OCEANARIUM-AN UNDERWATER UNIVERSE, MUMBAI

THESIS SUBMITTED TO THE DEPARTMENT OF ARCHITECTURE BBDNITM, LUCKNOW IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF

BACHELOR OF ARCHITECTURE

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CERTIFICATE

I hereby recommend that the thesis entitled ,**OCEANARIUM –AN UNDERWATER UNIVERSE ,MUMBAI** under the supervision, is the bonafide work of the student and can be accepted as partial fulfillment of the requirement for the degree of Bachelor's degree in architecture, School of Architecture and Planning, BBDU, Lucknow.

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ACKNOWLEDGEMENT-

First and foremost gratitude towards the almighty "**GOD**" for his blessings.

I am thankful to **Proff. Keshav Kumar, Ar. Arvind Singh** and all my faculty members who have been extremely co-operative since the very beginning and who helped me to utilize my skills and creativity to the utmost.

Sincere thanks to **Ar. Sailesh Kumar and Ar. Urvashi Dixit (**Co-ordinator), who left no stone unturned to shape our thesis in the best possible way and also for his untimely help whenever required.

I express my deepest gratitude to my thesis guide **Ar. Sangeeta Sharma and Ar. Naveen Singh**, for his valuable dispassionate guidance, critical discussions, suggestions and continuous support all through my B.Arch thesis.

Special thanks to my seniors **Ar. Nagendra Tripathi, Ar prabhakar Mishra,Ar. Tabhish,Ar. Ankur Verma, Ar Mayur Srivastava, Ar. Saurabh Yadav, Ar. Pallav Pratiyoge.**for their guidance and support regarding the studies for this project as well as the whole 5 years of study.

I am grateful to **Er. Subeth Kumar Das**(Geotechnician in Coastal Department)**Er. Nikhil Kumar**(Civil Engineer in Coastal Department) for their guidance regarding the case study and helped me in the initial stage of this thesis project.

I would like to thank all my friends **Kaushlendra**, **Swadha, Saket, Rahul** and **Anshuman** specially for their support during my thesis as well as the whole 5 year of study. Each one of them has contributed towards making me a better person and the time I spent with all of them will always be cherished.

Thanks to my junior **Ankit Maurya** for his help in the case study and thesis.

At last but not the least, I have no words to express my gratitude for the love and affection of my parents and my elder brother who gave me support at every step of my life. So, this thesis is dedicated to them.

Divyanshi Sahu

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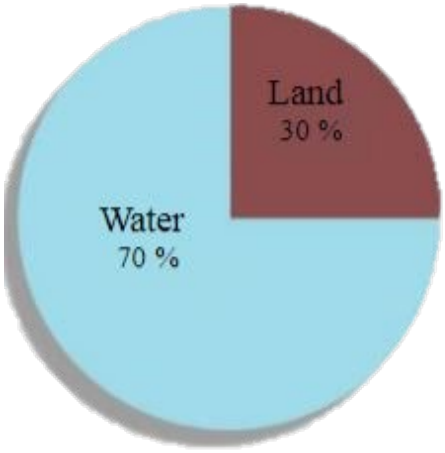
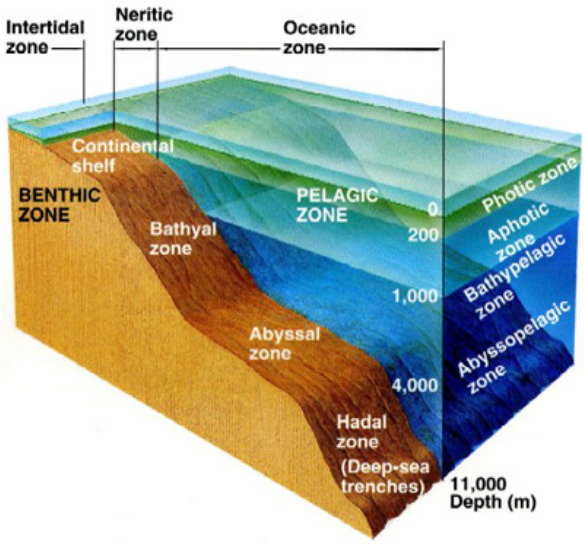
OCEAN-AN UNDERWATER UNIVERSE



An Introduction It is a belief that life on earth, began from the oceans. The Oceans are known to have covered the entire space. It took centuries of evolution, to lead to formation of land. Moreover water now covers 2/3 of earth surface and it is to this, that our planet owes its unique position in the solar system. For the one thing that distinguishes our planet, is the EXISTENCE OF LIFE on it. The first sign of existence Of life, is said to have been in an aquatic environmental, the form of unicellular microorganisms and lead to the evolution of the most complex organism – MAN. Oceans are thus the Origin of Life on Earth

OCEAN AS BIOLOGICAL ENVIROMENT

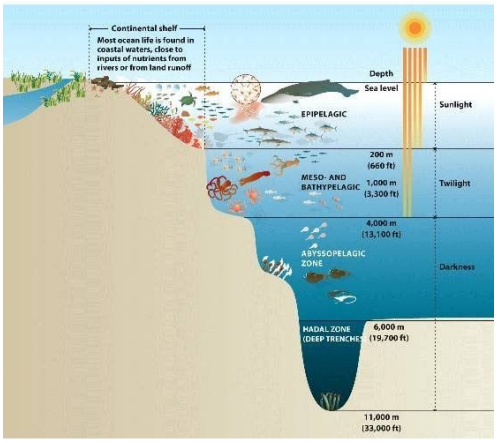


It is rich in all the three kingdoms of nature – minerals, vegetable and animal the last being well represented by groups of zoophytes, classes of mollusks, fish. Fish, is that infinite order of animals, which include more than 13000 species, only 1/10 of which life in fresh water. Sea is a vast reservoir of nature, therein lies supreme tranquility. Life so to speak began in the sea and who knows might end in the sea

CONSERVATION OF NATURAL MARINE HERITAGE:

Aquariums:- The word Aquarium has a Latin base. The aquarium is artificially constructed and seems to have been invented by Gosse, who needed a term to describe a vessel in which aquatic organisms could be kept alive for observation. A traditionally public aquarium consists essentially of a building containing of a number of separate tanks in which aquatic plants and animals are made available to the public for observation at close quarters.

Sea-Life Park or Marine Life Park:- The Marine-Life Park consists of a natural aquatic ecosystem conserved in its natural from with no artificial elements. The aesthetic and scientific aspects of marine life will become easily noticeable. There are certain pockets, which show the presence of luxuriant growth and unique flora and fauna. These constitute an important part of natural heritage and provide Opportunities for recreate on, education and research. A Marine-Life Park needs unpolluted area with clear and calm water with a transparency of 7 ft. Aquatic flora and fauna have to be observed in their natural form. A Marine-Life Park is equivalent to a wild life sanctuary.



Oceanarium:- An Oceanarium is an Aquarium on a bigger scale. It is more often more spectacular and dynamic and does not provide the same facilities for intimate study. An Oceanarium consists of large giant tanks with different species of huge fishes, which are more spectacular. It may consist of whale pools and dolphinarium for entertainment purpose. Touch tanks may be provided for special study purpose where the students or learners would like to touch the fishes and study more about them. Considering all these factors, a good combination of an Aquarium and an Oceanarium would be the best to suite the purpose of conservation and study, harmoniously.

FISHES AND THEIR BEHAVIOUR

FRESH WATER FISH GROUPS

Fishes can be divided into certain groups, each one made up of various genera that are useful categories for the aquarists. These include body shape, fins, mouth and teeth, coloration, plus other specialized traits. Based on these features, the majority of the fresh water fishes can be divided into seven broad types.

- LOACHES
- CATFISH
- CARACINS
- BARBS AND RESOBARS
- LIVE BEARING AND EGG LAYING TOOTH CARP
- SCICHILIDS
- LABYRINTH FISH

FRESH WATER FISH GROUPS

MARINE WATER FISH GROUPS

- SURGEON AND TANGS
- CARDINAL FISH
- WRASSE AND
- RAINBOW FISH
- TRIGGERFISH
- BLENNIES
- MANDARIN FISH
- ANEMONE FISH AND
- DAMSELFISH

MOVEMENT OF FISH IN WATER

Their shape is important for swimming purpose but their internal structure is even more important. It is this that limits them to a particular movement. Two important observation can be made the main part of the movement is not carried out by their fins but by the later part of the body. The movement is a result of a series of rhythmic flexures of the body.

FISH AND SOUND

From an acoustic point of view, water has outstanding characteristics such as a better diffusion of sounds and noise than in air. Fishes are able to utilize this property of water to catch he vibrations emitted by the other fishes and to distinguish predators from harmless fishes. A jack listening to a noise made by a shoal of small fishes. Feeding normally will become very agitated and swim towards the noise.

MARINE WATER FISH GROUPS

THE IMPORTANCE OF COLOR

This is usually more obvious in pelagic fishes, which living rather in pelagic surroundings have a concealing system that uses the effect of light that falls on the bodied of the fish from above. If the light distribution were normal, the back would be light and the belly in the dark shadow dark. In which case the fish would be visible even an in way off

MAINTAINACE OF WATER QUALITY FOR HEALTHY FISH

TEMPERATURE

Tropical fishes required water temperatures range from 75 to 850F
Cold water species require temperature range below 50*F, to maintain system require chiller or heater.
Extremes in temperature should be avoided (rate change greater than 2c increase or 1c decrease in 24 hour could affect health of fish.
Fish exposed to temperatures slightly out of their optimum

temperature range may suffer from disease.

WATER HARDNESS

Concentration of ion in water predominated by calcium and magnesium
Expressed in terms of calcium carbonate (CaCO3)

CHLORINE

Chlorine used in municipal water supplies(0.2-0.7 chlorine) to destroy pathogenic organism.
Chlorine value refers to free chlorine and chloramines concentration in in water
Chlorine can be removed by aeration .

PH VALUE

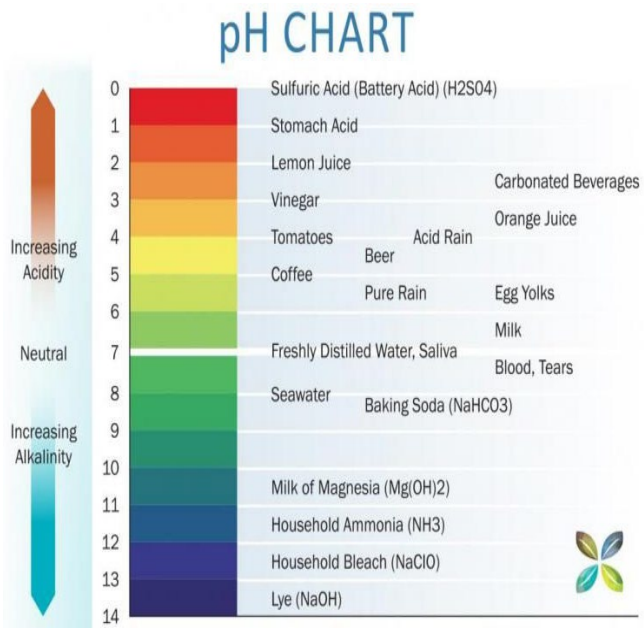
fresh water aq. 6.8-7.8
Marine water aq. 7.8-8.3
An acid pH decreases oxidation of NH3 by bacteria and a pH of 4 and will damage gills.

SALINITY

Normal salinity for sea water is 35 ppt

Water Hardness Scale		
mg/L & ppm as CaCO3	dH	Classification
0 - 75	0 - 4	Soft
75 -150	4 - 8.5	Slightly Hard
150 - 300	8.5 - 17	Hard
300+	17+	Very Hard

AQUATIC ANIMALS	WEIGHT	SPEED	SIZE
KILLER WHALE	Male: 3,600 – 5,400 kg, Female: 1,400 – 2,700 kg	-	Male: 6 – 8 m, Female: 5 – 7 m
WHALE SHARK	19,000 kg	56KM/H	5.5 – 10 m
DOLPHIN	50 KG	60KM/H	1.7-9.5 M
GREAT WHITE SHARK	520-1100 KG	56KM/H	4.5-6.4 M 3.4-4.2 M

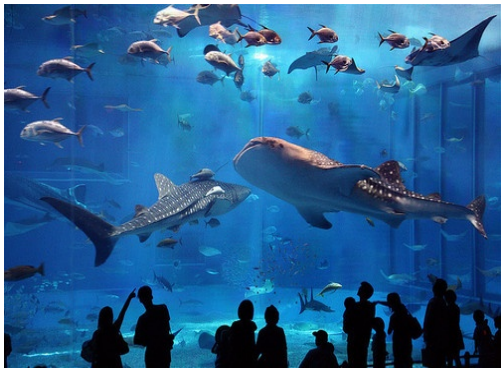


DESIGN OF AQUARIUM TANKS

Aquarium displays are placed according to visitors movement to attract the eye of the visitors and to maintain the flow of the visitors and provide a better circulation . There are variety of aquarium designs present in an oceanarium-

TYPES OF TANKS

OCEAN SHORE TANK



This is a tank that replicates the ocean shore, complete with sand, waves and the shoe animal life. Wave machines are utilized here to produce waves so as to create a natural effect.

GIANT OCEAN TANK

It is generally a free standing cylindrical tank, 50 feet in diameter and around 4 stories high with all window all the way up and down. It has a depth of 25 feet of water. In this 200,000 gallons of salt water live sharks, sea turtles, stingray, moray eels and other marine animals. The giant ocean tank is a large basket of glass and concrete. Compression rings to support the outward pressure of 22 feet of water tie down its precast concrete columns together. The glass windows surrounding the tank are 54 inches wide and 74 inches high. At the bottom of the tank where the pressure on each panel approximates to 15 tons, the glass is 3 inches thick and is made up of 4 laminations. Glass fiber piping is used for the piping purpose to meet this enormous pressure of water. The circulation of this tank contains 200,000 gallons of water. The sand is piled up into a slope, then the rocks are buried deep into the slope of the piled up sand, then the rocks hold the bank in its place and prevent it from collapsing.

ACRYLIC TUNNELS

A **shark tunnel** (or **aquarium tunnel** or **acrylic tunnel** or **exhibit tunnel**) is an underwater tunnel that passes through an aquarium, typically with sharks and related aquatic life. They are usually made of thick acrylic glass
Most aquarium tunnels are cylindrical in shape, though tunnels can be made elliptical (to make them wider and still keep the top of the tunnel closer to the visitors), or even square

CORAL REEF TANKS

reef tank is a marine aquarium that prominently displays live corals and other marine invertebrates as well as fish that play a role in maintaining the tropical coral reef environment. A reef aquarium requires appropriately intense lighting, turbulent water movement, and more stable water chemistry than fish-only marine aquaria, and careful consideration is given to which reef animals are appropriate and compatible with each other.

SHAPE OF TANKS

RECTANGULAR BLOCK TANKS:

These types of tanks are suitable for small fishes or invertebrates living in shoals and measuring 0.3-0.8 m in length the size of the tank depends on the number of exhibits to be displayed in it, usually for proper maintenance, tank capacity is restricted to 1500 to 2000 gallons (6750 to 9000litres).

SLOPING SIDEWALL TANKS

In these tanks the side walls are titled to an angle the maximum being 45 degrees so as to avoid the fishes from going out of vision of the viewers.

ROUNDED TANKS

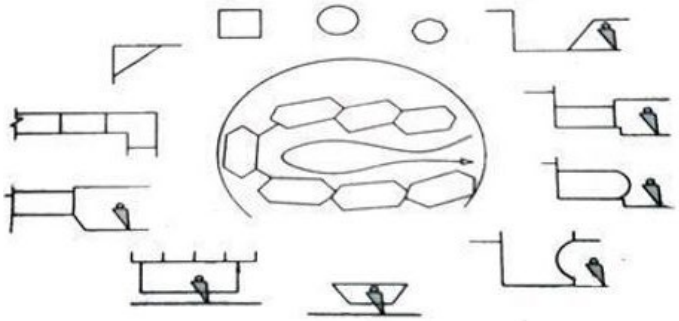
In this case the sides are rounded to prevent the aquarium from looking like concrete tanks with rigid form. They often help to break the monotony. These are helpful especially for the sharks that are incapable of sharp and abrupt turns.

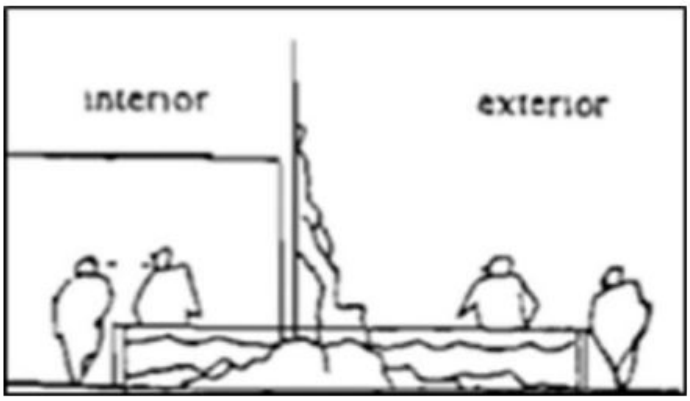
CROSSECTION THROUGH TANKS

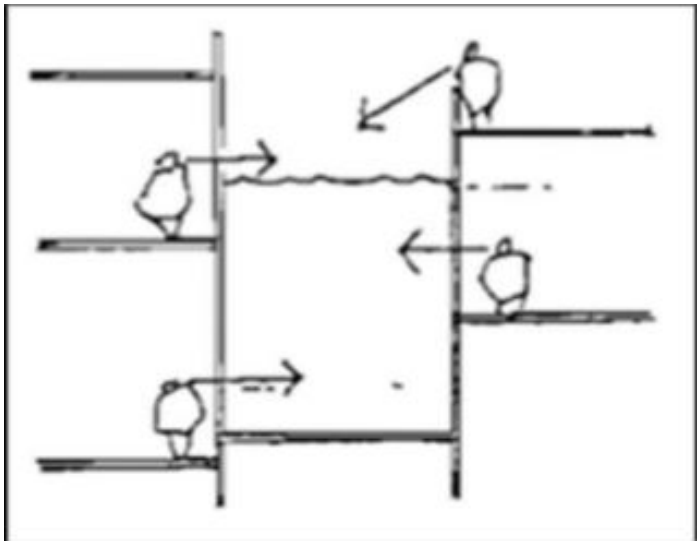
Inclined surface: The surface of the water in the aquarium acts as a mirror, giving an impression that the depth of the water is greater than what is actually in reality.

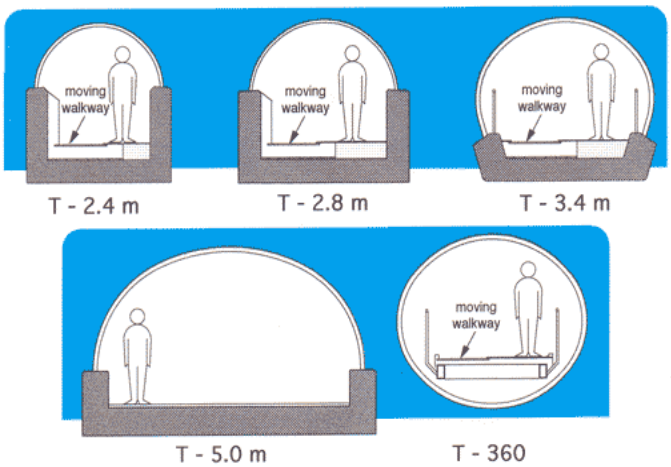
Convex Viewing Surface: The convex glass enlarges the view of the exhibits inside the tanks and thus facilitates better viewing.

Concave Viewing Surface: Concave glass diminishes the size of the exhibits, in the tank, giving the impression of a wider field of vision









CONSTRUCTION MATERIALS OF TANKS

FIBREGLASS

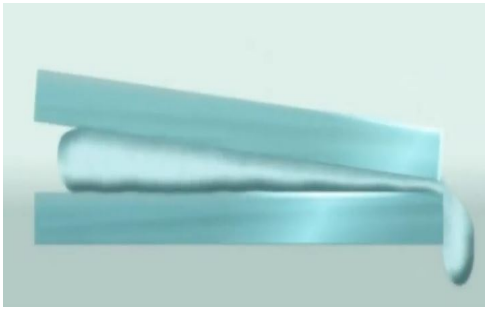
For small tanks containing about 2000 gallons of water Fiberglass or plastic, impregnated plywood seems to be a good choice. Fiber glass is completely inert, light weight and can be readily altered or diluted fiber glass is probably the most practical supporting material for all but the largest tanks since it is lightweight, strong, does not deteriorate and can be easily fabricated into any shape. Adhesives for sealing the tank include epoxy resins, polyvinyl chloride, silicone rubber and neoprene

GLASS

Sheets of polished plate glass up to 61 in length can be used. As a thumb rule _ inches or 6 mm thickness of the glass for 12 inches or 30 cm of depth could be allowed. Therefore water that is 24 inches deep requires _ inches thick glass and 36 inches deep requires _ inches thick glass. For an extra safety margin _ inches should be increased.

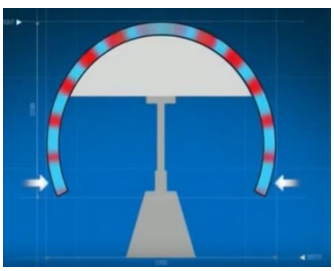
CONSTRUCTION OF ACRYLIC TUNNEL

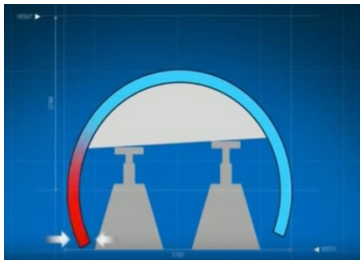
Thickness of Acrylic Panel- 600, 750 mm
the acrylic sheets of thickness 20to60 mm are pasted toghter with elastic glue material
By heating or cooling the acrylic sheets are joint toghter ,the chemical bonding inside create the joint which don't appear on the surface.
Iron rings on acrylic tunnel holds the pressure of water.
1 acrylic tunnel weighs 32 tonne , fragile it can hold water upto 10 million litres of water.

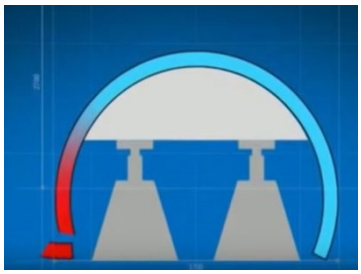


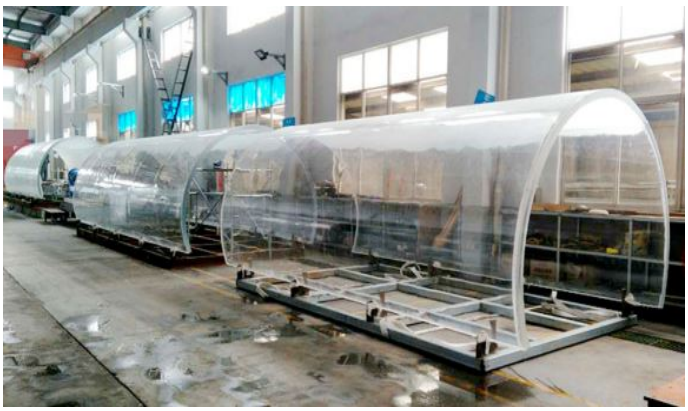
INSTALLATION OF ACRYLIC TUNNEL

- Hoist the tunnel roll it along and place it in position
- Workers built up the support to level the jacks before it take the weight of the tunnel
- Acrylic tunnel is supported on wooden roiling jacks , maintain support to base the tunnel in straight position (no angle)
- After this jacks are brought down and tunnel is placed on position with help of lever and pulley system.









INSTALLATIONS BEHIND THE TUNNEL

WATER SYSTEM

Water system defines the use and circulation of water in oceanarium

There are 3 basic type of system is used for the purpose-

OPEN WATER SYSTEM-Take water from natural body of water and circulate through exhibits and then discarded

Advantages : Waste products from specimen are continually carried away.

Disadvantages :Economics should be considered as water is discarded after one use only, added cost would rise if some water had to be treated or cooled.

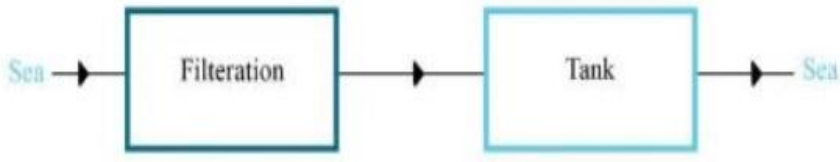
SEMI CLOSED WATER SYSTEM- They are same as closed closed system except that there is a constant water supply and problem of dissolved wastes is controlled by regular addition of new water.

CLOSED WATER SYSTEM-Completely closed system in which water is added only to make up for the loss of evaporation. By equipping a closed water system with good aeration and an efficient biological filter the two most serious problems - ammonia toxicity and the change of the pH levels can be greatly reduced

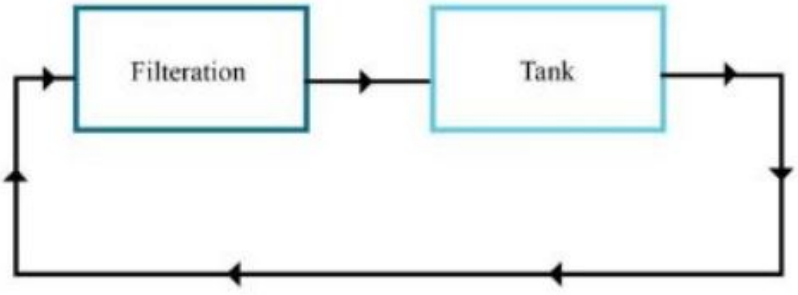
The following parameters have to be adhered to: 500 liters of cultured water are needed by per kg of animals. 0.1 sq. mts filter Bed consisting of 2.5 mm gains to calcareous filter containing some magnesium shall be used.

A flow rate of 80 liters per minute through each sq. m of the filter bed surface shall be maintained. Replacement of 25% of cultured water per month or in some cases 33% every fortnight.

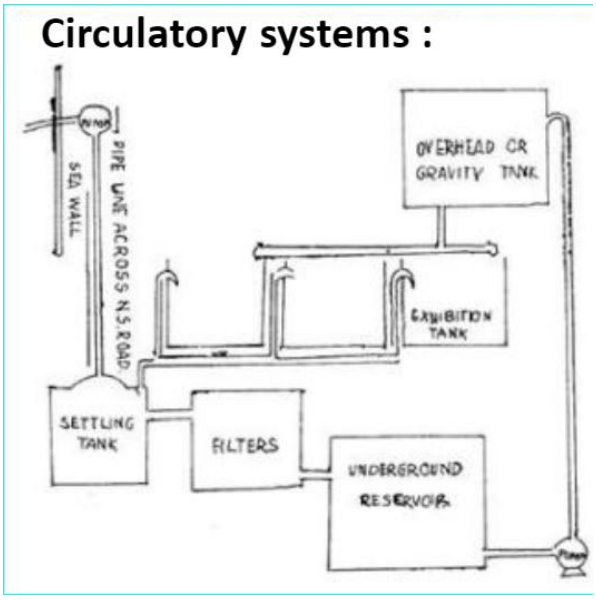
The lamp and the water surface will prevent damage and will cut down excessive losses due to evaporation.



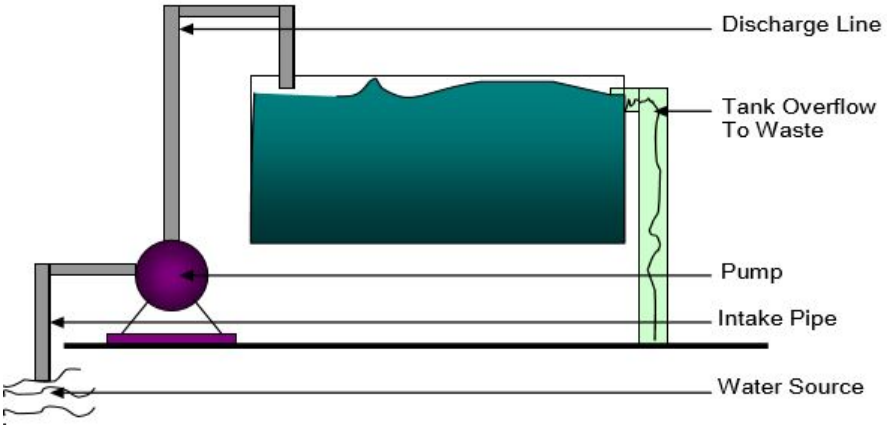
OPEN WATER SYSTEM



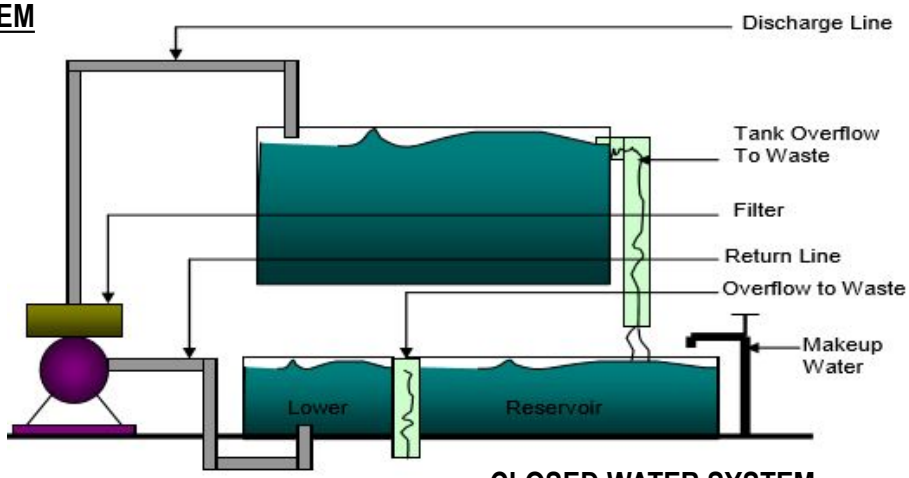
SEMI CLOSED WATER SYSTEM



CLOSED WATER SYSTEM



SEMI CLOSED WATER SYSTEM



CLOSED WATER SYSTEM

AQUARIUM FILTERATION

Aquarium filtration is the important part of the oceanariums to maintain the health of species and hygiene and cleanliness of water.

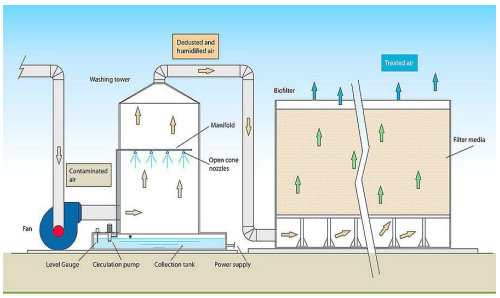
BIOLOGICAL FILTRATION: It is a term used for fostering ammonia - neutralizing bacterial growth. Bacteria decompose ammonia to nitrites and nitrites to nitrates which are less toxic - rich water bio filtration requires only the following surface, on which to attach, ammonia for food and oxygen - rich water.

MECHANICAL FILTRATION: It is the straining of the solid particle from the aquarium water. It does not remove directly the dissolved Ammonia nor does it remove the algae or the solids trapped in the plants and other objects. Wave makers improve the chances of removing the trapped solids through the mechanical filter or vacuum filters can also be used. Mechanical filter use filter media such as sponge paper phlox etc. sponge being the commonest.

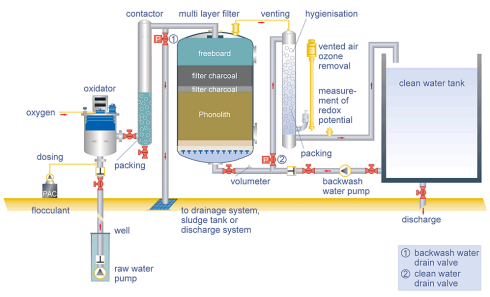
SAND FILTRATION: Sand filtration is a process in which the treatment of the is realized by the porous nature of a sand layer which traps particles present in water. Various other physical/biological processes also take place in a sand filter which further strip the water of different substances (deferristation,demanganisation,ammonium removal).

FOAM FRACTIONATORS: These fractionators are used to remove dissolved organics and pollutants. They utilize Airmaster aqua foil design that injects micro bubbles into a pressurized water flow where its mixes in water column . These foam fractionators are compatible with ozone.

Fresh and salt water compatible ,applications include aquaculture recirculating systems, aquarium/zoological exhibits, mammal exhibits, seafood holding system .



BIOLOGICAL FILTRATION:

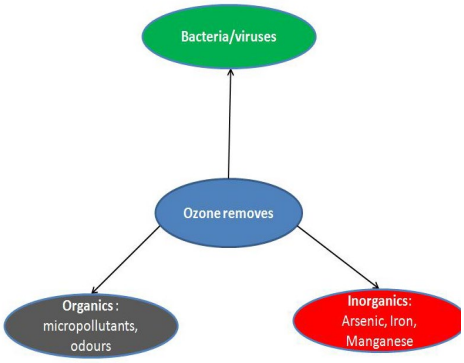


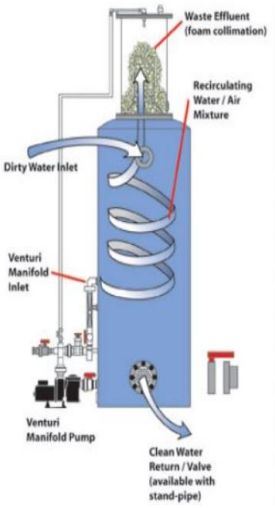
MECHANICAL FILTRATION:

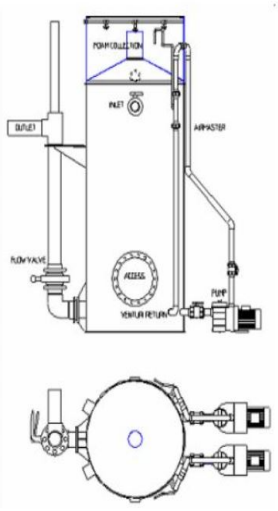
SPONGE FILTERS: These provide an efficient and economical form of biological filtration. Water is forced through the porous foam by means of power heads or by bubbling air-by-air tubes. The flow of water through the foam fosters the growth of bacteria in the foam and biological filtration takes place.

OZONE FILTERATION: Ozone water purification requires something called an ozone generator. The ozone generator produces ozone much in the same way as the sun does in the upper atmosphere. High-intensity ultraviolet lamps inside ozone the generators simulate the ozone producing ultraviolet rays of the sun. When compressed air is passed through the ultraviolet chamber of the ozone generator, some of the oxygen is converted to ozone.

Ozone can also be created through chemical and electrolytic reactions.

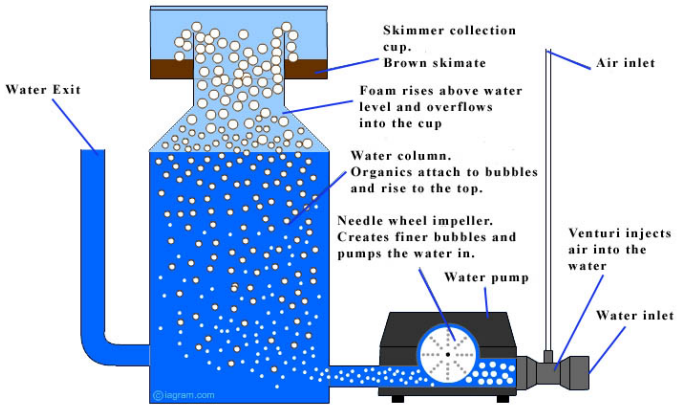






SAND FILTRATION:

FOAM FRACTIONATORS :



PIPING IN AQUARIUMS

All the piping should be of non-corrosive and chemically inert material. Non-wet table pipes with smooth interiors should be used so that the chances of the marine organisms getting a hold and forming colonies are reduced. Piping should be preferably be non-metallic as even lead and stainless steel which are generally considered safe are effected by sea water. Where unavoidable metal pipes may be used as to see cetaceans, seals, penguins, but this may prove clear in the long runners expensive replacements are generally required due to corrosion .The materials that are used for the pipes are-

- Rigid PVC,
- Vulcanite Ebonite
- Fibre glass
- Cement lined galvanized irons pipes for fresh water
- Cement lined steel pipes, Thoroughly cured cement concrete pipes

INLETS: Covers over the opening of feed pipes inside the tanks have to be finely perforated to let water through but preventing specimens from entering the pipe. Sharp turns are acceptable with metallic pipes. Short turns should also be avoided with large diameters as required. All the electric installations, plumbing or airlines should be embedded in the concrete. External piping shall not be embedded in the loose soil

LIGHTING IN AQUARIUM:

LIGHTING constitutes a highly important and a highly sophisticated part of an aquarium. For keeping the aquarium healthy, well balanced and flourishing, it is essential for the aquarists to take proper notice of the lighting in the aquarium. A perfect aquarium should have electric lighting supplementing the natural lighting. In an aquarium it is highly important to provide the correct type and amount of lighting.

NATURAL LIGHTING: This is a correct spectral range for all animals and plants. This encourages algal growth. But this is quite unpredictable and uncontrollable. Excess of sunlight would cause excessive growth of algae, which would suffocate the aquarium.

TUNGSTEN LIGHTING: These are ensuring unsuitable as a form of illumination for any type of modern aquarium. They do not give an optimum light spectrum for good plant growth and are inefficient, converting most of the energy into heat, rather than into a useful light output. They are therefore no longer recommended as they have nothing to offer to the aquarist.

FLUORESCENT LIGHTING: Fluorescent tubes are the most suitable form of aquarium lighting. They give a better spread of light and are relatively cheap to run in cool operation.

ENHANCED RED / BLUE: Output contains the correct spectrum for the plant requirements and is thus good for plant growth. Light output is low, however therefore this type of lighting is generally used in conjunction with full spectrum bulb.

FULL SPECTRUM: This stimulates daylight and is extremely useful where space permits only one bulb.

SPOT LIGHTING: These are ideal for creating dramatic and for emphasizing any surface water movement. They are particularly useful for punching light down the relatively deep tanks.

MERCURY VAPOR LAMP: The point source light produced is bluish white, while giving a sea bed effect will sow fishes off in their best colors in the aquarium. **HIGH PRESSURE MERCURY VAPOR:** High power lighting for tanks deeper than 45 cms. It is less costly than metal halide, it has a fairly broad spectrum, but is lacking in blue / green wavelengths and requires blue supplementary lighting.

LIGHTING IN AQUARIUMS

ANIMAL POOL

SHARK AND THEIR MAINTAINANCE CAPTIVITY

Aquariums often face the problem of exhibiting larger predatory fish, like sharks.In case of Bony fishes and other cartilaginous fishes the maintenance is not as problematic as is encountered in the case of maintaining sharks in captivity. In case of considerable difficulty is often involved in capturing, handling, feeding and providing suitable aquarium especially for large sharks

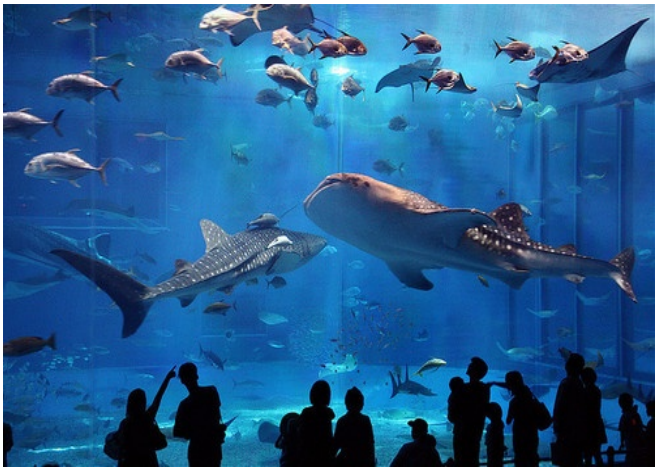
SHARK TANKS: Their relatively primitive gills are less efficient at extracting oxygen from the water than those of the bony fishes extract so it is important that high oxygen concentrations are maintained

To ensure that adequate oxygen is always available addition aeration can be provided to complement oxygenation carried out by the scrubbers. This becomes especially important in the summer months when the water is warmer and is capable of containing less life giving oxygen. Space is also important to sharks in captivity.

Space is a very important factor to maintain sharks in captivity. Unlike the bony fishes they do not possess swim bladders with which to regulate their buoyancy and must keep swimming to avoid sinking to the bottom. In the unconfined waters of the ocean this presents no problem but in captivity adequate space must be available to permit normal swimming. It has been seen that actively swimming sharks require a certain amount of space to achieve the speed necessary for normal swimming

FEEDING THE SHARKS: Unlike the reef community, the predator tank community is not self-sustaining and needs to be fed regularly. Sharks are very messy in captivity. They are voracious eaters and there is a large amount of excretion of the wastes. Hence these predators need to be fed to prevent them from depleting the population of the other fish.

POOL DIMENSIONS: The shark pool or shark channel should be torroidal or circular ended to allow for the large turning radius of the sharks. The minimum width should be 24 feet and the minimum depth should be 7



DOLPHIN POOLS

The pool should be shaped to allow the dolphins to swim easily and safety at a speed, and should provide facility to watch them below the water. Adult dolphins vary in sizes from 2 to 3 meters long and weigh 200 to 300 kg. Dolphins can reach 1 speed of 60 km per hour within a few meters. They surface every half-minute to breath, although they can remain underwater for a period of 6 to 7 minutes.

The oil slicking has to be prevented by rapid surface water draw off, with large main drains to collect the heavy debris, which the dolphins themselves, by activity and agitation, help sweep along the floor. Extra pre-strainers to the filter pumps are particularly important and should be cleaned regularly to reduce the load on large capacity filter beds and total oxidation ids-infection like humans, dolphins suffer.

ZONES OF OCEANARIUM

- ENTERTAINMENT FACILITIES
- EDUCATIONAL FACILITIES
- FUN AND RECREATIONAL
- RESEARCH FACILITIES

ENTERTAINMENT FACILITIES

- AQUARIUM DISPLAYS
- ACRYLIC TUNNELS
- CORAL REEF TANKS
- TOUCH POOLS
- DOLPHIN POOLS

EDUCATIONAL FACILITIES

- AQUA MEUSEUM
- FOSSIL LIBRARY
- SEASHELL DISPLAY
- AUDIO VISUAL TEACING
- INVERTEBRATE SECTION

RESEARCH FACILITIES

- QUARANTINE AREAS
- LABORATERIES

RECREATIONAL FACILITIES

- AQUA SHOPS
- CAFES AND RESTRAUNTS
- SCUBA DIVING
- SUBMARINE RIDE
- MARINE ANIMAL SCANTUARY

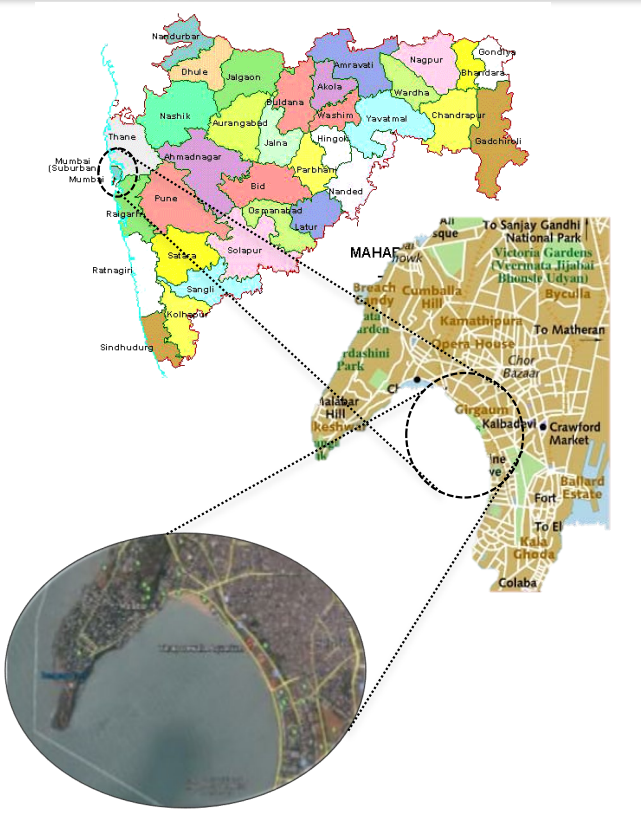
INDEX-

SITE STUDY-

LOCATION OF SITE

The site is located in Arabian sea offshore Marine Drive ,Mumbai.
Site is a 16-hectare rock islet in Arabian sea, located 1.2 km from Raj Bhavan and 3.6 km from Girgaum

Chowpatty .



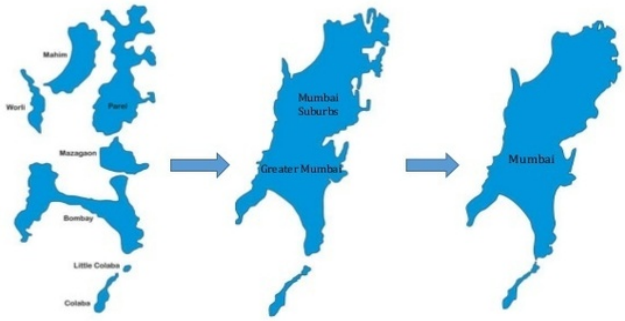
ABOUT MUMBAI

Mumbai is the Centre of the Mumbai Metropolitan Region, the sixth most populous metropolitan area in the world with a population of over 23.64 million
Mumbai is the financial, commercial[and entertainment capital of India. generating 6.16% of India's GDP[and accounting for 25% of industrial output, 70% of maritime trade in India

ARABIAN SEA

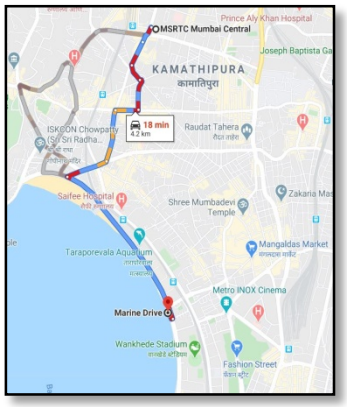
The Arabian Sea is a region of the northern Indian Ocean bounded on the north by Pakistan and Iran, on the west by the Gulf of Aden, Channel and the Arabian Peninsula, on the southeast by the Laccadive Sea, on the southwest by the Somali Sea, and on the east by India. Its total area is 3,862,000 km^2 (1,491,000 sq mi) and its maximum depth is 4,652 meters (15,262 ft)

SEVEN ISLANDS TO MUMBAI CITY



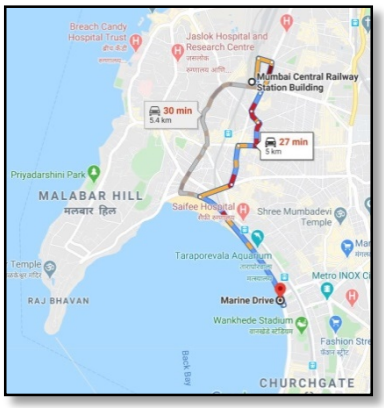
APPROACH TO SITE

CST BUS TERMINAL-4.2km

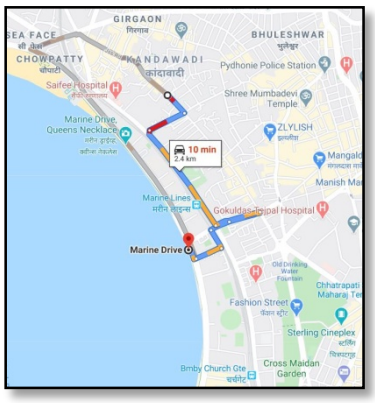


CST AIRPORT-21.2Km

CST RAILWAY STATION-5Km



GIRIGAON METRTO 2.4km



SITE ANALYSIS

The exact location of the site is Arabian sea,in the stretch of Marine Drive to Malabar Hills.

- **Distance of site from various location-**

1. 3.6 km fromchowpatty North side
2. 1.5 km from Raj Bhawan East side
3. 3.5 km from Marine Drive West side
4. 2.68 km from Nariman point

- **Built structure on Chowpatty-**

1. Hotel
2. Bal Krida kendra
3. Mafat swimming and boating club

- **Chowpatty footfall-** 4000-5000 max. (Saturday-Sunday)
- **Other week days-**500.

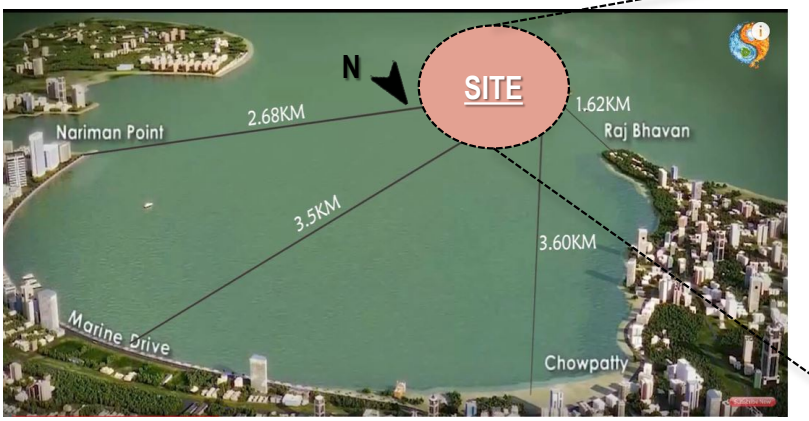
AMMENITIES NEAR SITE

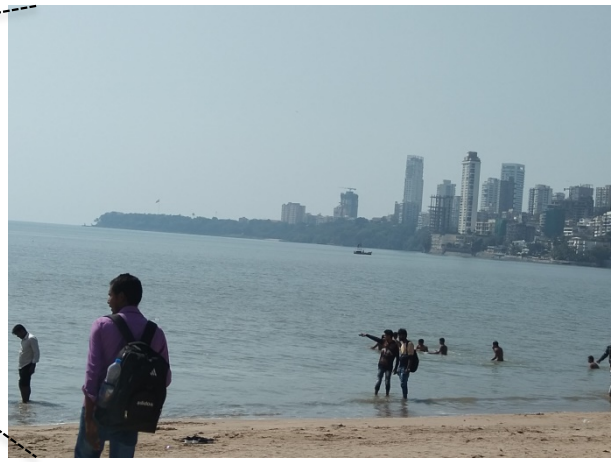
Wilson College1.0 km

Saifee Hospital 1.5 km

Wilson College 650m

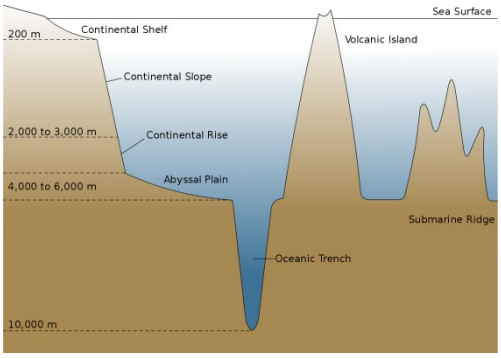
EXISTING SITE

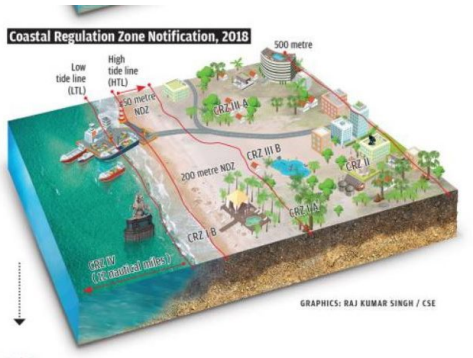




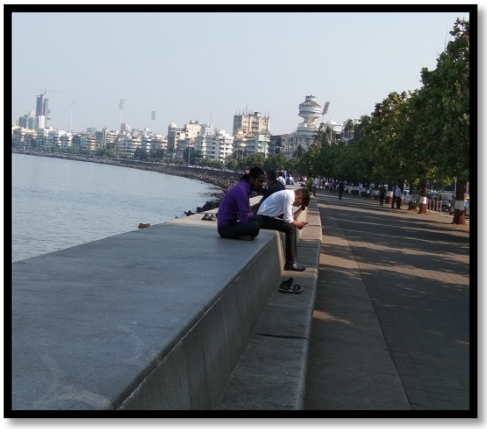
SITE GEOLOGY

- The **site** lies in **coastal regulation zone -4** as per coastal development Mumbai.
- The investigation of the sea bed through Sand Penetration Test, specifies that-
- **Rocks available on site location**- Bruccia and Tough and Carbonious Shale.
- **Strength-** 15-25 Mpa.
- **Bearing capacity of sand**-45-60 N value.(n- no. of blows)
- No presence of abyssal plain ,sand is flat
- **Sea depth** -20 m.



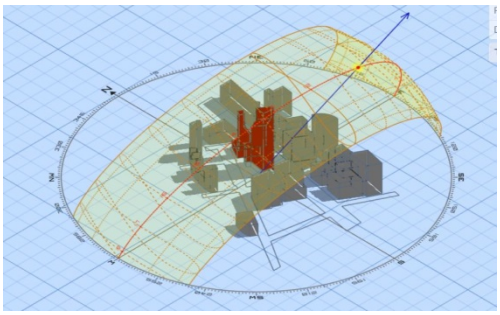


SITE SURROUNDING

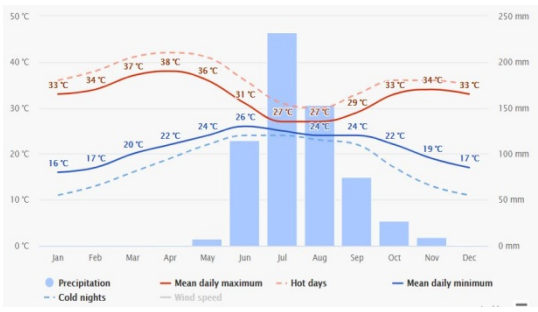


MACROCLIMATE

Monthly precipitations above 150mm are mostly wet,
Average maximum temperature range-30 to 35*C
Seismic zone of Mumbai-zone 3, zone factor of 0.16



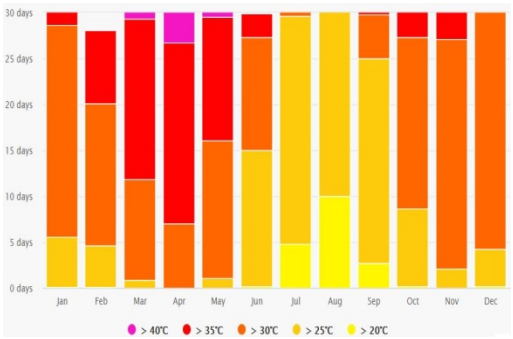
SUN PATH DIGRAM



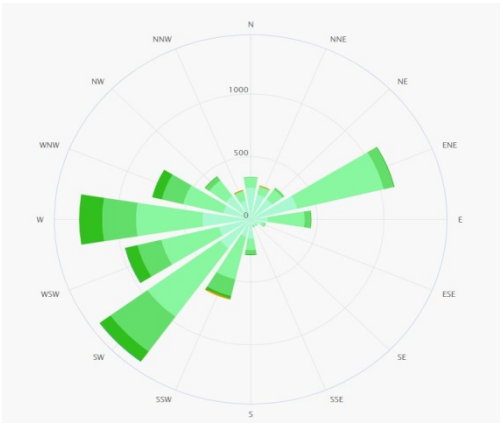
PRECIPITATION (mm)

MICROCLIMATE

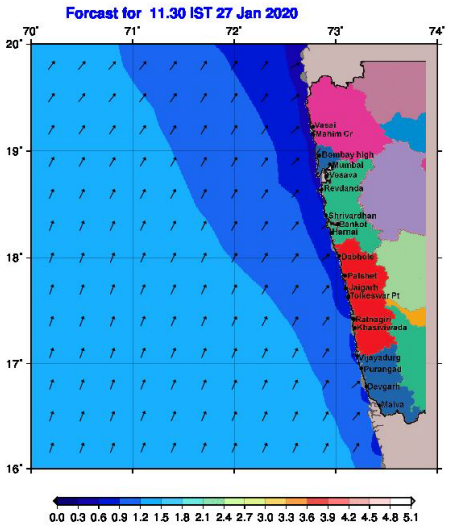
- The **tidal rise** for Mumbai Harbor (Bombay Harbor) is 4.4m at MHWS and 3.3m at MHWN.
- **Tidal currents** within Mumbai Harbor (Bombay Harbor) have velocities that range between 0.75 knot and 3 knots.
- The **velocity of strong spring tides** between Thal Shoal and Prongs Reef (18°53'N., 72°48'E.) is from 2.5 to 3 knots
- **Average wind speed(** max.)-23km/h
- (Min)-6km/h



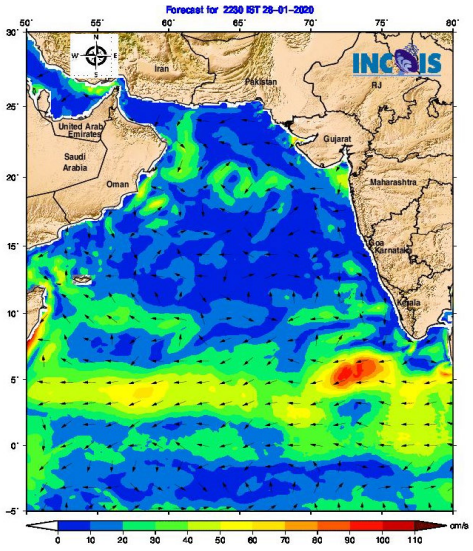
TEMPERATURE(*C)



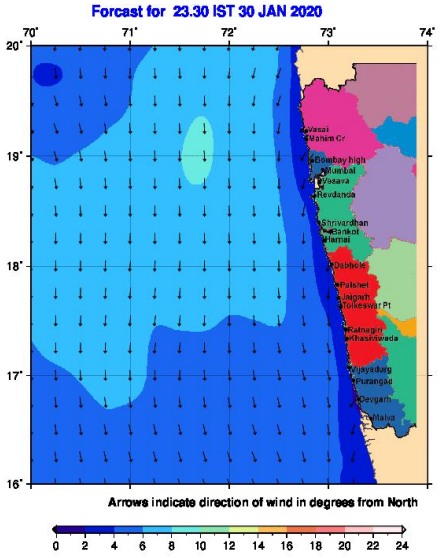
WIND SPEED CHART



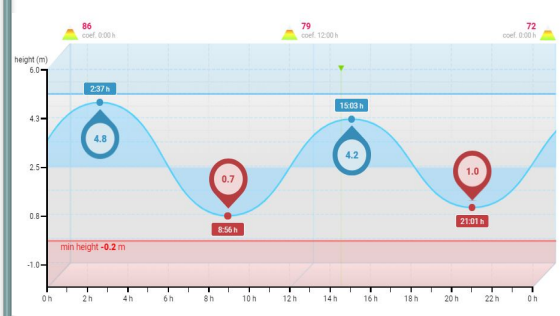
SIGNIFICANT WAVE HEIGHT



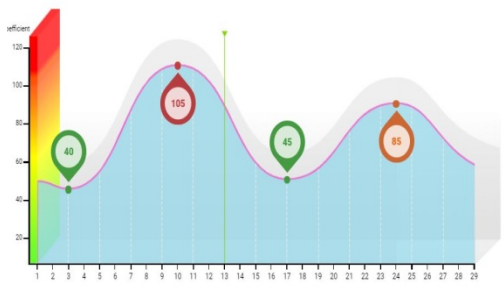
SURFACE CURRENT



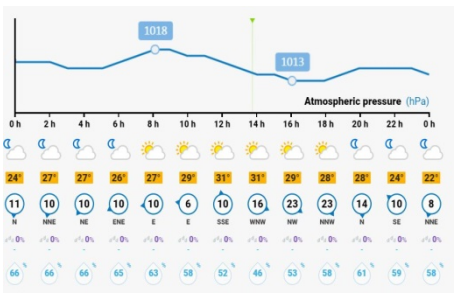
REIGONAL WIND SPEED



HIGH TIDE AND LOW TIDE



TIDAL COFFICIENT



MEAN ATMOSHPHERIC PRESSURE

BYE-LAWS OF CRZ-4

- The building between 200m and 5oom from HTL shall not have more than 2 floors
- The total covered area on all floors shall not be more than 50% of the plot size
- Total height of construction shall not exceed 9 m
- Corals from beaches and coastal waters shall not be used for construction and for other purposes.
- Dredging and underwater blasting in and around coral formations shall not be permitted.
- FSI of 1.33 in the island city.

LAND RACLAIMATION

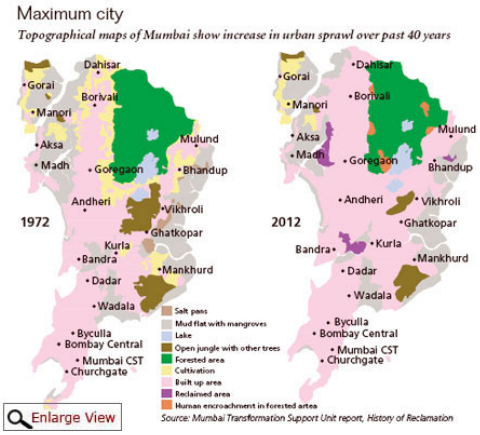
It is the process of creating new land from oceans ,sea, riverbeds etc. The land reclaimed is called landfill.

METHODS –

- filling the area with large amounts of heavy rock then filling with clay and dirt, this process is called infilling.
- Draining of submerged wetlands is often used to reclaim land for agricultural use
- Land Dredging

EXAMPLES –

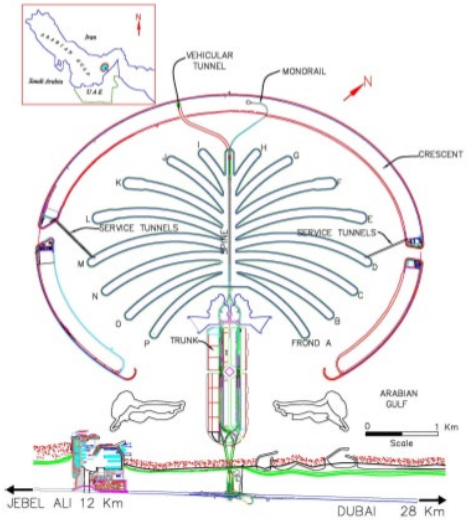
Palm Jumeirahi,Burj- Al –Arab (Dubai), Mumbai urban development



A STUDY OF PALM JUMEIRAH

GENERAL BREIF

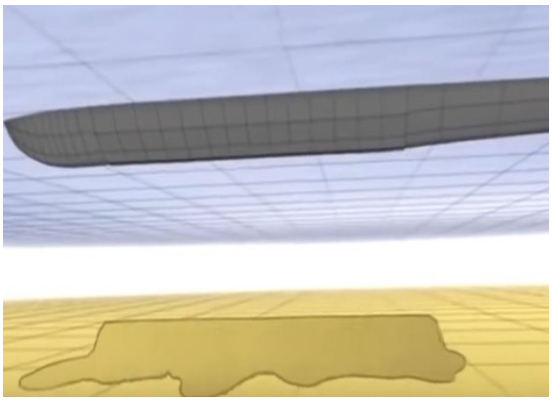
- **ARCHITECT-**HHCP Helman (Hurley Charvat Peacock) architects
- **LOCATION**-Dubai, in the United Arab Emirates ,extended into Persian Gulf.
- **LAND RECLAIMATION COST-** 12 billion
- **AREA-** 5.72 sqkm
- **POPULATION-** 10500 till 2016
- ARABIAN GULF SIZE- 30m deep, 160 km wide
- **METHOD-** Rain bowing, vibro compaction of sand.
- **SAND QUANTITY USED-**5.5 million cubic stuff for break water,
- 94 million cubic m for island
- **ROCKS-** rock brought by blasting the mountains, rock weigh up to 6 tonns.



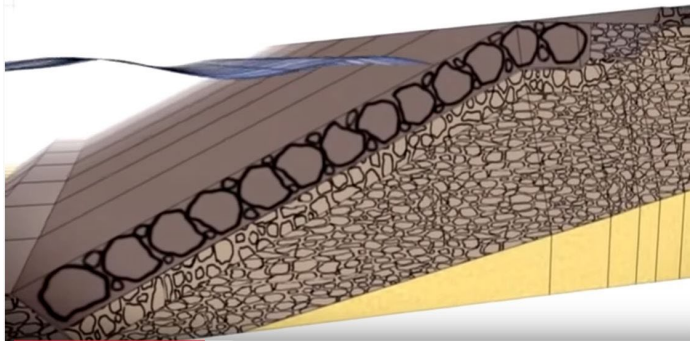
PLAN OF PALM JUMEIRAH

CONSTRUCTION

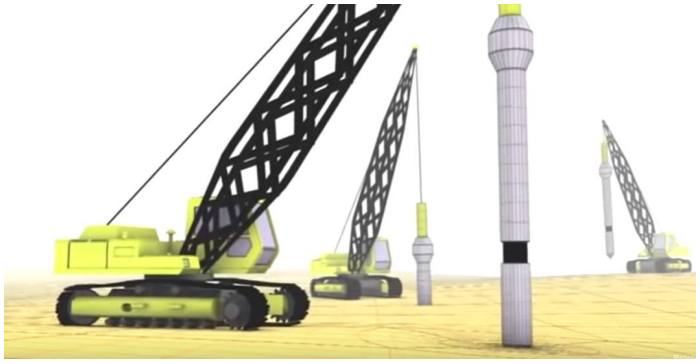
- Break water work as sea defense from waves etc.
- Arabian Gulf is too shallow to built catastrophic waves to build up.
- Miles stone brings high winds in winter for this break water must be 3m high above the waves and 11 km long, 200 m wide
- 7.4 m thick sand layer was made as a base ,then rock layers placed on sand 4m below sea lvl and 3m above sea lvl.
- The size and volume keeps the island in position , each rock is interlocked with other to withstands force of sea.
- Shaking of earth causes vibration and movement in rocks and sand particles resulting in sinking of land called **liquefaction**.
- To provide safety from this compaction of sand should be done ,according to depth of sea sand need to be compact till depth of 12m deep
- Vibro compaction is used for this process.

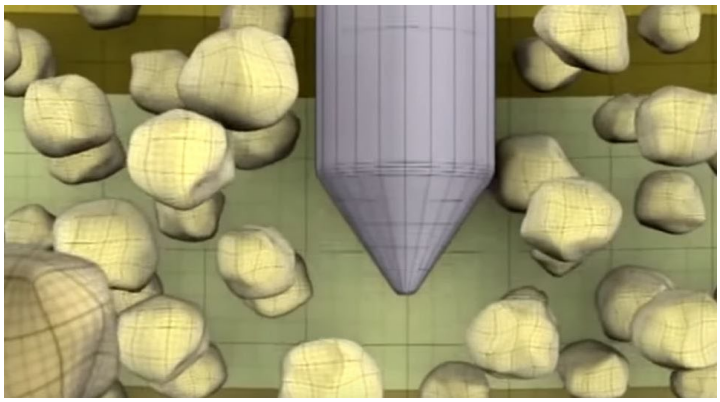


PLACNG OF SAND IN POSITION THROUGH DREGERS

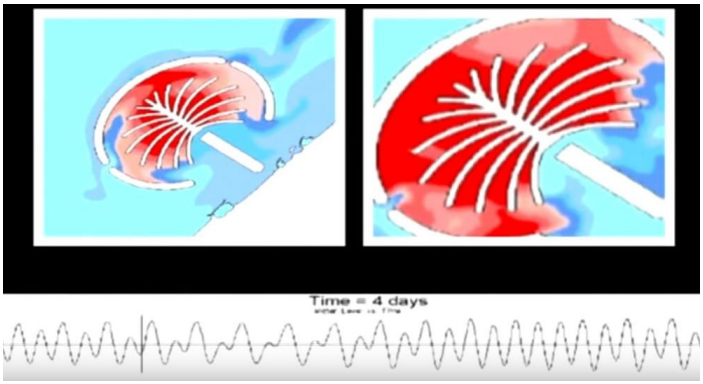


CROSSECTION OF BREAKWATER





COMPACTION OF SAND UNDER WATER



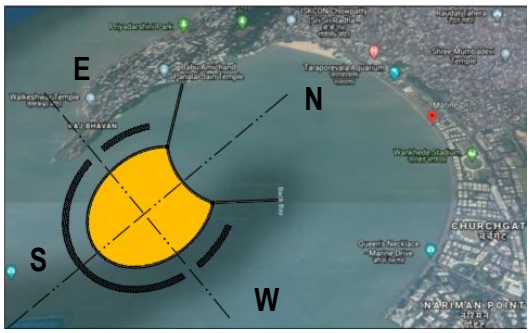
BREAK IN BREAKWATERS ALLOW THE MOVEMENT OF WATER , RESULTING IN GOOD WATER QUALITY

VIBRO COMPACTION METHOD

DEVELOPMENT OF SITE

The existing condition of site is the sea surface i:e water
Hence the site has to be reclaimed -

- **METHODOLOGY**-Rainbowing and Dredging.
- **MATERIALS-** sand and rocks.
- **CONST. EQUIPMENT'S-** Dredger, Cranes, Barges etc
- **SITE AREA TO BE RECLAIMED-20** acre
- **SITE CONNECTIVITY-** approach to the site is from chowpatty beach through ferry available on chowpatty beach.

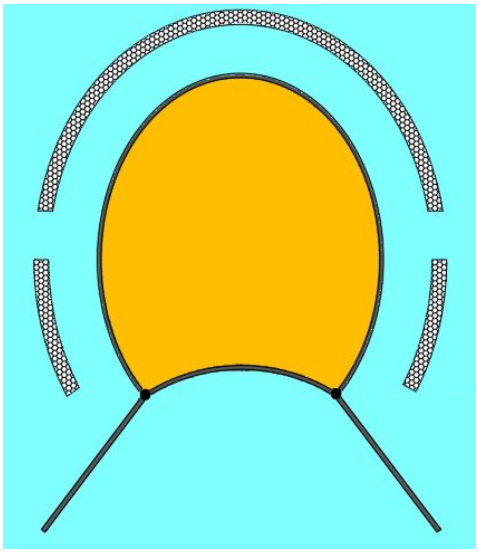


ORIENTATION OF SITE

CALCULATIONS

- **Wave height-** 3-4 m
- **Sea depth –** approx. 20 m
- **Height of breakwater above sea**
- **leveL-4m**
- **Length of breakwater-**900 m
- **Material-** tetrapod available on site
- **Sand for filling-** approx. 16 lakh
- cubic m
- **Availability of sand-** from nearby
- sea bed through dredging.

DETAILS	DIMENSIONS
BREAKWATER	900X20
GAPS FOR WATER FLOW	50
DISTANCE OF SITE AND BREAKWATER	50
PATHWAY /DOCKS	172X4



SITE

SITE DESIGN

- **Shape of the site –**oval form(no inclination and use of sharp edges)
- **Orientation of site-** according to
- the waves direction site is oriented, in N-S direction (longer side).
- The shape and orientation so designed as to distribute the flow of wave in different direction .
- **Breakwater design-** breakwater is placed parallel to site with two gaps of 50 m for circulation of water through waves, Hence to save island from stagnation of water.

SWOT ANALYSIS

STRENGTH- as structure is being built in water, the location of the site has sea depth of 20 m which is short and shallow to build catastrophic waves.
Materials need for reclamation is available nearby site.
WEAKNESS- Site is 3.6 km inside the sea from beach which can affect the visibility of oceanarium from beach
OPPORTUNITY- site gives an opportunity for land reclamation which create a natural effect of marine life for visitors
Approach to site through ferry.
THREAT- shaking of earth can cause vibration in rock and sand particles which can lead to sinking of island

SITE SERVICES

ELECTRICAL SUPPLY- Brihanmumbai Municipal Corporation, Colaba
WATER SUPPLY- Malabar Hill Reservoir BMC
DRAINAGE- Through drains into Arabian sea.
SEWAGE DISPOSAL- waste arrives at STP Malad and dumped into sea.

INDEX-

CASE STUDY

1. **TARAPOREWALA AQUARIUM, MUMBAI**
2. **DOLPHIN AQUARIUM , MUMBAI**

- LOCATION OF SITE
- ABOUT SITE
- PROJECT COST
- SITE LAYOUT
- AQUARIUM PLAN
- DISPLAY TANKS
- RESEVOIR CAPACITY
- AREA AND STORAGE ANALYSIS
- WATER FILTERATION
- AQUARIUM SERVICES
- OTHER SERVICES

TARAPOREWALA AQUARIUM,MUMBAI

The project deals with ocean and sea life. the intention of studying this is to gain familiarity with existing infrastructure & level of technology. to study in depth the life support system provided, despite of being the only prototype in Indian context,
this is the best known since 1951.

ABOUT TARAPOREWALA

- **ESTABLISHED -1951**
- aquarium is named after a Parsee who donate 200,000 for the construction.
- **BUILDING COST-** 800000 RS.

- **RENOVATION**
- **ARCHITECT(S)-**VADARA & ASSOCIATES
  RENOVATION **COST-** 20 CRORE RS.
- **NO. OF SPEICIES-** 400
- **ANNUAL VISITORS-** 400000
- **ACRYLIC TUNNEL-** 12 FT LONG 180*

- **Site area**:212'X212', (64mX64m)
- **Floor area:** 106'X94' (32mX28m)
- **Long axis of site:** East-West
- Lying 200 **feet** away from seawall.
  - **STRUCTURE**

Foundation rest on reinforced concrete piles 30' deep to make structure earthquake proof.

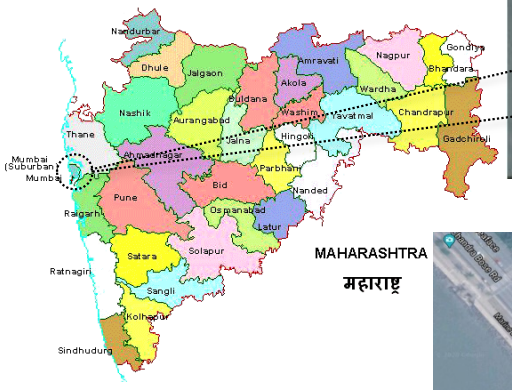
SITE LOCATION

Address: Netaji Subhash Chandra Bose Road, Marine Drive, near Charni Road, Railway Station, Mumbai, Maharashtra 400002

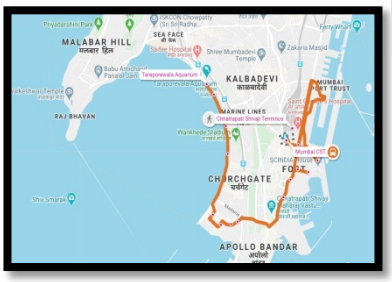
PROJECT COST

BUILDING	5,77,975.00
WATER AND AERATION SYSTEM	1,07,150.00
ELECTRIC INSTALLATION	74,079.00
GAS CONNECTION	3,700.00
WATER BARGE	80,000.00
MINIATURE EXHIBIT SEA	6,000.00
AQUARIUM TANKS AND EQUIPMENTS	42,00.00

TARAPOREWALA AQUARIUM

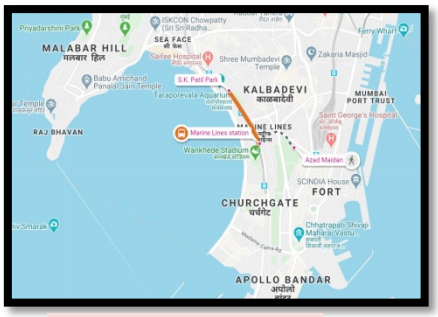


CST AIRPORT-11Km

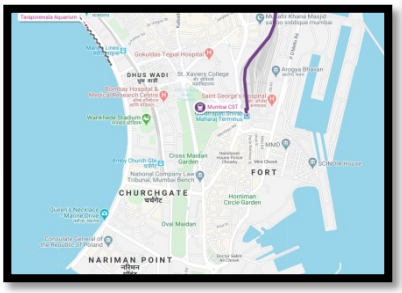


CST BUS TERMINAL-3.6 km

CST RAILWAY STATION-4.2Km



CST METRTO STATION-3.1km



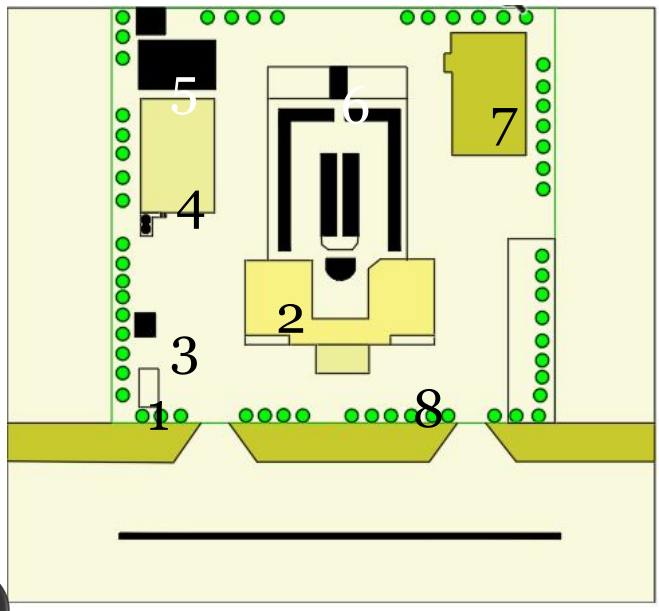
- JAVA
- SUMATRA
- MALYA
- PHILIPINES
- EXOTIC FISHES

MARINE EXHIBITS

SITE LAYOUT

5.TOILET

3.WATER RESEVOIRS



4.FILTERATION ROOM

1.TICKET COUNTER

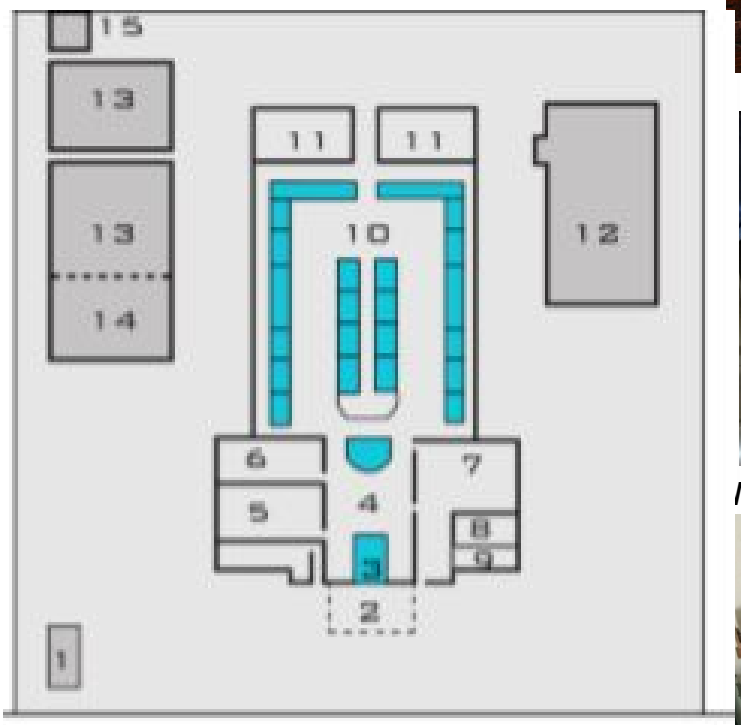
8.PARKING

6.ELECTRIC LAYOUT

7.TECHNICIANS CABIN

2.AQUARIUM BUILDING

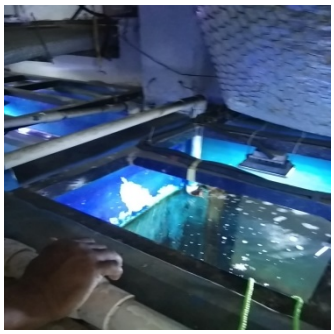
AQUARIUM PLAN



DISPLAY TANKS

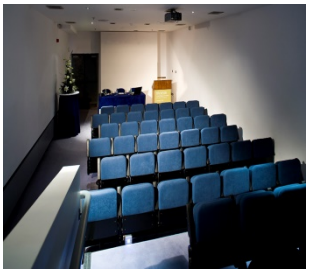
FOUNTAIN

WATER CIRCULATION PIPELINES



FEEDING OF FISH

QUARANTINE ROOM



AUDIO/VISUAL ROOM

AREA & STORAGE ANAYSIS

BUILDING AREAS-

.TICKET COUNTER-12+18 SQM 2.PORCH-24 SQM
3.ACRYLIC TUNNEL-14.25SQM 4.LOBBY-71.5 SQM
5.AV ROOM-50 SQM (48+2 SEATING)
6.QUARANTINE ZONE-33.6 SQM. 7.TROPICAL FISH HALL-70.96 SQM.
8.OFFICE - 19.8 SQM 9.MANAGER ROOM- 6 SQM.
10.EXHIBITION AREA-560 sqm 11.LEFT FOR FUTURE CONS. 12.RESERVIORS/PUMP ROOM-198 SQM
13.CANTEEN (GROUND+1ST FLR.)
14.FILTRATION ROOM/SETTLING TANK
15.TOILETS -4 SQMX2

RESEVOIRS CAPACITY-

PURPOSE	NO.OF TANKS	CAPACITY(LTRS)	DIMENSIONS
MARINE BROUGHT FROM ARABIAN SEA VIA UNDERGROUND SUPPLY	2	20,000	(45X15X10) FT
FRESH WATER BROUGHT FROM BMC	2	20,000	(18X15X10)FT
OVERHEAD TANKS TO STORE FILTERD WATER	2	8000	DIA-2M HEIGHT-2M

RECIRCULATION OF WATER:

- The **closed type recirculation system** is used here , the filtered water is stored in overhead tank.
- Water is circulated to display tanks, at alternate days water is filtered this water is circulated to filteration room via pipe of 11cm dia .

SET BACK

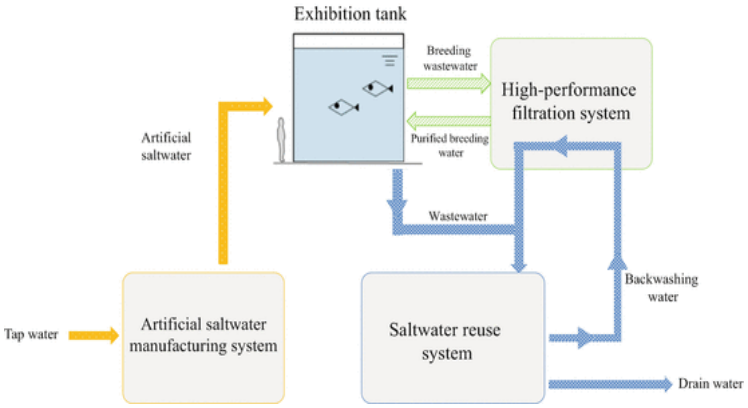
FRONT- 6 M
REAR- 4.5 M
SIDES- 3 M & 4.5 M
SITE AREA- 4095SQM.
FSI - 1.83
BUILDING HEIGHT- G+2

DISPLAY TANKS-

16 MARINE WATER TANKS - 3 DIFFERENT SIZES-(**10X4X7 FT,16X4X7 FT,12X8X7 FT)**
32 TROPICAL FISH TANKS - **4X2X2.5FT**
9 FRESH WATER TANKS -2 DIFFERENT SIZES- **(8X4X4 FT,10X4X7 FT)**

FILTERATION OF WATER:

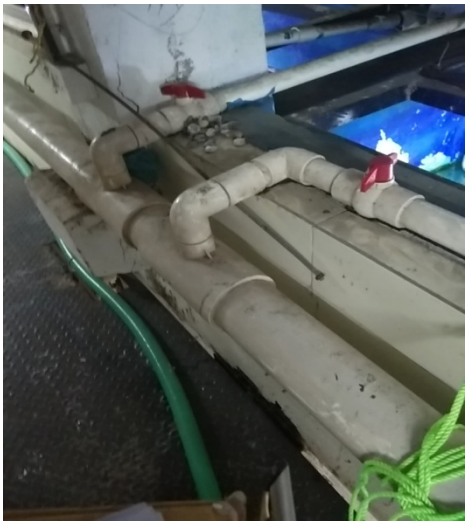
- 2 rooms are built for filteration of marine and fresh water
- Marine water is brought through underground pipeline supply with a diesel pump from Arabian sea.
- This water is circulated to filteration room , filteration room has **14 tanks with 500 ltr capacity** each.
- Different tanks have different media for filtering water like **ozone filter, bio filter, sponge etc.**
- The water is circulated through these media and then filtered water is stored in overhead tank.
- Filteration is done through **2 motor pump for (marine and fresh water)of 3HP which continuously work with break ofn 10 min ,elec. Supply from MSRTC**
- **2 protein skimmer, calcium reactor, I ozone filter,2 bio filter**



FILTERATION TANK

PIPE DIA11CM FROM FILTERATION TO OVERHEAD TANK

PIPE DIA 9CM FROM OVERHEAD TANK TO DISPLAY TANKS



ONE PIPE CONNECTED TO EACH DISPLAY TANK.

CLEANING OF AQUARIUMS

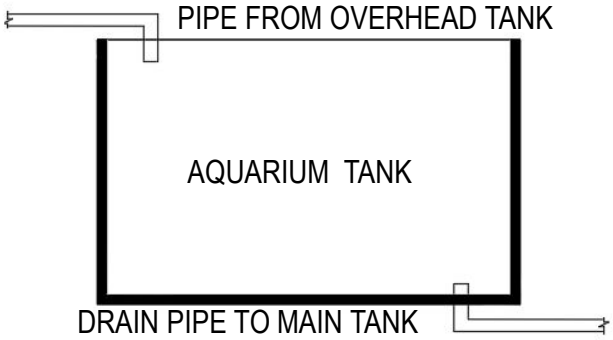
An overflow pipe placed down of aquarium to recirculate overwater to tank
Through drain pipe water is drained to main tank outside ,
2 pipes are connected to aquarium tank –
1 pipe from upper surface to feed water in aq. Tank
2 pipe at bottom surface to evacuate the dirt with water .

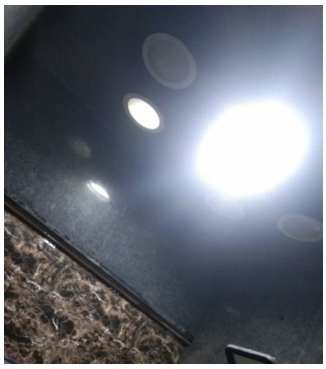
FEEDING OF FISHES

- Feeding of fishes is done through platform at 1.5 m from floor
- This platform is placed behind the aquarium tanks
- Live feed tanks: food are prepared in circular tanks and checked everyday

RAMP FOR TOILET

OVERFLOW PIPE





AQUARIUM LIGHTING

CLEANING NET

DRAIN OUT PIPE

SECURITY

DOLPHIN AQUARIUM,MUMBAI

The project deals with ocean and sea life. the intention of studying this is to gain familiarity with existing infrastructure & level of technology. to study in depth the life support system provided, despite of being the only prototype in Indian context,

ABOUT DOLPHIN AQUARIUM

Small animal park with birds, fish & reptiles on display, plus a miniature railway for train rides.
Dolphin aquarium is in Mumbai suburban district .the aquarium is built on the old dumping ground, but the land has been transformed into quaint little aquarium and boating lake surrounded by natural wildlife, rather than trash.

ABOUT THE BUILDING:

The aquarium is in the middle of the lake, it also has ducks rabbits ,and lots of birds
The building has circular arrangement of aquarium tanks display which has more than fifty aquarium tanks with different speces.

STRUCTURE

- Foundation rest on reinforced concrete piles
- The aquarium display area has a dome structure supported on columns and made of truss and sheets

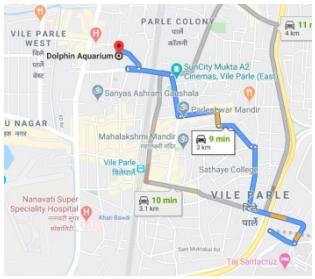
ARCHITECTURAL FEATUTRES

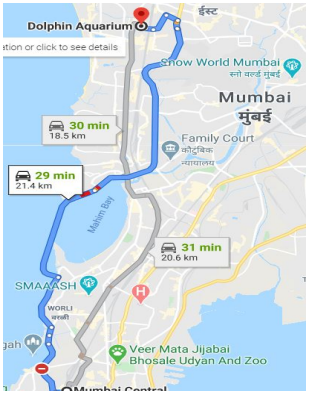
- Lake design with respect to the dolphin show and entertainment purpose(but dolphin were unable to adopt the environment).
- Main aquarium building block was circular in plan having dome in its top.
- Around the aquarium block 1.5 m deep water pond,
- The main aquarium at the center of pond was looking like a island .
- The visitors pathway and pavilion deck was design in keeping the clear vision of the pond all aroun the pathway.
- Landscaping – lotus flower was planted at the side of the deck.
- Around the building periphery green landscaping was done
- The placement of the canteen was such that it was such that it was utilized from inside and outside of the site.
- The plan of the Dolphin aquarium was according to vaastu shastra .

SITE LOCATION

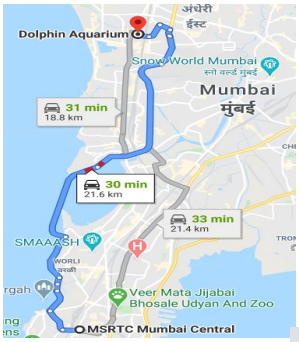
SITE APPROACH

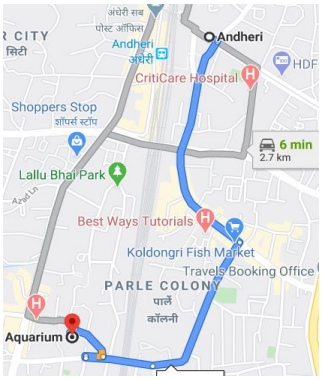
CST AIRPORT-3Km





CST RAILWAY ST.21.4Km

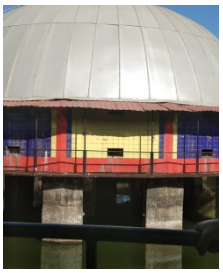




ANDHERI METRTO STATION-2.7km

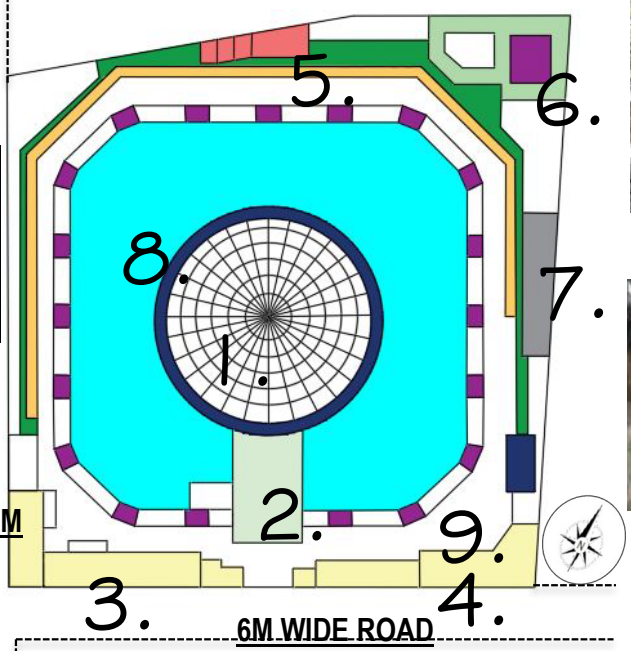
CST BUS TERMINAL-21.6 km

SITE LAYOUT



1. AQUARIUM BUILDING

2. LOBBY TO AQUARIUM



5. MALE\ FEMALE TOILETS

6. TEMPLE AREA

7.DOLPHIN
OFFICE
G.LCARE TAKER

3,4.BIRDS CAGE

BUILDING STRUCTURE

AQUARIUM & ENTRANCE LOBBY

- 5.5 wide lobby supported on steel column
- Truss roof installed
- Lobby supported on 4 rcc col. 300x300
- Aquarium building base is supported on rcc col.
- Dome above is supported on brick wall covered with tiles.
- The dome was constructed of steel and covered with fibre

BUILDING SERVICES

WATER SUPPLY

Fresh water pipe are laying along aq. Tank.
Water in tanks are recycled and used
Cap. Of water in aq. Tanks 38000 ltr.
Water in pond is filled with pump.

ELECTRICAL SUPPLY

Water proof lights installed in tanks
Air pump, lights and temp. of tanks are maintained through electricity.
Artificial lights are intalled around lake for decoration purpose.

AREA ANALYSIS

PLOT AREA	2525 SQM
BUILT UP AREA	452 SQM
GROUND COVERAGE	18 %
WATER BODY	860 SQM
AQYARIUM BLOCK AREA	320 SQM
DOME ABOVE	20 M DIA
TOILET	10 SQM EACH
RCC COLUMN	450X1200 MM

INDEX-

LITERATURE STUDY

1. **LISBON OCEANARIUM,PORTUGAL**
2. **GEORGIA AQUARIUM , ATLANTA**

- LOCATION OF SITE
- ABOUT SITE
- PROJECT COST
- SITE LAYOUT
- AQUARIUM PLAN
- DISPLAY TANKS
- RESEVOIR CAPACITY
- AREA AND STORAGE ANALYSIS
- WATER FILTERATION
- AQUARIUM SERVICES
- OTHER SERVICES

LISBON OCEANARIUM PORTUGAL

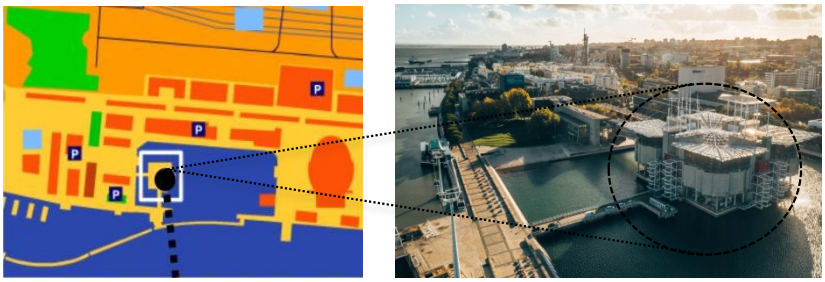
GENARAL BREIF:

- **LOCATION-** Lisbon,Portugal
- **COORDINATES-**38.7635°N 9.0937°W
- **ESTABLISHED –**1988
- **BUILDING COST-** 21.3 million $
- **ARCHITECT-** Peter Chermayeff
- **SITE AREA-** 20 acre
- **STRUCTURE-**suspended on 7 concrete pylons,
- **BUILDING EXTERIOR-**exterior skin is covered with more than 5000 ceramic pieces made in unit of ceramic stoneware 50x50 cm
- **NO. OF BLOCKS –** 2(admin. Block and oceanarium
- **NO. OF SPECIES-** 450
- **NO. OF ANIMALS-**16,000
- **CAPACITY OF LARGEST TANK**-1,300,000 US gall
- **VOLUME OF LARGEST TANK**-5000cubic
- **DESIGN EXHIBITS-** 4 tanks of diff. habitats
- The North Atlantic(rocky coast)
- The Antarctic coastline
- The Temperate Pacific kelp forests
- the Tropical Indian coral reefs
- **ACRYLIC TUNNELS-** 40 m long

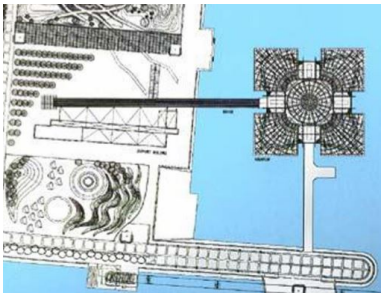
SPECIES IN DIFFERENT EXHIBITS

EXHIBIT	SPECIMENS
THE NORTH ATLANTIC ZONE	PENGUINS SEAGULLS
ANTARTIC COASTLINE	ACRYLIC TUNNEL WHALE SHARK MANTRA RAY
PACIFIC KELP FORESTS	STAR FISH SEA URCHINS SEA HORSE BONY FISH
TROPICAL INDIAN CORAL REEF	JELLY FSH OCTOPUS MARINE PLANTS CORAL REEF

LOCATION



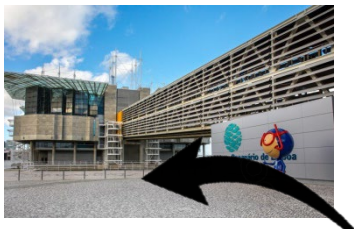
LISBON OCEANARIUM



KEY PLAN

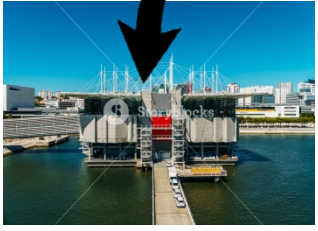
BUILDING ARCHITECTURE

The complex consist of two main building – administration and oceanarium building.
which is connected to land by bridge.
The exhibit building is placed on water like an island linked to an entrance/exit support building on land.
Visitors entered by a ramped bridge to an upper level where 4 ocean later same habitats are seen again underwater visually linked to central tank .

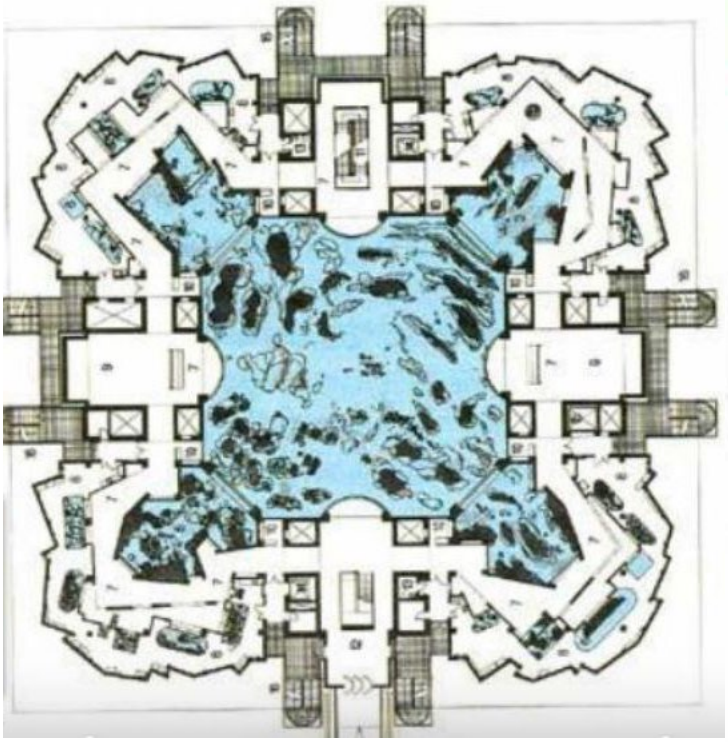


PEDESTRIAN MOVEMENT (RAMPED BRIDGE)

ENTRANCE OF BUILDING

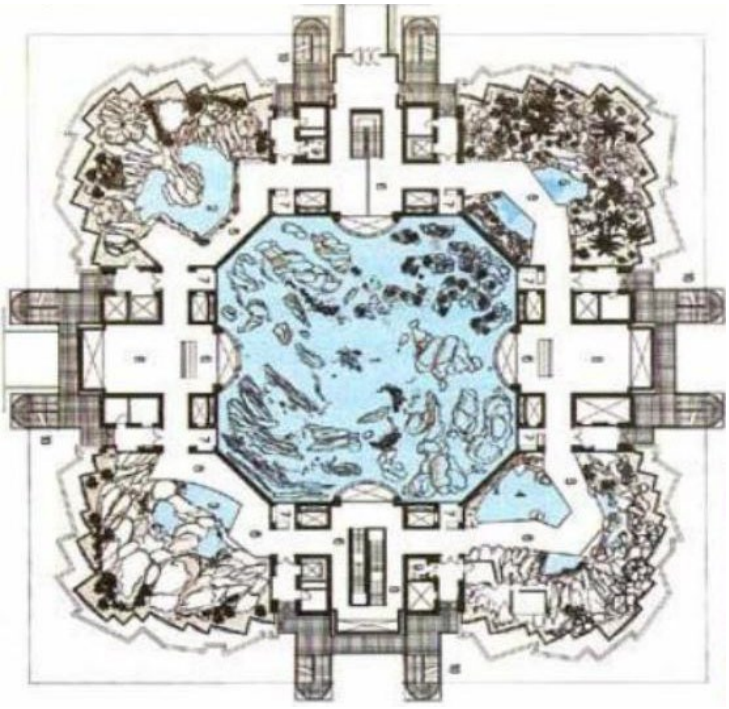


VEHICULAR MOVEMENT



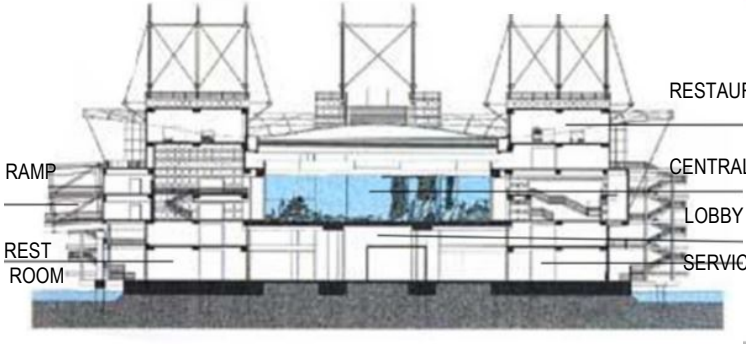
LOWER LEVEL FLOOR PLAN

GROUND FLOOR PLAN

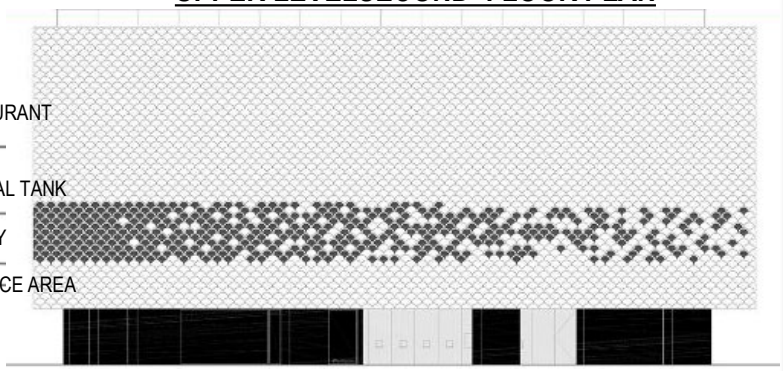


UPPER LEVELFIRST FLOOR PLAN

UPPER LEVELSECOND FLOOR PLAN



SECTION



ELEVATION

AQUARIUM FEATURES

- 8000 organism between plants and animals of over 450 species.
- Around 550 kg food is consumed per day.
- 75000 pieces of artificial corals used in decoration in Indian habitat ocean
- 7 million litres of salt water divided between more than 30 aquariums.
- Every day 200 test are performed to check the quality of aquarium

BUILDING ELEVATION (FACADE)

The entrance complex is elevated from 5000 ceramic tiles reminiscent of marine scales which provide the necessary shading and permeability for views and ventilation.

OTHER FACILITIES AT AQUARIUM

AQUARIUM SHOPS

FOOTOVER BRIDGE

RESTAURANT

AUDITORIUM

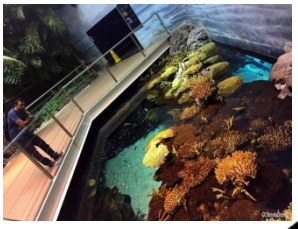
GROUND FLOOR (SERVICE)

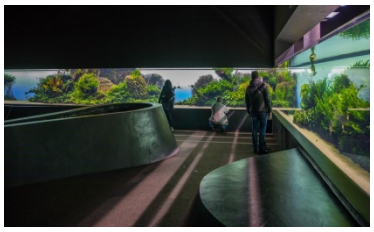
Ground floor is over pile ,act as service floor which include lifts,staircase,mechanical room, maintainance office, storage , water purifier room, generator room, temperature maintaining room, control room etc.

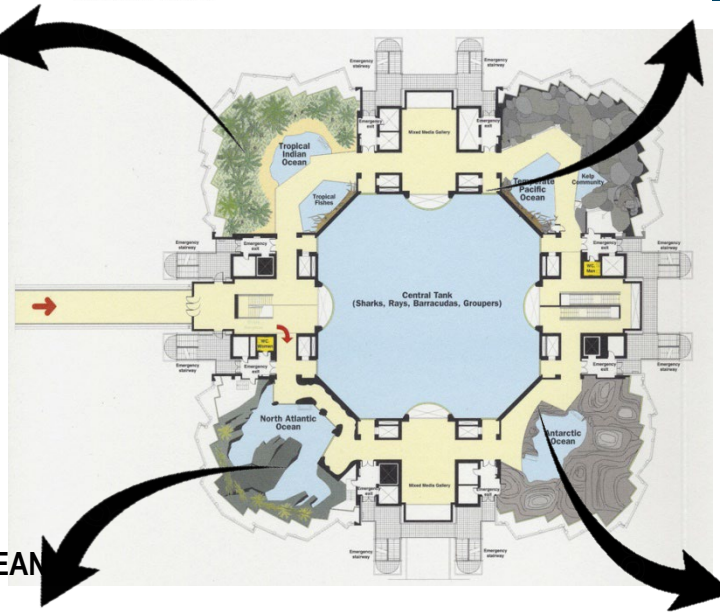
PARKING SPACE-

Oceanario park-274 parking

Doca parking-700 parking spots







ANTARTIC OCEAN

NORTH ATLANTIC OCEAN

AQUARIUM SERVICES

SYSTEM TYPE- Closed re-circulation system using artificial sea water

Salt + mineral water= salt water

FILTERS MEDIA USED-

Foam fractionators
141 Sand filters
70 protein skimmers
100 ozone generators
Bio filters
Heat pumps

ELECTRIC PUMPS-

218 pumps placed for filtration to circulate 261,000 gpm
25 miles of wiring
31 pump water motion system circulating 29,500 gpm

WATER CAPACITY-

34 saltwater tanks and 11 fresh water tanks are placed in aquariums holding 8 million gallons of water .

WATER SUPPLY-

Water is been distributed from overhead hanging PVC pipes needing at leadind at least free space of 1m above clear height

WATER PIPES-

Water pipes of dia 24" at 3m c/c on periphery
54" dia pipes re installed at bottom
4035 valves

ACRYLIC WINDOW-

24 inch thick acrylic viewing wall weighing 238,00 gpm.

LIGHTING-

Instead of direct sunlight fluorescent tubes and neon lamps are used all time.
Lighting is done at bottom and top surfaces using lamps

TEMPEARTURE MAINTAINED-

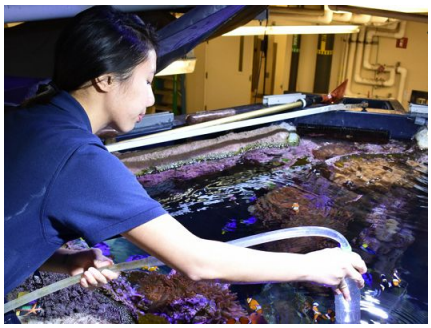
Filtration done daily at temperature 24* C

LIFE SUPPORT SYSTEM-

The system monitors the oxygen content ,acidity , and water temperature
Pupms are placed in basements responsible to send sea water in
aquariums through fractionators,

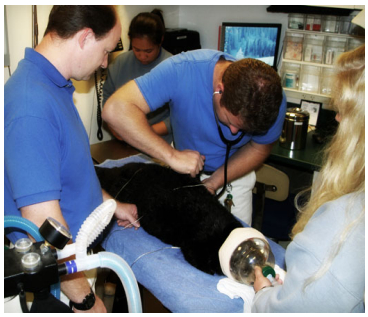
OTHER FEATURES-

Plant is setup at basement adjacent to the main building and duct are exposed to the surroundings as a interior treatment.
The walls from inner side have high acoustic .
Treatment so that sound of water flowing through and working staff doesn't travel outside at galleria arena.



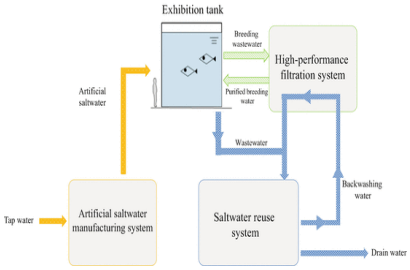
FEEDING IN SMALL TANKS

FEEDING IN TUNNELS



QUARANTINE AREA FOR TREATMENT

DRAINAGE OF TANK

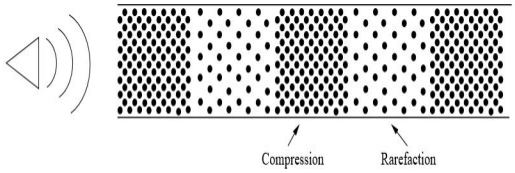


FILTERATION SYSTEM

FILTERS AND PIPE LAYOUT

FOAM FRACTIONATORS

FOAHEALTH MONITORING SYSTEM



SOUND WAVES MOVEMENT FROM BARRIERS HAVING (COMPRESSION AND REFRACTION)

GEORGIA AQUARIUM,U.S

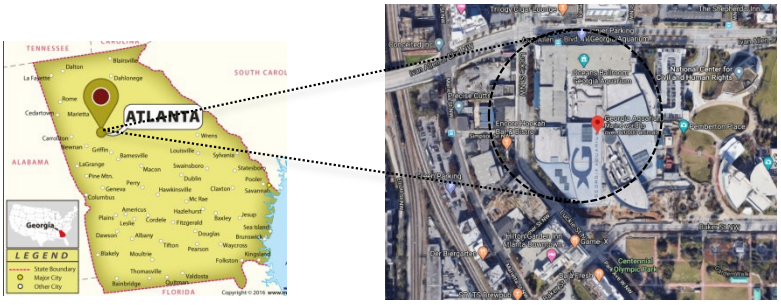
GENARAL BREIF:

- **LOCATION-** Atlanta,Georgia,U.S
- **COORDINATES-** 33°45'46"N 84°23'41"W
- **ESTABLISHED –**November 2005
- **BUILDING COST-** 21.3 million $
- **ARCHITECT-** Jweff Swanagan
- **SITE AREA-** 20 acre
- **NO. OF BLOCKS –** 1
- **NO. OF SPECIES-**500
- **NO. OF ANIMALS-**100,000
- **CAPACITY OF LARGEST TANK**-6.3MILION US gallon
- **VOLUME OF LARGEST TANK**-24,000 cubic
- **TOATAL VOLUME OF TANKS-more** than 10 million US gallons.
- **DESIGN EXHIBITS-** six different galleries-
- Georgia explore,Ocean voyager,Tropical driverCold, waterRiver scout,Dolphin tales
- **ACRYLIC TUNNELS-** 48 m long (4 giant pieces of acrylic panel)

SPECIES IN DIFFERENT EXHIBITS

EXHIBIT	SPECIMENS
GEORGIA EXPLORE	AFRICAN PENGUINS CALIFORNIA SEA LIONS
OCEAN VOYAGER	ACRYLIC TUNNEL WHALE SHARK MANTRA RAY
TROPICAL DRIVER	OVERHEAD CRASHING WAVE TROPICAL FISH CORAL REEF
COLD WATER QUEST	WEEDY SEADRAGON BELGUA WHALE GAINT PACIFIC OCTOPUS JAPANESE SPIDER CRAB
RIVER SCOUT	FISHES OF RIVER AND LAKE OF ASIA , AFRICA
DOLPHIN TALES	DOLPHINS

LOCATION



KEY PLAN

FACILITIES AT AQUARIUM

DISPLAY EDUCATION

BUILDING APPERANCE

The design of the Georgia Aquarium purposely breaks away from Atlanta's street grid and its indigenous architectural aesthetic.

PLANNING-

The zones of the aquarium is planned on ground floor, and services in basement.

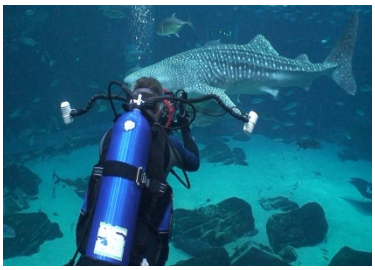
The exhibit galleries are connected through central atrium.

TURTLE SCANTUARY

CORAL REEF TANK

AQUA SHOPS

TOUCH POOLS



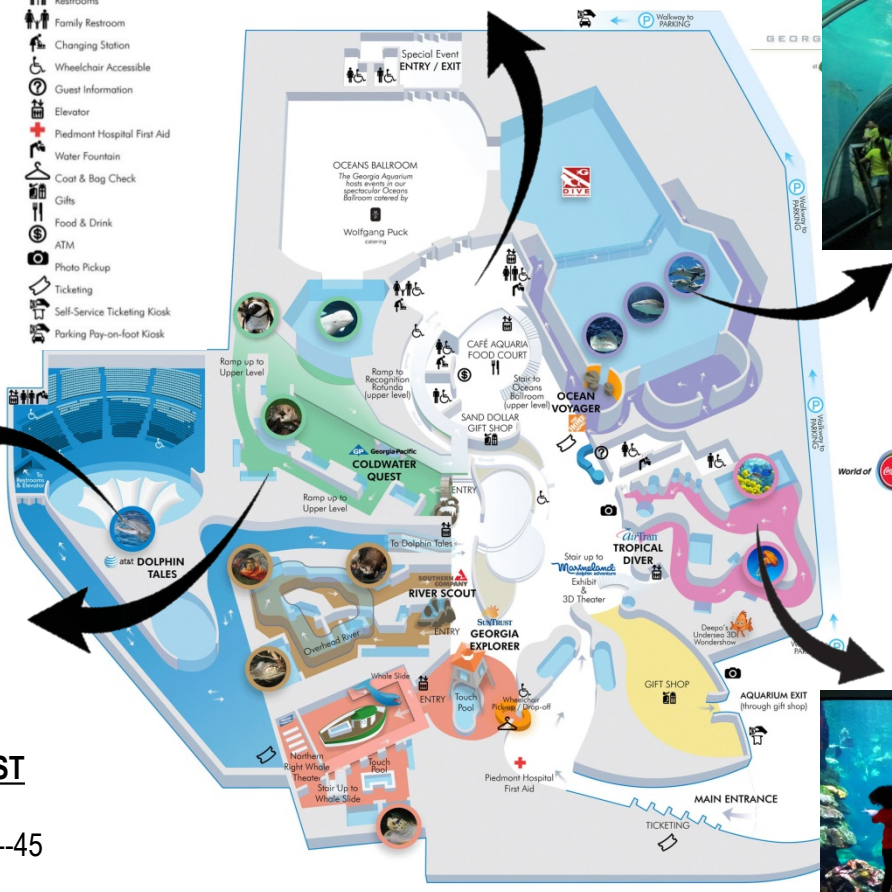
SCUBA DIVING

UNDERWATER RESTAURANT

AQUARIUM CAFE

DOLPHIN TALES
AREA- 2150 SQM
THEATRE-1050 SQM
CAPACITY-100 PERSON
HEIGHT-9M
WATER BODY-100 S

COLD WATER QUEST
AREA- 800 SQM
VOYAGE CAPACITY--45 PERSON
HEIGHT-4.5M



OCEAN VOYAGER
AREA- 2000 SQM
TUNNEL-48M LONG, 4M WIDE
CAPACITY-80 PERSON
HEIGHT-6.5M
WATER CAP.-6.3 MILLION LITRE

AQUARIUM FILTRATION

SYSTEM TYPE- Closed re-circulation system using artificial sea water
Salt + mineral water= salt water

FILTERS MEDIA USED-
Foam fractionators
141 Sand filters
70 protein skimmers
100 ozone generators
Bio filters
Heat pumps

ELECTRIC PUMPS-
218 pumps placed for filtration
3650 HP pumps in one side of room
3425 HP pumps in other side of room

WATER CAPACITY-
140,000 gallons per minute are pumped through i.e. 6.3 million gallons in an hour

WATER PIPES-
Water pipes of dia 24" at 3m c/c on periphery
62" dia pipes re installed at bottom

LIGHTING-
Lighting is done at bottom and top surfaces using lamps

TEMPEARTURE MAINTAINED-
Filtration done daily at temperature 24* C

LIFE SUPPORT SYSTEM-
The system monitors the oxygen content ,acidity , and water temperature
Pupms are placed in basements responsible to send sea water lin aquariums through fractionators,

			AQUARIUM BLOCK		
S.No	Typology	Pool/tank detail	Water capacity	Design placement	Area
A	Mammal				
A1	Gigantic of indian ocean	Indoor aquarium			2720
	Whale shark (6m-10m size)	80x46x10	10 million litres		36800
	Killer whale (5.5m -10m size)				
	Hammerhead shark 3.6m				
	Sharpnose guitarfish				
A2	Ray hall (spread tank)	18.2x18.2			
	Longtail butterfly ray (900)	Depth 1050		Placed on low 3'depth flat open tank	330

			AQUARIUM BLOCK		
B	Indian mixed fish				
B1	Indian marine fish				
	Mixed fish tank	6m dia x 1.5 m high	111981 us gallons		28.26
	Individual tanks	2.4x1.81.2	13694.5 us gallons		43.2
	30% circulation added				21.43
	total				92.9
B2	Individual tank	1.8x0.9x0.9	3851 us galons		16.2
	30% circulation				4.86
	total				21.06
C	Turtle scantuary				

			AQUARIUM BLOCK		
C1	Olive ridley turtle(750mm)	4.2 m depth	488186 us gallon	Open sky sand shore	
	Green turtle(1500mm)				
	Hawksbill turtkle (900mm)				880
	Loggerhead turtle(900mm)				
	30% circulation				264
C2	Crocodile terraium				
	1 salt water crocodile (6.3 m)	Land area -300 sqm(l-20,w-15) Water area-500 sqm(l-20, w-25)	264170 us gallon		800
	Mugger crocodile(5m) Gharial	Land area-252 (l-18,w-14) Water arae- 396(l-22,w-18) Depth 1.5m	156916.5 us gallon		
	30% circualtion				434
D	**Shell fish**				

			AQUARIUM BLOCK		
D1	Giant mud crab(280mm)				
D2	Blue mana crab(800mm)				
D3	Three spot swim ming crab (125mm)				
D4	Crucifix crabs(177mm)				
D5	Smooth cell swimming crab				
D5	Thaivunger crabs(38. mm)				
D6	Malua plapines(65mm)				
	total				6.2
	Lobster 5 species	3.6x3x1.5	4488 us gallon	Placed in group tank	10.8
E	Mollusks				

			AQUARIUM BLOCK		
E1	Cuttlefish	1.8x0.9x0.9	385.3 us gallon	Individual tank	1.62
E2	squid	2.7x2.7x2.7	385.3 us gallon	Individual tank	7.29
E3	octopus	2.7x2.7x2.7	385.3 us gallon	Individual tank	7.29
E4	Gastropods (snails, slugs)				
E5	Oyster(50 species)				
E6	Mussels(5 species)	21x21	12517.5 us gallon	Gallery tank	441
E7	scallop				
G	Echinoderms				
	Star fish	15x15		Gallery tank	225
	Sand dolars				

			AQUARIUM BLOCK		
H	Amphibians				
	Aquatic and semi aquatic frogs	0.9x0.9x0.6	513.4 us gallon	Individual tank	35
	30% circulation				10.5
	total				45.5
I	Individual theme collection				
	Seahorse (7 types of seahorse)	1.8x4.2x1.4=4.32sqm	11884us gallon		45.36
	Spotted eagle ray upto 5m Devil ray	21x6x6	698893us gallon		441
	Japanese flying squid(500mm)				
	Four wing flying fish (300mm)	10x10x3	641923us gallon		300
	Yellow win flying fish(210mm)				

			AQUARIUM BLOCK		
J	Ocean theme world	6dıax 10m	111981 us gallon	Individual cylindrical tank	28.2
	Pacific ocean species	6dıax 10m	111981 us gallon	Individual cylindrical tank	28.2
	Atlantic ocean species	6dıax 10m	111981 us gallon	Individual cylindrical tank	28.2
	Medeterrian sea	6dıax 10m	111981 us gallon	Individual cylindrical tank	28.2
			DOLPHINARIUM		
	Entertainment pool	36 m dıa			1200
	Swim pool	23 m dıa			450
	Backup pool				371
	Quarantine				100
	Amphitheatre		800 seating capacity		1485

			AQUARIUM BLOCK		
	Pump room				100
	Trainers room				50
	Storage				150
	Medical room				100
	Fish kitchen				50
	Toilets(m+f)				100
	Monitoring room				40
	Changing room				50
	Circulation 30%				1500
	total				5000

			AQUARIUM MAINTAINANCE AND SERVICE	
s.no	function	no.	area	Total
1	Species rehabiliation room	1	300	300
2	Pathological lab	1	20	20
3	Aquarium maintenance office	1	300	300
4	Food preparation area	1	15	15
5	Food freezers	1	10	10
6	breeding+ quarantine room	1	300	300
7	Diver's equipment room	1	100	100
8	Store	1	100	100
9	Generator room	1	120	120

		AQUARIUM MAINTAINANCE AND SERVICE		
10	Heating room	1	100	100
11	Ahu	1	240	240
12	Electrical substation	1	150	150
13	Water treatment	1	750	750
14	circulation	-	454.8	454.8
	total			2728.8
		RESEARCH AND MEUSEUM		
	RESEARCH			
s.no	function	no.	area	Total
1	Labs and surgical room	1	70	

2	Preservation lab	1	150	150
3	Pathogenic lab	1	200	200
4	Ecological lab	1	95	95
5	Experimental lab	2	47.5	95
6	Breeding room	2	60	120
7	Quarantine treatment	2	100	200
8	Library	1	150	150
9	Storage	1	20	20
10	Cubicles for marine biologist	10	10	100
11	Lecture room	1	50	50

12	Record /documentation room	1	50	50
13	Seminar room	1	50	50
14	Photography room/dark room	2	50	100
15	Toi/drinking water space	2	60	120
16	Research secretary	1	30	30
17	circulation	-		318.4
	total			1680
	MEUSEUM			
s.no	function	no.	area	Total
1	administraton	1	60	60

2	Historic and geographic info	1	200	200
	Fishing technique and equipment library	1	120	120
	Environmental degradation	1	120	120
	Skeleton display	1	200	200
	Circulation 30%			196
	total			980
		ADMINISTRATION BLOCK		
s.no	function	no.	area	Total
1	Director room+ toi	1	30+3.5	33.5
2	Personal secretary	1	12	12

3	Admin office	1	12	12
4	Account office	1	15	15
5	Store	1	20	20
6	Sales manager	1	15	15
7	Maintainance office	1	10	10
8	Chief security office	1	10	10
9	Security control	1	25	25
10	Medical assistance	1	6	6
11	Medical officer	1	15	15
12	Engineer(civil +elec.)	1	10+10	20
13	Toilet	2	15x2	30

14	Supervisor office	1	10	10
15	Technician	1	12	12
16	Assistant worker	1	10	10
17	Conference room	1	60	60
18	Gardner/sweeper	1	4	4
19	Circulation 30%	-		106.5
	total			520
		ENTRANCE LOUNGE		
1	Ticket counter	1	40	40
2	Registration office	1	30	30
3	Reception	1	35	35

4	Outdoor seating	150 person	180	180
5	Toilet (male+female)	1	30+30	60
6	Circulation 20%			66
	total			456
	Souvenir shops			
1	shops	2	40x2	80
2	store	1	15	15
3	Circulation 20%			19
	total			115
1	Kids pool	1		
2	Changing rooms	2		

OCEAN-AN UNDER WATER UNIVERSE

INTRODUCTION

AN INTRODUCTION IT IS A BELIEF THAT LIFE ON EARTH, BEGAN FROM THE OCEANS. MOREOVER WATER NOW COVERS 2/3 OF EARTH SURFACE AND IT IS TO THIS .THE FIRST SIGN OF EXISTENCE OF LIFE, IS SAID TO HAVE BEEN IN AN AQUATIC ENVIRONMENTAL, THE FORM OF UNICELLULAR MICROORGANISMS AND LEAD TO THE EVOLUTION OF THE MOST COMPLEX ORGANISM

ABOUT THE PROJECT

OCEANARIUM IS A LARGE AQUARIUM IN WHICH MARINE ANIMALS ARE KEPT FOR STUDYING AND PUBLIC ENTERTAINMENT PURPOSES

OCEAN + AQUARIUM = OCEANARIUM

OCENARIUM

PROJECT OBJECTIVE

RECREATION-IT ATTRACTS THE VISITORS OF ALL AGE GROUP DUE TO ITS FACILITIES.

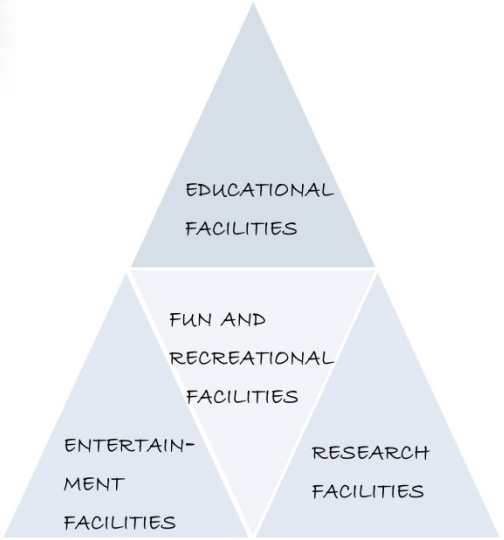
TOURISM- IT INCREASES THE TOURISM OF PLACE AND GENERATE REVENUE.

EDUCATION- IT IS A STEP TO PROMOTE KNOWLEDGE OF MARINE LIFE TO PEOPLE.

CONSERVATION- IT IS ASTEP TO CONSERVE THE MARINE LIFE BY PROVIDING A CLEN AND NATURAL ENVIROMENT.

ARCHITECTURAL INTERVENTION

TO FULFILL THE OBJECTIVES OF THE PROJECT , OCEANARIUM HAS BEEN DIVEDED INTO 4 ZONES WHICH HAS DIFFERENT FACILITIES GROUPED TOGHTER



OCEANARIUM-AN UNDERWATER UNIVERSE, MUMBAI

THESIS 2019-20

SITE LOCATION

THE SITE IS LOCATED 3.6 KM IN ARABIAN SEA OFFSHORE CHOWPATTY BEACH MUMBAI

SITE PROFILE

SITE IS A 20 ACRE OF MANMADE ISLAND IN ARABIAN SEA LOCATED 1.2 KM FROM RAJ BHAWAN AND 3.6KM FROM GIRIGAON CHOWPATTY.

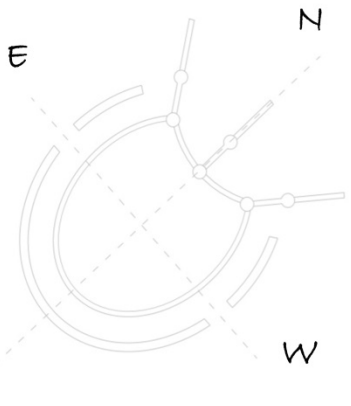
ABOUT MUMBAI

MUMBAI IS THE CENTRE OF THE MUMBAI METROPOLITAN REIGON ,MUMBAI , MUMBAI I S GENERATING 61.6% OF INDIA'S GDP AND ACCOUNTING FOR 25% OF INDUSTRIAL OUTPUT , 70% OF MARITIME TRADE IN INDIA

ABOUT ARABIAN SEA

THE ARABIAN SEA IS A REIGON OF THE NORTH INDIAN OCEAN BOUNDED ON NORTH BY IRAN AND PAKISTAN ON SOUTH BY YHE LACCADIVE SEA AND EAST BY INDIA. TOTAL AREA IS 3862000SQKM AND MAXIMUM DEPTH IS 4652 M

DEVELOPMENT OF SITE



SITE AREA- 20 ACRE
BREAKWATER- 900X20
GAPS FOR WATER FLOW-50M
DISTANCE OF SITE AND BREAKWATER- 50M
PATHWAY-170X9

SITE CLIMATE

MACROCLIMATE

PRECIPITATION (ABOVE 150 MM,MOSTLY WET)

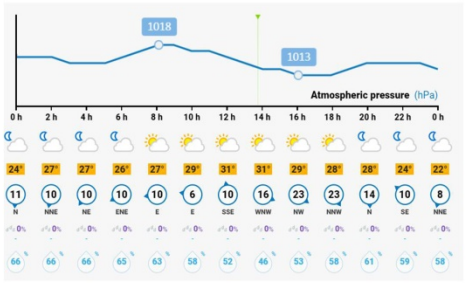
AVERAGE TEMPERATURE :30 TO 35*C

WIND ROSE DIGRAM

MICROCLIMATE

TIDAL RISE- 4.4M AT MHWS AND 3.3M AT MHWN

VELOCITIES THAT RANGE BETWEEN 0.75 KNOT AND 3 KNOTS



AVERAGE WIND SPEED-MAX. 23KM/H
MIN. 6 KM/H

SITE CONSIDERATION

ORIENTATION OF SITE

LONGER FACE OF SITE LIES IN N-S DIRECTION.

THE SITE IS PLACED DIAGONALY IN WIND DIRECTION TO DISTRIBUTE THE WATER PRESSURE THROUGH BREAK WATER.

DESIGN PHILOSOPHY:- "MERGING INTO NATURE"

CONCEPT DERIVATION

NATURE ITSELF A CREATOR

NATURE HAS ITSELF CREATED A DIVERSITY AND SPACES TO HOUSE THOSE CREATURES . WE CAN ENDLESS ELEMENTS OF NATURE SUCH AS MOUN TAINS , FORESTS, OCEANS , SEA ETC.

NATURE AND ARCHITECTURE

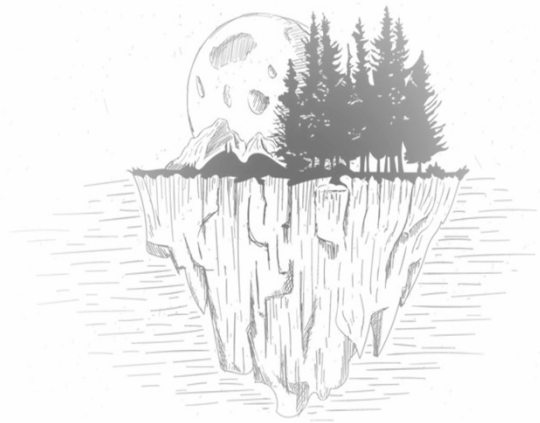
CONTEMPORARILY NATURE BECOMES A MATERIAL FOR ARCHITECTURE AND PUBLIC SPACES -
MAN'S PLACE OF RESIDENCE. NATURAL ELEMENTS, UNDERSTOOD AS THE BUILDING MATERIAL
FOR A HOUSING ENVIRONMENT, ARE NOT JUST A LANDSCAPE - AN AESTHETICAL SUP-

STABILITY OF NATURE

THE CRAETON OF NATURE EXISTS ON SATATEMENT OF STABILITY , NATURE HAS A BALANCE IN ITS CREATION , THE DISTRIBUTION OF ELEMENTS CAN BE SEEN TO MAINTAIN THAT BAL
ANCE-
THE BALANCE IN ECOSYSTEM AND THE DIVERSITY DEFINES A STABLE ENVIRO-

EVOLVING ARCHITECTURE FROM NATURE

ARCHITECTURE CAN 'LET NATURE IN'. (AS MARIO PEI ADVISED).
ARCHITECTURE CAN BE EVOLVED FROM NATURE , AND THEIR COMES THE CONCEPT OF "MERGING INTO NATURE" .
THE LANDSCAPE ARCHITECTURE ,ORGANIC ARCHITECTURE ARE THE EXISTING EXAMPLES OF ABOVE STATEMENT



CONCEPT OF DESIGN

ORGANIC ARCHITECTURE

ORGANIC ARCHITECTURE REFERS TO DESIGNING AND BUILDING STRUCTURES AND SPACES THAT ARE BALANCED WITH THEIR NATURAL SURROUNDINGS AND TAILORED TO THE FUNCTION THEY SERVE FOR THEIR INHABITANTS

PRINCIPLE OF ORGANIC ARCHITECTURE

SHELTER:- BUILDINGS MUST SERVE TO PROTECT THEIR INHABITANTS' SAFETY AND PRIVACY.

SPACE:- SPACES SHOULD FLOW NATURALLY FROM ONE AREA TO THE NEXT WITHOUT FORMIDABLE SEPARATION, YET NO ROOM OR SPACE SHOULD BE COMPLETELY VISIBLE FROM ANY ANGLE.

NATURE:- INSPIRATION SHOULD BE DRAWN FROM THE NATURAL SURROUNDINGS, NOT IN IMITATION OF THEM, BUT AS GUIDES TO SELECTING MATERIALS, TEXTURES, AND COLORS.

SIMPLICITY:- DESIGNS MUST BE CLEAR WITH A UNIFORM SCHEME.

MECHANICAL COMPONENTS AND FURNITURE:- WHENEVER POSSIBLE, FURNITURE SHOULD BE A BUILT-IN PART OF THE SPACE IN ORDER TO INTEGRATE THE UNITY OF DESIGN. MECHANICAL COMPONENTS, LIKE LIGHT FIXTURES, APPLIANCES, FURNACES, AND PLUMBING SHOULD BE CONSIDERED AS PART OF THE SPACE ITSELF, NOT OVERLY OBVIOUS, BUT NOT A DISJOINTED OR HIDDEN ASPECT.

CIRCULATION INSIDE
(NATURAL FLOW BETWEEN SPACES)

FORM OF THE BUILDING

BIOMIMICRY

BIOMIMCRY IS A GREEK WORD DERIVED FROM JOINING TWO WORDS -

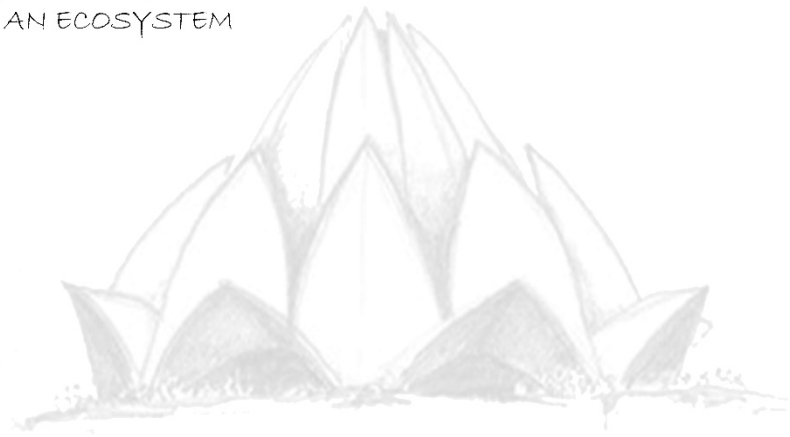
BIOS- MEANING LIFE

MIMESIS- TO IMITATE

IN ARCHITECTURE BIOMIMICRY IS ADESIGN APPROACH IN WHICH NATURE'S TECHNOLOGY IS INFUSED WITH HUMAN ENVIROMENTI MIMICKING IS DONE ON TWO WAYS -

MIMICKING AN ORAGANISM

MIMCKING AN ECOSYSTEM

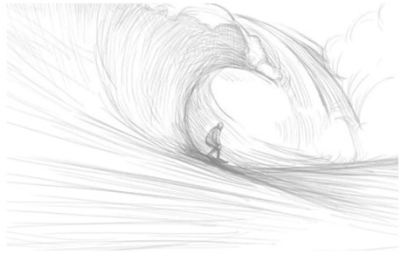


BUILDING ARCHITECTURE

THE CONCEPT OF THE BIOMIMICRY CAN BE SEEN IN THE FORM OF BUILDING , THE FORM FOLLOWS BOTH THE MIMICKING CRITERIA , (ORGANISM)

THE MAIN BUILDING I:E AQUARIUM BLOCK FOLLOWS A FORM OF ROTATING WAVES FORMING A CYCLONE .

THE REST OF THE BUILDINGS , ADMINISTRATION BLOCK,RESEARCHAND RECREATIONAL BLOCK ARE DERIVED FROM SEASHELLS.

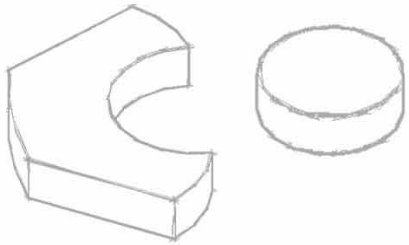


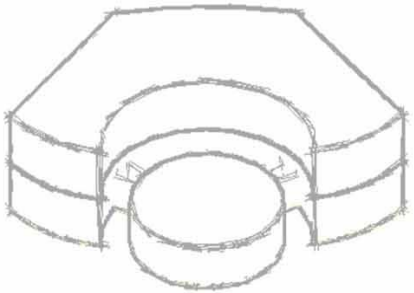
FORM EVOLUTION

ORGANIC SHAPE FOLLOWED THROUGHOUT THE BUILDING

RECREATIONAL BLOCK

THE FORM EVOLUTION OF THIS BLOCK IS TAKEN FROM THE SHAPE OF SEA SHELL JOINED WITH THE CIRCULAR BLOCK, UNITED TOGHTER THEY DEFINE A PATTERN OF BUILDING FORM



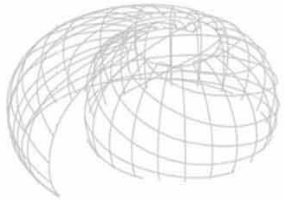


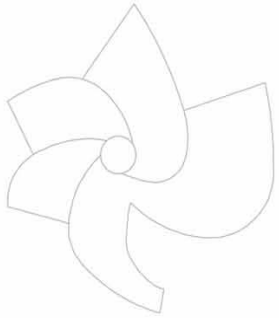
OCEANARIUM BLOCK

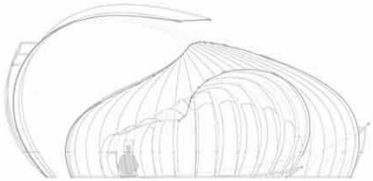
THE FORM EVOLUTION IS TAKEN FROM THE ROTATORY MOTION WAVES

ENTRANCE LOUNGE BLOCK

THE FORM EVOLUTION OF THIS BLOCK IS TAKEN FROM THE HELICAL AND CONTINOUS PATTERN OF SEA SHELL.

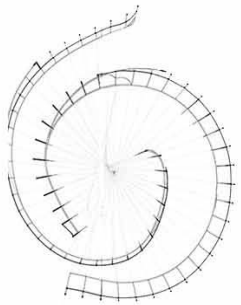


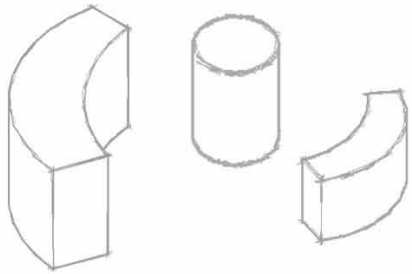




RESEARCH AND MEUSEUM BLOCK

THE FORM EVOLUTION OF THIS BLOCK IS TAKEN BY BREAKING AND RE JOINING ATHE CONTINOUS PATTERN OF SEA SHELL.



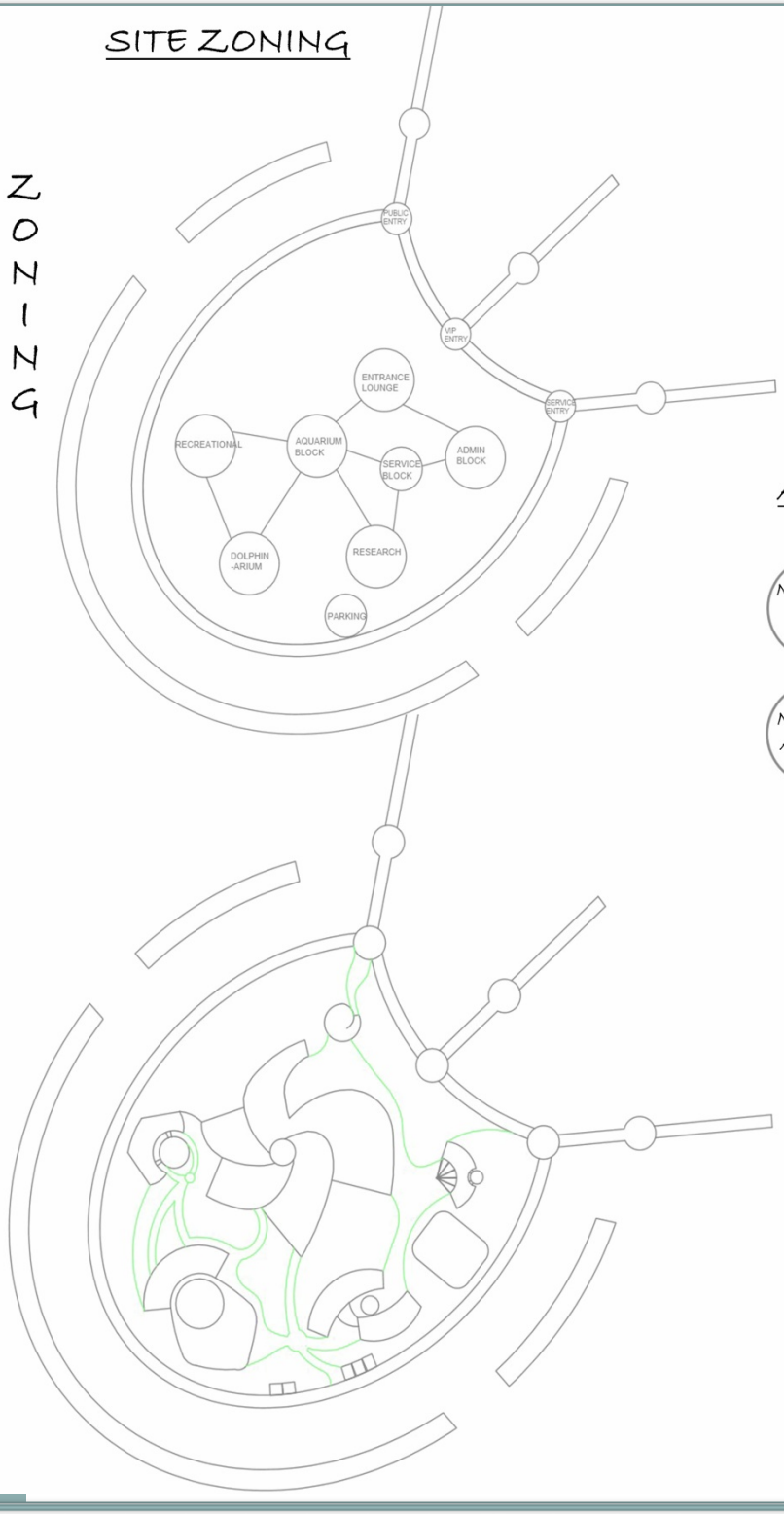


OCEANARIUM-AN UNDERWATER UNIVERSE, MUMBAI

THESIS 2019-20

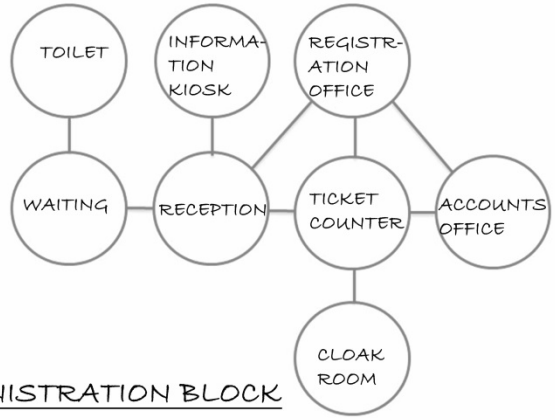
SITE ZONING

ZONING

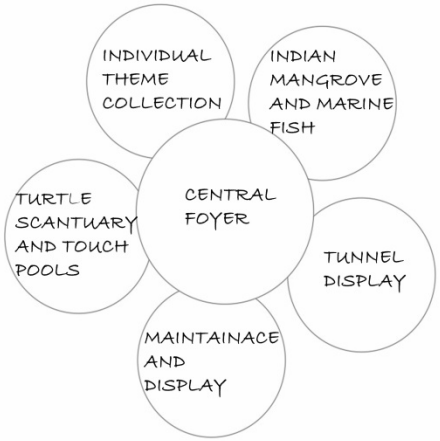


BUILDING BLOCK ZONING

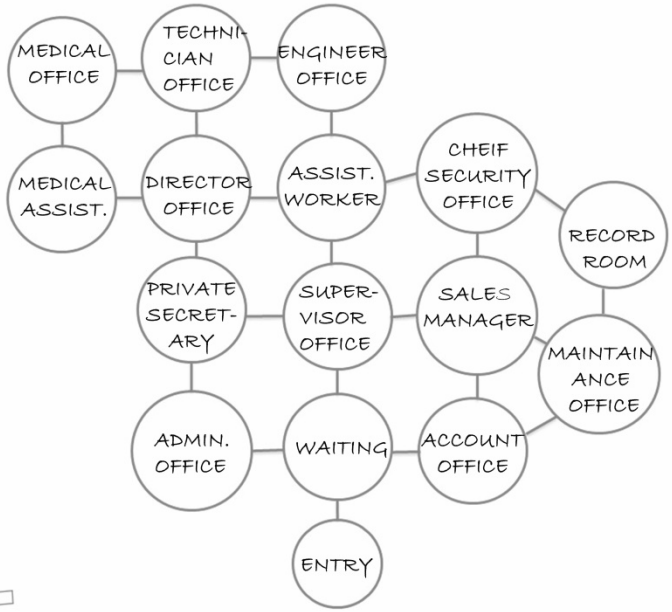
ENTRANCE LOUNGE



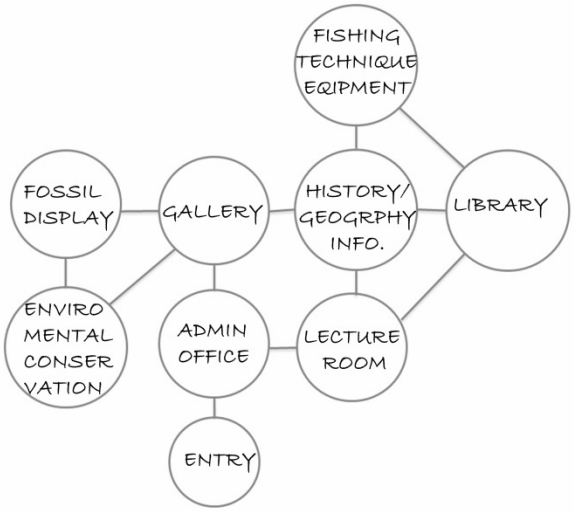
OCEANARIUM BLOCK



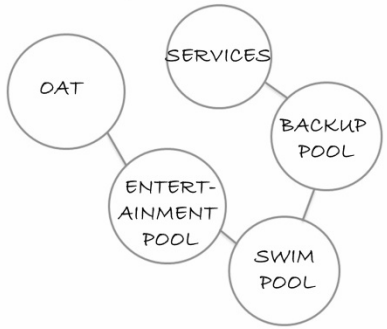
ADMINISTRATION BLOCK



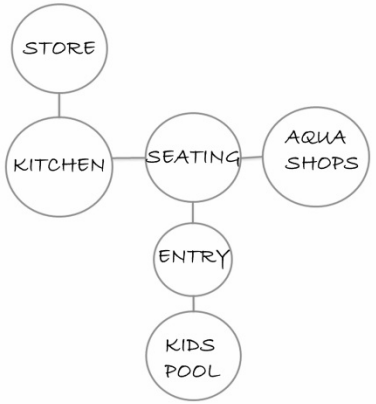
RESEARCH/ MEUSEUM BLOCK

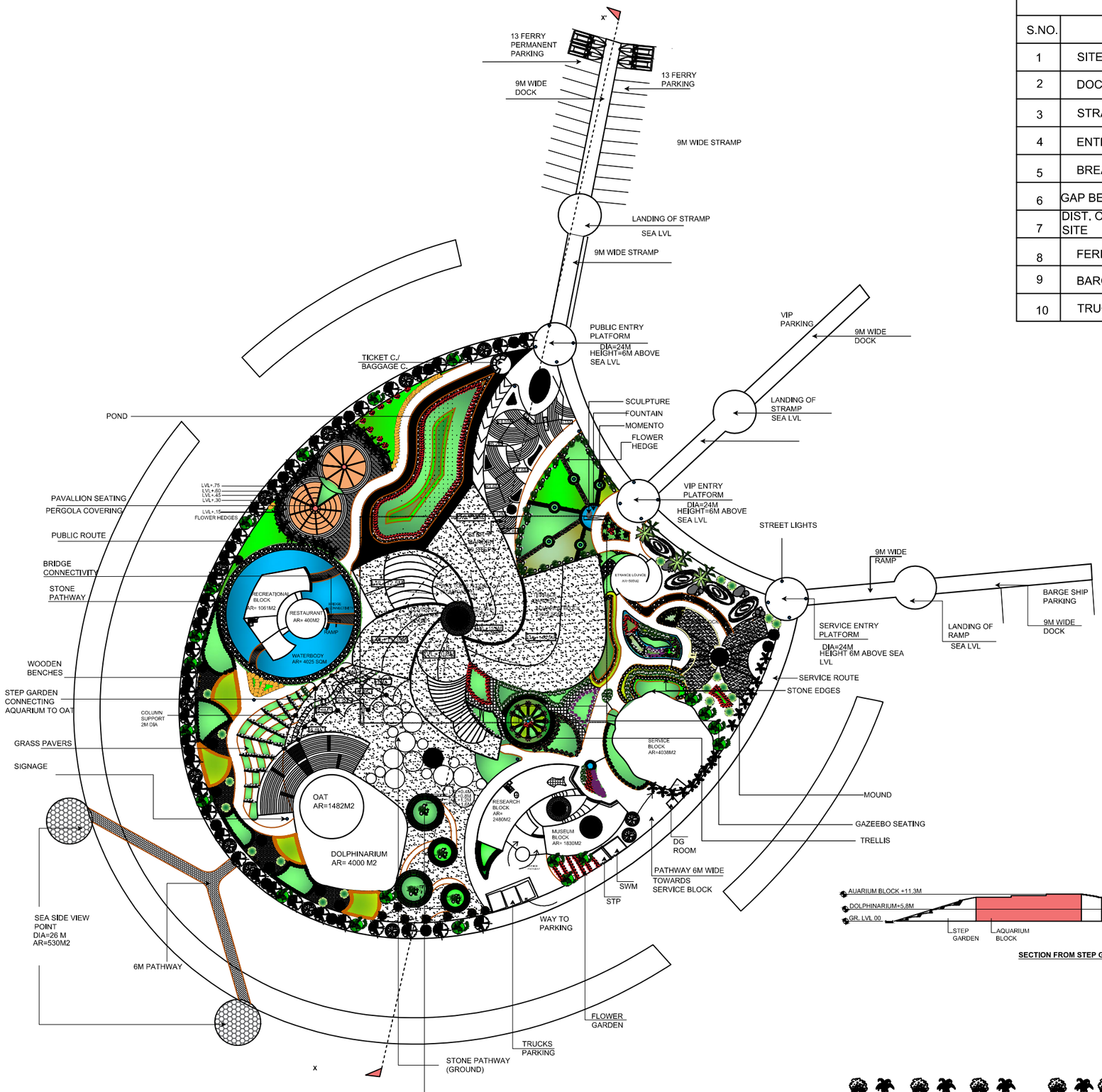


DOLPHINARIUM BLOCK

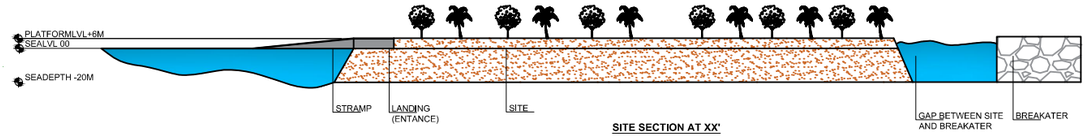


RECREATIONAL BLOCK





LANDSCAPE LAN



SITE SECTION AT XX'

SECTION FROM STEP GARDEN

SITE DETAILS

S.NO.	DESCRIPTION	UNITS
1	SITE AREA	20 ACRE
2	DOCKS	90M X 9M
3	STRAMP	60M X 9M
4	ENTRANCE PLATFORM	2M DIA 6M FROM SEA LVL
5	BREAKWATER	900MX20M
6	GAP BETWEEN BREAKWATER	50M
7	DIST. OF BREAKWATER AND SITE	50M
8	FERRY PARKING	13 PERMANENT/ 13 MOVING
9	BARGE PARKING	1
10	TRUCKS PARKING	3 ON SITE

SITE AREAS

S.NO.	DESCRIPTION	GROUND COVERAGE
1	SITE AREA	20 ACRE
2	ENTRANCE LOUNGE	565 SQM
3	ADMIN BLOCK	629 SQM
4	RESEARCHERS RESIDENCE	629 SQM
5	RESEARCH BLOCK	1240 SQM
6	LIBRARY BLOCK	148 SQM
7	MUSEUM BLOCK	915 SQM
8	DOLPHINARIUM	4000 SQM
9	AMPHITHEATRE	1482 SQM
10	RECREATIONAL BLOCK	1389SQM
11	AQUARIUM BLOCK	11811SQM
12	STP	58SQM
13	SWM	80SQM
14	TOTAL GROUND AREA	24823SQM
15	TOTAL GROUND COVERAGE	30%
16	TOTAL BUILTUP AREA	39674SQM
17	SOFTSCAPE AREA	44297SQM (54%)
18	HARDSCAPE AREA	6810SQM (9%)
19	WATERBODY AREA	5000SQM (6%)

OCEANARIUM,MUMBAI

SITE PLAN

DRAWING: N.T.S

SUBMITTED BY

DIVYANSHI SAHU

B.ARCH 5 YEAR
BBD UNIVERSITY LUCKNOW

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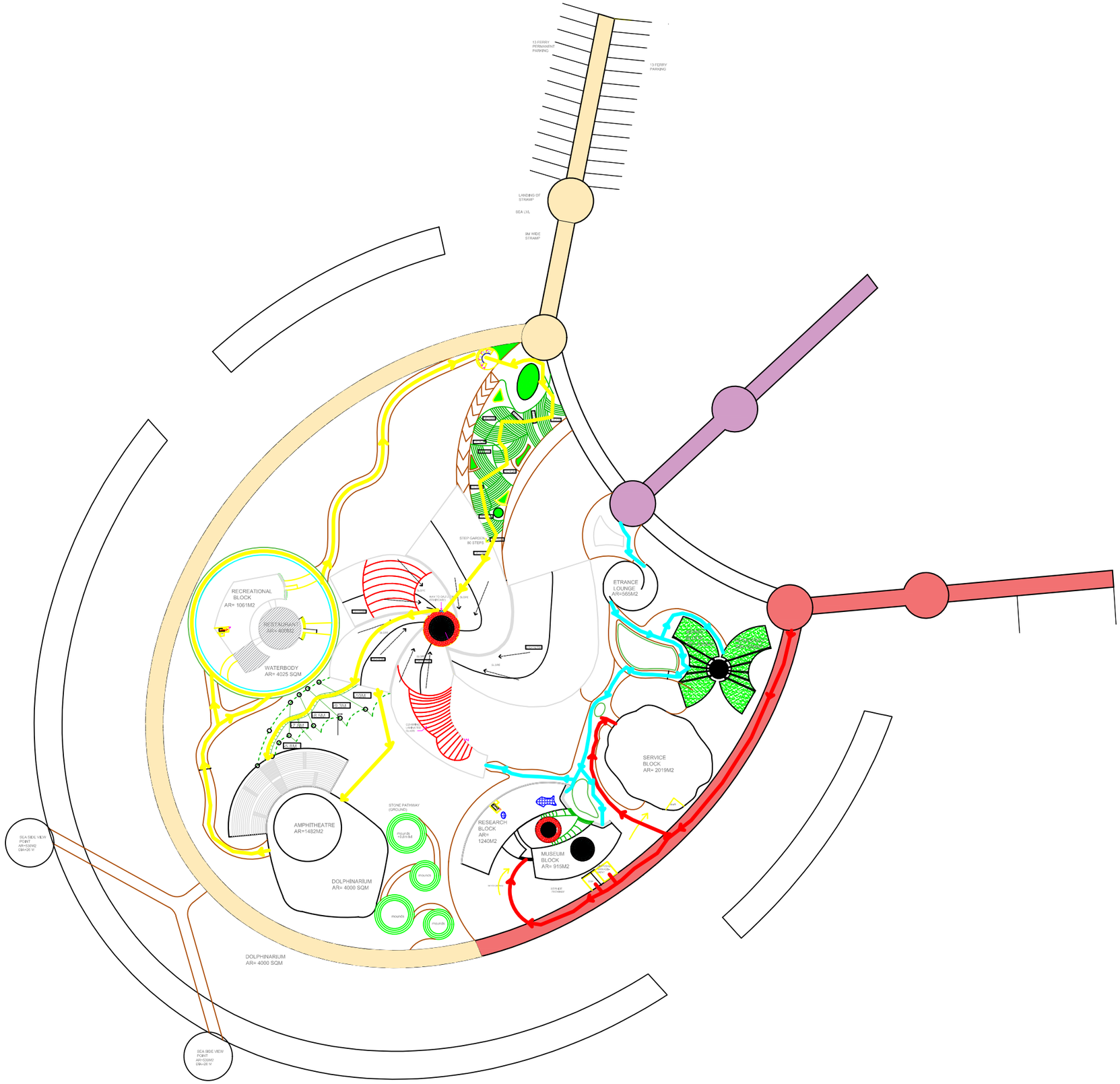

SITE DETAILS		
S.NO.	DESCRIPTION	UNITS
1	SITE AREA	20 ACRE
2	DOCKS	90M X 9M
3	STRAMP	60M X 9M
4	ENTRANCE PLATFORM	2M DIA 6M FROM SEA LVL
5	BREAKWATER	900MX20M
6	GAP BETWEEN BREAKWATER	50M
7	DIST. OF BREAKWATER AND SITE	50M
8	FERRY PARKING	13 PERMANENT/ 13 MOVING
9	BARGE PARKING	1
10	TRUCKS PARKING	3 ON SITE

LEGEND		
S.NO.	DESCRIPTION	SYMBOL
1	VEHICULAR MOVEMENT	
2	PEDESTRIAN MOVEMENT	
3	PUBLIC ENTRY/ROUTE	
4	VIP ENTRY/ROUTE	
5	SERVICE ENTRY/ROUTE	
6	PUBLIC MOVEMENT	
7	ADMIN/VIP MOVEMENT	
8	SERVICE PATHWAY	

OCEANARIUM,MUMBAI

SITE CIRCULATION PLAN
DRAWING: N.T.S.

SUBMITTED BY
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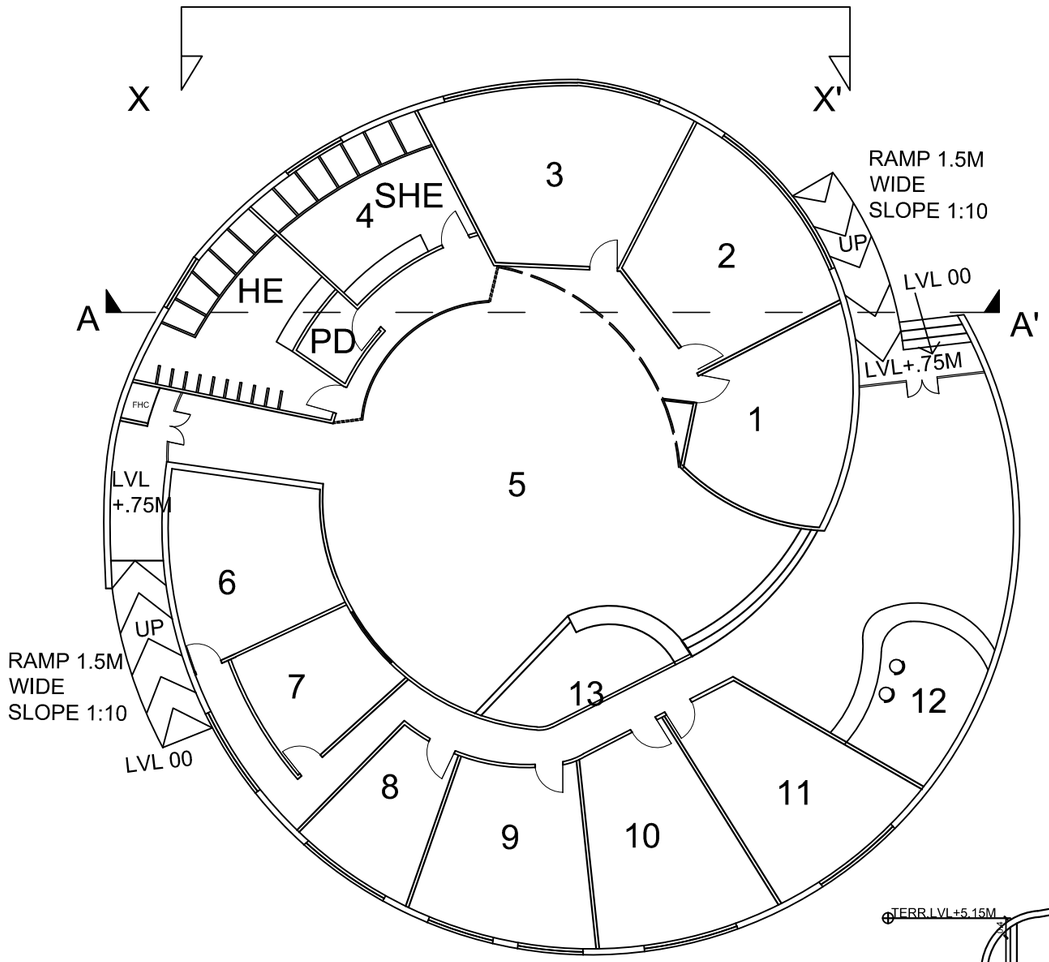
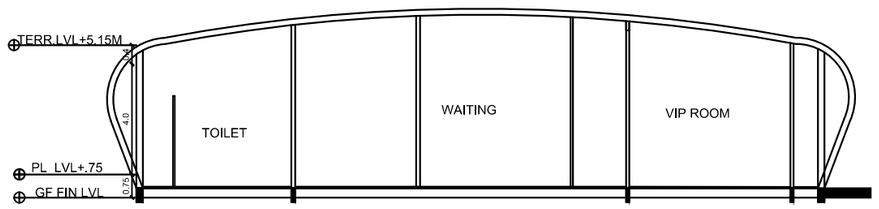
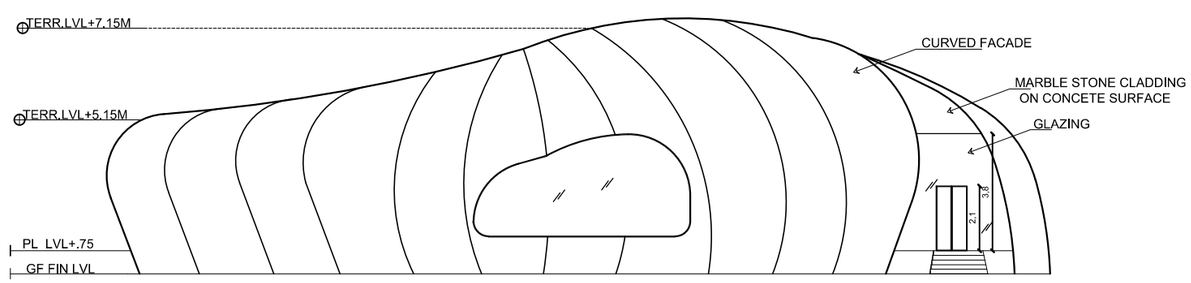


FLOOR PLAN



SECTION AA'



FRONT ELEVATION AT XX'

LEGEND		
SNO	ROOMS	AREA
1	CLOAK ROOM	20
2/3	VIP ROOM	32
4	TOILET	50
5	WAITING	135
6	AHU ROOM	25
7	REG. OFFICE	30
8	STORE AREA	15
9	STAFF AREA	30
10	ACCOUNT OFFC	28
11	OFFICE AREA	25
12	RECEPTION	35
13	SNACKS CO.	15
	TOTAL AREA	565

OCEANARIUM,MUMBAI

PLAN, ELEVATION,SECTION
DRAWING: N.T.S.

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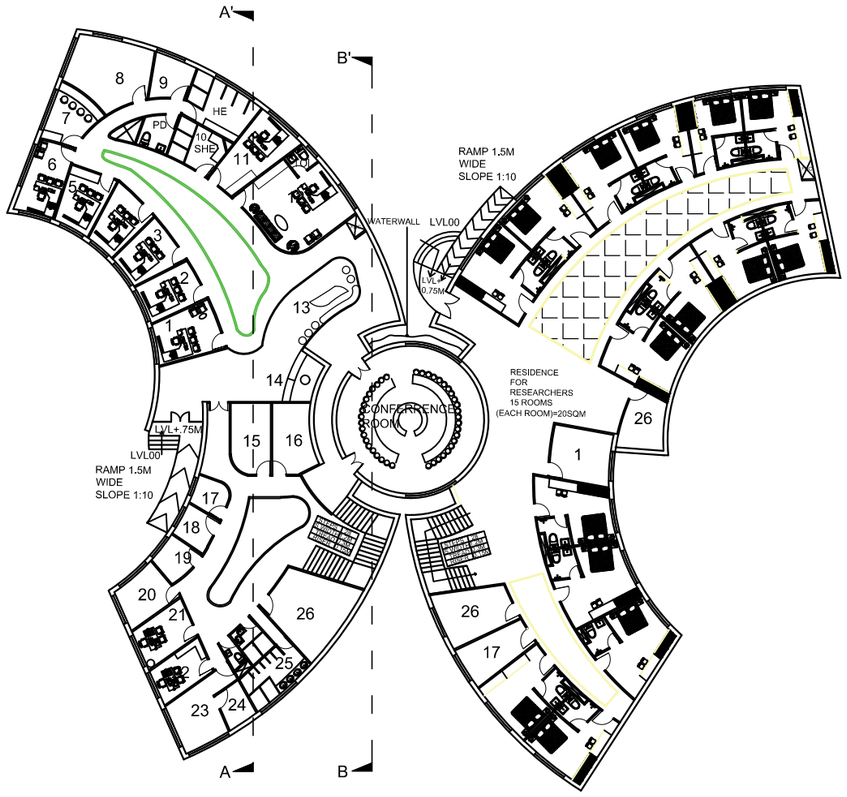
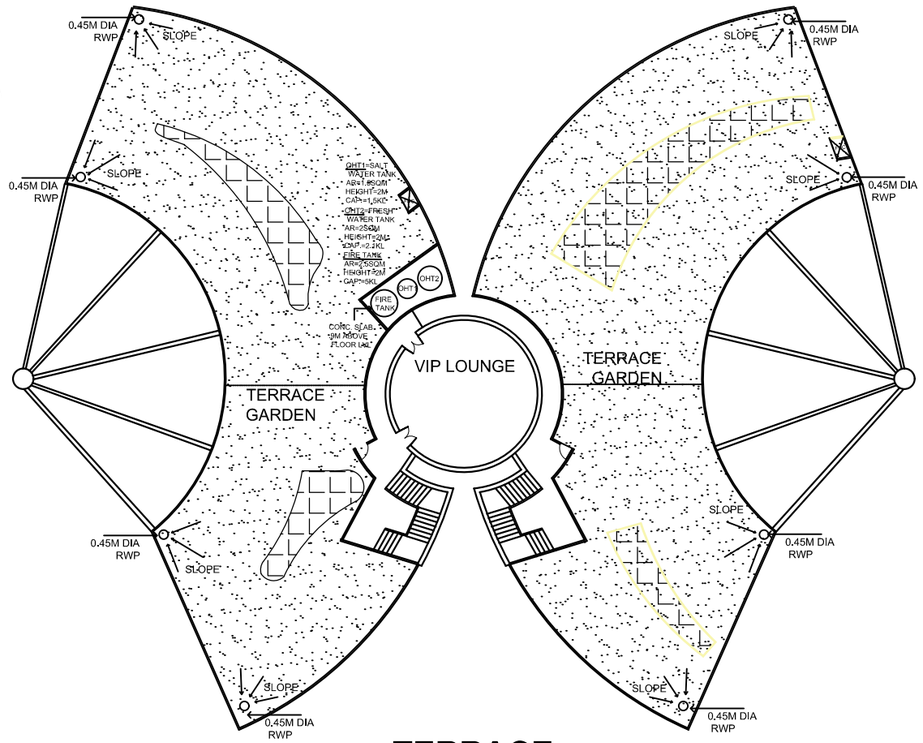
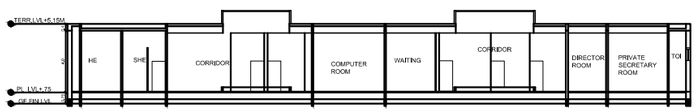


GROUND FLOOR



TERRACE



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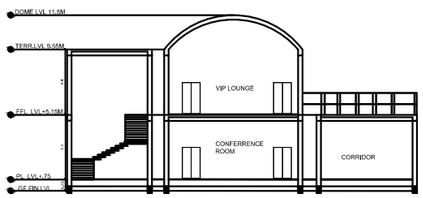

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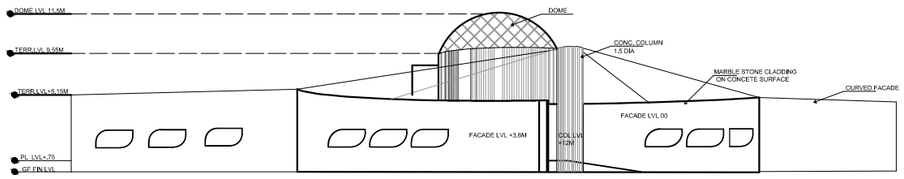

ELEVATION AT XX'

ADMINISTRATION AND RESEARCHERS RESIDENCE

	LEGEND	AREA
1	ADMIN OFFICE	12
2	MAINTAINACE OFFICE	10
3	SALES MANAGER OFFC	15
4	SUPERVISOR OFFC	12
5	PUBLIC RELATION OFFC	12
6	CHEIF SECURITY OFFC	10
7	ACCOUNT OFFC	10.5
8	STORE AREA	12
9	RECORD ROOM	12
10	TOILET	12
11	PRIVATE SEC. ROOM	15
12	DIRECTORS OFFC	33.5
13	RECEPTION	12
14	WAITING	12
15	COMPUTER ROOM	12
16	STAFF AREA	12
17	STORE	12
18	TECHNICIAN ELECTRICAL	6
19	TECHNICIAN PLUMBER	6
20	TECHNICIAN PLUMBER	6
21	ASST ENGINEER	10
22	ASST. ENGINEER	10
23	MEDICAL OFFICE	15
24	DISPENSARY	12
25	TOILET	23
26	AHU ROOM	25

OCEANARIUM,MUMBAI

PLAN, ELEVATION,SECTION
DRAWING: N.T.S.

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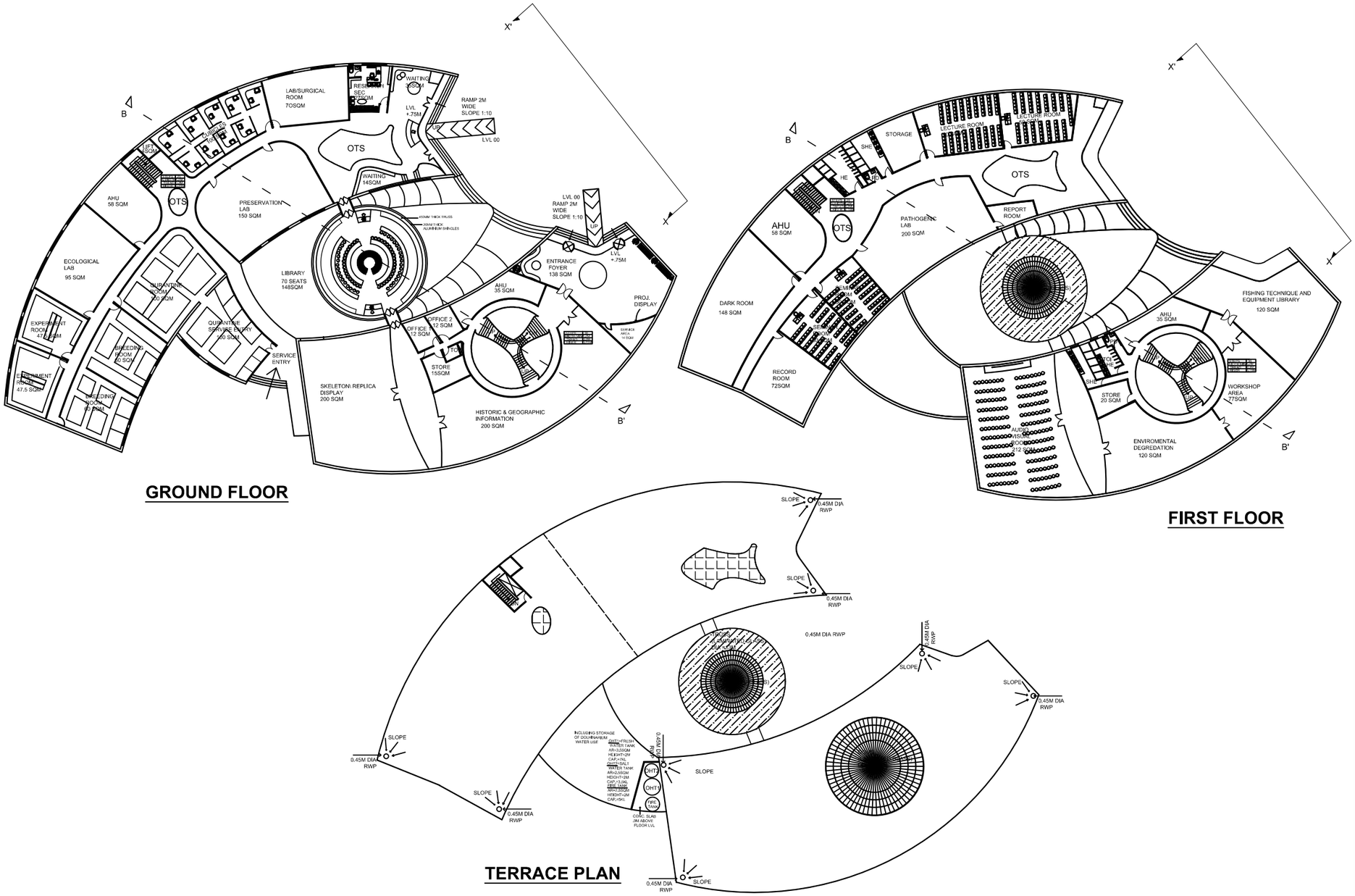
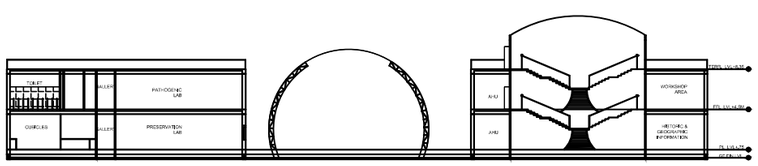


GROUND FLOOR

FIRST FLOOR

TERRACE PLAN



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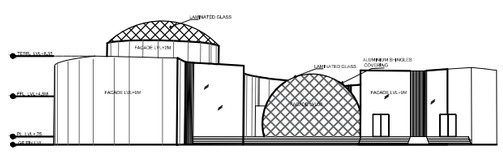

ELEVATION AT XX'

RESEARCH AND MUSEUM BLOCK

OCEANARIUM,MUMBAI

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DRAWING: N.T.S.

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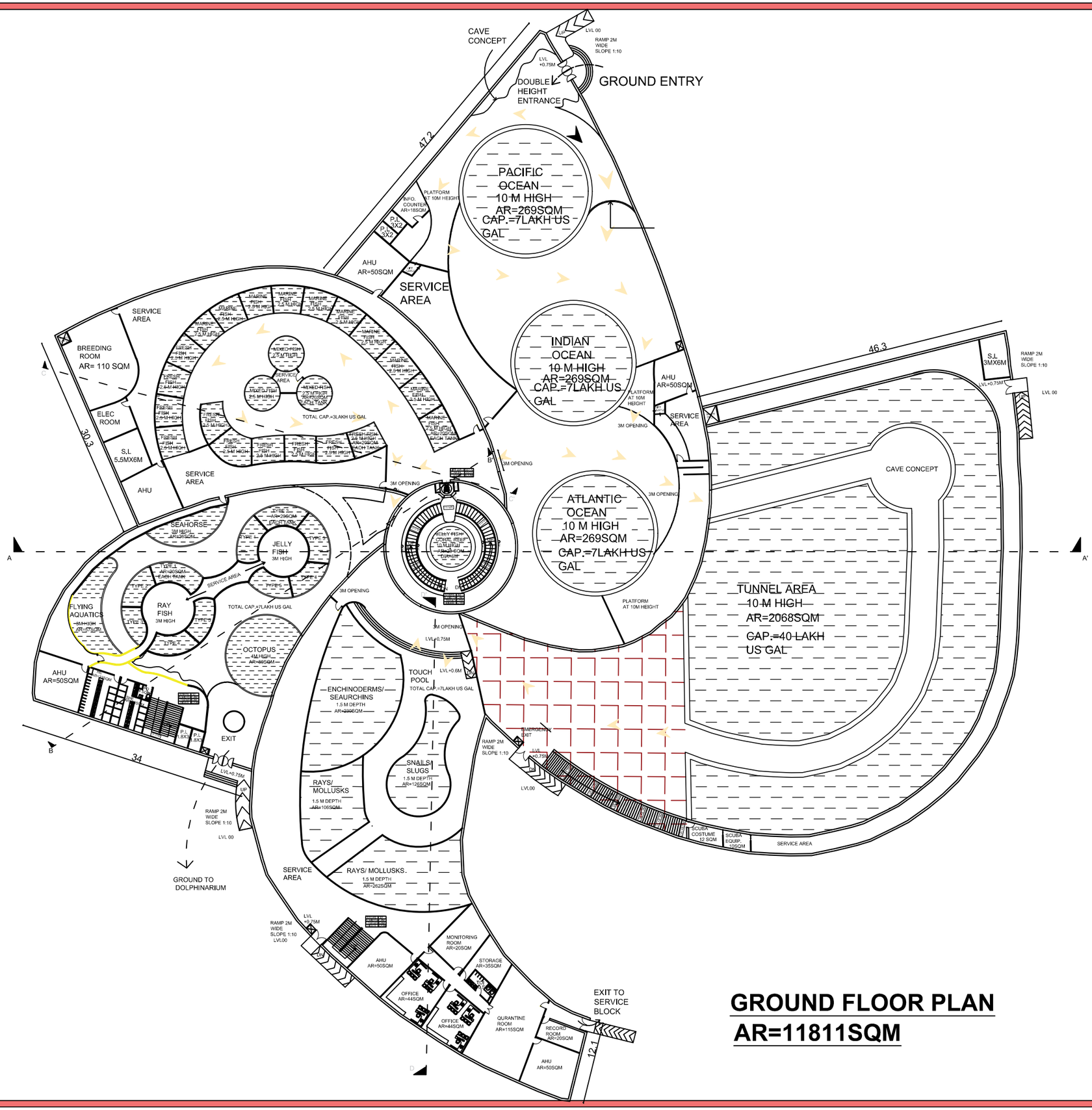

GROUND FLOOR PLAN
AR=11811SQM

OCEANARIUM,MUMBAI

PLAN, ELEVATION,SECTION
DRAWING: N.T.S.

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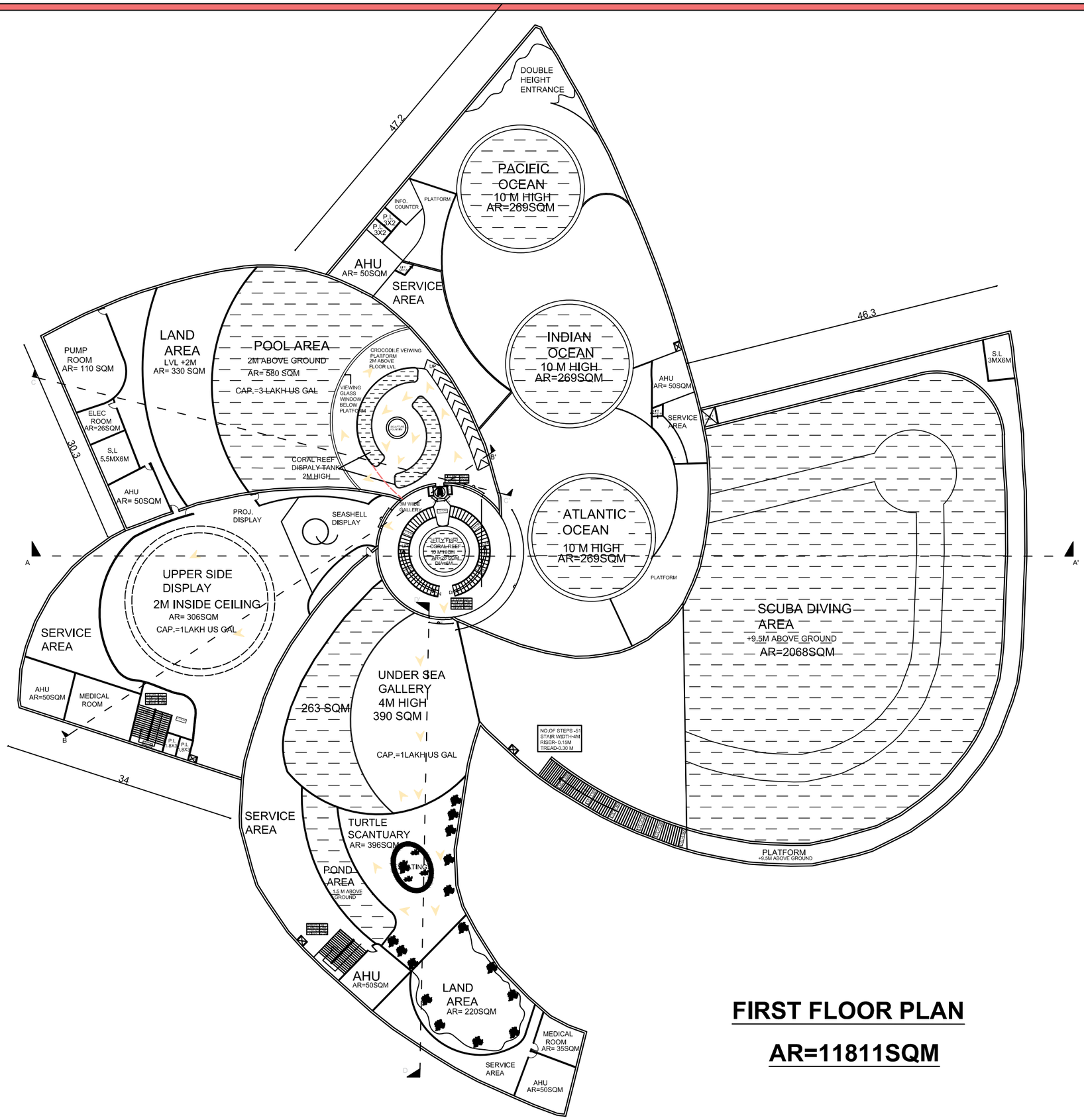

FIRST FLOOR PLAN

AR=11811SQM

OCEANARIUM,MUMBAI

PLAN, ELEVATION,SECTION

DRAWING: N.T.S.

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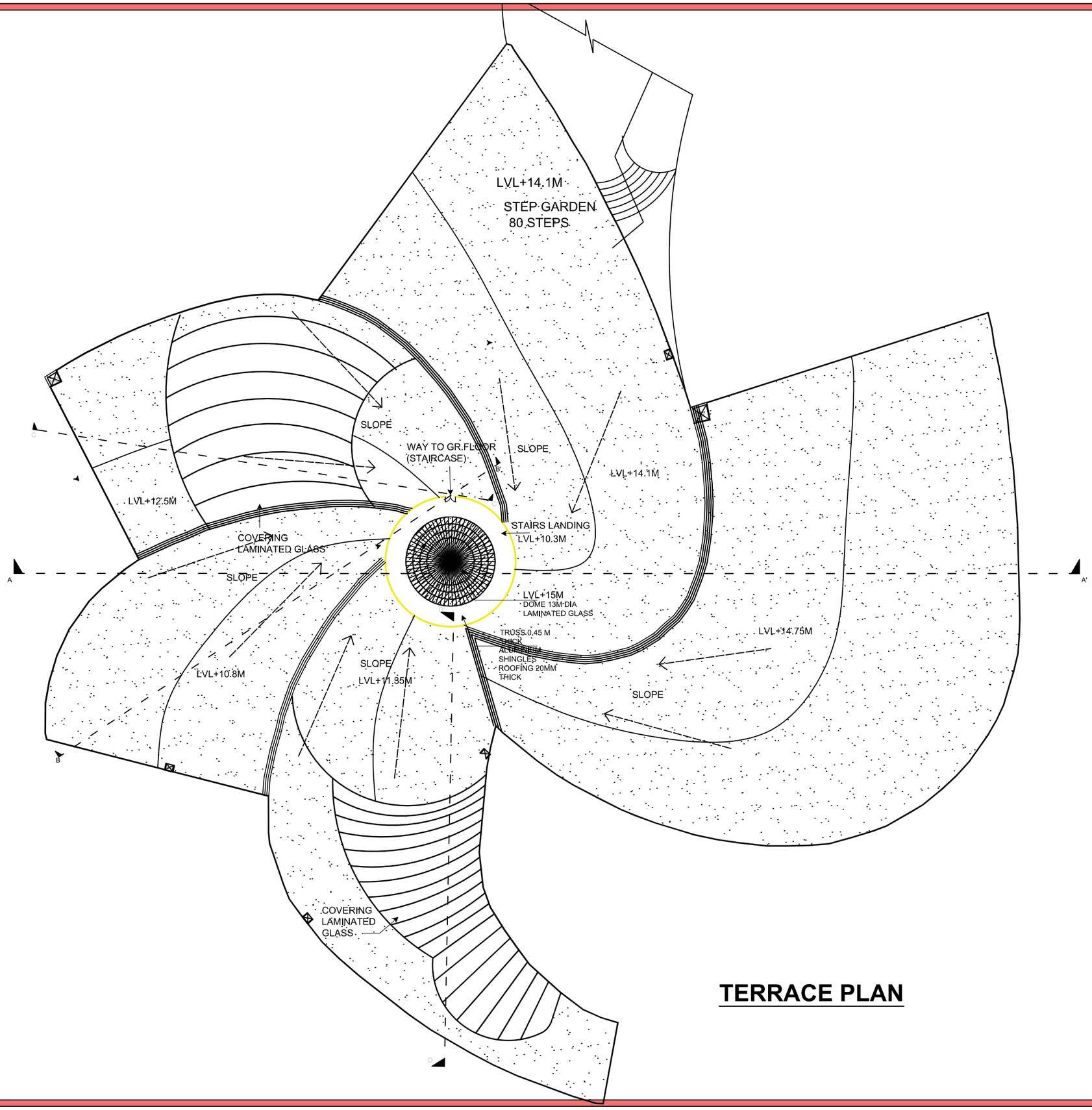

TERRACE PLAN

OCEANARIUM,MUMBAI

PLAN, ELEVATION,SECTION
DRAWING: N.T.S.

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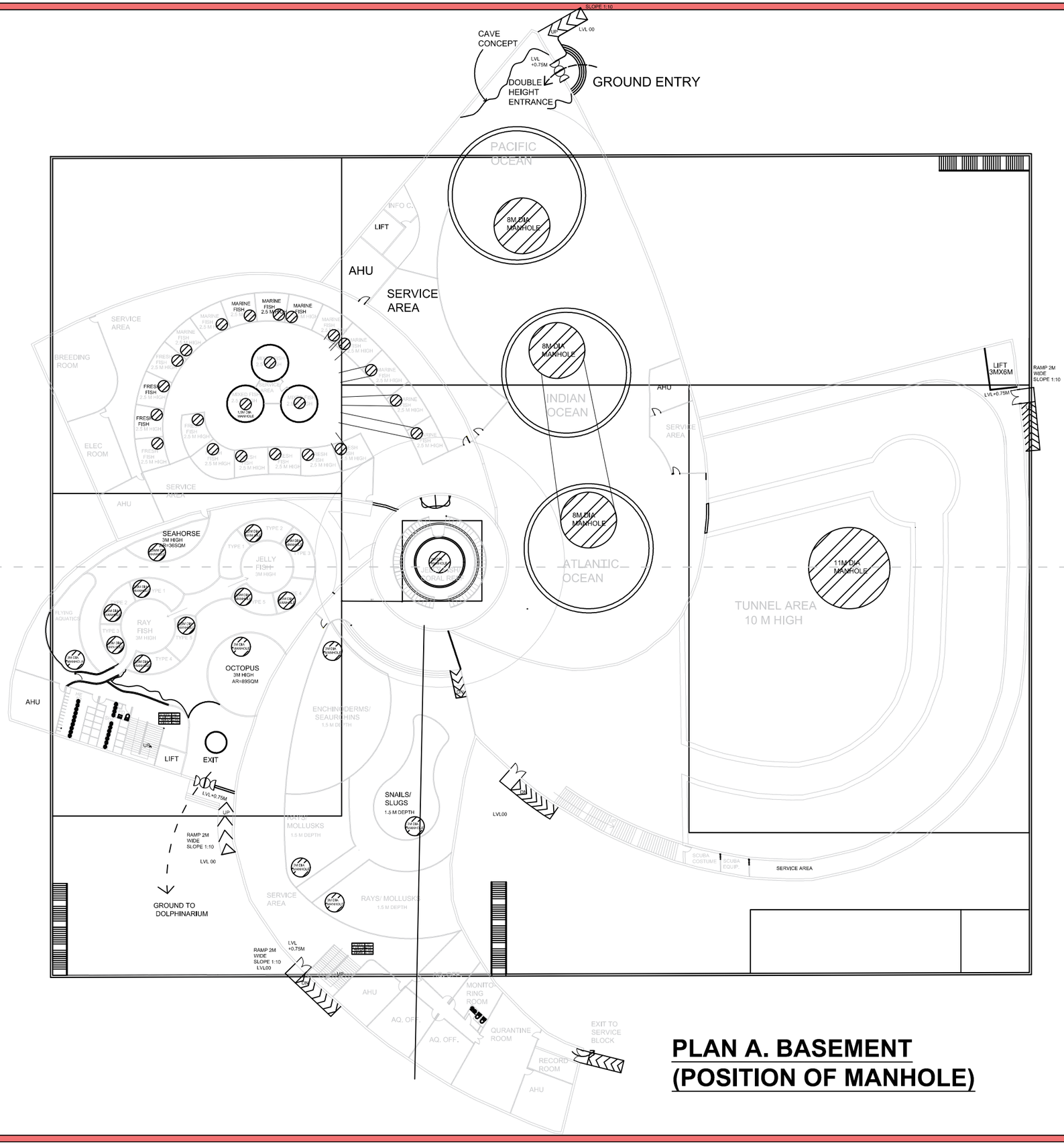

PLAN A. BASEMENT (POSITION OF MANHOLE)

OCEANARIUM,MUMBAI

PLAN, ELEVATION,SECTION
DRAWING: N.T.S.

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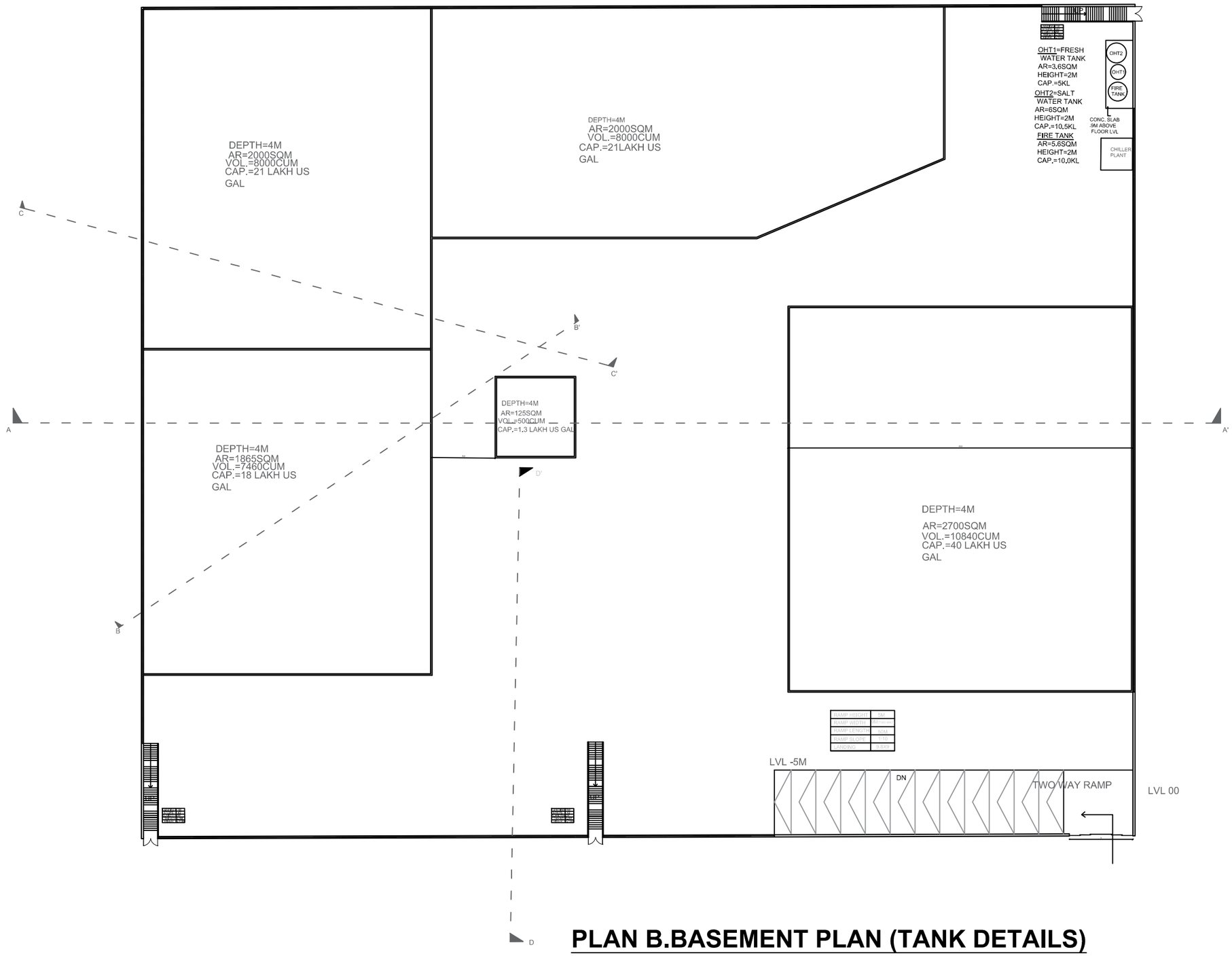

PLAN B.BASEMENT PLAN (TANK DETAILS)

BASEMENT AREA =16400SQM

OCEANARIUM,MUMBAI

PLAN, ELEVATION,SECTION

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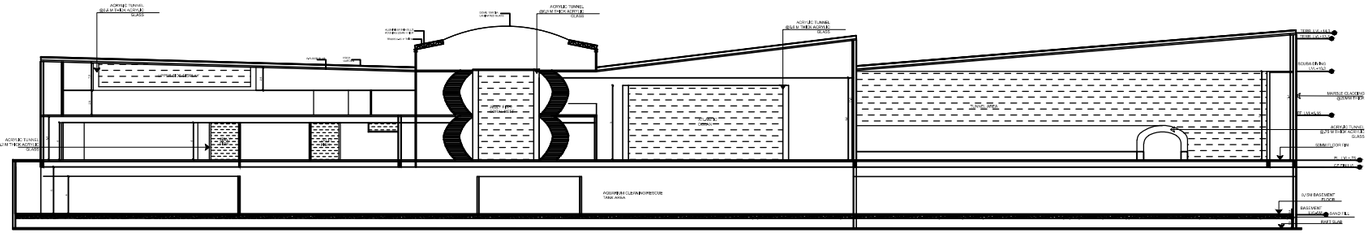
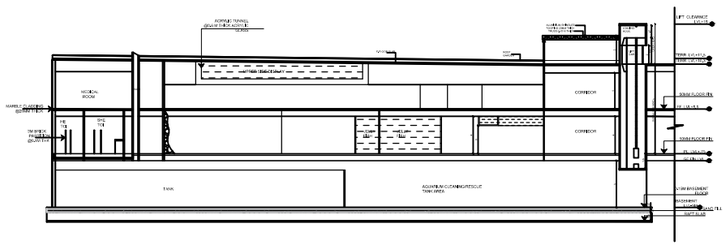


SECTION AA'



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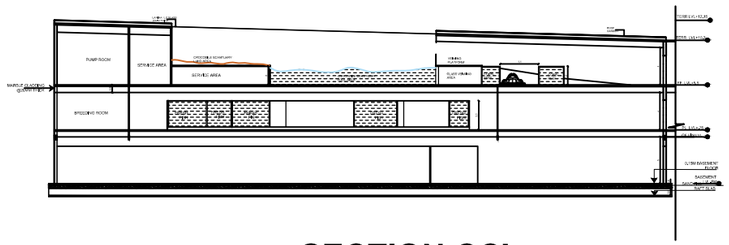
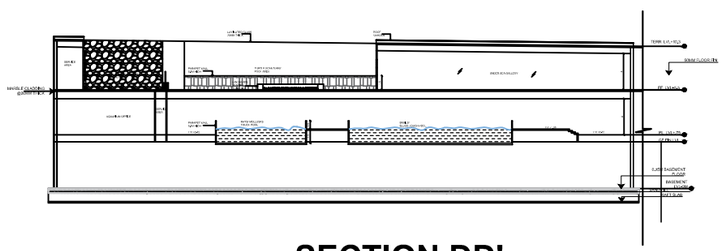
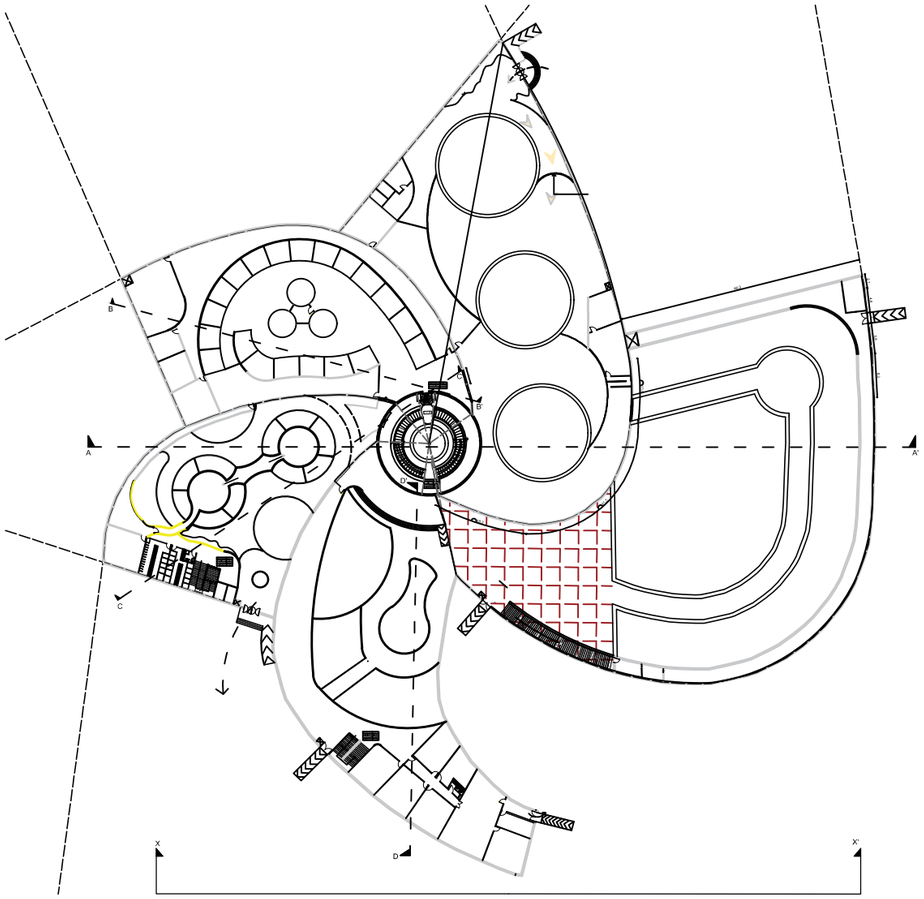


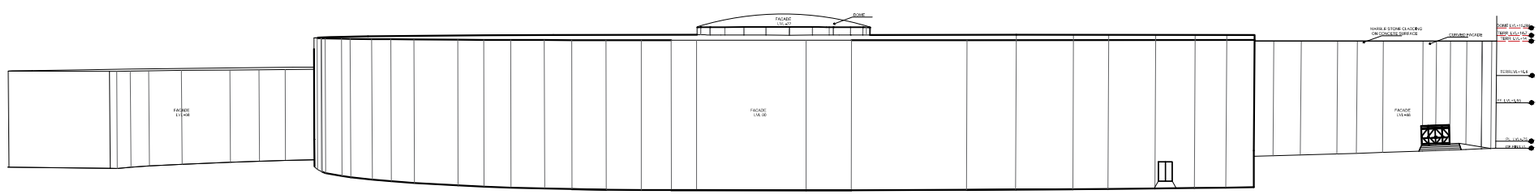
SECTION CC'



SECTION DD'



KEY PLAN



ELEVATION AT XX'

OCEANARIUM,MUMBAI

ELECTIVE 2

WORKING DRAWING

DRAWING: N.T.S.

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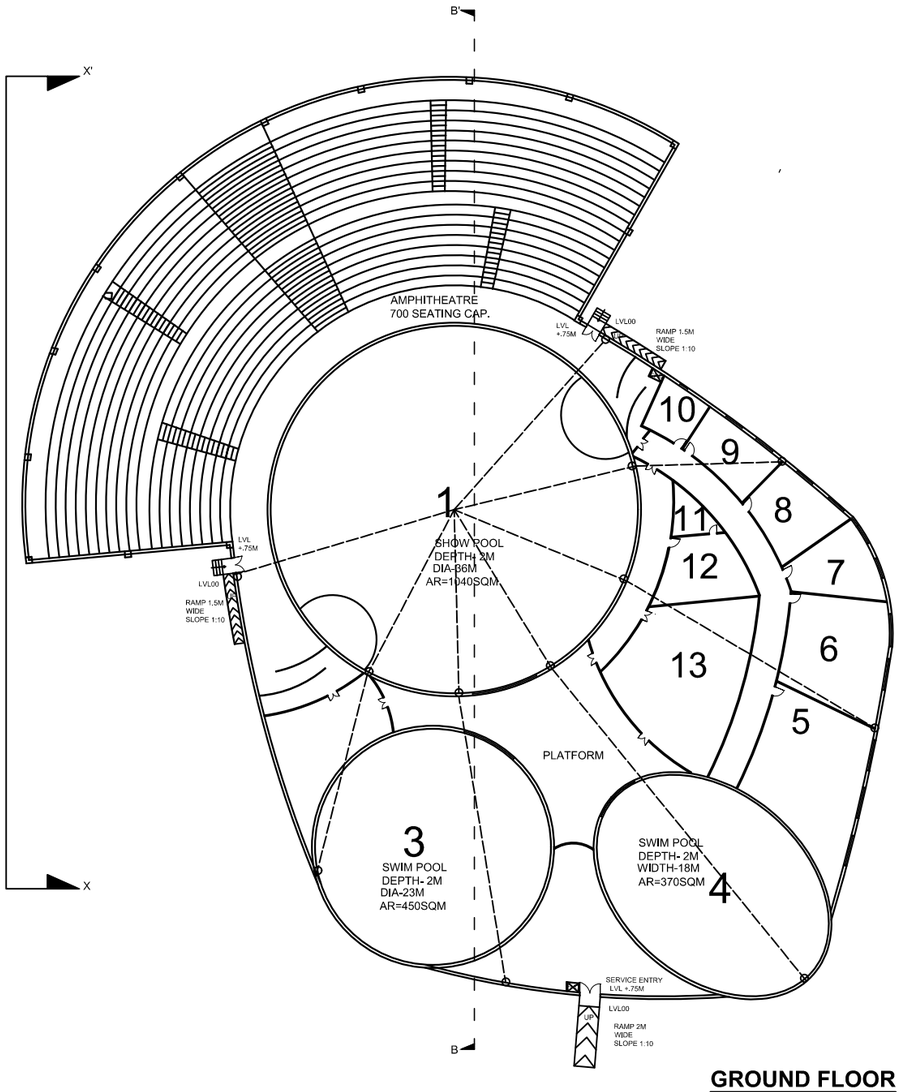
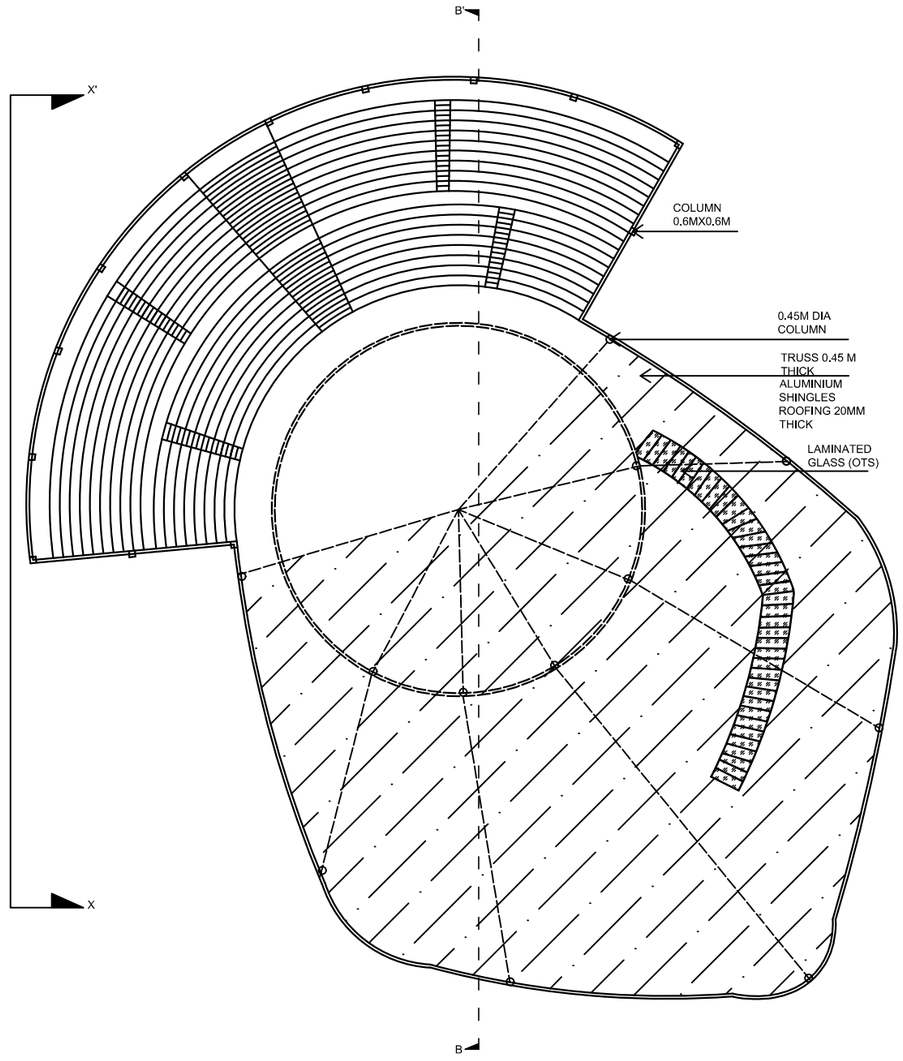
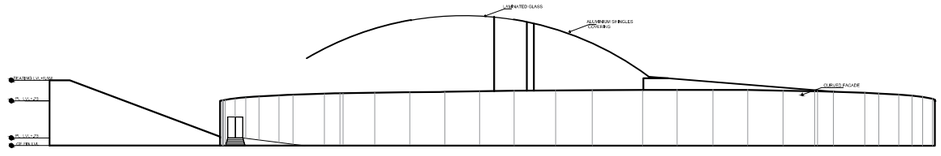


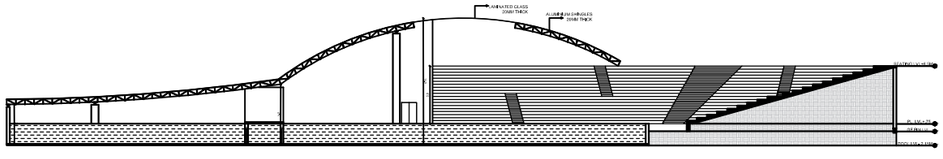
GROUND FLOOR



FIRST FLOOR



ELEVATION AT XX'



SECTION BB'

DOLPHINARIUM BLOCK

LEGEND		
SNO.	AREAS	SQM
1	SHOW POOL	1040
2	AMPHI THEATRE	1482
3	SWIM POOL	450
4	BACKUP POOL	370
5	PUMP ROOM	152
6	MONITOR ROOM	108
7	STORE AREA	48
8	CHANGING ROOM	43
9	TRAINER ROOM	43
10	TOILET	25
11	STORE (KITCHEN)	14
12	KITCHEN	52
13	MEDICAL ROOM	175

OCEANARIUM,MUMBAI

PLAN, ELEVATION,SECTION
DRAWING: N.T.S.

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BBD UNIVERSITY LUCKNOW

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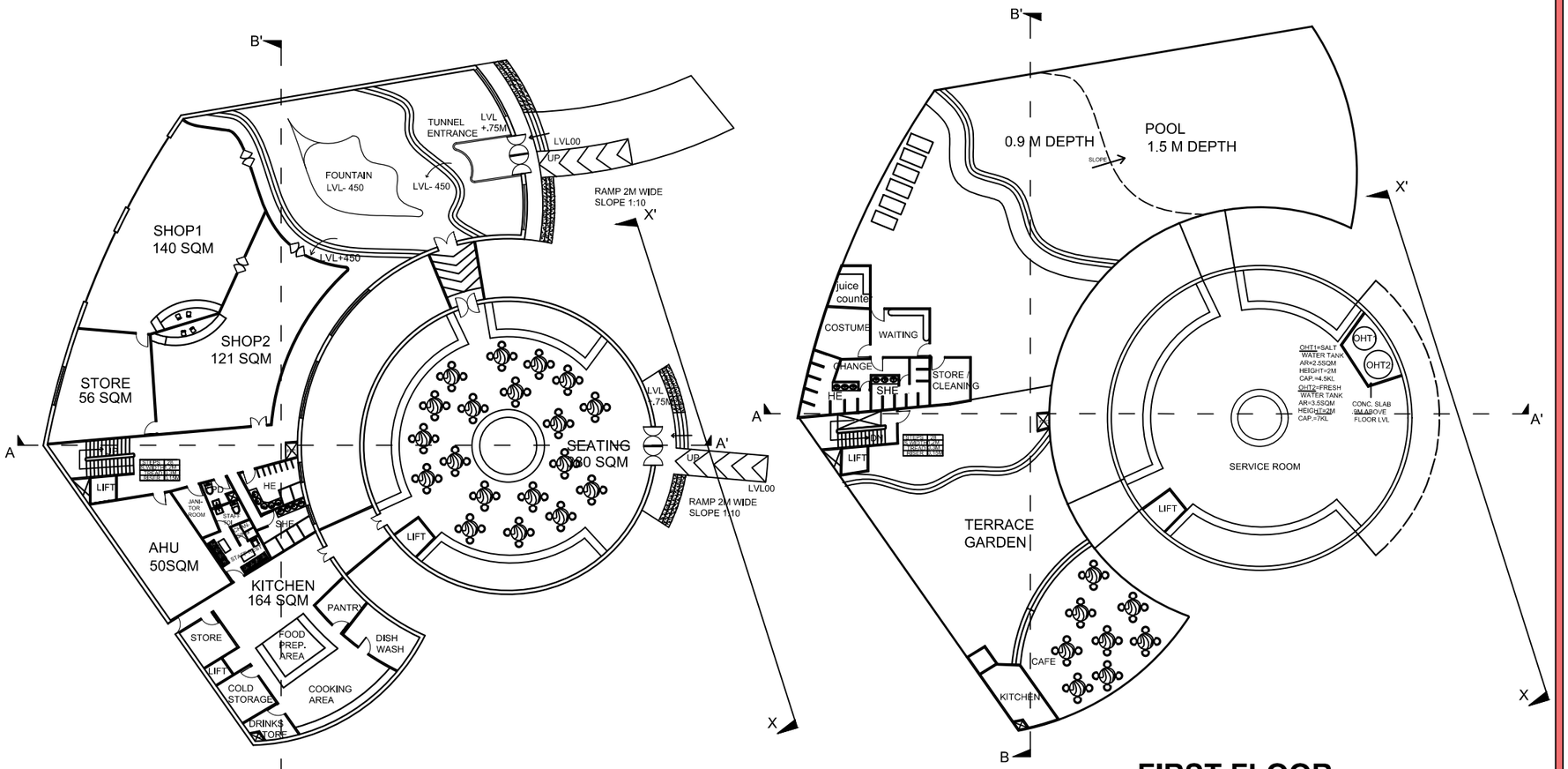
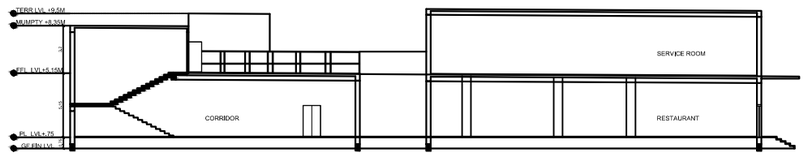
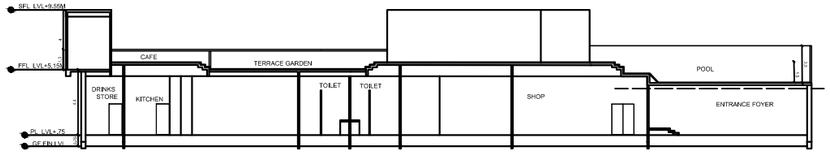




SECTION AA'



SECTION BB'

ELEVATION AT XX'

RECREATIONAL BLOCK

OCEANARIUM,MUMBAI

PLAN, ELEVATION,SECTION
DRAWING: N.T.S.

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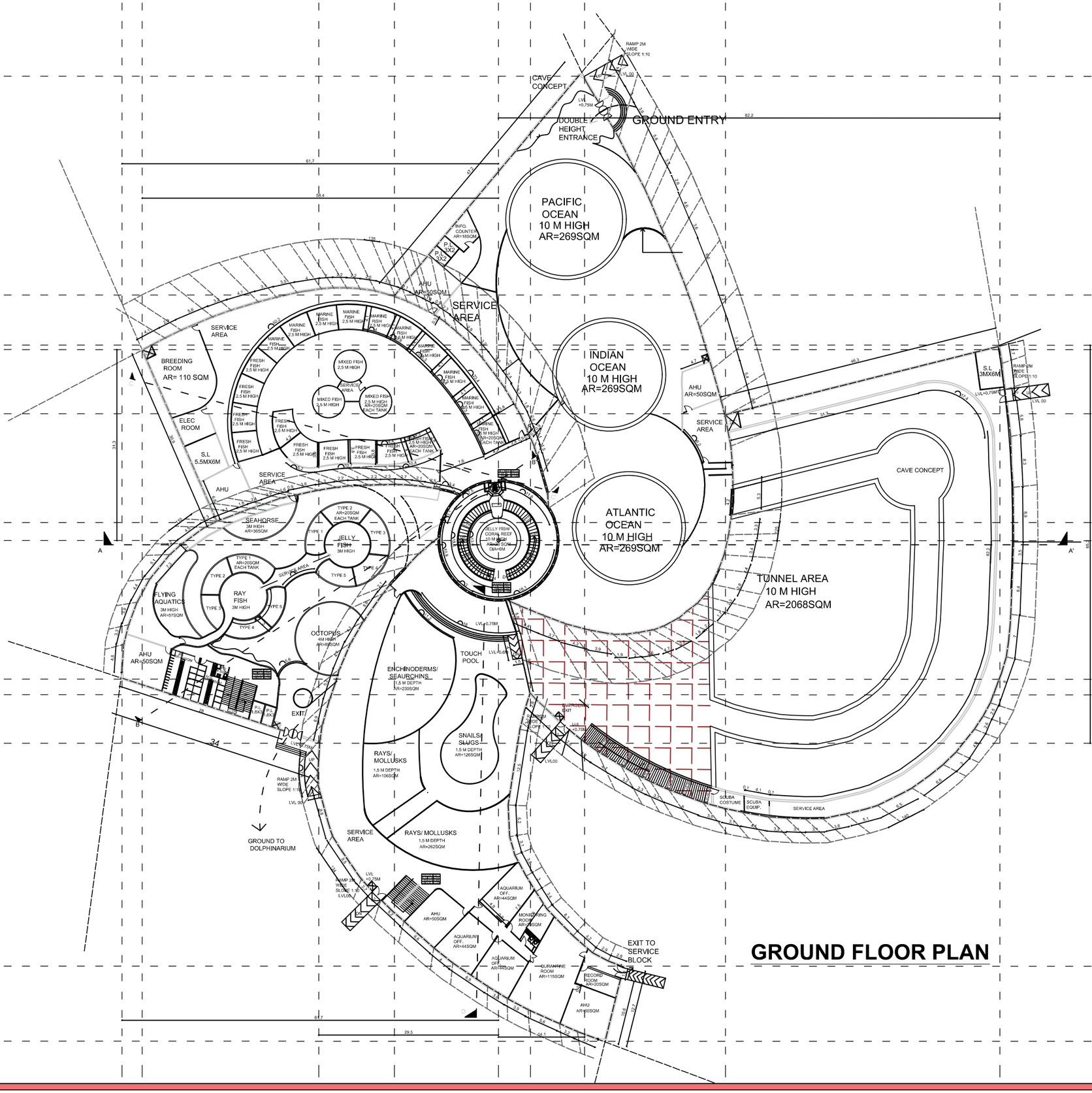

GROUND FLOOR PLAN

OCEANARIUM,MUMBAI

ELECTIVE 2

WORKING DRAWING

DRAWING: N.T.S.

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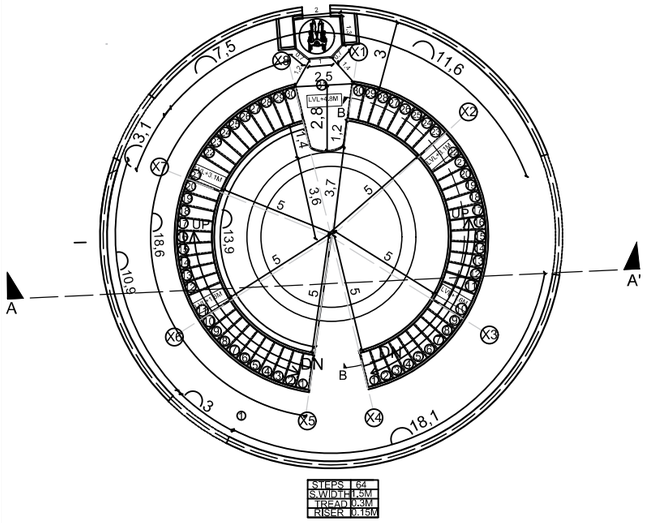
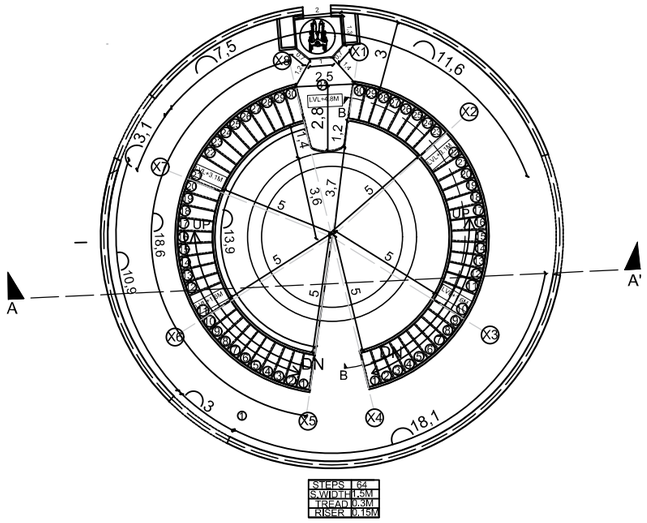
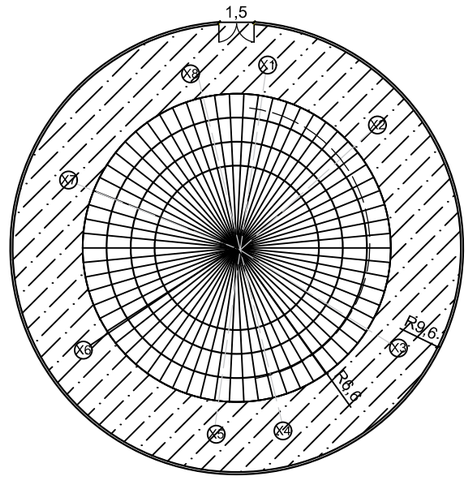


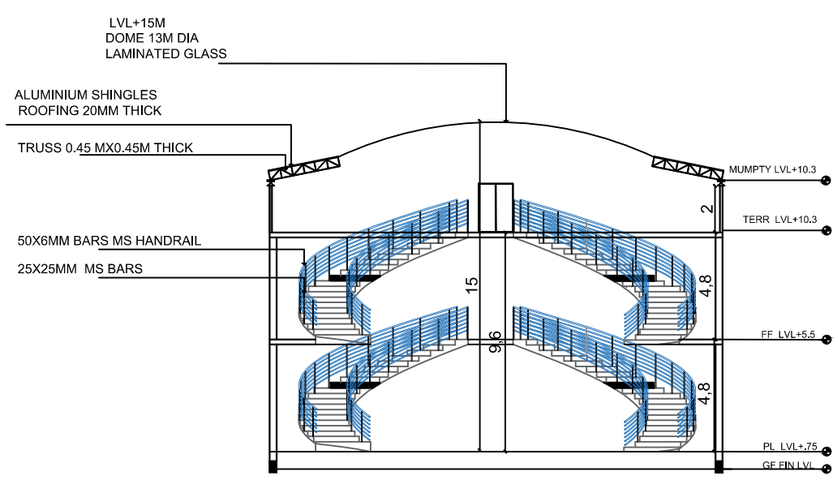
GROUND FLOOR PLAN



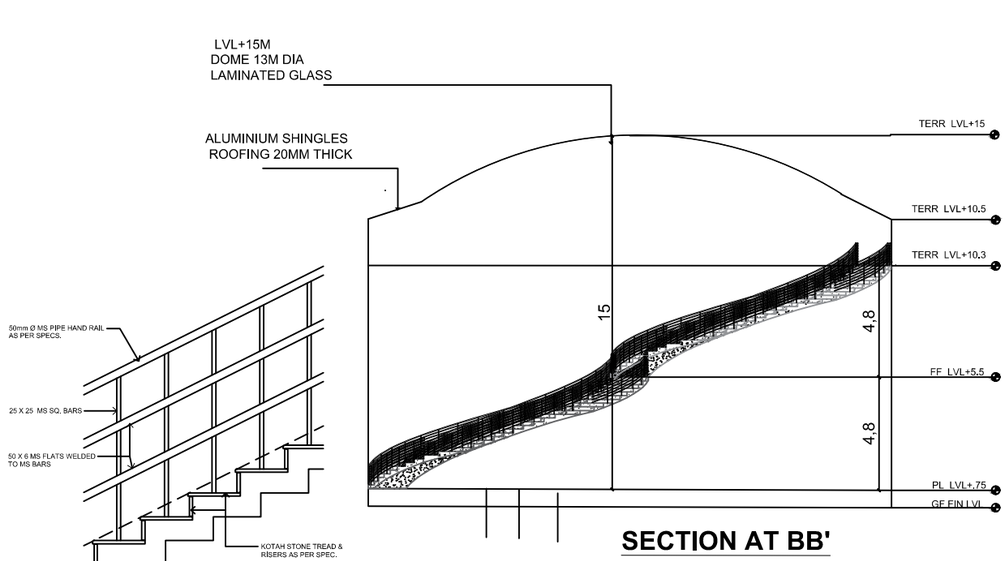
FIRST FLOOR PLAN



TERRACE PLAN



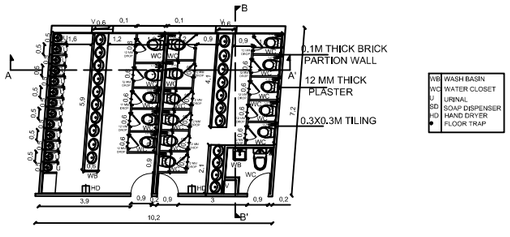
SECTION AT AA'



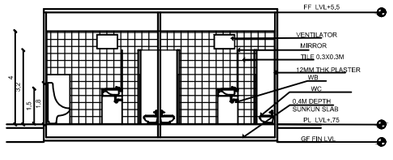
SECTION AT BB'

STAIRCASE DETAIL

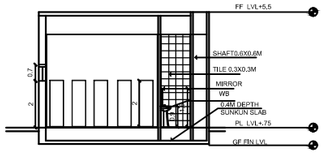
TYPICAL ELEVATION OF RAILING



TOILET AT GROUND FLOOR



SECTION AT AA'



SECTION AT BB'

TOILET DETAIL

OCEANARIUM,MUMBAI

ELECTIVE 2

WORKING DRAWING

DRAWING: N.T.S.

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