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Masterarbeit

Aquamarina Dorcol/Blue Wave Aquarium and research center with special accent on energy consumption, construction and spatial organization

ausgeführt zum Zwecke der Erlangung des akademischen Grades eines Diplom-Ingenieurs unter der Leitung

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The project occupies a prominent marina "Dorcol" near the inner port of the city of Belgrade. Located on this particular site on the river near the city center, it is influenced by contrasting hard elements of ship building constructions and on the other side the soft transparancy of water.

The design object is inspired by marine flora and fauna with the goal of preserving and further research of the marine life, as well as increasing awareness of environmental issues and importance of marine ecosystem. The systems of aquariums and exhibitions are allocated in the object depending on the temperature requirements for the animals and the plants, as well as the movement of hot air, so e.g. Rain Forest exhibition is in the south part of the object above the ground level and the North Pole exhibition area is located in the north part.

The organic concept of the west and north façade of the object, as well as the interior of the aquarium is driven by the idea of water, its movement and flow, reflections of light through water and imagining space with "water walls". The formal language of the project combines natural element of object's surroundings-transparency and reflections of water surface, with the built element inspired by an old crane on the site-externally visible truss structure of contemporary architecture.

The object consists of three parts joined by a partially glazed steel roof structure spanning over the building-the Aquarium, the Museum, and the Hotel. The main entrance of the ground floor of the aquarium is a large atrium of four stories. User's orientation is enabled by open and fluid space with its focal points of gathering on the ground floor level, which is constructed as a curved surface enabling the visitors of the aquarium a unique experience of walking on the landscape resembling the bottom of the ocean. Each floor has passageways constructed as bridges suspended from a truss roof from which it is able to see the flow of the people on this curved surface-open space.

The façades are connected to a system of steel space frames, which support the concrete structures specially constructed to hold a large quantity of water for aquariums. The focus of the architectural design and project is on the complexity of the steel construction holding the tanks and the "glass box" with the Rain Forest exhibition, as well as the containers on the east façade, which serve as laboratories and office space. The "moving" west and north façade, constructed as free-form geometry with its organic form resembling a sea creature evokes association of a living water organism with the flowing curves and reflective paneled aluminum cladding resembling fish scales. The surfaces are mathematically subdivided and optimized with the help of various 3D programs and calculated in order to reduce difficulties regarding planarity of the panels.



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The thesis is dedicated to my loving family, who supported me spiritually, emotionally, and in every other way throughout my life.

Foremost, I would like to express my sincere gratitude to my mentor Prof. Alsop for the continuous support of my master's thesis, for his patience, motivation, enthusiasm, and immense knowledge, as well as to my other professors of University in Belgrade and Vienna for their guidance.

And a special consideration to Jelisaveta Nacic(1878-1955) first woman architect in Serbia for taking the high road and making the walk with the elephants so magnificent.



Picture 02 Belgrade River Scene 1960.

:Prologue

The backstory

"I am walking that road and feeling the wind on my plexus. I look at myself as if I were a sailor-dishwasher on a boat which everybody left in panic. The captain, officers, passengers and even the rats. Under the rush of air the fortification of Kalemegdan seams to be transforming into the bow of a ship sailing into the heart of darkness. While somewhere far away on the other side of the river shimmering lights are sparkling, I hear how down under in the deep Danube seethes-the wind is bringing me the smell of anchored tankers, the tar, the moss of Djerdap and the fish roe. What am I doing alone on this windswept deck? I am passing by the closed shops and windows with the lights turned off, wondering did I wasted my life, did I make a mistake by staying here in Belgrade, living my life in two streets and the same three cafés, or should I have found the strength to set out and embark into the world? Before falling asleep Andersen's book which I hold in my hands is opening by itself on the page where the God of Dreams is telling a story of those who leave and of those who stay..."

"Prelazim tu stazu, a košava mi udara u pleksus. Licim sam sebi na mornara-sudopera na brodu koji su svi napustili u panici. Kapetan, oficiri, putnici i pacovi. Kalemegdanski bedemi pretvaraju se pod naletima vetra u pramac ladje što plovi u srce tame. Negde daleko na drugoj strani reke svetlucaju uznemirene lampe, cujem kako negde dole, duboko, kljuca Dunav — košava mi donosi mirise usidrenih šlepova, katrana, djerdapske mahovine i riblje ikre. Šta radim sam samcijat na ovoj vetrovitoj palubi? Prolazim po ko zna koji put pokraj zatvorenih prodavnica i izloga u kojima su pogašena svetla, pitam se jesam li glupo procerdao zivot, jesam li pogrešio što sam ostao ovde u Beogradu,nastavio zivot u dve ulice i tri kafane, ili je trebalo smoci snage i otisnuti se u svet? Andersenove bajke koje drzim u ruci pred spavanje otvaraju mi se same od sebe na stranici gde Bog spavanja prica o onima što putuju i onima koji ostaju..." [1]

:Introduction











The city of Belgrade is built on two rivers, on a confluence, where river Sava is meeting river Danube. It is also a symbolic point, especially meaningful for the people living here, where two streams flow together, merging into a single stream, exactly as an old part of the city on east riverside merges with the new one on the west, representing the historical symbiosis between the western and the eastern influence. On this exact spot is where the history of the city begins. In order to understand the richness of cultural mixture that influenced the city of Belgrade to be what it is today, the background story of its origins needs to be told, as also the story of its numerous battles, in which the city was razed to the ground astonishing forty-four times.

The city is not just located at the meeting point of the two large rivers, Danube and Sava, but it is also a place where two opposite geographical areas- a plain of Pannonian Basin and a mountain range of the Balkan peninsula- meet in creating a unique blend. This uniqueness of natural crossroads made Belgrade a strategic point for many conquers, a permanent border between worlds, a place of meeting and exchange, but also of perpetual conflicts and bloodshed.

From the first found traces of a civilization during Neolithic, about 8000 years ago, the history records many settlers and invaders of Belgrade: Greeks, Romans, Celts, Huns, Averies, Sarmatians, Slavs, Goths, Ugrians, Bulgarians, Russians, Turks, Austrians, Germans are just some of many other people and nations leaving their mark behind.

In 3rd Century BC, the Celts built the fortification Singidun on the meeting point of the rivers. During the roman reign the first bridge over river Sava- aquaduct was erected and the fortification was reconstructed with stone, the remains of which can be seen today, existing under name Belgrade Fortress, although the fortification was destroyed and rebuild so many times in battles that it lost its original form. The confluence of rivers separated the Habsburg Empire and Ottoman Empire for more than three centuries, representing a border between two distinctive cultures, which influenced two different urban developments, known today as Stari grad(Old city) and Novi Beograd(New Belgrade).

One of the oldest and smallest quarters of Stari grad is Dorcol, the area between Belgrade Fortress, the Student's Square, Despot Stefan Lazarevic Boulevard and the Danube River. The quarter got its name after the Turkish expression 'Dörtyol', which means four roads. Indeed, during the Ottoman rule, the corner of Kralja Petra, Dubrovacka and Cara Dušana Streets was an important intersection of four merchant roads leading towards Istanbul, Vidin (Bulgaria), Vienna and Dubrovnik. Consequently, Dorcol developed into the region's trading centre with its first harbor near the fortification. Today it is a harbor for tourist ships and the main port of Belgrade was opened near the city center in 1961. along a coastline of the river Danube, with the marina Dorcol next to it, developed as a natural harbor for small and sailing boats.

"Belgrade seen from this side is unforgettable. It's a true wonder how this disorganized (unarranged, disorderly) city can look so dignified from a distance. Many of foreign visitors I have brought here felt the same way. Only from here can you feel how big of a heart is beating in this city. 'Belgrade has none of the true architectural monuments', I say sometimes, because, as a host, I should be modest. 'But for goodness' sake, this city is a monument itself'–shouted once one of my guests. I think nothing better has yet been said." [2]

In the past 15 years people in Belgrade have witnessed the announcement of several master-planned projects in areas involving river waterfronts, where Belgrade's 'investor urbanism' is taking place at various scales. Iconic architecture and 'urban renewals' have been proposed for very attractive locations in the city, promising a monumental master-planned districts. One of these renewal project aimes at evolving the "Belgrade Waterfront" into "a hub for businesses of all kinds" and a "natural destination for big public celebrations", including "the Belgrade Mall, the region's largest". The goal is to renew the waterfront and to change the working-class image into a modern entertainment big-city image meant to support and encourage conspicuous consumption and discourage discrepant social interactions. More grandiose than any of its predecessors in scale and cost to tax payers, it brings both potential risks and violated regulations. The frightening social consensus is that for the first time the Serbian Government has become, not only an enabler of the project, but also its instigator. The first public presentation of the Belgrade Waterfront project came with a campaign for the municipal elections in 2012. The project reappeared during the 2014 parliamentary election as the trump card of the current prime minister and the ruling party who were promoting a "better future". Planning a better future through the construction of luxurious flats when hundreds of thousands of people are without permanent housing solutions; construction of new retail and office spaces while fading "for rent" signs on the same buildings have been an everyday sight for years.



"A Flashy, Mysterious Plan for Belgrade's Waterfront Investors from the United Arab Emirates appear set to give Serbia's capital a Dubai-style makeover. But tons of questions remain unanswered." [!]

Pricy Belgrade Waterfront apartments "will sell immediately"[!]

"JUNKSPACE"

Junkspace is political: it depends on the central removal of the critical faculty in the name of comfort and pleasure

Junkspace pretends to unite, but it actually splinters. It creates communities not of shared interest or free association, but of identical statistics and unavoidable demographics, an oportunistic weave of vested interests

"Junkspace seems an aberration, but it is essence, the main thing... product of the encounter between escalator and air conditioning, conceived in an incubator of sheetrock (all three missing from the history books)."

"verbs that start with re- produce Junkspace...Junkspace will be our tomb" [5]



"Daniel Libeskind vision of Belgrade waterfront"[!]

"Serbie : Belgrade Waterfront, la folie des grandeurs"[!]

"Zaha Hadid creates the new face of Belgrade..."[!]

ACTIVISTS DISTRIBUTING PUBLICATION CRITICAL OF "BELGRADE WATERFRONT" PROJECT DETAINED BY POLICE[!1]

Picture 07 Belgrade Waterfront Picture 08 Libeskind master project

Picture 09 Zaha Hadid#s project for Belgrade



These processes created a reaction in the shape of the initiative Don't drown Belgrade! The organization was formed to stop further degradation and plundering of Belgrade in the name of colossal urban and architectural projects. The changes brought about by Belgrade's General Plan produced a new legal framework that enabled occupation and privatization of public space owned by the city. It erased the obligatory architectural competition as a format for expert and public involvement allowing fragmentary planning and increasing the possibility of ignoring social aspects of city life. Creating the new legal framework was the Spatial Plan of the economically "most valuable" part of Belgrade, which transferred the investor's model into the planning documentation – in contrary to the regulations of the Republic of Serbia. Don't drown Belgrade again worked with collective complaints, but this time having only one goal in mind – the complete rejection of the dubious plan and the creation of the new one. Complaints focused on spatial and social segregation, collapse of traffic and the disappearance of small economies.

The signing of the contract was followed by a protest organized by Ne da(vi)mo Beograd, where hundreds of people gathered alongside a giant yellow duck, the symbol of an ongoing fraud. The protesters were separated from the Belgrade Cooperative (Geozavod) building by a cordon of police. However, at the moment government officials and their Abu Dhabi partners were leaving the building, two trams halted in front of it and blocked the protesters from view. The mayor claimed that: "The trams could not pass because of the citizens who had gathered there and traffic returned to normal after the protest was over", even though the citizens were on the other side of the police line.

The social movement in Belgrade was always decisive in showing their opinion as a united front in time of need and protesting against political decisions

affecting the history of making the city. Whether it lead to destruction of Belgrade, as it was in the case of the protest Bolje rat, nego pakt-Better War, Than a Pact, when Serbian people raised in 1941. against the government decision to let the Germans pass through our country, and as a result suffered a distruction of the city in bombing, or whether it is against the government decision to build a large scale waterfront entertainment districts in the city center, the goal was, and still is to preserve our and our city's identity.



"The city lives in its own way and not even by setting the most rigorous set of rules we can't force it to live differently than it has to. Truth to be told, there are a lot of things in life of the city that can be cultivated. To be styled up or to be re-styled." [2]

"Belgrade's Savamala district: Serbia's new creative hub"[!!]

"Creativity is blossoming in Belgrade where a riverside cultural hub has sprung up in the derelict mansions and warehouses, led by free thinkers looking to the city's future"[!!]

The change in urban development of Belgrade riversides is evident in the last ten years. What used to be a port areas with train tracks preventing a direct connection between the city center and riversides, today are more and more becoming cultural center for young innovative artists leaving their unique marks through graffiti art and other interventions. Small economy blossomed with new cafes, restaurants, night clubs being opened in affordable empty storage spaces units. People are gathering and using this space, which used to be vacant, neglected industrial area behind Belgrade's central station.

"Wandering through the area it's easy to see how the empty buildings – among them derelict art nouveau mansions from the days when this was a high-end neighbourhood and workshops built after the second world war – are being transformed. Stretching along the riverbank is Beton Hala, or Concrete Hall (a name that makes sense once you see the row of white warehouse blocks it describes), now occupied with upmarket contemporary restaurants, as well as providing an open waterside promenade during Belgrade's hot summer months. The area is beginning to resemble the kind of creative quarter you would expect to find in most modern cities."[!]

A cultural impact of this neighborhood on the city is seen through opening of the new prominent venues, design centers and performance spaces, galleries and is becoming the new cultural meeting point in Belgrade. Number of music and art festivals increased, as if artists in Belgrade were looking for an authentic place for expression, and they found it almost symbolically just where our history starting to write itself.

Picture 11 Belgrade Waterfront 2015



PRESERVING THE IDENTITY of the industrial zone- marina

The project's attempt is to criticize the current processes of "reinventing" Belgrade, and to introduce another standpoint, namely to view the historical significance of landmarks and monuments in these industrial areas, which are giving the identity to the city. Since an architectural art piece, as any other art piece according to Arthur C. Danto, is not just what appears in front of the viewer, but is defined by knowledge of the entire art history and current events in the world, and their interpretations that bring it into the art world, the designing process for creating an architectural object requires the knowledge of historical and sociocultural context in which it is created. One of the objectives of the project AQUAMA-RINE is to promote the marina as a historical and contemporary attraction, which will meet the growing interest not only of the specialized scientific community, but also the general public. The project would **not** transform the riverside of the city of Belgrade, but give the existing historical landmarks a new point of view, in preserving the identity of Dorcol.

In building of such a project on this particular location, the link between the city landmarks is continued. Developing new urban spots through reviving the existing structures will provide urban decentralization of city's activities. Although urban development of the city of Belgrade is historically connected to the rivers, their banks are more of an industrial purpose, than residential. All of the industrial riverside areas near city center are locations of prominent land for future projects. The main concern should be not to destroy already recognizable city silhouettes, with its industrial tower and cranes, but to add to their potential appeal. The main symbols of Dorcol Marina are the old crane, which was used for extracting boats for maintenance, the tower of the power plant, which is the highest point of Docol, seen from surrounding areas of Belgrade, and the old abandoned power plant factory, one of the first built in Bauhaus style. The project will give a new meaning and purpose to these landmarks.

"The cities in the making, which are in process of consolidation, which are only recently starting to find themselves, as in case of Belgrade up to a certain point, can potentially, secretly carry a style of their own. Although they are often not aware of it, so they are not showing it openly enough. Belgrade is the city with some sort of inner style, waiting to be properly upgraded."[2]



"The cities in the making, which are in process of consolidation, which are only recently starting to find themselves,-as in case of Belgrade up to a certain point,-can potentially, secretly carry a style of their own. Although they are often not aware of it, so they are not showing it openly enough. Belgrade is the city with some sort of inner style, waiting to be properly upgraded."[2]





Picture 16 Dorcol, Sport center



"In contemporary world, process of globalization, which was made by developed capitalistic society in order to negate stability and autonomy of identity, brought the fascination with abstraction, disappearance, over presence and availability. In that sense, abandoned/ghost spaces, non-places, and other similar phenomena are easily identified "as typical expressions of the age of globalization" (Ibelings, 2003, pp. 66). Inexistence of identity, absence of function and meaning, lack of liaisons with surrounding characterizes architecture of no programme. Causes of their existence often lay in failed concepts, political, economical and cultural breakdowns that affect all structures and layers of society's actions, especially architecture, as highly dependent discipline. One of the most recognizable characteristics of abandoned space is the absence of content, activity and program. Object without program represents just a simple shell. If we follow Bernard Tschumi's premise that "there is no architecture without program, without action, without event" (Tschumi, 2004, pp.11) our recognized abandoned spaces represent unique, ambivalent architectural act. They are not solely present in Belgrade, but seem to be an emerging phenomenon throughout developed countries of both the East and West.

The other coherent characteristic is by time beginning to appear- the aesthetic of decadence. Marked by solitude of architecture without everyday life and maintenance, emptiness, wracked glass, broken concrete, peeling paint, demolished glass and sometimes water and fire scars. "

http://pedjamarkovic.com/ghost-spaces-of-belgrade

Blagojević, Lj. (2011). Postmodernism in Belgrade architecture: Between cultural modernity and societal modernization, Spatium Internation Review, No.25, pp. 23-29.

Bourriaud, N. (2007). Postproduction. 3rd edition. Berlin-New York:Lukas & Sternberg.





:Location

"Belgrade was among few European cities that, by the end of 19th century, introduced electrical power. Due to industrialization of the city, the country was drawn by modernization. This was important because it brought new social layers, development of transport and telecommunications, and mostly, general cultural progress. One of this kind of projects is the power plant "Power and light" in Belgrade. It is situated in old city centre, Dorćol, near right riverside of Danube. Project represented the great power of country (at that time Kingdom of Yugoslavia (1929-1941.)) that tended to be technologically advanced, at the end of 19th and beginning of the 20th century, by introducing AC.

Life for this architectural artefact began in 1929. when the Commission members of the Municipality of Belgrade decided to build a power plant through an architectural competition in which 14 foreign and 2 Yugoslav companies participated. After only two years of construction, in 1933. Power plant began to work and it was in property of Municipality of Belgrade city.

The architecture of the building was based on modularity, and four production units were constructed, latest in 1938. Form of the building adopted relatively new Bauhaus aesthetics that was marked by the absence of ornamentation and harmony between the function of an object and its design, unifying art, craft, and technology. In 1947. power plant "Power and light" by nationalization process was transferred into state ownership. Unfortunately Plant worked until 1967. when the technology changed and it was necessary to shift to fuel oil. It stopped working in 1969. Once more political, ideological and economic changes of the Federal Public Republic of Yugoslavia have affected on architecture. Ever since, it was exposed to a constant decadence and neglecting.

Although it seems that the main reason of its abandonment wasn't economy, yet a need for new technological advances, it is clear that during the process of overall metropolization of Belgrade, it could not contribute sufficiently. Today, all that is left is the main building, water pump, crane and filter plant. This is an ideal condition for project reprogramming, because it is a true ghost space without memories, ready for new ones to be made. In today's sense, industrial heritage, in addition to be important part of urban and architectural tissue, is a specific part of city's culture. Because of this, it is of great importance to infiltrate and re-programme this kind of buildings in new historical, social and economic aspects of contemporary life, as to create place for urban pop culture to develop."

http://pedjamarkovic.com/ghost-spaces-of-belgrade


Picture 17 Abandoned factory present state, Marina Dorcol, Belgrade









Picture 18 Marina Dorcol :View from the river and on the river Picture 19 Plan of the detail regulation for the site of Marina Dorcol





>>>> 1975 >>>> 2025



Picture21 Marina Dorcol with its landmarks

:Concept

Residents of Belgrade are defining themselves with the life of the rivers, the connection existing between its citizens and the water and the influence is mutual.

The design object is inspired by marine flora and fauna with the goal of preserving and further research of the marine life, as well as increasing awareness of environmental issues and importance of marine ecosystem.

In order to design an aquarium several factors influencing the flora and fauna of the exhibition area must be included when orientating tanks with water. The systems of aquariums and exhibitions are allocated in the object depending on the temperature requirements for the animals and the plants, as well as the movement of hot air, so e.g. Rain Forest exhibition is in the south part of the object to have the most beneficial orientation regarding sun movment during the year and the North Pole exhibition area is located in the north part, in inner area of the object, protected from the heat impacts.





roof truss

north stairs serving as a view platform towords the river

Rain Forest exhibition in Glass Box holded by truss "window"

Aquarium Tanks with Beluga Whales and Shark Tank lifted in the air by steel columns in V shape;south Coral Reef exhibition located inside the construction core seen beneeth and lower water for the Rain Forest exhibition(lower part of Glass Box)

Terrain covering the underground floor and covering instalations /communications for the staff of aquarium

West Facade Blue Wave glazed with ALUMINIUM panels and louvers Steel construction holding passageways for the aquarium suspended by cords and the ceiling for the maintenance of two large Tanks Cores with steel construction, large V pilars holding the roof and floors on the west side

Ceilings and passageways

East Facade Wall where containers are stacked with the crane from the port east from the marina

Underground floor with instalations/storage areas/maintenance

Foundations



The economical potentials of the river are immense since the Danube River connects various countries, allowing the tourists to visit Belgrade by river cruises. In a city which suffers from the recession, the shift to new economic activities such as tourism is essential for the sustainable development. The aquarium as a part of a revitalization plan is seen as a popular tourist attraction, drawing visitors from surrounding regions and countries, helping in economic activity. The premises of the building complex will be built as a part of the river marina bay and would point out the identity and the landmarks of the riverside. Among the many factors that must be considered are traffic flow patterns of visitors, reflections off glass, acoustics, and tank-maintenance problems such as water clarity, dissolved wastes, temperature, tank decor, disease treatment, and nutrition.

:HISTORICAL BACKGROUND

The earliest known aquarists were the Sumerians, who kept fishes in artificial ponds at least 4,500 years ago; records of fish keeping also date from ancient Egypt and Assyria. The Chinese, who raised carp for food as early as 1000 BCE, were probably the first to breed fish with any degree of success. Their selective breeding of ornamental goldfish was later introduced to Japan, where the breeding of ornamental carp was perfected. The ancient Romans, who kept fish for food and entertainment, were the first known marine aquarists; they constructed ponds that were supplied with fresh seawater from the ocean. Although goldfish were successfully kept in glass vessels in England during the middle 1700s, aquarium keeping did not become well established until the relationship between oxygen, animals, and plants became known a century later.

The first containers specifically designed for aquatic specimens were the strictly functional open-air tanks used by the Romans to preserve and fatten fish for market. It was not until the 18th century that the importation of goldfish into France from the Orient for aesthetic enjoyment created the demand for small aquariums; ceramic bowls, occasionally fitted with transparent sections, were produced. In the large public aquariums built in many European cities between 1850 and 1880, efforts were made to create the illusion that the spectator was entering into the underwater world. More recently, the trend has been to emphasize the natural beauty of the specimens and to make a sharp distinction between the water and the viewing space.

:MATERIALS

Glass is probably the safest basic material, although polyethylene, polypropylene, acrylic plastics (Plexiglas), and fluorocarbon plastics are normally nontoxic. Fibre glass has been widely used and is nontoxic if properly prepared. Adhesives for sealing include epoxy resins, polyvinyl chloride, silicone rubber (except for certain coloured preparations), and neoprene. Metals are not usually used, especially in seawater, which is highly corrosive. Stainless steel, however, has a low toxicity, and is often used, especially in freshwater systems. A small aquarium can be constructed entirely of glass and without supporting frames by using silicone rubber as an adhesive. Fibre glass is probably the most practical supporting material for all but the largest tanks since it is lightweight, strong, does not deteriorate, and is easily fabricated into any shape. Wood, though widely used, is subject to rot and boring organisms and thus must be protected. Reinforced concrete, including special mixes for seawater, is the principal supporting material used in the construction of large aquariums. Polished plate glass, fully tempered polished plate glass, and Plexiglas are the most commonly used glazing materials. Polished plate glass is usually used only in small aquariums because it breaks into large pieces when it fails. One generally accepted practice is to glaze large tanks with two or three layers of tempered glass so that if breakage occurs it is confined to one layer. Although Plexiglas is easily scratched, it can be repolished.

:TEMPERATURES

The temperature of the water forms the basis of one of the two most basic aquarium classifications: tropical vs. cold water. Most fish and plant species tolerate only a limited range of water temperatures: Tropical or warm water aquaria, with an average temperature of about 25 °C, are much more common, and tropical fish are among the most popular aquarium denizens. Cold water aquaria are those with temperatures below what would be considered tropical; a variety of fish are better suited to this cooler environment.

Water temperature can be regulated with a combined thermometer/heater unit (or, more rarely, with a cooling unit), while water movement can be controlled through the use of powerheads and careful design of internal water flow (such as location of filtration system points of inflow and outflow).

The temperature in the Coral Reef, Open Sea, and Ray Tray are precisely regulated according to season. Chillers on each system keep the water from becoming too warm during the warmer months, while heaters (rarely used) can warm the water in the winter. Solid-state thermostats regulate each tank's temperature to a tenth of a degree while displaying it continuously on a monitor. Aquarists and laboratory technicians control the temperature, adjusting the settings on a monthly basis according to a yearly temperature schedule that closely replicates temperatures in the natural environment. The Rain Forest has both heating and cooling systems. In winter, the Rain Forest is heated by an electric heating system, as well as through solar heating. Humidity must be kept high for optimum plant growth. This is accomplished with a mist system that simulates rainforest conditions.

Water movement can also be important in accurately simulating a natural ecosystem, depending on the conditions best suited for the aquarium's inhabitants. For the reef tank the valves installed above the tank are enabling water movement with a constant water flow. [6]



Picture19 Public Aquarium

:SIZE

An aquarium can range from a small, containing a few litres of water - to immense tanks built in public aquaria which are limited only by engineering constraints and can house entire ecosystems as large as kelp forests or large marine species. In general, larger aquarium systems are more resistant to rapid fluctuations of temperature and pH, allowing for greater system stability. The Shedd Aquarium features an individual aquarium of two million U.S. gallons (19,000 m³), as well as two others of 400,000 U.S. gallons (1,500 m³). The Monterey Bay Aquarium has an acrylic viewing window into their largest tank. At 17 by 5 m, it used to be the largest window in the world and is over 330 mm thick. The Okinawa Churaumi Aquarium is the world's second largest aquarium and part of the Ocean Expo Park located in Motobu, Okinawa. Its main tank, which holds 7,500 cubic meters of water, features the world's largest acrylic panel measuring 8.2 meters by 22.5 meters with a thickness of 60 centimeters. The size of public aquaria are usually limited by cost considerations.

In designing a public aquaria for exhibition of large species or environments, there are several factors influencing the construction: most notably the weight of the water (fresh water weighs about 8.3 pounds per U.S. gallon (1 kg/L), and salt water is even denser, as well as the internal water pressure requiring thick, strong walls.

Surface area and height are important in the set-up and maintenance of a living biotope. The surface area contributes to providing superior in-tank oxygenation and it also facilitates the creation of attractive aquatic themes. Freshwater environments benefit more from short and wide aquariums, due to the larger surface area they present to the air, which allows more oxygen to dissolve in the water.

:SPECIES SELECTION FOR THE SALTWATER AQUARIUM

There are several theories on species selection and one of these is the division of aquaria into either a community or aggressive tank type. Community tanks house several species that are not aggressive toward each other. This is the most common type of aquarium kept today. Aggressive tanks, in contrast, house a limited number of species that can be aggressive toward other fish, or are able to withstand aggression well. In both of these tank types, the aquarium cohabitants may or may not originate from the same geographic region, but generally tolerate similar water conditions. In addition to the fish, invertebrates, aquatic plants, and decorations or "aquarium furniture" (all of which may or may not be natural neighbors of any of the fish) are typically added to these tank types.

Species or specimen tanks usually only house one fish species, along with plants, perhaps found in the fishes' natural environment and decorations simulating a true ecosystem. These tanks are often used for killifish, livebearers, cichlids etc. They can be simple as bare bottom with a few necessities or a complex planted aquarium. Some tanks of this sort are used simply to house adults for breeding.

Ecotype or ecotope aquaria attempt to simulate a specific ecosystem found in the natural world, bringing together fish, invertebrate species, and plants found in that ecosystem in a tank with water conditions and decorations designed to simulate their natural environment. The reputable public aquaria all use this approach in their exhibits whenever possible. This approach best simulates the experience of observing an aquarium's inhabitants in the wild, and also usually serves as the healthiest possible artificial environment for the tank's occupants. In addition to the types above, a special category of saltwater aquaria is the reef aquarium. These aquaria attempt to simulate the complex reef ecosystems found in warm, tropical oceans around the world. These aquaria focus on the rich diversity of invertebrate life in these environments, and typically include only a limited number of small fish. Techniques of maintaining sea anemones, some corals, live rock, mollusks, and crustaceans, developed since the 1980s, have made the recreations of a reef ecosystem possible. Fish come in a large variety of species, from several different geographical regions. Most aquarium fish originated in Central America, South America, Africa, or Asia. Fish can be kept in different combinations of species and in different kinds of aquatic environments. Four common themes include the community aquarium, the goldfish aquarium, the African cichlid aquarium, and the planted aquarium.[2]



:INSTALATIONS

Accessories for individual tanks normally include filters, air pumps, lights, and electric thermostatically controlled immersion heaters, or perhaps alternately, some means of chilling the water. In aquarium buildings the tanks are usually grouped so that they have a common filter and method of temperature control.

Most public aquaria are located close to the seaside or oceans, for a steady supply of natural seawater. An inland pioneer was Chicago's Shedd Aquarium that received seawater shipped by rail in special tank cars. The early (1911) Philadelphia Aquarium, built in the city's disused water works, ironically had to switch to treated city water when the nearby river became too contaminated. Similarly, the recently opened Georgia Aquarium filled its tanks with fresh water from the city water system and salinated its salt water exhibits using the same commercial salt and mineral additives available to home aquarists.

There are three basic types of water systems: open, closed, and semiclosed. In open systems the water flows through the aquarium once and is discarded. This provides water quality comparable to that of the natural environment and there is no buildup of toxic metabolic wastes; however, temperature control and pumping are usually costly, and filtration often is necessary. Water is continuously recirculated in closed systems and is only renewed periodically. Metabolic wastes must be treated since they are not continuously flushed from the system. An important problem is that ammonia must be rapidly removed or transformed because it is harmful even at very low concentrations. In the aquarium the bacteria that convert ammonia to nitrite reside primarily in the filter material, and a slow sand filter with a large surface area is usually provided to ensure their abundance. Plant growth in the aquarium, especially in marine systems, is not usually sufficient to utilize all the nitrate produced by bacteria from nitrite. Although some aquariums have operated many years with a minimum of water renewal, it is normally necessary to replace from 1 to 10 percent of the water per month to maintain a low level of nitrates. The use of charcoal in both fresh water and seawater systems helps to slow the accumulation of nitrogenous wastes. Metabolic wastes also cause an increase in the acidity of the water. Carbonate compounds are commonly used to maintain an optimal level of acidity, particularly when water renewal is infrequent. Semiclosed systems are essentially the same as closed except that there is a constant connection to the water supply, and the problem of dissolved wastes is controlled by the regular addition of new water; this system is less costly than the open one with regard to temperature control and pumping.

Filters vary from simple flow-through systems to completely automated recirculating systems, with special provisions for monitoring and controlling the physical and chemical characteristics of the water.

Freshwater pools for mammals and birds present special problems. They generally require a higher filtration rate and greater filter capacity because they accumulate large amounts of fecal wastes. Air-breathing animals, however, are not highly sensitive to water quality; thus, chemical treatments, such as chlorination, which would kill fishes, can be used to control bacteria and to improve water clarity. Seawater formulas are simpler; for example, a 2 percent sodium chloride solution would satisfactorily maintain whales and dolphins. Seals and sea lions have been kept in fresh water, but this may increase their eye problems because of the osmotic effect of the fresh water on the eye tissues.

Plumbing in large aquariums with multiple systems is sometimes complex, involving a variety of automatic controls and water-quality monitoring systems. Because of its cost and fragility, glass plumbing (e.g., for aeration or circulation of water within an aquarium) is used only in cases in which low toxicity is essential. Unplasticized polyvinyl chloride pipe is widely used. Fibre-glass pipe and epoxy-lined asbestos pipe are sometimes used, but lead and hard rubber pipe are obsolete. In seawater systems the growth of fouling organisms such as mussels and barnacles is avoided by providing the system with duplicate pipes and alternating their use on a weekly basis. When a line is dry, the few organisms present die and are flushed out when the line is again put into service.

Generally, the most effective illumination is by incandescent lamps placed above the front glass. Fluorescent lights provide even illumination but may overilluminate the tank walls; coloured lights accentuate natural colours; and mercury-vapour lamps encourage maximum growth of marine plants.

The introduction of some form of aquatic plant life is of practical value in an aquarium, although the presence of plants can cause complications. Aquatic plants consume dissolved oxygen and give off carbon dioxide; under the influence of bright light, plants also consume carbon dioxide and give off oxygen while engaged in photosynthesis. In turn, the waste products of the fishes form fertilizer or food for the plants and are consumed by them. This operates very well so long as light of a certain intensity falls on the plants—the animals thus give off what the plants can use and vice versa. Aquariums in which the plants and animals are believed to balance each other in the respiratory process are generally referred to as balanced aquariums.







"The terrain" is hiding the maintenance passage ways as well as the instalations, allowing visitors of the aquarium "the walk to remmember", a unique landscaping on ground floor level, enabling them to see the exhibited species through round windows, wich are the size fited to sit in





"The terrain" is hiding the maintenance passage ways as well as the instalations, allowing visitors of the aquarium "the walk to remmember", a unique landscaping on ground floor level, enabling them to see the exhibited species through round windows, wich are the size fited to sit in; from above visitors can see the two large tanks round windows



:West Facade Shaping/ Finding the form/ Movement



The economical potentials of the river are immense since the Danube River connects various countries, allowing the tourists to visit Belgrade by river cruises. In a city which suffers from the recession, the shift to new economic activities such as tourism is essential for the sustainable development. The aquarium as a part of a revitalization plan is seen as a popular tourist attraction, drawing visitors from surrounding regions and countries, helping in economic activity. The premises of the building complex will be built as a part of the river marina bay and would point out the identity and the landmarks of the riverside, offering the tourist a unique expirience in hotel areathe rooms oriented to the west have a natural light and a view towards the marina and the river, and on the other side different type of hotel rooms are connected with two large aquarium tanks with round windows serving as a light source.











Industrial port crane will serve double purpose, not only for the port containers, but also for the containers which will build the east side of the building. The flexibility is seen through alterations in any given moment, depending on a user preferences and affordability.

These containers plug-ins are designed as units with multiuse, as they can be rented as an office space, as a residential unit for students, as a motel room. They consist of cargo containers' skeletons that are equipped with wall-, ceiling- and floor panels. By connecting, removing and shifting the units depending on demand of the residents, different spatial organizations are provided. In this way, a standardized pre-fabricated mass product becomes a unique element.







:PLANS












Third floor +12.00 and +13.00



Fourth floor +16.00 and +17.00



S 1:1000

Fifth floor +20.00 and +21.00



Sixth floor +20.00 and +21.00



S 1:1000



:SECTIONS





















East view



South view



Aquarium

In order to minimize energy consumption river water would be used as a source for aquarium tanks, as well as in the cooling process, which is estimated to reduce energy consumption for cooling by at least 50%. Energy production would be obtained with solar panels integrated into the shape of the building object and also, in addition, the building would be fitted with low-energy glazing.

Building façade

To keep heat losses as low as possible, a compact space is required. Furthermore, the insulation of all parts of the building must be ensured in order to reduce the transmission heat losses. The windows that are oriented towards the south allow a passive use of solar energy.

Exposure and shading

The south-facing windows allow for optimal exposure of the rooms. In order to prevent an overheating in summer these areas are in shadow due to louvers of the building.

Ventilation and cooling

Instalations are hidden behind the shape of the terrain shape and integrated in steel truss structure. The natural ventilation is possible due to proper positioning of the window openings. In spring and summer a pleasant room climate can be achieved with natural ventilation and shading without additional electric cooling. For the south facade the louvers are not instaled because of the demand of higher temperatures for the Rain Forest exhibition.

The building is heated through a hybrid system which provides up to 50% more energy (in the form of solar electricity + solar heat) than a conventional solar PV system. The heat energy captured from the PV modules is ducked into the building's HVAC system (heating, ventilation and air conditioning) where it is used to displace the conventional heating load. The secondary benefit is to provide PV cooling by reducing the operating temperature of the PV modules, which improves the electrical performance. The modular units are easy to install and are angled at an ideal orientation for maximum solar gain.

Water concept

Aquariums are connected to the the public water network, as well as the river. The water is being then processed with filters and instalations for the two large tanks. From there the water is distributed to the smaller aquariums. The waste water is discharged through the public sewer system.

Hot water

The hot water is processed through solar thermal panels on the roofs. The hot water can be stored over a certain period of time. In addition, a connection to the public long-distance heating system is in place.

Rainwater harvesting

Rainwater is collected over the roofs and used for watering of the existing vegetation.

:Construction





:Interior

:References

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