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I N

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Dedicated to GOD

"for I can do all things through Christ who strengthens me"

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ABSTRACT

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The constant change in technology has made it possible to change environment on a much larger scale than before changes in the social organisation of our society has made it necessary to educate ourselves on various aspects of the environment. It becomes meaningful to talk about the correspondence between the human beings and their environment. Such needs can be met through activities. My thesis, the National Aquarium isbeing designed to educate man on an aspect of his environment - water by bringing him in direct contact with water creatures tamed for viewing and study.

It would seem an impossible task to duplicate a a natural phenomenon such as this but an attempt has been made to handle as realistically and sensitively as possible various aspects of the design to come very close to the natural habitat in which the creatures thrives. Most aquatic creatures and plants are adaptable and the success of fish keeping depends entirely on the artificial environment created. This is my point of concern. In intend to provide this designed

environment by careful study and planning that will result in a simple and efficient design that is consistent with proper maintainance of the desired environment.

Retailed and careful studies of the peoples' activities daily life and existence have shown that in the future there will be greater leisure time and with higher prosperity more opportunity for wider interests outside one's work. People need a challenge outside their field of work. Also more people are becoming adherent of water recreation with the extensive coastline we have in our Country. The aquarium project would serve as an educational recreation complex.

Lastly, there is a provision for the National Aquarium project in the Third National Development Plan to be sited in Lagos and other parts of the Country between 1975 and i960. This project will not only have a national outlook but will express its character through form, landscape and structure.

CONTENTS

		Page
1.	INTRODUCTION	1
2.	THE AQUATIC ENVIRONMENT	6
	A. Key Factors in Aquatic Environment	
	- Space	
	- Water	
	- Air	
	- Light	
	- Temperature	
	- Food	
	- Nitrogen Cycle	
	B. Major Aquarium Systems	
	C. The Aquarium	
3.	SITE ANALYSIS	15
	- Natural Factors	
	- Cultural Factors	
	- Aesthetic Factors	

Page

4. CONCEPTUAL ANALYSIS 20

5. DESIGN ANALYSIS 23

- Site Organisation
- The Architectural Form
- The Structure
- Services
-

6. APPENDIX

7. BIBLIOGRAPHY

INTRODUCTION.

INTRODUCTION

Fish keeping is a very old and well investigated hobby but unfortunately one in which practical information is badly documented and often not readily available, especially in terms which can be understood by a Designer. There is an emphasis on the circulation of information on the fishes' physical characteristics, their breeding habits and food requirements which while being obviously essential is not sufficiently balanced by information on environmental requirements. Much of the information required is passed by word of mouth from one Aquarist to another with consequent alterations due to misunderstanding, exaggeration and so on. The aquarium tank of popular conception dates only from about the middle of the nineteenth century and it is still a new aspect of architecture to be explored. Notwithstanding, a good knowledge of the basic environmental requirements has enabled me to sort out those methods, which when correctly applied in addition to my architectural background, make all the difference between satisfaction and progress and a state of mystified slavery for both the fishes and the viewers.

All fish-keeping depends for its success on the establishment and maintenance of a stable aquatic environment which is suited in all respects to the needs of the particular fishes and any special activities which one wishes them to perform. The environment provided must resemble as closely as possible the natural habitat in which the fishes thrive and this may be achieved by natural or artificial stimulation. Some natural factors can be reproduced by artificial substitution of various pieces of equipment if the requirements are understood and adhered to. To satisfy these demands a knowledge of the basic factors involved has obviously been advantageous and rewarding.

The environment in which fish live in captivity is made up of a very complicated mixture of various factors; physical, chemical and biological covering many areas of knowledge. The fishes to be exhibited are many and varied from the river, lagoon and the ocean. Their individual requirement may vary in extreme but there are fortunately many basic factors which are common to almost all species. Fish can be divided into categories and classified in terms of the environmental factors which form the most noticeable differences in their way of life.

For example, a particular fish can be described as fresh water rather than marine, tropical rather than cold water and so on. By sign posting its environmental and biological characteristics, it becomes easy to know what its requirements will be in captivity.

The most accepted unit of design is the human need; the enthusiasm with which some people take up fishing, swimming, underwater diving to view life beneath the sea and the popularity of films giving away yet more secrets of marine life is an evidence that there is a basic curiosity in most of us. The aquarium is proposed to give us a chance of looking into a world from which we are normally excluded - the world of water and it will be a fascinating sight for many people. It will serve a dual purpose, providing observatory facilities for Aquarists and students of all categories as well as recreation for tourist and others: in short an educational recreation centre.

Throughout the scheme, I have tried to express the characteristics of the building through the site chosen, the landscape, the forms and the structure. This will communicate to the viewers at a glance the whole idea of the scheme and also educate them on the various aspects of our waters namely fresh water, brakkish and marine. The purpose is to present a simple design to house simple, safe and reliable methods which can be recommended for the three aquatic environments.

This has been done through research and study yielding this report and the design drawings. The report consists mainly of four chapters. The first chapter deals with a full description of the aquatic environment and the factors that need careful consideration for example space, air, light, type of food equipment and so on. The second chapter describes the site, its characteristics and all the other aspects that make it suitable for an aquarium project like its water surroundings, beautiful scenery plus water qualities that will have to be integrated into the design.

The Conceptual Analysis is contained in the third chapter. The main concept is that of expression through the various aspects of design the characteristics of the buildings by using forms that are symbolic of water. This chapter also consists of the architectural considerations for the aquarium tanks, the grouping of the various functions and their relationship and also the various points of emphasis.

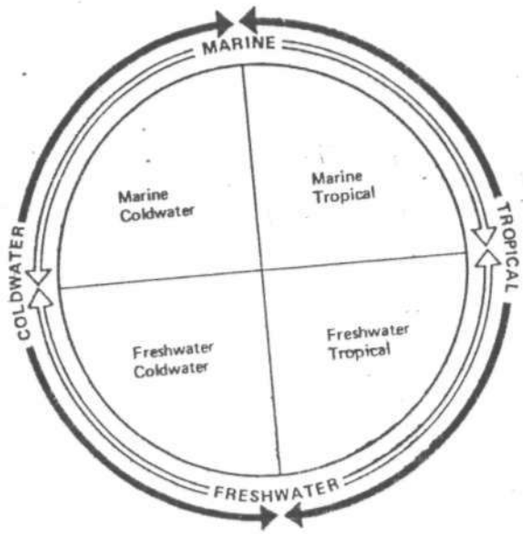
The fourth chapter, the Design Analysis describes how the site analysis, the conceptual analysis and the other requirements have been put together to yield the prepared design. Much as I have tried to use symbolic forms, harmony in the various buildings has been given proper consideration too. The aquarium project can be grouped into

five main functions, the reception, the administration, the exhibition, the recreation and the services. In carrying out the design, I found it necessary to merge the reception and administration, the exhibition and the services so I have three main buildings. The design drawings will further explain the concept and the architectural ideas.

THE AQUATIC ENVIRONMENT.

THE AQUATIC ENVIRONMENT

The major types of aquatic environment are illustrated in figure 1. The principal factors in each one is absolutely fundamental because almost any fish which is kept under conditions given in the wrong sector for that fish will almost invariably die sooner or later. The correct choice of salinity and temperature is so basic to the fish's well-being that it is vital for its survival. Other factors are not always quite as demanding as this and in this respect it is often quite possible to keep a particular type of fish for all of its normal life span in conditions which do not suit it at all. For instance, it is well known that fishes grow to their full adult size only if enough space is made available to them. There is no reason at all to suppose that a stunted fish is any unhappier or suffers in any way in comparison with its fully grown counterpart. But it is better to provide enough space for the fish to achieve its full expectations. In Nigeria, the difference in the three aquatic environments is the degree of salinity.



The major types of aquatic environment

FRESHWATER ⟶ BRACKISH ⟶ MARINE

FIG. 1

KEY FACTORS IN THE AQUATIC ENVIRONMENT

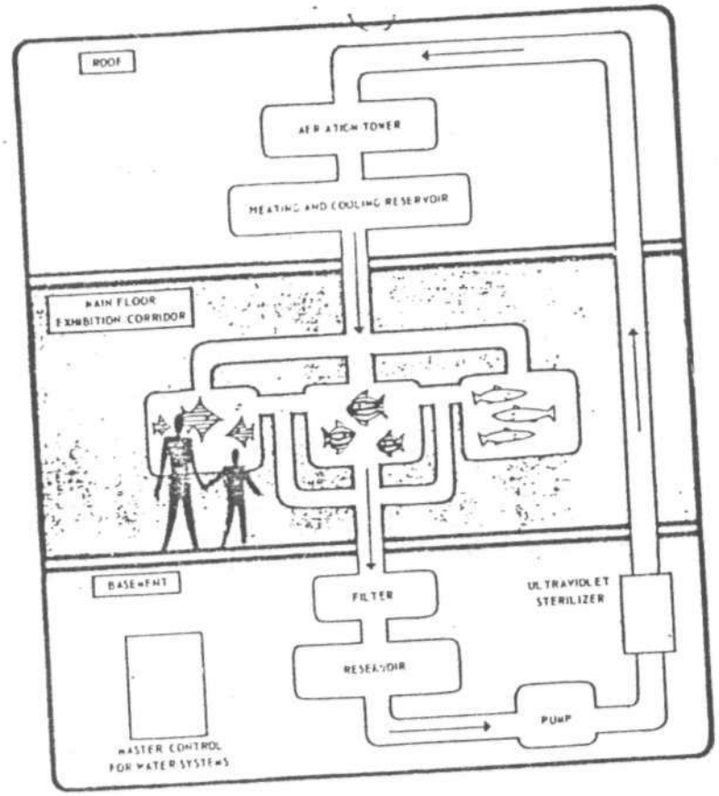
The key factors in an aquatic environment are space, water, air, light, food, temperature and the nitrogen cycle.

a. SPACE

The adult body size of a fish depends largely on the space available. Small space or over-crowding results in stunted fish. As much space as possible is required for adequate growth of the fishes. Space is also important in the relationship between fish or groups of fishes whose interests conflict. The volume of the aquarium also affects the biological set up, the larger the volume with no over-crowding the smaller the changes and their effect on the biological balance is minimal.

b. WATER

It is better to obtain water which in its original state is as close as possible to that required for the particular environment. When collecting specimen it is essential to collect the natural water in which they exist with the specimen initially. Most fishes can be exhibited in fresh filtered sea water. There are two main water systems - the closed system and the open system. The open system is the least complicated provided an adequate source of disease f



Simplified diagram of the aquarium water system.

FIG. 2

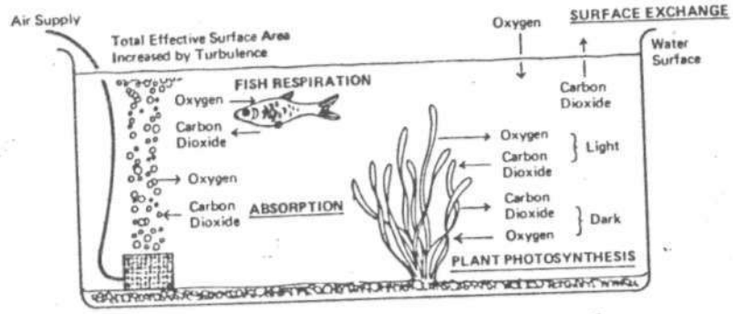
water is available. Water is discarded after one use. The closed system is that in which the water is recirculated for use. It is useful where water is not readily available. For this project, the open system will be used since water is easily available at the site. Figure II shows a simple aquarium water system.

c. AIR

There exists two air-water surfaces in aquatic environment, the air between the water surface and the atmosphere above and that between water and air artificially injected into the tank. Oxygen is vital for the fish and it gets it from two sources, the air and the growing water plants. It is essential to have the right number of fishes in a tank for adequate distribution of the oxygen got through the water surface and also for exchange of carbon-di-oxide produced by the fishes. The area of water surface is more important than amount of water (see fig. III).

d. LIGHT

The importance of proper lighting cannot be over-emphasised. Healthy growth of water plants is a requirement of successful aquarium keeping and to obtain this light must reach the tank. from the top strong side lighting is detrimental to the fishes for in nature the light source is always above the water.



The oxygen-carbon dioxide exchange processes in the aquarium

FIG. 3

Day light is the best but its illumination cannot be controlled so it is better to use artificial lighting systems for proper control of intensity and direction. Light is also essential to enable visitors to see the fishes clearly in the tank.

e. FOOD

Any artificial environment requires the inclusion of food in one form or another and in such a manner as not to spoil its long-term stability. It should be such that it can be absorbed easily and quickly by the inhabitants with serious effect such as fouling and of course it must be nutritious and efficient in promoting growth.

Ideally, food should be given as often as the fishes will take it but in an artificial environment, it is possible to plan a programme to meet the various needs of the different species. It is also very important to give a balanced diet containing all dietary constituents for growth and normal life to occur.

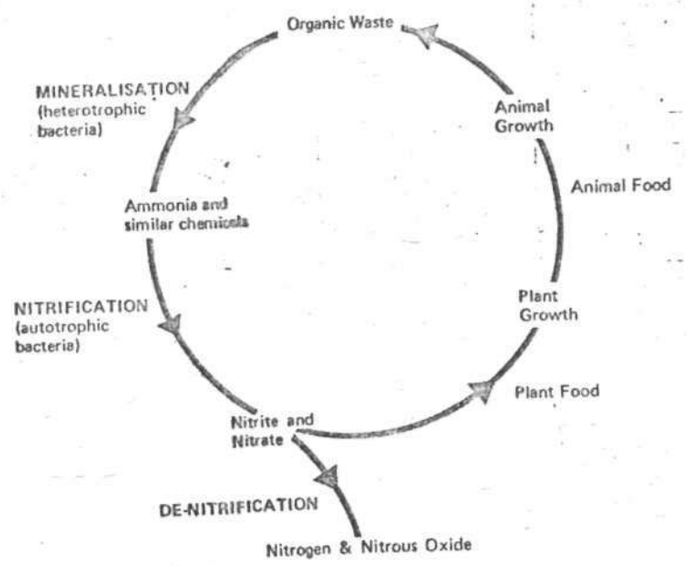
f. TEMPERATURE

Fishes are cold-blooded animals and as such, only have a limited control over their body temperature which varies with the temperature of the surrounding water. They employ the processes for the conversion of food into energy and heat as

other animals, but any excess heat is quickly dissipated into their surroundings so their body temperature can be said to be equal to that of the water. A fish's functions such as its feeding activity, health and growth, its activity area level and the workings of its internal processes, are all affected directly by the temperature of its immediate environment. In mixed environment created artificially, it is essential to keep the inhabitants that live naturally within the same temperature range.

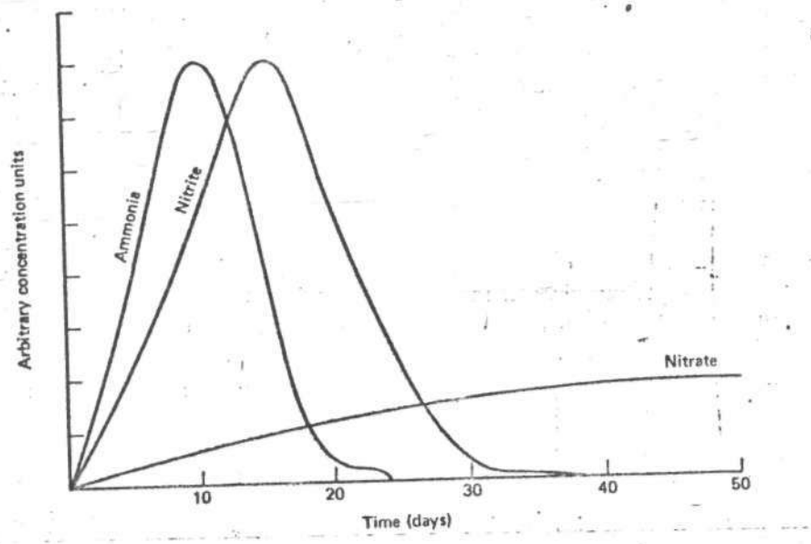
g. THE NITROGEN CYCLE

In any enclosed container of mature water, organic materials such as fish excreta, uneaten food or dead bodies is automatically converted into mineral form by bacteria. These organisms feed only on the organic substances and develop quite easily and naturally wherever sufficient food of this kind is available. The result of their activity is production of ammonia which are toxic to fishes in sufficient quantities. This process of breaking organic matter into simple chemical is fundamental part of the Nitrogen Cycle (Figure IV) and when the cycle is completed the wastes are eventually converted into nitrogen and nitrous oxide. This can be absorbed by plants and animals to complete the cycle. It is essential



The nitrogen cycle

FIG. 4



A diagrammatic illustration of the changes in concentration of the various components of the nitrogen cycle during the maturation period of a typical biological system

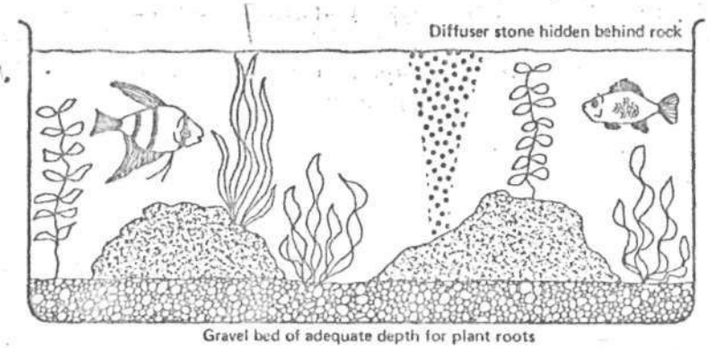
through careful management to complete the nitrogen cycle by addition of suitable inorganic material, rocks, glass, gravel for nitrifying bacteria to develop and also to keep the aquarium tank clean. Natural methods are for true representation of the normal environment because of the inclusion of animals and organisms with which the fishes normally associate. It is better to use natural methods to satisfy the various needs. Fewer equipment is needed and even the space and time of maintenance is minimised.

B. MAJOR AQUARIUM SYSTEMS

If the environmental factors detailed in the previous chapter are carefully considered, it can be seen that all of them are common in varying degree, to all aquatic environments, depending on the required conditions and nature of the inhabitants. The critical factor which determines the success of an aquarium project is the completion of the nitrogen cycle. Other factors such as temperature and illumination are readily adjustable but the method used to complete the nitrogen cycle is best throughout to suit the kind of environment planned.

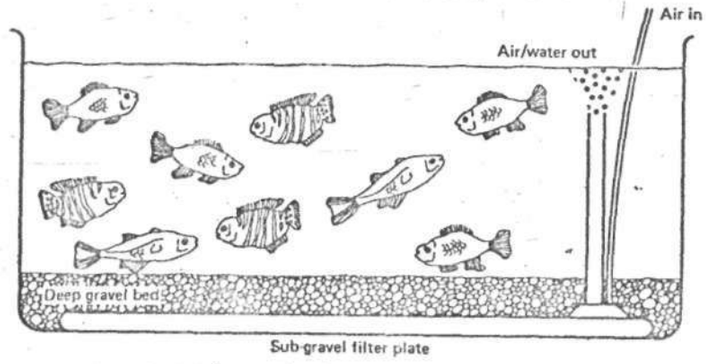
There are three basic types of nitrogen cycle systems that can be used - natural, biological and sterile systems.

The natural system is that in which the wild aquatic environment is reproduced as closely as possible and only nature's own methods are used to ensure stability and completion of the nitrogen cycle (Figure 5 shows the fresh water natural system while Figure 6 shows the marine natural system).



. The freshwater natural system. The nitrogen cycle is completed by natural methods involving plant growth and the use of scavengers such as snails and other organisms which are found in the fishes' natural habitat. A fertilising medium may be included in the gravel bed to encourage a lush growth of rooted plants. The air-bubble column ensures adequate gaseous exchange and provides natural turbulence

FIG. 5



. The freshwater biological system. This figure shows an aquarium in which a number of young fishes are successfully being reared in a container which would be overpopulated if it were not for the biological system. No ornamental inclusions or plants are present in this specialised environment

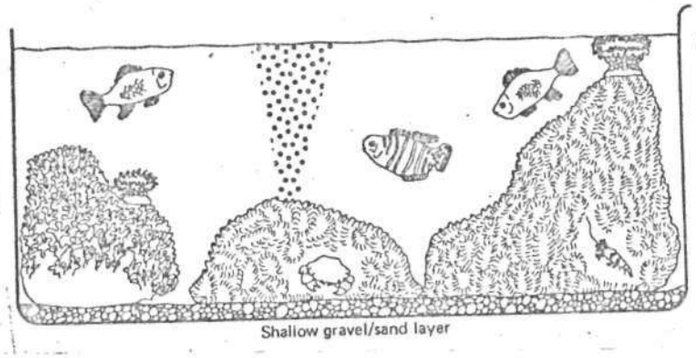
FIG. 6

The biological system, the problem of nitrification is solved by using deep gravel bed with a large total grain surface area through which the aquarium water is continuously circulated by a sub-gravel filter, thereby producing aerobic conditions and exposing as much of the water as possible to bacterial action.

The biological system is probably the best overall method for general use. Its large nitrifying potential allows for more time since there is no need for constant surveillance and removal of wastes. This system is adaptable to all kinds of environment. It is economical and easy to understand and to use.

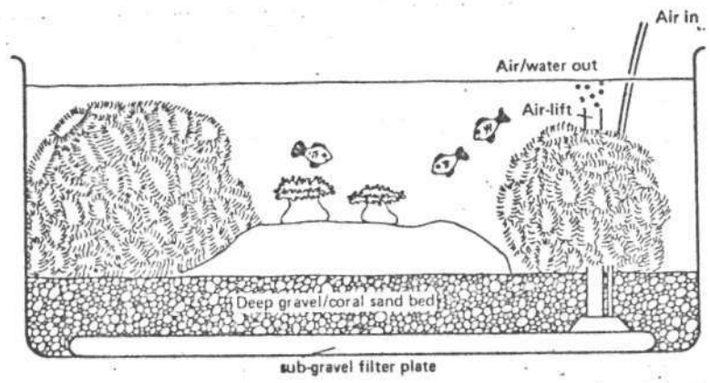
The sterile system is mainly for keeping expensive and delicate marine specimens, the only creatures present in the environment are those for whom it is designed. It is more applicable to the marine environment. The method is very technical and totally dependant on correct application of complex equipment. It is artificial both aesthetically and biologically and by its very nature must be spotlessly clean.

In all, the systems, the aim is to complete the nitrogen cycle and the simpler the method the better in terms of cost and maintenance.



. The marine natural system. Scavengers such as crabs and other crustaceans search out uneaten food, while filter-feeding invertebrates such as living corals remove organic material from the water. In this way the nitrogen cycle is completed, provided no heavy loadings occur. The air-bubble column provides natural exchange functions and turbulence

FIG. 7



. The marine biological system. The nitrifying potential of this environment is so high that some overfeeding, and even dead fishes, can be tolerated. These happenings are not to be encouraged, but they do demonstrate the system's capacity to cope with common emergencies

FIG. 8

C. THE AQUARIUM

It is my intention to have three main aquarium tanks to exhibit fishes from the river (fresh water), lagoon (brakkish) and the sea (marine). The difference is mainly in the salt contents of each one. We have the three types existing in Lagos around the site chosen. It is not necessary to go into the details of the different physical, chemical and biological composition of each type since most of the factors are common to the three types and a separate tank has been provided for each type to avoid the problems of mixed aquatic environment.

The types of fishes to be exhibited are those which live peacefully and happily together in their natural habitat. These can be grouped together in large tanks while other specialized breeds can be exhibited in separate tanks. It is more economical to provide a large tank for a considerable number of species to provide a tank for each one.

I do not find it necessary to specify the types of fishes to be exhibited and the detailed requirements of each one since I intend to adhere as much as possible to the conditions that exist in their natural habitat. I have only found it necessary to find out how much space is required for an average number of fishes for adequare growth and normal life for easy viewing and maintenance. Below are a few examples of some

of the fishes in and around Lagos from the Atlantic Ocean, the lagoon and Ogun River.









SITE ANALYSIS.

SITE ANALYSIS

The National Aquarium project was proposed to be sited in Lagos and work has already been started on Victoria Island in Lagos under the Nigerian Institute of Oceangraphy and Marine Research which caters mainly for research work. No provision has been made for recreational facilities despite its location at the sea front. The Bar Beach is popular for recreation on public holidays and a lot of activities take place hence I decided to site the Aquarium along the coastline not too far from the Nigerian Institute of Oceangraphy and Marine Research to co-ordinate both the research work and the observatory facilities.

The Victoria Island in Lagos is mainly for recreational buildings, residential and a few office buildings most of which are specialised like Embassies, the Mint, the Television House and so on. There are two main hotels i.e. the Eko Hotel and the Federal Palace Hotel. There are other institutions like the Nigerian Institute of International Affairs, the Federal School of Arts and Science and the Nigerian Law School.

The site chosen as seen from the photograph below is adjacent to the Eko Hotel on the western side separated only by the narrow Kuramo Creek. It is protected from the sea front by sand dunes on the southern side while on the eastern and northern sides exist small residential clusters and the main village Maroko.


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SITE

The main reasons for choosing this site are the excellent views of the sea and part of Victoria Island seen from various points of the site and the availability of water required for the aquarium tanks. The lagoon is on the northern side and the sea is on the southern side.

The site has been investigated under the following factors: Natural, Cultural and Aesthetic.

a. NATURAL FACTORS

1.	Geological Base	-	Alluvial soil
2.	Topography	-	Generally flat ranges from 1m-3m above the sea level.
3.	Hydrography	-	Surrounded on three sides by Kuramo waters about 2-4 metres deep. Kuramo Cree, Five Cowrie Creek and site drains naturally to the western side into the Kuramo Creek.
4.	Soils	-	White loose sand.
5.	Vegetation	-	Completely protected from sun and wind by coconut palms.

6. Climate - Humid and warm prevailing winds south west north east and the sea breeze have a cooling effect. Average rainfall of about 12mm monthly. Average daily temperature of about 2 [illegible] °C.

b. CULTURAL FACTORS

1. Existing Land Use - adjacent to site on the western side is the Eko Hotel and the Igbosere Village on the north eastern side is the Maroko Village and the Lawani Village. The occupants are mainly fishermen.

2. Accessibility - The existing vehicular access is through Maroko from the main road that links Victoria Island to Ikoyi and other parts of Lagos. Circulation on site is mainly pedestrian and a foot-bridge links up the site to Eko Hotel. The other access is by boat through the dunes on Kuramo waters.

c. AESTHETIC FACTORS

The natural features of the site that is the trees, the gentle slope, the openess to the sea front, the sand dunes, Kuramo waters, the coconut palms all present an excellent scenery suitable for the aquarium project. The views of the site from the south western side given a good visual movement from one side of the site to the other and views from the site to other areas are also excellent as can be seen from the photographs below. There is sufficient space for the project and the space sequence is such that adequate use can be made of the area directly in contact with the water front since the tidal height is low, a maximum of two metres.

Having analysed the site as above, I reached the following conclusions:

- Orientation of buildings should be north-south.
- Trees should be protected to serve as sun and wind break, buffer zones and screens.
- Access to site can be vehicular, pedestrian as well as boat.













- Adequate flow within site to give viewers the benefit of the excellent scenery of the sand dunes and the ocean waves.

These plus other detail investigations have been integrated into the concept for the whole design. The next chapter deals on all these factors.

CONCEPTUAL ANALYSIS .

CONCEPTUAL ANALYSIS

At the on set of my thesis, the first thing that appealed to me was to try and find a medium by which all aspects of the design will be symbolic of the world of water and expressive of the functions for which they are designed.

With this in mind, I thought of things that exist naturally in water. First is the wave motion. There is a centre of oscillation from where the waves radiate in cyclic patterns. Secondly, an octopus with the main part of the body and eight arms serve as linkages for its various activities. These are shown in fig. IX and X respectively. Combining both ideas gave a flexible arrangemen. of activities radiating from a focal point and yet are linked up for flexibility.

I found it necessary to make the movement spaces architectural and to have spatial continuity and harmony for easy flow of the crowd that may visit the project at any given time - in sun shine or in rain.

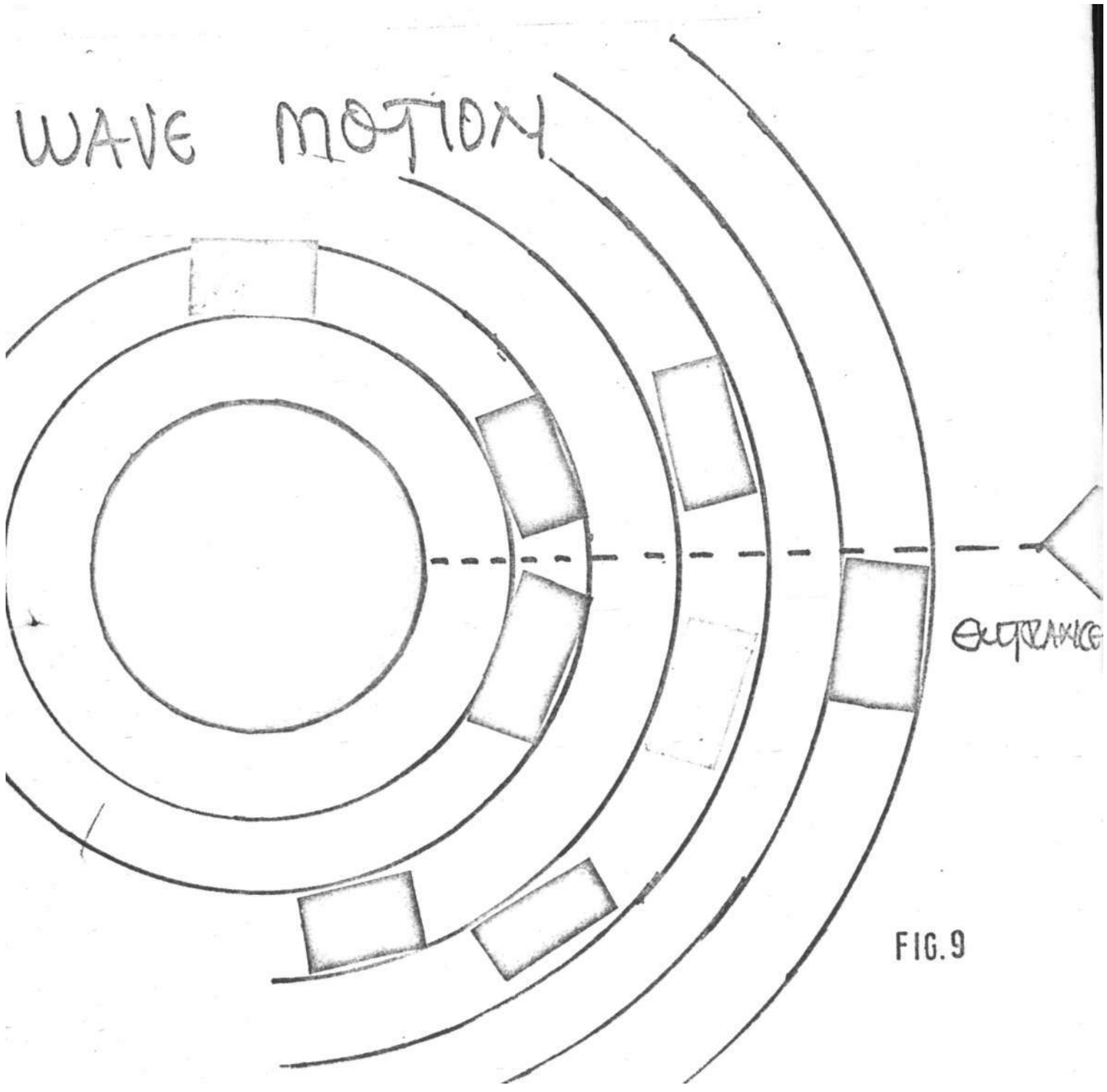


FIG. 9

OCTOPUS SHAPE

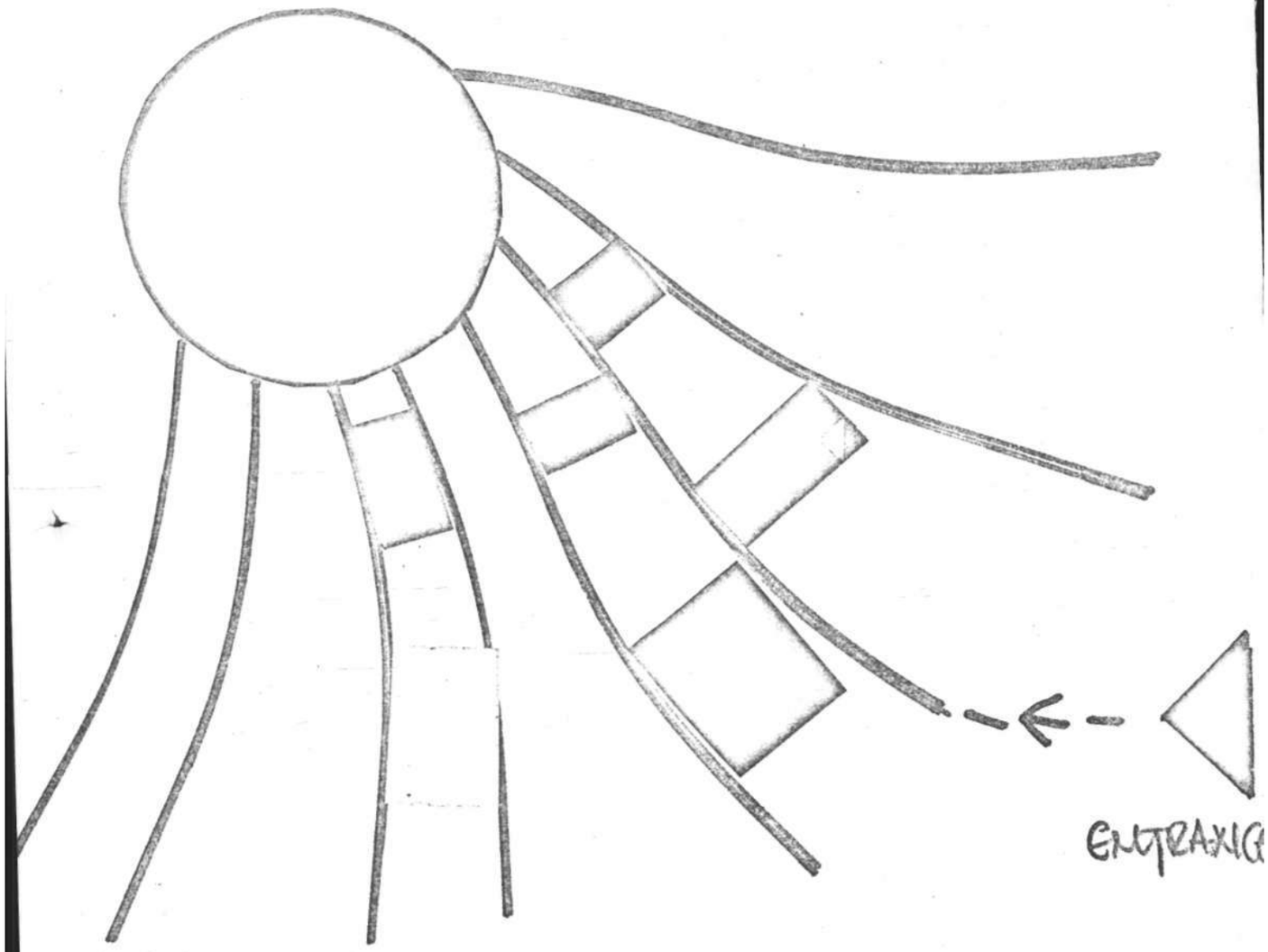


FIG. 10

B. DISPLAY TANKS

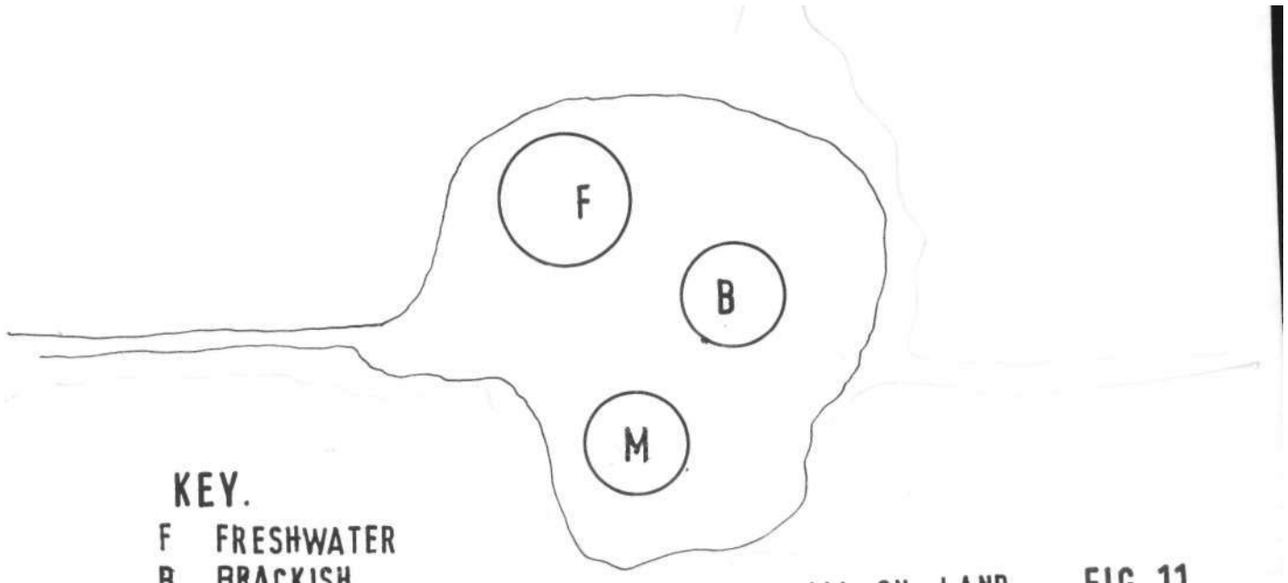
The placement of the three different tanks will also influence the design. This had been considered in terms of cost of maintenance and the ease with which it can be carried out. There are three possibilities as shown in the diagram below fig. XI to fig. XIII.

The first is placing all the tanks on land. The cost of maintenance is high while construction is easy and this means having all the fishes in captivity.

The second is to have some tanks on land and some in water. The cost of maintenance will be lower but construction will be higher though it has the advantage of keeping man in captivity to view the fishes in their natural habitat.

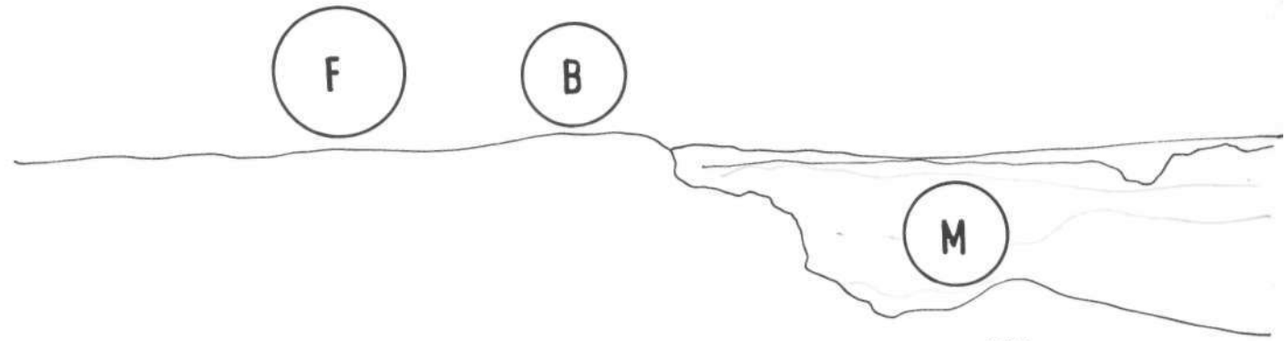
The third possibility is having all the tanks under water. This will present serious problems since the water sources are some distance to the site. To have the tanks underground is absolutely difficult since the water table on site is considerably high.

Monotony is to be avoided in the placement of display tanks since variety serves to orient the visitor.

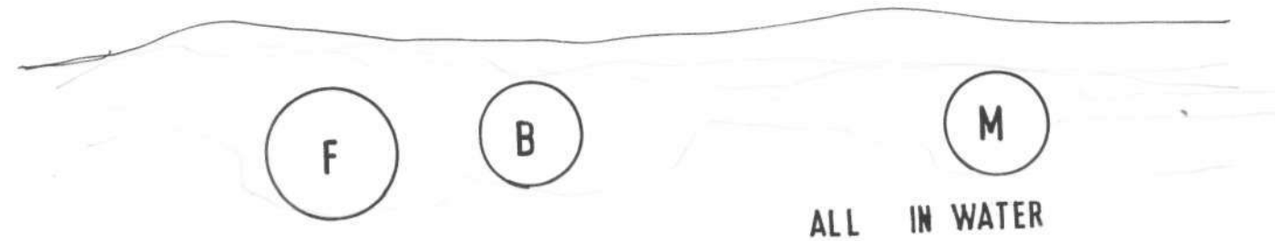


KEY.
F FRESHWATER
B BRACKISH
M MARINE

ALL ON LAND FIG. 11



PARTLY ON LAND
PARTLY IN WATER FIG. 12



ALL IN WATER

FIG. 13

PLACEMENT OF TANKS

Since the main concept of my thesis is that of expression the forms used, the site organisation and landscape, the placement of tanks and their maintenance, the structure of the buildings should all depict the aquatic environment. This can be achieved in different ways and each one influences the other and there are other minute factors to be considered when these objectives are to be met. This is dealt with in the next chapter - the Design Analysis.

DESIGN ANALYSIS.

DESIGN ANALYSIS

The term design has been defined as " to conceive the idea for and prepare a description of a proposed system artifacts or aggregation or artifacts" L. Bruce Archer.

One can only grasp design problems fragmentedly. That is, there are practical limits to the number of notions that can be thought simultaneously when trying to solve complex problems. The best way to overcome this inherent problem is to break a complex situation down into smaller parts, dealing with these parts seperately and then bringing them together to understand the situation.

When the problems of the physical environment are broken down into concepts like services, spatial requirements, landscape, structure and so on the ideas about how these needs or properties are best dealt with are formed and the particular way in which they function together should be thought of early in the design process to avoid disjointed solutions of the whole complex problem. It should be seen as one entity.

In this design, the various problems have been broken down into the following sub-headings:

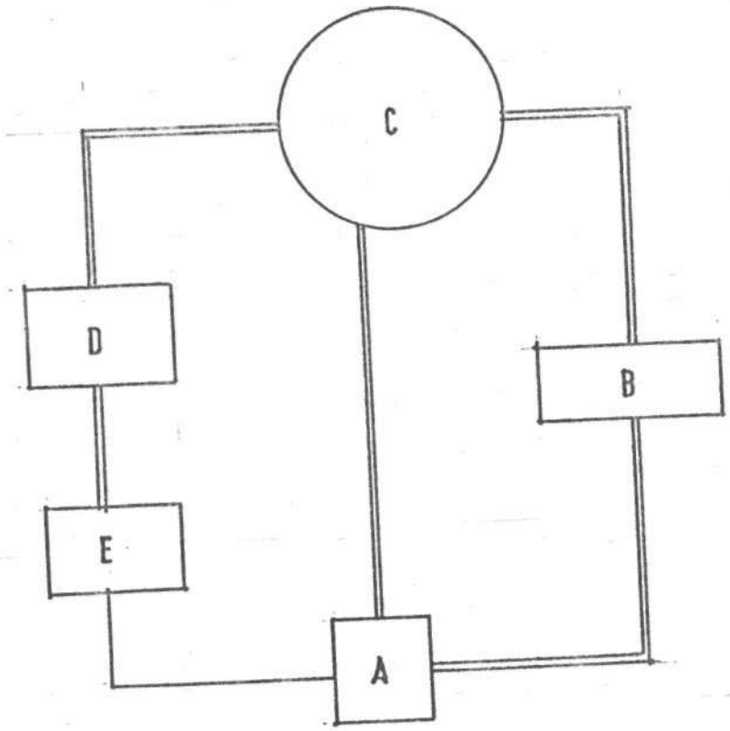
- the site including the spatial requirements, Functional relationship and other factors that affect the site organisation. Landscape.
- the architectural form.
- the structure including materials and all other details.
- services.

1. SITE ORGANISATION

In order to provide the best position for each activity on the site , an analysis of factors that affect each function was carried out such as good views from and onto site nearness to access and so on. The main functions can be divided into five: Reception, Administration, Exhibition, Services and Recreation. This can be further grouped into three as shown below due to the functions.

Reception	A
Administration	
Exhibition	B
Services	
Recreation	C

The functional relationship diagram is shown in Fig. 14.



A RECEPTION
B ADMINISTRATION
C EXHIBITION
D SERVICES
E RECREATION

FUNCTIOAL RELATIONSHIP

FIG. 14

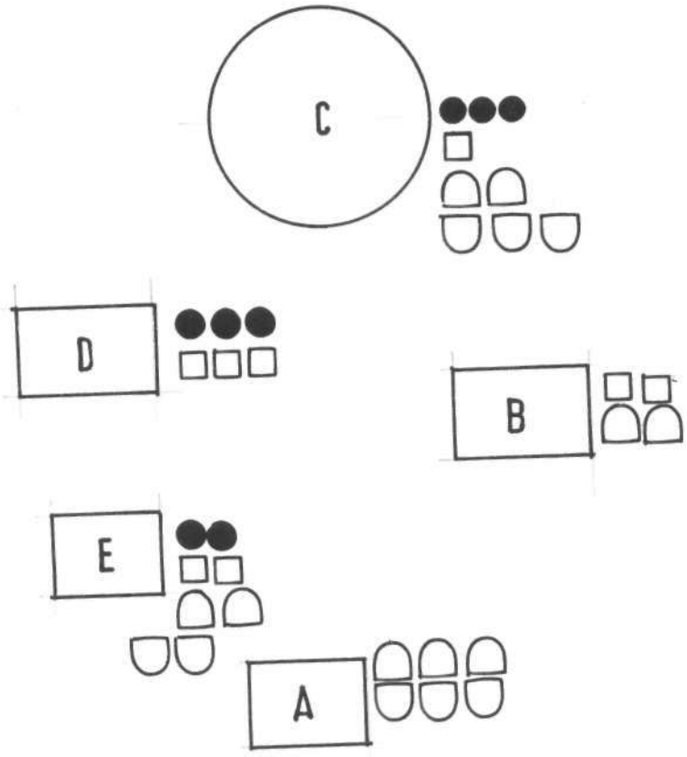
The most vital factor is the water supply in the arrangement of the site. Other factors are good views, points of access, these help to relate the good points on site to the various sections of the complex. This has been analysed as shown in Fig. 15.

The circulation within the site has been structured to follow the format outlined in the conceptual analysis. Circulation within the site is completely pedestrian and the vehicular accesses are on the periphery of the site. Most people will come to the site on foot since it is only five minutes walk from the main bus stop and three minutes from Eko hotel on the foot bridge. The other means is by boat for motorists who may park at the bar beach.

The vegetation is mainly Coconut palms scattered all over the site given adequate protection. This has to be reorganised to provide the protection in the places of need and also from an aesthetic view point.

Climatic conditions on site favour a North-South orientation of buildings with their openings in this direction for proper cross ventilation and avoidance of the heat of the sun.

The landscape should entail various forms symbolic of water and also other exhibits like ware forms, boat shapes, fishes made from dry materials such as tiles, shells and so on.



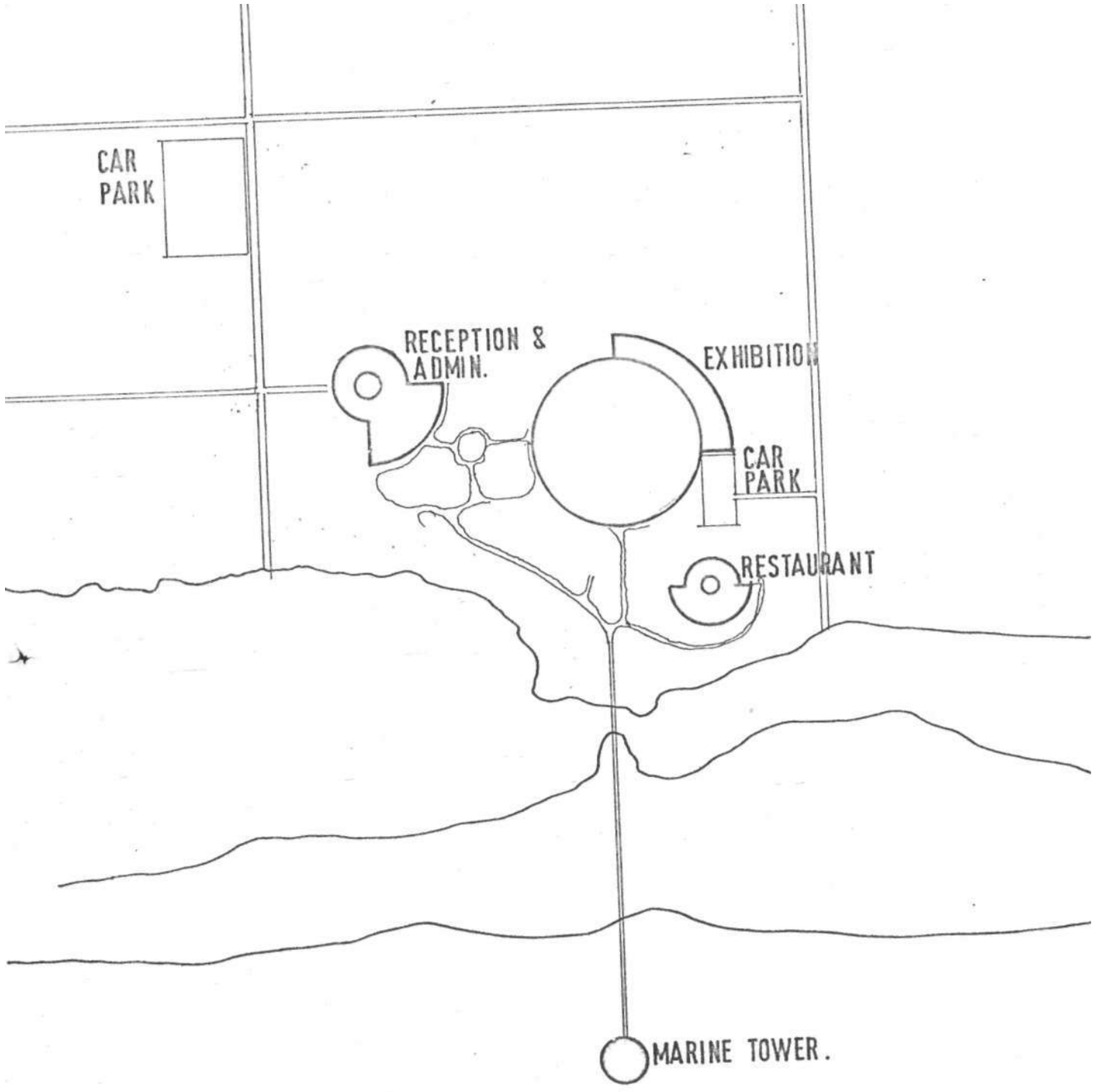
● CLOSSNESS TO WATER
□ CLOSSNESS TO ACCESS
GOOD VIEW OFF SITE
GOOD VIEW FROM SITE

○ DESIRED
○○ NECESSARY
○○○ ESSENTIAL

RELATIONSHIP OF ACTIVITIES TO SITE. FIG. 15.

The site slopes gently to the western side, open gullies can be made for rain water to drain into Kuramo creek. This prosents no pollution problem since the Kuramo waters only flow in one direction all other wastes are taken care of by use of a Central Sewage System.

The outlined objectives for the site organisation evolved a schematic site plan as shown in Fig. 16.



SITE PLAN

FIG. 16 (schematic)

THE ARCHITECTURAL FORM

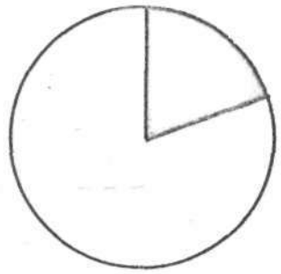
From the concept of the wave pattern, the form that comes to mind is the circle and this is most adequate with the thought of constructing under water. A circular structure distributes the forces equally around its circumference and no problems are created at the joints since they do not exist.

The different functions were thought of as either a part of a circle or a complete one. Use was made of segments of a circle, sectors, semi-circle and whole as shown in Fig. 17

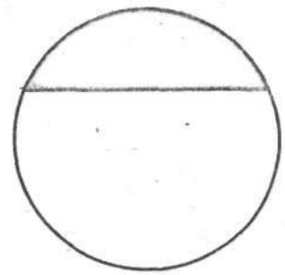
The use of the circular form expresses the characteristics of the project and its aesthetic values serve as attraction to visitors.

THE STRUCTURE

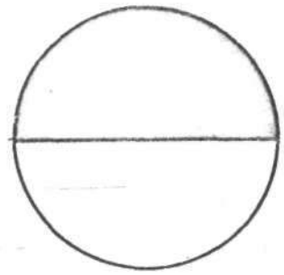
The structure of the building though expressive in nature were made simple to contrast with the detailed landscape of the site. This is necessary to avoid monotony or worse still chaos. Reinforced concrete has been used throughout since site is very humid and the load to be carried is heavy for example, the water tanks. There is still the need to coat concrete by painting to avoid blistering.



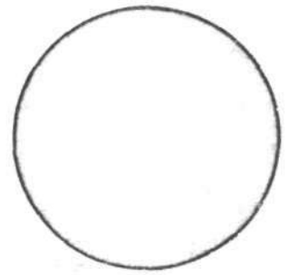
SECTOR



SEGIMENT



SEMI CIRCLE



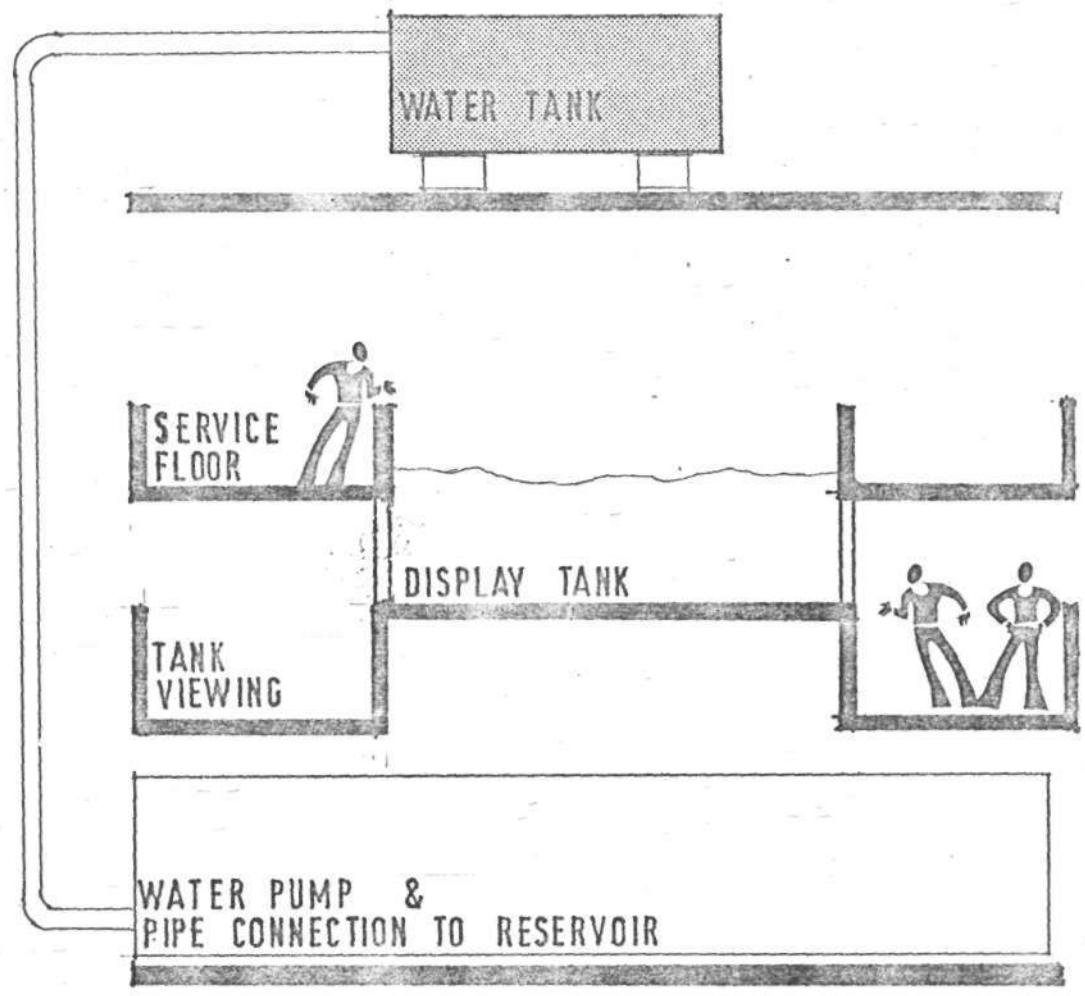
FULL CIRCLE

CIRCULAR FORMS FIG. 17.

SERVICES

The design should consider problems of water supply, drainage, cleaning and viewing for the successful management of the aquarium. Maintainance should be given its priority because the success of the project depends entirely on this fact alone.

Water supply must be constant and kept clean for proper viewing and survival of the specimens in it. It should also contain plants, rocks and other organism that exist in their natural state hence it is essential to take water directly from the type of water the fishes live in for instance sea water for marine specimens. Fig. 18 shows in detail a proposed scheme for water supply, cleaning, feeding and aeration of tanks. This is a simple method for easy maintainance and cut on costs of heavy equipment that may be necessary in a complicated system. It is the biological system.



SIMPLE AQUARIUM SERVICES. FIG. 18

SPATIAL REQUIREMENTS

A. OPERATIONS AREA

An adequate work space should exist behind the display tanks and the quarantine tanks. This will allow easy movement of new specimen, tanks, equipment and bulky materials by hand truck. The operations floor should be above the viewing area floor. The placement or arrangement of tanks should be such that work can be carried out comfortably behind the scenes.

Direct sunlight should be excluded from the operations and viewing areas. Sunlight accelerates algae growth increasing maintenance.

A food preparation area with all necessary equipment must be considered. Storage for materials, decorations and small equipment is necessary. A disease and water quality laboratory including quarantine tanks should be included in the research section.

A moderate shop is necessary for minor repairs on equipment, tools, plumbing and display fabrication.

The equipment room for standby generators and air blowers should be adjacent to the operations area and properly sound proofed to relieve staff of noise.

B. PUBLIC AREA

Tank design and placement with consideration for a smooth natural flow pattern is essential. The arrangement should offer variety in size, type and placement contributing to an aesthetic authentic display.

The exhibits must be pleasing and artistic to be effective and natural working material should be used throughout. For example, natural local rock formations, gravel, driftwood in accordance with the general ecological niche associated with the display animals.

An intercom or some form of oral communication between the viewing and operations area would help simplify the tank maintainance and placement of display materials in the tank.

The crowd should be kept from direct contact with the display tank to avoid soiling or marking of walls and glass and to provide viewing for a greater number of visitors.

These guidelines helped to find out just how much area was required for each of the activities to be performed. They have been grouped into three main buildings :

A. RECEPTION AND ADMINISTRATION

(i) Information and Orientation Cashier

(ii) Theatre for lectures, slides etc.

(iii) Sovenir Shop

(iv) Administration.

B. EXHIBITION

(i) Display tanks.

(ii) Service Core

(iii) Laboratory

(iv) Quarantive tanks

(v) Pumps and Engine room.

(vi) Maintainance Workshop.

C. RESTAURANT

For 100 people at the peak hours.

Other recreational activities like swimming and boating take place in the surrounding creek. It is shallow, clean and safe.

Parking facilities are provided for both staff and visitors. The maximum number of visitors provided for is 500 (Five hundred).

The design has been done to satisfy the different requirements listed above in this chapter. A requirement is a situation that must be present otherwise an observable human or social need would go unsatisfied. Design formulations have been proposed and are better explain design drawings.

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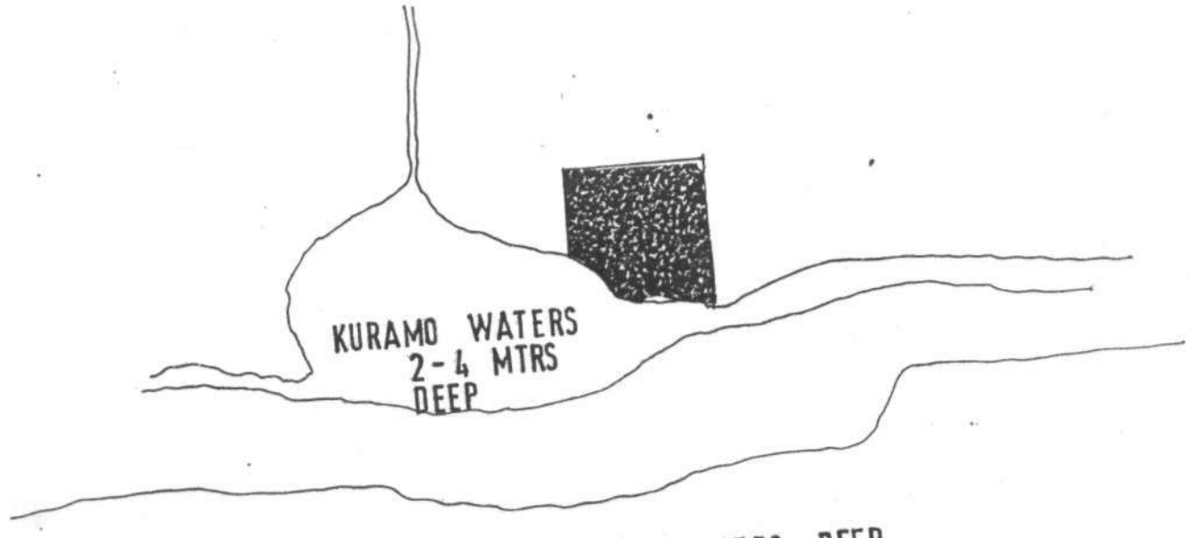
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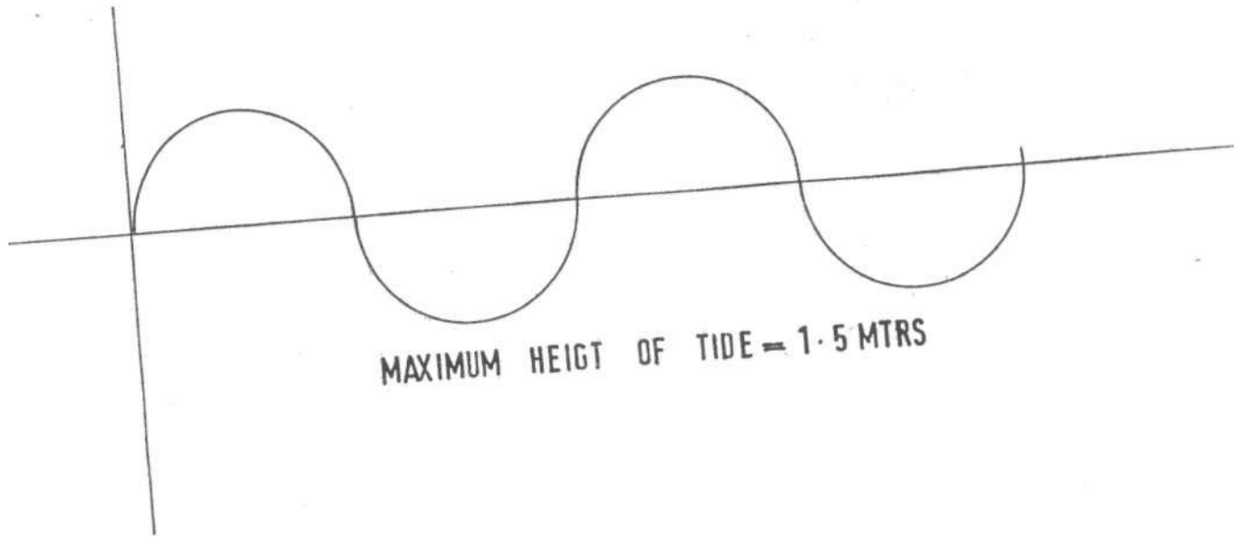
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APPENDIX .

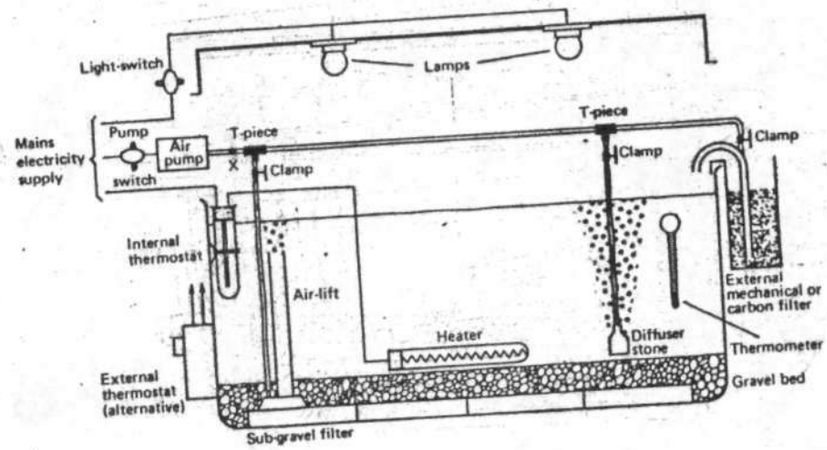




TIDAL VARIATIONS

COMMONLY AVAILABLE WATERS AND THEIR CHARACTERISTICS.

Type	*Characteristics*	*Disadvantages & Methods of use*
Tap water	Hardness and acidity vary with geographical area of supply. Clean and well oxygenated.	Too 'new' for immediate use as it contains dissolved chlorine. Dilute with mature water or allow a maturing period. May carry copper from pipework.
Rain water	Soft and neutral. Basically clean. Well oxygenated.	May be polluted by chemicals from the air or from collecting surfaces. No maturing period needed.
Natural Fresh water	Hardness and acidity vary with geographical area. Contains various organisms and microscopic life.	May be polluted by fertilizers or other chemicals or by organic refuse. May contain parasites and disease organisms. Usually dirty.
Natural Sea water	Stable characteristics which do not vary much geographically. Contains various organisms and microscopic life. Usually well oxygenated.	Usually polluted when collected around coastline. Microscopic life dies quickly in small containers and can foul water. May contain disease organisms.
Artificial Salt water	Stable characteristics in right proportions when correctly made up. Clean and pure when made up with good tap water.	Must be properly mixed and will need maturing period. Expensive in quantity. Some trace elements may be missing.
Distilled water	Clean and pure. Soft and neutral.	Too pure for biological life when new — used to mix with other waters as neutraliser.



The equipment used in a typical tropical aquarium