of the President, Commander-in-Chief of the Armed Forces of the Federal Republic of Nigeria, the Board may increase the number of directorates as it may consider necessary and expedient to facilitate the realization of objectives of the Commission.

10. There shall be for the Commission a Management Committee which shall -

a. consist of a Chairman who shall be the Managing Director, two Executive Directors, the Directors responsible for the Directorates

established under section 9 of this Act and such number of other members as may be determined from time to time by the Board.

b. Be responsible to the Board for the General administration of the Commission.

11. 1. There is hereby established for the Commission, A Niger-Delta Development Advisory Committee (in this Act referred to as "the Advisory Committee") which shall consist of -

a. the Governors of the member States of the Commission; and

b. two other persons as may be determined, from time to time, by the President, Commander-in-Chief of the Armed Forces.

2. The Advisory Committee shall be charged with the responsibility of advising the Board and monitoring activities of the Commission, with a view to achieving the objectives of the Commission.

3. The Advisory Committee may make rules regulating its own proceedings.

2.3.4 **Part IV – Staff**

12. 1. There shall be for the Commission, a Managing Director, and two Executive Directors who shall be indigenes of oil producing areas starting with the member states of the Commission with the highest production quantum of oil and shall rotate amongst member States in order of production and shall –

a. have such qualifications and experience as are appropriate for a person required to perform the functions of those offices under the Act;

b. the Managing Director shall be the Chief Executive and accounting officer of the Commission;

c. be appointed by the President, Commander-in-Chief of the Armed Forces and confirmed by the Senate in consultation with the House of Representatives;

d. hold office on such terms and conditions as to emolument, conditions of service as may be specified in his letter of appointment and subject to the provision of section 3 of this Act;

2. The Managing Director shall, subject to the general direction of the Board, be responsible -

a. for the day to day administration of the Commission;

b. for keeping the books and proper records of the proceedings of the Board; and

a. for –

i. the administration of the secretariat of the Board; and

ii. the general direction and control of all other employees of the Commission.

3. The Board shall have power to -

a. employ either directly or on secondment from any civil or public service in the Federation or a State such number of employees as may , in the opinion of the Board, be required to assist the Board in the discharge of any of its functions under this Act; and

b. pay to persons so employed such remuneration (including allowances as the Board may determine).

13.1. Service in the Commission shall be approved service for the purposes of the Pensions Act.

2. The officers and other persons employed in the Commission shall be entitled to pensions, gratuities and other retirement benefits as are enjoyed by persons holding equivalent grades as appropriate.

3. Nothing in subsections (1) and (2) of this section shall prevent the appointment of a person to any office on terms which preclude the grant of pension and gratuity in respect of that office.

4. For the purposes of the application of the provisions of the Pension Act, any power exercisable there under by the Minister or the authority of the Government of the Federation, other than the power to make regulations under section 23 thereof, is hereby vested in and shall be exercisable by the Commission and not by any other person or authority.

2.3.5 Part V – Financial Provisions

14. 1.The commission shall establish and maintain a fund from which shall be defrayed all expenditure incurred by the commission.

2. There shall be paid and credited to the fund established pursuant to subsection (1) of this section-

a. From the Federal Government, the equivalent of 15 percent of total monthly statutory allocations due to member states of the commission from the Federation account, this being the contribution of the Federal Government;

b. 3 percent of the total annual budget of any oil producing company operating on shore and off shore, in the Niger Delta area; including gas processing companies;

c. 50 percent of monies due to member states of the commission from the Ecological Fund;

d. such monies as may from time to time, be granted or lent to or deposited with the commission by the Federal or state Government, any other body or institution whether local or foreign;

e. all monies raised for the purposes of the commission by way of gifts, loans, grants-in-aid, testamentary disposition or otherwise; and

f. proceeds from all other assets that may, from time to time accrue to the commission.

g. The fund shall be managed in accordance with the rules made by the board and without prejudice to the generality of the power to make rules under this subsection, the rules shall in particular contain provisions;

h. specifying the manner in which the assets or the fund of the commission are to be held, and regulating the making of payments into and out of the fund; and

i. wanting the proper keeping of accounts and records for the purpose of the fund in such form as may be specified in the rules.

15. The commission shall apply the proceeds of the fund established pursuant to section 14 of this Act-

a. the cost of administration of the Commission;

b. the payment of salaries, fees, remuneration, allowances, pensions and gratuities payable to the members of the Board specified in section 6 of this Act or any committee of the board and the employees of the Commission;

c. the payment of all contracts, including mobilization, fluctuations, variations, legal fees and cost on contract administration;

d. payment of all purchase; and

e. undertaking such, other activities are connected with all or any of the functions of the Commission under this Act.

16. 1. The Commission may accept gifts of land, money or other property on such terms and conditions, if any, as may be specified by the person or organization making the gift.

2. The Commission may not accept any gift if the conditions attached by the person or organization making the gifts are inconsistent with the functions of the commission under this Act.

17. The commission may, with the consent of the president, commander-in-chief of the Armed Forces, borrow, on such terms and condition as the commission may determine, such sums of money as the commission may require in the exercise of its functions under this Act.

18. 1. The Board shall, not later than 30th September in each year, submit to the National Assembly through the President, Commander-in-chief of the Armed Forces and estimate of the expenditure and income of the commission during the next succeed year for approval.

2. The Board shall cause to be kept proper accounts of the commission in respect of each year and proper records in relation thereto and all

cause the accounts to be audited not later than 6 months after the end of each year by auditors appointed from the list and in accordance with the guidelines supplied by the Auditor-General for the Federation.

19. The Commission shall, at the end of every quarter in each year, submit to the President, Commander-in-chief of the Federal republic of Nigeria report on the activities and administration of the commission.

20. 1. The Board shall prepare and submit to the President, Commander-in-chief of the Armed Forces of the Republic of Nigeria not later than 30th June in each year, a report in such form as the president commander-in-chief of the Armed Forces may direct on the activities of the commission during the immediate preceding year, and shall include in the report a copy of the audited accounts of the commission for that year and the auditor's report thereon to be submitted to each of the National Assembly.

2.3.6 **Part VI Miscellaneous**

21. 1. There is hereby established for the Commission a Monitoring committee which shall consist of such number of persons as the president, Commander-in-chief of the Armed Forces may deem fit to appoint from the Public or Civil Service of the Federation.

2. The Monitoring Committee shall

a. Monitor the management of the Funds of the Commission and the implementation of the projects of the Commission; and

b. Have access to the books of account and other records of the commission at all times, and submit periodical reports to the President, Commander-in-chief of the Armed Forces.

22. 1. For the purposes of providing offices and premises necessary for the performance of its functions under this Act, the Commission may, subject to the Land use Act.

a. purchase or take lease any interest in land, other property and

b. construct offices and premises and equip and maintain same.

2. The commission may, subject to the Land Use Act, sell or lease out any office or premises held by it, which office or premises are no longer desired for the performance of its functions under this Act.

23. Subject to the provisions of this Act, the President, Commander-in-chief of the Armed Forces may give to the Commission directives of a general nature or relating generally to matters of policy with regard to the performance by the commission of its functions and it shall be the duty of the commission to comply with the directives.

24. 1. Subject to the provisions of this Act, the provisions of the public officers protection Act shall apply in relation to any suit instituted against any officer or employee of the Commission.

1. Notwithstanding anything contained in any other law or enactment no suit shall lie against any member of the Board, the Managing Director or any other officer or employee of the commission for any act done in pursuance or execution of this Act or any other law or enactment, or of any public duty or authority or in respect of any alleged neglect or default in the execution of this Act or such law or enactment, duty or authority, shall lie or be instituted in any court unless.

a. it is commenced within three months next after the Act, neglect or default complained of; or

b. in the case of continuation of damage or injury, with six months next after the ceasing thereof.

25. A notice, summons or other documents required or authorized to be served upon the commission under the provisions of this Act or any other law enactment may be served by delivering it to managing. Director or by sending it by registered post and addressed to the managing director at principal office of the commission.

26. 1. In any action or suit against the commission, no execution or attachment of process in the nature thereof shall be issued against the commission.

2. Any sum of money which may by the judgment of any court be awarded against the commission shall subject to any direction given by court where notice of appeal of the said judgment has been given, be paid from the general reserve fund of the commission.

27. A member of the Board, the managing Director, any officer or employee of the commission shall be indemnified act of the assets of the commission against any proceeding whether civil or criminal, in which judgment is given in his favour or in which he is acquitted, if any such proceeding is brought against him in his capacity as a member of the Board, the Managing Director, office or employee of the commission.

28. 1. The Oil Mineral Producing Areas Development Commission Decree established under that Decree (in this section referred to as "the dissolved commission") is consequently dissolved.

2. By virtue of this Act, there shall be vested in the commission immediately at the commencement of this Act, without further assurance, all assets, funds, resources and other movable and immovable property which immediately before the commencement of this Act were vested in the dissolved commission.

3. As from the date of the commencement of this Act, all rights, interests, obligations and liabilities of the dissolved commission existing before the commencement of this Act under any contact, or instrument or in law or equity, shall by virtue of this Act be assigned to and vested in the Winding-up. Committee to be established and funded by the Federal Government to verify and settle outstanding debt of the dissolved commission.

4. Any proceedings or cause of action pending or existing immediately before the commencement of this Act by or against the dissolved commission in respect of any right, interest, obligation or liability of the dissolved commission may be commenced or continued, as the case may be and any determination of any court of law, tribunal or other authority or person may be enforced by or against the commission to the same extent that the proceedings, cause of action or determination might have been continued, commenced or enforced by or against the dissolved commission as if this Act had not been made.

5. Notwithstanding, the provisions of this Act but subject to such directions as may be issued by the commission, a person who immediately before the commencement of this Act held office in the dissolved commission shall be deemed to have been transferred to the commission on terms and conditions not less favourable than those obtaining immediately before the commencement of this Act, and service in the dissolved commission shall be deemed to be service in the commission for purpose of pension.

6. The President, Commander-in-chief of the Armed forces, if he thinks fit, may, with twelve months after the commencement of this Act, by order published in the Gazette, make additional transitional or saving provisions for the better carrying out of the objectives of this section.

29. The commission may, with the approval of the President, Commander-in-chief of the Armed Forces, make regulations, generally for the purposes of giving full effect to this Act.

30. In this Act, unless the context otherwise requires "Chairman" means the Chairmen of the Board; "Commission" means the Niger-Delta Development Commission established by section 1 of this Act; "Board" means the governing Board established for the Commission under section 2(1) of this Act; "member" means a member of the Board and includes the Chairman, Managing Director and Executive Directors; "member state" include Abia, Akwa-Ibom, Bayelsa, Cross-River, Delta, Edo "Oil" means oil and gas.

31. This Act may be cited as the Niger-Delta Development Commission (Establishment, etc) Act 2000.

CHAPTER THREE

3.0 RESEARCH AREA:

3.1 CONTROL OF WATER IN EARTH SHELTERED DESIGNS.

INTRODUCTION

The possibility of a moisture problem is one of the biggest concerns of people considering an earth-sheltered building. The generally poor performance of normal basement construction with respect to moisture problems seems to be the major cause of concern. It must be recalled, however, that basements were not considered as living space until sometime in the last 25 years. Basements were originally provided because footings for buildings had to extend below the frost line.

This attitude towards waterproofing basements has continued to the present day even though living space is now often anticipated in the a basement. The effectiveness in conventional damp-proofing is very limited. Forming an opinion in this way, is like looking at a bam and deciding houses shouldn't be built of wood above ground because the wind will blow right through. The requirements of construction between a bam and a house are very different and hence so are the standards of construction. The same is true for basement storage space compared to earth sheltered home.

3.1.1 Surface Run-Off

The first steps in controling water in a building should be taken when the sites is selected and preliminary layouts and landscaping are considered. At this time the main aim is to avoid as many water problems as possible rather than have to deal with them in the design stage later.

The number one decision to make is with the choice of site. A perfect site from the waterproofing aspect will rarely be found and is not necessary, but a good site will save money and potential problems as opposed to a bad side.

3.1.2 **Low areas and flood plains.**

Avoidance of such areas with any type of housing if possible is highly necessary. The potential danger to an earth sheltered house compared to an conventional depends very much on its layout or design type.

If a low lying area is being considered as a potential site, the contours of the surrounding area water will tend to collect during heavy rains or snow.

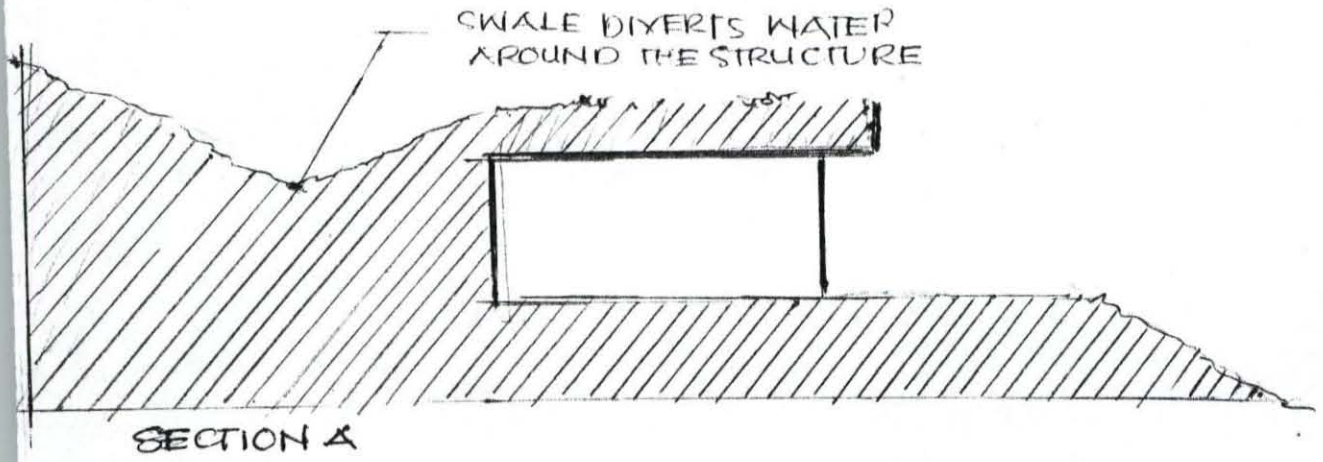
3.1.3 **Gullies**

A similar question to the avoidance of low areas is to avoid sites, even on higher ground, which are potential gullies for surface run-off during heavy rains.

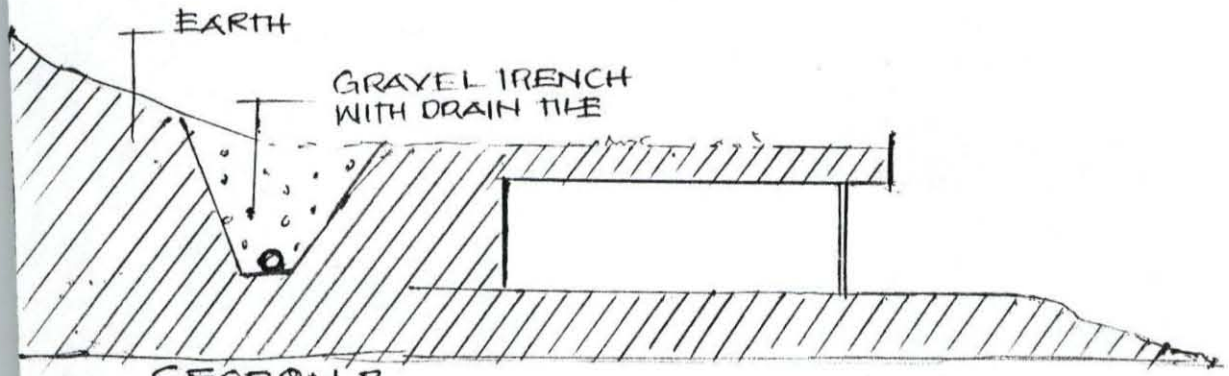
3.1.4 **Ground slopes.**

On identification of possibility of potentially disastrous surface run-offs, more gentle run-offs and water percolation must be considered. Also different designs and different sites have different implications as shown in the diagram below.

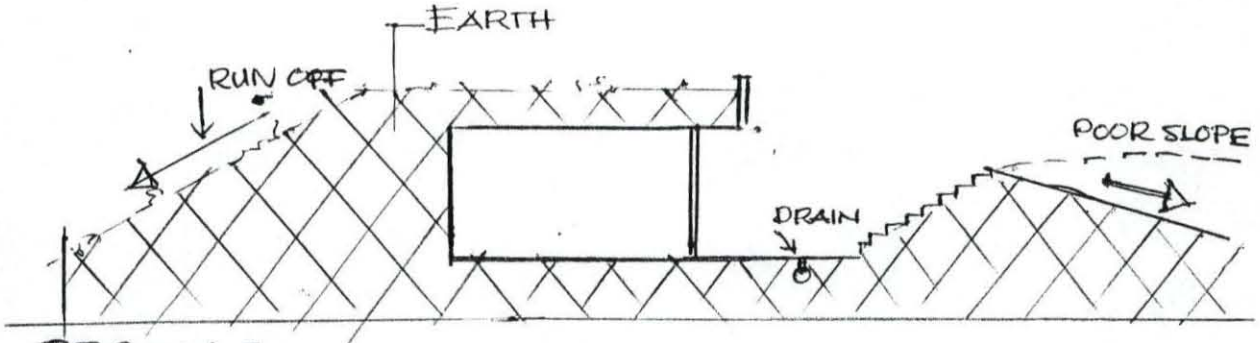
Sections A and B reveal different methods by which water can be diverted away from an earth sheltered structure of the base of a slope. Section A illustrates a drainage swale or gully which diverts the run-off around the house



SECTION A



SECTION B



SECTION C

while Section B shows a cut-off gravel trench with drain tile at the base. Section C illustrates some drainage problems associated with sunken courtyards which are common in earth sheltered designs. It is preferable for the surrounding ground to slope away from the structure on all sides, then only the rainfall which falls directly into the court must be handled by a drainage system.

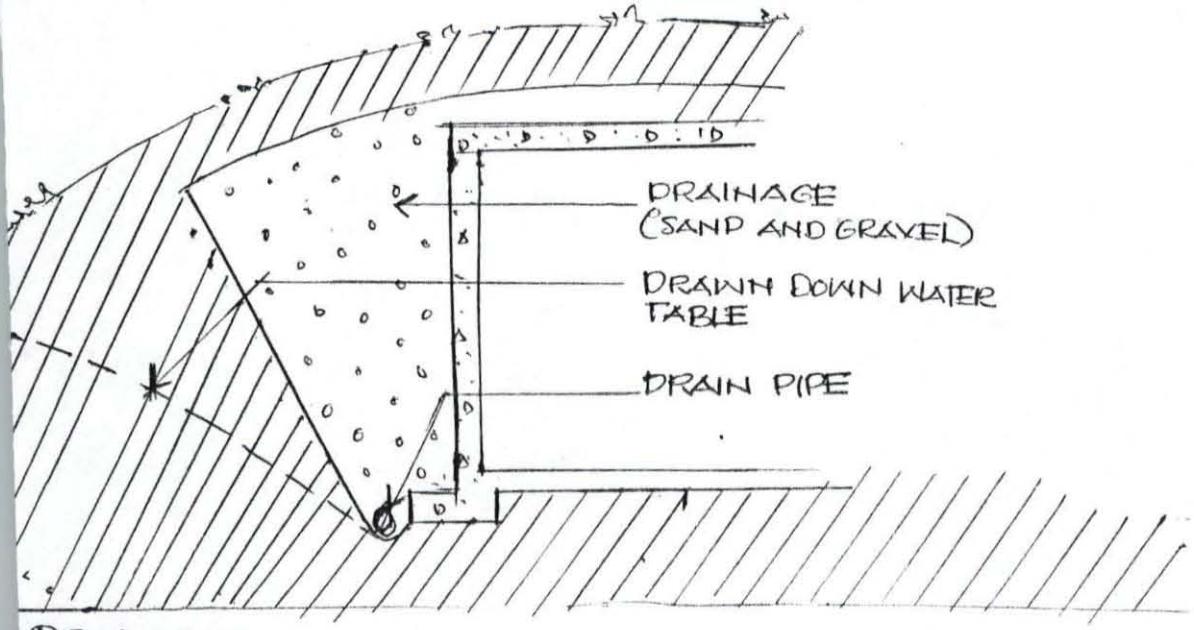
3.1.5 **Water table**

A high water table, like a low lying site, preferably should be avoided. If a site with a high water table is selected for other overriding considerations, however, this problem can be overcome in most situations. One technique is simply house of drainage system to draw down the water table around the structure. Better analysis of this can be seen on drainage techniques.

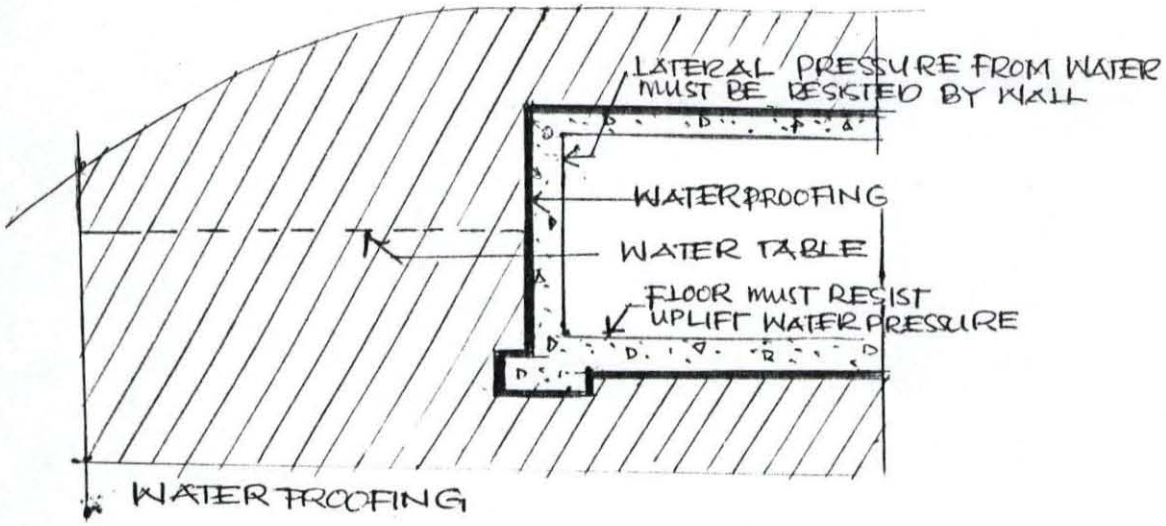
3.1.6 **Temporary water pressures on walls**

Temporary water pressures can occur even when the foundation of the house is substantially above the water table. Seepage of water into the ground adjacent the house faster than it can soak away below the natural ground water table can cause this during heavy rainfalls. This is mitigated by sloping the ground away from the house and making sure that the backfill is properly compacted so that it does not slump to trap water and so that large voids are not left which can rapidly fill up with, water during a rainfall.

This build up of temporary water pressures is the biggest complication in designing a moisture control system for a foundation above the normal water table. If temporary water pressures could be eliminated, only a damp



DRAINAGE



WATERPROOFING

proofing technique would be needed to stop any capillary draw moisture into the wall. When temporary pressure cannot be eliminated, and this could rarely be guaranteed, damp-proofing will not surface for complete protection because damp-proofing is not designed to keep out water under pressure. Diagrams below show in the best language of architecture, what need to be done.

3.1.7 **Vapour transmission**

It is obvious that gases or vapour always tend to move from an area of high pressure to an area of low pressure, and since the temperature inside the earth sheltered house will almost always be warmer than the ground around it, the water vapour transmission will tend to be from the inside of the house towards the ground. In controling this a vapour barrier is placed on the warm side of the construction to prevent the water vapour from reaching a cold part of the wall where it could condense and could cause damage to the structure.

3.1.8 **Capillary draw**

This is the mechanism responsible for most of the dampness (other than condensation) which occur in basements. Moisture from damp earth can be drawn into the wall by capillary suction. This is the same mechanism by which a sponge laid on a wet surface will draw water up into itself. This moisture will be drawn through the wall and if the air inside the basement is not saturated, the moisture will evaporate and raise the relative humidity.

There are basically two methods of breaking this capillary draw. The first is to cut it off with an impermeable barrier such as a water proofing or damp-proofing application. A more effective means of capillary break is the use of an air gap or a material that is so open that moisture will not be drawn through it. Swedish and Norwegian research has indicated the effectiveness of using either an air gap of a 5cm layer of rigid mineral fibre insulation in keeping basement walls dry. In fact the use of open weave insulation in preventing moisture problems illustrates the fact that it is not necessary to have a vapour proof layer on the outside of wall as long as the capillary draw is interrupted. The figure below illustrates the Swedish system.

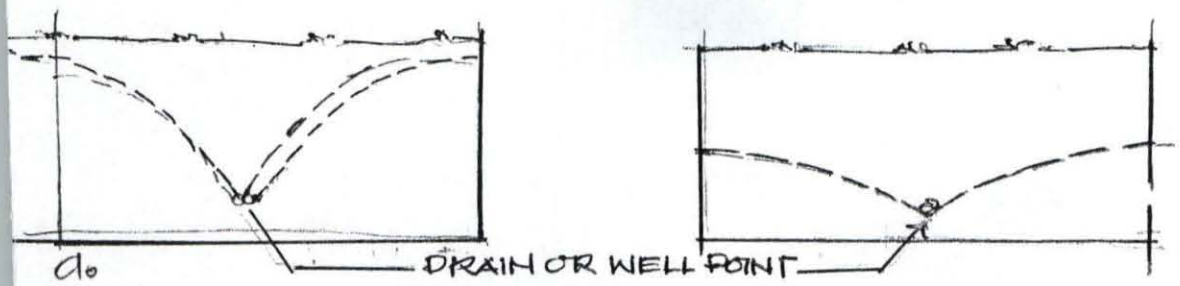
(See Fig. 3.3 below)

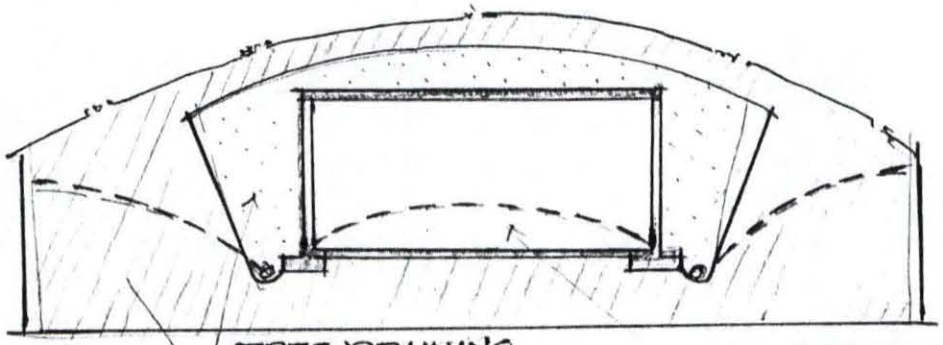
3.2 DRAINAGE TECHNIQUES

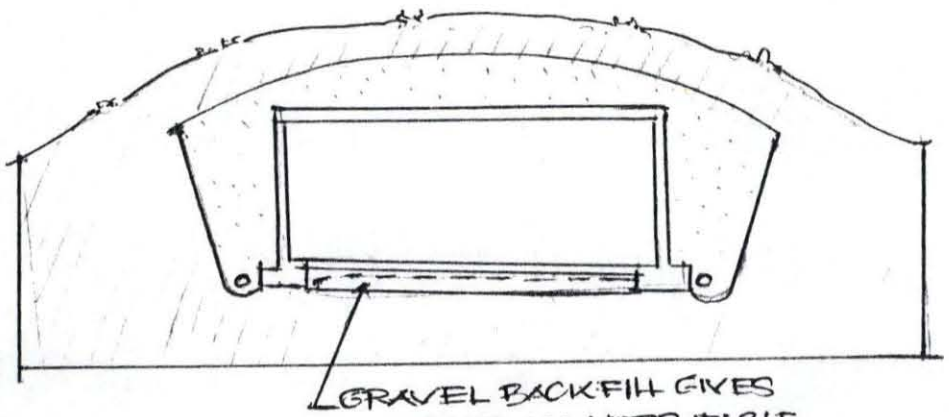
Drainage techniques should always be an important consideration in controlling water in buildings since they reduce the frequency and duration of water conditions that actually test the membrane. It is important to locate the drains as low as possible with respect to the foundation and the finished floor level especially if the drains are being used to permanently lower the water table. Even if the drains are functioning perfectly, the water table will only be held to the level of the drains at the drain itself, the water table will rise away from the drains at a slope as shown in the figures below, which is dependent on the permeability of the soil.

Major considerations in the design of a drainage system:

1. The backfill should be preferably a free drawing material except for capping of soil of low permeability.


a.
DRAIN OR WELL POINT


b.
FREE DRAINING
GRAVEL BACKFILL
POOR DRAINING SOIL
WATER PROBLEMS
DRAW DOWN IS
NOT ENOUGH


c.
GRAVEL BACKFILL GIVES
LOW RISE TO WATER TABLE
AND STORES CAPILLARY DRAW

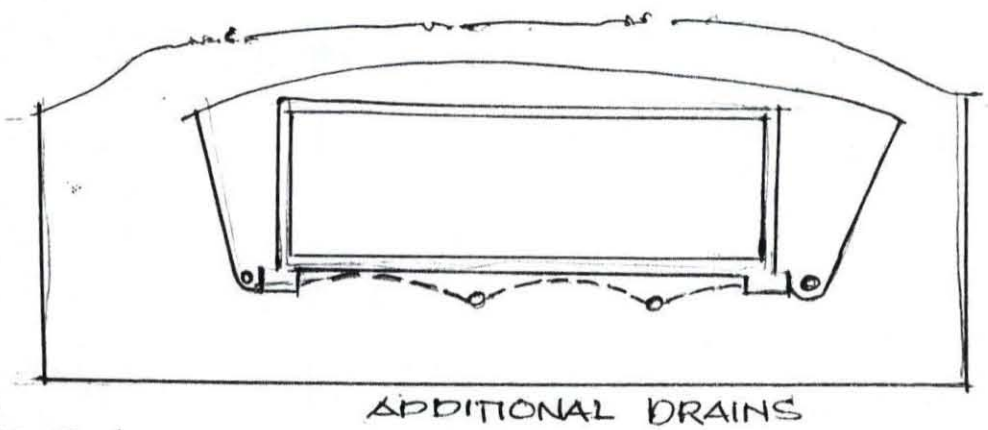

d.
ADDITIONAL DRAINS

FIGURE 3.4

2. The backfill should act as a filter material preventing the washing of clay and still particles from the surrounding ground through the backfill and into the drain. This can cause settlement problems also clog the drain. To further prevent dogging of the drain purpose designed fibrics are available which can be wrapped around the drain.

3. If the drawndown curve of the water table will not be sufficiently shallow to keep the water table below the floor with only perimeter drains additional drains should be placed under the floor as in figure 3.4d.

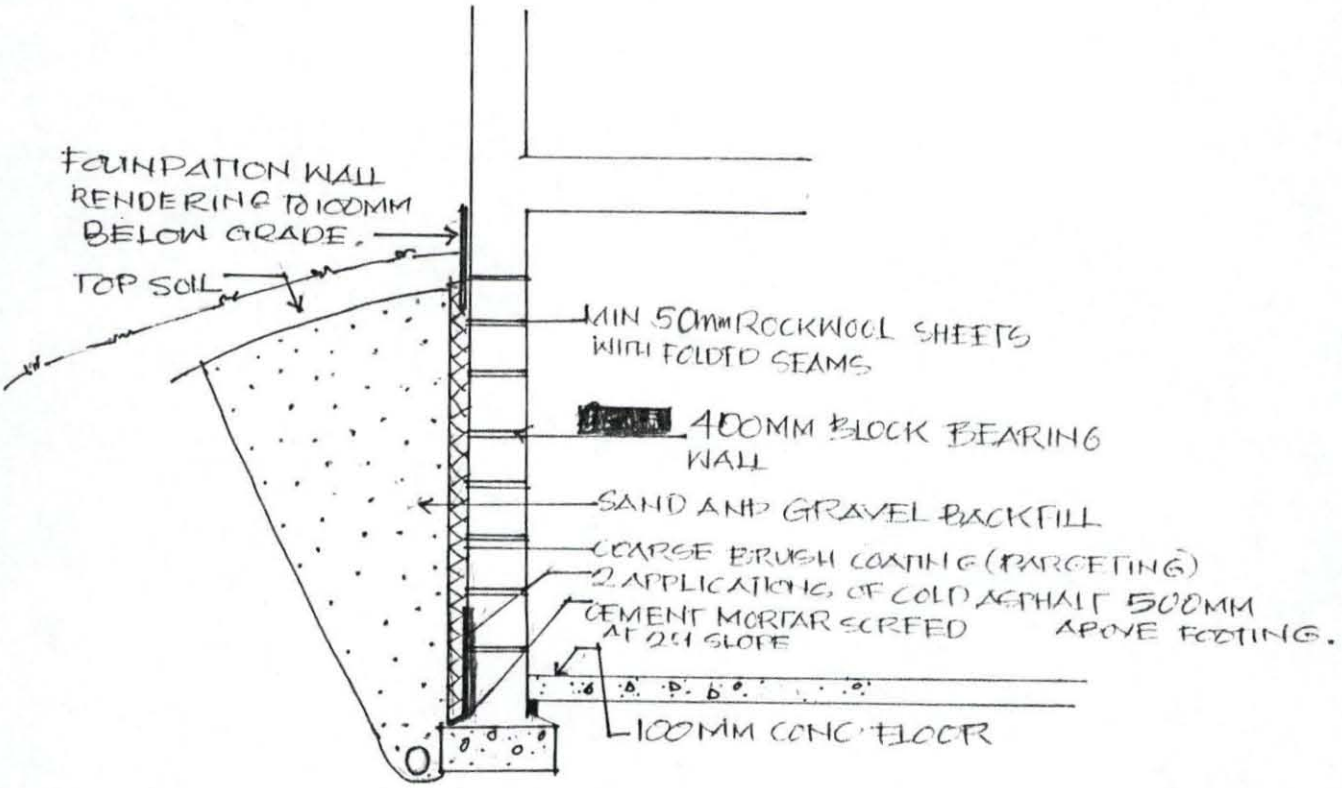
4. The drains will preferably be able to daylight naturally on a sloping site. On a flat site they can be drained to a storm sewer or to a sump where the water can be pumped out whenever sufficient amount has collected.

5. It is very desirable that some access for clearing out the foundation drains should be incorporated in the design.

3.3 DAMP-PROOFING METHODS

Damp-proofing products are those which will interrupt the capillary draw of moisture into the walls of a building but are either too thin, have too little resistance to building wall cracks or deteriorate too easily to be considered as a good water-proofing technique. Some of the techniques for damp-proofing are discussed below.

FIGURE 3.3


FOUNDATION WALL RENDERING TO 100MM BELOW GRADE.
TOP SOIL
MIN 50mm ROCKWOOL SHEETS WITH FOLDED SEAMS
400MM BLOCK BEARING WALL
SAND AND GRAVEL BACKFILL
COARSE BRUSH COATING (PARGETING)
2 APPLICATIONS OF COLD ASPHALT 500MM ABOVE FOOTING.
CEMENT MORTAR SCREED AT 2:1 SLOPE
100MM CONC. FLOOR

3.3.1 **Concrete Mix Design and Additives**

There is much that can be done to make a concrete more impermeable than it normally is including keeping the water-cement ratio as low as possible, using adequate vibration when placing the concrete and including well distributed reinforcement to limit the size of the shrinkage cracks that occur when the concrete dries out. Admixtures can fill the capillary channels in the concrete others reach when they come in contact with water. All these techniques will cut down the permeability of the wall, but as long as the concrete cracks and shrinks when it dries, which is always the case cracks will occur which destroy the integrity of the seal.

3.3.2 **Pargeting**

In this technique, the wall is coated a dense cement plaster, or similar material. This can be done on the inside or outside of the wall, but as with all other water-proofing applications it is best done on the outside of the wall so that any water pressure will not tend to force the coat off the wall. Cracking of the wall, which almost inevitably occurs, will also crack these generally brittle materials and hence, they cannot be relied on as a waterproofing material.

3.3.3 Asphalt Coating

The application of this could either be hot or cold and can be sprayed, brushed or trowelled on. In general, trowelling gives a better job than spraying because a denser layer with better adhesion is obtained. Hot asphalt become brittle when they are cool and the cold asphalt applications have some bridging characteristics over cracks but not sufficient to bridge

normal sized structural cracks. Asphalt emulsions are slowly soluble in water and the quality of asphalt supplied to the building trade has deteriorated over the past few years.

3.3.4 Pitch

It is considered as a more stable material to use underground than an asphalt emulsion. A special waterproofing pitch used to be available but was discontinued because of its health risks. This was based on the standard of fumes released during application. The major pitch available now is a general purpose pitch designed for roofing applications. It has a softening point of about 150°F and hence underground it will remain brittle with no resealing abilities.

3.3.5 POLYETHENE SHEET

It is a very cheap material to use. It degrades when exposed to sunlight but when completely covered underground it should last a long time. With reasonable laps and care taken not to puncture the sheet during placement and backfilling it will function as a good barrier against capillary draw and vapour transmission. No attempt is usually made to seal the laps completely and hence it will not resist a water pressure on its own. It does not have the capability of bridging some cracking in the concrete. For the floor of an earth sheltered hose that is above the water table, has a foundation drain system and gravel layer under the floor, this type of damp proofing protection will usually be adequate.

3.3.6 Liquid Seals

These suffer from the same problem as most damp-proofing techniques. The integrity of a seal goes with the cracking of a wall.

3.4 WATERPROOFING METHODS

It is noteworthy that not all the techniques which shall be considered here are suitable for waterproofing against a continuous water pressure and this will be noted in the discussion. Techniques other than those intended for damp proofing are considered here. They include;

3.4.1 Built-Up Membranes

These consist of layers of asphalt or pitch alternated with felt or fabric reinforcing. Three to four piles would be considered a minimum for waterproofing purposes. Membranes can be used on the roof or walls of the structure. The fabric does give mechanical strength but little elasticity. Glass fibre should be used rather than organic felts because the felt will rot if they become exposed to water and replacement is not easy with a conventional roof.

The big disadvantage of any membrane like this is that if the roof does not leak in one place, the adhesion is usually not good enough to prevent water from traveling behind the membrane and appearing inside at a point remote from the actual leak. It makes locating leaks difficult. All membranes are susceptible to damage between the time they are applied and inspected and the time after they have been backfilled.

3.4.2 **Bituthene**

It is a polyethylene coated rubberized asphalt. It has sufficient adhesion to allow it to be rolled out and applied to a wall or roof surface. The burying of this membrane is compulsory, or it should be covered to prevent ultra-violet induced deterioration of the polyethylene but once covered it should have a long life. It should not be used under a continuous water pressure and it is recommended that when applied to roof surfaces, the membranes should have a slight slope to give positive drainage for the roof. Adhesion will be poor if the surface to which it is applied has moisture on it or is below about 45°F in temperature. The disadvantage common to membranes applies here.

3.4.3 **Polyethylene Embedded in Mastic**

The application of mastic is to the wall of an earth sheltered and sheet of polyethylene with generous laps (also sealed with mastic) embedded into it. This would be unlikely to be enough for continuous immersion in water but may provide adequate protection against occasional water conditions. It is not recommended for the roof of an underground structure and should be used with a foundation drain system. General advantages of membranes apply.

3.4.4 **Butyl Rubber, Epdm, Neoprene Membranes**

These materials are all quality materials and have good bridging characteristics. Water traveling behind the membrane are still problems. Compartmentalization (where a material is glued down with glue line at

regular intervals) is often used to reduce the travel of water from a leak. These membranes can be used for the roof or walls of a structure. They should be water tested if possible.

3.4.5 **Liquid Applied Polymer Membranes**

They are usually polyurethane and are mostly traveled on. Liquid membranes do not need seams and can easily be used to seal in awkward areas or around vent pipes e.t.c. There is however, some loss of control over exactly how thick a membrane is applied and whether all parts of the surface are adequately covered. The materials usually have reasonable bridging characteristics but no resealing ability. In general, these products are used where conventional membranes would be awkward to use. Surfaces should be cleaned and dry for application. Liquid membranes would not be recommended for use on precast roof systems. They can be used for roof and walls.

3.4.6 **Bentonite Panels**

They are basically cardboard panels filled with bentonite, which is a clay which expands when it comes into contact with water. As the clay tries to expand, it seals itself against further penetration by water. Application can be done by unskilled labour without difficulty and can be nailed to vertical surfaces. There is rapid decomposition of the cardboard once it comes in contact with water so the panel must be protected from rain until the backfilling is complete. It has been observed that because of its swelling characteristics, betonite does not have some resealing ability as well as a

bridging capacity. There is some degree of concern about the cardboard, which remain behind the bentonite providing a lateral water transmission path. The material is natural and not subject to degradation with time and it has been used successfully for continuous water immersion. It should not be used where running water could slowly carry the betonite away from the wall and it should not be used where there is high concentration of salts in the ground water since this interferes with the swelling mechanism.

3.4.7 **Spray-On Betonite (Betonite System)**

The composition of this material is a mixture of bentonite with small amount of mastic binder so that the material can be sprayed onto a wall or roof and will adhere to it. It must be protected from rainfall prior to backfill although it is more resistant to slight wetting than panels. The material is sprayed on 9.5 millimeters thick and will provide complete water proofing for a structure with the bridging and resealing properties described above. Water does not easily travel behind the membrane and hence leaks are localized. A limited five-year guarantee for any repairs necessary to the membrane is offered when the material is applied by a licensed operator. As with any spray-on membrane, the biggest problem with this material is making sure that complete coverage of the required thickness is achieved. The waterproofing does not requires a perfectly smooth wall and the thickness applied can easily be inspected with changing the membrane.

3.4.8 **Water Stops**

These are of various types and are used to reduce water leakage at cold joints or expansion joints in concrete. Joints poured concrete walls, floors e.t.c. are places where most leakage occurs and the water stop simply provides a much longer leakage path for the water. Water can tend to travel laterally along these water stops and unless the joints between water stop sections are perfect, leakage can occur at these points. For this reason, they are not recommended when a full water proofing system is used on the outside of the wall. If water gets through the main membrane, the water stop can mask where the leak in the membrane really is and makes leaks extremely difficult to find. Water stops are used when the reduction of the amount of water leakage is of major importance rather than the elimination of all leaks. See diagrams below.

3.4.9 **Flashing Details**

This is an area of waterproofing which merits special attention. They include corners and projections such as skylight wells or roof vents. These connection and termination points of the waterproofing system, generally referred to as flashing detail, are very critical since they often represent the weak link in the system. With membrane sheet systems, generous laps should be provided whenever possible, and fillets are often used at corners to avoid sharp changes in direction. Non-sheet waterproofing systems are usually thickened at corners and joints. Since every product and every situation have different requirements, it is best to consult a professional in order to ensure the proper technique for this important detail.

3.5 DRAINAGE FROM ROOFS

Most houses are roofed with overlapped shingles, overlapped corrugated metal or asbestos cement and long span aluminium. Most other roofs are designed to be entirely flat and are waterproofed, although a completely flat roof is seldom a design necessity and can never be achieved in practice because of normal construction inaccuracies and structural deflections. A completely water tight membrane is extremely difficult to construct and difficult to keep water tight in service when exposed to the full onslaught of the weather experienced in most areas.

Every discontinuity or penetration through a roof is a potential source of imperfections at the flashings. The amount of water penetrating any imperfection in such a roofing membrane is directly proportional to the time during which the imperfection remains covered with water; that is, generally, the time that water remains ponded on the roof of the building. Shallow pools that form in depressions on the roof expose the membrane to the combine attack of moisture and sunshine at the edges of the pools in summer and ice action in winter depending on the region of the world. For these reasons, it is most desirable to provide slopes to drains on roofs so that water does not collect in pools but drains away almost as fast as it falls.

Few structural failures of lightweight roofs are known to have occurred in different parts of the world as a result of ponding, water falling on the roofs in heavy rainstorms caused progressive deflection and accumulation of water until the loading collapsed the roof. Usually in Canada, the snow load requirement produces a sufficiently strong roof to preclude any possibility of such failure. The designer should however, keep this possibility in mind and provide sufficient slope to avoid deflection from ponded water on lightweight roofs.

3.5.1 **Steeply Sloped Roofs**

When overlapping units such as shingles are used for roofing, the minimum slope is about 100 millimeters vertical rise to 300 millimeters horizontally. Asphalt shingles are used on lower slopes when solidly cemented, but this is essentially a waterproofing type of application. The penetration of water at the overlaps of uncemented shingles or tiles is related to the roof slope and the amount of overlap. Wind forces and capillary suction tend to drive water up under the lap and gravity flow tends to carry it out. If water is not to penetrate, the force tending to cause outward flow must be greater than the forces causing inward flow. Minimum slopes and overlaps are based for the most part on experience. Most codes and standards state a maximum exposure of underlying units that varies with the length of the unit and the slope. For double coverage unit without side laps, this is sometimes based on a minimum head lap of 76.0 millimeters, so that exposure would be the length of the shingle less 76.0 millimeters divided by two.

3.5.2 **Low Sloped Roofs**

A slope of 25.0 millimeters in 1.2 meters is about the minimum practicable slope, and even with this it is probable that for large surfaces, there may still be depression where some water will pond. Studies in drainage channels by Martin and Tilley in Australia in 1968 showed that the relative discharge capacity of a roof increases by 50% when the slope is changed from zero to 25.4 millimeters in 1.5 meters.

For complete water control, it is necessary to consider all the details as well as to provide slope on the main roof surfaces. One of the major sources of leaks in flat and low-slope roof is faulty flashing at the termination of the roofing membrane where it meets movement joints parapets or other wall and building features higher than the roof surface, and where vent pipes and ducts penetrate the roof. If imperfections occur at such locations because of design or application omissions and water is allowed to cover them, penetration will almost certainly take place.

All such details should be arranged, if possible, to be above the general level of the roof so that they are not covered with water, and slopes should be provided so that water will drain away from the flashings. Even if the details are not perfect, water will probably penetrate only when conditions are extreme, as might occur from flooding or during high winds. The cover or counter flashing detail should be designed with slopes to shed water. This includes individual pipes or duct penetrations as well as movement joints and parapet walls.

Parapet walls need roofing that must be linked to the main roof of the building. Parapet cappings, whether of concrete, stone or metal, should be sloped to shed water although they can be relied upon to provide complete water control at the end joints. A roofing membrane (or through wall flashing) is required below the capping to intercept and lead away any water that penetrates the joints of stone, concrete or tile cappings. For metal cappings, this may not be necessary, but it is desirable to have upstanding end joints as well as sloped surfaces to assure that there is no water penetration. Even when perimeter slopes are used to put base flashings above the main roof level, water may still be blown under counter flashings and penetrate unless the flashings are carried well up the vertical walls.

3.5.3 **Sizing and Location of Drains**

Eternal gutters and down pipes are sometimes at the eaves of sloped residential type roofs to direct water away from foundation walk and to protect entrances and foundation planting. In areas where it snows in winter, it is frequently filled with ice and sometimes when the build-up is severe, is torn from their supports. The size of such gutters is seldom a matter of design.

The more usual drainage system for flat and low-sloped roofs consists of drains on the main surface of the roof connected to internal down pipes (or leaders) leading to storm sewers or discharged at ground level to drain into open drainage ditches. The number and size of drains for these roofs are based on rainfall information for the geographic area and on drainage information for drains and leaders. Such information is available in civil engineering handbooks, drain manufacturers design manuals and building codes.

The choice of leader size or the number of leaders of a specific size for a particular roof area can be determined by a reference to table 7.4.11.G, which forms part of Article 7.4.11.12 of the NBC 1970. In this table, partly reproduced in Table 1, the diameter of the leader in inches is related to the hydraulic load from the roof. The hydraulic load from the roof in square meter is defined in Article 7.4.11.5 of the NBC 1970 as the maximum minute rainfall in inches multiplied by the sum of:

a. area in square feet of the horizontal projection of the vertical surface that is to be drained and;
b. one-half the area in square feet of the largest adjacent vertical surface.

Table 1: Leader size and Hydraulic load.

Lead size, in	Hydraulic Load, sq ft.
2	720
$2^1/_2$	1300
3	2200
4	4600
5	8600
6	13500

Although rainfall and drainage information are the basis for sizing and determining the required number of drains, other considerations are necessary in achieving a satisfactory system. The shape of a roof, penetrations through it, and superstructures above it that provide obstruction to drainage may well be overriding considerations. Where one drain might be sufficient in relation to roof area and rainfall, it may be necessary to specify two or more adequate drainage in such cases.

On slopes that do not have drains, the drains should not be located at columns. These locations will become high points on the roofs when structural deflections occur between columns. If drains are located at the center of bays between columns, any structural deflection will produce slopes to the drains, but allowance must be made in the leader connection to the drain for any vertical movement resulting from the structural deflection.

Drains should not be located close to parapet walls, movement joints, or the walls of higher building elements that installation and waterproofing will be difficult to achieve. It is generally good practice to locate them several feet from roof edges and walls.

Emergency overflow drains or scuppers should be provided for parapet type roofs. They should be installed slightly below the level at which collected water would impose the design loading for the roof if the drains were blocked for any reason. Base flashings should extend above this level for obvious reasons.

3.5.4 Control Flow Drainage

From the fundamentals of roofing alone, it is desirable to drain rainwater as fast as it accumulates. If no water is present it obviously cannot penetrate any imperfections in the roof, and even with water running over a roof, there is little head to cause entry. As water is a principal agent of deterioration of materials, deterioration will also be slowed down if the minerals are kept dry except when rain is falling or in snow region, snow is melting.

The designer, however, may be faced with several additional considerations. Underground storm drainage in the area where the building is to be located may sometimes be overloaded by rapid run-off of water from large roofs during flash storms. This can cause flooding of basements or surface flooding and considerable damage to property. It may be necessary to dispense with immediate drainage of rainwater and consider controlled flow drainage.

With this approach, water is allowed to build up some depth on the roof during flash storms, to be drained at a controlled rate over a longer period. smaller drain piping and fewer drains may be used for such systems, thus reducing overall cost of the drainage system. Cost by itself, however, is seldom justification for its use because water on a roof always continues a hazard.

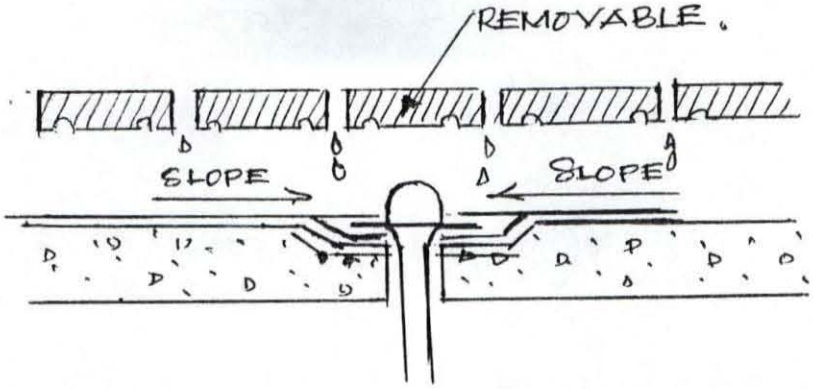
3.5.5 **Flooded Roofs**

Water on a roof can be used for evaporative cooling, and where air-conditional is a factor in design, it can usually be justified economically as a means of reducing the cooling load. This means, keeping a roof flooded with water to a depth of several inches or using a continuous water spray. The latter gives the more effective evaporative cooling and can be used with a sloping roof. Water running over a sloping roof with a large supply of water and a relatively large head can cause a great deal of drainage in the event of a leak. Flooded roof also usually become stagnant pools that collect dirt and support algae growth. When used they should be capable of complete drainage for cleaning intervals.

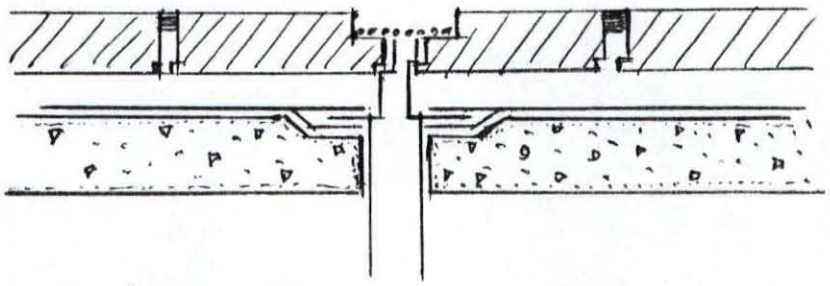
3.5.6 **Roof Terraces**

Drainage of surfacing materials of roof terraces requires special attention. Most terrace surfacing materials can be damaged or displaced by water or frost action. In addition to sloping the continuous membrane at the structural deck, it is usually necessary to provide a surface drainage percolation layer through which water can run freely. Such a layer can be provided by a system of voids, uniform sized gravel, clean coarse sand, or no-fines concrete. The void system is the most preferable (CBD 151). Roof drains at the surface drainage level are essential, but surfacing may be made open or closed. In a case where joints between surfacing units are closed the terrace surface itself must be drained, see figure below. The joint in the surfacing at the perimeter of the roof terrace, especially at building walls, must be open in any case to prevent surface ponding against the building wall.

DRAINS FOR ROOF TERRACES.

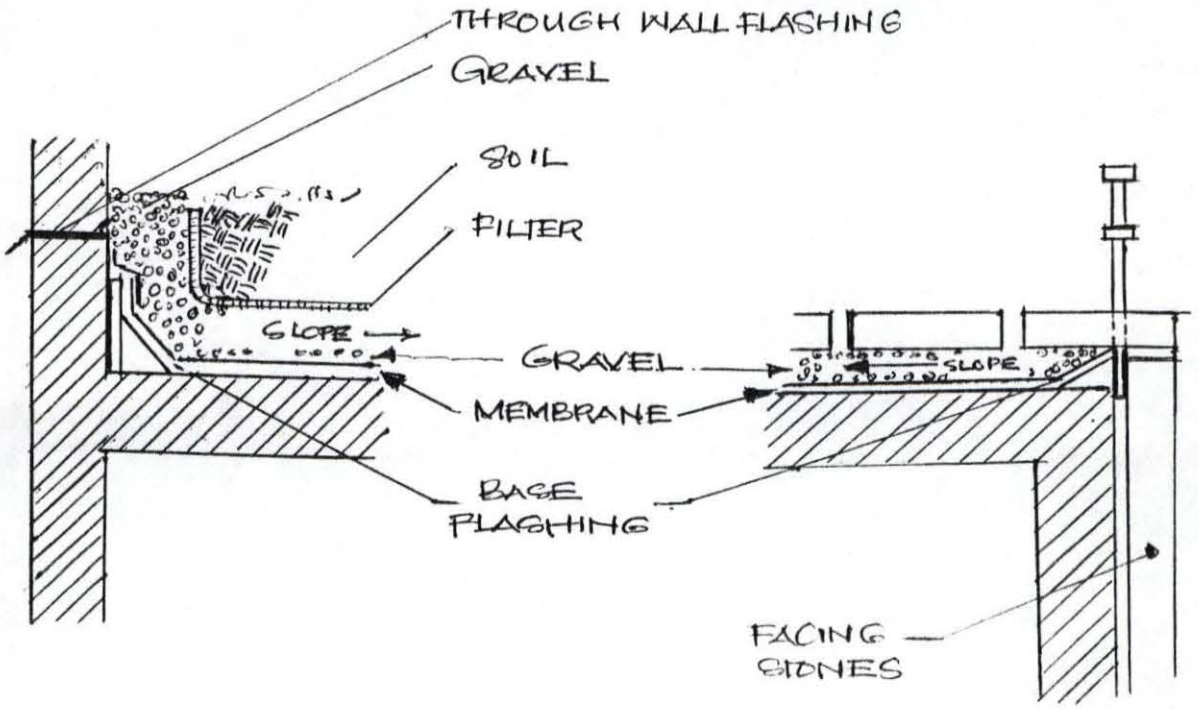


OPEN PAVING



CLOSED PAVING WITH SURFACE DRAINAGE

ROOF TERRACE FLASHINGS.



More so, the details are important to the success of a roof terrace, and in some instances the walls of the building as well. Typical schematic details are shown in figure below where the membrane is arranged to carry water away from the walls.

3.6 RAIN PENETRATION AND ITS CONTROL

The penetration of rain in building walls occurs too frequently despite the advances in building technology. Through wall or complete penetration may damage building contents as well as cause stains and deterioration of interior finishes; uncontrolled partial penetration, which is less frequently recognized. Better understanding of these mechanisms will make it possible to design and construct walls from which the problem is virtually eliminated.

3.6.1 Mechanisms of Rain Penetration

Rain penetration results from a combination of water on a wall, openings to permit its passage and forces to drive or draw it inwards. Eliminating any one of these three conditions can prevent it.

Water blown against a windward wall and thrown by air turbulence onto sidewalls produces an accumulation of water on the building exterior. Wide roof overhangs and cornices minimize wetting of low buildings. Solar shading devices design can minimize wetting, but there is little likelyhood that a building can be designed so that walls will never be wet.

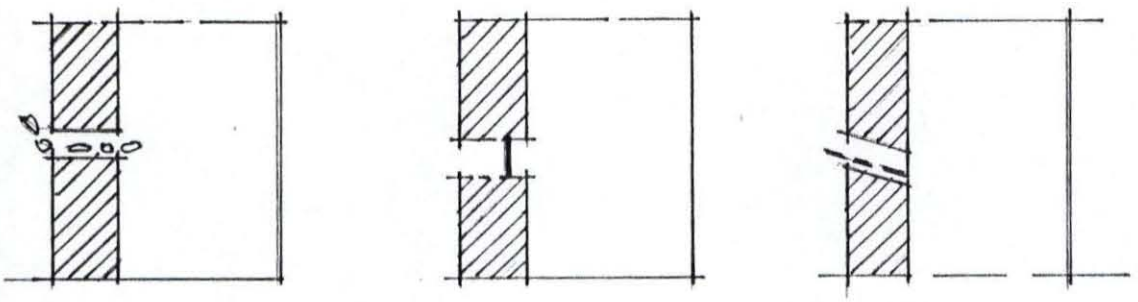
Depending on the absorptive and moisture storage capacity of surface materials and upon the rate of rainfall, a substantial film of water can form and

flow on a wall face. The flow of this film is influenced by surface texture, gravity and air movements along the wall face. Experiments have shown that the flow in narrow vertical depressions (i.e. joints) in a wall face can be many times greater than the average over the wall..

Opening that permit the passage of water are quite numerous on the face of a building in the form of pores, cracks, poorly bonded interfaces and joints between elements or materials. Very small pores and cracks can be covered with impermeable or semi-permeable coatings or treated with surface waterproofing compounds but these treatments are less likely to be effective for longer pores and cracks. Joints between elements or materials can be sealed with gaskets or sealants if they are located were they can be wetted by rain, however, the seal must be perfect, and this is difficult to achieve because of fabrication or job site inaccuracies. Even more difficult is the maintenance of a perfect joint for a long time, because of aging of the sealant and differential movements skills and new sealing materials can be employed, nut it is seldom possible to guarantee that no openings will develop to permit the passage of water.

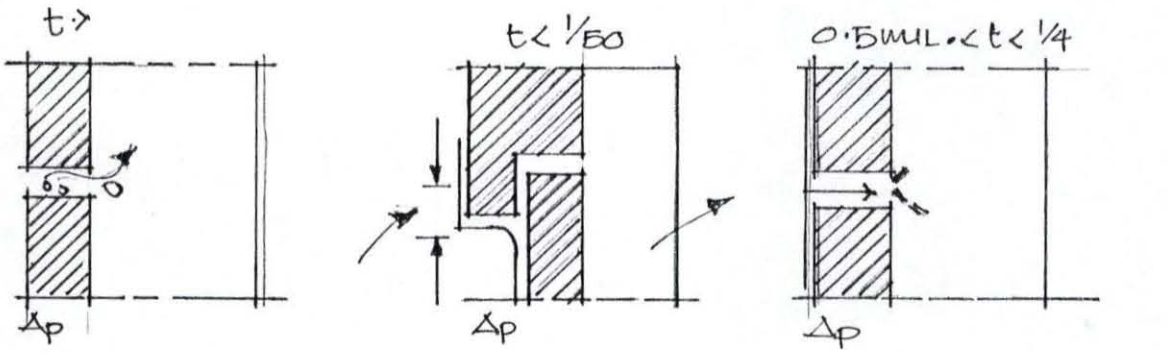
Even when there is water and an opening exists, leakage will not occur unless a force or combination of forces is available to move the water through the opening. These forces could be kinetic energy of raindrop, capillary suction, gravity and air pressure differences. It is explained schematically in the figure below.

FORCES PRODUCING RAIN PENETRATION.



(a) KINETIC ENERGY (b) CAPILLARITY (c) GRAVITY

L = WIDTH OF JOINT OR CRACK Δp = AIR PRESSURE DROP



(d) AIR CURRENTS (e) WIND PRESSURE CAPILLARITY (f) WIND PRESSURE

The influence of wind on raindrops may cause it to approach the wall of a building with considerable velocity so that their momentum or kinetic energy carries them through large openings (figure a below). If an opening is small, the raindrop will be shattered upon impact, but small droplets will continue inwards. The absence of a through path however will restrict deep passage of water into the wall. Thus, batten, splines, baffles, interlocks or labyrinths can be used to advantage at joints to control rain penetration from kinetic energy.

Capillary suction acts only to draw or hold water in a space bound by wettable surface. When a material approaches saturation, the capillary suction approaches zero, but the water it holds will have no tendency to exude from it unless an external differential force is introduced (figure b). Gravity or an air pressure difference can cause a certain amount of water to flow through or out of this saturated material at a rate limited by the size of the capillaries. Fine capillaries of less than about 0.01 millimeter (normal hard fried clay brick or concrete) draw and hold a small volume of water with such high suction that they seldom contribute to rain penetration. If the interior and exterior surfaces of a wall are connected by capillary passages, severe at the interior finish may occur because of capillarity alone, but only after the moisture storage capacity of the materials of the wall has been filled. Partial water penetration of a wall by capillarity is difficult to overcome, but complete penetration can be by introducing a discontinuity or air gap in the capillary, the joint, or the wall.

Gravity acting on water on the wall surface or in large capillaries will pull it through any passages that lead downwards and inwards (figure c). Water running down the sides of vertical cracks or joints can also be diverted

inwards by surface irregularities. Rain penetration as a result of gravity alone seldom occurs through internal openings. Cracks or other openings that develop after construction, however, often allow water to enter. An air space or discontinuity in the joints or wall immediately behind the wetted face will prevent further flow of water inwards. Water reaching this space will cling to the surface and will flow down the outer face of the space so that it can be led out of the wall by flashings at suitable locations.

Wind pressure produces a pressure drop through a wall on the face of a building. At a point where high rate of inward airflow occurs as a result of an opening and an air pressure drop, water can be dragged along the walls of opening and cause rain penetration (figure d). Relatively low velocity airflow can also carry fine water droplets or snow into the wall to create the same problem. Water can be raised a considerable distance and caused to flow into a wall when air pressure difference is added to capillary suction (figure e). An even more serious situation can occur when, as a result of large amount of water at the surface, openings up to 3/8 inch or more are bridged with water, which is readily forced through the passage by even small differences in air pressure (figure f).

As with capillary suction and gravity, water entry resulting from an air pressure difference can be controlled by the introduction of an air space in the joint or wall; but the air pressure in the space must always be equal to that on the wall face. This can be accomplished by providing sufficient free area of opening to the exterior to allow the wind pressure to maintain equalization. In a situation where the air pressures both inside and outside a wetted plane are equal, there is no air pressure difference to move the water inward.

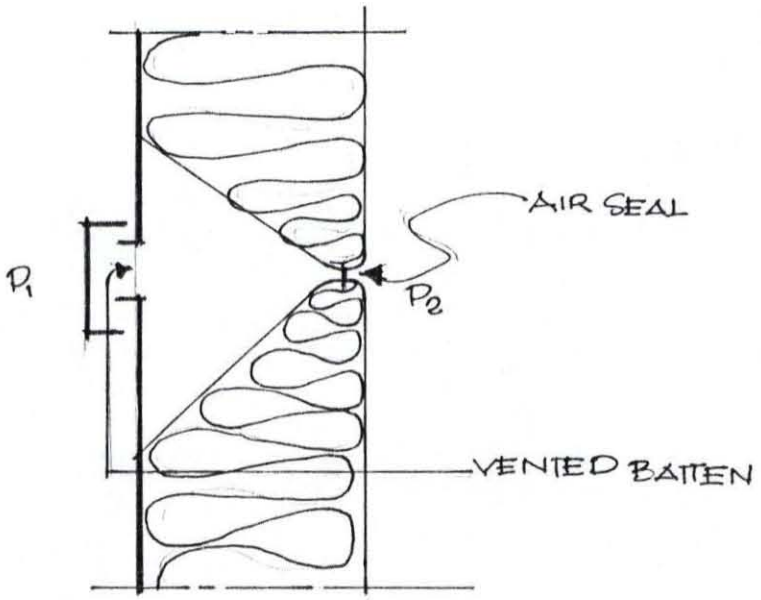
Noteworthy here is that the infiltration air barrier of the building must be located inward of this air space. The barrier, regardless of its position, is the point at which the pressure difference between inside and outside the building occurs and must resist wind loads. Provided the air barrier does not get wet, minor air leakage through it will not be accompanied by rain penetration.

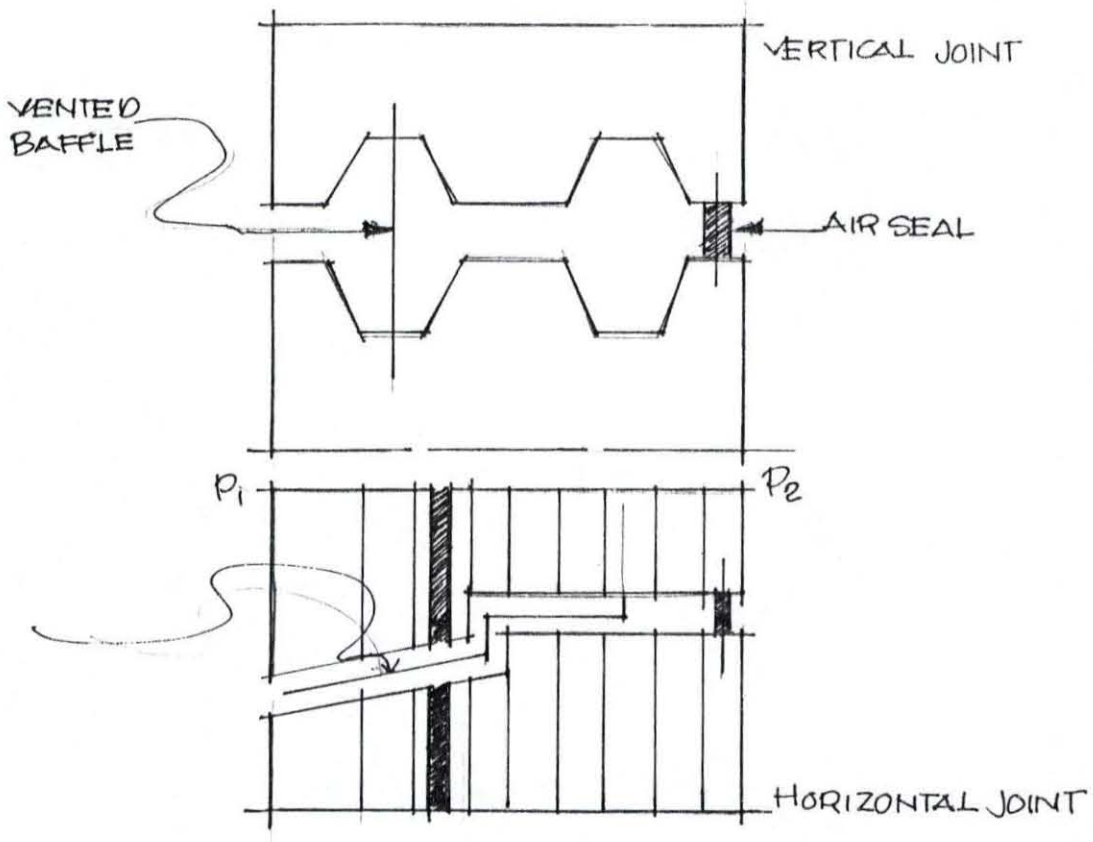
It has been shown that through-wall penetration of rain can be prevented by incorporating an air drain bar in the joint or wall where the air pressure is always equal to that on the outside. The success of the walls shown in figure below is explained by this principle. Partial rain penetration or the wetting of the rain screen materials can be minimized by reducing the surface porosity and absorptive or by control of the forces necessary to produce it. It should be emphasized that the open rain screen principle of rain penetration control can be employed for any situation where rain penetration of wall and wall components can occur, especially at joints between prefabricated components (figure 2 below).

3.6.2 **Special Considerations**

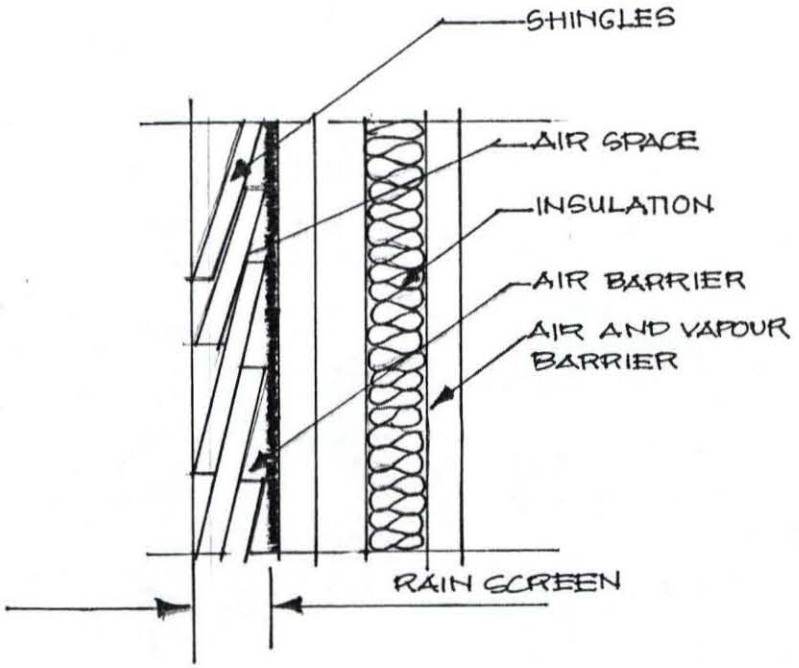
A building employing this principle must assume that water may enter a joint and gain partial penetration of a wall. The water must then be led out of the joint or wall by flashings at horizontal joints of panels or at the bearing planes of multiplayer walls (ventilated cavity masonry walls). Openings such as windows, doors, and grilles in multiplayer wall must be sealed to the air barrier portion of the wall with projections or overhangs connecting with the rain screen. The air barrier must prevent major air leakage and resist wind loads on the building.

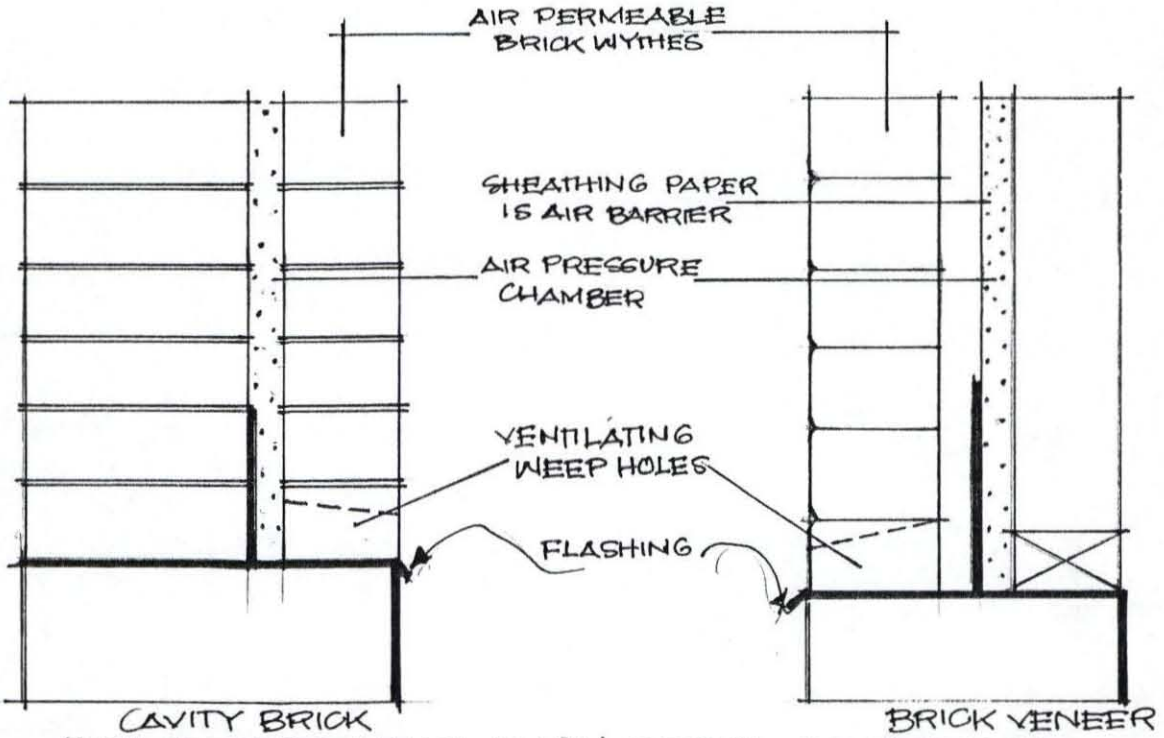
JOINTS BETWEEN PREFABRICATED COMPONENTS





(b) CONCRETE PANELS
P_1 = WIND PRESSURE
P_2 = BUILDING AIR PRESSURE





BOTH OF THESE WALLS ALLOW PARTIAL AIR PRESSURE EQUALIZATION IN CHAMBER

A most important consideration in the application of the open rain screen principle is related to the fact that air pressure on the exterior of a building vary from the positive pressure caused by stagnation of the wind down to suctions several times greater in magnitude (CBD 40). Because of this variation, an air pressure drop occurs that causes air to flow from a point of high pressure through the wall and along the air chamber to come out at a point of lower pressure. As this airflow could move a large amount of water or snow into the chamber, with the risk of rain penetration, the air chamber should be interrupted at suitable intervals to minimize lateral or vertical air movement. The frequency of the chamber closure should be such that the variation of air pressure outside any compartment is at an acceptable minimum. Therefore, the compartment could vary over the face of the building, being relatively small near the extremities of walls where the rates of wind pressure change is the greatest, and quite large over the central portion where there will usually be only slight wind pressure variation. The space must, however, be closed at all corners of the building to prevent air from going around the corner to feed the high suctions that occur at the adjacent wall face. In the absence of more information it is suggested that the closures occur at not more than 1.22 meters centers parallel to ends and tops of walls in a 6.10 meters wide perimeter zone, and at 30.5 meters to 6.10 meters centers in both directions over the central portion.

The advantages inherent in designs based on the open rain screen principle go far beyond those associated with rain penetration control. Movements and minor imperfections of the joint seal between prefabricated components become less critical, and the life of sealants is extended by shading of rain and solar radiation.

CHAPTER FOUR

4.0 CASE STUDIES

CASE STUDY ONE: **UPPER NIGER BASIN DEVELOPMENT AUTHORITY, MINNA, NIGER STATE.**

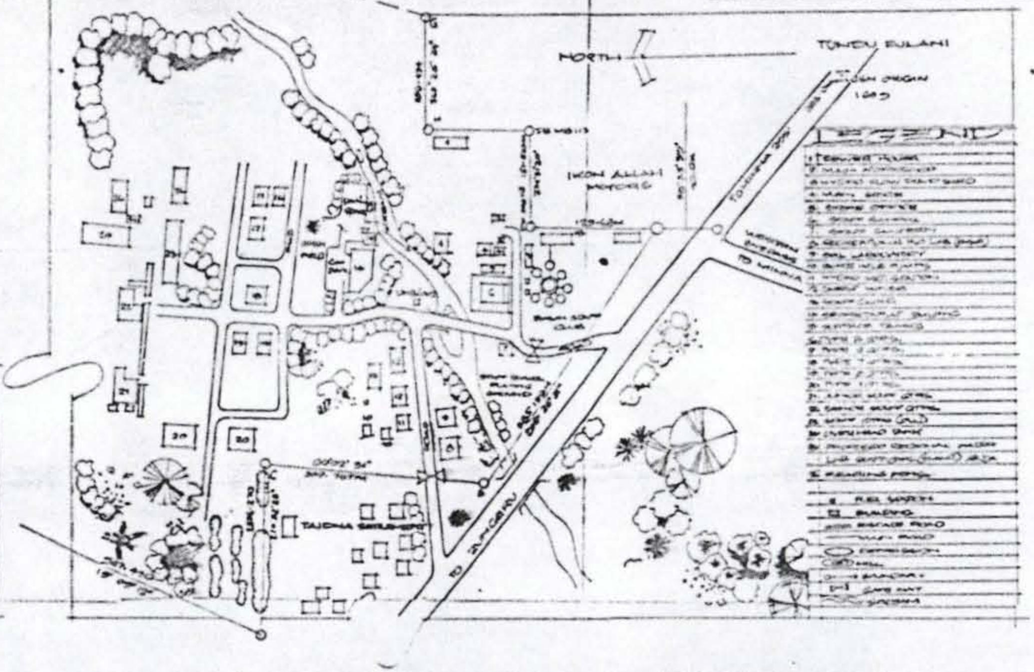
CASE STUDY TWO: **NIGER DELTA DEVELOPMENT AUTHORITY, PORT HARCOURT, RIVERS STATE.**

4.1 CASE STUDY ONE: UPPER NIGER BASIN DEVELOPMENT AUTHORITY, MINNA, NIGER STATE.

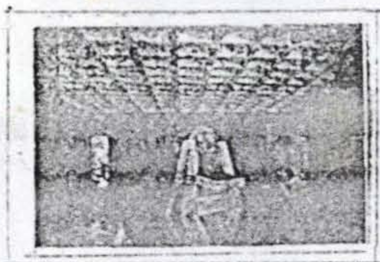
BACKGROUND:

Upper Niger Basin Development Authority is a comprehensive water resources development institution, which was recreated on the fourth day of January, 1994 from the defunct Niger River Basin Development Authority which was established by the Federal Government under Decree No. 25 of 15th June, 1976. It was created when the River Basin and Rural Development Authorities (RBRDAs) were restructured into eighteen (18) along the nineteen (19) states structure of the Federation with the exception of Lagos state, which shared the same river basin with Ogun State. After the creation as Niger Basin it was reconfirmed as same in 1987 to help accelerate the development, conservation and efficient utilization of available land and water resources in the "Niger River Basin", with a view to improving the standard of living and quality of life of Nigerians particularly those in the rural areas through irrigation agronomy and supply of water for both human and animal consumption.

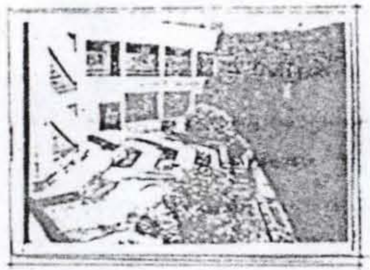
CASE STUDY



ENTRANCE PORCH



COURT YARD



BASIC INFORMATION.

BACKGROUND.

THE UPPER NIGER RIVER BASIN DEVELOPMENT AUTHORITY AS IT IS KNOWN TODAY WAS RECREATED ON THE FOURTH DAY OF JANUARY 1984 FROM THE DEFUNCT NIGER RIVER BASIN DEVELOPMENT AUTHORITY WHICH WAS ESTABLISHED BY THE FEDERAL GOVERNMENT UNDER DECREE NO.25 OF 18TH JUNE, 1976. BASICALLY IT WAS CREATED WHEN THE RIVER BASIN AND RURAL DEVELOPMENT AUTHORITIES (RBRDA) WERE RESTRUCTURED INTO EIGHTEEN (18) ALONG THE THEN NINETEEN (19) STATES STRUCTURE OF THE FEDERATION WITH THE EXCEPTION OF LAGOS STATE WHICH SHARED THE SAME RIVER BASIN WITH OGUN STATE.

THE AUTHORITY IS A PARASTATAL UNDER THE SUPERVISION OF THE FEDERAL MINISTRY OF WATER RESOURCES AND IT IS FULLY OWNED BY THE FEDERAL GOVERNMENT OF NIGERIA. IT HAS BEEN PARTIALLY COMMERCIALISED.

LOCATION: THE HEADQUARTERS IS LOCATED IN KM 5 TUNDU FULANI, MINNA - ZUNGERU ROAD, IN NIGER STATE.

CATEGORY: BASED ON THE TECHNICAL COMMITTEE ON PRIVATISATION AND COMMERCIALIZATION (TCPC), NOW BUREAU OF PUBLIC ENTERPRISES (BPE) IT HAS BEEN PLACED IN CATEGORY B BASED ALSO ON APPROVED BPE ... THE ORGANISATIONAL STRUCTURE CONSISTS OF TWO MAIN DEPARTMENTS VIZ: OPERATIONS AND FINANCE AND ADMINISTRATION

MEMBER STATES: FCT ABUJA, KADUNA AND NIGER STATES

BANKERS: INTER CITY BANK PLC MINNA
HABIB (NIGERIA) BANK LIMITED MINNA
INTERCITY BANK PLC KADUNA

MERITS.

- WAS IMPRESSED BY THE LEVEL OF LANDSCAPING
- PRETTY GOOD ARRANGEMENT OF FACILITIES ESPECIALLY STAFF PRIMARY AND NURSERY SCHOOLS
- PRETTY GOOD LEVEL WATER CONTROL WITHIN THE BUILT ENVIRONMENT.

DEMERITS.

- INADEQUATE PARKING FACILITIES
- ROAD CONDITIONS ARE PRETTY BAD

U.N.R.B.D.A. DESIGN PROPOSAL FOR HEADQUARTERS PORT HARCOURT WITH EMPHASIS ON CONTROL OF WATER IN BUILDINGS.

M.TECH. FINAL MISSION

The authority is a parastatal under the supervision of the Federal ministry of Water Resources and it is fully owned by the Federal Government of Nigeria.

Location:

The headquarters of the Authority is in Minna, Niger State. More specifically, it is located in Km 5 Tundun Fulani, Minna – Zungeru Road, in Niger State. In addition, the Authority has an Area Office in Kaduna and Projects Offices opened in Wushishi, Swashi, Suleja, Gusoro Awohu, Igabi, Zangon Kataf and Zaria. These Area and Projects Offices coordinate Field operations of the Authority in areas that fall under their jurisdiction and report directly to the Headquarters.

Category:

Based on the Technical Committee on Privatization and Commercialization (TCPC) now Bureau of Public enterprises (BPE), it has been placed in category B. based also on approved BPE's guidelines, the organizational structure consist of two main Departments viz: Operations and Finance and Administration. In addition to this, there is the office of the Managing Director which has four (4) units: Corporate Affairs, Corporate Planning and Management, Legal and Internal Audit. The two main Departments are headed by Executive Directors who report directly to the Managing Director/Chief Executive.

Functions:

1. To carry out comprehensive development of both surface and underground water resources for multipurpose use with particular emphasis on provision of irrigation infrastructure and the control of floods and erosion and for watershed management.
2. To construct, operate and maintain dams, dykes, polders, wells, boreholes, irrigation and drainage system.
3. To supply water from the Authority has completed storage schemes.
4. To construct, operate and maintain infrastructure services such as roads and bridges linking project sites; if such infrastructure services are included and form an integral part of the approved projects.
5. To develop and keep up-to-date comprehensive Water Resources Master Plan, identifying all water resources requirements in the Authority's areas of operation, through adequate collation of water, water use, socio-economic and environmental data of the River Basin.

Corporate Information

1. **OFFICES**

i. **Headquarters:** Tudun – Fulani Km 5, Minna – Zungeru Road,
P. M. B. 68, Minna, Niger State.

ii. **Area Office:** No. 11 Wumo Road, Badarawa, Kaduna, Kaduna State.

iii. **Project Office:**

a. Niger State: Wushishi, Swashi, Suleja & Gusoro Awohu.

a. Kaduna State: Igabi, Zango – Kataf, Zaria.

b. Federal Capital Territory: Project Office, Suleja.

1. **BANKERS**

a. Intercity Bank Plc. Minna.

b. Habib (Nigeria) Bank Limited, Minna.

c. Intercity Bank Plc., Kaduna.

1. **AUDITORS**

MU – ALLAHYIDI & Co.

(Chartered Accountants) Kaduna.

L.8 Ahmadu Bello Way,

P. O. Box 7772.

1. **LEGAL RETAINERS**

i. Summit Chambers, Minna.

ii. Paul Usoro and Co., Kaduna.

Observations:

Merits

- Good arrangement of facilities
- Maintenance outline is pretty good
- Water control within the courtyard is interestingly good,
- Landscaping level is above what we may consider as average.

Demerits

- Inadequate parking facilities
- Lack of drainage facilities along the road
- Inadequate provision of staff accommodation

4.2 CASE STUDY TWO: NIGER DELTA DEVELOPMENT AUTHORITY, PORT HARCOURT RIVERS STATE.

Introduction:

NIGER DELTA BASIN DEVELOPMENT AUTHORITY

a. **Introduction**

Niger Delta Basin Development Authority (NDBDA) was established by decree 37 of 3rd August 1976 and consolidated by decree 87 of 29th September, 1979 (NDBDA annual report). Decree 35 of 1987 readjusted the boundaries of the River Basin, thus the geographical area of the Authority covers the whole of Rivers, Bayelsa and eighteen Local Government Areas of Delta State. The local government area in Delta State are: Bomadi; Burutu, Ethiope East, Isoko South, Ndokwa North, Ndokwa South, Okpe, Sapele, Udu, Ugheli South, Ughelli North, Urwie, North, Warri south and Warri Central Patani, Ethiope West, Isoko North, (NDBDA) annual report 1999).

The exploitation of both underground and surface water resources of the Niger Delta area for multi-purpose uses is the main function. The need for people in the Authority's catchment area, and indeed Nigeria, to attain their full potential in Agriculture and self-sufficiency in food production has been the ultimate goal of the Authority.

Provision of irrigation and drainage infrastructures would be made sure at various locations to enable farmers plant all year round. Other functions include erosion control and water shed management; collection; analysis and storage of hydrological and metrological data, and to support the foundation and implementation of water resources master plan.

The Authority is headed by the general manager who is the chief executive. Three departments exist, each headed by an Assistant general manager.

1. The includes Administration/Finance Department
2. Planning, investigation and Design Department
3. Construction, open and maintenance department

d. **CORPORATE INFORMATION**

OFFICES/BANKERS/INSURERS/AUDITORS

OFFICE:

Headquarter: 1 Azikiwe road,
PMB 5676,
Port Harcourt

Bankers:

1. All states Trust bank,
   Aba Road,
   Port Harcourt
2. Hallmark Bank Nig. Ltd.
   Aba Road,
   Port Harcourt

3. Fortune Bank Nig. Ltd.

   Boro park,

   Port Harcourt

4. City Express Bank

   Olu Obasanjo Road,

   Port Harcourt

5. Continental Trust Bank Ltd

   Olu Obasanjo Road,

   Port Harcourt

6. Citizen Bank Ltd

   Olu Obasanjo Road,

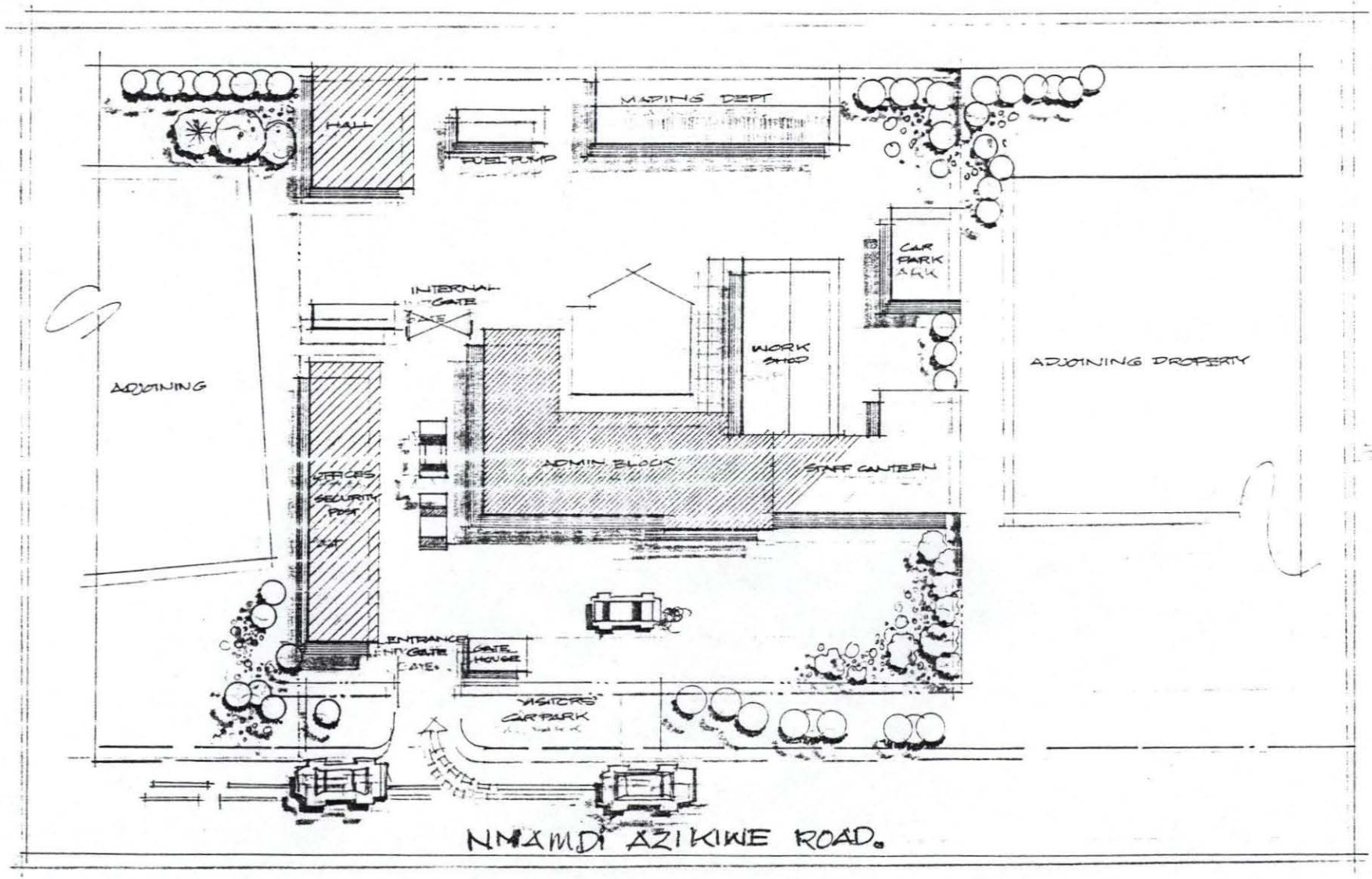
   Port Harcourt

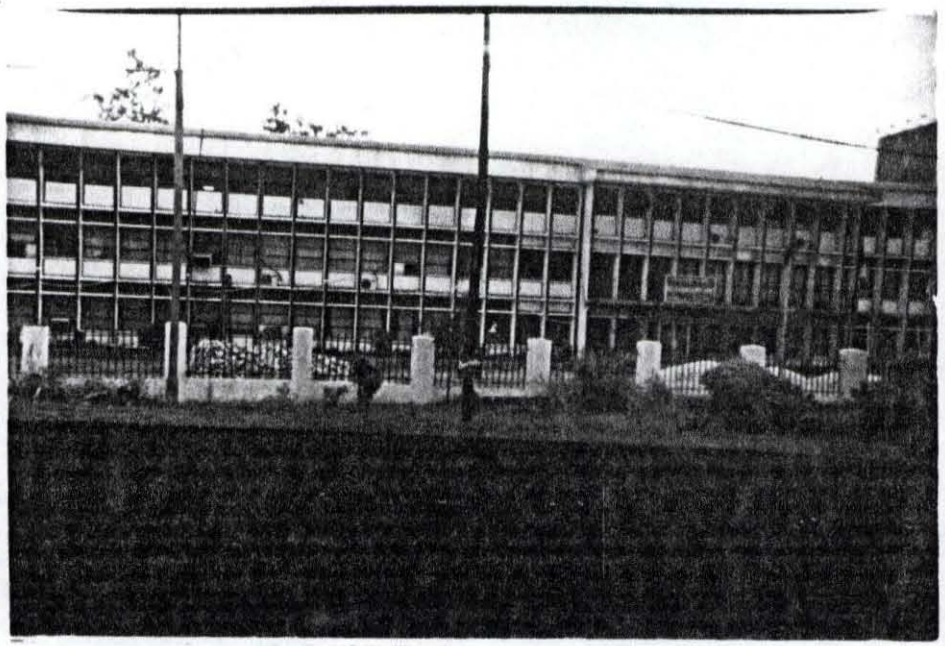
Insurers:

1. National Insurance Corporation of Nigeria (NICON)
2. Niger Insurance Company
3. Rix-Bank Company
4. Bellerest Insurance brokers and Consultancy

Auditors:

Messers Anderson Eseimoh & Co. (Charactered Accountants)


HALL
MAPING DEPT
FUEL PUMP
CAR PARK
INTERNAL GATE
WORK SHED
ADJOINING
ADJOINING PROPERTY
OFFICES
SECURITY POST
ADMIN BLOCK
STAFF CANTEEN
ENTRANCE GATE
GATE HOUSE
VISITORS CAR PARK
NNAMDI AZIKIWE ROAD.



EXTERNAL VIEW OF

NIGER DELTA DEVELOPMENT AUTHORITY

Observations:

Merits

- Good maintenance.
- Control of water within the structure is good.
- Security precautions are pretty good,
- Good circulation within the building.
- Adequate day lighting.

Demerits

- Control of water without the building is pretty bad.
- Poor landscaping techniques.
- Inadequate car parking facilities.

CHAPTER FIVE

5.1 Climatic Conditions:

From the diagram, it can be clearly stated that Nigeria is divided into four climatic regions, namely; the High Plateaux, the tropical continental north, the tropical hinterland, and the sub-equatorial south of which Port Harcourt belongs. It extends from the coast to roughly 130 to 160 kilometers inland. It has over 150 centimeters of rainfall per annum, double maxima rainfall, and no month has less than 2.5 centimeters of rain. The total rainfall increase from 150 centimeters in the west to more than 300 centimeters in the delta area.

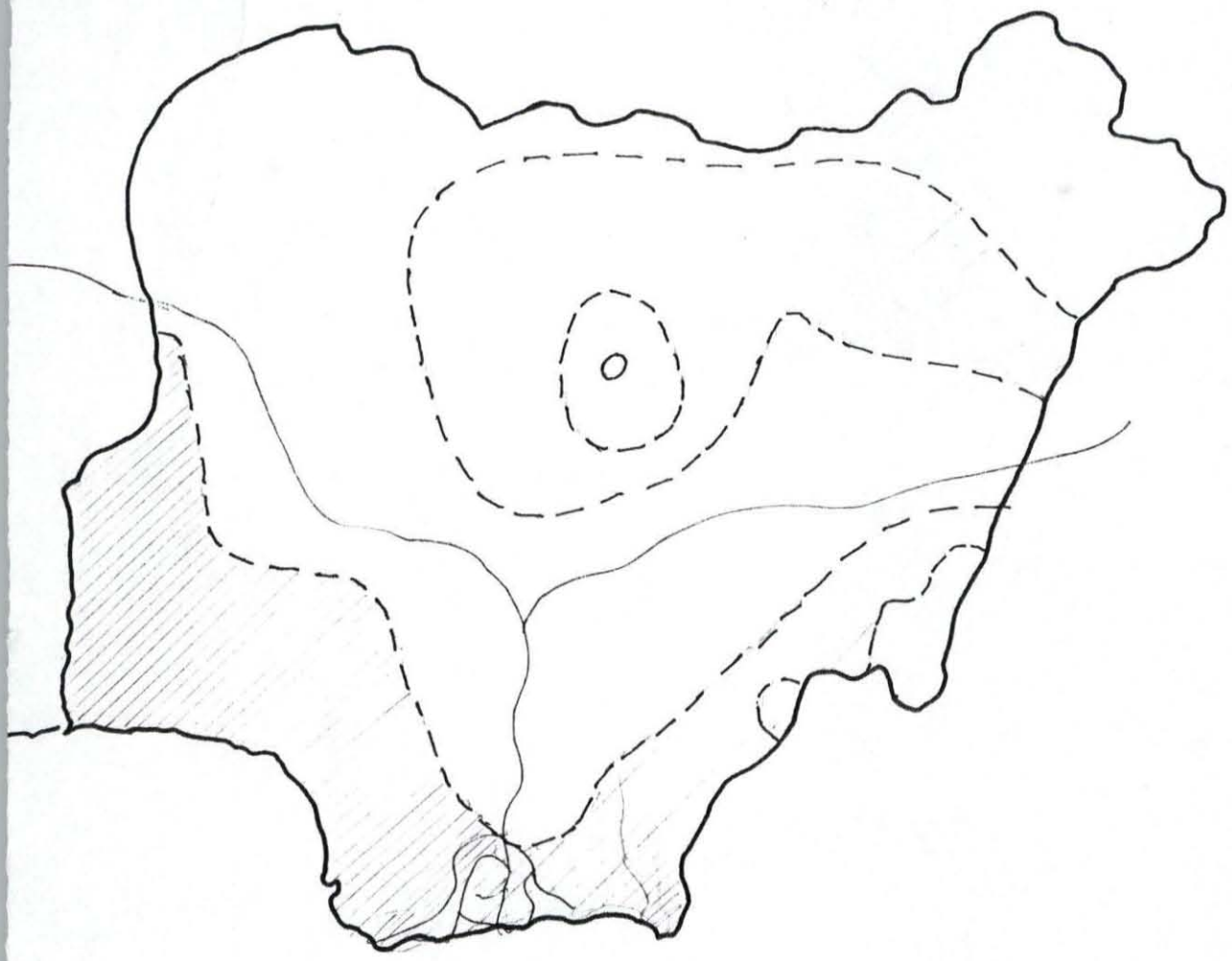
5.2 RELATIVE HUMIDITY

Humidity is the amount of moisture present in the atmosphere while the relative humidity is expressed as a ratio of observed vapour pressure to that which would prevail when the volume of air becomes saturated and at the same temperature. Here the relative humidity is normally over 90% in the early part of the morning, but fall to between 60% to 80% in the afternoon.

5.3 SUNSHINE

There are differences between the maximum sunshine hours and the actual sunshine hours received. Sunshine hours vary with latitude. In general, values are high during the dry season throughout this region, mainly because skies are less cloudy than during the rainy season. The actual number of sunshine hours increases with increasing zenith angle of the

FIGURE MEAN ANNUAL TEMPERATURE DISTRIBUTION IN NIGERIA.

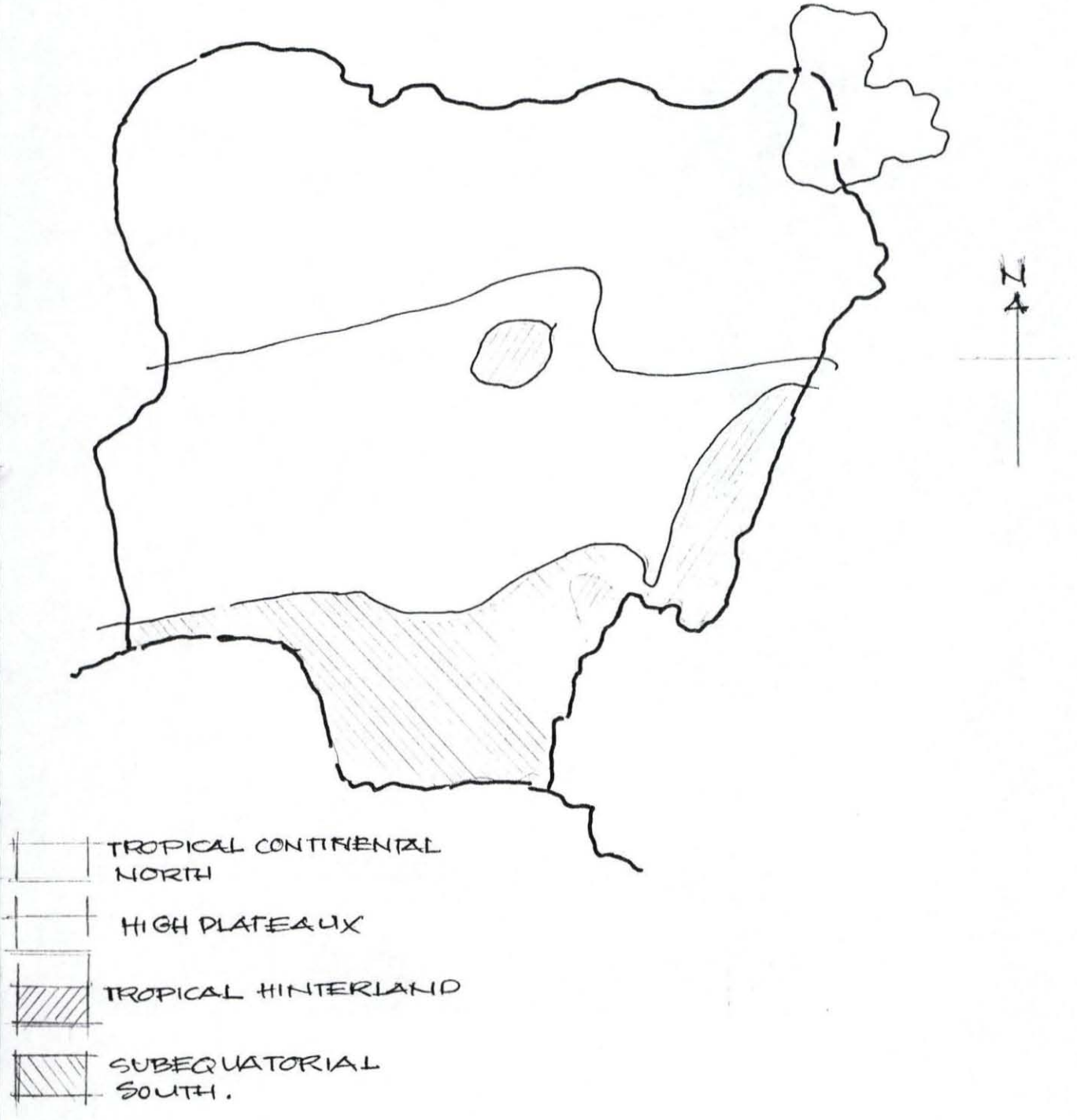


HOTTEST AREAS OVER 27°C

MODERATELY HOT AREAS 24°C–27°C

COOL AREAS LESS THAN 24°C

FIGURE DIAGRAMATIC REPRESENTATION OF CLIMATIC REGIONS IN NIGERIA.



sunshine before the rainy season and highest in month's preceeding the rains. The figure below gives a graphic picture of the sunshine hours in Port Harcourt.

5.4 GEOLOGY AND TOPOGRAPHY

The relief of Nigeria is such an interesting one, and based on the classification, the Port Harcourt area belongs to the lowlands as shown in the figure below. A sub-classification places the Port Harcourt area as belonging to the coastlands. This run along the coast from east to west approximately below 30 meters and made up of recent deposits of sand, clay and mud. These coastlands can be divided into two.

1. The lagoon coast lies in the west where strip is narrow. Sands predominate and sandbars cut off east-west lagoons. The Lagos lagoon is partly made up of fresh water from the rivers and partly of seawater stranded behind a sandbar. The sea front of this bar is popularly known as bar beach.
2. The Niger Delta consists mainly of muddy deposits pushed out by the Niger into a relatively tide less salt sea. A broad fan – shaped piece of land is thus built up to form the most extensive flat area along the coast and one of the best examples of a delta in the world.

5.5 SOCIO – CULTURAL LIFE

The major inhabitants of this area include the Igbos, Ibibios and Ijaws. It is one of the most densely populated parts of Nigeria. Densities of about 550 per square kilometer are usual.

Rural settlements are more closely packed here than any other part of Nigeria, like the other parts of eastern coastal lowlands. They still engage in display of masquerades during festive periods.

5.6 ECONOMY AND COMMERCE

Rural Economy:

Crop farming and petty trading predominate with the addition of fishing. This area has scattered all over the place oil mills for the processing of palm yields.

Commercial and Industrial Activity.

Believed in many quarters as the oil capital of Nigeria, it is situated on the Bonny River 66 Kilometers from the open sea and at the southern end of the eastern railway. It is sited just where the coastal marshes give way to the lowlands of the interior.

Its importance as a transshipment point and commercial center and also because of its proximity to many oil wells, Port Harcourt has become the premier industrial city east of the Niger (see fig.below). It has numerous industrial undertakings including a furniture factory, a cycle assembly plant, a flourmill and a ₦15 million tobacco factory at its time of construction. It has a production capacity of 4 million cigarettes a day.

Also in existence here is a tans-Atlantic industrial estate similar in many respect to Ikeja in Lagos, it houses the tyre factory worth ₦ 6 million at the time of construction and a glass factory worth ₦ 1, 600, 000.00 at the time of construction.

By far the most important industrial undertaking around Port Harcourt is mineral oil and gas production.

5.7 TRANSPORTATION AND TRAFFIC FLOW

The importance of the city can be associated with its development as a route center. Its rail and road connections with the interior have brought most of the eastern and part of Northern Nigeria within the orbit of its hinterland. Sea route radiate from Port Harcourt, it was possible for the city to become an exporter of petroleum and palm from the immediate hinterland, and of tin and groundnut from the north.

To cope with this traffic, the Bonny River was dredged to a depth of 6 meters at low water. The wharf has been extended, the first phase of the extension been completed in the 1950s. The second phase was started in 1965 and the third in 1977.

CHAPTER SIX

6.1 CRITERIA FOR SITE SELECTION

The selection of site has been based on two factors. The macro selection factor and the micro selection factors.

6.1.1 Macro Selection Factors

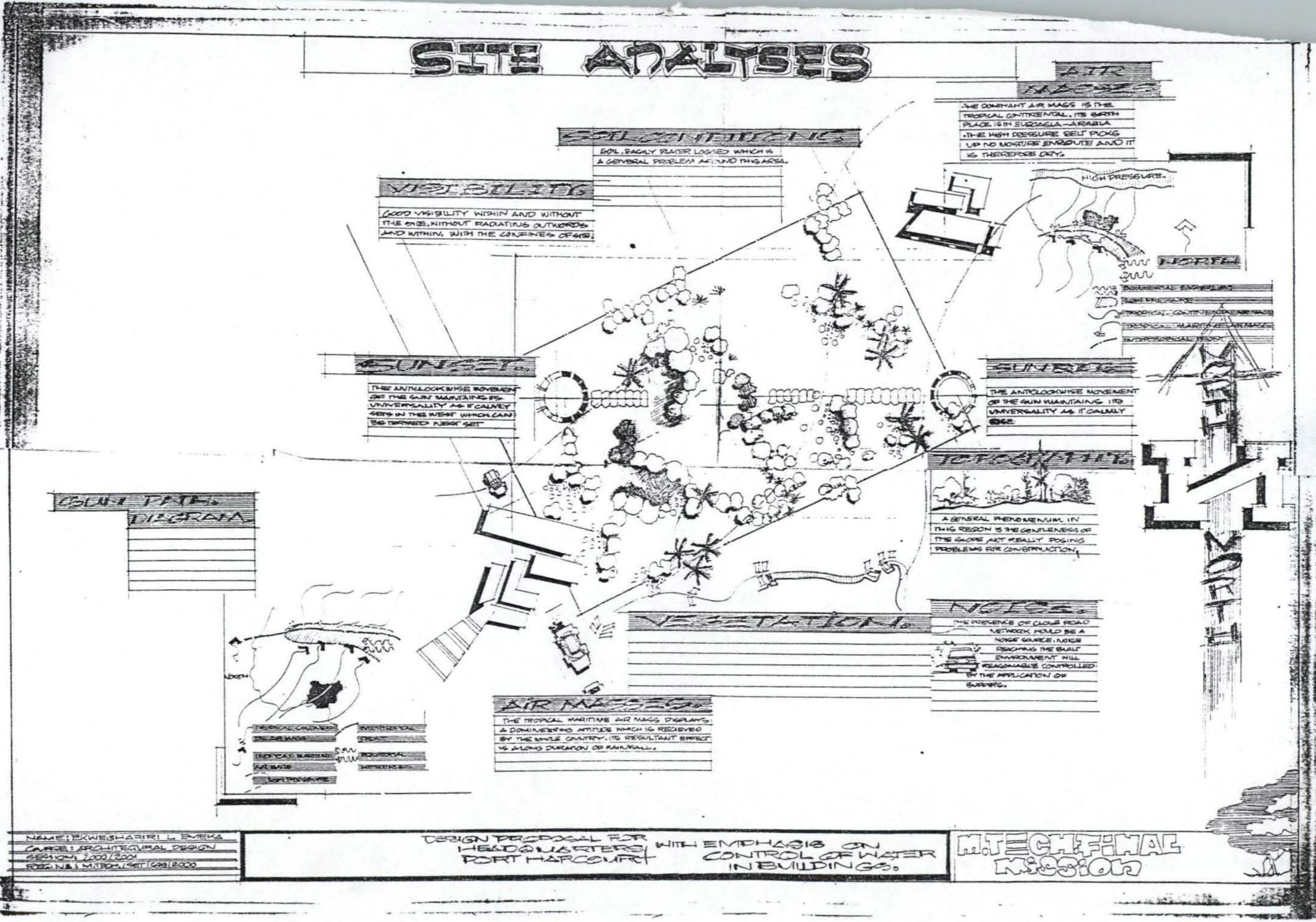
The Act in section one (1) sub-section three (3) known as the establishment of the Niger Delta Development Commission, etc. state. The commission shall have its head office in PortHarcourt, Rivers state and establish an office in each member state of the Commission. It was this that drew the first interest of locating the headquarters proposal in Port Harcourt.

6.1.2 Micro Selection Factors

The selection of site has been based on the availability of basic utilities which the site can be connected to such as telephone line, water lines, and electric lines. Also available is good access from the Nnamdi Azikiwe Road, and good views to the surrounding environment.

6.2 LOCATION OF SITE

The site is located along the express way popularly called Nnamdi Azikiwe Road. It is boardered on the north by West African Examination Council (WAEC), on the west by express, on the south by Areta farm Estate and on the east by fallow land.



SITE ANALYSES
AIR MASSES
THE DOMINANT AIR MASS IS THE TROPICAL CONTINENTAL. ITS BIRTH PLACE IS IN EURASIA-ARABIA. THE HIGH PRESSURE BELT PICKS UP NO MOISTURE ENROUTE AND IT IS THEREFORE DRY.
SOIL CONDITIONS
SOIL EASILY WATER LOGGED WHICH IS A GENERAL PROBLEM AROUND THIS AREA.
VISIBILITY
GOOD VISIBILITY WITHIN AND WITHOUT THE SITE, WITHOUT RADIATING OUTWORDS AND WITHIN, WITH THE CONFINES OF SITE.
HIGH PRESSURE
NORTH
SUNSET
THE ANTICLOCKWISE MOVEMENT OF THE SUN MAINTAINS ITS UNIVERSALITY AS IT CALMLY SETS IN THE WEST WHICH CAN BE TERMED NEST SET
SUNRISE
THE ANTICLOCKWISE MOVEMENT OF THE SUN MAINTAINS ITS UNIVERSALITY AS IT CALMLY RISE
TOPOGRAPHY
A GENERAL PHENOMENUM IN THIS REGION IS THE GENTLENESS OF THE SLOPE NOT REALLY POSING PROBLEMS FOR CONSTRUCTION.
SUN PATH DIAGRAM
VEGETATION
NOISE
THE PRESENCE OF CLOSE ROAD NETWORK WOULD BE A NOISE SOURCE. NOISE REACHING THE BUILT ENVIRONMENT WILL REASONABLE CONTROLLED BY THE APPLICATION OF BARRIERS.
AIR MASSES
THE TROPICAL MARITIME AIR MASS DISPLAYS A DOMINEERING ATTITUDE WHICH IS RECIEVED BY THE WHOLE COUNTRY. ITS RESULTANT EFFECT IS A LONG DURATION OF RAINFALL.
NORTH
NAME: EKWEGHARIRI L. EMEKA
COURSE: ARCHITECTURAL DESIGN
SESSION: 2000/2001
REG. NO.: M.TECH./SET/699/2000
DESIGN PROPOSAL FOR HEADQUARTERS PORT HARCOURT WITH EMPHASIS ON CONTROL OF WATER IN BUILDINGS.
M.TECH. FINAL MISSION

Geographically, based on latitude, the site is located between 4°49.1' and 4°.49' north of the equator and between 7°00.5 and 7°01' east of the Greenich meridian.

Site Characteristics (Inventory)

The site possess good qualities for the kind of development being proposed. The soil is loamy dark grey in colour. They are usually waterlogged. Water control techniques will be highly important here. The water logged nature might have prompted the existence of the Areta farm Estate. Based on standardized classification it is known as the zone of alluvial soils.

It has its fair share of both mangrove and fresh water swamp display of vegetation. Dominating species is the raffia palm, with scattered distribution of tree and grasses.

Generally, the slope of the site is almost flat based on visual observation.

6.4 ACCESS AND CIRCULATION

The presence of the Nnamdi Azikiwe express way avail the site good access by road from the surrounding environments. Circulation within the site is easy because of the degree of slope within the site.

6.5 UTILITIES

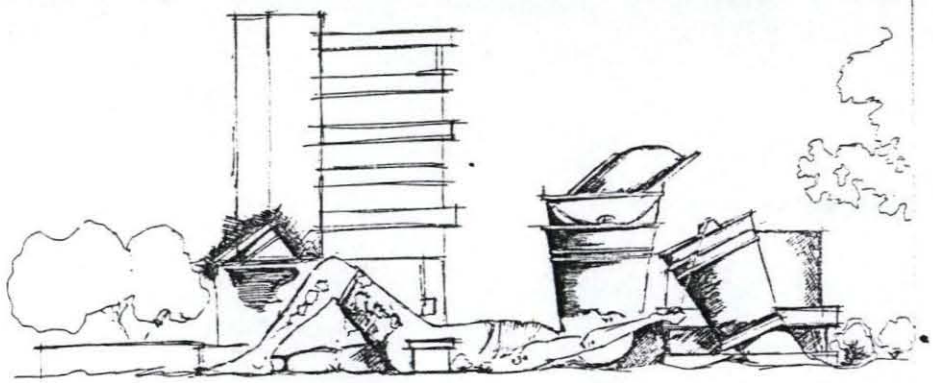
The site has a reasonable access to public utilities such as electric lines water lines and telephone lines and must recently the operation of GSM service providers.

6.6 SCENERY/MAN-MADE FEATURES

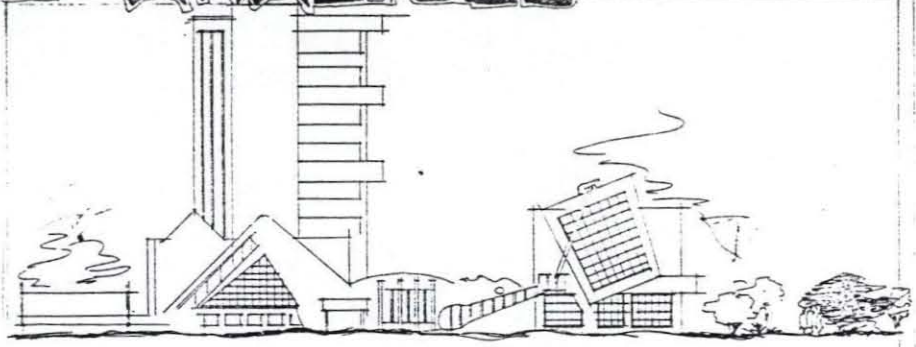
Good road network, West African Examination Council, Rivoc Clinic, Nnamdi Azikiwe Express Way and Areta farm Estate, seen to be the dominating construction works around.

The level of pollution considered to be seen relatively high considering the other parts of the country. This can be said to the result of the industrial activities around which is heavily dominated by the oil operation.

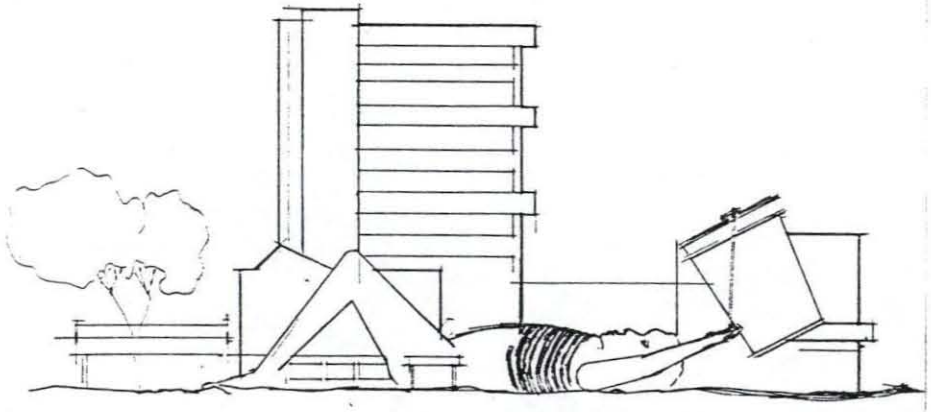
CONCEPTUAL ANALYSIS



STAGE 1.



STAGE 3.



STAGE 2.

STAGE BY STAGE ANALYSIS.

STAGE 1.

NAME: EKWEGHARIRI L. EMEKA
COURSE: ARCHITECTURAL DESIGN
SESSION: 2000/2001
REG. NO: M.TECH.ARCH/699/2000
SUPERVISOR:

M.T.D.C. DESIGN PROPOSAL FOR HEADQUARTERS, PORT HARCOURT WITH EMPHASIS ON CONTROL OF WATER IN BUILDINGS.

M.TECH. FINAL Mission

CHAPTER SEVEN

7.0 DESIGN AND CONCEPT

In the Niger Delta, it is almost an everyday scene to see people discussing the oil companies and how their activities are causing them more pain. The discussion encompasses the support, which they feel the government of the Federal Republic of Nigeria seem to give without hesitation. In the year, 1999 for example there was so much to worry about.

There were series of attacks on the facilities of oil companies because of their refusal to give reasonable assistance to the local communities. People were forced into fetching oil from broken pipes. As it is well known, there were series of consumption of human beings by fire. There is this common documentary on Nigeria Television Authority which shows a woman being flogged as she fetched from a broken pipe by soldiers but she made sure she still fetched. It was a heartbreaking scene, then came the case at Odi where an entire community was brought down by men of the Nigerian Military.

The concept of this design proposal was born out of the touching sights of the struggle for better living standards by the people of the Niger Delta. The stage-by-stage analysis is as shown in the diagrams below.

The conceptual method form follows function was used because of the need to achieve the look of a frustrated-to-death Niger Delta man. The stage-by-stage analysis is as shown below.

7.1 DESIGN

The thorough research work have culminated in a simple design with due considerations to the basic need of a modern day office facility. In the design, provision have been made for the following;

An administrative Unit: Provided for the running of the administrative activities in the commission. These administrative activities have been sub-divided with floors allocated to the various directorates. In situations where two sections exists for instance, before the end of the library section series of floors, two directorates share, partly, a floor level which have been sub-divided into sections.

Some of the floors and their directorates' allocations are as follows with the inclusion of supporting facilities.

Ground Floor:

Section A: Corporate affairs and Library and first aid

Section B: Maintenance and Services.

Section C: Restaurant and Conference Centre.

First Floor:

Section A: Research and Statistics and Management Information System. Library continues.

Section B: Agriculture and Fisheries.

Second Floor:

Section A: Environmental Protection and Control.

Section B: Utilities, Infrastructural Development and Waterways.

Third Floor:

Section A: Community and Rural Development

Section B: Health, Education and Social Services.

Fourth Floor:

Section B: Commercial and Industrial Development

Fifth Floor:

Section B: Project Monitoring and Supervision

Sixth Floor:

Section B: Finance and Supply.

Seventh Floor:

Section B: Legal Services.

Eight Floor: Managerial Floor.

Fuel refilling stations have also been provided. While on the site plan provisions have been made for the allocation of;

a. Gate House
b. Fencing facilities
c. Training Institute

Reasons for the provision of some facilities:

Restaurant:

i. For the purpose of quality control of food to be eaten by members of staff.
ii. To discourage the idea of members of staff having to leave office premises for the purpose of something else to it eat under the guise of going to eat.
iii. To discourage the intrusion of hawkers for the purpose of selling food.

Training Institute:

i. To give the people a better orientation of life, through the teaching of some skills.

ii. To have a better coordination of the activities within the center.

Refilling station:

i. This is born out of the desire to have a reduced stress for members of staff having the need to fill their tanks while still at work.

ii. To create an environment void of cheating when buying fuel.

Landscaping

Incorporated here are hard and soft landscaping elements. Soft landscaping elements used here include; flowers - i.e. hibiscus, yellow bush, bourgavillia, and scattered trees to give it a natural feeling. Grass have been used to cover the lawns and to give the whole site a feeling of life.

Hard landscaping elements have also been used to create a more complete and interesting environment. These include; concrete sculpture, kerbstones, ground slab and fountain.

The organization of the landscape was based on the principles stated below;

a. Preserving existing vegetation where necessary.

b. Each plant is selected and positioned in such a way as to serve its intended function such as light, shade, screening, ground cover, shading terrace from glare, providing enclosure and windscreen for structures.

c. Grouping of trees in such a way as to simulate natural stands. Avoiding regular spacing patterns within open areas.

d. Plants are used to emphasize the alignment of paths (walkways), roadways and facilitate clear direction.

e. Ground covers are used on the base plane to retain soils and soil moisture, define paths and areas, provide turf where required.

f. Shrubs are utilized for supplementary low level buffers and screens.

7.2 CONSTRUCTION

Construction has been scheduled into four (4) basic parts. They include;

Part I: Substructure

Part II: Superstructure

Part III: Roofing

Part IV:Finishes.

Part I. Substructure: This basically involves the digging of foundation trenches and construction of foundation members. This is carried out after the appropriate soil tests have been carried out and results gotten. After this has been properly done and the recommendation of foundation type and depth, based on the soil condition, pile foundation has been recommended, then the construction of the foundation, the hard core and floor slab.

Materials used for the construction of the foundation include; crushed aggregate, steel for reinforcements and concrete members.

In the construction, water problem prone areas will be particularly taken care of.

This is basically a framed structure with internally hidden structural columns.

Part II. **Super structure:** This is basically the building shell, which comprises of the walls, the windows. The construction of this part has engulfed so much considerations, these include; solar, water and comfort. Some parts of the structures have their shells made up domineeringly of curtain walls and some are made up of solid concrete.

Materials used here include thermopane glass for glazing linked together using aluminium frames. Concrete and reinforced concrete members have also been used.

Part III. **Roofing:** this is the part of the structure covering the walling members. They include the roofing trusses, roofing sheets, roofing slabs waterproofing elements.

Chosen material for roofing trusses is steel. The roofing sheet is long span aluminium. The roofing slab where it has been used is a complex structure basically made up of concrete and reinforcements.

Waterproofing has been taken care of using materials such as asphalt bitumen gravels.

Part IV. **Finishes:** This can be classed external and internal. The internal embraces the materials used for partitions such as wood panels, glass and alloy frames. These also include the floor finishes, which are marble in some areas, terrazzo and ceramic tiles in some others.

Ceiling has been of special consideration because of the services within it. Acoustic ceiling have been used.

Skirting within the structures is built of terrazzo.

Decorations have been installed within working areas in order to give a better look to the internal environment. Such decorations include paintings on canvas, sculptural works of art reflecting the people and their way of life.

7.3 SPACE REQUIREMENTS:

The general considerations with respect to space have been so carried using the floor-by-floor analysis.

Ground Floor

Entrance Foyer

Reception area

Lobby

Courtyard and fountain

Water closets

Clinic

Drugs store

Nurse section

Rest room

Treatment room

Water closets

Waiting area

Library

Consultation

Librarian

Chief librarian

Store

Social sciences

Engineering

Stair well

Lobby

Indoor planting

Store

Offices

Museum

Telephone exchange and mailroom offices

Maintenance and Services

Section

Mechanical services

Electrical service

Architectural maintenance

Mechanical maintenance

Electrical maintenance

Assistant Director

A. D's. Sec.

Deputy Director

D. D's. Sec.

Director

Director's Sec.

Core

Lobby

Cleaners store

Closets Gen

Director's closet

Deputy director's closet

Indoor planting

Courtyard

Total

Conference

Conference hall

Water closet

Stair well

Restaurant

Entrance Foyer

Eating area

Fountain

Servery

Snack store

Pantry

Washing section

General store

Cold store

Dry store

Kitchen

Lobby

Changing, male and female

Water closets, male and female

Service foyer

First Floor

Library Continued

Lobby

Courtyard

Indoor planting

Water closets

Stair well

Offices

Consultation

Human sciences

Children's section

Research and Statistics and Management Information System

Archives

General office hall

Research and statistics

General office hall

Management information system

Water closets

Lobby

Store

Office 1

Courtyard

Director

Directors WC

Deputy director

D. D's. Sec.

D. D's. WC.

Assistant director

A. D's. Sec.

Agriculture and Fisheries

Service cores

Lobby

Assistant Director

A. D's. Sec.

Visitors waiting

Deputy Director

D. D's. Sec.

D. D's. WC

General Water closets

Indoor planting

Senior staff General office

Director

Director's Sec.

Director's WC

Cleaners' store

Courtyard

Second Floor

Environmental Protection and Control

Stair well

Indoor planting

Lobby

Office 1

Office 2

Assistant Director

A. D's. Sec.

Deputy director

D. D's. Sec.

D. D's. W. C.

Director

Director's Sec.

Director's WC

Courtyard

Utilities, Infrastructural Development and Waterways

Service cores

Assistant director

A. D's. Sec.

Visitors waiting

Deputy director

D. D's Sec.

General water closets

Senior staff general office

Director's Sec.

Director's W.C.

Cleaners' store

Courtyard

Third Floor

Community and Rural Development

Stair well

Indoor planting

Lobby

Office 1

Office 2

Assistant director

A. D's. Sec.

Deputy director

D. D's. Sec.

D. D's. W.C.

Director's

Director's Sec.

Director's W.C.

Courtyard

Health Education and Social Services

Service cores

Lobby

Assistant director

A. D's. Sec.

Visitors waiting

Deputy director

D. D's. Sec.

General water closets

Senior staff general office

Director's Sec.

Director's W.C.

Cleaners' store

Courtyard

Fourth Floor

Commercial and Industrial Development

Its space requirement is basically the same with that of B part of third floor. This is also the same for the fifth, sixth and seventh. On the eight there is same area requirement with the other floors but the functions are not the same.

Fourth Floor

Commercial And Industrial Development

Service cores

Lobby

Assistant director

A. D's. Sec

Visitors waiting

Deputy director

D. D's. Sec.

D. D's. W.C.

General water closets

Senior staff general office

Director's Sec.

Director's W.C.

Cleaners' store

Courtyard

Fifth Floor

Project Monitoring and Supervision

Service cores

Lobby

Assistant director

A. D's. Sec

Visitors waiting

Deputy director

D. D's. Sec.

D. D's. W. C.

General water closets

Senior staff general office

Director's Sec.

Director's W.C.

Cleaners' store

Courtyard

Sixth Floor

Finance and Supply

Service cores

Lobby

Assistant director

A. D's. Sec

Visitors waiting

Deputy director

D. D's. Sec.

D. D's. W.C.

General water closets

Director

Director's Sec.

Cleaners' store

Courtyard

Seventh Floor

Legal Services

Service cores

Lobby

Assistant director

A. D's. Sec

Visitors waiting

Deputy director

D. D's. Sec.

D. D's. W.C.

General water closets

Director

Director's Sec.

Director's WC.

Cleaners' store

Courtyard

Eight floor

Managerial

Service cores

Office 1

General office

Office 2

Lobby

Courtyard

General water closets

Cleaners' store

Executive eating section

Board room

Executive director 1

E.D's. Sec.

E.D's. WC.

Executive Director 2

E.D.2's WC.

Chairman '

Chairman's Sec.

Chairman's W.C.

CHAPTER NINE

9.0 GENERAL APPRAISAL

In carrying out this project basic research process had been followed to produce a unique structure facilitating the activities of workers in the Commission.

The major goal of architecture is the harmonious combination of functionality and beauty popularly known as aesthetics. Design is not really complete without the coming into play of functionality and aesthetics.

The commission has been so designed to tackle the problems imminent within the site. Noise, Solar and traffic control have been properly taken care off. Within the building careful selection of materials and construction, techniques have been made to create a very conducive working environment with circulation having two branches, the horizontal and the vertical have been taken care of. The horizontal within the building with the lobby and balcony links. Without with the walkway and road networks.

The landscaping have been uniquely planned to combine a great deal of natural look with the artificial. The use of hedges along the sides of roads and parting spaces gives the entire environment a unique level of organization and an aesthetic look that is eye relaxing.

The structure itself is of the people, what a painful thing to belong to be part of a failing struggle, but what joyful thing to be in the succeeding struggle. It is wonderful that the struggle is for better life is succeeding

9.1 CONCLUSION

It is interesting and very gladdening that the wish of the people were granted. It will be more interesting and very gladdening that the best is made of this granted wish. This design proposal is a step, and very important step towards gladdening the hearts of the people. It is noteworthy that the design has sought and made necessary provisions for the structural stability of the building as well as its beauty.

The unification of the disregarded people of the Niger Delta for better living conditions have been given special considerations through the provisions of various departments.

It is not enough to have a structure but to have a functional structure. Peace in the Niger Delta will go a long way in enabling the search for peace in the country (Nigeria) as a whole. The proper running of this commission is much desired to hinder the negating factors, which broke the active wings of its predecessors.

The philosophy, which informed the creation of the Authority, which boarders on the need to accelerate the rate of development in the Niger Delta via adequate harnessing of oil revenue from the Federal Government should not be neglected.

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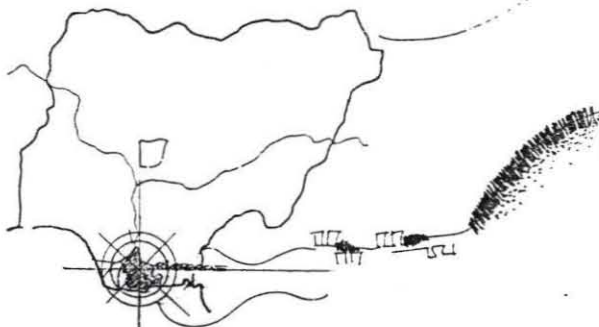
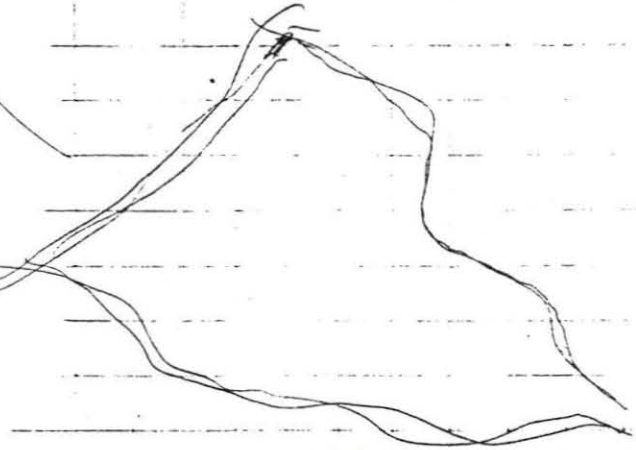
SITE LOCATION



MAP OF NIGERIA SHOWING RIVERS STATE



MAP OF RIVERS STATE SHOWING PORT HARCOURT AREA.

BASIC INFORMATION ABOUT PORT HARCOURT.

LAND USE MAP OF PORT-HARCOURT SHOWING CHOSEN SITE FOR NIGER DELTA DEVELOPMENT COMMISSION HEADQUARTERS.

NAME: EKIKE CHARITY EMEKA
COURSE: ARCHITECTURAL DESIGN
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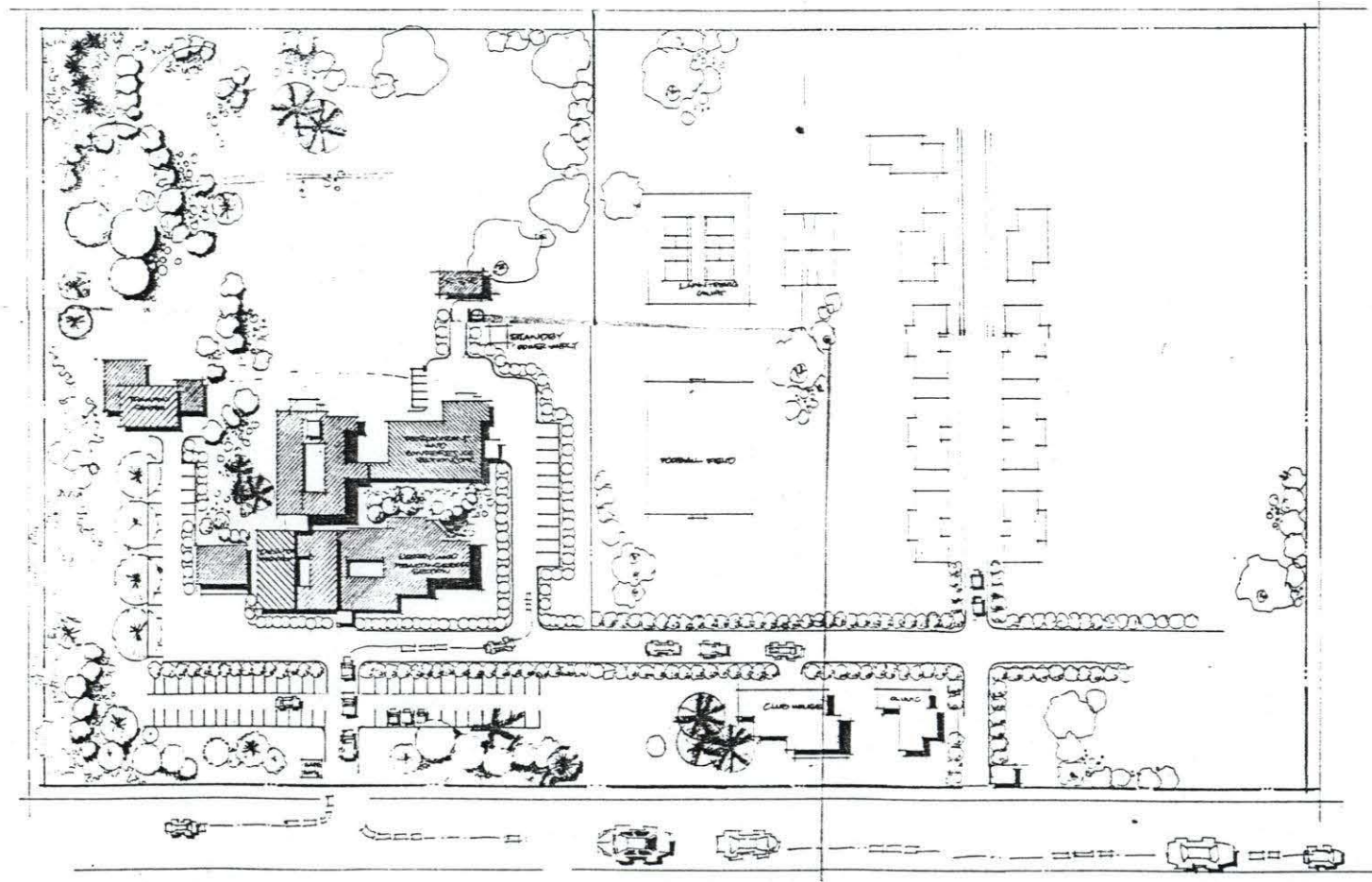
DESIGN PROPOSAL FOR HEADQUARTERS OF PORT HARCOURT WITH EMPHASIS ON CONTROL OF WATER IN BUILDINGS.

M.TECH. FINAL MISSION

SITE PLAN



NAME: EKWEGHARIRI L. EMEKA
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SUPERVISOR:

P.D.D.C.

DESIGN PROPOSAL FOR HEADQUARTERS WITH EMPHASIS ON CONTROL OF WATER IN BUILDINGS. PORT HARCOURT

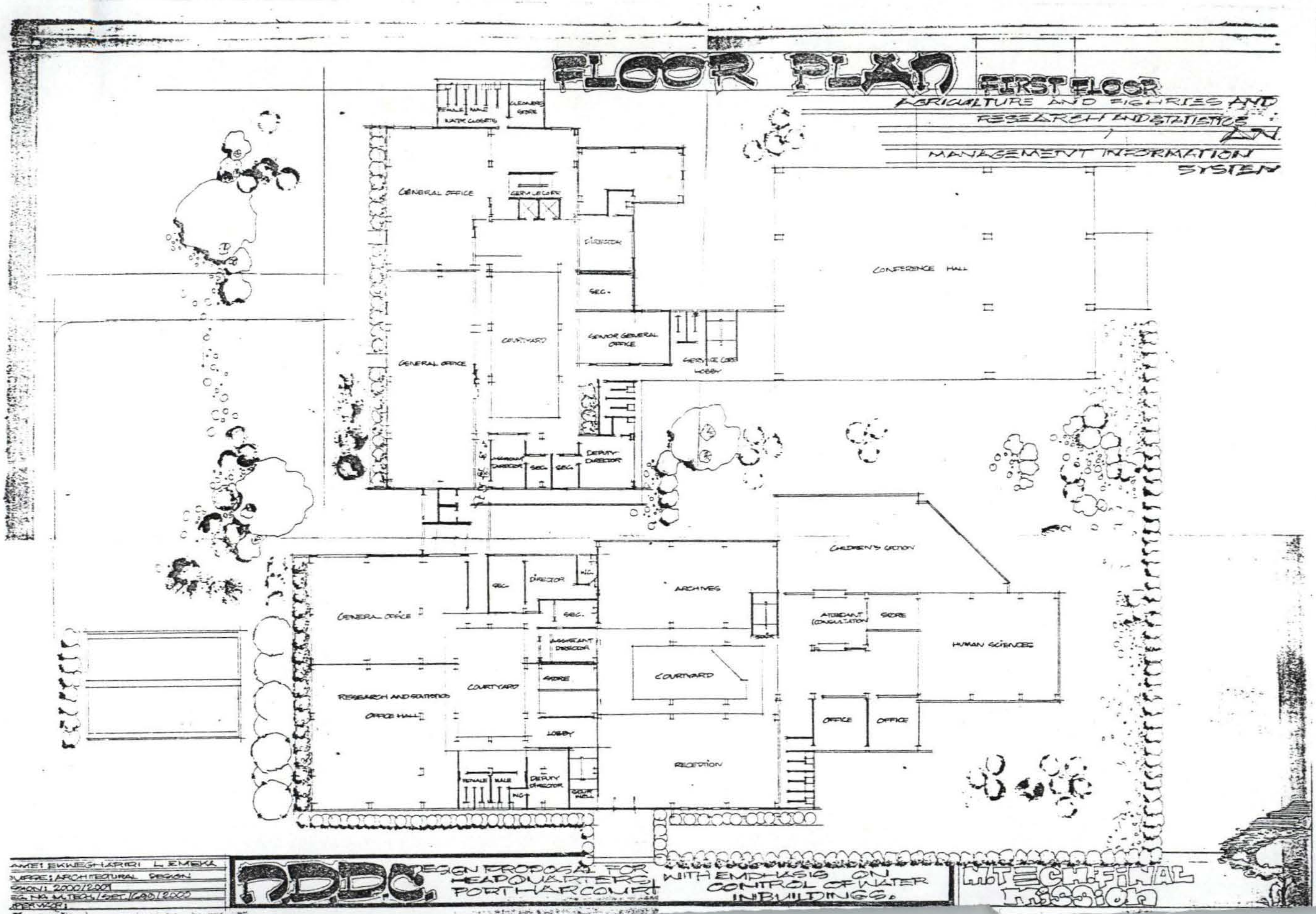
M.TECH. FINAL MISSION

FLOOR PLAN

DESIGN PROPOSAL FOR
HEADQUARTERS WITH EMPHASIS ON WATER CONTROL OF BUILDINGS
FORT HARCOURT

MIGHTFUL MISSION

MUSEUM
COURTYARD
CONFERENCE HALL
RESTAURANT
MAINTENANCE AND SERVICES
OFFICE AFFAIRS
LIBRARY AND CLINIC SERVICES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FIRST FLOOR
AGRICULTURE AND FISHERIES AND RESEARCH AND STATISTICS / AN MANAGEMENT INFORMATION SYSTEM
GENERAL OFFICE
FEMALE MALE WATER CLOSETS
CLEANERS STORE
DIRECTOR
SEC.
COURTYARD
SENIOR GENERAL OFFICE
SERVICE CORE LOBBY
CONFERENCE HALL
ASSISTANT DIRECTOR
DEPUTY DIRECTOR
CHILDREN'S SECTION
ARCHIVES
ATTENDANT CONSULTATION
STORE
HUMAN SCIENCES
RESEARCH AND STATISTICS OFFICE HALL
LOBBY
RECEPTION
OFFICE
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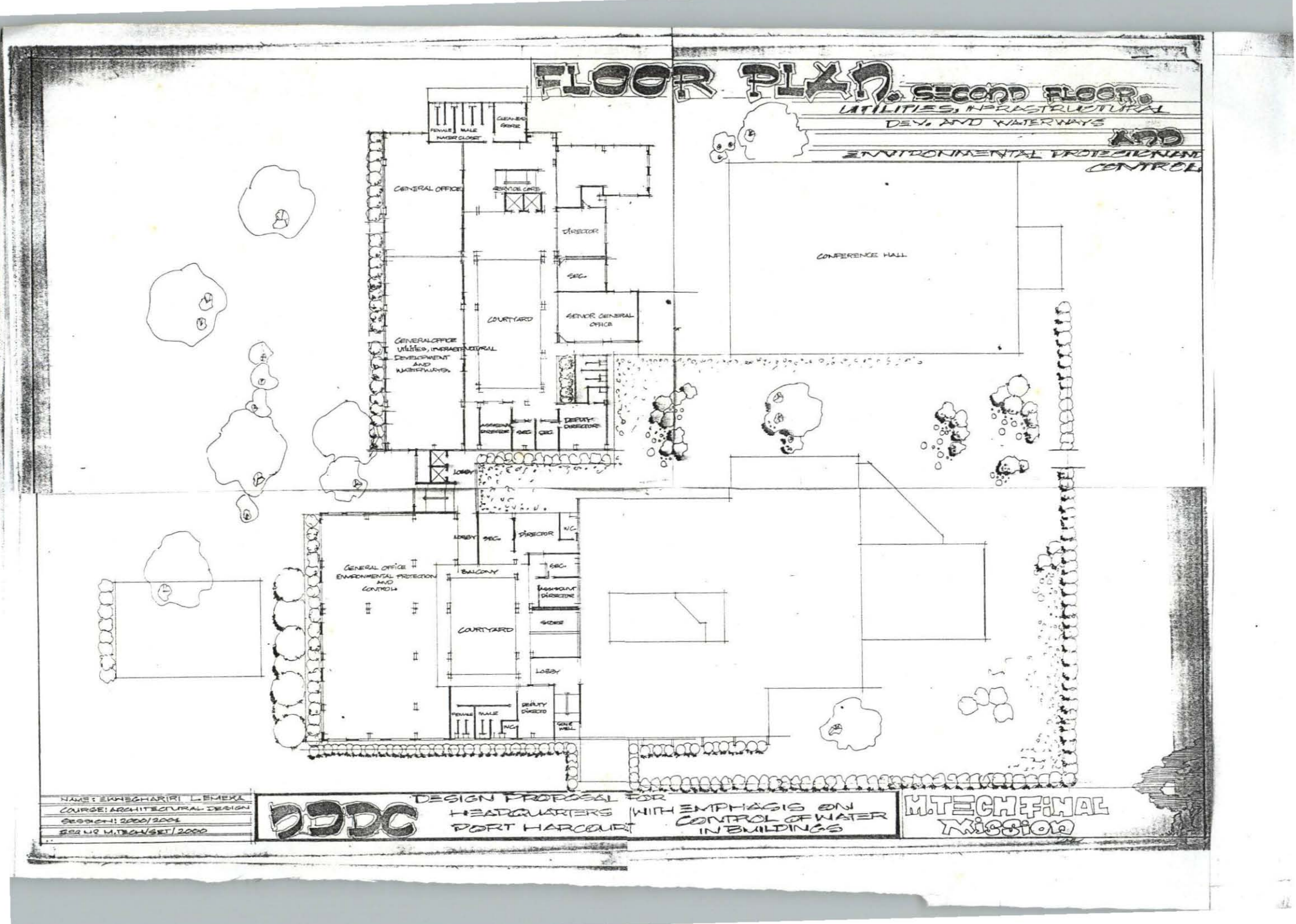
N.D.D.C. DESIGN PROPOSAL FOR HEADQUARTERS, PORT HARCOURT WITH EMPHASIS ON CONTROL OF WATER IN BUILDINGS.
M.TECH. FINAL SUBMISSION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UTILITIES, INFRASTRUCTURAL DEV. AND WATERWAYS AND ENVIRONMENTAL PROTECTION CONTROL
GENERAL OFFICE
SERVICE CORE
DIRECTOR
SEC.
COURTYARD
SENIOR GENERAL OFFICE
CONFERENCE HALL
GENERAL OFFICE UTILITIES, INFRASTRUCTURAL DEVELOPMENT AND WATERWAYS
DEPUTY DIRECTOR
LOBBY
GENERAL OFFICE ENVIRONMENTAL PROTECTION AND CONTROL
BALCONY
ASSISTANT DIRECTOR
LOBBY
FEMALE
MALE
N.C.
GENTS WELL
NAME: EWNEGHARIRI L. EMEKA
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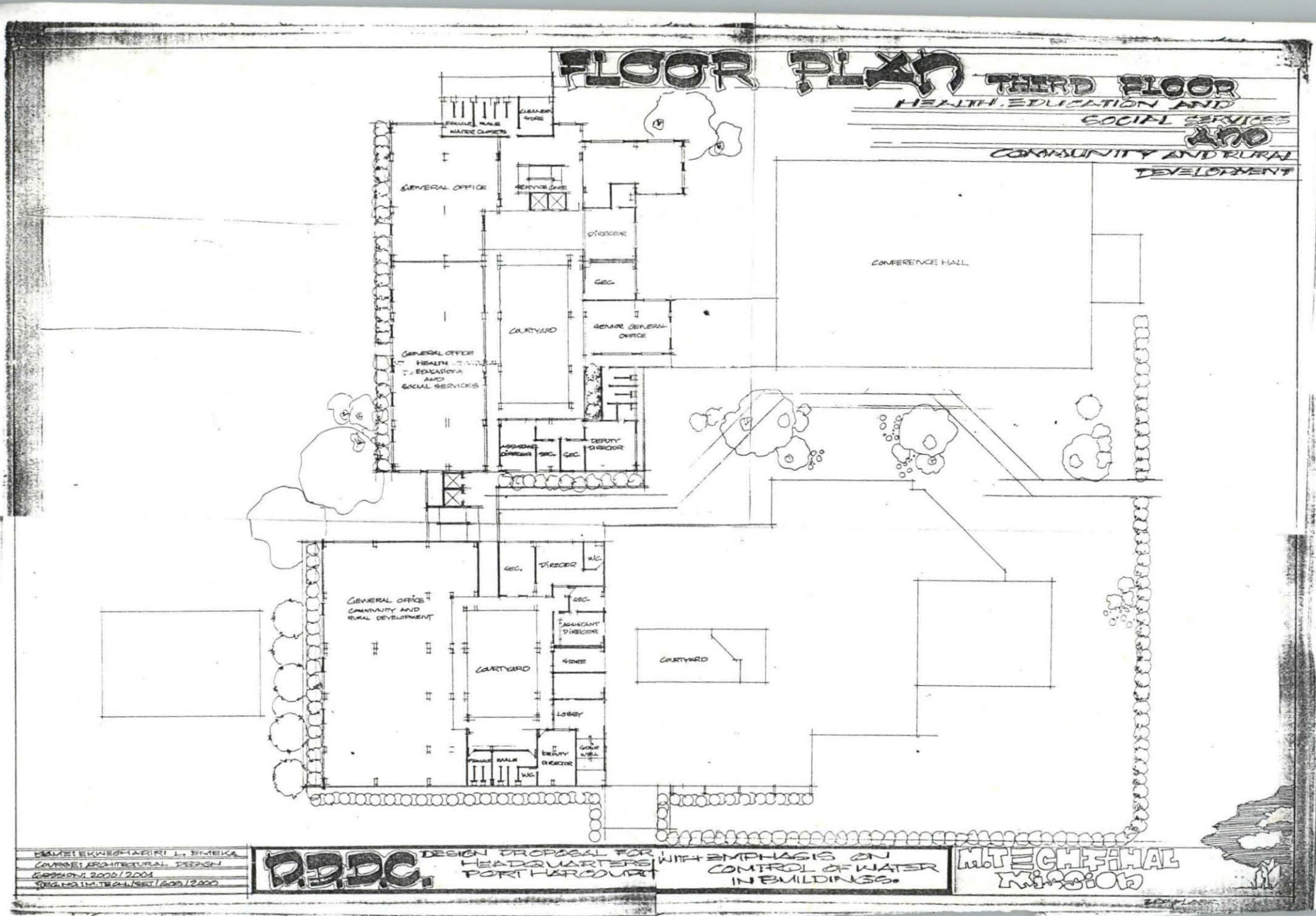
REG NO: M.TECH/SET/2000
DDDC
DESIGN PROPOSAL FOR HEADQUARTERS PORT HARCOURT WITH EMPHASIS ON CONTROL OF WATER IN BUILDINGS
M.TECH FINAL MISSION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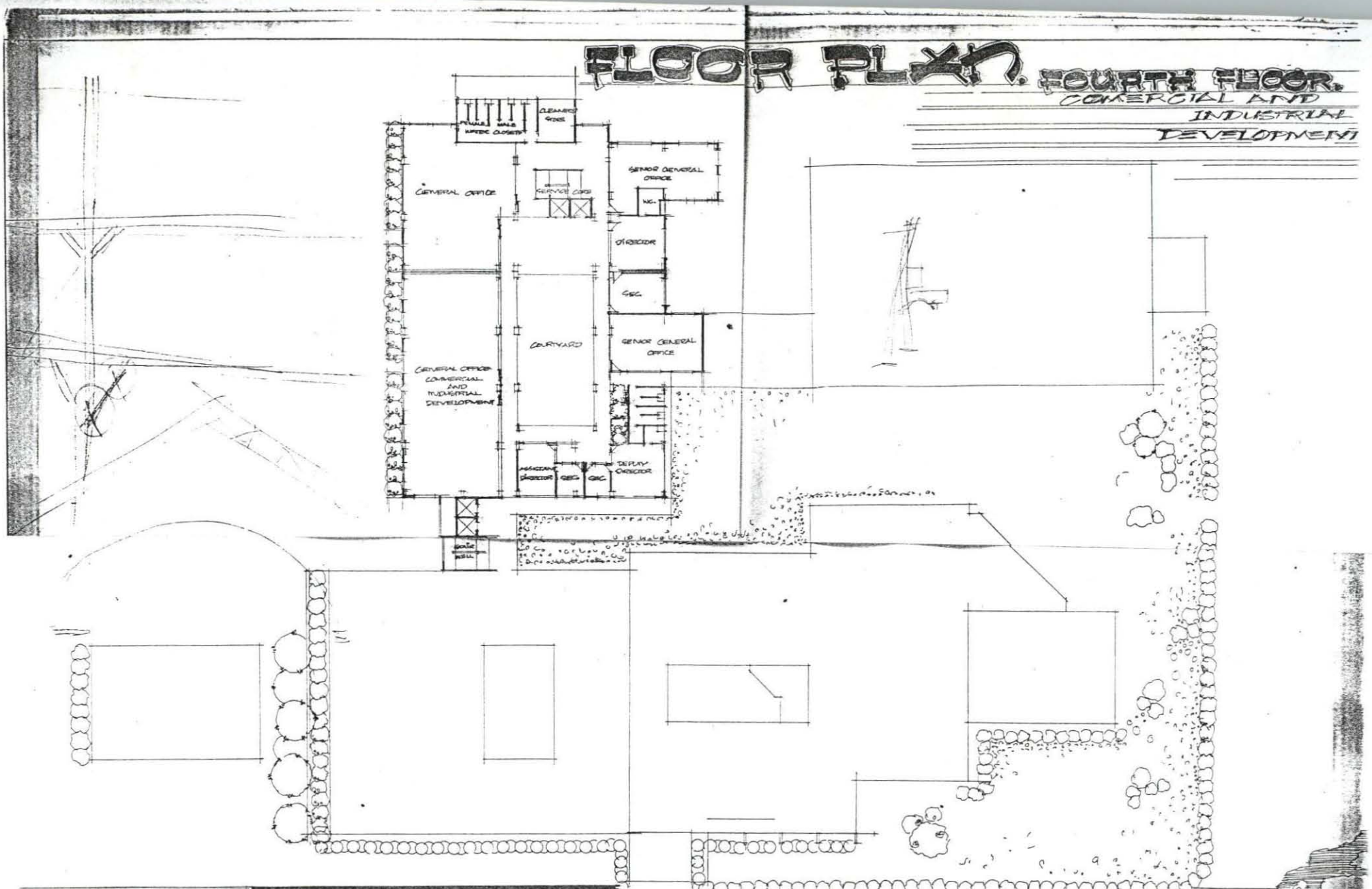
HEALTH, EDUCATION AND SOCIAL SERVICES AND COMMUNITY AND RURAL DEVELOPMENT
GENERAL OFFICE
SERVICE SPACE
DIRECTOR
SEC.
SENIOR GENERAL OFFICE
CONFERENCE HALL
COURTYARD
GENERAL OFFICE HEALTH EDUCATION AND SOCIAL SERVICES
ASSISTANT DIRECTOR
SEC.
DEPUTY DIRECTOR
GENERAL OFFICE COMMUNITY AND RURAL DEVELOPMENT
DIRECTOR
W.C.
ASSISTANT DIRECTOR
STORE
LOBBY
DEPUTY DIRECTOR
COURTYARD
P.H.D.C.
DESIGN PROPOSAL FOR HEADQUARTERS PORT HARCOURT WITH EMPHASIS ON CONTROL OF WATER IN BUILDINGS.
M.TECHNICAL MISSION

FLOOR PLAN. FOURTH FLOOR.

COMMERCIAL AND INDUSTRIAL DEVELOPMENT



NAME: BOLE GHARRI L. EMEKA
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DATE: 3 MARCH/9TH/6TH/2009
SUPERVISOR:

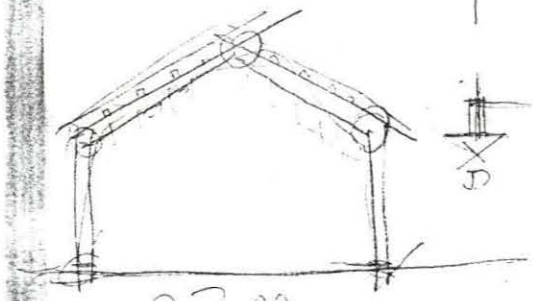
PDPC

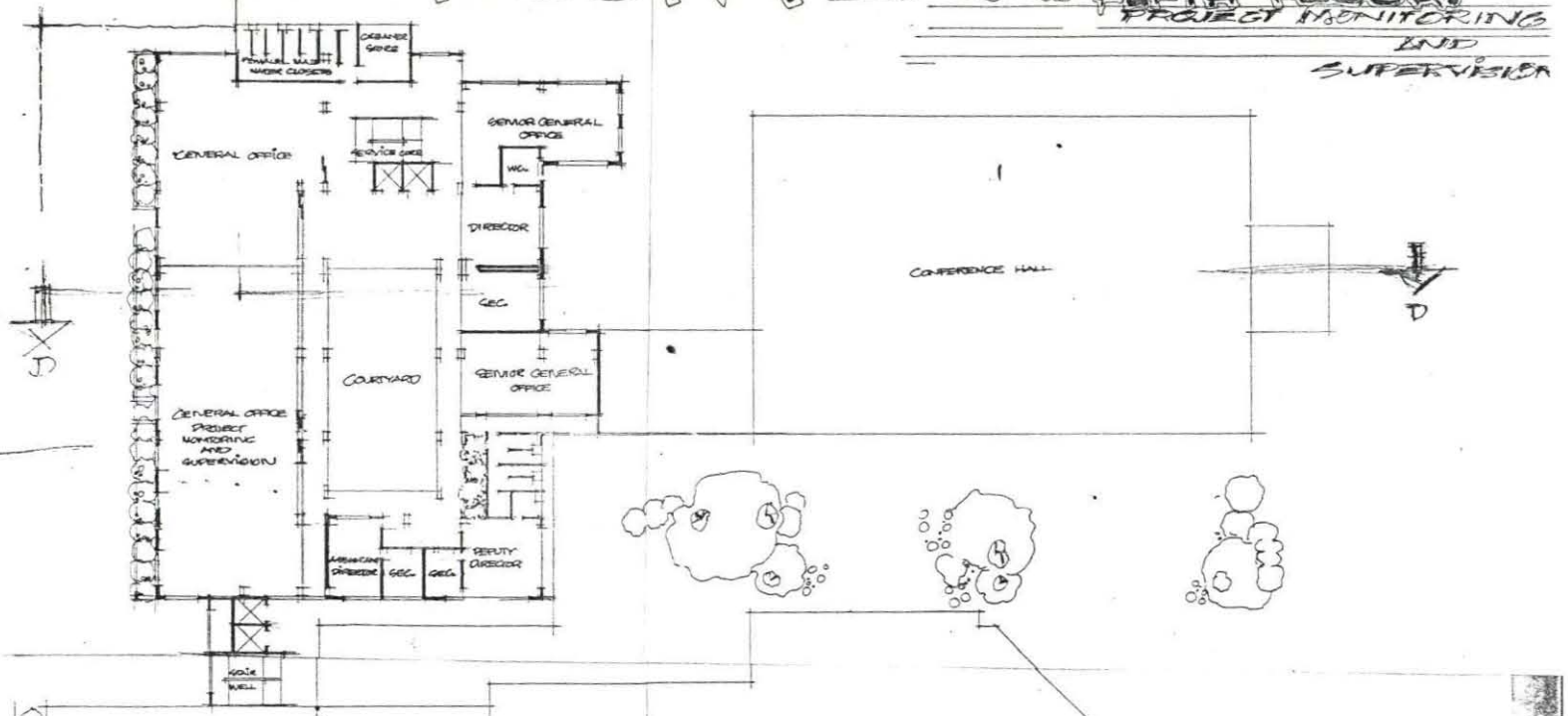
DESIGN PROPOSAL FOR HEADQUARTERS PORT HARCOURT WITH EMPHASIS ON CONTROL OF WATER IN BUILDINGS

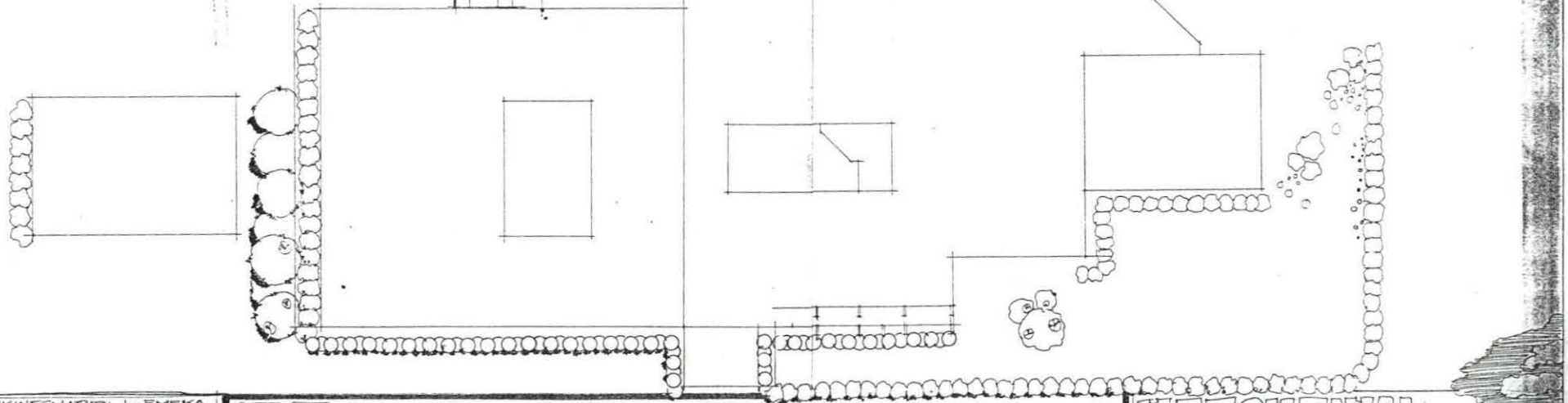
M.TECH FINAL Mission

FLOOR PLAN. FIFTH FLOOR.

PROJECT MONITORING AND SUPERVISION





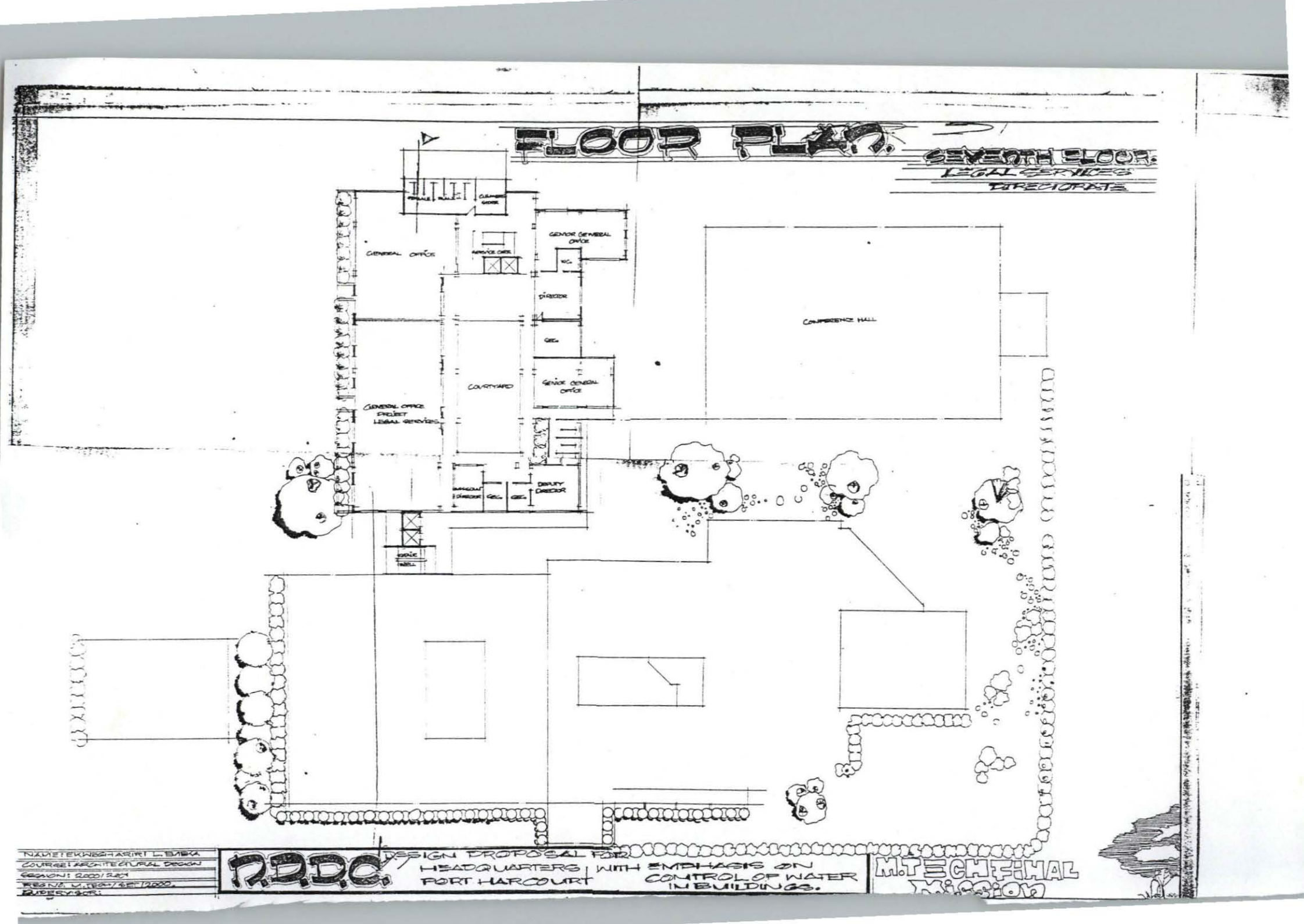


NAME: EKWEGHARIRI L. EMEKA
COURSE: ARCHITECTURAL DESIGN
SESSION: 2000/2001
REG. NO: MTECH/SET/98/2000
SUPERVISOR:

P.D.P.C. DESIGN PROPOSAL FOR HEADQUARTERS PORTHARCOURT WITH EMPHASIS ON CONTROL OF WATER IN BUILDINGS.

M.TECH FINAL Mission

5TH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DIRECTORATE
GENERAL OFFICE
SERVICE CORE
SENIOR GENERAL OFFICE
DIRECTOR
REC.
COURTYARD
SENIOR GENERAL OFFICE
GENERAL OFFICE PROJECT LEGAL SERVICES
CONFERENCE HALL
DEPUTY DIRECTOR
LOBBY
NAME: EKWEGHARIRI L. EMEKA
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REG. NO. UI 03/4EF/2000.
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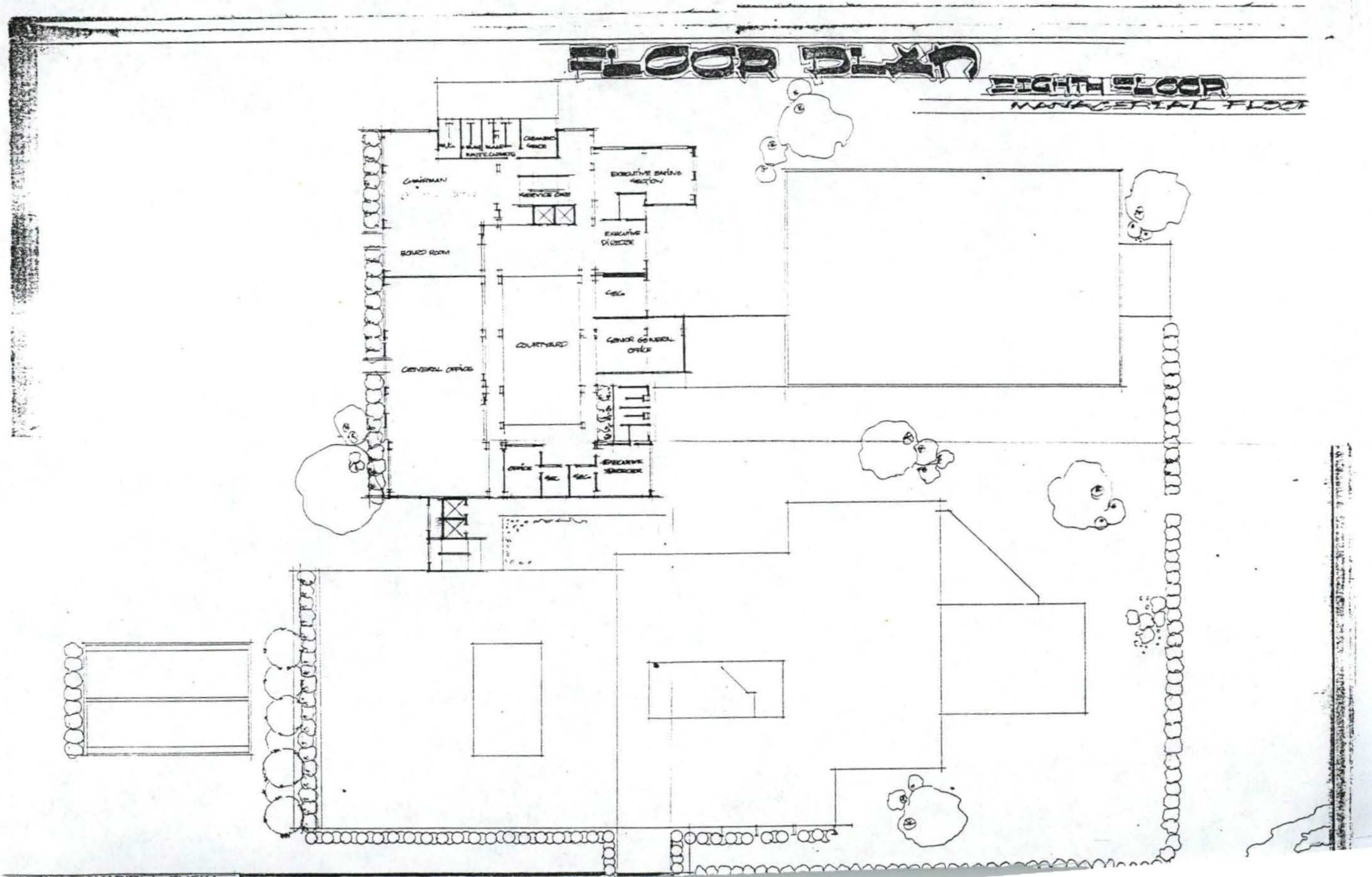
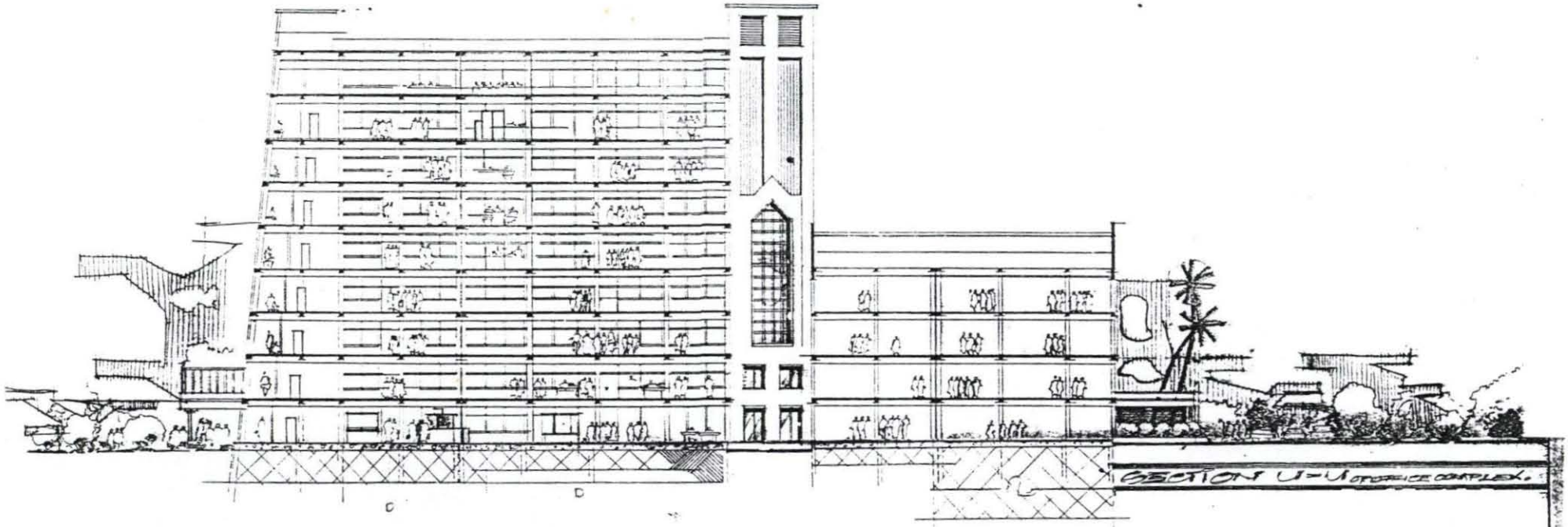
N.D.D.C.
DESIGN PROPOSAL FOR HEADQUARTERS | PORT HARCOURT
WITH EMPHASIS ON CONTROL OF WATER IN BUILDINGS.
M.TECHNICAL MISSION



NAME: EKWEGHARIRI I. EMEKA
COURSE: ARCHITECTURAL DESIGN
SESSION: 2000/2001

SECTION A - A



SECTION U-U OF OFFICE COMPLEX.

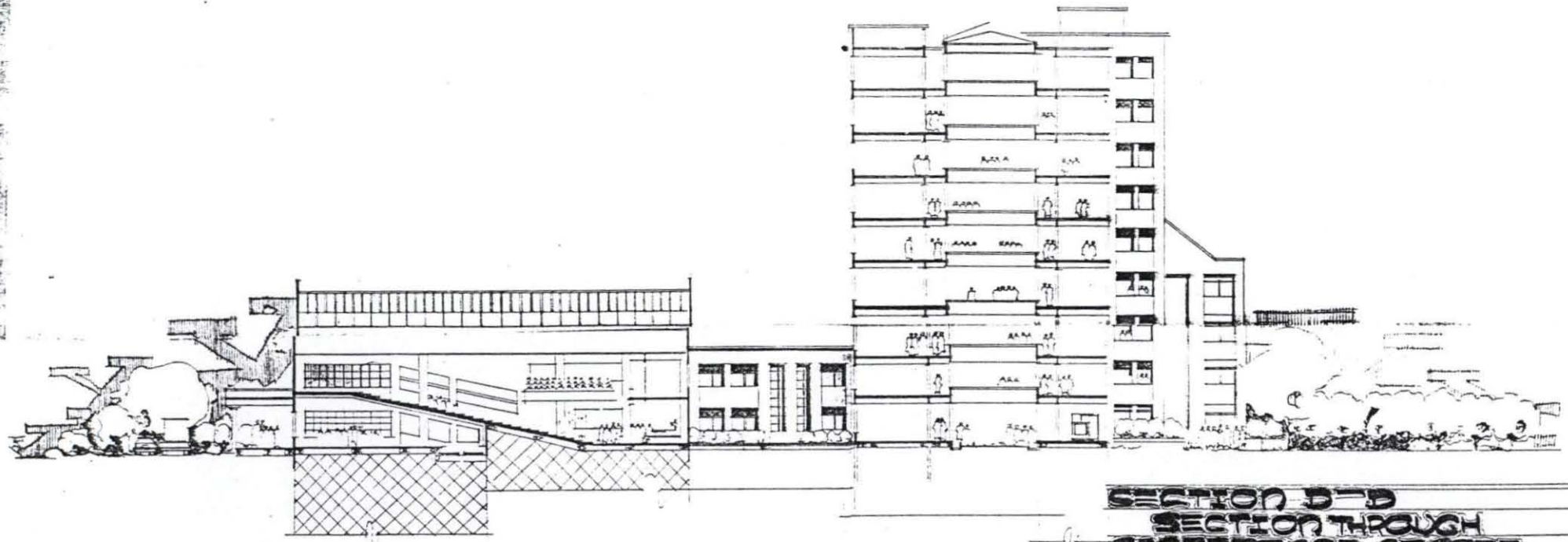
NAME: EKWEARIRI L. EMEKA
COURSE: ARCHITECTURAL DESIGN
SESSION: 2000/2001
PROJECT: M.TECH/SAT/2001/200
SUPERVISOR:

PDDC

DESIGN PROPOSAL FOR HEADQUARTERS PORT HARCOURT + WITH EMPHASIS ON CONTROL OF WATER IN BUILDINGS

M.TECH FINAL

SECTIONAL ANALYSIS.



SECTION D-D
SECTION THROUGH
CONFERENCE CENTRE,
REST. AND OFFICE SECTION.

NAME: EKWEGHARIRI L. EMEKA.
COURSE: ARCHITECTURAL DESIGN
SESSION: 2000/2001

DESIGN PROPOSAL FOR
HEADQUARTERS
PORT HARCOURT

WITH EMPHASIS ON
CONTROL OF WATER
IN BUILDINGS.

M.TECH FINAL
Mission

ELEVATION.

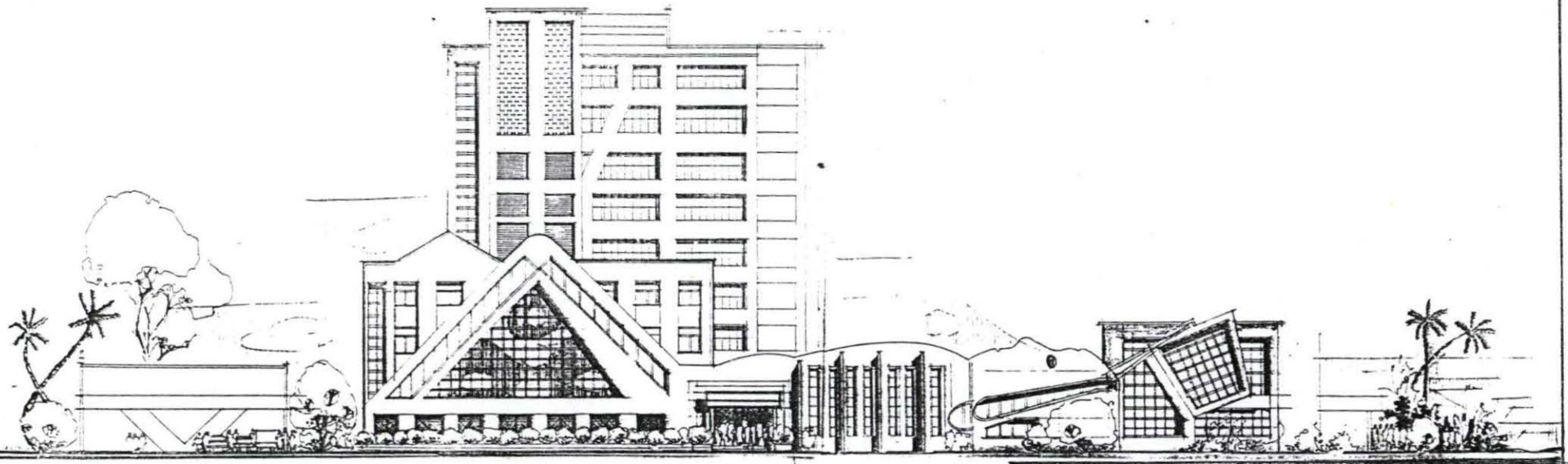
BACK ELEVATION OF OFFICE COMPLEX

NAME: EKUNSHARIFI LEMBIKA
COURSE: ARCHITECTURAL DESIGN
SESSION: 2008/2009
REG NO:

DDC. DESIGN PROPOSAL FOR HEADQUARTERS PORT HARCOURT WITH EMPHASIS ON CONTROL OF WATER IN BUILDINGS

M.TECH FINAL MISSION

ELEVATION



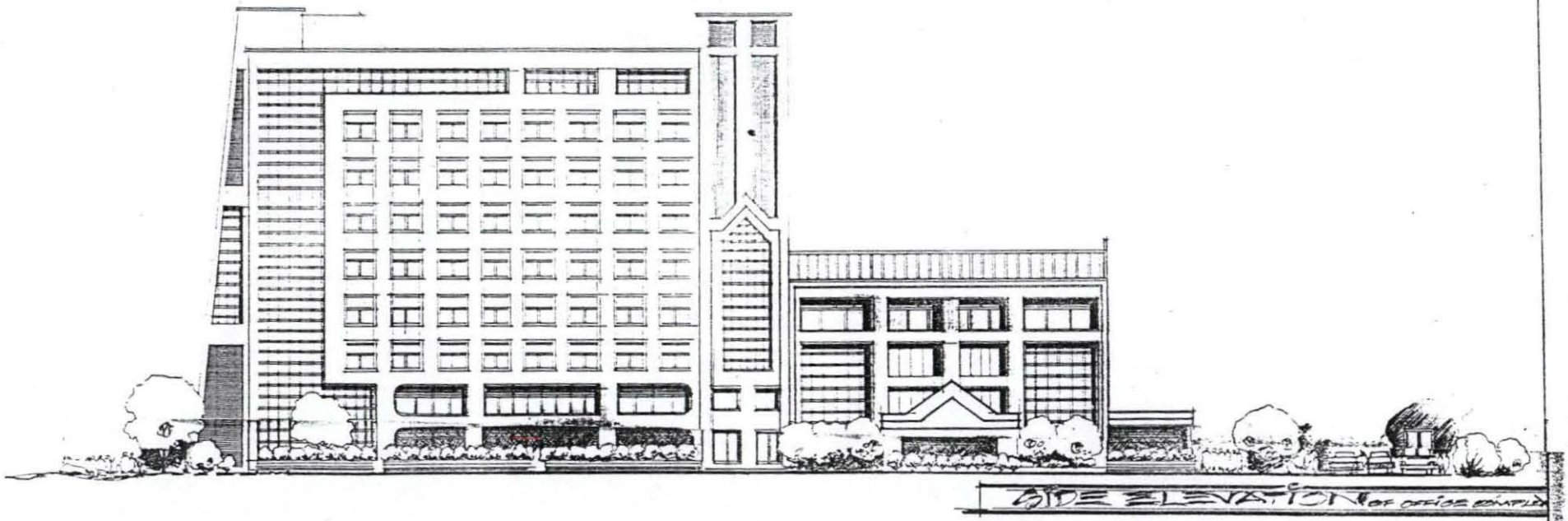
FRONT ELEVATION OF OFFICE COMPLEX.

NAME: EKWEGHARIRI J. EMEKA
COURSE: ARCHITECTURAL DESIGN
SESSION: 2000/2001
REG.NO: M.TECH/SET/693/2000
NIGERIA

R.D.D.C. DESIGN PROPOSAL FOR HEADQUARTERS PORT HARCOURT WITH EMPHASIS ON CONTROL OF WATER IN BUILDINGS.

M.TECH FINAL Mission

ELEVATION



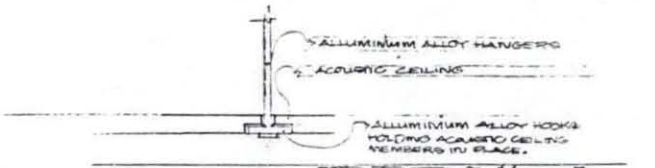
SIDE ELEVATION OF OFFICE COMPLEX

NAME: EKWECHARIRI L. EMEKA.
COURSE: ARCHITECTURAL DESIGN
SESSION: 2000/2001
REG. NO: M.TECH/SET 99/2000
SUPERVISOR:

R.D.D.C. DESIGN PROPOSAL FOR HEADQUARTERS WITH EMPHASIS ON CONTROL OF WATER IN BUILDINGS. PORT HARCOURT

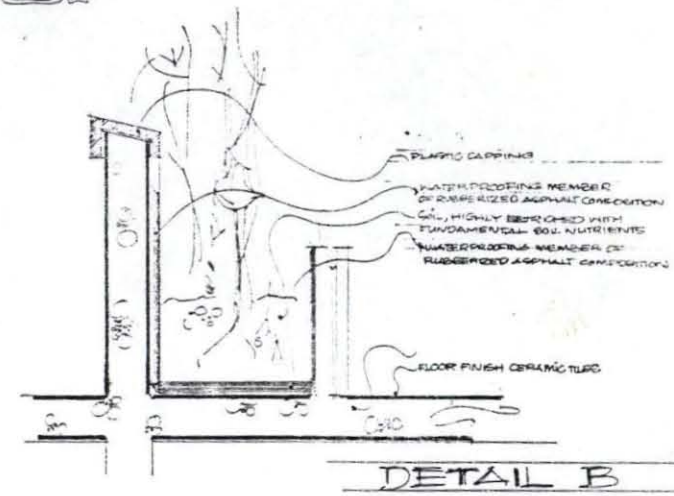
M.Sc TECH. FINAL Mission

DETAILS.



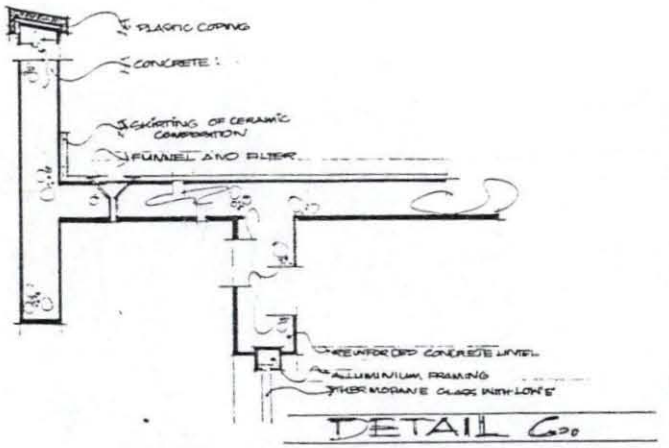
DETAIL A

SUSPENDED ACOUSTIC CEILING SYSTEM.



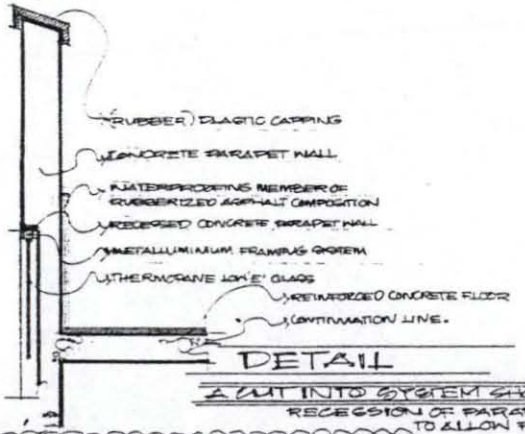
DETAIL B

INDOOR CORRIDOR PLANTING.



DETAIL C

BALCONY DRAINING SYSTEM.



DETAIL

A CUT INTO SYSTEM SHOWING RECESSION OF PARAPET WALL TO ALLOW FOR BETTER GLAZING

NAME: ELWEGHARIRI I. EMEKA
COURSE: ARCHITECTURAL DESIGN
SESSION: 2007/2008
DESIGN SUBJECT: DESIGN
SUPERVISOR:

P.D.D.C DESIGN PROPOSAL FOR HEADQUARTERS PORT HARCOURT | WITH EMPHASIS ON CONTROL OF WATER IN BUILDINGS.

M.TECH. FINAL MISSION