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OCEANARIUM: 'MARITIME HUB' LIFE UNDER WATER AT MAHABALIPURAM

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Abstract –

Aquatic life in the sea are getting affected with the changes done by us 'humans'. Due to this today condition is such that there are change in temperature of water, ph. level lightings and so on. This change in condition are very critical for the survival of aquatic life in the ocean. So designing an oceanarium for the peoples will help them to get aware of the situation as well as displaying the beauty under the sea, the different kinds of the species and changing their perspective towards the ocean.

Keywords – Oceanarium, Aquatic life, Aquarium, Architecture.

Introduction –

Oceanarium acts as a bridge between humans and the ocean to get a wider perspective towards a natural under the sea. As India has a longest coastline of 7,517 km, consisting of many fresh water bodies which houses many varieties of fresh water species. Where 80% of the marine fishes comes from the west coast and the remaining 20% comes from the east coast. So designing an oceanarium in India will provide a shelter to showcase the variety of species from throughout India and also from globe, being a great tourist attraction in India. This will help the people to get educate who are less aware of the aquatic life and different types of species present in Indian water and also around the globe.

Aim –

- To design a world-class oceanarium displaying a variety of species under one roof and also attracting people from all age groups.
- To educate people about marine life, also educating the visitors by displaying the importance of aquatic life.
- To increase the tourism of Mahabalipuram, and as well as of India.
- To change the way of interaction between peoples and the environment.

Objective –

- The project will help in studying the various species of aquatic life and the environment suitable for their living.
- To study the user group i.e. the visitors and the aquatic life with the help of physical and psychological requirements.
- To study the international oceanarium and its facilities which are being provided all around the world.
- To understand the method of transportation and storage of the species.
- To study the process for conservation of species and storage.
- To study the filtration of water and recirculation of same.
- To study the footfall of tourism at Mahabalipuram and visitors' expectations.
- To study the traditional architecture of Mahabalipuram since the site is with a rich heritage.

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Background –

Prior to the middle of the 19th century, the term aquarium was applied in botany to describe a container used for growing aquatic plants. Although French-born naturalist Jeanne Villepreux-Power invented the first recognizable glass aquarium in 1832, it was in the works of British naturalist Philip Gosse, however, that the term first took on its modern meaning as a vessel in which aquatic animals, as well as plants, can be held. His work aroused increased public interest in aquatic life. By 1850 the keeping of fishes, amphibians, and reptiles had become useful in the study of nature.

The first display aquarium was opened to the public in 1853 at Regent's Park in London. It was followed by aquariums in Berlin, Naples, and Paris. P.T. Barnum, the circus entrepreneur, recognized the commercial possibilities of living aquatic animals and, in 1856, opened the first display aquarium at the American Museum in New York City as a private enterprise. By 1928 there were 45 public or commercial aquariums throughout the world, but growth then slowed and few new large aquariums appeared until after

World War II.

Many of the world's principal cities now have public aquariums as well as commercial ones. Another category encompasses those aquariums that serve chiefly as research institutions. Among the best known of the latter are those at Naples; the Oceanographic Museum of Monaco; Plymouth Marine Laboratory, Eng.; and Scripps Institution of Oceanography, La Jolla, Calif. Still another category includes temporary aquariums that have served as exhibits at world's fairs and expositions.

In 1938 the first oceanarium, or large marine aquarium, Marine land, opened near St. Augustine, Fla., as a private enterprise; it featured a giant community fish tank and trained dolphins. The Aquarium, Miami, is similar, the emphasis in this type of aquarium is on very large tanks, up to 1,000,000 gallons each, in which a great variety of fishes is placed with no attempt to separate them. In the formal aquarium (*e.g.,* the Shed Aquarium, Chicago), the kinds and types of fishes are separated in most of the exhibits.

WORLD'S LARGEST MARINE LIFE PARK

When a new 1, 70,000 sq.ft exhibit at the shed Aquarium in Chicago opened on April 27, 1991. It debuted as the largest indoor marine mammal facility in the world. The position as world's largest oceanarium has since shifted repeatedly in recent years. From 2005 to 2012 it was the Georgia Aquarium in the United States with an initial total water volume of 32,000m^3(85,00,000 US gal), later it expanded to 38,000 m^3 (10,000,000 US gal), and home to 100–1,20,000 animals of 700 species. In 2012 it was surpassed by Marine Life Park in Singapore with a total water volume of 45,000 m^3 (1,20,00,000 US gal.) and over 1,00,000 animals of more than 800 species. In 2014, the Singapore park was surpassed by the chimelong Ocean kingdom in china, the current record holder with a total water volume of 48,750 m^3 (1,28,80,000 US gal.).

After this the oceanarium gets on evolving as the technologies are developing. This helped in achieving the new design, different and difficult forms, and structures.

Literature Review –

Review of Article 1

Research paper - "Principles of Water Recirculation and Filtration in Aquaculture"
By - Michael McGee and Charles Cichra.

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This report consist of 'Recirculating water systems that designed to minimize or reduce dependence on water exchange and flushing in fish culture units. These systems have practical applications in commercial aquaculture hatcheries, holding tanks, and aquaria systems, as well as small scale aquaculture projects. Water is typically recirculated when there is a specific need to minimize water replacement, to maintain water quality conditions which differ from the supply water, or to compensate for an insufficient water supply. There are innumerable designs for recirculating systems and most will work effectively if they accomplish:

1) Aeration, 2) removal of particulate matter, 3) biological filtration to remove waste ammonia and nitrite, and 4) buffering of ph.

These processes can be achieved by a simple composite unit such as an aquarium filter, or in larger systems, by several interconnected components.'

Review of Article 2

Research paper – "Design and Control of Aquarium Water Management System using Programmable Logic Controller (PLC)"

By - M.Z.A Rashid1, S.K.S Nordin

This report consist of 'the design and control of the aquarium management system. The design of the system is accomplished by using the AutoCAD software while the control of the system is done by using the OMRON CQM1H Programmable Logic Controller. The paper covers the simulation stage where after all the details of the system have been finalized, the system will be fabricated. The objectives for this project can be summarized and listed as : (i) To design an aquarium control system using PLC (water management system for aquarium), (ii) To investigate how PLC able to control the changes of the aquarium condition such as temperature, pH level, lighting, cleanliness and water level,(iii) To develop PLC programming that can automatically regulate the temperature, pH level, lighting, cleanliness and water level of the aquarium and improve the traditional aquarium water management system in terms of, performance, time and cost.'

Review of Article 3

Thesis – "Water Purification Using Photo catalysis, Ozonation and Ultraviolet Disinfection"

By - TSOI Chi Chung.

This research study has covered three parts with the view of real applications, including the solar reactors for water purification, the photo catalytic ozonation for seawater decontamination and the combined method of UV and ozone for water disinfection. The study of real application has been finished by developing a new design of reactor, which is large-size, closed-chamber, light weight and nonbrittle. Experimental tests show a degradation of 30%of MB when the reaction is operation for 2 hours in outdoor sunlight by that reactor. Although the efficiency is not high, it is already 23.6 times of the photolysis, and the use of sunlight is abundant, environment friendly. The photo catalytic ozonation for seawater decontamination has been finished by finding out the best concentration of ozone in the process and by using the synergistic effect of the photo catalysis and the ozonation. For low cost and human safety, the ozone concentration is kept to be < 60 ppm in the pumping gas (0.026 ppm in solution). More specifically, the PCO has a reaction rate constant about 23 times higher than only the ozonation. The combined method of UV and ozone for water disinfection has been accomplished by the successive use of the UV disinfection and the ozonation, which is experimentally observed to enable full disinfection of bacteria in the efficiency of waste water treatments work. And avoid the photo-resurrection. With the research study of this M. Phil. study, I am able to deal with the major problems of waste water treatment: the polluted fresh water can be decontamination by the solar reactor in

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chapter 3, the polluted sea water can be decomposed by the photo catalytic ozonation method in chapter 4, and the residual bacteria in the waste water can be disinfected by the UV-ozone method developed in chapter 5. Therefore, this M. Phil. study us highly potential for practical applications of waste water treatment.'

Review of Article 4

Research paper – "Renewable Waste Water Filtration System with Phytoremediation Used in Aquaculture of Freshwater Ornamental Fish"
By - Charlotte Palao, Glyda Aricon Marquez, Kenneth Ibasco, Lady Claudette Ferrer and Patricia Sagge.
This research paper conclude that used water from aquarium can be renewed with the use of filtration media classified as mechanical, chemical and Biological. The selected materials such as Lava ring, Honey comb Matt, K1-media, are the best used natural-biological removal of Nitrogen compounds such as Nitrate. In the chemical filtration, Addition of carbon and Resin can improve water quality. Phytoremediation in terms of using the POTOS plant is really effective because the fast growth of plant indicates absorbance of toxic nutrients. Lastly, it is best to use different types of filtering materials in the mechanical part of the filtration since particles have different sizes and a specific mesh is design to capture base on the size present in water. Water quality is the key to a healthy livestock. With this design it can help improve the Aquaculture society on the given problems.

Case Study and Conclusion -

The case study choose for the oceanarium is based on its architecture form, circulation, experience and space planning. Reason for choosing this examples as case study is because giving the user and visitor a different perspective towards aquatic life.

The case study are as follows:

1. Batumi aquarium.
2. Antalya aquarium.
3. The Blue planet aquarium.

1. BATUMI AQUARIUM

Location – rustaveli str., Batumi, the republic of Georgia.
Architect – henning Larsen architects.
Client – association A.T.U.
Gross floor area – 2000 m^2.

Introduction – The building combines educational, commercial and recreational program. Batumi aquarium has become a hub where it is offering visitors an educational and entertaining with visual simulating journey of different types of species. As the building is inspired by nature making Batumi

Figure 1 Bird Eye View

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aquarium a new landmark in Georgia and contributing to explore life under the sea surface.

Purpose of case study –

1. Analyzing the form and concept development process.
2. Studying its aesthetic feature and designing.
3. Understanding various types of species and study of spaces required for them.

List of spaces provided –

1. Display areas for different species according to their climatic region.
2. Ticket counter.
3. Café and kitchen.
4. Toilets.
5. Multipurpose hall.
6. Shops.
7. Maintenance areas.
8. Mechanical areas.

Concept and form evolution –

- The design was inspired by the characteristic pebbles of the Batumi beach.
- As the project was situated on Georgian port of Batumi keeping it standing as an iconic rock formation.
- The design was made with the four stones representing a unique marine biotype.
- The space formed in between indirectly formed multipurpose spaces.

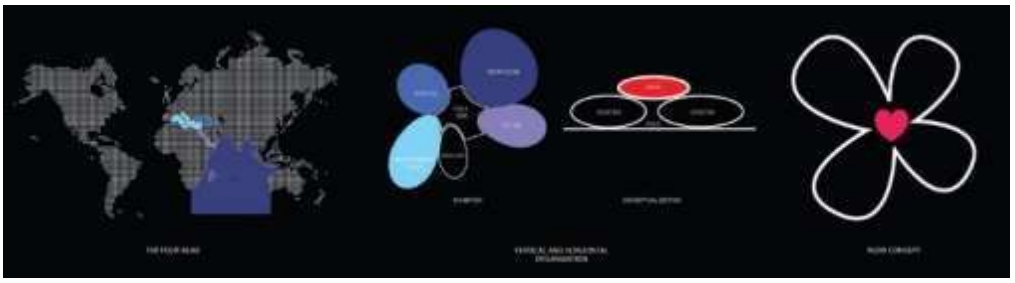

Figure 3 Form Evolution Step 01

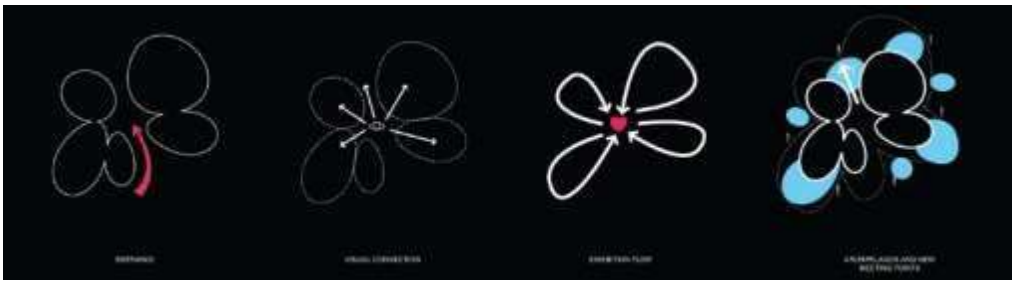

Figure 2 Form Evolution Step 02

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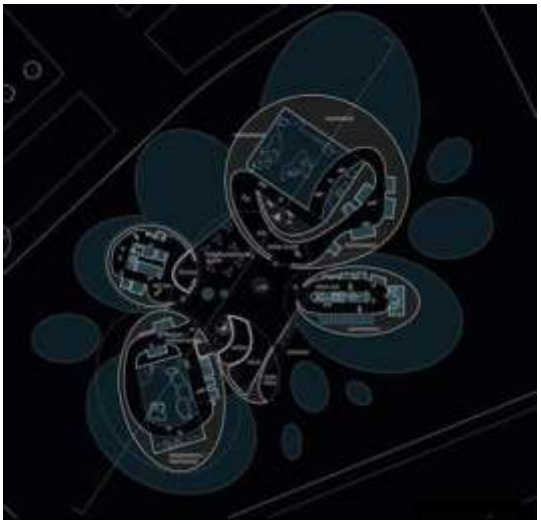

Figure 4 Ground Floor Plan

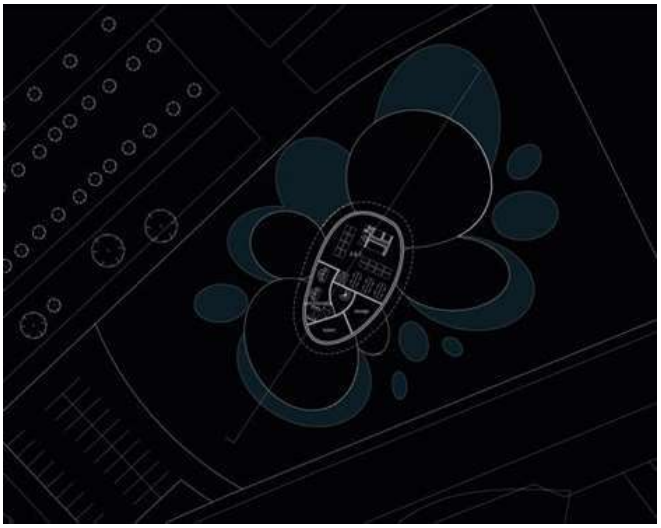

Figure 5 First Floor Plan

Conclusion –

- The aquarium serves being an iconic structure in Georgia consisting of entertainment and recreational zone, helping to boost the visitor's activities in the area.
- The continuity gets breaks as the four exhibition area are very distinct with each other can create trouble in travel through the space.
- The common spaces could be utilized for gatherings or displaying or visual effects thus serving the purpose of multifunctional space.
- Due to its form of the outer pebbles i.e. asymmetrical and the tanks which is symmetrical thus creating number of dead spaces which is termed as maintenance areas.
- Overall the design creates the ambience required for an oceanarium and also creates the curiosity within the visitors.

2. ANTALYA AQUARIUM

Location: Antalya, Turkey
Architect: Bahadir kul architects
Area: 12000 m^2.

Figure 6 Street View

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Introduction - It's a largest contemporary aquarium with themed exhibits, consisting of a long tunnel tank and also consisting of tropical reptiles and eateries.

Purpose of the case study –

- Helped to understand and study various species required for the oceanarium.
- Understanding the circulation pattern of various users within the facility.
- Analyzing the placement of exhibit areas and the relation between the rests of the areas in the design.

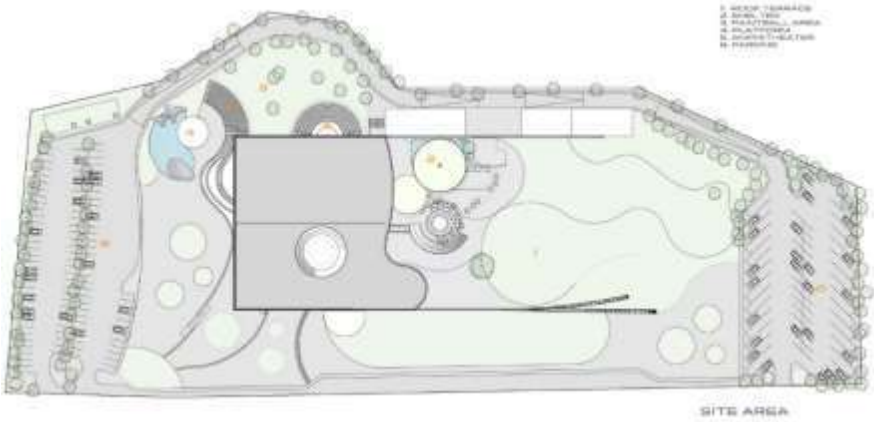

Figure 9 Roof Plan

Figure 8 Ground Floor Plan

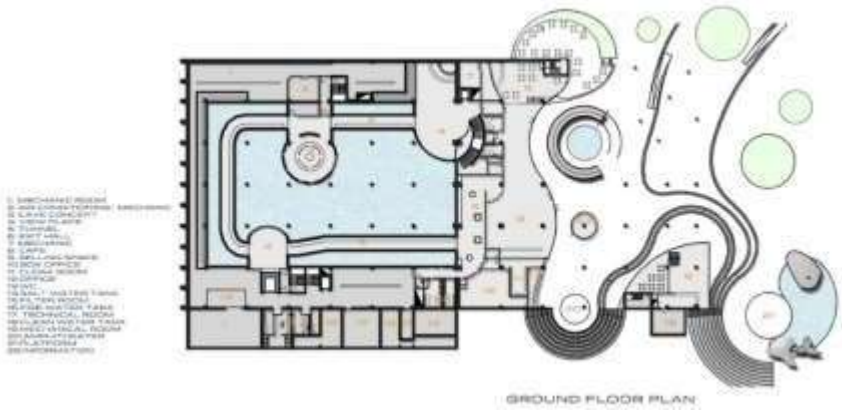

Figure 7 First Floor Plan

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Conclusion –

- The public gathering area at the entrance is being shaded by means of various floor plates above helped in creating an interesting design feature.
- The oceanarium is unhindered in terms of the experience by planning the circulation and the placement in design that the user can enjoy.
- The user in the aquarium can moves freely as they are well connected with each segment or display area consisting of its own character.

3. THE BLUE PLANET AQUARIUM

Location: National Aquarium Kastrup, Denmark
Architect: 3xn
Area: 10000 M^2.

Figure 10 Bird View

Information -
Denmark's aquarium in charlottenlund started construction in 1937 and was opened in 1939. In 1974, this aquarium was expanded to feature five large landscape aquaria and a biological museum with theme based exhibits and aquariums. In 1990, the facility was further expanded by a new front hall, café, improved toilet facilities and a schooler service. In the final years before the closer of the aquarium is charlottenlund, it had about 10,00,000 litters i.e. 2,60,000 US gal. Of water in about 70 aquarium tanks.

List of Spaces Provided -
1. Intro space.
2. Amazonia display area.
3. The Mediterranean display area.
4. Café.
5. Exotic amphibians.
6. Marine animal touch pool.

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7. Cold water animals.
8. Warm salt and fresh water display area.

Concept and Form Evolution -

- The concept is inspired by the shape of water in endless motions, it is shaped as a great whirlpool. The building describes the story of what awaits inside.
- The whirlpool concept originates in a narrative about water, as an image, is at once both abstract and figurative.
- The stirs attention with its distinctive vortex blades, but at the same time as a building changes dramatically depending on viewing angle, distance and daylight conditions.

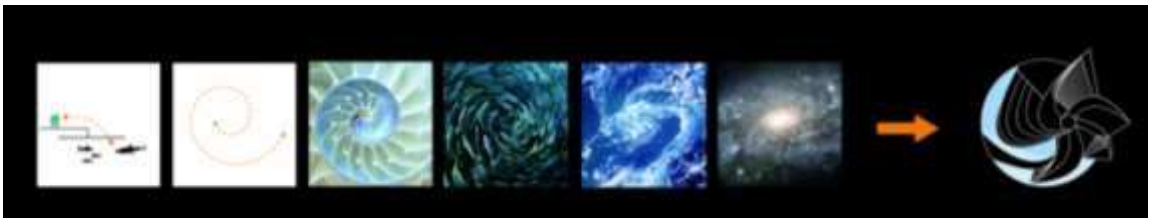

Figure 11 Form Evolution 01

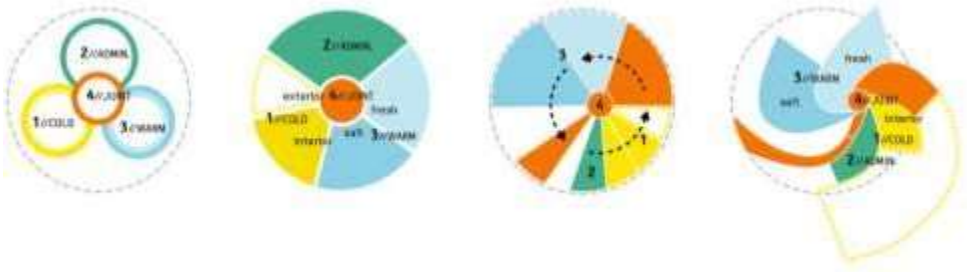

Figure 14 Zoning

Figure 12 Exploded View

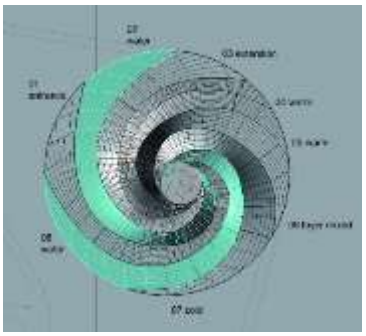

Figure 13 Zone Diagram

Conclusion –

- The building is extended beyond the original coastline, placing special requirements on the facility's structures in a terrain with tendency to subsidence.
- The load bearing system consists of 54 unique steel frames. A service line is built 1.7 km long out to obtain suitable water for the aquariums.
- The cooling system for aquariums and climate system for public area also use seawater.

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Architecture Intervention and Conclusion –

The oceanarium of India being of its first kind will have greater expectations and enthusiasm from all the peoples in the country and also from the world. Oceanarium is not a rectangular or a square or a circular structure where all the tanks are placed on one side of the other. It is about creating the journey of a relationship between the user and the aquatic life and planning the spaces accordingly so that it would narrate a story rather than just moving around.
Architecture for the oceanarium is just not about the great façade or attractive interior but it is also about the internal planning and exterior architecture which plays an important part in the design factors as the exterior architecture will give the identity for the oceanarium in the world. All major structures in the world get an identity because of their architectural styles. Thus with the help of advancement in technology and engineering the oceanarium architecture will be giving identity to the place.
The oceanarium will have the facilities for the research by providing qualitative information about the ecosystem. Research done by the researcher will help the oceanarium in the development of strategies towards saving and conserving aquatic life.
It aims to increase the tourist activities of Mahabalipuram city. It shall change the interaction of the people with the environment. Oceanarium will develop the tourism industry of Tamil Nadu state.

Design Strategies as Per Climate Analysis –

- In this climate air conditioning will always be needed, but can be reduced if building design minimizes overheating.
- Climate responsive buildings in hot humid climates used light weight constructions with open able walls and shaded outdoor areas, raised above ground level.
- Climate responsive buildings in warm humid climates used high ceilings and tall open able (French) windows protected by deep overhangs and verandas.
- Windows overhangs (designed for this latitude) or open able sunshades (awnings that extend in summer) can reduce or eliminate air conditioning.
- Raise the indoor comfort thermostat set point to reduce air conditioning energy consumption (especially if occupants wear seasonally appropriate clothing).
- Minimize or eliminate west facing glazing to reduce summer and fall afternoon heat gain (if summer rains support native plant growth).
- A radiant barrier (shiny foil) will help reduce radiated heat gain through the roof in hot climate.
- Long narrow building floor plan can help maximize cross ventilation in temperature and hot humid climates.
- Good natural ventilation can reduce or eliminate air conditioning in warm weather, if windows are well shaded and oriented to prevailing breezes.
- High efficiency air conditioner or heat pump (at least energy star) should prove cost effective in this climate.
- Screened occupancy areas and patios can provide passive comfort cooling by ventilation in warm weather and can prevent insect problems.
- Keep the building small (right-sized) because excessive floor area wastes heating, cooling, and lighting energy.
- On hot days ceiling fans or indoor air motion can make it seem cooler by 5 degrees F (2.8 C) or more, thus less air conditioning is needed.
- Use light colour building materials and cool roofs (with high emissivity) to minimize conducted heat gain.
- In wet climates well ventilated pitched roof work well to shed rain and can be extended to protect entries, outdoor porches, and outdoor work areas.
- If soil is moist, raise the building high above ground to minimize dampness and maximize natural ventilation underneath the building.

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- To capture natural ventilation, wind direction can be changed up to 45 degrees toward the building by exterior wing walls and planting.

Reference –

Links –

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