RIVERPORT TERMINAL, MAKURDI

(AN ARCHITECTURAL RESPONSE TO WATERFRONT CONDITIONS)

BY

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A THESIS SUBMITTED TO THE POSTGRADUATE SCHOOL OF AHMADU BELLO UNIVERSITY, ZARIA IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTER OF SCIENCE IN ARCHITECTURE (M.Sc.ARCH).

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AUGUST, 2002.

DECLARATION

I hereby declare that this thesis has been composed by myself and that it is a record of my own research work. It has not been accepted in any previous application for a higher degree. and has been under the supervision of my supervisor. Arc. S.S. Tulpule

All quotations are distinguished by quotation marks, and the sources of information are specifically acknowledged by means of references.

.....

AHAR RALPH TERVER Date.....

CERTIFICATION.

This thesis entitled "RIVERPORT TERMINAL MAKURDI" (An architectural response to waterfront conditions) meets the regulations governing the award of the degree of master of Science in Architecture (M.Sc. Arch) of Ahmadu Bello University, Zaria-Nigeria and is approved for its contribution to knowledge and literary presentation.

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DEDICATION

This thesis is warmly and heartedly dedicated to my mother, Mrs. Elizabeth Ahar for her perseverance and to my late younger brother Kor Ahar,may your soul rest in peace (Amen).

ACKNOWLEDGEMENT

The quest for success is the ultimate essence of human struggle, for me life has never been a bed of roses I must therefore thank God for protecting and guiding my life to attain this height, a step towards my paramount objectives. As the saying goes "A TREE CAN NOT MAKE A FOREST," many people have influenced my stay in Ahmadu Bello University positively, without these people; my studies would have been unsuccessful. My heartfelt appreciation and gratitude goes to the following:

My supervisor, Architect S. S. Tulpule, for his positive and constructive criticisms throughout the project. My relationship with you during my project is more of father to son, to you I say, Am grateful sir. The advice of Architect Muktar has also been of immense contribution to the success of this project; sir thanks you. Dr. W.B. Qurix for his consistent critism. Other staff in the department who had assisted all along, I say thanks to you all.

My family, particularly my mother Mrs. Elizabeth Kumberena Ahar, your love, prayers concern and sacrifices has seen me through my education, thank you Mum. Mrs Patricia Ashi Aondo-akaa and Cdr. James Aondowase Ahar, both of you have been understanding and have contributed in no small measure to my struggles I sincerely thank you. Dr Terna Ahar who has been a true brother and a major source of inspiration, thank you big brother. My invaluable and unmeasurable appreciation also goes to my younger brother Mr. Zungwe Ahar for his financial and moral support. To Msugh, Mgueshima, Msuean, Vagohol and Kumakwagh, all my younger ones, thank you for your love.

My gratitude also goes to Miss Mary Mamman for her love, concern, patience, advice companionship, prayers and moral support during this program. You have been an indicator and expression of incomparable true friendship

I wish to also acknowledge the following friends and colleagues: Henry Ojobo and Ugochukwu Hamlet Okere for their true friendship. Arc. James Akoh, Arc. Bobby Edeboh, Camble Gindau, Jubrin Alabila, Charles Ufua Mustapha Sani, Ibrahim Anas, Samuel Ryad Ndarni Godwin, Mr Edward Tom Mr T.T. Ghem and Miss Mfoniso Umoh for there care love and concern.

I wish to also use this medium to express my many thanks to the staff of National Inland Waterways Authority, who were instrumental in my acquisition of relevant data for this thesis. They include the following: Mr N.I Ibrahim of Riverport terminal Lokoja, Engr Asindi, area manager, Onitsha Riverport terminal Mr Itakpe John of National Inland Waterway Makurdi.

I wish to also thank the following staff of Nigerian Ports Authority who were very helpful to me, they are: Mr Ogwuche Ochefu of Apapa Wharf, Lagos and Engr Adesina Adeola of Tin Can Island, Lagos.

And lastly, by no means the least, I wish to express my gratitude to my able text compiler,Miss Judith Damsue who took to the typing of this text personal.

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QUOTATION

"Man is both creator and moulder of his environment, which gives him physical sustenance and afford him the opportunity for intellectual, moral, social and spiritual growth"

-THE UNITED NATIONS conference on the human environment.

ABSTRACT

Water transport in the world has increased considerably in recent years, particularly Rivcrport terminals, from small ports to increasingly complex ones. Problem ranging from strict environmental constraints to escalating labour and construction cost beset today's rivcrport terminal facilities.

Nigeria is endowed with rivers Niger, Benue, Katsina-.ala, Donga, Taraba, Gongola, Zamfara, Sokoto, Rima, Kaduna, Cross Rivers and Creeks. In the Delta, they are almost the only means of communication. Light freight ships barges and boats arc mainly used on these rivers and creeks. These rivers however have potentials for improvement.

The Federal government in recent years has made efforts to improve the two major rivers in Nigeria for commercial river transport in the hinterland thereby instigating the dredging and development of rivcrport terminals on these two rivers being river Bcnuc and river Niger. Makurdi port is one of the major rivcrport terminals along the river Bcnuc selected by the Federal government for development. It is in line with these and to respond to waterfront conditions in order to have a well-planned development that adequately meets the standards for a riverport that this thesis research was undertaken.

Waterfront development encompasses many separate entities, which arc often interrelated in design and function. The term River Port Terminal conveys an association with water transport components, ship repair services, new or used boat

sales, commercial docking space and services, mooring, marina and other related waterfront activities.

The planning of Makurdi Riverporl Terminal facilities therefore addressed not only the many components of the single proposed River Port Terminal but also the use and constraints of the surrounding environment and activities.

The thesis research work also examined other important architectural elements such as services, functionality, form, space requirements and equipment in the design.

CHAPTER ONE

1.0 INTRODUCTION

1.1 INTRODUCTION

Ian Ritchie (2000) describes transport terminals as ***"places that celebrate arrival and departure"***. Terminal buildings in other words are places where interchanges between one form of transport to another take place.

Terminal buildings are used for land, sea and air transport. For land transport, there are bus and train terminals, for water transport, there are seaports, riverports and marinas, for air transport, there are airports and helipads. All these terminals handle passengers, cargo and act as interchanges between one means of transport to another.

For the purpose of this thesis emphasis is on Makurdi River Port Terminal which shall serve as an inter-change between water transport and land transport.

The Makurdi Riverport terminal is one of riverport terminals to be developed along the river Benue by the National inland waterways Authority. The Makurdi port also serves as an area Office covering a range of other ports along the Benue. Therefore, an architectural response to waterfront condition is studied in context of the proposed Makurdi Riverport terminal.

1.2 PROBLEM STATEMENT.

Riverports terminals are water-related developments. The location of riverports along the river opens the designer to problems associated with the waterfront. From a sloping site to geostatically unstable soil conditions, the designer is faced with peculiar site conditions to manipulate in order to meet the demands of passengers and cargo handling. The problems

associated with the waterfront are addressed in this thesis work.

1.3 MOTIVATION

The thesis topic is highly motivated out of the following facts:-

i. Makurdi River port terminal falls under one of Riverports selected by National inland waterways Authority an autonomous body of the Federal Ministry of Work for development. The National inland waterways as such seek to find an Architectural design proposal that would adequately respond to the peculiar design constraints associated with waterfront developments in the design of the Riverport.

ii. The Federal Government of Nigeria has realized the potentials of inland water transport in terms of economic growth, thus the need for dredging and development of Riverport terminals has become imperative.

iii. Knowledge is boundless, therefore the urge to study and understand the intricacies of a waterfront development such as a Riverport is geared towards contributing to knowledge.

iv. The Nigerian seaports are congested due to increase in demand on them therefore the need to find a lasting solution has led to the decision to develop Riverports in order to ease the pressure on the coastal Seaport.

v. Makurdi Riverport is one of the ports along the river Benue throughout its course in Nigeria that is situated in a state capital, therefore, Cargo, Passengers and accessibility is readily available if the Riverport is developed.

1.4 AIMS AND OBJECTIVES

1.4.1 Aims

This thesis research work has challenging number of goals to achieve and these are stated below:

i. To assess and study closely the problems and appraise the existing situations in inland transport, their functions and mode of operation.

ii. The waterfront poses complex and challenging condition in designing for water related developments such as a Riverport terminal, it is of paramount importance to designers as guide on how to manipulate the conditions of the waterfront in their designs. This thesis seeks to respond and explore waterfront conditions in design to achieve the designer's end design.

iii. The thesis aims to create a good working environment for workers in a well-organized Riverport terminal.

iv. This thesis work also seeks to explore architectural design solutions for maximum passenger comfort and easy movement of Cargo.

v. To integrate and respond to waterfront conditions through the adaptation of appropriate forms, space, and structures in the design.

vi. And to propose an architectural edifice that could satisfy its functions and compare positively with any such project elsewhere.

1.4.2 OBJECTIVES

The objectives of this thesis are:

i. To provide required facilities in the design for the effective functioning of the

Riverport terminal.

ii. To utilize the site conditions of the waterfront and create an environment ideal for working.

iii. To design a Riverport terminal that will be able to attract and boost patronage of water transport in the inland waterways as a means of communication.

iv. To actualize the conception of ship as a tool of water transport in the planning of the passenger building, administration office, thereby reflecting the impression of a ship's relationship to the harbor or environment.

1.5 JUSTIFICATION

i. Benue State serves as a transition state between the north and the south, with the location of the river port terminal in Makurdi, the port will serve as a service point to the rest of the northern states of Nigeria.

ii. The vast agricultural produce from Benue State will easily be transported to the coastal seaports in bulk for exportation from the Makurdi port.

iii. Imports for hinterland states will have a closer discharge point to their destinations instead of the far away seaports.

iv. The Riverport terminal will stimulate economic growth by enhancing communication and interrelation between the government and her citizenry.

1.6 SCOPE AND LIMITATIONS

With due considerations on the context of the research and without forgetting other design considerations and parameters in Riverport design, the thesis shall mainly concern

itself with the principles underlying marine architecture in the design of a riverport terminal. The exploration and application of the conditions associated with the riverbank shall achieve this basically. Thus emphasis shall be on responding to waterfront conditions in the proposed design. Appraisal of water transport architecture or port designs within and outside Nigeria will help form the brief and survey of ports operations, facilities and procedures will be concentrated on how ports are integrated with their immediate environment.

The thesis design shall therefore incorporate standard facilities for the smooth running of the Riverport terminal and other users.

1.7 RESEARCH METHODOLOGY

The research format designed for this thesis is a scientific one and therefore will entail; references to relevant literature through review of Newspapers, Journals and Technical papers, Books and Thesis write-ups.

For the researcher to have a view of Riverport design and also know areas of efficiency and deficiency, case studies will be carry out this will assist in formulating a possible solution in order to achieve a totalitarian design.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 DEFINITION

In the terminology of marine architecture; the Latin word portos, means "a gateway" and from it comes the English word port. Thus; a port can be defined as a gate or entrance from water bodies to land – in other words, a place where one form of transport is changed for another, that is between land and water, and thus constituting a link in the chain of transport.

Ports may be regarded from two distinct points of view; either as the terminals of great water trunk lines of communication or as intermediate stations on the entire route from the manufacturer to the mart, from the producer to the consumer.

As a terminal, the port must provide ample accommodation and berths; it must be readily accessible and fully equipped with all necessary appliances for speedy transfer of merchandise and passengers between ships and shore and to some means of inland transport.

While seaports are gateways to greater oceanic water bodies, riverports provide gateways to the coastal seaports from the hinterland. Thus, riverports can be considered as part of the maritime sector of the economy whose competitive roles lie in joining a common hinterland or they can be considered mainly as evolving terminal nodes of a country's transport network linked by the distribution or network of rivers.

2.2 HISTORICAL BACKGROUND

Ever since man devised the first primitive boat, man has made use of tide, winds and currents in order to migrate, explore and initiate trading routes on a scale that overland travel would not permit. The connected waterways have played a crucial role in prehistoric world, the tradition of coastal navigation, beginning in the Mesolithic period, has continued almost unbroken in to modern times. The Celtic saints and Viking raiders traveled early waterways, as did the pilgrims of the middle age. The hinterlands of coastal lands were further accessed through hinterland waterways or rivers as the only routes of access into the hinterlands.

Civilizations have also been borne and spread along the seas and rivers of the world. Today, the seas and rivers still influence many human endeavors.

Riverport terminals and small craft harbor facilities have existed since man's earliest ventures on the water bodies. Vessels of all types have sought refuge in protected embankments on rivers to allow the safe mooring of the vessels and transfer of passengers and cargo.

As far back as the 15th and 16th century, docks and piers provided direct connection of a vessel to land. Early docking facilities, were generally used by fishermen and for maritime activities.

In the developing world, most ports may have begun as colonial bridgeheads, with concession to foreign nationals, either as ship owners or railway companies. These ports which were basically a tool to facilitate the movement of slaves to the home countries of the colonial masters also served as vital points for the evacuation of cargo from these colonies where these ports were located.

Bowen, E.G. (1959) posits that for centuries before the arrival of the colonial masters in Nigeria, dug-out canoes were in use on the creeks and rivers as the most important means of transport for local and small-scale transport. Where this type of vessel (dug-out canoe) could be used, it was much less laborious and often quicker, than movement by carriers, besides permitting the movement of loads much too heavy for head carriage.

These canoes with their shallow draught (30-90 mm) not only carried foodstuff, between the small villages and the markets, but also extended their services of the river companies to bush stations. They were slow, probably averaging not more than two knots.

2.2.1 Precolonial period

However, recurrent explorations by foreign geographers of the river Benue and river Niger paved way for the subsequent expeditions by the colonial masters. The first construed correlation between the river Benue and river Niger after Mungo Park's exploration in 1805 was that of Dr Baikie who descended the Niger and Benue in 1854, with the aid of government subsidy (British government). This team of explorers headed by Dr Baike made a careful survey for four months and carried out successful trading for the first time. This was the first exploration without casualties, owing to the prophylactic use of quinine against malaria. This exploration gave rise to the establishment of trade stations along the river Niger and river Benue.

By 1865, a good deal of irregular trading by individual firms and persons had sprung up on river Niger and river Benue and many ships were sent inland to evacuate cargoes and slaves. This was the real start of the opening up of the river Niger which from then onwards steadily increased.

By 1878, striking progress had been achieved. Four British companies were then

operating in the Niger valley.

i. The West African company (Manchester),

ii. Messrs. Alexander Miller Brothers and Co (Glasgow),

iii. The Central African Trading Company (London) and

iv. James Pinnock and Company (Liverpool).

These companies had fourteen steamers in the Niger trade, all of them were maintaining river stations at Akasa, Aboh, Ndoni, Abragada, Odogiri, Utchi, Osamari, Akuso, Lower Oko, Onitsha, Gbokem, Lokoja, Yamaha, Egga, Makurdi and many other smaller places along the Niger and Benue.

2.2.2 Colonial Period

At the beginning of 1900, the British government took over the administration and military assets of the royal Niger company on payment of compensations, the only means of communication or transport was the rivers Niger and Benue. From that time a governmental fleet was in existence. There were no roads through the forest and animals could not be used because of the testse flies. The only means of transporting loads through the forest was on the heads of human porters along narrow and winding footpaths. Thus, the only means of transportation that was largely used with ease by the British government to explore and expedite the hinterland was the river transport. However, other means of transport started with the commencement of Lagos- Ibadan railway in 1889-1901, reaching Jebba in 1909. The road network developed decades later with the introduction of motor vehicles.

According to an old map of 1907, the shipping fleet at that time consisted of fourteen self-propelled vessels, most of them stern- wheelers, fifteen poling house-boats, four lifters and two pontoons totaling thirty five units.

Increase in governmental fleet was subsequently based on the availability of cargo in the hinterland. By 1959 when the British government was preparing to hand over to Nigeria as an independent state, a navigation branch of inland waterways department was in existence. This department supervised and maintained 176 units of various crafts, divided into 86, 59, and 84 units serving respectively the Northern, Eastern and western divisions.

The Nigerian Ports Authority commenced operation on 1st April 1955 and was formally established as an autonomous public corporation on 1st May, 1955 by the ports Acts 1954 N. P. A (1984). At the commencement of operation, it assumed responsibility for certain port and harbor activities previously conducted by departments of government and the assets formerly used by such Departments in conduct of their activities became vested in the Authority.

2.2.3 Post-Colonial Period

With the exit of British government from Nigeria, the Nigeria ports Authority took full operations of maritime activities in 1960. The departure of the British saw the Nigerian government directing capital development at the countries coastal ports and neglecting the hinterland Riverports which were effectively used by the colonial masters. More than seventy percent of the activities are conducted from the following major ports.

i. Apapa (lagos port complex),

ii. Tin Can, Island

iii. Rivers

iv. Delta and

v. Calabar with headquarters in Lagos.

Though was in existence the Inland Waterways Division under the federal ministry of

transport, development of riverport terminal facilities was not fully implemented.

In 1994, the Petroleum Trust Fund (P.T.F.) was in the process of reviving hinterland riverports, but the proposal never left the drawing board before the P.T.F was discontinued by the present administration. However, with the hand over processes of the P.T.F to related ministries almost completed, the federal government of Nigeria through the ministry of transport, has decided to dredge the rivers Benue and Niger to boost hinterland water transport to ease the pressure on the coastal seaports and encourage passenger movement through water transport.

2.3 RIVERS AS A MEANS OF TRANSPORT

Not all nations are endowed with the resource of being on coastline of the seas and oceans, but most countries are traversed by rivers. In Nigeria, rivers, creeks and brooks form a good network of waters. In most parts of the delta region of Nigeria, especially near the Atlantic Ocean, the waterways are the only means of transport.

Water routes in Nigeria are one of the first means of transport: despite their first use in Nigeria as a means of traveling, the hinterland waterways have not seen any development during the post-colonial era beyond their original state. The difficulty in the development of Nigerian river transport lies in the navigable period, available depth, of the river and non-maintenance by the government of Nigeria.

In proper developed conditions, water routes provide even surface for smooth sailing and resistance due to friction is small, such that energy consumption is low thereby making water transportation economical. The capacity of most developed water routes is almost unlimited.

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Light freight ships, canoes and small boats can navigate nearly all waters but tugs, barges and ships are confirmed to the developed and larger waterways. In Nigeria, the Niger, Benue and Cross Rivers and their tributaries are navigable by barges and ships for considerable distances along their lengths. However, total river transport is dependent largely on good and bad season; that is rainy and dry season. Until appropriate and commensurate developmental attention is given to the Nigerian river transport by developing riverports and dredging consistently, our waterway will never see full utility.

The river transport is the cheapest mode of transport with increasing quantities and hauls and passengers, therefore, capital investment from the government and private firms certainly seems justified in river transport.

2.4 RIVERS AND ECONOMIC DEVELOPMENT

Transport facilities are the basic power of economic growth and lack of them are a major setback to rapid economic growth and social progress of a country. Transport difficulty retards the exploitation of natural resources, industrialization, expansion of trade and to a large extend, the achievement of national unity. Certain parts of the country are isolated because of lack of efficient means of transport; some of such cases are found in the Delta area

Ojo Maduekwe (minister of transport) (2001) posits the importance of River transport as follows:

> "***My ministry has put new strategies in place to improve the standard of the transport industry, especially the maritime sector which is one of the most vital source of income to the government. To this effect seaports will be improved and new Riverports constructed with due attention given to the dredging of inland waterways. The development of riverports and dredging of these rivers is therefore aimed at creating a better relation***

between the people and Government thereby stimulating economic growth".

The countries of Africa and a few exceptions have spent varying but considerable periods under colonial control. Even a country like Liberia, which was not colonized, still shares the essential characteristic of former colonies. The trade structure which developed in these African countries under European control was highly unbalanced, defined basically by the exportation of a limited range of agricultural, mineral and raw materials and the importation of varied assortment of manufactured goods. Distributions of these goods were limited to areas where the Europeans lived which were usually the major urban centres.

The neo-colonial legacy in terms of transport system is of paramount importance. Ports were initially developed for military, political or administrative purposes. Even where the economy was uppermost, the ports were designed for the export of a limited range of raw materials in mind. Thus, the system was not considerate to either internal exchange of locally produced good or to the distribution of imports from local markets.

The problems fore mentioned were realized with the inception of independence by the African nations. The inadequacy and inefficiency of the ports became a stumbling block to rapid economic development and industrialization, which the new states expected. To be able to handle the available cargo, the few existing ports had to be improved and enlarged. The resulting make-shift ports usually lack order and cause delays in ports business because of the haphazard method of development.

The achievement of independence by the African states and the functions of regional economics and political grouping stimulated new efforts towards port development, at both coastlines and hinterland to facilitate movement of people and goods from land-locked states.

Thus, goods from and to Niger Republic can be shipped through Nigerian ports using the river Niger and to and from Cameroon using the river Benue. The proposal by the federal Government to dredge and develop Riverports is in lines with the government's intention to stimulate economic growth through River transport. The Federal Government aims at utilizing the Rivers Niger and Benue and their tributaries to link the land locked areas of Nigeria with the Atlantic Ocean. This will greatly improve trade, other economic activities and social interactions among states. To this end, the federal has chosen Makurdi port as one of the Riverports with human and agricultural produce concentration for development.

Thus, the researcher's proposed Riverport will be sited in Makurdi which is along the River Benue. The town Makurdi, has developed over a period of over hundred years since its first contact with Europeans into one of the largest commercial and political centres in Nigeria. Although there was in existence some inadequate port facilities at Makurdi during the colonial era, the National Inland Waterways has proposed the development of a new port at Makurdi to meet the demand of modern port requirements.

The nature of port facilities provided in the researcher's proposal will therefore, influence the pattern of economic advance of the area. Ports development is a vital sector in national economic planning, therefore a developing nation like Nigeria should break the vicious circle whereby port developments are postponed until increased traffic density provide an obvious demand. If Inland ports were developed long before now, the problems of congestion wouldn't have come into existence at the Seaport as it is the case with the Nigerian Seaports.

The activities of a port, which are multifunctional in character, extend to industrial, as well as commerce and passenger handling. The location of a port therefore encourages

industrial location and passenger movement. It is therefore necessary to integrate these activities properly to achieve order in the port

River transport is suitable for reaching the inner parts of the hinterland, therefore the development of ports with adequate facilities will facilitate the smooth running of the Makurdi port terminal for economic growth of the immediate state and her surrounding states. Ninety percent of total external trade of African continent passes through the sea or river ports. Therefore, the provision of efficient ports has been a necessary precondition to modern economic growth. Trade has become the decisive factor in stimulating the money economy, expansion of urban population in commercial centers and the growth of local markets for goods and services.

2.5 ADVANTAGES OF TRANSPORT

Momoh A. (2001) a reknowned writer of maritime activities asserts that "*The nations transportation system has not been fully tapped or harnessed, to create enabling economic indicators to stimulate national growth*". In his analysis of importance of transportation, he identified "*waterways transportation as the cheapest form of transportation.*

Her Royal Highness, Princess Anne of Buckingham palace, posits the advantage of water transport as follows "*in the third world countries, economic development is so dependent on water transportation such that the industry serves as a major source of revenue generation.*" In Nigeria the industry also serves as a major source of revenue generation through the importation and exportation of goods by these ports.

The advantages that abound developed inland waterways of a nation are immeasurable. For instance, the recent opening of a canal joining the Main and Dunabe

Rivers made it possible for vessels to sail from the North sea to the Black sea without ever leaving European inland waterways. The European inland waterways and surrounding coastal waters, which are similarly to the Nigerian situation, are within reach of virtually all the continent's urban centres by virtue of developmental efforts of respective Government of European Countries.

Shipping on the inland waterways and Coastal waters must naturally come in to it's own as one of the primary means of moving goods from points of production to areas of consumption and passengers to their destinations, to boost economic activities.

In 1991 the International Maritime Organisation (I.M.O) on 'economic advantages of water transport' assert that *"rivers or inland waterways serve as the means by water transport which brings goods and passengers closer to their destinations."*

Netherlands Development and Engineering Consultants (NEDECO) (1959) also asserts that "*transportation by water has the advantage of heavy haulage*". Large quantities of any commodity can be transported from one point to another in one batch.

River transportation as describe by Ezetulugo J.S. (1974) on 'advantages of River transportation,' posits that "*River transportation is about the cheapest means of transportation*". Rivers provide access to areas, which are not served by airways, railways and good roads. In the Niger Delta for example, the river routes are indispensable as almost the only means of transport that is closer to the people.

The rivers Niger and Benue and their tributaries traverse the entire country in a network of rivers, which reach the remote villages as well as big cities. By establishing transport facilities and routes on these rivers, adequate interflow and exchange and foreign

goods and passengers are ensured.

Transport problems in Nigeria have withheld the proper distribution of foodstuff, goods and passengers' movement, these rivers, therefore compliment the other means of transport in such areas. Air, Road, Railway and River transport systems are complimentary. Where possible, all four means have been used together. Goods for shipment are transported by road and rail. These means of transport are all essential for the economic development of a country, the difference been in the cost and fastness of each means of transport. Air transport is the fastest and most expensive in terms of cost, followed by road and rail, while water transport is the cheapest means of transport.

Transportation by waterways also requires the least energy consumption amongst other means of transport; the low friction between water and vessels makes easy the smooth sail of vessels with the least power consumed.

2.6 THE NAVIGABILITY OF THE RIVER BENUE

Rivers that can be used for commercial navigation accord to Bird J. (1978) are "those whose lengths can justify the cost of capital investment for improving them for sailing by large crafts". Such rivers should be able to connect a number of towns in the hinterland and countries of production and distribution or countries of exportation. The river Benue fulfills these requirements of length and connection to many towns and it is also linked to the Atlantic Ocean via the river Niger, thereby connected to other countries through the Atlantic Ocean.

The Benue is the largest tributary of the Niger. It rises in the Cameroon's on the Adamawa plateau at about 1452 metre above sea level. The tributaries of the Benue, even

the larger ones such as rivers Katsina-ala, Donga and Taraba enter the river Benue calmly without rapids. According to NEDECO (1959) " These tributaries of the river Benue are navigable during the rainy season and part of the dry season. Thus with a developed inland waterways system which is on the way by the Federal Government through National Inland waterways Authority, it will be easy to reach the remote part of the country traversed by the river Benue and its tributaries. This would in effect promote efficient and cheap movement of domestic products and people to parts of Nigeria traversed by the Benue and its tributaries.

2.6.1 Cross Section of the Benue

According to NEDECO (1959), the width of the river Benue is normally well over 100meters throughout it course. This does not therefore restrict navigation in terms of available width. Exceptions are however found at Wuro-Boki and Gamadio flats along the Benue during low water stages, which can be restricted to 49.5m. Therefore, According to Marshal (1997) on 'River studies' *"from the view point of resistance to ships, the Benue and its tributaries can be compared with a channel of infinite width for navigation"*.

2.6.2 Available Depth

BOWEN, E.G. (1959) inputs that the least available depth ((L.A.D) during high water stages is between 5m-7m on the Gamadio and WuroBoki flats and 10m-15m on the lower Benue. Therefore it possible for very large craft to go up to WuroBoki during high water stage or period. During mid-water stage shipping on the lower Benue is very possible with 5m-8m draught, but on the flats near Gamadio and WuroBoki navigation is restricted to 2m-4m.

During low water stage, this picture changes considerably. The upper Benue is not navigable with more than 1.5m-2.6m draught after November and before April. The lower Benue however is navigable with draught of 2.5m-4m during low water stage.

The dredging of the river Benue as proposed by the Federal Government through National Inland Waterways shall however, increase the depth of the river thereby increasing the draught for larger craft to ply the river Benue.

2.7 AN ASSESSMENT OF PRINCIPAL RIVERPORTS, TONNAGE AND FACILITIES.

Most riverports in the country saw their better days during the era of colonialism. Post-colonialism saw attention for the riverports shifted to the coastal seaports. Therefore, an assessment of the performance of the Riverports is going to be based on activities that took place during the colonial era.

Johnson D.H. (1958) assessed the riverport terminals as *"been developed by private companies before they were taken over by the British Government"*. The Ports were well sited along high banks and were sufficiently accessed from the river and the hinterland; therefore their conditions did not affect river transport adversely.

Below is summary of principal ports along the river Niger and river Benue

Table 1

Ports	**Approx. Annual Tonnage Handled**	**Facilities**
1. Warri	100,000	Quay, berth; man-handling and mechanized handling, and sheds

2. Burutu	350,000	Quay, tanks for petroleum products, mechanised handling and sheds.
3. Onitsha including Asaba opp. Onitsha	80,000	Quay, tanks for petroleum products, manhandling, mechanized handling and transits sheds.
4. Idah	20,000	Man-handling, warehouse
5. Lokoja	10,000	Tanks for petroleum, manhandling and transit shed.
6. Baro	75,000	Manhandling railway connection and transit sheds.
7. Makurdi	12,000	Manhandling, railway connection and transit sheds.
8. Ibi	3,000	Manhandling covered storage.
9. Numan	7,000	Manhandling and stores.
10. Yola	8,000	Man-handling stores
11. Garua	35,000	Quay, tanks for petroleum products, manhandling and transit sheds.

2.8 FACTORS FOR PORT CONSIDERATION

For a port to be developed, the following considerations are assessed before the location of the port is selected for development.

i. **location of port in relation to potential demand for port services from the hinterland.**

The vast Nigerian hinterland is dependent on the seaports for exports and imports. This has resulted in the seaports becoming congested thereby arousing the demand for riverports in the hinterland where the import or exports will be closer to their destination or departure point.

ii. **Envisage Port Capacity**

The projected cargo available and passengers also is a precondition for the consideration for port development. The Makurdi part terminal is largest port terminal on the river Benue throughout its route in Nigeria. The vast agricultural produce from the state as a food basket of the nation will find a good means of evacuation of these products from the state capital.

iii. **The structure and quality of connecting transport system**

The Makurdi port has a rail connection, roads and water. The railway was used during the colonial era, though it is abandoned, it can be revived when the port development comes into being.

iv. **Institutional Factors**

In the organization of trade, which influences the flow of goods, government's policy and bureaucracy also detects the of flow of these goods through selection of the terminals by government.

These factors mentioned above are of changing and equal significance at different ports. But they are still considered in every port development.

2.9 NATIONAL INLAND WATERWAYS AUTHORITY

According to Bowen, E.G. (1959), ***"inland waterways existed as a division under the ministry of transport during the colonial period"***, the post-colonial era saw the inland waterways been renamed National Inland Waterways, but as a department under the Federal Ministry of Transport. However, in 1997, the National Inland Waterways was upgraded to

an Authority under decree 13 as National Inland Waterways Authority.

According tc decree 13 of 1997, the Federal Military Government established the National Inland Waterways Authority under part 1 section 1 ***"There is hereby established a body to be known as the National Inland Waterways Authority"***. Under section 2, ***"The Authority shall be a body corporate with perpetual succession and a common seal, and may sue and be sued in its corporate name"***. A governing board was therefore established to conduct the affairs of the Authority. The headquarters of National Inland Waterways Authority was located in Lokoja.

2.9.1 Objectives Of National Inland Waterways Authority

The basic objectives of the National Inland Waterways Authority as defined by decree 13 of 1997 under part I section 2 includes the following:

(i) improve and develop inland waterways for navigation;

(ii) Provide an alternative mode of transportation for the evaluation of economic goals and persons; and

(iii) execute the objectives of the national transport policy as they concern inland waterways.

2.9.2 Functions And Powers Of National Inland Waterways Authority

The functions and powers of National Inland Waterways Authority are defined according to decree 13 under part II section 8-9 as follows: -

(i) to pr vide regulations for inland navigation;

(ii) ensure the development of infrastructure facilities for a national inland

waterways network connecting the creeks and the rivers with the economic centres using the river ports as nodal points for internodal exchange; and

(iii) ensure the development of indigenous technical and managerial skill to meet the challenges of modern inland waterways transportation.

iv. undertake capital and maintenance dredging;

v. undertaken hydrological and hydrographic surveys;

vi. design ferry routes;

vii. survey, remove, and receive derelicts, wrecks and other obstructions from inland waterways;

viii. operate ferry services within the inland water ways system;

ix. undertake installation and maintenance of lights boys and all navigational aids along water channels and banks;

x. issue and control license for inland navigation, piers, jetties, dockyards;

xi. examine and survey inland water crafts and shipyard operators;

xii. grant permit and license for sand dredging, pipeline construction, dredging of slots and crossing of waterways by utility lines, water intake, rock balsting and removal;

xiii. grant licenses to private inland waterway operators;

xiv. approve designs and construction of inland river crafts;

xv. approve and control all:-

a. jetties, dockyards, piers within the inland waterways,

b. advertising within the right-of-way of the waterways;

c. reclaim land within the right of way;

xvi. undertake the construction, administration and maintenance of inland river-ports and jetties;

xvii provide hydraulic structures for river and dams, bed and bank stabilization, barrages, groynoes;

xvii. collect river tolls;

xviii. undertaken the production, publication an broadcasting of navigational publications, but and notices, hydrological year books, river charts and river maps;

xix. carry out consultancy and contractual services;

xx. represent the Government of Nigeria at national and international commissions that deal with navigation and inland water transportation.;

xxi. subject to the provision of the Environmental Impact Assessment Decree 1992, carry out environmental impact assessment of navigation and other dredging activities within the inland water and its right of ways;

xxii. undertaken erection and maintenance of gauges, kilometer boards, horizontal and vertical control marks;

xxiii. advise government on all border matters that relate to the inland waters;

xxiv. undertake acquisition, leasing and hiring of properties;

xxv. run cruise boats;

xxvi. carry out boat repairs, boat construction and dockyard services; and

xxvii. clear hyacinth and other aquatic weeds.

2.10 AN APPRAISAL OF MARINE ARCHITECTURE

Of wide range of architectural endeavors, marine architecture is by far the most disposed area of architecture that is exposed to prominent and challenging environmental constraints. The evolutionary design process of water related developments begins with detailed environmental analogy which is characterized by vast difficult factors and conditions to be analysed and adopted in the formulation of the design considerations. This analogy involves concise scientific processes in order to obtain precise data which are then studied and adopted by the Architect in his design, This process of collection of data involves a team of other professionals working together in order to obtain the data.

According to Lampard J.S. (1999) ***"The physical characters of waterfront projects are determined by climatic and environmental factors of the site"***. James B. ((1988) in his book title "River Studies" also posits that ***"the conditions associated with waterfront determines the design parameters of design project"***. Waterfront developments are largely shaped by the constraints associated with the waterfront thereby influencing the overall design out come. After the design has been completed and executed, the building is further exposed to hash environmental conditions associated with the waterfront. Therefore sustainable architecture becomes imperative in the design, selection of materials and construction stages of the project.

CHAPTER THREE

3.0 FUNCTIONAL ANALYSIS OF PORT FACILITIES AND OPERATIONS

3.1 LAYOUT OF GENERAL PORT FACILITIES

Port facilities are important installations, which make operations in port possible, they aid in smooth running and performance of shipping activities. Bird J. (1971) posits that, "The objective in providing loading and discharge equipment is to reduce a ship's turn-round time in a port''. In essence port facilities are the most paramount installation that make shipping and operation at a port efficient.

The installations of a port can be divided into two broad categories. First there are port infrastructures designed to steppen the junction between land and water and to join that junction with landward ground communication. Secondly, port superstructures are concerned with aiding movements of cargoes to and from ships across that prime junction between water and land.

Installation superstructures are sited in the backup area of each berth, quay, or dock. The total of back up areas is the upland of the port. The cargo handling and cargo manoeuring area back from t he quays up to the port perimeter, which may be a customs fence or simply the boundary between ports and non – port land uses.

Port facilities are thus installed on these two broad categories of installations. The major aim of port facilities is the facilitation of speedy transfer of good and passengers to other means of mode of transport. This therefore posits quays, docks, wharves and jetties as the most important installations in a port. Facilities like policing services, rescue, medical, port security and fire fighting are equally important ancillary services that are required in the

smooth running or operations of a port complex. Other facilities include the following rest rooms, temporary living quarters, equipment maintenance areas, dangerous material areas, canteens, and fuel bunkering facilities are equally important. Shipping operations facilities such as installations, spare parts, quarantine facilities, communication, services (water, light and sewage) waste disposal and environmental protection are also needed among other port facilities. Recreational facilities for ship crew, port workers, port administration and control offices are also required for workers welfare. Passenger services are also port services that need to be in stalled in ports that double as cargo and passenger terminals.

In this thesis research work, it is the intention of the researcher to give attention to facilities that are directly connected to architecture, though engineering aspects of a ports shall be high–lighted in the course of the design, input shall be more on Architecture oriented aspects of the port such as administration, passenger services, and transit sheds.

3.2 SHAPE AND SIZE OF HARBOUR TURNING BASIN

The outline of a port basin takes the shapes of the quay, wharf or jetty of the port. This basin allows for easy access and manoeuring into port facilities that aids in the loading and off loading of the water vessels. According to International Association of Navigation congress report on consideration for size of port turning basin, " the size of port turning basin should by proportionate to the size of expected ships that would patronize the port."

In lieu of the above mentioned, it is thus mandatory to consider the allowable or standard water vessel size that is stipulated by National Inland Waterways for navigation on inland waterways. The design vessel for river Benue by National inland waterways is vessels of 2 .5 meters deep draught. This draught allows for vessels of 10-40 meters length to

ply the inland waterway. Thus the turning radius of vessels with maximum of 40 meters according to International Sailors organization (ISO) is 30 meters. The minimum depth of water should also not be less than 5 meter deep.

3.3. PORT APPROACH

The length of a port approach is dependent on the size of the ship. A small vessel will be able to head towards the inner berths of the port, whereas a mammoth vessel could be deemed to begin her approach much further out and probably be able to berth at only the most water ward berth in the port. Ideal port approaches are deep. Thus therefore involves dredging of the shoreline to attain the required deepness for port approach.

3.3.1. Wave and current breakers.

These are required at ports to allow stability of vessel that are at berth in a port. This is achieved by the use of rubble mounds, solid vertical wave barriers, wave boards and wave fences and floating wave attenuators.

3.4. SHIPPING OPERATIONS.

Vessels traffic at ports are guided or aided into and out of port basin by the pilotage department. This is important in the avoidance of conflict between arriving, berthed and departing vessels. In coming and out going traffic are viewed from a watchtower and relayed to pilotage department, which take physical control of this traffic.

For inland waterways operations, ports shipping activities are confined to accepting, forwarding and delivering goods between the inland towns or hinterland and the coastal

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3.4.3. General Cargo

These are goods handled separately from passenger movement and traveling baggage e s. cargo carrying vans drive straight to transit sheds where they are delivered for inspection, onward packaging if they require packaging and loaded on vessels. On arrival, the goods are also taken into transit sheds where they are inspected then cleared for delivery. Offices therefore are needed in transit sheds for paper processing.

3.5. CARGO FACILITIES

Cargo facilities are those facilities in a port that their functions are strictly for their handling of cargo movement from ship to truck, train and other means of land transportation and vice versa. These facilities include the following.

3.5.1. Transit Sheds

Transit sheds within a port complex serve the basic purpose of providing buffer zones to unites and fasten the cargo traffic between ships and storage means. These are means of temporary storage for goods discharged from vessels awaiting clearance and distribution to warehouse, rail and other means of inland transport. Goods arriving from main land and awaiting shipment are also kept in transit sheds.

In addition to the above-mentioned primary use of transit sheds, they also provide a safe place for inspection of cargo and correspondence with bills of loading and for necessary customs and delivery formalities. Transit sheds should not therefore be used for long-term storage at ports. The locations of transit sheds are normally near cargo docks, quay and wharves close to the waterfront.

not allowed to be located on the waterfront. This is because economic considerations do not justify their construction on or alongside the docks. Another reason is to avoid the possibility of using them as transit sheds, thereby changing their true function.

3.5.3 Open Storage Area.

Open storage areas are provide in a port complex to accommodate container cargo that has not been claimed by the owners for a long time. They also act as storage means at times that sheltered storage facilities cannot take inflow of cargo. Open storage spaces should be accessible by trucks and cargo handling facilities like fork lifts, mobile cranes e.t.c.

3.5.4. Cold Stroage

Cold storage is provided in a port complex for food items that require refrigeration. These food items are shipped by refrigerated vessels and carried by refrigerated trucks and distributed for use or consumption. Cold storage facilities are provide on the dock such that the food item can be taken directly from the ship to the cold store, therefore distances between the vessel and the store should be as short as possible. This short distance help in keeping temperature change to minimal and manageable level.

Fish, meat, diary produce, fruits and vegetable are the main foodstuff that falls under this category of goods that require cold storage. Cold storages are therefore designed to maintain correct temperature, air circulation and humidity, which are essential in food preservation. Adequate floor height should be provide to allow for manoeuring within the cold store.

Provision for insulation is also very important and in most cases, cork is used as an

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cargoes are mostly, the type of cargo that pass through them.

The handling of break-bulk cargo in River port Terminal is done in three major ways, the third is a combination of the two fore-mentioned.

i. Manual handling

ii. Mechanical handing and

iii. Manual and Mechanical handling

3.6.1. Manual Handling

Manual handling involves the use of human labour for loading and discharging of cargo from a vessel. It is common in third world countries because of cheap cost of labour which is always readily available. In this type of handling, men using their heads or shoulders carry loads. In Nigeria, man handling was the primary means of handling cargo in Riverport Terminals during colonial era and it is known from statistics that 150 men could load 1,200 tons of bagged commodities in a day.

3.5.2. Mechanical Handling

This is the use of equipments and appliances to load and discharge ships. Mechanization of cargo handling is known to have high initial cost of installation than man handling. Technological developments of industries brought about the mechanization of cargo handling in ports. The equipment and appliances make handling of cargo easier and faster. All modern ports take advantage of mechanized handling of cargo to reduce labour cost and minimize the time it takes a ship to remain in a port due to loading or discharge.

3.7 HANDLING EQUIPMENTS.

Equipments employed in ports for loading and discharging of vessels include fork left truck, ship's gear, mobile crane and mobile transverse fork lift truck. Others include trucks, trailers, multipurpose lorry mounted crane, conveyors etc.

3.7.1 Mobile Cranes

There are cranes used in lifting cargo from one point and transferring them to another point within the port complex. These types of cranes are normally fixed on a vehicle, which has pneumatic tyres. Care should be taken to avoid lifting of cargoes that their weights are more than the maximum capacity of the crane in order to avoid toppling of the crane. Sometimes the mobile cranes are fixed to a rail track and are used only for close distance lifting of cargoes.

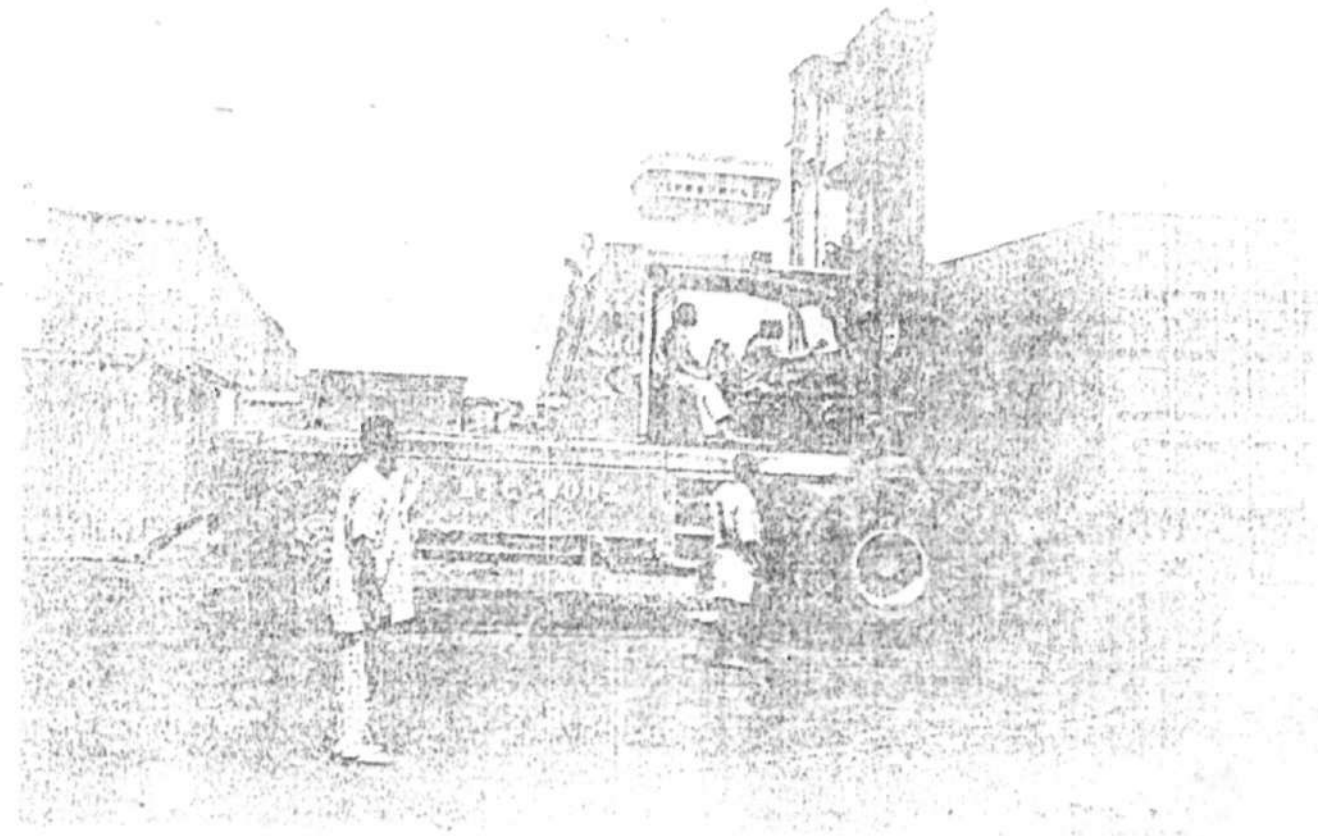
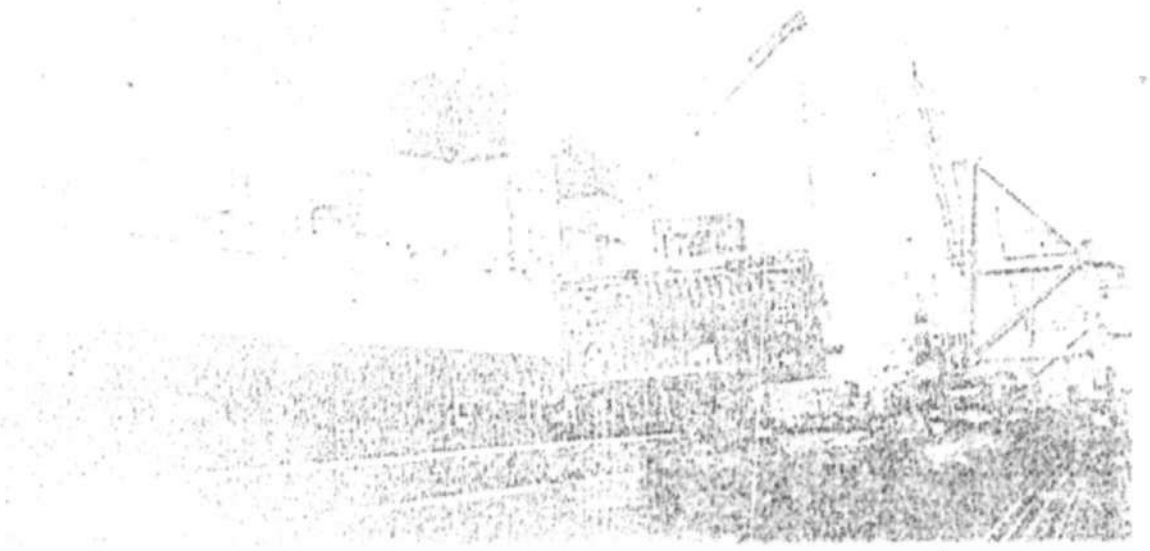


PLATE 3.1: PICTURE SHOWING A MOBILE CRANE CARRYING A CONTAINER

3.7.2 Fixed, Rotating and Pedestral Cranes

There are cranes that are fixed to a sling frames. They pick up loads from one point and rotates to drop the load as desired, they are capable of rotating for 360° in the course of lifting and dropping cargoes.



3.7.3 Ship's Gear

Modern cargo vessels have its hatch equipped with a pair of cargo booms. To load and unload a vessel, one of the hatches is strayed over the offshore edge of the hatch, the other over hanging the wharf. There are cargo hooks hung from a link to reach both hoisting lines. The operator is able to drop the hook into either side of the vessels by joint manipulation and maneuver the load vertically and horizontally to place of storage stalk where they are furtl:er picked up by other means of handling within the port.

3.7.4 Conveyors

These are handling equipments that are used for handling of bulk cargoes from their storage within the port storage facility to vessels and vice verse. Different types of conveyors are used in ports, these include belt or slat, overhead chain or manorial, pressure pipes and inclined plane conveyors.

3.7.5 Fork Lift Truck

These are small mobile cargo handling machines that can pick up unit load which are either containerized or palletized cargo off the quay or apron and take them into the sheds. A forklift truck is capable of stocking these cargoes up to a height of 18 feet. For horizontal travel up to about 190 feet, forklift trucks are considered efficient, their efficiency diminishes beyond this distance because the truck run at fairly slow speed.

3.7.6 Floating Equipments

Some of the heaviest loads are handled by floating cranes or derricks. These are usually operated on the offshore side of the vessel transferring cargo to barges and canoes.

3.8 CONTAINERIZATION

This is a system of cargo handling whereby smaller units of cargo are packed together into large re-usable containers. Cargo containers are made of boxes with an operable door, which can be locked and sealed. They are made in various sizes to suit the type of cargo to be conveyed in them and innovation are constantly appearing on the market according to demand on types of cargoes to be parked in them.

Containerization makes easy the transportation of goods on water by ships and land by trucks and trains, from one place to another. The designs of containers have been standardized to international specification for usage internationally.

Container are capable of carrying all sorts of goods, these include, liquid cargo, dry cargo, live animals therefore they are designed with special feature to meet the requirements of carried goods.

Problems in the wake of containers use are faced in capital demand for establishing initial thorough container routes. Cellular vessels, which carry containers, are more expensive than conventional vessels of similar size and power. Container vessels require specialized construction of berth for berthing of container carrying vessels and associated facilities are expensive to construct and equip.

The main advantages associated with containerization are:

i. They can be filled in factories and transported with at any breakage of cargo to their point of shipment. At the port handling of containers is easier and faster.

ii. The speed of handling of cargo in containers reduces shipping cost incurred by paying berthing dues on a daily basis, this also speeds up the turn- around time of the vessel at the port.

Materials used for construction of containers include steel, aluminum wood etc.

3.9 PALLETISATION.

A pallet is a device on the deck of which a quantity of goods can be assembled to form a unit load for purpose of transportation or of handling and stacking it with the assistance of mechanical appliances. A pallet is made of two decks separated by bearers, or a single deck supported by footings; it's overall height is reduced to the minimum compatible with handling by fork lift truck and pallets truck. It may or may not have a superstructure.

Sea going pallets may have hocks welded at each corner for hoisting. Pallets are made of wood, steel, aluminium or plastic. They are designed for use with forklift trucks.

Palletisation has some distinct advantages over containerization. Its advantage is note worthy over its ability of easy handling. Save in cost is also an advantage pallets have over containers as a result of their packaging. Port charges are also sometimes lower for palletized goods and customs inspection are also simpler thereby saving time.

3.10 PASSENGER FACILITIES

Passenger facilities are provided in modern port because contemporary trends in ports designs have ports that double as cargo and passenger terminals. Passenger and cargo movements are separated from each other. Passenger facilities include the following

i. Farewell
ii. Greetings
iii. Arrival lounge
iv. Departure lounge
v. Restaurants
vi. Shops
vii. Ticketing boots
viii. Communication facilities
ix. Toilets
x. Baggage collection and check in
xi. Conveyor belt etc

3.11 PORT ADMINISTRATION BUILDING.

Port administration facilities are dependent on the system of administration, the size of the port and it geopolitical location. For inland waterways, it is generally accepted that central administration machinery is put in place with area administration to take care of smaller station. The port administration is under the control of the port manager.

Port administration has the following departments.

i. General administration department.

ii. Traffic department.

iii. Commercial department.

iv. Harbour pilotage department.

v. Port estate department

vi. Account department

vii. Statistic department

viii. Communication and radio department

ix. Medical department

x. Stores department

xi. Customs department

xii. Port police department

xiii. Agents officers

xiv. Engineering department

xv. Port maintenance department

3.12 CONCLUSION

From the study of port facilities and operations, it can be concluded that a good port without facilities cannot perform the functions that are required of a port appropriately. It is thus the duty designers to provide relevant facilities for the effective and efficient operation of a port.

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CHAPTER FOUR

4.0 CASE STUDIES

4.1 INTRODUCTION

In conformity with the research methodology formulated in the introductory chapter, local and international case studies were carried out by the researcher to have an insight of existing similar projects. These case studies involved the inventory and appraisal of existing ports in order to guide the researcher in the pursuit of this work. Two case studies have been taken in Nigeria while two are also taken as foreign ones.

The major considerations among others on which the case studies were carried out are:-

i. The relationship between facilities and the surrounding environment especially the waterfront.

ii. The relationship between built-up spaces in terms of functionality.

iii. The treatment of buildings and facilities on the waterfront.

iv. The composition of ports' general layout in terms of facilities requirement.

4.2 LOKOJA RIVERPORT TERMINAL

4.2.1 Location

The Lokoja Riverport terminal is located on port road on the bank of river Niger in Lokoja, the state capital of Kogi State.

4.2.2 Description/Facilities

Lokoja Riverport Terminal was established and constructed partly by the British colonial masters in the early part of the 20th century. It's activities were strictly restricted to the loading of cargo for onward shipping to the colony countries. Thus the facilities in Lokoja port at it's inception were to facilitate cargo handling. However with the independence of Nigeria as a state, the Lokoja Riverport has seen subsequent developments which in recent times up-graded the Lokoja Riverport terminal to a national headquarters to oversee the activities of inland waterways.

The new Lokoja Riverport terminal which is presently undergoing, construction work, is intended to facilitate the smooth running of activities. The passenger terminal building has already been commissioned earlier this year and has since been in full utility.

The passenger building is linked to the waterfront by steps and the terminal building itself is raised above the highest water level by round metal columns filled with reinforced concrete. A gangway connects the passenger terminal to the landside of the riverport terminal.

Cargo facilities at the Lokoja port installed by the colonial masters are desolate, thus, replacements are underway for new cargo facilities.

The Lokoja Riverport Terminal is provided with facilities which are aimed at smooth operations of the Riverport, these include the following:-

i. Administration buildings
ii. Workshops
iii. Transits sheds
iv. Ware houses

v. Passenger terminal etc.

vi. Tanks for petroleum products

vii. Dry dock

4.2.3 Design Appraisal

From the case study carried out on the Lokoja Riverport Terminal the following were noted based on the case studies parameters.

I. **Association with waterfront:**

The Riverport is blended with the River water by the use of steps and piers. The pier raises the gangway, which connects the land and the passenger building; the steps connects the passenger building to the water.

II. **Concept**

The Lokoja Riverport has no visible or defined concept, but the arrangement of facilities allows for a clear vista of the waterfront.

III. **Construction/Structure**

The facilities studied at the Lokoja Riverport terminal exhibit a clear and simple structure. This is composed of beams on columns for the passenger building and administration building and portal frames and cladding for the workshop, warehouse and transist sheds. See picture below.

IV. **Accessibility**

The Lokoja River port Terminal is directly accessible from the adjourning port road through the entrance gate. The road network provides adequate circulation to all functions and facilities in the port complex.

V. **Finishes.**

The entire port buildings are painted with oil paints, which withstand humidity a common problem to waterfront buildings.



Plate 4a: Shows workshop and administration buildings



Plate 4b: Administration building

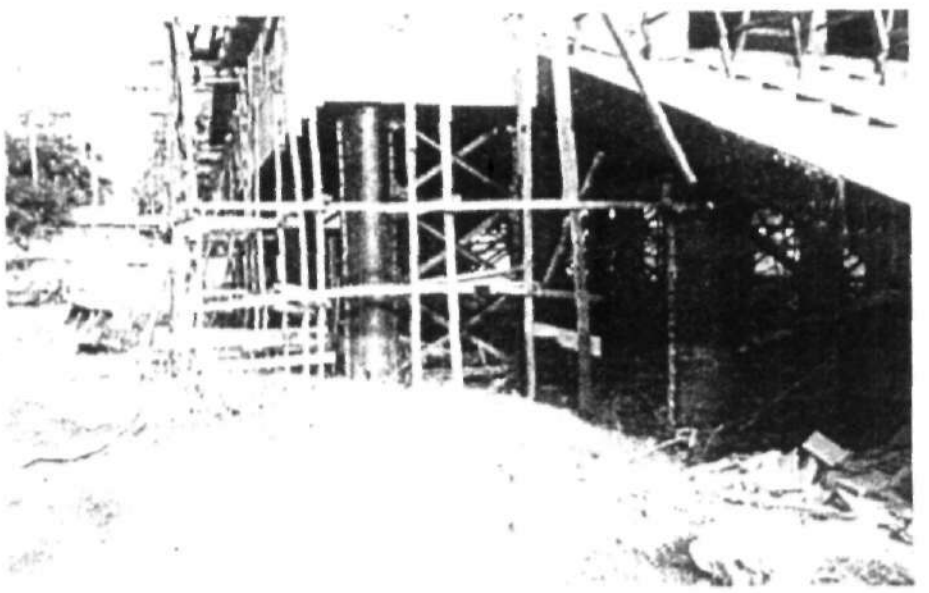


Plate 4.1: A detail of beams that raise the passenger building.

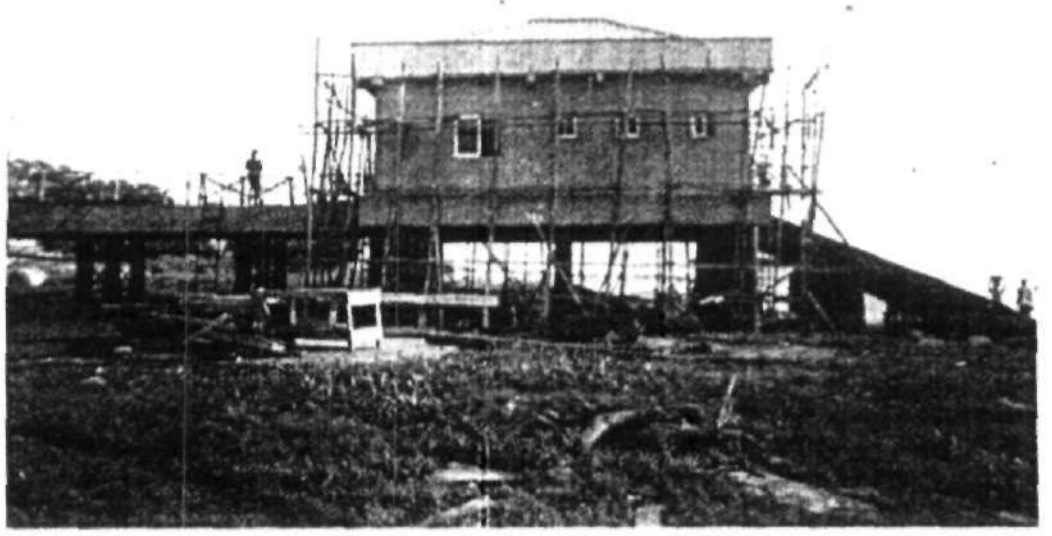


Plate 4.2: A view of passenger building



Plate 4.3: A view of transit sheds from water side on the port



Plate 4.4: A back view of transit sheds from access road into the port

4.3. ONITSHA RIVERPORT TERMINAL

4.3.1 Location

Onitsha Riverport Terminal is located along the River Niger off Niger, Bridge road in Onitsha Town, a commercial nerve centre of Anambra State.

4.3.2 Description /Faciliteis.

The Port was designed by P.R.C. Limited Lagos in 1980 and was planned to be develop in three phases. The first and second phases were completed and commissioned by Shehu Shagari in 1983.

The completed facilities were basically for administration and cargo handling. These facilities include the following.

i. **Quay**

It is constructed with reinforced concrete slab raised on columns made of hallow columns metal filled with concrete. The quay who has steps for access to the waterside and a road for access from the landside. Two cranes with crane tracks for loading and off-loading of cargo from ships are also installed on the quay.

ii. **Transit Shed**

The port has a transit shed with a total area of 5190m^2 and the structure is made of metal stanchion portal frames cladded with sandcrete blocks.

iii. **Port Complex**

This building accommodates offices, which are used in the daily operations of the port.

iv. **Fire Brigade Building**

This building accommodates fire fighting equipments and offices that pertains to fire fighting operations.

v. **Workshop**

The Riverport has a mechanized workshop which is used for maintenance repairs.

vi. **Police Post.**

The police post accommodates port security operatives.

vii. **Electrical substation.**

The Riverport has it's own substation for effective power supply to the entire port complex.

viii. **Open Storage Spaces**

An open storage space is provided for storage of unclaimed cargo storage.

ix. **Embarkment**

The waterfront or waterside of the complex is embarked for proper soil retention of soil movement.

4.3.3 Design Appraisal.

i. **Association Wih Water Front.**

The Onitsha Riverport has a standard embankment that spans through the Quay with surface drainage pipes running through it. The Quay is the closest facility to the waterfront, it is blended with the waterfront by columns which raises it to level up with the land.

The Quay is accessed from the waterside by steps and cargo movement is made possible by the use of two cranes mounted on the quay.

The raising of the quay by the usage of columns allows for free flow of river water in conformity to the river course without causing any diversion in the natural flow of the river.

ii. **Concept.**

The Onitsha River port Terminal has no clear defined concept in it's design.

iii. **Construction /Structures**

The facilities studied at the Onitsha Riverport Terminal has simple structural system, the Quay been closest to water is raised on round metal steel columns filled with reinforced concrete. The quay itself has beams on it soffit, both beams on the soffit and concrete slab above are monolithically cast in situ, to attain maximum strength with expansion joint running through to allow for expansion due to changes in temperature.

The warehouse is made of steel stanchion I – Steel portal frames with sandcrete blocks as a cladding. All other building in the buildings in the port complex are made of beams and columns with sandcrete blocks as cladding.

iv. **Accessibility /Circulation.**

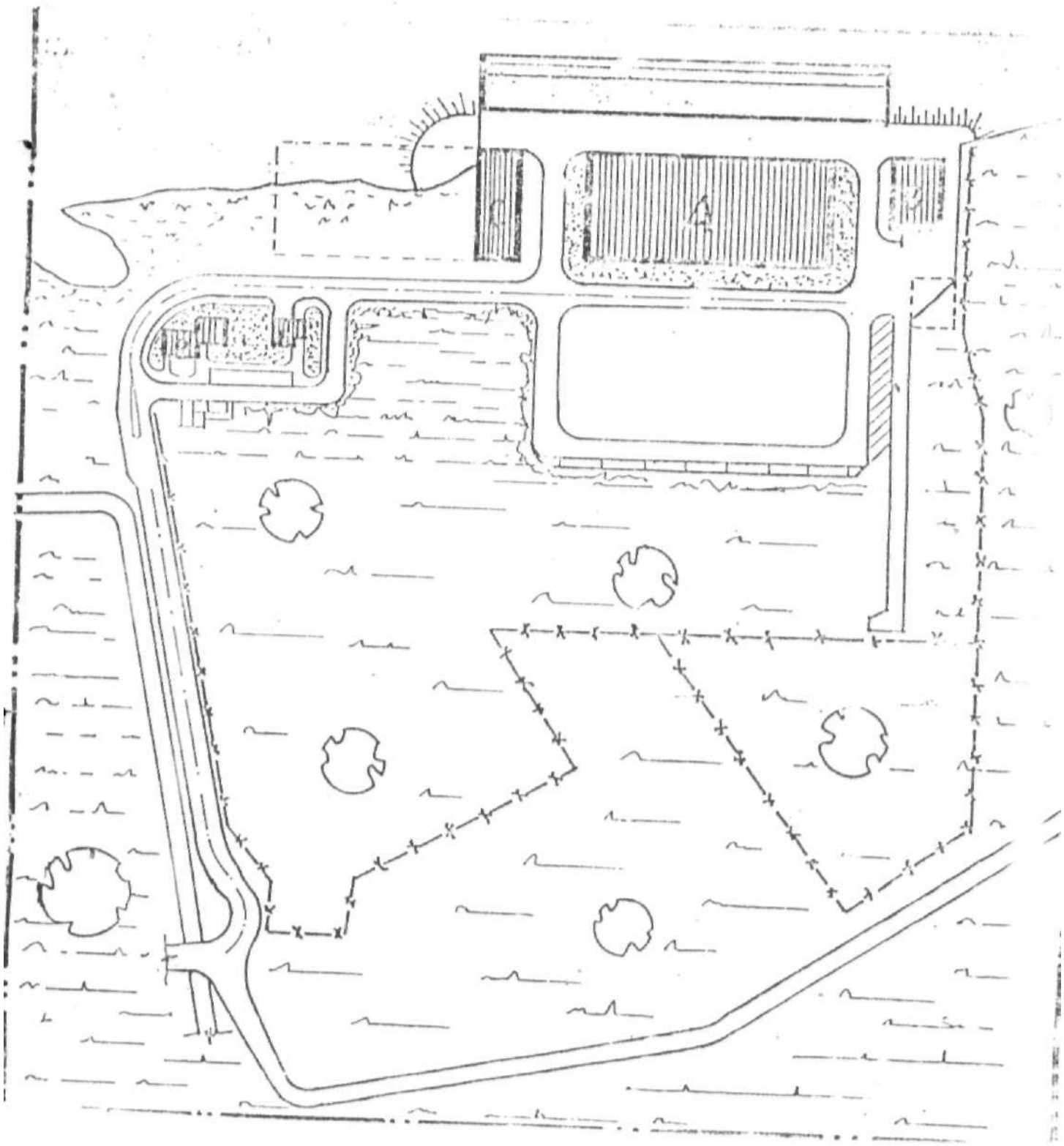
The Onitsha River, port Terminal is directly accessed from a road tapped from Niger Bridge Road through the port gate, which has a security post. A good network of roads within the port complex connects all port facilities.

v. **Finishes.**

The external finishes of most buildings in the port complex are treated with emulsion paint, but emulsion paints are not good with high humidity environments, this has lead to the pilling and wearing of the paint due to high humidity and weathering effect.

4.3 CONCLUSION FROM NIGERIAN CASE STUDIES.

There local case studies carried out by the researcher would not be complete without a general overview of the Nigerian situation, the researcher has observed that though, the Federal Government has made genuine positive efforts toward inland waterways development, the governments and private sector needs to develop more River port Terminal so that there would be a chainage or linkage of riverport for smooth inland waterways operations as a mode of transport. While putting in more efforts, the government needs to look into proposals that are architecturally inclined so that port architecture of the inland waterway can comfortably compete with international standards or meet with modern riverports trends that are environmentally acceptable and attractive.



SITE PLAN OF ONITSHA RIVERPORT TERMINAL.

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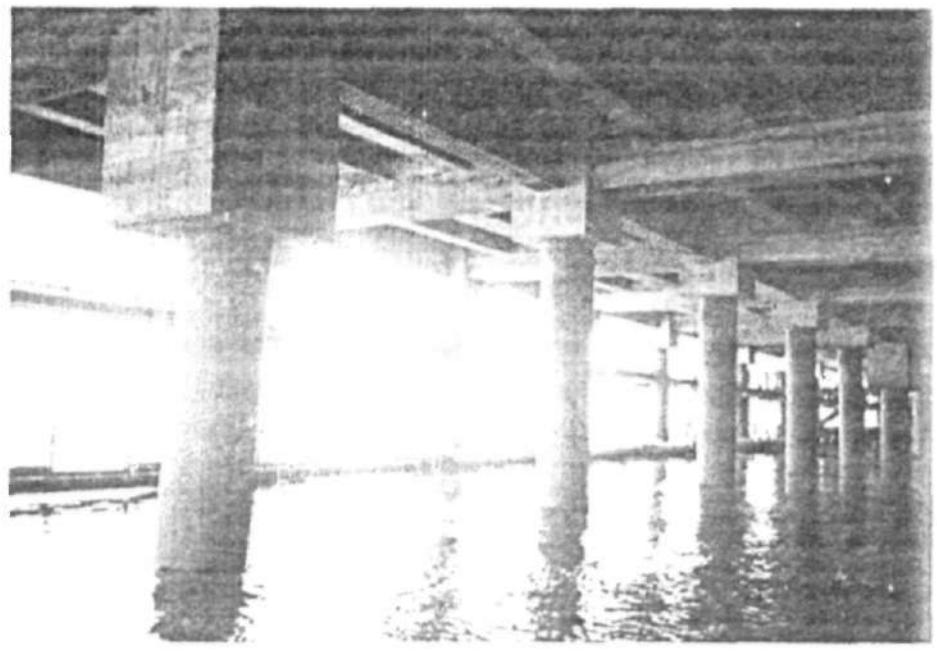


Plate 4.5: A view of soffit of quay showing reinforced concrete beams encased in hollow metal casing



Plate 4.6: Shows the warehouse of the port terminal



Plate 4.7: Perspective view of quay shows the quay equipped mobile cranes for loading and discharging of cargo

4.4 HAMBURG FERRY AND CRUISE SHIP TERMINAL.

4.4.1. LOCATION.

The Hamburg Ferry and Cruise Ship Terminal is located along the River Elbe in Hamburg, Germany.

4.4.2. DESCRIPTION / FACILITIES.

The building was designed by Willian Alsop, the Terminal building has a total length of 200 metre, this makes it the longest office building in Europe.

The Hamburg Ferry and Cruise ship Terminal was created to reflect the longstanding affinity between the River Elbe and the connecting sea. This consideration was the key fctus in the design of the Hamburg Ferry and Cruise ship terminal.

The waterside of the building is visually open to and embraces the river and shipping activities, while the landside is less so. The Terminal has green glass walls overlooking the river; this green glass reflects the colour and pattern of the water. The landside has silver metal spandrel panels, which present a more solid face to the street. The exception is only at the ground floor where a double –height glass walls allows a visitor a clear vista through the waterside and ship beyond.

The Hamburg Ferry and cruise ship Terminal has two major groups of functions; essential ones such as administration, passport inspections, customs inspection, luggage handling, reception, greetings farewells e.t.c and public ones such as event hall, gallery, restaurant, and observation decks.

4.5.3 Design Appriasal

I. Association With Waterfront.

The Hamburg Ferry and Cruse ship Terminal design blend perfectly with the waterfront by the adoption of raft foundation, embankment, and use of green glass to overcome reflection from the water body in order to allow for viewing from the terminal building.

II. Concept

The concept of the design of the terminal is developed to reflect the physiognomy of a ship. The shape was adapted to define the activity going on in the terminal building. The size of the building was created to define the long standing relationship between the river Elbe and the sea.

III. Construction /Structure.

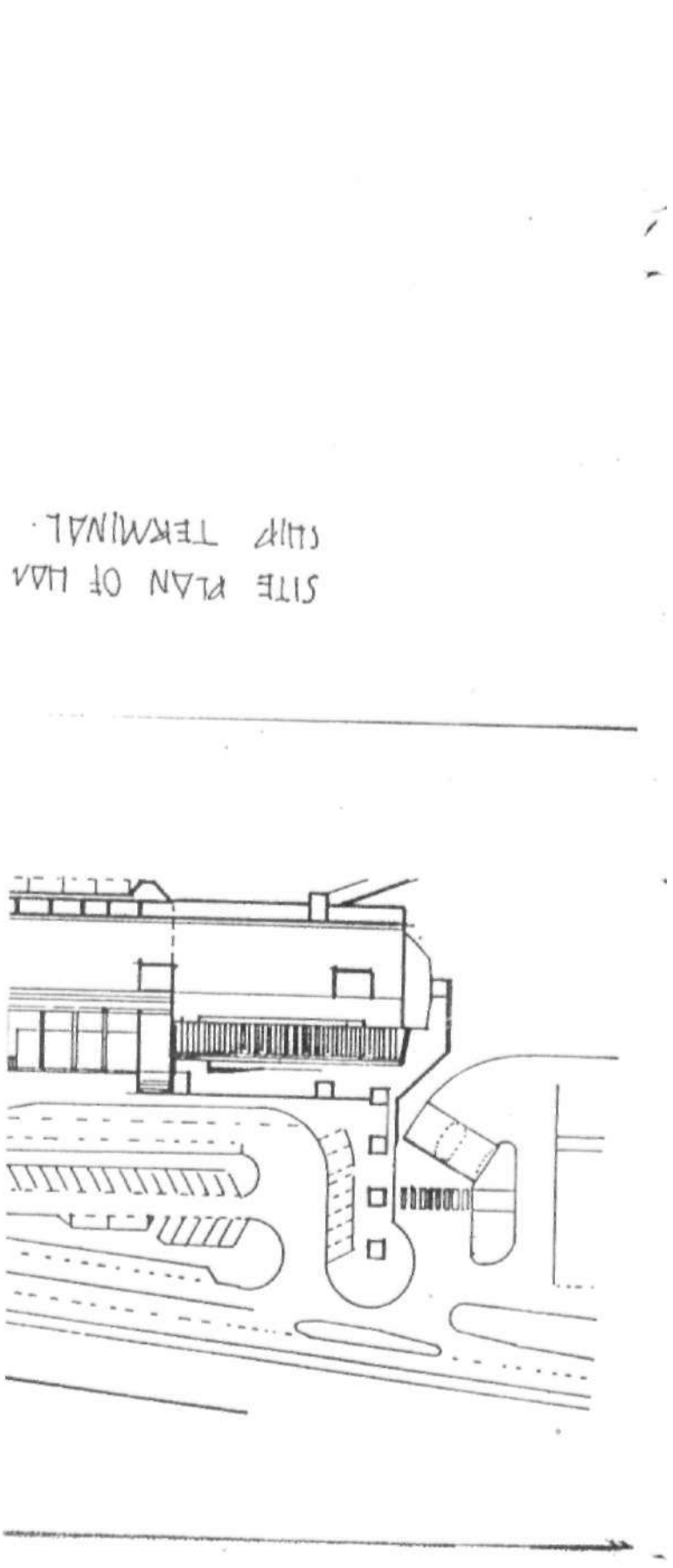
The Terminal building is constructed with simple structural elements, the columns are A-shaped this allows for balance and strength, floor slabs are made of reinforced concrete.

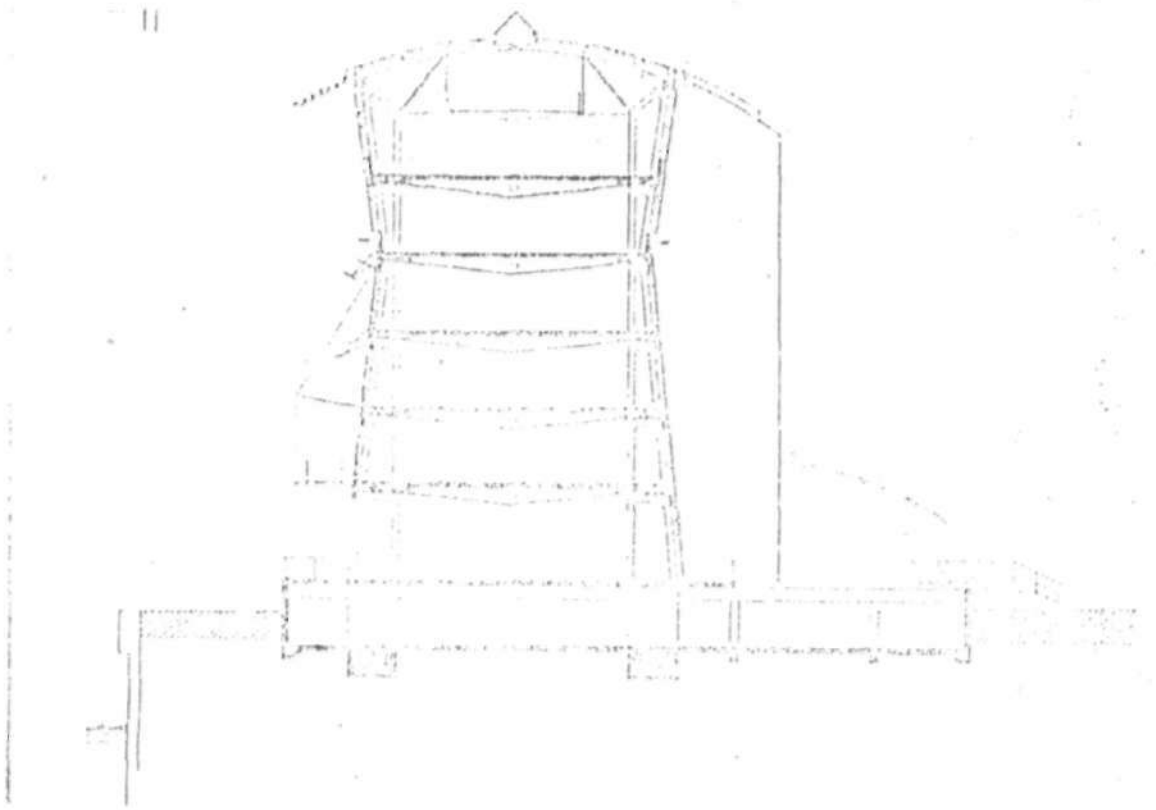
Glass certain walls are used to allow for viewing. The foundation is raft foundation, which is made of over site concrete and thick beams running through the span of the building at the foot of the A-shaped columns.

IV. Finishes

The Terminal hay good inferior and exterior finishes which expresses the ability of the building to ado pt to conditions associated with the waterfront.

SITE PLAN OF HOA
SHIP TERMINAL.

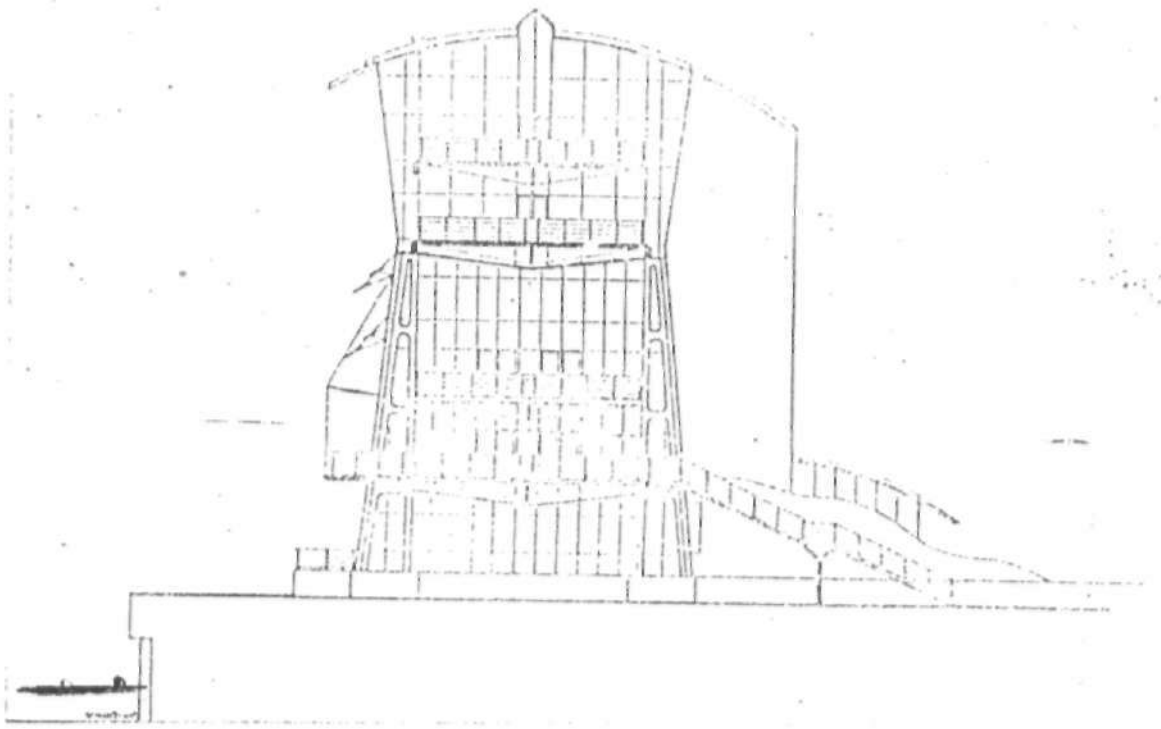




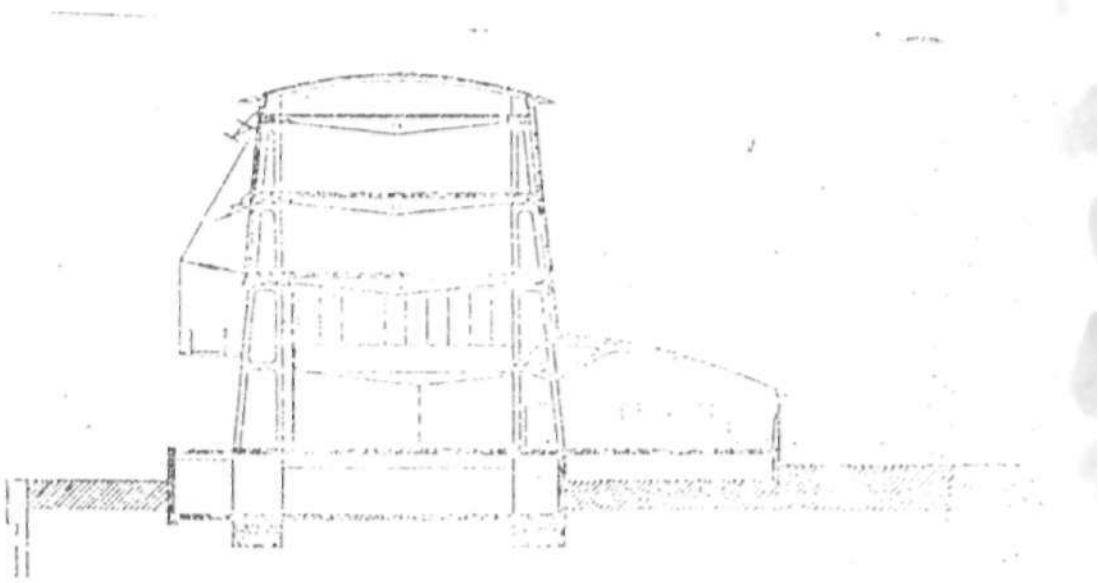
SECTION THROUGH TERMINAL BUILDING



SECTION



SIDE ELEVATION



SIDE ELEVATION

4.5 TOKYO HARUMI PASSENGER TERMINAL, JAPAN

4.5.1 Location

The passenger Terminal is located at the southeast corner of Harumi, one of the oldest reclaimed lands in the port of Tokyo. Geographically Harumi belongs to the heart of the city; it acts as an important link between the portside and the developed urban center on reclaimed land.

4.5.2 Description /Facilities.

The Terminal was designed by Miroru Takeyama, it is an international Terminal which was proposed by the Port Authority of the Metropolitan Government to commemorate the fiftietli anniversary of the opening of the port of Tokyo. The Terminal was designed to establish a syntactic context in urban landscape based on geomorphologic elements to perceive the earth in an urban district.

Two superimposed areas orchestrate the complex: a land axis taken from the exiting street network of Harumi; and the sea axis, these make a dramatized vista from site to the Tokyo to and the Tokyo Bay through the suspensions bridge.

The house like form is located on the top of a manmade hill like structure with multiple terraces and plat forms to allow for viewing.

The Terminal has the following facilities;

a. Official

i. A huge suspension bridge across the port, which connects the traffic system.

ii. Administration

iii. Passport inspection

iv. Customs inspections

v. Luggage handling and receptions

b. Public area

i. Greets

ii. Farewells

iii. Event Hall

iv. Gallery

v. Restaurant

vi Observation desks and

vii. Squares

4.5.3 Design Appraisal.

I. Association with waterfront.

The Terminal has an excellent building – water relationship, this is achieved by the employment of water and plants as landscape elements.

The public service area is laid out along the sea axis, which presents a stage for visual discoveries to excite the visitor's imaginations.

II. Concept

The Terminal has a clear concept, which was borne out of the intention to make the Terminal a symbol of the metropolis, to welcome passenger ships, from a broad and to be a point of urban animation along the waterfront.

III. Construction /Structure

The Terminal is constructed with structural systems made up of columns and

beams with glass certain walls.

IV. **Finishes**

The Terminal building elements has exquisite finishes that suits the waterfront environment; the external metal frames are chrome electroplated to avoid corrosion, floors are treated with exotic mosaic floors tiles finish and the walls are painted with radiant colors that blends with the waterfront.

4,6 CONCLUSION FROM CASES STUDIES

From case studies carried out, the following inferences were made:

4.6.1 ARCHITECTURE.

If is note worthy that the evolution of the total designs for port terminals were basically defined by the waterfront and related conditions .This is clearly seen in the two foreign case studies, the design concept of the two foreign cases studies were based on the physical forms and shapes of water vessel. This gave the buildings a definition of their activities. In line with this, the researcher shall also adopt forms and shapes that clearly define the activities that shall be going on the Makurdi Port.

4.6.2 CONSTRUCTION / STRUCTURE.

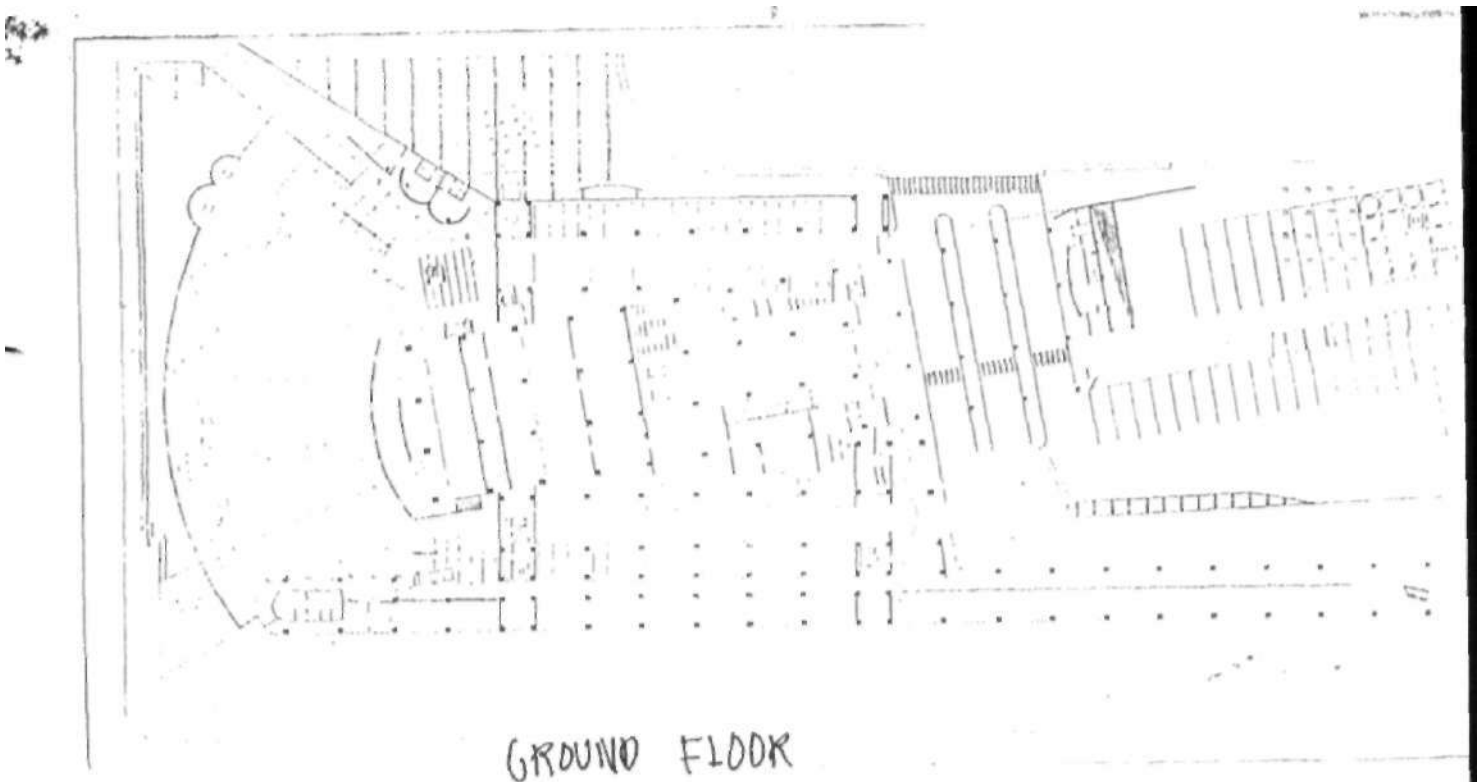
From the case studies, it was noted that special construction and structure were adopted to assimilate the buildings with the peculiar site condition that were associated with waterfront. This shall be applied in the proposed design by carrying out detailed analysis of the site which shall determined the construction and structures to be use.

4.6.3 FINISHES

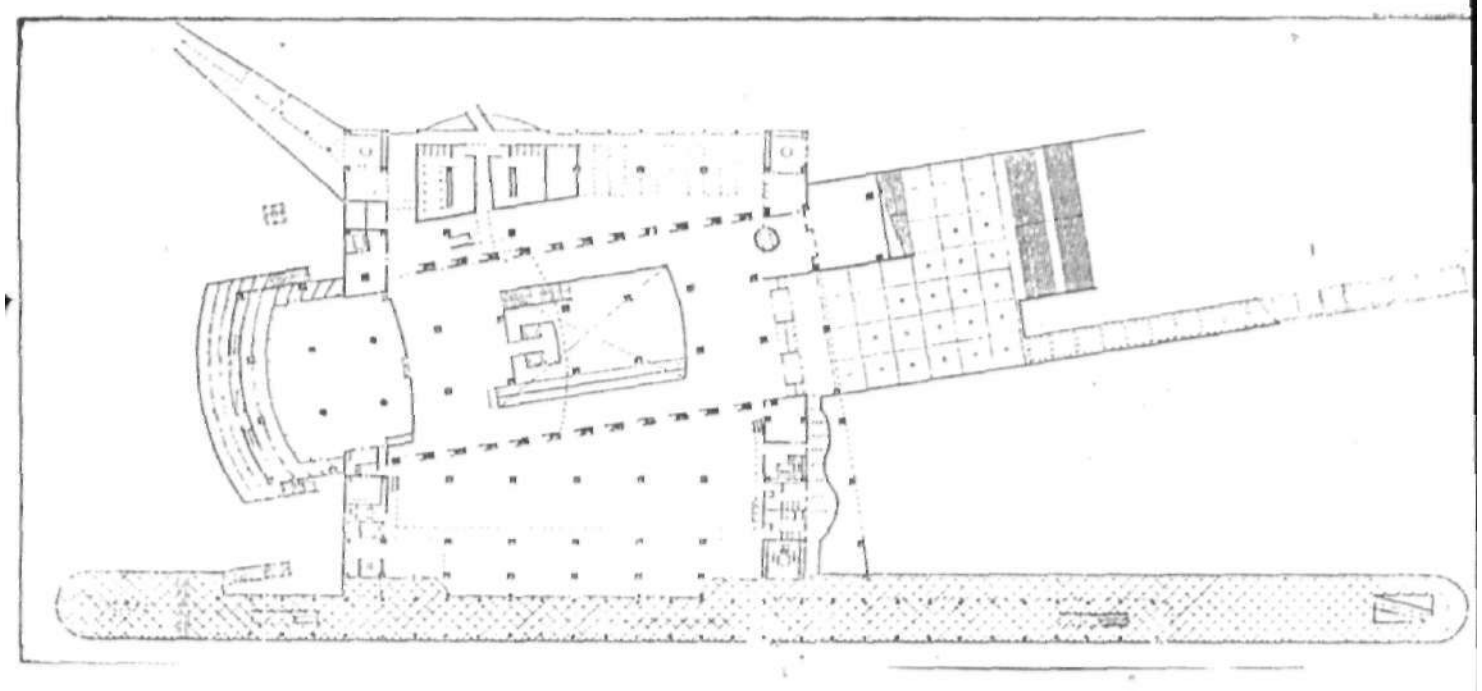
From the case studies, it was noted that special finishes were required to withstand the peculiar waterfront condition like humidity and rising damp. for example, the Onitsha riverport terminal has suffered finishing deterioration because of wrong selection of pant type. In the proposed Makurdi riverport terminal, case shall be taken in the selection of paints to avoid deterioration due to humidity.

4.6.4 ASSOCIATION WITH WATERFRONT.

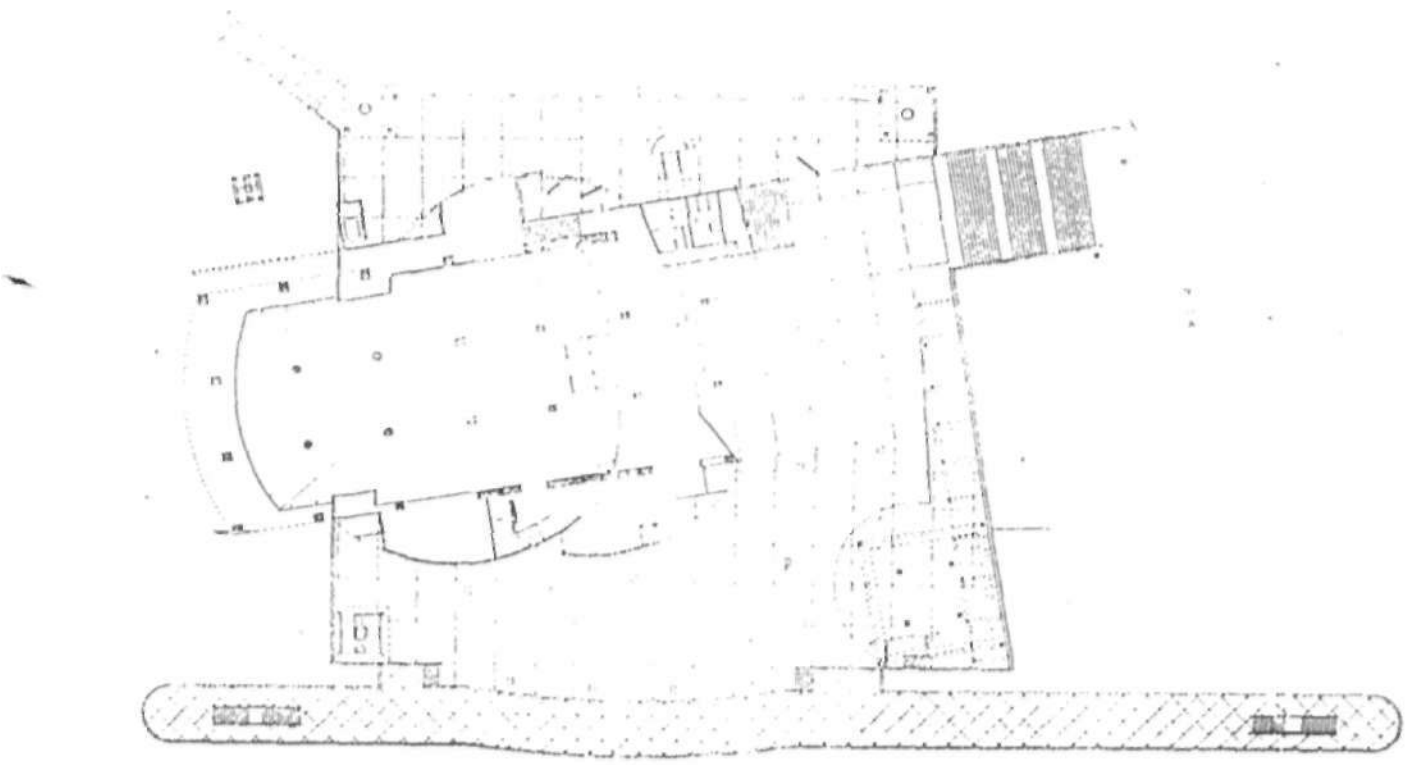
From the case studies it was noted that, the assimilation of the building with the challenging site condition of waterfront prelude to the success of design itself. Constructional techniques ranging from filling, cut and fill, to raising on piers and columns were employed in the wake of blending the building with its site. Some of these assimilation elements shall be employed to blend the Makurdi Riverport Terminal with its site.



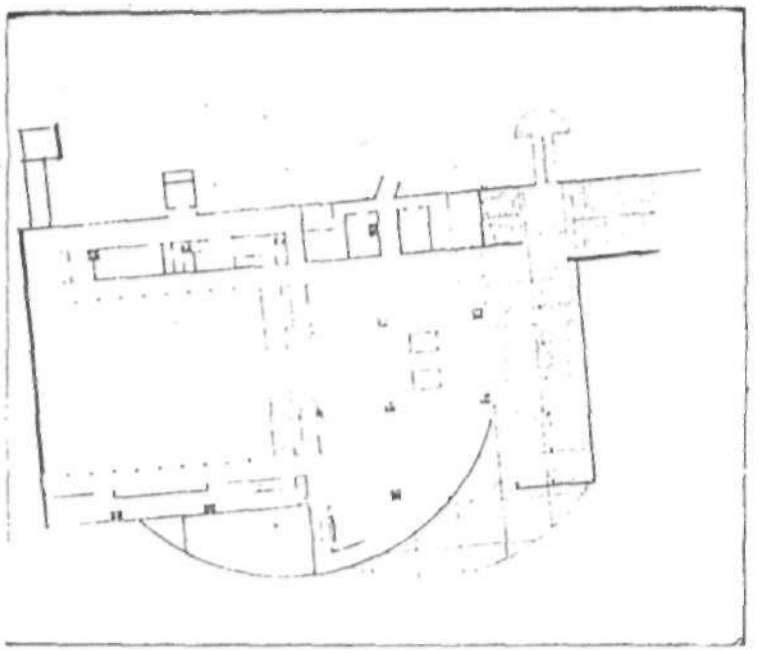
GROUND FLOOR



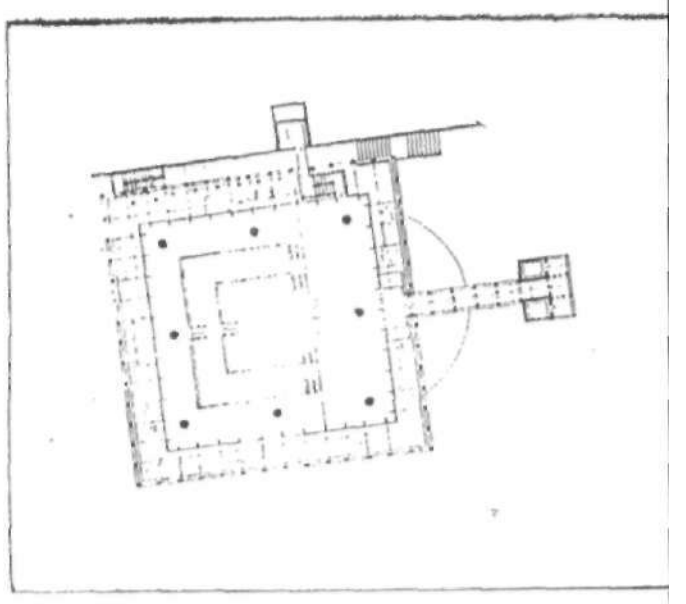
FIRST FLOOR



SECOND FLOOR



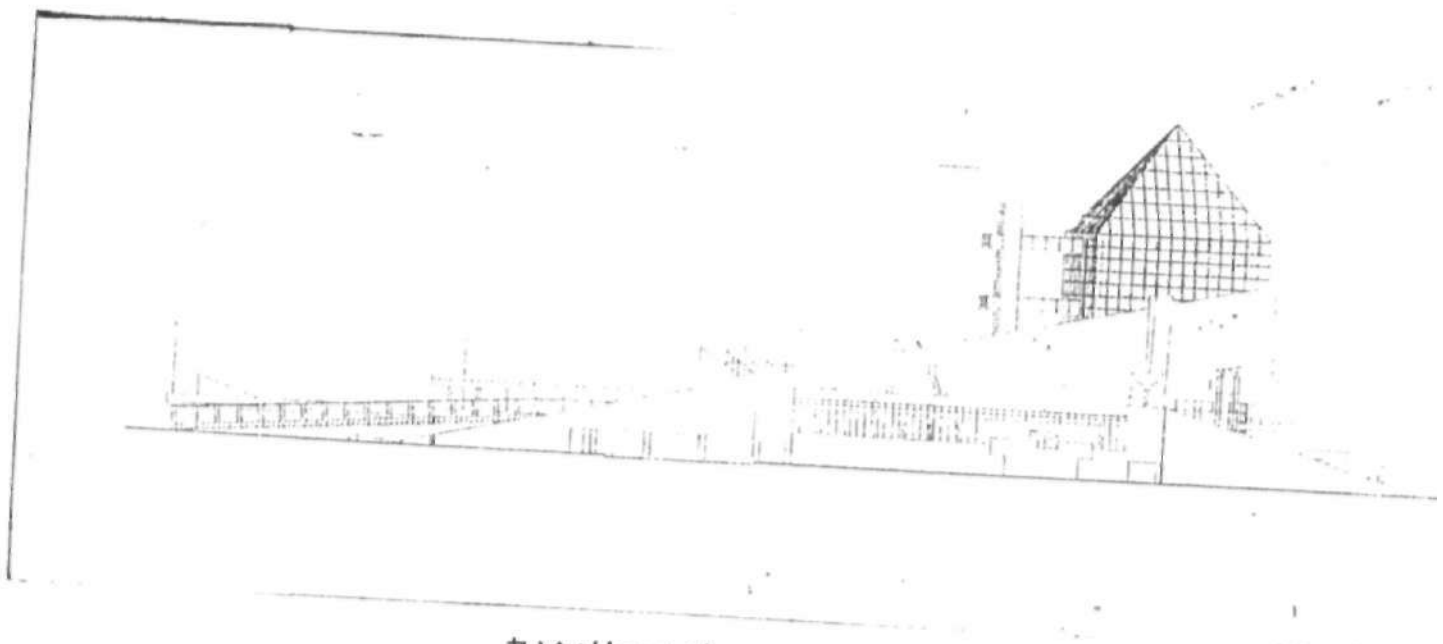
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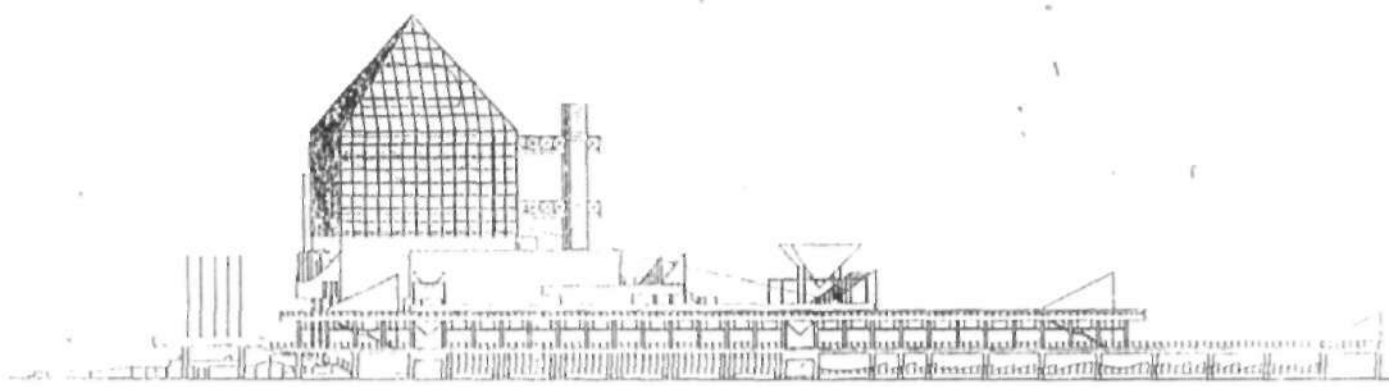
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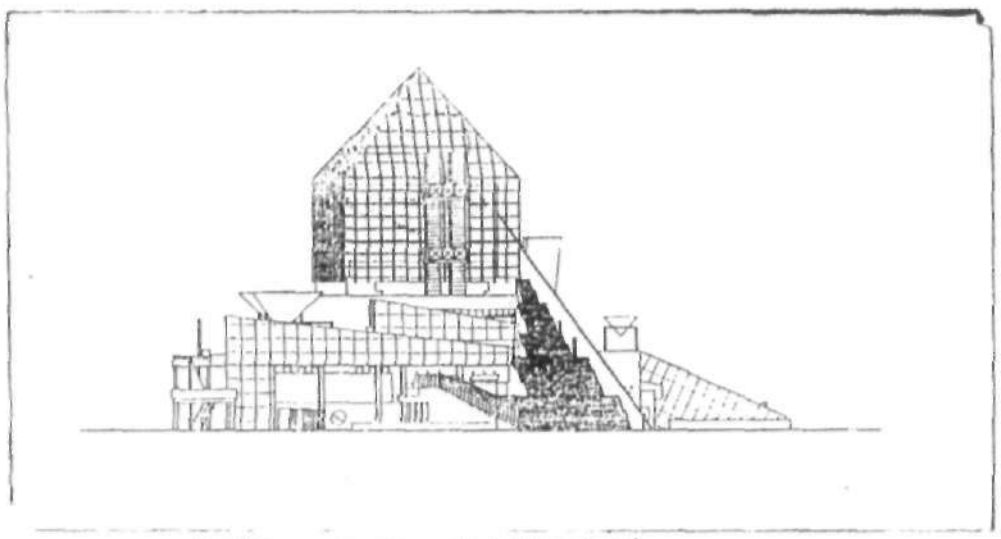
FIFTH FLOOR



ELEVATION FROM NORTH WEST.



SOUTH EAST ELEVATION



SOUTH WEST ELEVATION

CHAPTER FIVE

5.0 PROBLEM SYNTHESIS AND WATERFRONT CONDITIONS

5.1 INTRODUCTION

"The natural state of a river and the use that is to be made of are seldom in harmony, the more so when advanced society increases it demands on nature" – Jansen, P.Ph (1979).

The works associated with river port development cause changes in the riverbed, banks, natural ecology of the immediate river and it's surrounding. The water in turn tends to impose its effects on the immediate environment and associated developments through the conditions defined with waterfront. These conditions are:

5.2 PHYSICAL ENVIRONMENT

To understand the geognosy of the physical character of a riverbank it would be preferable to discuss the elements of the physical environment of a riverfront or coast.

5.2.1 Morphology

Jansen P.Ph (1979) describes morphology as the study of features of a river. A three-dimensional time-dependent water movement forms these features over a mobile bed.

The plan form of a river is dependent on rainfall transported overland and groundwater flow to river Channel. It is only in exceptional cases that these river channels are straight, thus physical shape of a river is either meandering or braided in nature.

The mobile character of the riverbed which is reflected through constant erosion will be taken care of by the use of piles and columns throughout the design.

5.2.2 Geology.

The geology of a riverbed is the study of formation of the underlying of riverbed and it's immediate surrounding. In designing for a river port terminal, it is necessary for the architect to ascertain the strength of surface soil and type of rock or soil underlying the surface of the site. This way he is able to determine appropriate foundation design for the particular site.

5.2.3 Topography

The banks of a river are characterized with either gentle or sleep slopes. The nature of the slope determines the relationship between the building and the sites Depending on the site conditions, the architect could employ split-levels, cut and fill, leveling or raise up the building with columns.

5.2.4 Hydrology

Gauges are used to determine water levels at all time of the year, this water level determines the type, size and tonnage of ships that can ply the river. Architecturally, a water level determines the type of docks to be used, the location of the docks, the distance of the building from the water body and possible embankment.

5.3 CLIMATE

The climate of a place is the average weather conditions of that place or region through out the season or a long period of time. It is governed by latitude, position in relation to continents or ocean and local geographical conditions. It is described in terms of

atmospheric pressure, temperature, solar radiation, wind speed and direction, humidity, rainfall, evaporation, fog, lightening and thunderstorms, visibility and other characteristics.

River coast is characterized with a mesoclimate, which is local in influence and extends its influence over several kilometers. The mesoclimate contrasts with the regional or macroclimate and microclimate.

The river coast is influenced by a mesoclimate. The characters of the climate are explained below.

5.3.1 Temperature

The temperature of the coastal area of a river is affected by land and river breeze. The diurnal temperature variation is small. The wind direction is often influenced by the mass of water body and immediate environment.

Land Air

This is the movement of air from land to river. On clear nights, the land cools faster than the water, cooling more quickly the lowest layer of air thereby making the land air to move to the water.

River Air

This is the movement of air from river to land. On clear days the land usually heats faster then water, the lowest air layer adjacent to the land warm quickly; this is displaced by inflowing heavier and cooler river air.

The two types of airs described above keep the temperature around riverbanks relatively uniform. The cool breeze therefore cools the temperature of the riverbank.

5.3.2 Humidity

The humidity of coastal regions of a river is prevalently uniform and high between 65 – 85%. The high moisture content will be responded to in design by the use of materials that are corrosion resistant and moisture resistant paints. These materials include glass, stone, concrete, aluminium and steel. Window openings shall be large to allow free flow of air.

5.3.3 Rainfall

Rainfalls are more on coastal areas of rivers. This implies good insulation against water penetration in flat roof or reasonable roof pitch in design of coastal structures. The above climatic factors determine design considerations for a project such as a river port.

5.4 WATER

Charles W. Moore (1997) describes architecture as always engaging in a critical dialogue with its environment. Water as an architectural resource has featured ever since the first Architecture was created in all kinds of ways; but never until now has if been the subject of a systematic element of design that bring man closed to nature.

The canals of Venice and the waterfront of New York are only isolated examples of the predominant role water has always had in conjunction with architecture. These waterfronts provide a calm and welcome vista to the immediate environment.

The properties of water as it appears in nature are inviolable, since they are always restricted by a code of natural limits. Although it's complex physical behaviour cannot be completely explained by science equations, knowledge of its properties is an important basis of design.

5.5 ECOLOGY

The Ecology of a place defines the relationship between living organism and their environment. In designing for a peculiar environment like the water front of a river, it is a challenge to the architect to blend his design with the bank of a river without having to cause much changes in the ecosystem of the river coast.

A riverport terminal should respond to the ecology and landscape that occurs is the waterfront of a river. This can be achieved by employing a landscape that build open the natural elements of the riverbank.

The method of design and construction of structural components should be tailored towards energy efficient and environmentally acceptable method to the immediate surrounding water and land as an environment. Applying the principle of ecosystem planning and management, designers should adopt techniques that would minimize waste, avoid excessive use of energy and prevent pollution of the environment.

The landscape should therefore the created by interweaving the designer's construct with the propose phenomena of the waterfront.

5.6 DESIGN

With due assessment of possible variables that could pose challenges to an architect in the design of a river port terminal, design itself would be based on considerations adopted from the above factors and variables. Some of these design variables that can possibly be applied in river port terminal build design are:-

5.6.1 Design Concept

From the above variables, design itself would involve a manipulation and balancing of the above variables to attain a result which best suits the end user and his activities. Therefore, an architect's conceptual challenge lies in his ability to evolve a design based on the dynamic balance, technically worked out amongst restrained design factors.

5.6.2 Design Parameters

The design parameters of a water-based development such as a river port involves considerable work and thorough examination of various influencing parameters before a logical and functional solution can be arrived at. Some of these parameters that pose challenges to the architect are environmental, planning and construction.

Environmental Considerations

- The study of wind direction and speed to determine the thermal comfort.
- Topographical studies to determine the integration of the design on the site.
- Ecological considerations for possible wild life preservation.

Planning Considerations

- Air movement- Provision of fenestration in wind direction for effective ventilation.
- Opening- 50 to 60 percent large openings to allow for view and ventilation.
- Functional relationship between facilities identifying zones.
- Consideration on circulation planning for users, operational services and maintenance including provision for vehicular traffic and human traffic.
- Layout- Consideration on which axis orientation is best suitable.

- Roof: consideration on adequate roof drainage and insulation.

Construction

- Foundation – The foundations employed should be suitable for soil type and bearing capacity of the soil of the site.
- Adequate damp proofing to prevent rising damp from the soil.

  Structural consideration Required structural system should be explored to attain structural stability.

CHPTER SIX

6.0 THE THESIS SITE AND ENVIRONMENT ANALOGY

6.1 STATE OF LOCATION

The project is located in Benue State of Nigeria. it is one of the states located in the middle Belt of the country. The state was created in 1976 from the defunt Benue plateau and Kwara State, it derives it's name from the River Benue which flows through parts of the state and forms state boundaries in other parts. The state is bounded by Nassarawa state in the North, to the east by Taraba state and Cameroon, to the West by Kogi state and to the sooth by Enugu state and Cross-River state.

The major tribes in the state are the Tivs and Idoma. Other minor tribes or ethnic groups include the Igede, Agatu and Etulo. Major towns in the state include, Makurdi, Gboko, Otukpo, katsina –Ala and Aliade.

Agriculture constitutes on of the main occupations of the people of Benue state, cash crops like Beni-seeds, ground-nuts, soyabeans and food crops like yams rice, cassava, potatoes, guinea corn and maize are grown by farmers in abundance.

Mineral resources found in the state include limestone, coal, and petroleum and iron ore. Some of these minerals such as limestone are already being explored.

Map of Nigeria showing the 36 States and their Capitals



MAP OF NIGERIA SHOWING THE LOCATION OF BENUE STATE.

6.2. TOWN OF LOCATION

Makurdi was until the creation of 12 states in 1967, the provincial capital of the defunct Benue province. However, the creation of Benue plateau state saw Makurdi becoming the divisional headquarters of Makurdi division – one of the three divisions in Tiv land. The others were Katsina Ala and Gboko divisions.

Makurdi finally became a state capital in 1976 when Benue state was created from Benue Plateau and Kwara states by Murtala regime. Makurdi serves as the commercial nerve centre and political capital of Benue state.

6.2.1 Geographical Location Of Makurdi

Geographically, Makurdi is located on the bank of the river Benue on Latitude $7^{0}45^{1}$ and longitude 8^{0} 32^{1} at an elevation of approximately 70m above sea level. It consists principally of four wards, which are; Ankpa ward, Wadata ward, high level ward in the South bank and Getere at the north bank of the river Benue.

6.3 CLIMATE CHARACTERISTICS

Makurdi is located in the Savannah region and has a warm humid climate which characterizes tropical areas.

The climate of Makurdi has too distinct seasons, that is, dry and rainy seasons. The rainy season being from March to October and dry season from November to March. The seasons are dominated by the tropical maritime air mass which blows from the South-West and the continental air mass, which blows from the North –East.

The climate of Makurdi has the following characteristics:

6.3.1 Precipitation

Rainfall in Makurdi is of the conventional type; it falls between March and October with the highest mean monthly rainfall of 260mm occurring in September and the mean monthly rainfall in December. Makurdi has about 94 days of rainy days with a total yearly average of 1311mm. The early and late rains are usually torrential and proceeded by high wind speed and thunderstorm. See table below.

Table 6.1: Monthly mean Rainfall for Makurdi

Month	Jan	Feb	Mar	Apri	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Rainfall (mm)	6	10	29	116	198	183	192	198	260	145	12	2

Source : NASME CIVIL DIV. 1999.

6.3.2. Temperature

The mean annual temperature of Makurdi is between 25-30^{0}c with as much as 36^{0}c on extremely hot dry and a minimum of 17^{0}c. The highest and lowest Temperature occurs in March and July respectively.

The high Temperature is attributed basically to the proximity of Makurdi Town to the river Benue. This effect is as a result of the major climate the river imbides on it's surrounding due to land and river breezes. See table below.

Table 6.2: Maximum and Minimum Temperature for Makurdi.

Month	Jan	Feb	Mar	Apri	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Max ^{0}C	33.5	34.5	36.1	36.1	33.9	32.2	30.5	29.4	30	31.1	32.7	32.7
Min ^{0}C	18	18.3	21.1	23.9	22.7	27.2	22.2	22.2	21.7	21.7	20.6	17
Mean ^{0}C	26	26.4	28.6	28.9	27.5	21.4	25.8	26.1	25.9	26.4	26.4	25.0
Range	16	16.2	15.0	10	9.5	8.3	7.7	7.8	8.3	9.4	12.1	15.5

Source :Saro '97.

6.3.3 Relative Humidy

Relative humidity in Makurdi is high all year round with the highest occurring in September and October recorded to be 95% which is above the upper limit of the comfort zone of 80%. The lowest relative humidity occurs in February and is recorded at about 28% slightly above the lower limit unit of the comfort zone of 20%. This high relative humidity attributes to Makurdi being hot in temperature.

6.3.4 SUNSHINE

Makurdi has a high number of sunshine hours per month. Solar radiation is high between January and April, with cloudless sky most of the time. There is some cloud cover in the months of June to September, and heavy dusty cloud and ground cover during t he harmattan period of November to January.

6.3.5 PREVAILING WINDS

Makurdi experiences the North –East trade winds during the months of November to January and South –West trade winds March to September.

River and land breeze influences the area close to the riverbank and some times truncates the conventional and dominant trade winds.

Occasional thunderstorms and squalls especially at the inception of rainy season in March and April usually heralded by strong wind storm, thunder and lightening.

Occasionally destruction of poorly constructed structures occurs due to these strong winds. The average wind speed of about 7m/s is recorded.

6.4 PHYSICAL CHARACTERISTICS AND SITE ANALYSIS

The site of the Makurdi Riverport, is located in Makurdi along the South bank of the river Benue. The location of the site falls along the navigable stretch of the river Benue is within lower course of the river Benue.

6.4.1 Vegetation and Site

Makurdi vegetation is of the transition between rainforest and the Savannah. The large expanse of grassland is dotted with typical tress like palm, oil beans, locust beans and shea butter tress. The Benue bank river is however richer in trees as compared to the other parts because of the presence of the water.

6.4.2 Site and Topography

Makurdi is approximately 70m above sea level, and slopes towards the river Benue on both sides of it banks. It has good natural drainage towards and into the river, and there is little or no erosion threat. The general slope of the Makurdi Riverport Terminal site is on the average of 5. 2% gradients.

6.4.3 Geology and Soil Type

Makurdi fails within the lower south Benue valley. In this sub-region, very thick, marine dark grey shales, silt stones and subordinate limestone were deposited in the middle Albian / Lower cretaceous age. The underlying base soil consists of a thick mass of cement bedded coarse-grained deposits descried as the Makurdi sandstone, which has a thickness of up to 9 meters. It's basalt parts are literally equivalent to the Keana sandstones of the middle Benue valley.

The site has predominantly sandstones, which has shale sands that are the same with the Keana sandstone. Topsoils comprise mainly of ferratic comb soil and loamy sand of weak structure and slightly acidic.

6.4.4 Hydrology and Site

The most prominent Hydrological feature around the site is the river Benue. During the daytime, "river breeze" effect is felt on the site from the river Benue, this should be utilized for ventilation and evaporative cooling effects.

The presence of the river also makes possible good visual quality as it give interesting views from it's banks.

6.4.5 Site and Services

The main services within the site include the 132kv power lines from main power lines adjacent to the site, telephone line and an existing road that boarder the site from the south. The Makurdi, water works, which is about 700 meters from the site, will serve as a source of water supply to the site.

6.4.6 Site and Sound

By virtual of location of site on the riverbank of the Benue, it is relatively quiet with the only source of noise from the adjoining road and engine boats that ply the river. Therefore sound sources are only from the road and water by vehicles and engine boats respectively.

6.4.7 Site and Views

Interesting site views include the river water; the water works from eastern side of site, settlements on the north bank especially NASME and surrounding barracks. The location of the site also allows for views of both the old and new bridges across the Benue River.

6.4.8 Site and Drainage

Surface water drainage is gradual towards the river on the site; this is due to the natural gentle slope of the site towards the water body. However the site is not liable to flood from the river water body.

6.5 ECONOMIC ACTI VITIES

The major economic activities that go on the site are sand winning and fishing. The National Inland Waterway Authority (NIWA) authorizes the sand winning and fishing. This acts as a source of revenue generation for the Authority.

Makurdi being the state capital with a high population of over one million people, the fish and sand from fishing and winning are easily consumed by people usually falling short of demand.

6.6 SITE SELECTION CRITERIA

The basic condition that influence the choice of the site for the Makurdi River Port Terminal are as follows:-

i. The site is located on an area that is not liable to flood and it falls along the navigable stretch of the river Benue.

ii. The river Benue has access to the coastal oceans viz the river Niger, this makes accessibility to and from the ocean possible.

iii. The selection of the site has the benefit of availability of services such as road, rail, telephone line and water from water works. This will makes communication, and accessibility easy.

iv. The location of the port in Makurdi being a state capital shall attract high traffic flow of both cargo and passengers.

v. The location of the site in Makurdi, the state capital of Benue state which acts as a transition states between north and south will serve land locked state and goods can equally be brought to the port for further processing and transporting by water vessels.

6.7 SITE ZONNING CONCEPT

The zoning of the site for respective facilities is governed basically by site features. Water related functions are zoned close to the riverbank that is jetties, quay, transits sheds and passenger Terminal. Offices and managerial facilities are taken away from the waterfront, this allows for access by the general public who are on visit for official obligations only.

6.7.1 Accessibility

The Makurdi Riverport Terminal site is accessed from Wadata road that boarders the site from the southern part of the site. An adjoining road tapped directly into the site can also access the site. The access roads shall be used concurrently, the adjoining road from the east shall be used for cargo engress and egress while the Watada road that borders the site from the south shall be used for human traffic access.

Adequate facilities shall also be provided for proper access from the waterfront by the use of quay and jetties.

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CHAPTER SEVEN

7.0 DESIGN BRIEF

7.1. INTRODUCTION

The National Inland waterways Authority was established in 1997 by decree 13 and it was charged with the following objectives.

i. To improve and develop inland waterways for navigation-part one, subsection one, clause one.

ii. To provide an alternative mode of transportation for the evacuation of economic goods and persons-part one, subsection one, clause one.

iii. To execute the objectives of the National transport policy as they concern inland waterways. Part one, subsection one, clause one.

With the above mention objectives of the National inland waterways Authority, provision of facilities for inland ports has to be in conformity with the dual purpose of aiding both cargo and passengers movements and administrative facilities well.

In lieu of the functionality underlying the establishment of National Inland Waterways Authority Makurdi Riverport design brief shall be in response with these principal functions for efficient and effective operations of the River port Terminal.

Markurdi River port acts as one of the zonal offices (area offices), thus it is mandatory according to NIWA hierarchy and organogram to provide offices to serve as a zonal office with an area manager as the chief managerial executive.

Thus the design brief for Makurdi Riverport Terminal shall be in line with laid down stipulations by the National Inland Waterways Authority.

This thesis is therefore an architectural proposal and contribution, which sort to ensure profitable Inland waterway transportation as a mode of transport. In response to this, a part terminal facility is therefore proposed for efficient passengers and cargo flow and office functioning.

7.2 DESIGN BRIEF NAD FUNCTIONAL REQUIREMENTS

In formulating the design brief, it of paramount importance to assess the basic requirements of a port as deduced from case studies and organogram of the National Inland waterways Authority.

The design brief for this project is formulated from three areas, these are:

i. The port as a passenger-handling Terminal

ii. The port as a cargo handling Terminal and

iii. The port as an area office of the National Inland Waterways Authority.

7.2.1 The Port As A Passenger Handling Terminal

The port as a passenger-handling terminal defines the port in terms of provision of passenger handling facilities. The flow of passenger movement shall have a specific flow, which shall be unobstructed with related passenger conveniences.

7.2.2 The Port As A Cargo Handling Terminal

Here, the brief is formulated for typical cargo handling where proper attention shall be give to the movement of cargo.

7.2.3 The Port As An Area Office

As an area office of the National Inland Waterways Authority, the brief shall be formulated to cater for office services, effective flow, commercialization, utilization and aesthetic appeal, to portray the function of the port and attract patronage.

The client's brief and functional requirements are:

i. Passenger Terminal facilities

ii. Quay facilities and installations for cargo handling.

iii Storage facilities

iv. Administration facilities

v. Workshop and fire services station.

vi. First aid

vii. Fueling station for water vessels and

viii. Accommodation for staff.

With the out line of the clients requirements, the clients requirements shall be combined with architectural professionalism to produce a design that would satisfactorily meet the client's demand. However, this work is concern with facilities that are architecturally oriented, i.e Administration, passenger terminal and transit shed buildings.

7.3 FACILITIES

Facilities provided in the proposed river port terminal are defined by different requirements of the users of the port facilities. The requirements are also deduced from studies carried out on related facilities from both local and international case studies.

7.4 ADMINISTRATION

A port is composed of an administrative body which is responsible for the running of the port's activities which entails makings sure that set down aims and objectives are met. Offices are for purpose of spaces for official operation. Space provided shall be based on operational organogram of the National Inland Waterways Authority. Office spaces shall therefore be categorized according to related functions, these categories are; commercial, welfare, technical, security and environmental.

7.4.1 Commercial

Commercial generation of funds by National Inland Waterways Authority is not restricted to shipping activities only; the authority also generates money through the provision of lettable and profitable spaces to tenants and anticipated occupants. This spaces provided when let out, does not only generate money for the Authority but also help in merging associated activities to inland water transport together. Banking spaces shall also be provided as part of lettable spaces to be provided.

7.5 WELARE FACILITIES

These are facilities provided for the social welfare of works. Welfare facilities shall be provided to meet the needs of works. These facilities are:-

i. CANTEENS –To serve food for staff

ii. RESTAURANTS –To serve food on commercial basis to visitors.

iii. KITCHEN –The kitchen shall be provided in the design to prepare food and also serve as a place for washing of dishes and utensils.

iv. TERRACES –The provision of terraces shall be for the purpose of workers relaxation during breaks time and serve as observation seeks for visitors.

7.6 TECHNICAL FACILITIES

Technical facilities are important to ensure effective operation and functioning of the building with minimum use of automated means. These facilities are:-

i. Access staircases

ii. Lifts

iii. Mechanical and electrical installations.

iv. Service ducts.

v. Engine room

vi. Water storage system

vii. Air conditioning and

viii. Machine and generator room

7.7 SECURITY FACILITIES

Port security is of paramount importance in securing the incoming and outgoing goods from being made away with. Security in the port shall also be provided to ensure the safety of the building and it's users. These facilities include:-

i. Automation –within the building to prevent fire hazards.

ii. Strategic location of escape stairwells for users incase of fire outbreak.

iii. Gate house – To monitor incoming and out going traffic and activities going on in the port premises.

7.8 ENVIRONMENTAL FACILITIES

These facilities are provided to blend the buildings with the waterfront. They are:-

i. A proper landscape environment that responds to the waterfront .

ii. Adequate access and parking spaces

iii. A well l it premises.

7.9 PENT HOUSE

The organogram of the National inland waterways Authority defines the managing Director as the chief executive of the Authority and Area managers as being in charge of zonal activities. It is therefore totally necessary to provide a pent house, which shall serve as a liaison link between the Managing Director and the Area manager during official visits. The pent house shall therefore cater for the managing Director and guest accommodation for a few days.

7.10 PASSENGER FACILITES

The passenger terminal building shall serve as a service center for transfer of passengers and baggage to land transport means and river crafts. This passenger terminal shall have facilities that would foster passenger conveniences; these include ticket boots, weighing scales, officer and post office. Care shall be taken to design good circulation network to ease direct boarding and off loading of water vessels. Attention shall also be directed towards providing adequate space for ticket acquisition, this shall in turn cater for peak hours.

7.10. SCHEDULE OF FACILITIES

The river port Terminal shall be made of the following units.

FACILITY	DESIGNATION
A. SECURITY	Entrance to site
1. Gate house	Building ends
2. Escape stairwells	
B ENVIRONMENTAL FACILITIES	
3. Well landscaped premises	Site premises
4. Parking bays at 1 car /75m^2 of office area	Site premises
C. COMMERCIAL FACILITIES	
5. Brach Bank	- Ground floor
6. Lettable space, to cover 40% of total office floor area.	3rd and 4th floors
D. WELFARE FACILITIES	
7. Canteen /Kitchen /Servery	
8. Terraces	Ground and 1st floor-administration and passenger terminal.
E. TECHNICAL FACILITIES	
9. Stairs, lifts, service ducts etc.	Building core or other wire.
10. Engine room	Roof top –Administration building
11. Water storage	Rooftop –Administration building
12. Generator house	site premises.
13. Air conditioning system	Otherwise.
F. GENERAL ADMINISTRATION FACILITIES	
14. Traffic control department	4th floor, Terminal building
15. Security department	Ground floor,-Administration
16. Administration department	1st, 2nd 5th 6th floors
17. Customers department	Ground floor / 1st floor

18. Project research department	1st floor
19. Establishment department	1st floor
20. Store department	Ground floor
21. Estate department	1st floor
E. ENGINEERING SECTION	
22.General Engineering Administration	2nd floor
23. Civil Engineering department	2nd floor
24. Mechanical Engineering department	2nd floor
25. Electrical Engineering department	2nd floor
26. Planning and control department	2nd floor
27. Survey department	2nd floor
G. Provision of housing for staff accommodation.	Otherwise.

7.11 SCHEDULE OF ACCOMODATION

The facilities in the River port Terminal that shall be given due architectural definition is:

- Passenger Terminal
- Administration building and
- Transits shed. The schedule of Accommodation for these facilities is as follows: -

7.11.1. PASSENGER TERMINAL

GROUND FLOOR			
- Linking walkway	25 x 5	1	120
- Arrival concourse		1	360
- Baggage collection and sorting room	7 x 5	1	35
-Reception	8 x 5	1	40
-Stair case	8 x 3.5	1	28

-Toilets	1.2 x 1	6	7.2
-Lavatory	2 x 1.2	2	4.8
-Circulation for toilets		1	12.5
-WATERSIDE			
-Observation deck	30 x 5	1	150
-Raised walkway	25 x 10	1	250
-Fixed jetty		1	503
- Floating jetty	25 x 5	2	250
TOTAL			**1890.5**
OVERALL			
-Service Area + stairs and reception.			302
Total useable area + circulation			1890.5
TOTAL			**1890.5**
2 FIRST FLOOR			
-Linking corridor	25 x 5	1	125
-Departure concourse		1	302
-Reception	8 x 5	1	40
-Restaurant		1	37
-Kitchen	7 x 5	1	35
-Store	5 x 2.5	1	12.5
-Stairs			28
-Shop		1	20
-Toilet and toilet circulation /lavatory		6	66.5
-Observation deck	40 x 5	1	200
-TOTAL			**564**
3 SECOND FLOOR			
-Reception lounge		1	78
-Stairs	3 x 4		12
-General office	5 x 5	1	25
-Rest rooms		5	118

-Toilet /Toilet circulation		2	50
TOTAL			**283**
4. THIRD FLOOR			
- Stairs			
-Observation room	7 x 5	1	
-Record office		1	
-Rest room		1	
-Toilet /circulation		1	
TOTAL			**109.7**

7.11.2. ADMINISTRATION BUILDING

1. GROUND FLOOR			
1A SERVICE CORE			
- Entrance porch	12 x 6	1	72
-Reception from landside	10 x 5	1	50
-Stairs /lift well	5 x 5	1	25
1B. BANK BRANCH			
-Customer lounge	10 x 5	1	50
-Banking hall	7 x 5	1	35
-Strong room	5 x 5	1	25
-Manager's office	5 x 3	1	15
-Toilet	1.5 x 1.5	1	2.25
TOTAL			**274.25**
Reception from passenger Terminal	5 x 5	1	25
Farewell		1	182

Ticket boots	1.2 x 1.5	5	9
Telephone boots	1 x .6	6	3.6
Luggage check in	10 x 5	1	50
Greetings	10 x 10	1	100
Restaurants	10 x 10	1	100
Kitchen\ store		1	62.5
Store	5 x 5	1	25
Circulation /corridor			101
Escape stairs	3 x 5	2	30
Toilets	1.2 x1.5	6	10.8
TOTAL			**698.9**
OVERALL			
Service core	5 x 5	1	25
Total useable floor area			**767.9**
Circulation			101
Escape stairs	5 x 3	2	30
TOTAL			**973.1**
2. FIRST FLOOR			
-Service core	5 x 5	1	25
-Reception	10 x 5	1	50
-General offices	10 x 5	5	250
-Library /project research	7 x 5	1	35
-Librarian	5 x 5	1	25
-Toilets	1.5 x 1	8	12
-Canteen	10 x 10	1	100
-Voids	20 x 6	2	240
-Escape stairs	5 x 3	2	30
-Circulation/Corridors			76
TOTAL			**868**
3. SECOND FLOOR			
-Service core	5 x 5	1	25

-Reception	10 x 6	1	60
-Escape stair	5 x 3	2	30
Computer room	10 x 10	1	100
Planning officer	6 x4.6	1	27.6
Estate manager	6 x 5	1	30
Project manager	6 x 5	1	30
Traffic manager	6 x 5	1	30
Engineering superintendents.	6 x 7	1	35
Secretary	6 x 4.6	1	27.6
Port manager	6 x 5	1	30
Maintenance manager	6 x 5	1	30
Commercial manager	6 x 5	1	30
Chief accountant	6 x 5	1	30
Port administration officer	6 x 6	1	36
Circulation			66
Voids		2	240
TOTAL			**857.2**
4. THIRD FLOOR			
Service core	5 x 5	1	25
Reception	10 x 6	1	60
Escape stairs	5 x 3	2	30
Lettable spaces			345
Toilets	1.5 x 1	4	9
Voids	17 x 5	2	180
TOTAL			**674**
5. FOURTH FLOOR			
Service core	5 x 5	1	25
Reception	10 x 6	1	60
Escape stair	5 x 3	2	30
Lettable spaces			315
Toilets	1.5 x 1	3	4.5

Voids		2	160
TOTAL			**579.5**
6. FIFTH FLOOR			
Service core	5 x 5	1	25
Reception	10 x 6	1	60
Escape stairs	5 x 3	2	30
Waiting room	10 x 5	1	50
Area Manager	10 x 6	1	60
Area Manger's rest room	6 x 4.6	1	27.6
Area Manager's secretary	6 x 5	1	30
Chief port Engineer	6 x 5	1	30
Chief Accountant	6 x 5	1	30
-Computer room	6 x 5	1	30
Voids		2	**65**
TOTAL			**482.6**
7. SIXTH FLOOR AND PENT HOUSE			
Service core/Circulation	10 x 5	1	**60**
Living room	6 x 5	1	30
Bedrooms		2	102
Toilet		2	13.5
TOTAL			**145.5**
8. SEVENTH FLOOR / MACHINE ROOM			
Service core	6 x 5	1	30
Machine room	10 x 6	1	60
TOTAL			**90**

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7.12. CARGO/MAINTENANCE FACILITIES

1. Quay	70 x 20	1	1400
2. Slipway	30 x 20	1	400
3. Transit sheds		2	
- Cold room	10 x 10	2	200
- Office	5 x 5	2	50
- Office	5 x3.5	2	35
- Toilet	1.2 x 2.5	2	6
- Storage Area	30 x 25	2	1500
TOTAL			1791
4. Open Storage	35 x 27	2	1890
5. WORKSHOP			
- Store	9.5 x5	2	47.5
- Office	5 x 5	2	25
- Toilet	2.5 x 1.2	2	3
- Working area	15 x 15		225
TOTAL			300.5

FLOOR ANALYSIS

FLOOR	TOTAL AREA EXCLUDING VOID
1. PASSENGER TERMINAL	
- Ground floor	1890.5
- First floor	564
- Second floor	283
- Third floor	109.7
TOTAL	**2847.2**
2. ADMINISTRATION BUILDING	

- Ground floor	973
- First floor	868
- Second floor	857.2
- Third floor	674
- Fifth floor	482.6
- Sixth floor	145.5
- Seventh floor	90
TOTAL	**4090.3**
3. CARGO FACILITY	
- Quay	1400
- Shipway	400
- Transits shed	1791
- Open storage	1890
4. WORKSHOP	300
TOTAL	5781
GRAND TOTAL	**12,718**

KASU

CHAPTER EIGHT

8.0 DESIGN REPORT

8.1 INTRODUCTION

An ideal design and product starts with a critical analysis of factors and a design process which entails the strict employment and balancing of many design variables and parameters, this leads to a design solution that best meets the end users' requirements. The evolution of a completely workable and functional design for Makurdi Riverport Terminal would also follow the laid down and conventional design process which shall be formulated around the challenging waterfront conditions. In view of the aforementioned, a design program shall be based on design variables. This shall be achieved by striking a balance among the independent waterfront conditions to achieve a workable and dependable solutions.

8.2 DESIGN PROGRAMME

The design program employed and adopted to assist in the assessment of a complete design for the port terminal takes the form as stated, described and illustrated below.

i. Scientific / Logical approach

ii. Functional Approach and

iii. Integration Approach.

8.2.1 Scientific / Logical Approach

Here, the proposed design of the Makurdi Port Terminal is approached and assessed

from a scientific and logical point of view. Logically, the study of the port organization chart as seen in the case studies carried out and the client's requirements, shall determine the functional requirement of the port Terminal.

From the scientific point of view, the port Terminal shall be design to emulate the physiognomy of a boat, the boat – like shape and stepped tower podium associated with water vessels shall be combined to achieve this. The administration block shall have cantilevered ends and stepped podium to give the boat like shape while the passenger Terminal shall have a round base depicting radiating waves and stepped podium to conform with the administration block.

8.2.2 Functional Approach

This design approach aims at providing enough working space for the workers, associated building facilities and expected tenants. Upper limits of space standards are adopted from laid down standards and requirements considered to accommodate the functional requirements and activities of a port. A thirty to forty percent lettable space in the administration building is set aside to justify the cost of the proposed Terminal and act as a source of revenue generation for the port authority and also boost economic activities in the area.

8.2.3 Integration Approach

Integration approach is employed here to practicalize the aims of the thesis, this therefore entails the architectural demonstration of responding to waterfront conditions by harmonizing the port facilities with the challenging waterfront.

8.3 FUNCTIONAL RELATIONSHIP

An assessment of functional relationship was aimed at integrating the different functions in the proposed Riverport Terminal development. This is achieved by carefully locating functions and facilities where they are most suitable. For example the passenger terminal building shall be located closer to the water with necessary facilities to access the Terminal building installed for complete workability.

8.4 DESIGN CONCEPT

The concept of the design is deeply associated and defined by problems and activities related to the waterfront. The most important aspect in this concept is that of responding to waterfront conditions; for this reasons, form and spaces are adopted to resemble a boat and elevations conception are also liken to the physiognomy of a boat and ship.

The floor plan layout is generated from a primary means of water transport, the boat. A scientific analysis of the movement of a boat reveal that the paddling effort of a boat man generates waves which radiates in all direction in the wake of sailing. Thus the plan layout of the port Terminal is adopted from a paddling canoe man on water. The wave which are radiating and circular are adopted in the layout of the passenger Terminal. While the boat itself is adopted for the layout of the administration building. The waves from the paddle stick generated by paddling effort are connected to the canoe by the paddle stick, the paddle stick is thus, adopted as gangway or walk way in the design linking the passenger building and administration building. The radiating nature of the waves is reflected on the plan layout by having the radiating waves dividing into two equal parts; these two parts when taken apart

forms the jetty and passenger building.

8.5 PLANNING PRINCIPLES

The paramount aim of all designers is to create and designate space for suitable use by both the client and other users. The proposed Makurdi Riverport Terminal aims at creating a design which shall not only satisfy the clients requirements but also blend with the challenging waterfront conditions. This proposal is thus, created to make assessment by maximum number of senses easy creating a deep and lasting impact on the mind of the end users.

8.6 SITE CONCEPT

The site by virtue of it's location to the waterfront forms the basis of the entire design. The conditions relating to the site marks the backbone of the design conception as defined in the subtopic of this thesis work. Therefore, the site conception is determined by the organizational hierarchy of a typical port requirements in relation to port activities, functionality and easy flow of relationship between different facilities of the proposed Riverport Terminal. Functional and facilities zoning on site is dividing into two, with passenger and cargo movements separated by a buffer zone and gardens, to this effect packing were provided for both cargo and passengers separately so that maximum security could be attained on the site.

8.7 FLOOR PLANS

The floor plans of the proposed Makurdi Riverport Terminal were defined on the client's requirements, operational procedures of a port Terminal and facility requirement of a

plans by the use of the radiating waves as jetty and passenger building and the plan form of the boat is adopted for the administration building while the paddle forms the gangways. Upper limits of standards were adopted and where necessary, a utility factor was added for optimal space allocations.

8.7 GROUND FLOORS

The ground floors of the passenger and administration building are mainly designated to welcoming passengers from ship and visitors from land receptively in to the entire port Terminal. To this end, the entrances and receptions were carefully designed and equipped with necessary ancillary facilities to portray their functionality. Associated passenger handling facilities like customs inspection, luggage checking and collection, telephone boots security checks and restaurants are also located on the ground floors; a bank branch is also located on this floor.

Escape stairs are provided in the administration to bring users away from smoke and fire incase of a fire out break.

The floors of the two buildings are linked by a centralized gangway.

8.8. FIRST FLOORS

The passenger Terminal building has a large reception which flows into the departure lounge, a restaurant with a good view of the water is also located on this floor. Other facilities on this floor include kitchen, shop, toilet, security post. An observation desk facing the water is also provided on this floor for passengers recreation and relaxation while waiting for final departure from the river port Terminal. The ground floor of the

administration building is linked to the first floor of the passenger building by a raised gangway. Passengers are linked to the jetty by stairs which lead, them to the gangway connecting the passengers building and jetty.

The administration building on the land side of the port complex has the accommodation for general offices and semi executive staff on the first floor. The floor has a hardcore with a well defined reception and waiting. Other functions on this floor include; canteen, kitchen and store.

8.9 SECOND FLOORS

The second floor of the passenger building accommodates rest rooms for vessels crew, this rest rooms are linked by a corridor open to a lounge which has a stair and an adjoining office. Toilets and bathrooms are provided for crew conveniences.

The second floor of the administration building has a hardcore with an articulated reception and waiting area. Port managerial executive offices are accommodated on this floor, an internet café and computer room is also provided on this floor with toilets located at strategic positions for staff conveniences.

8.10 THIRD AND FOURTH FLOORS

These floors are reserved as lettable space for associated port activities and functions accommodation. These floors are linked to all essential service facilities provided in the pervious floor, they include; lifts, access stairs, reception, waiting area and toilets.

The third floor of the Terminal building accommodates the traffic control room or with a record office attached to it and a toilet for staff. The floor is connected to stairs linking to the floors below.

The terminal building has no fourth floor.

8.11 FIFTH FLOOR

The fifth floor is connected to the hardcore with an elaborate general waiting area and reception. The floor also accommodates the Area manager's office, Chief Port Engineer, chief Accountant's offices and a computer room with secretaries and toilets.

The floor is also linked to the escape stairs.

8.12 SIXTH FLOOR / ROOF TOP

The pent house is accommodated on the sixth floor, it is accessed by the service stairs and offer a fantastic view towards the entire site.

The pent house has two self - contained bed rooms with a living room and kitchenette.

The roof top is made of an engine room or machine room and water tank accessible through the stairs and lift connecting the rest of the building.

8.13 ELEVATIONS

The elevations conception of the proposed port complex were in conformity with the design concept the elevation are projected to give an impressive expression of shipping activities, thus, they take the form and shape of a typical ship and boat. The elevations are

necessary.

Both elevation of passenger and administration building represents a typical physiognomy of water vessels. The approach elevation of the administration building from the land side has projections on both ends which gives the impression of a boat. The side elevations gives the impression of approaching cargo vessels with slanting sides and the subsequent upper floors gives the impression of cargo ship mast. This depicts a loaded ship ready to sail.

The approach elevation of the passenger Terminal building from the waterside also takes the form of a loaded ship while the side elevations are reminiscent of a typical boat's transverse section.

8.14 STRUCTURAL SYSTEMS

The sections through both the passenger and administration buildings show a clear vista of the building structure. The building structure is made up of vertical columns and beams connected together to form a rigid network.

Due to low bearing capacity of the top soil and differential settlement of the soil analyzed on site, piles on raft foundation were employed for the foundation system.

8.15 DRAINAGE

The site of port complex is characterized by a gently sloping topography towards the river Benue. Surface water on the site is proposed to be channeled in conformity with the topography of the site using gutters. The gutters shall be made of concrete and will be located near buildings and fences.

Drainage of roof waters is achieved by the use of roof gutters, which collects water and passes it down to the ground by pipes embedded in fins or aesthetic columns. This drainage pattern is used for the drainage of roof water from the passenger and administration building.

8.15.2 Fresh Water

Fresh water is tapped from the water mains connected to the building and pumped to the water tank on the machine room by pumps. The water from the tank on the machine room is conveyed or carried to the different building floor by gravitational forces. Waste water disposal from both building is through service pipes that pass through service voids incorporated in both buildings.

8.15.3 Sewage Disposal

Sewage disposal is made possible by piping through service voids with inspection chambers on the ground floor which flush the waste into manholes which passes the waste to a centralized waste disposal tank. A service road is within access of the central disposal tank to make evacuation possible when filled up.

8.15.4 Electricity, Telecommunication and Air Conditoning

Electrical wiring in the building shall be achieved by conduit wiring which hides the wires from the surface of walls and shall be connected to floor through service voids. Telecommunication wire shall also be as same as electrical wiring. Air conditioning systems adopted for the building include the split unit and console or window units types of air

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conditions which shall be hidden between cladding walls and shedding projectings close to windows.

An electric generator is installed on site to ensure constant power supply for smooth port operations and functioning of services.

8.15.5 Fire Control

Fire control in both building shall be achieved through the used of fire prevention and protection mechanisms! There devices include : smoke detector systems, automatic water sprinkler and waste nuzzles. Fire fighting equipment including water hydrant points, extinguishers and a fire fighting station within the complex.

8.16 TECHNICAL FACILITIES

For proper functioning of within and outside buildings, these facilities are necessary, these include, security devices, security post and lifts.

8.17 MATERIALS AND CONSTRUCTION.

The selection of the proper materials far use in waterfront construction is critically important to the cost and life of the structure. The water land interface according to Bruce O.T. (1991) is "a harsh environment with many destructive forces working to batter, deteriorate and corrode material," selection of material for construction was therefore, thought of in terms of the follows factors:

i. Suitability for the intended use.

ii. Strength.

i. Suitability for the intended use.

ii. Strength.

iii. Resistance to degradation and cost.

iv. Availability.

v. Maintainability.

vi. Durability and

vii. Appearance.

The proposed Port Terminal explorers a wide range of material usage for different components, aesthetics, facilities and application. These material above all considerations were selected to perform structural functions which is of paramount importance in waterfront facilities development. These material include the following .

8.17 WOOD

Wood is one of mans oldest materials of construction. It's availability, strength, cost, workability and natural attractiveness have made wood the primary material of choice in waterfront constructions. The proposed river port employed wood in the construction of the following.

i. Floating dock

ii. balustrades and

iii. Roofs

Hard woods treated to withstand shrinkage, weathering, decay and breakage are used for the construction of port facilities components. The hard wood recommendated for the floating dock are beech, sycamore, cheery walnut elm mahogany, iroko etc. these woods are

a. Water borne preservative

i. Chromate copper arsenate (CCA)

ii. Ammonical copper arsenate (ACA)

iii. Acid copper chromate (ACC)

iv. Chromate zinc chloride (CZC) and

v. Fluor-chrome arsenate phenol (FCAP)

b. Oil-borne preservative

i. Penta chlorphenol (PCP)

ii. Coal-tar creosote

iii. Creosote coal-tar solution

iv. Copper napthenate

v. Tributyl tin oxide (TBTO) and

vi. copper-8-quinolinolate

8.17.2 Concrete

concrete is a versatile building material, it is a composite material made from three basic ingredients, cement, aggregate and water. The cement used to improve the quality of quality of concrete mix is water repellant cement. Concrete is used in the proposed Riverport Terminal for the construction of piers, piles, jetty, quay, ramps, mooring piles and mooring anchors block, side walks, and building structures like columns, beams, floor slabs, foundations and roof gutters.

8.17.3. Stainless Steel

Stainless steel is a steel alloyed with nickel and chromium in the percentages of 8%

and 18% respectively. This steel falls within the 300 series steel. They are used in construction of balustrades, gangway balustrades and window frames.

8.17.4 Aluminium

Aluminum is a metal renowned for it's strength to weight ratio, durability, appearance and ease of fabrication and erection. It naturally corrosion resistant because it forms a thin surface oxide film. If the oxide film is ruptured, it reforms again in the presence of oxygen. In the proposed riverport terminal, Aluminum is used as a roofing material.

8.17.5 Fibre Glass

Fibre glass is a composite and textured material which is bonded together by a thermosetting liquid resin. A more proper designation is glass reinforced plastic (GRP) or fiber reinforced plastic (FRP). It is similar to reinforced concrete in that a reinforce material (fibre glass or reinforcing rods) is encapsulated in plastic which hardens to bound the materials, together.

Fiber glass has a weight which is about half the weight of an equivalent steel or wood structure and about the same weight as an equivalent aluminium structure. In the proposed port complex, fiber glass is used as a cladding material for walls and windows.

8.18 LANDSCAPE

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Landscaping is used as a blended tool between the buildings and the site. Gentle landscaping elements are employed to give a clear view of the waterfront. Trees are planted to act as a buffer zone between cargo facilities and administration and passenger facilities.

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8.19 MAINTENANCE

Consistent maintenance culture inculcated on a building prolongs the life span of the building. Maintenance is further made easy by the choice of materials and method of construction. The choice of durable material also prolongs the life span of the building. Replaceable material for construction and finishes is thus recommended to ensure overall quality of the port complex buildings.

Regular maintenance at regular and consistent interval will also guide against damages and aesthetic deterioration.

CHAPTER NINE

9.0 CONCLUSION

9.1 SUMMARY.

The importance of maritime sector to national economy cannot be over emphasized contemporary trends in maritime activities depicts an increase in sophisticated water vessel usage and utilization of water as a mode of transportation. It is quite ironic to note that inland port development in Nigeria does not conform to contemporary trends. Inland transportation by waterways suffered severe abandonment after independence with just little developmental efforts towards inland ports development by the Nigerian Government and the private sector.

In recent times however, the federal government has made tremendous efforts towards inland waterways and ports development, from the construction and commissioning of Onitsha riverport by the Shehu Shargari administration to developmental efforts by the default Petroleum Trust Fund (P.T.F). The present government has assessed and realized the potentiality of riverports, and has thus decided to embank on the dredging of rivers Niger and Benue and construction of inland riverport to compliment and support the coastal seaports.

The Makurdi river port terminal is a proposal motivated by the federal government's decision to develop inland waterways transportation by dredging and construction of riverports. Makurdi port being one of the ports selected for development by government played an important role during the colonial era, it had a rail connection and acted as one of the important nodes that were used by the colonial masters for transportation. The location of the port in Makurdi during the colonial period thus complimented the town as a strong commercial nerve centre of the region. The selection of Makurdi port for development by the

government will thus bridge the bridge the long-standing affinity Makurdi town established with colonialism.

Though the colonial port of Makurdi is not in use today, the location of the new Makurdi port terminal within proximity of the colonial port, the facilities which were in use during the colonial period like the transits sheds of UAC and Royal Niger company could thus, be a source of tourist attraction for travelers and tourist visiting the port. The Makurdi port development shall therefore establish a strong link between colonial and post-colonial Nigeria.

In lieu of the above mentioned, the proposed Makurdi Riverport Terminal design sorted among other factor to establish a riverport terminal that is reminiscent of the history of Makurdi, and act as a catalyst for the revival of inland water transportation.

9.2 OBSERVATIONS.

In order to be in proper understanding of the subject of responding to waterfront condition as a basis of this thesis work, case studies were carried out on similar projects to acquaint the researcher with existing situations, inferences from the case studies were then made in view of effecting them in the design proposal.

The design of the proposed Makurdi port terminal has being quite a challenging task. Although most of the brief and data for the design are defined on the client's requirements, they were note worthy to compare with those of existing larger ports both within and outside Nigeria. A study of ports outside the country defined ports as combining Cargo and passenger facilities, Nigerian ports however face inadequate location of these facilities. In Nigeria, Cargo handling is given paramount attention neglecting passenger facilities, which

is also an important feature of modern port. Nigerian ports administration facilities were incorrectly located in relation to other port facilities resulting in minimal utilization.

The National Inland Waterways realized the shortcomings of port's design in Nigeria and has included as part of the client requirements the incorporation of passenger, cargo and administration facilities to form an entity. It is in line with this that the port proposed design was fashioned.

9.3 CONCLUSION

In view of the fore-mentioned observations, the design the Makurdi Riverport Terminal fashioned to meet the requirements of the client. The proposed Makurdi port has an administration facility that is accessible from all other facilities of the port. Passenger facilities are also provided in the proposed design; care is taken in the selection and allocation of forms and space to allow for free flow of cargo and human movement. The Makurdi Riverport therefore doubles as a passenger and cargo terminal, which was in conformity with the client's requirement.

In the proposed design, the passenger and administration are linked together with the ground floor of the administration used for passenger function. The passenger building is connected to a jetty on the waterside and a gangway to the administration building on the landside. The concept of the proposed design itself was developed from the combination of a canoe, which is a primary means of water transport, boat and ship. Celebration forms, elements and shapes were adopted from these three means of water transport.

The design of waterfront structures is different than traditional design of land structures. In waterfront design, material selection and peculiarity of the site condition are

critically important to a waterfront development such as a riverport. These two considerations formulated an overriding basis among other considerations in the proposed port terminal. The thesis work therefore, sorted among other factors to demonstrate an architectural response to waterfront conditions which were reflected in the designer's imagination, choice of materials, construction techniques, interplay of shapes and forms and response to site conditions. The proposal is thus a dream come true

9.4 RECOMMENDATIONS

The use of different modes of transport system is the bedrock for economic growth of a country. River ports are paramount junctions or revolving nodes between inland means of transportation and distribution routes between producers and consumers. With the potentials the inland waterways stand to offer to Nigerian if developed, the federal government owes Nigeria as a responsibility to dredge and construct river ports along the rivers Niger and Benue. The sum total of these river ports that shall be constructed on rivers Benue and Niger shall act as revolving nodes and therefore, present a linkage and continuous chainage for smooth operations on inland waterways as a means of transportation. The proposal is thus a reminder to the federal government that buildings are important indicators of water transport and their design and recommendation should be reminiscent of contemporary architectural trends and also launder the integrity, sovereignty, unity and culture of the Nigeria state.

To fellow researchers the proposal is aimed at providing a source of knowledge to those that might be interested in Marine Architecture. It is note worthy at this point to say that the waterfront poses challenges which the designer has to take into serious consideration in the wake of designing for the waterfront. It is therefore important that designer carryout a study of the prevailing waterfront conditions in order to properly to blend their design with the site.

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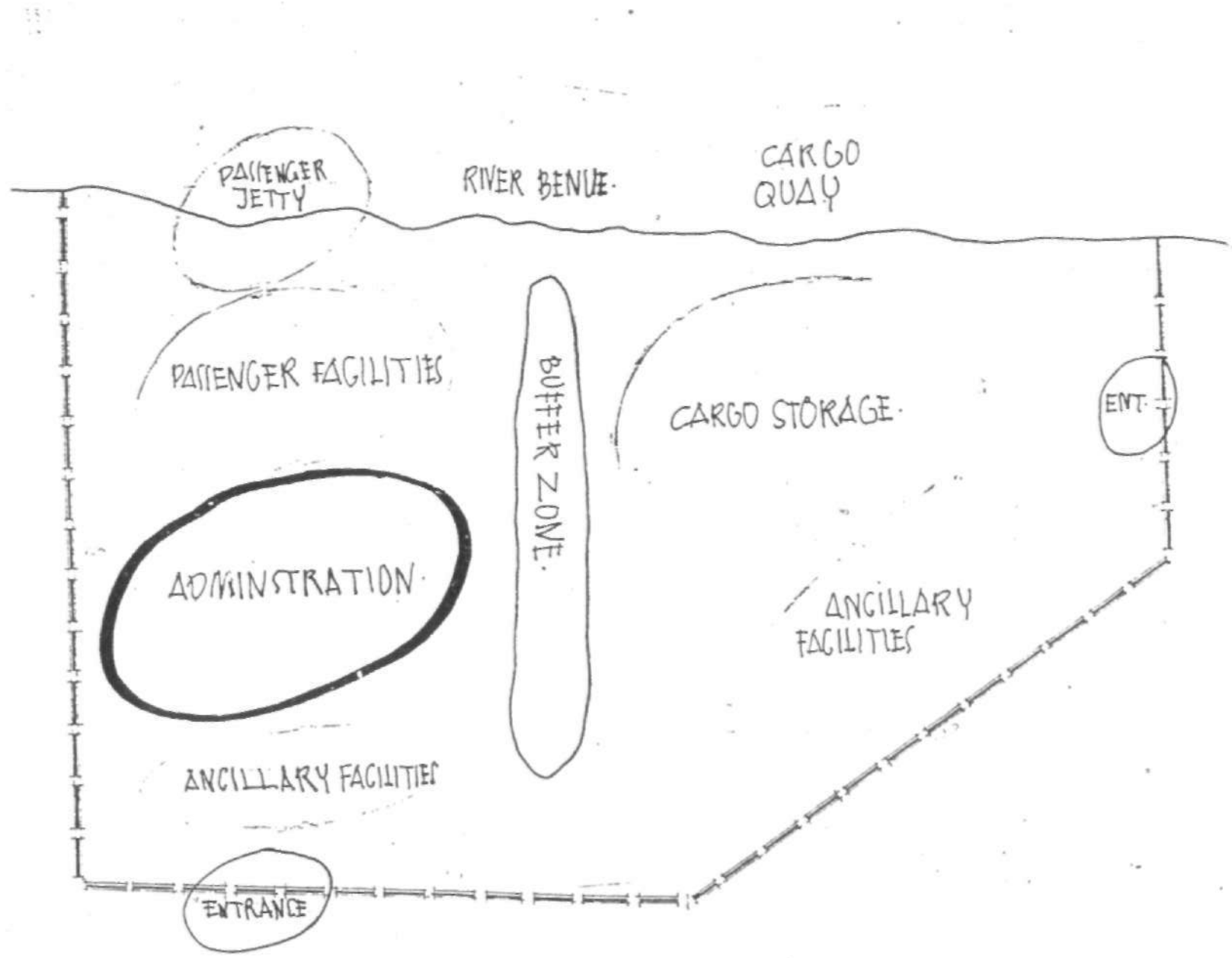
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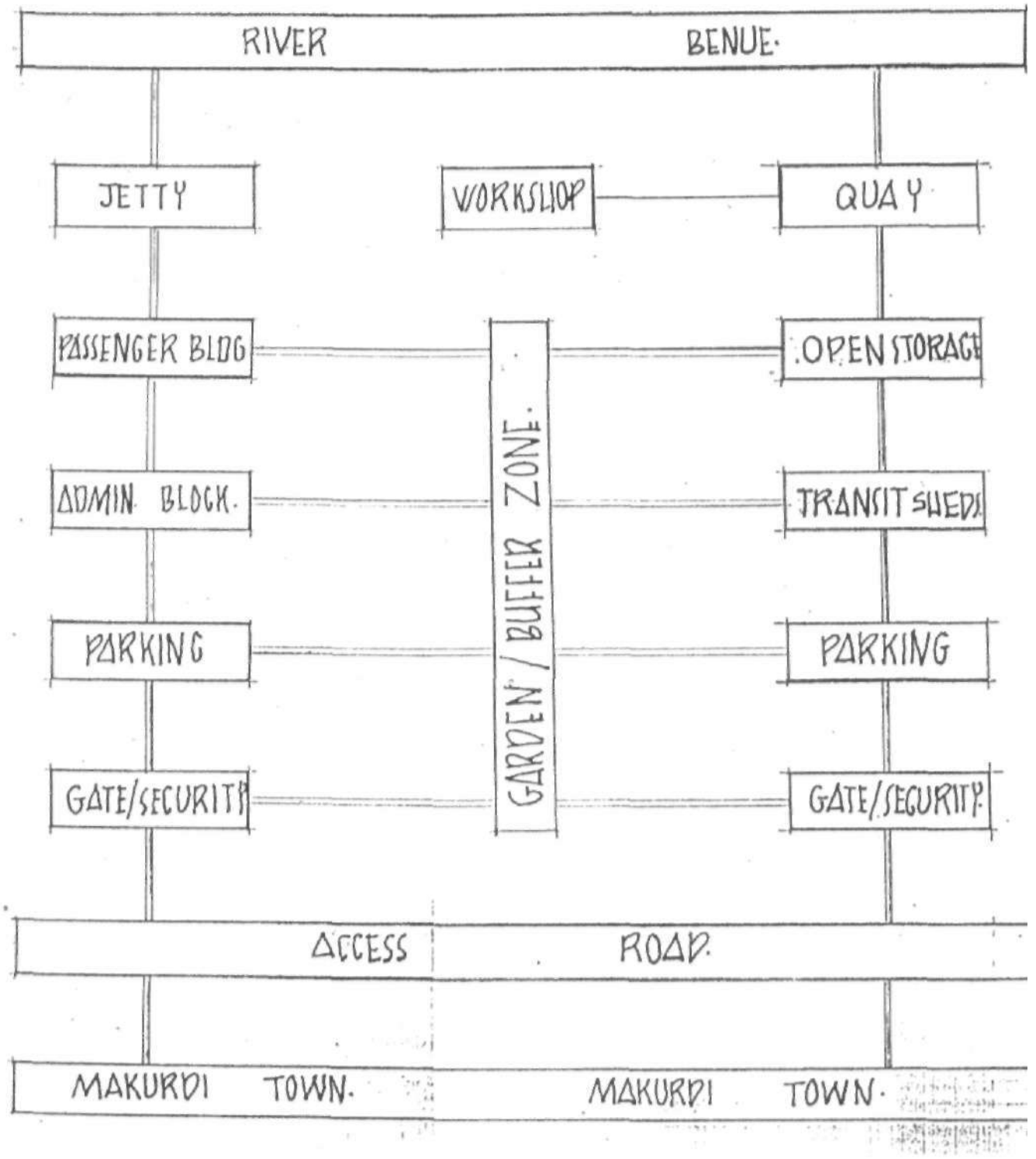
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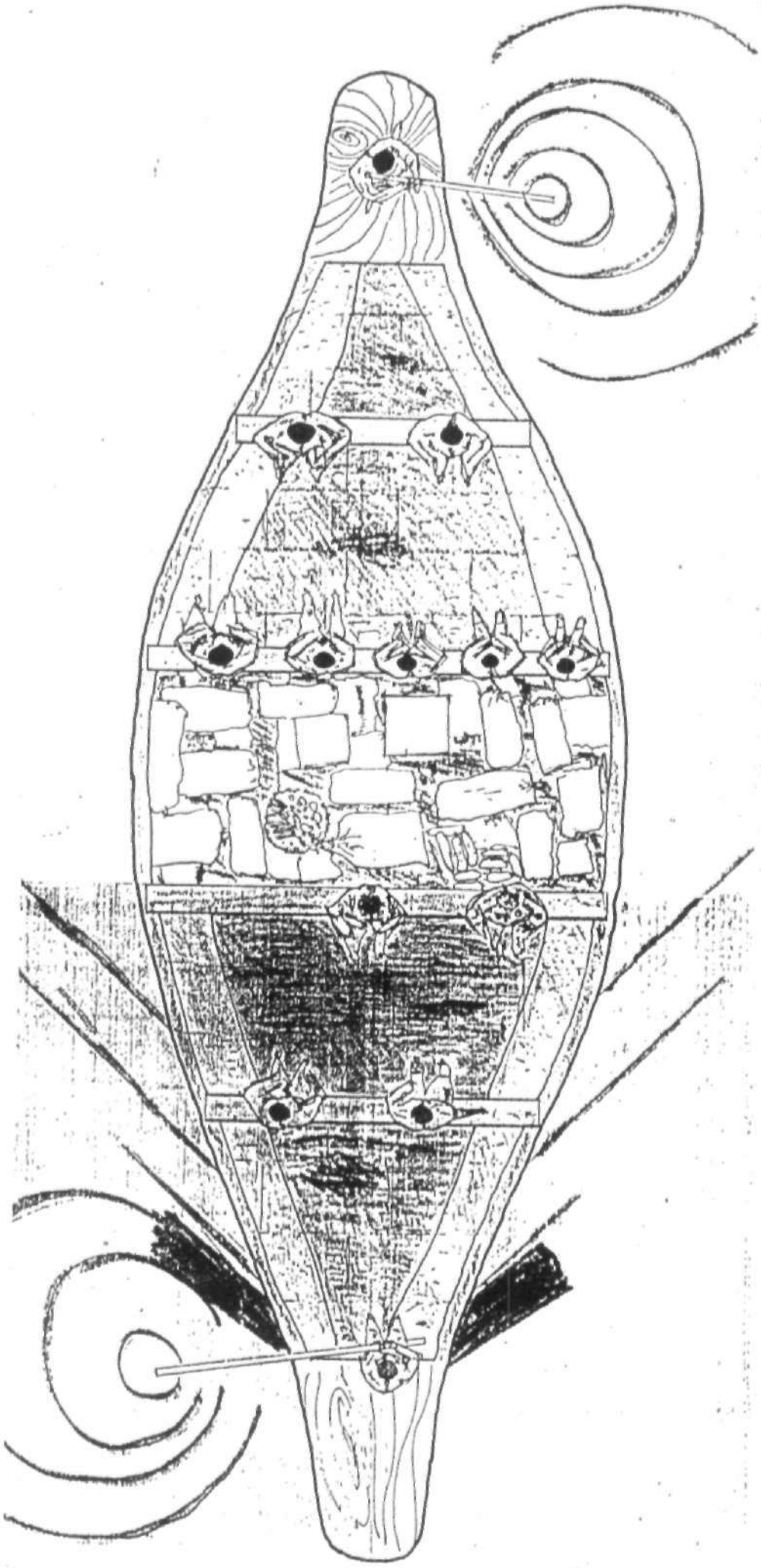
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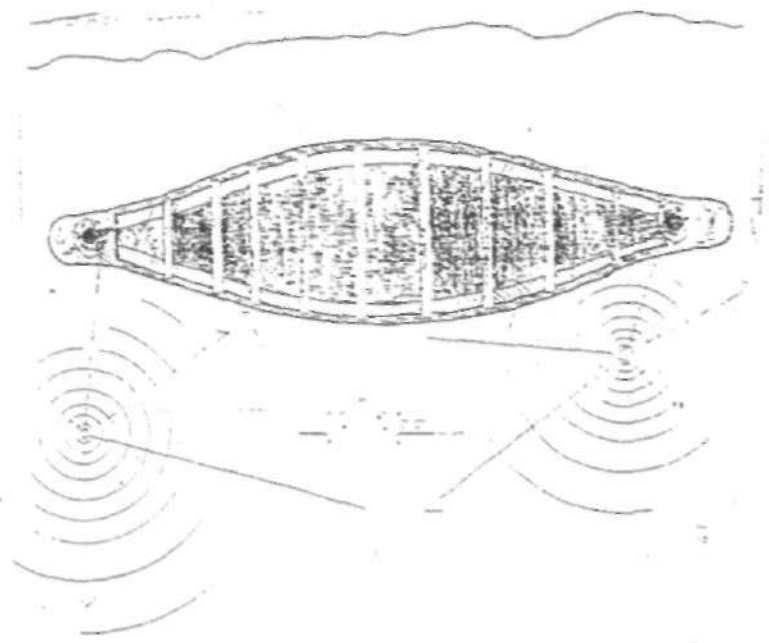
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PASSENGER JETTY
RIVER BENUE.
CARGO QUAY
PASSENGER FACILITIES
BUFFER ZONE.
CARGO STORAGE.
ENT.
ADMINSTRATION.
ANCILLARY FACILITIES
ANCILLARY FACILITIES
ENTRANCE

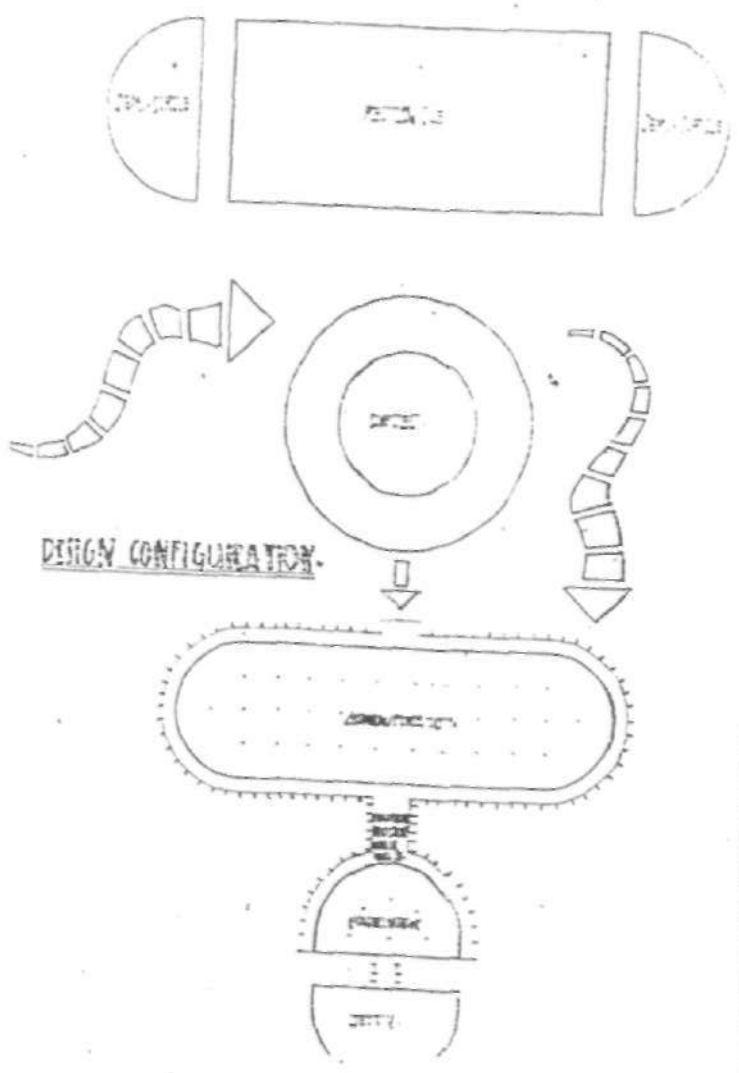

RIVER BENUE.
JETTY
WORKSHOP
QUAY
PASSENGER BLDG
OPEN STORAGE
ADMIN BLOCK.
TRANSIT SHEDS
PARKING
PARKING
GATE/SECURITY
GATE/SECURITY.
GARDEN / BUFFER ZONE.
ACCESS ROAD.
MAKURDI TOWN.
MAKURDI TOWN.



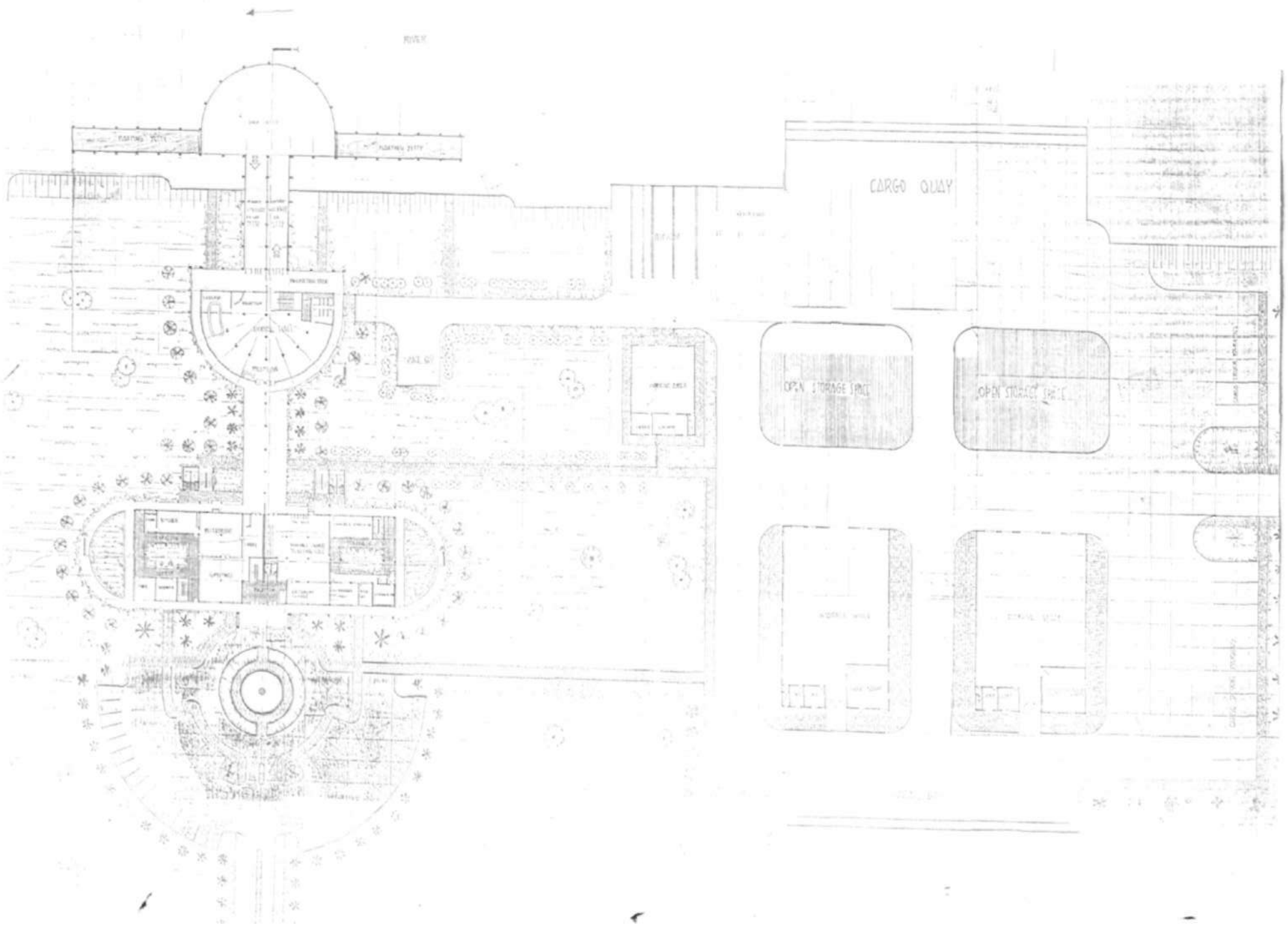


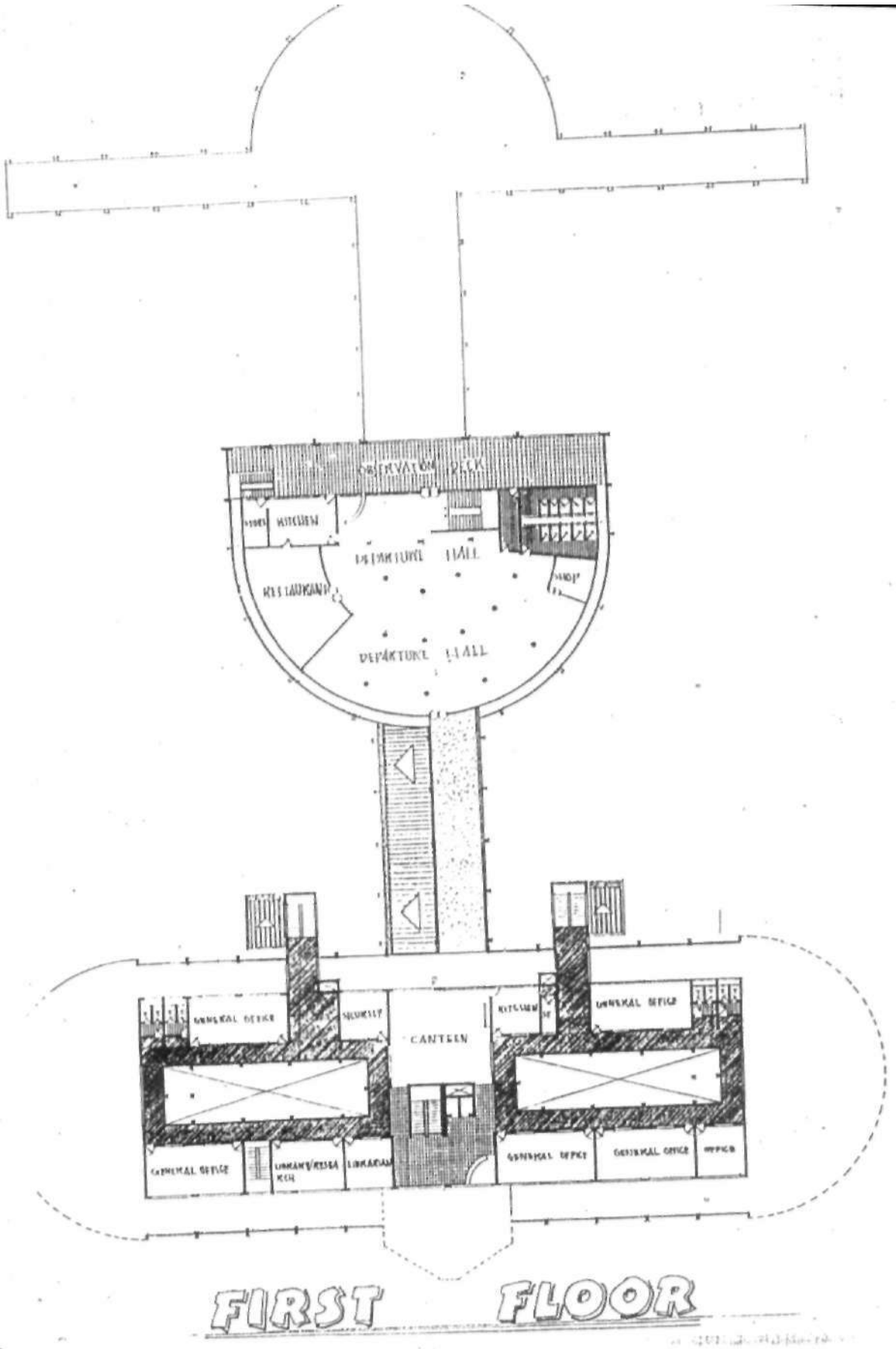
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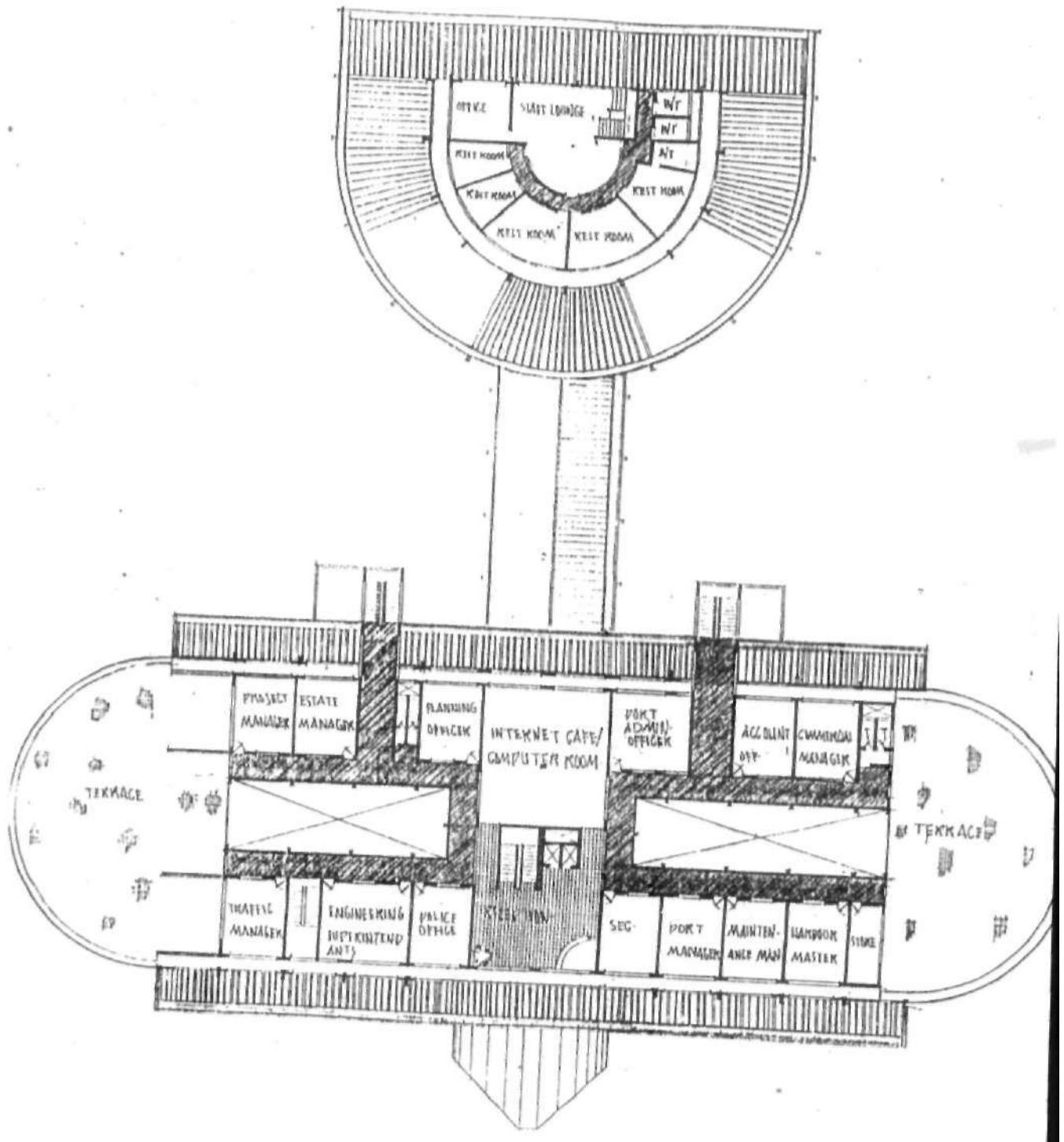


DESIGN CONFIGURATION.

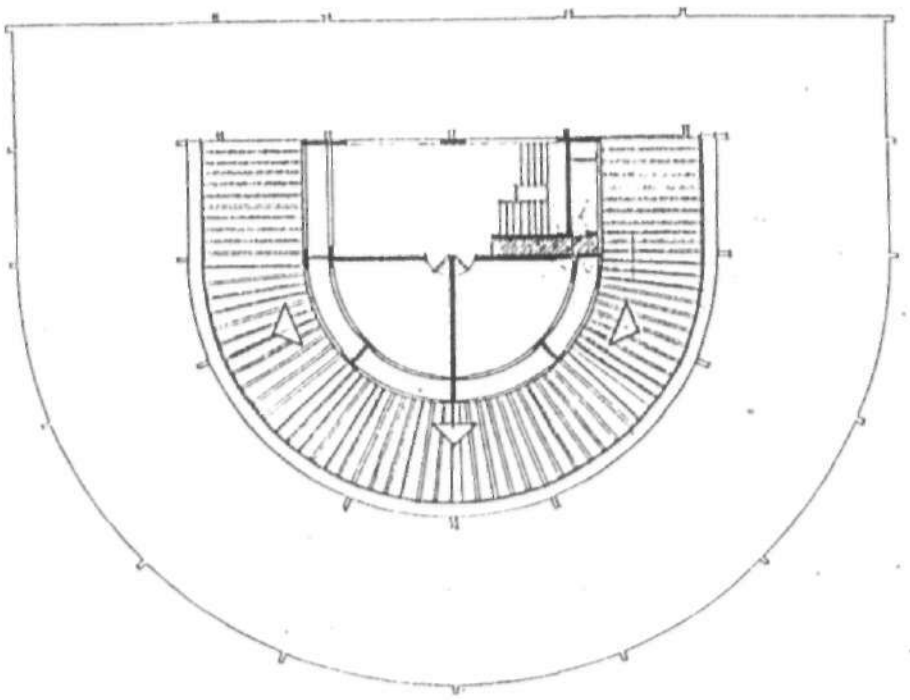

CARGO QUAY
OPEN STORAGE (RCC)
OPEN STORAGE (RCC)

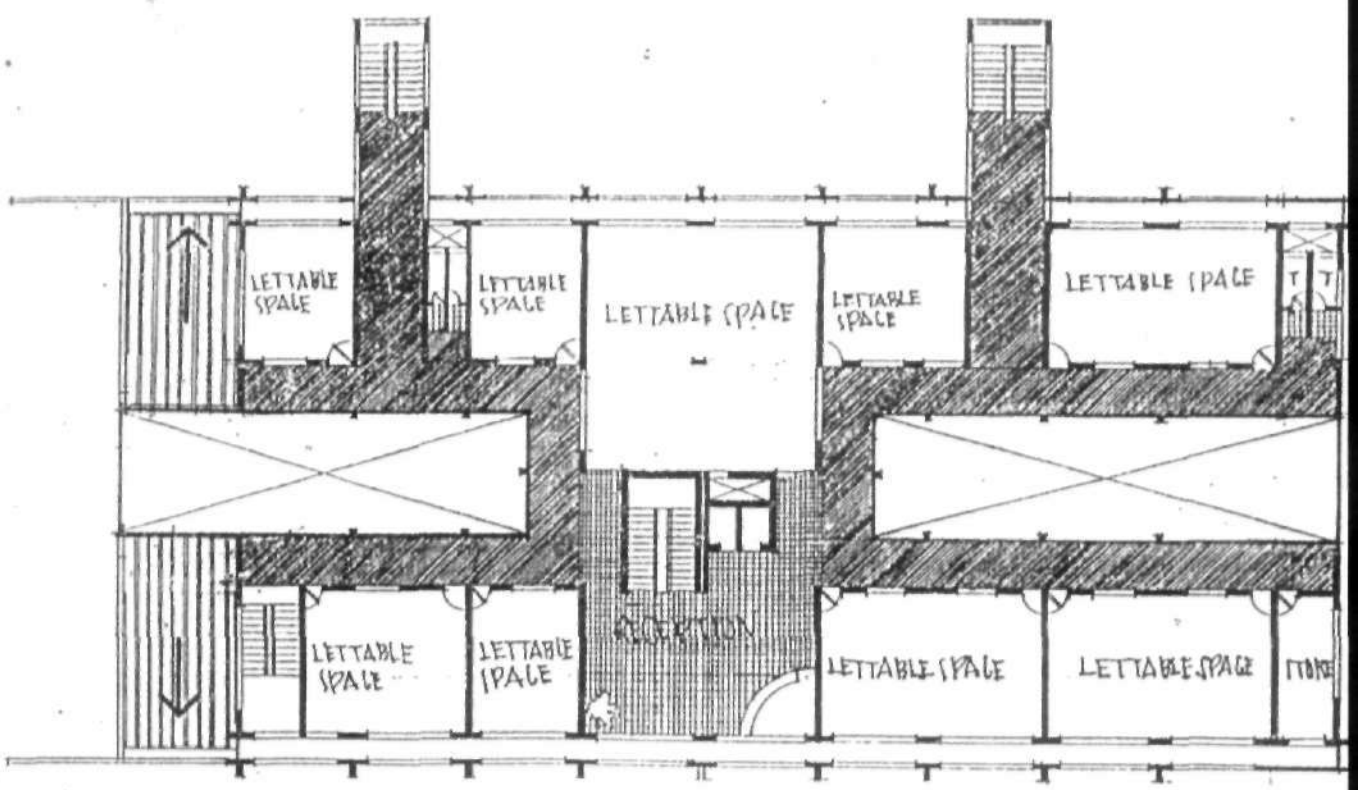

OBSERVATION DECK
KITCHEN
DEPARTURE HALL
DEPARTURE HALL
SHOP
GENERAL OFFICE
SECURITY
CANTEEN
KITCHEN
GENERAL OFFICE
GENERAL OFFICE
LIBRARIAN
GENERAL OFFICE
GENERAL OFFICE
OFFICE

FIRST FLOOR



SECOND FLOOR

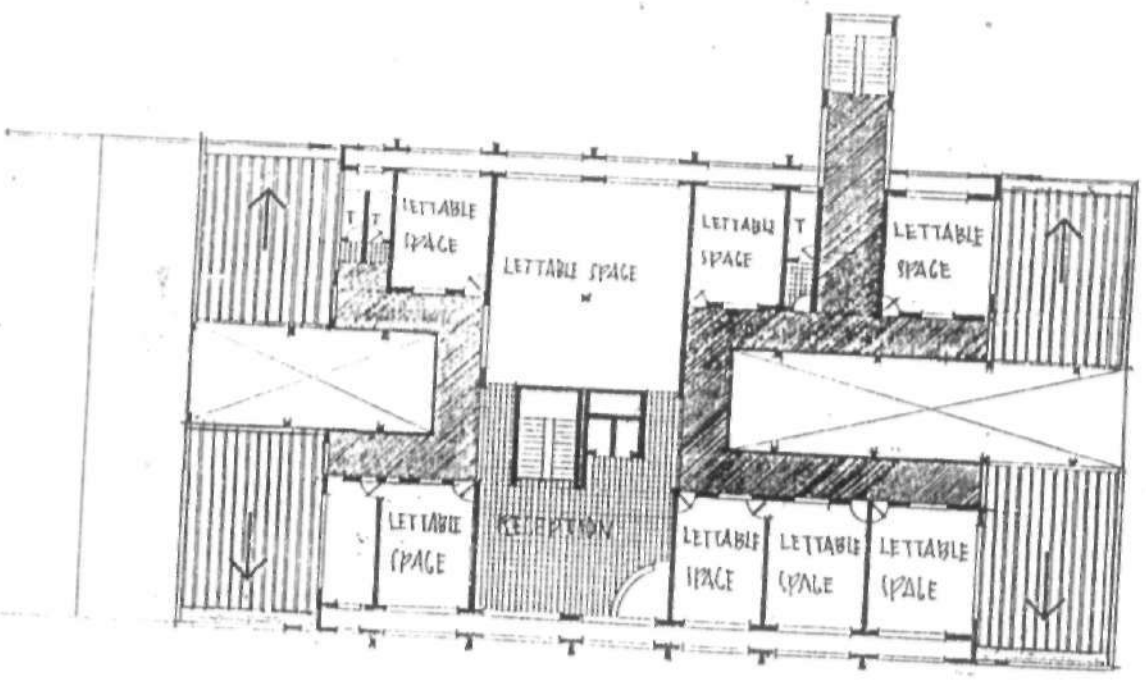



LETTABLE SPACE
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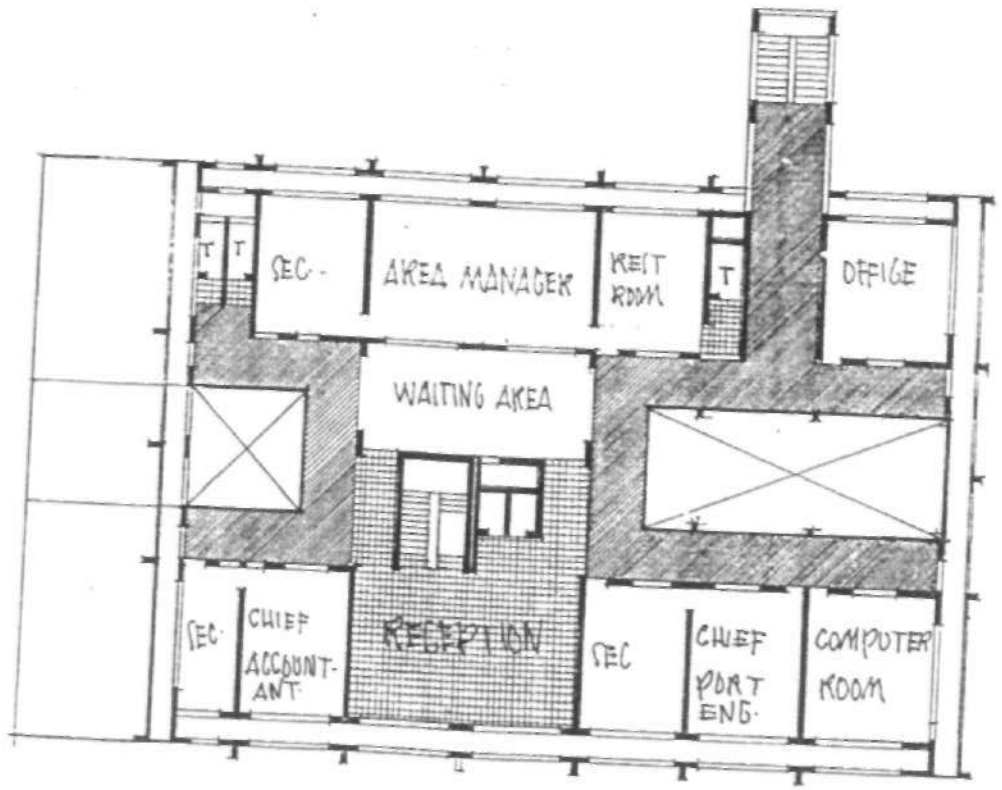
THIRD FLOOR

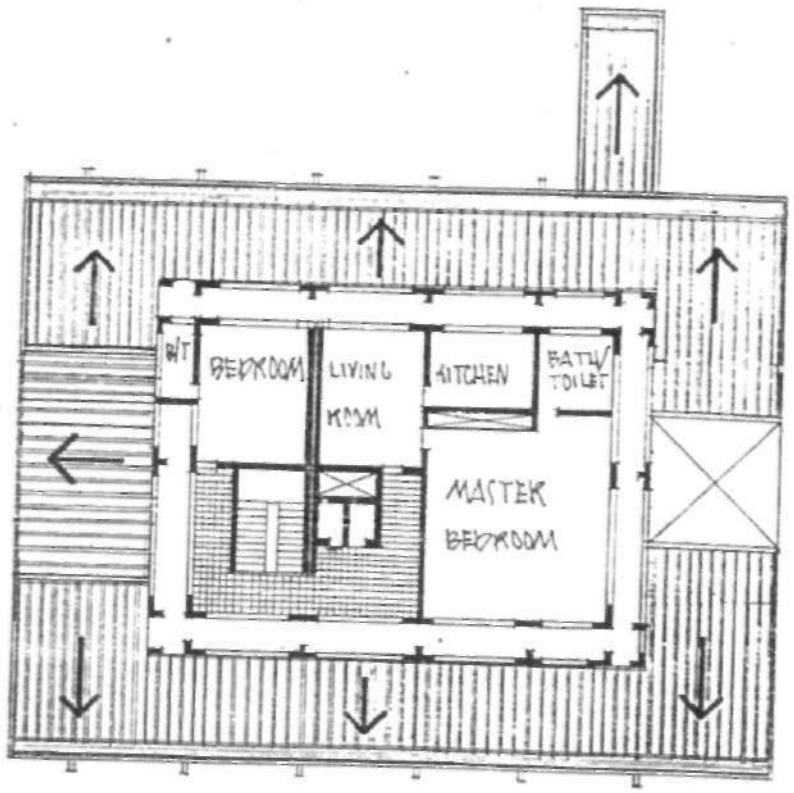
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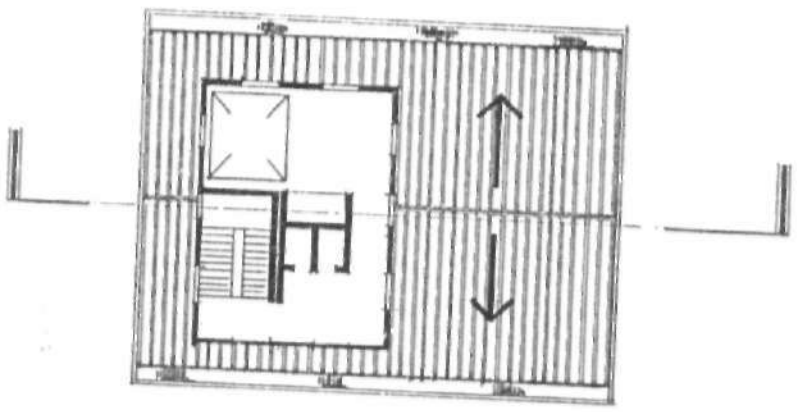
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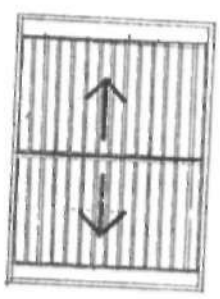
FIFTH FLOOR


T
T
SEC.
AREA MANAGER
REST ROOM
T
OFFICE
WAITING AREA
SEC.
CHIEF ACCOUNT-ANT
RECEPTION
SEC
CHIEF PORT ENG.
COMPUTER ROOM

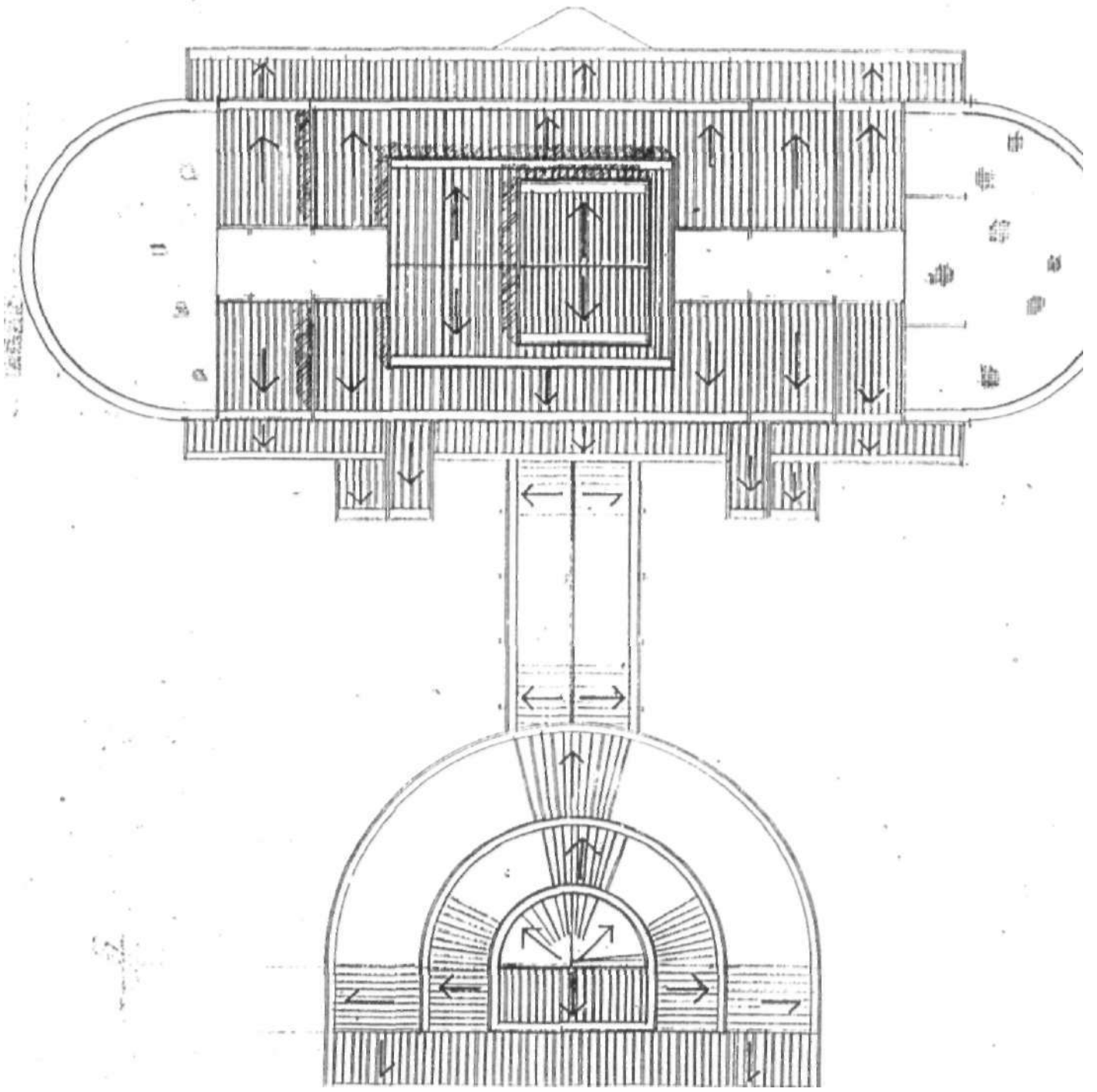

W/T
BEDROOM
LIVING ROOM
KITCHEN
BATH/ TOILET
MASTER BEDROOM

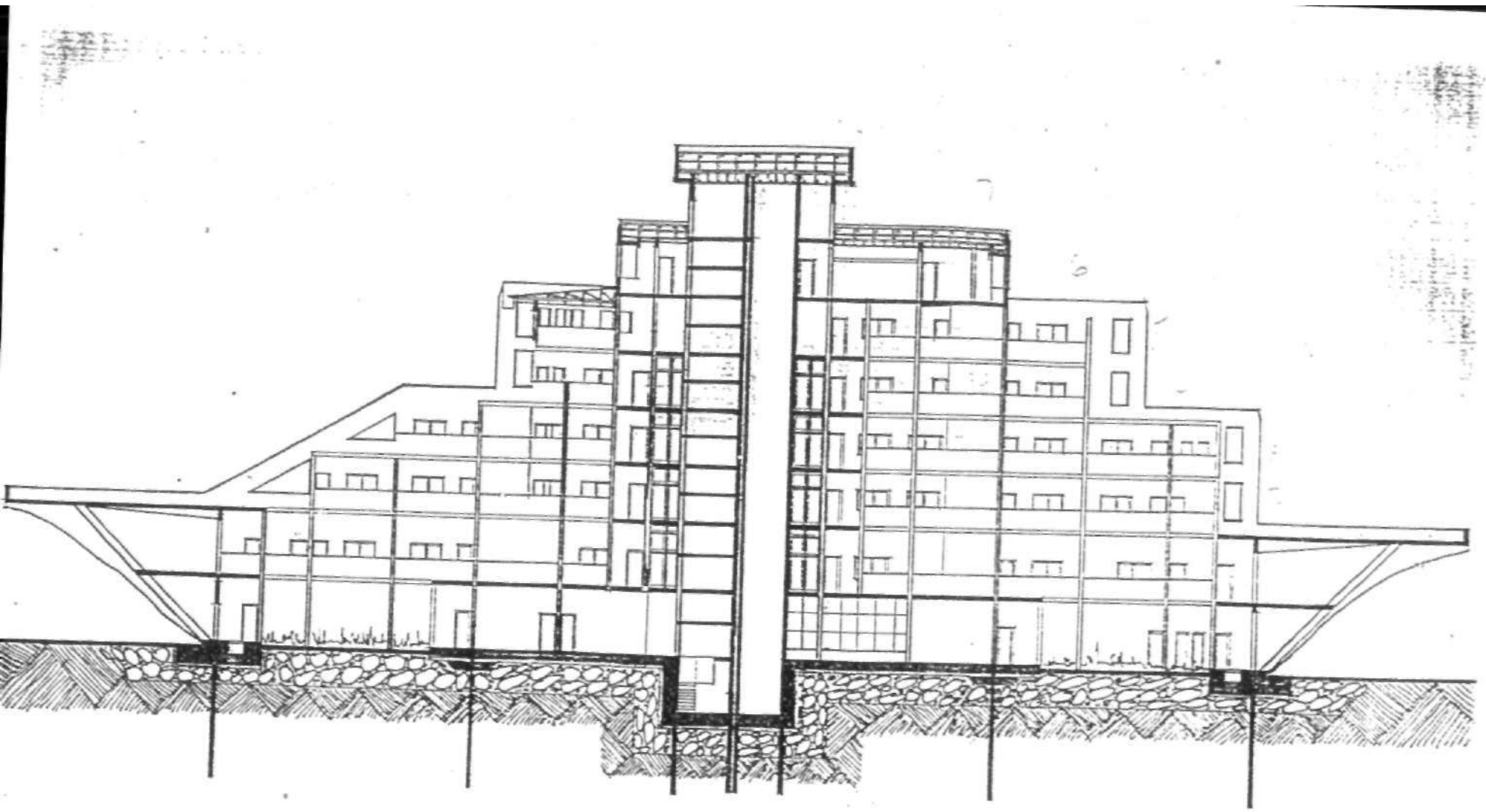


SEVENTH FLOOR- MACHINE ROOM

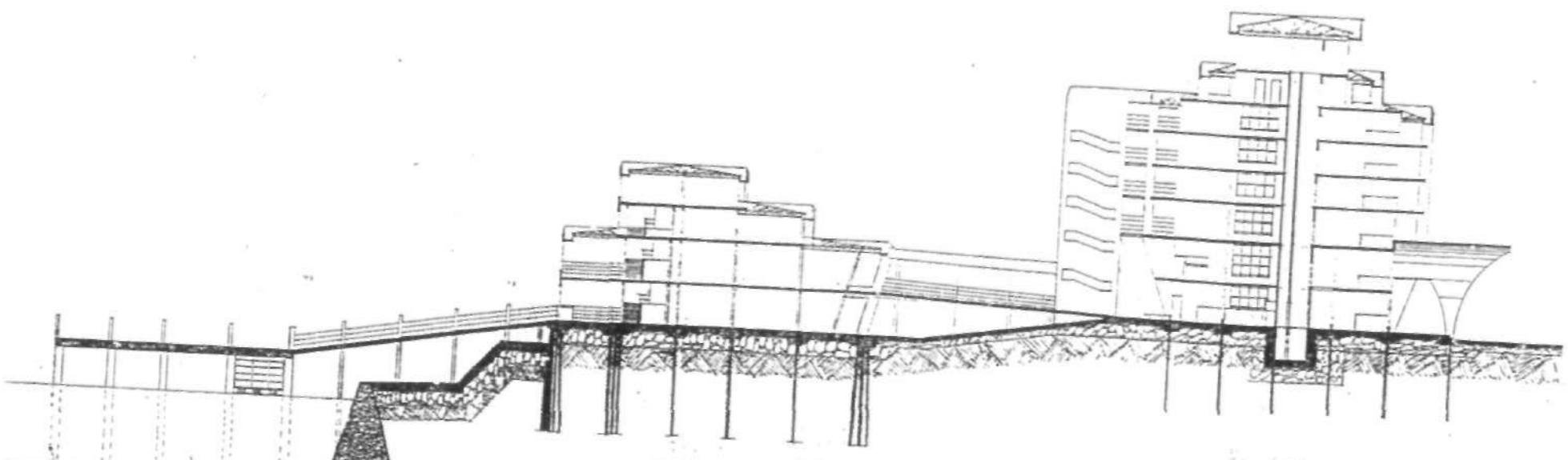


ROOF PLAN.



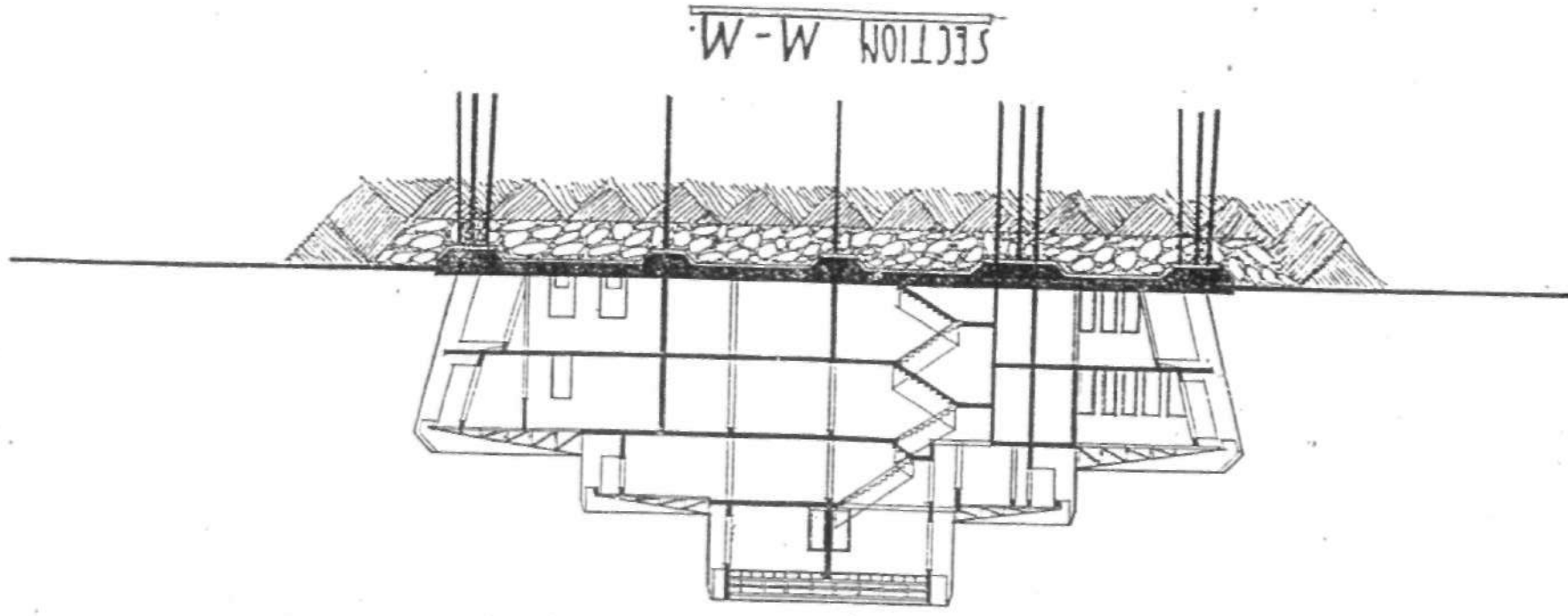


SECTION M-M



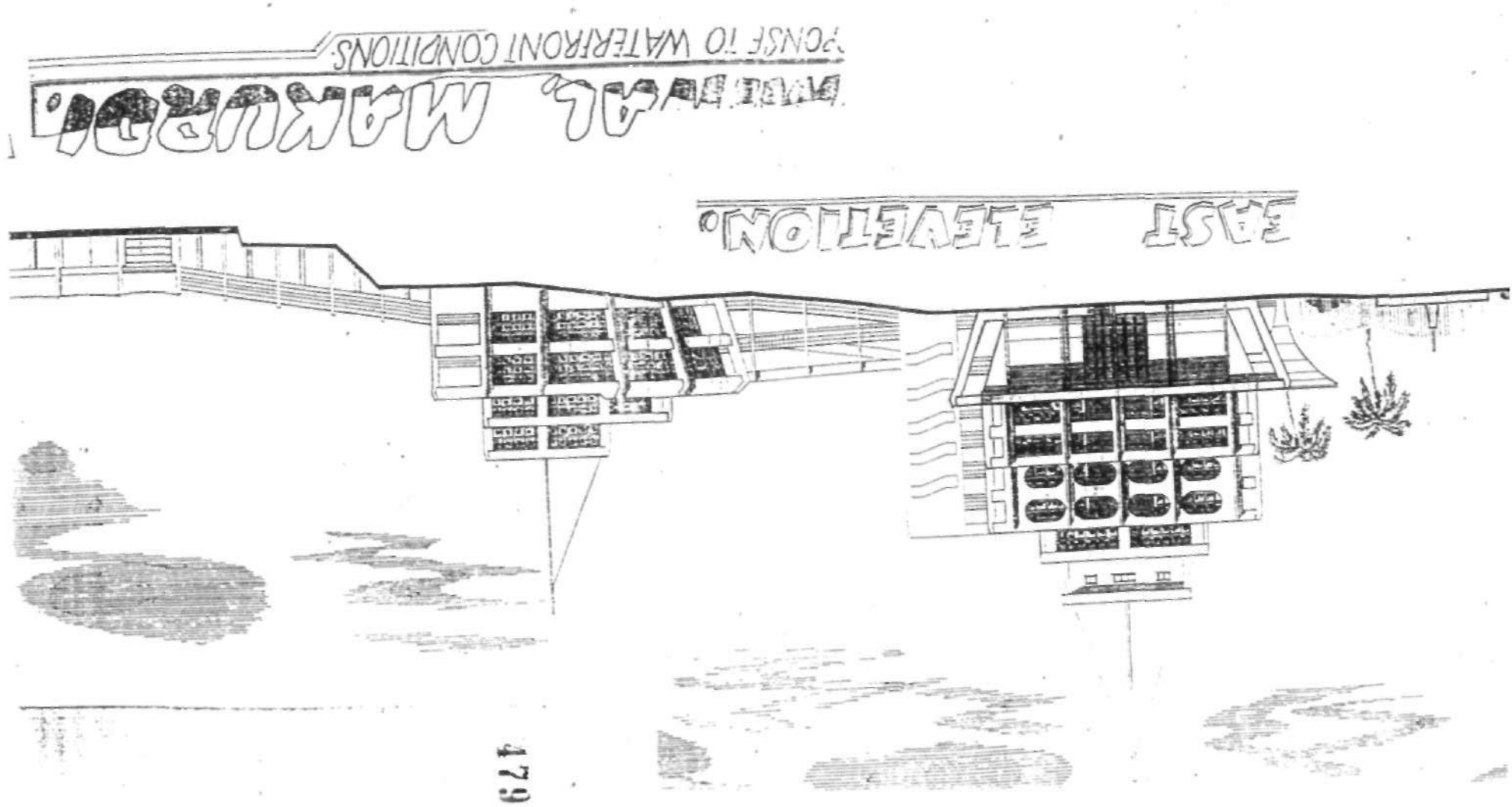
SECTION T - T

SECTION M-M.

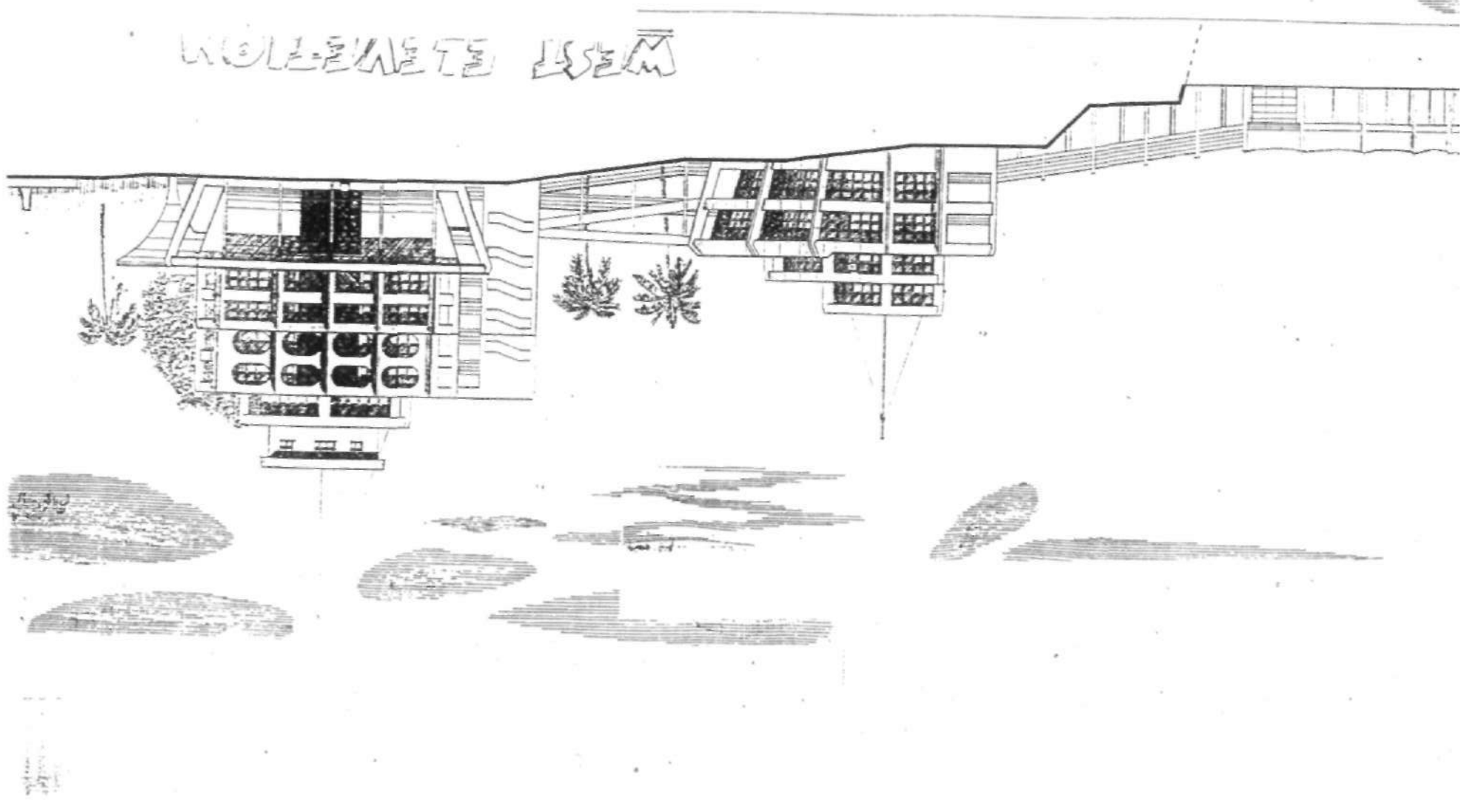


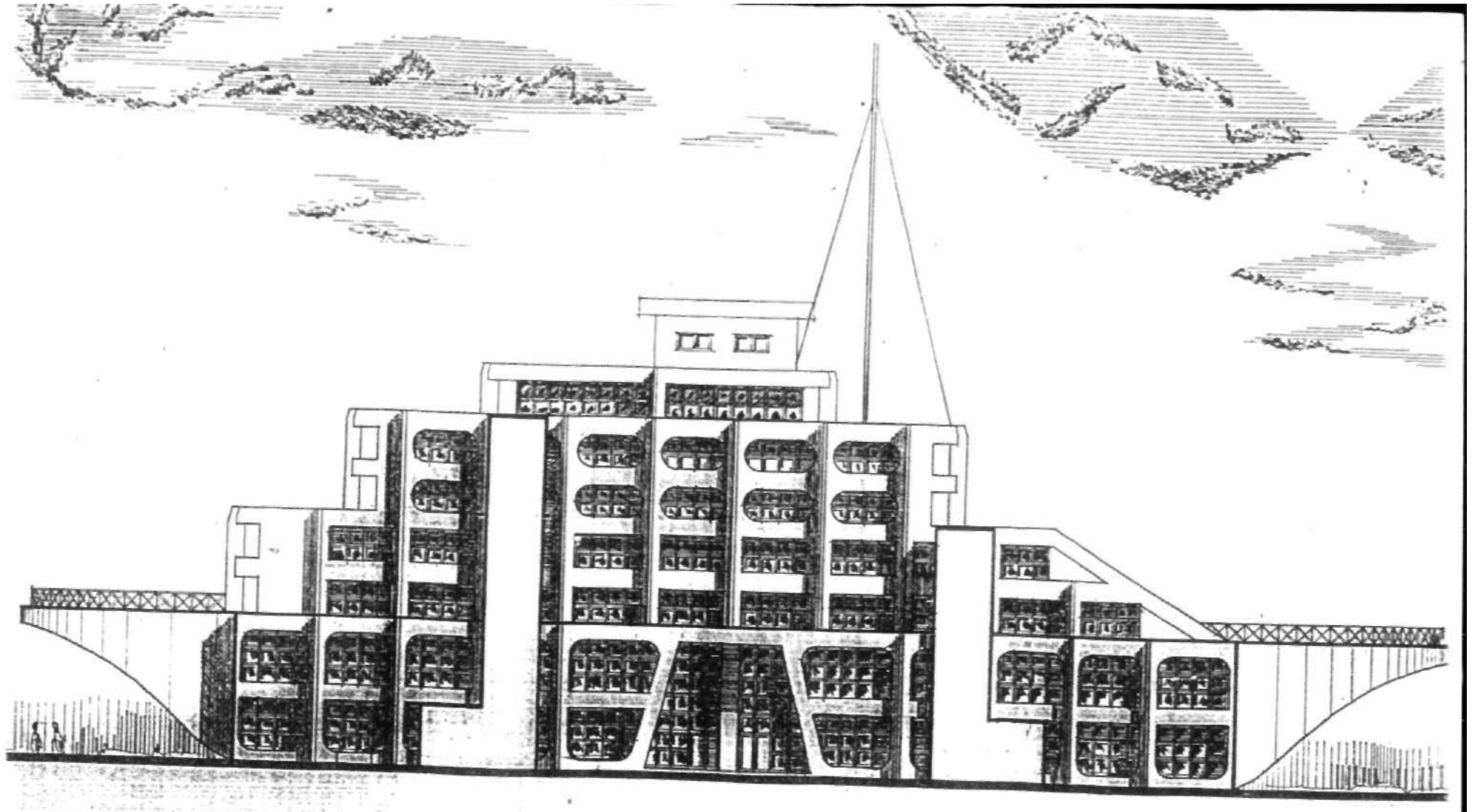

APPROACH ELEVATION FROM LANDSIDE


APPROACH FROM WATERSIDE

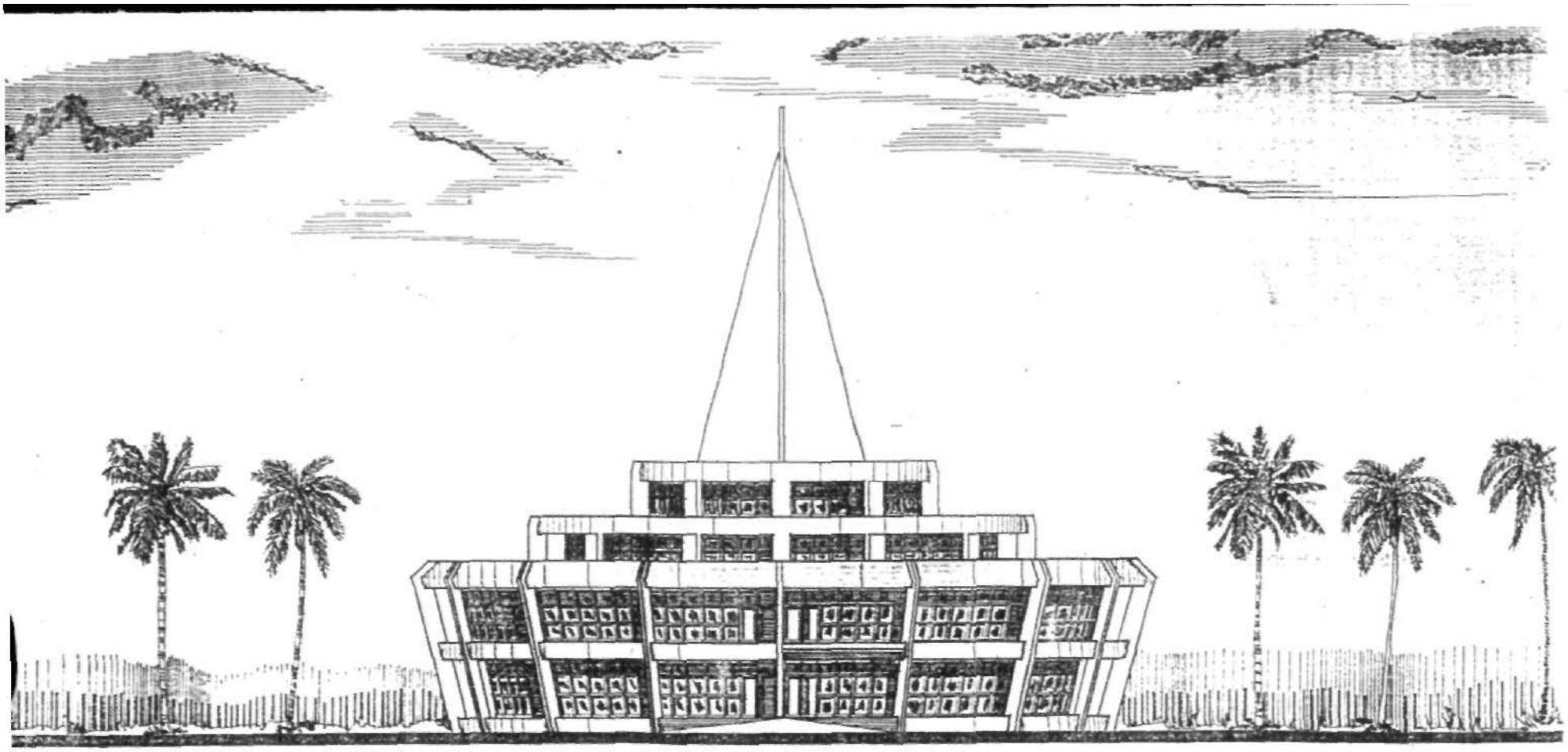

EAST ELEVATION.
EAL MARKUP.
RESPONSE TO WATERFRONT CONDITIONS.

479044





BACK ELEVATION OF ADMINISTRATION BUILDING



BACK ELEVATION OF PASSENGER BUILDING