

**GREEN MUSEUM AND CONSERVATION CENTRE
AT PURBACHAL**

BY
TASNIM FERDOUS
09208005

SEMINAR II

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CHAPTER 01

INTRODUCTION OF THE PROJECT

1.1. Project Brief

1.1.1. Name of the project: Green Museum and Conservation Centre

1.1.2. Client: Ministry of Environments and Forests, Govt. of Bangladesh.

1.1.3. Location: PURBACHAL, Gazipur, Bangladesh

1.1.4. Site area: 829149 sft (19 acres)

1.2. Background of the project

The proposal is for a museum and conservation centre dedicated to plants of Bangladesh. The green and sustainable building will exhibit the diversity of native plants under their own ecological environment and showing effects of climate change. Usually museums are created as theatres, with exhibits on display and visitors are trapped inside the opaque built form, but this building needs to be transparent so that there is a direct link with the nature with an extensive landscaping, serving as an open to sky exhibition space, and acting as a civic space.

1.3. Rationale of the project

Bangladesh is the only country with six different seasons, a country with such fertile land that plant grows without any extra care, yet somehow we are managing to destroy and exploit the green around us, the air we breathe in, and the land we live in. The museum not only exhibits the greenery of Bangladesh, at the same creates a social awareness towards sustainable living. It should be a proof that constructions can be carried out without reducing the green at the same time showcasing the natural treasures we have while educating and inspiring local members of the benefits of being good environmental stewards through conservation and better understanding of nature. It should be a reminder of what we are destroying and how we can prevent it.

1.4. Aim of the project

To design a sustainable building with

- Exhibiting galleries with plants and housing native ecosystems.
- Light transparent structure with massive landscaping, bringing the outside into the interior and vice versa.
- A library and herbarium preserving and spreading knowledge about the plants of Bangladesh.

To spread awareness among people about plants and trees

- How they can be grown, protected and conserved.
- How the responsible use of these natural resources can help in plant science.
- Encouraging interest in knowledge among different age groups of people.

1.5. Functions & Programs required for the project

- Permanent gallery
- Temporary gallery
- Herbarium
- Library
- Auditorium / Multipurpose hall
- Seminar room
- Workshops
- Studios
- Classrooms
- Faculty rooms
- Cafeteria
- Souvenir shop
- Administration / Offices

CHAPTER 02

SITE APPRAISAL

2.1. The Site

2.1.1 Location of the site: PURBACHAL, DHAKA, BANGLADESH.

2.1.2 Site area: 829148.941sqft

= 19.03 acres

= 76889.68 sqm

2.1.3 Altitude: 14.6m from sea level

2.1.4 Latitude: 23.50' N

2.1.5 Longitude: 90.29' E

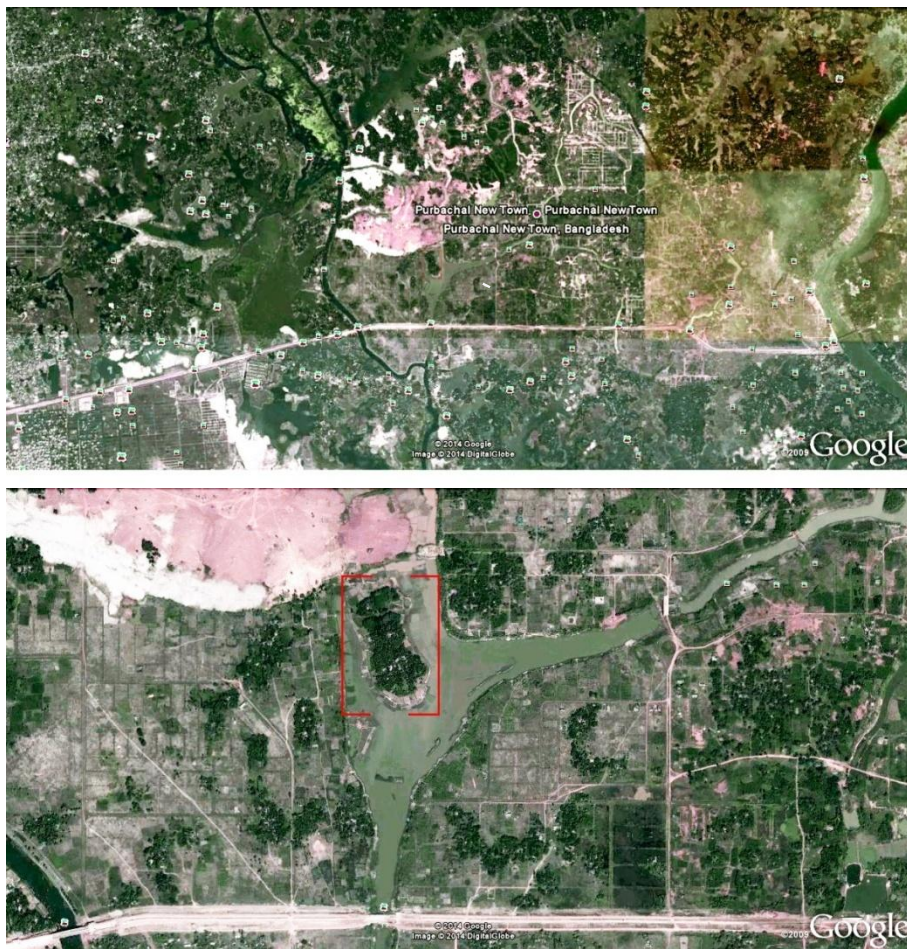
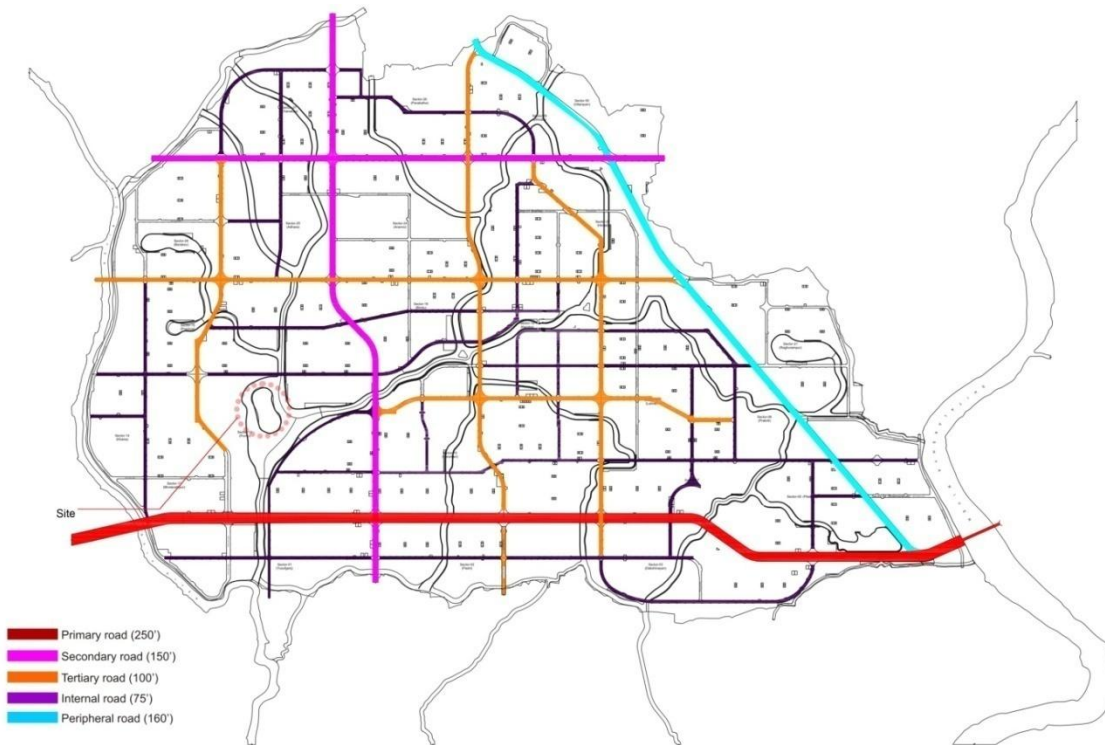
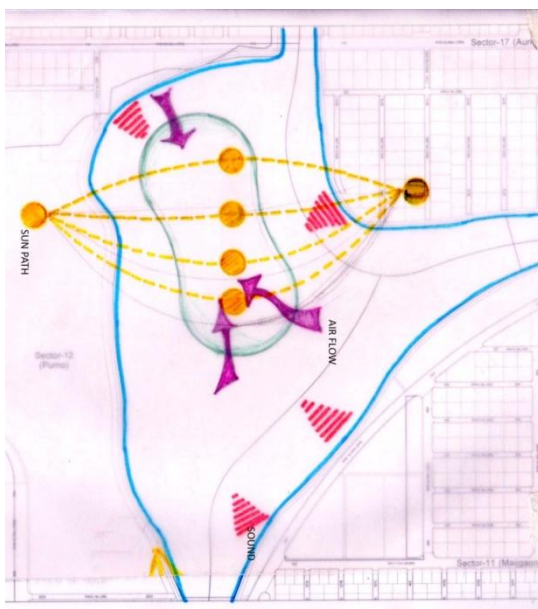


Fig 2.1: Location of the site. **Source:** Google Earth Map.

2.2.2 Road network urban connection



2.3. Environmental considerations.



2.4. Topography

The site is surrounded by water on all its sides. It is mainly flat with very slight contour on its south west side.

2.5. Photographs of the site



Current situation of the site

2.6. SWOT Analysis

2.6.1 Strength

- Proposed site for an ecological park
- Still not developed so high potential if designed properly
- Can be the centre of growth of the developing town
- Lush green site teaches how concrete and green can co-exist

- Potential urban park for the neighborhood
- Attraction for tourists (national and international), researchers, students of botany etc.
- Invites a diverse age group
- Separated by water body creating a water frontier and helping people escape from the hotchpotch of urban life (sound pollution, air pollution etc)

2.6.2 Weakness

- Vast site area to deal with
- The risk of creating negative spaces exist

2.6.3 Opportunity

- It will set a good example and reminder of living with sustainability
- Has the potential to become a good and useful public space with a scope of learning about plant science of Bangladesh.

2.6.4 Threat

- If not designed properly, the area might have a bad effect on community, as possibilities are huge
- Unplanned growth may spoil this site of such good possibilities

CHAPTER 03

LITERATURE REVIEW

3.1. Defining Green

Green refers to a sustainable built form for the museum and also to the fact that the museum exhibits the plants and trees of Bangladesh.

3.1.1. Defining Green building

Green building (also known as green construction or sustainable building) refers to a structure and using process that is environmentally responsible and resource-efficient throughout a building's life-cycle: from siting to design, construction, operation, maintenance, renovation, and demolition. The Green Building practice expands and complements the classical building design concerns of economy, utility, durability, and comfort.

Although new technologies are constantly being developed to complement current practices in creating greener structures, the common objective is that green buildings are designed to reduce the overall impact of the built environment on human health and the natural environment by:

- Efficiently using energy, water, and other resources
- Protecting occupant health and improving employee productivity
- Reducing waste, pollution and environmental degradation.

Green building practices aim to reduce the environmental impact of building. Goals of green building are

- Life cycle assessment of the building-A life cycle assessment (LCA) can help avoid a narrow outlook on environmental, social and economic concerns by assessing a full range of impacts associated with all cradle-to-grave stages of a process: from extraction of raw materials through materials processing, manufacture, distribution, use, repair and maintenance, and disposal or recycling. Impacts taken into account include (among others) embodied energy, global warming potential, resource use, air pollution, water pollution, and waste.
- Siting and structure design efficiency- The foundation of any construction project is rooted in the concept and design stages. The concept stage, in fact, is one of the major steps in a project

life cycle, as it has the largest impact on cost and performance. In designing environmentally optimal buildings, the objective is to minimize the total environmental impact associated with all life-cycle stages of the building project.

- **Energy efficiency**-Green buildings often include measures to reduce energy consumption – both the embodied energy required to extract, process, transport and install building materials and operating energy to provide services such as heating and power for equipment. As high-performance buildings use less operating energy, embodied energy has assumed much greater importance – and may make up as much as 30% of the overall life cycle energy consumption. To reduce operating energy use, designers use details that reduce air leakage through the building envelope (the barrier between conditioned and unconditioned space). They also specify high-performance windows and extra insulation in walls, ceilings, and floors. Another strategy, passive solar building design, is often implemented in low-energy homes. Designers orient windows and walls and place awnings, porches, and trees to shade windows and roofs during the summer while maximizing solar gain in the winter. In addition, effective window placement (day lighting) can provide more natural light and lessen the need for electric lighting during the day. Solar water heating further reduces energy costs.
- **Water efficiency**-Reducing water consumption and protecting water quality are key objectives in sustainable building.
- **Material efficiency**-building materials typically considered to be 'green' include lumber from forests that have been certified to a third-party forest standard, rapidly renewable plant materials like bamboo and straw, dimension stone, recycled stone, recycled metal, and other products that are non-toxic, reusable, renewable, and/or recyclable (e.g., Tress, Linoleum, sheep wool, panels made from paper flakes, compressed earth block, adobe, baked earth, rammed earth, clay, vermiculite, flax linen, sisal, sea grass, cork, expanded clay grains, coconut, wood fiber plates, calcium sand stone, concrete (high and ultra high performance, roman self-healing concrete).
- **Indoor environmental quality enhancement**-The Indoor Environmental Quality (IEQ) category in LEED standards, one of the five environmental categories, was created to provide comfort, well-being, and productivity of occupants. The LEED IEQ category addresses design and construction guidelines especially: indoor air quality (IAQ), thermal quality, and lighting quality.

- Operations and maintenance optimization-No matter how sustainable a building may have been in its design and construction, it can only remain so if it is operated responsibly and maintained properly. Ensuring operations and maintenance (O&M) personnel are part of the project's planning and development process will help retain the green criteria designed at the onset of the project.
- Waste reduction-Green architecture also seeks to reduce waste of energy, water and materials used during construction. Well-designed buildings also help reduce the amount of waste generated by the occupants as well, by providing on-site solutions such as compost bins to reduce matter going to landfills. To reduce the impact on wells or water treatment plants, several options exist. "Grey water", wastewater from sources such as dishwashing or washing machines, can be used for subsurface irrigation, or if treated, for non-potable purposes, e.g., to flush toilets and wash cars. Rainwater collectors are used for similar purposes.(*Wikipedia.org*)

3.1.2. Why sustainable architecture?

"Study nature, Love nature, stay close. It will never fail you."-Frank Lloyd Wright

The concept of sustainable development is at the centre of current concerns about environment and built development. It is not only the best known and best cited idea linking environment and development, it is also the best worked out, and it is the capstone of World Conservation strategy. However, the concept of sustainable architecture cannot be understood in historical vacuum. The history of thinking about sustainable development is closely linked to the peoples' attitudes towards nature. Both represent responses to changing scientific understanding, changing knowledge about the world and ideas about the society.

The ideas about nature, and particularly to treat and manage nature and ideas about change and development in society is the most subtle and intractable. Thus it's very complex to figure out all the strands that lead to it. However it is still necessary. The ideas are discussed in the book *Sustainability. Critical Concepts in the Social Sciences* by Michael Redclift, "The first is that of nature preservation, and later conservation in tropical countries. The second theme is the rise of tropical ecological science, particularly in Africa and the associated growths of concepts of ecological managerialism. The third theme concerns the growing global reach of scientific concern, particularly in the form of the Man and

the biosphere programme. The fourth is the rise of the perceptions of global environmental crisis, and the fifth is the way the international environmental concern was focused by the 1972 Stockholm conference” (Redclift, 2005)

3.2. Defining Museum

A museum is an institution that cares for a collection of artifacts and other objects of scientific, artistic, cultural, or historical importance and makes them available for public viewing through exhibits that may be permanent or temporary. Most large museums are located in major cities throughout the world and more local ones exist in smaller cities, towns and even the countryside. The continuing acceleration in the digitization of information, combined with the increasing capacity of digital information storage, is causing the traditional model of museums (i.e. as static “collections of collections” of three-dimensional specimens and artifacts) to expand to include virtual exhibits and high-resolution images of their collections for perusal, study, and exploration from any place with Internet connectivity.

The English word "museum" comes from the Latin word, and is pluralized as "museums" (or rarely, "musea"). It is originally from the Greek *Μουσεῖον* (*Mouseion*), which denotes a place or temple dedicated to the Muses (the patron divinities in Greek mythology of the arts), and hence a building set apart for study and the arts, especially the Museum (institute) for philosophy and research at Alexandria by Ptolemy I Soter about 280 BCE. The first museum/library is considered to be the one of Plato in Athens. However, Pausanias gives another place called "Museum", namely a small hill in Classical Athens opposite the Akropolis. The hill was called Mouseion after Mousaios, a man who used to sing on the hill and died there of old age and was subsequently buried there as well. Museum purposes vary from institution to institution. Some favor education over conservation, or vice versa. For example, in the 1970s, the Canada Science and Technology Museum favored education over preservation of their objects. They displayed objects as well as their functions. [Wikipedia.org]

3.2.1. Brief history of museum education

Education has always been an integral part of museum for as long as it is known. The objects are displayed for entertainment of public, as well as edification. In his book, *‘Learning in the Museum’*, George E. Hein, talks about how routine experiences do not challenge and stimulate a human brain

enough for it to be educative. “Experiences must be not only ‘hands-on’, but also ‘minds-on’. Secondly, it is not sufficient for experiences to be ‘lively, vivid and interesting’; they must be organized as well”. (George E. Hein, 1998). For the visitors to learn and grow from these museums, one needs to understand these functions and experiences sufficiently, so that it can be shaped well. The author states in his book how museums and encyclopedias are same since they both were growing parallel to each other. He quotes from Hudson (1975), a French Scholar, “both were an expression of the eighteenth century spirit of enlightenment which produced an enthusiasm for equality of opportunity of learning...The theory behind these movements was a simple one that collections which had hitherto been reserved for the pleasure and instruction of a few people should be made accessible to everybody”. During industrialization, as population was moving to the cities, science and industry reshaped life, extra effort were taken to improve education and social services. During this time, museums were used as another way of help by the agencies to show people how to better themselves and help them appreciate the modern life. Museum education was used for a lot of purposes for example for health education, to show off magnificent improvements in industries and advances in technologies, or to display curiosities, marvels and wonders for public education and entertainment. As James Paton, Superintendent of Glasgow Art Gallery and Museum, points out, “We are now on the threshold of other important changes, in connection with scientific and secondary education; and in efficiency of all these educational movements the museum of the city should be an important factor. It ought to be the centre around which the institutions cluster, the storehouse where whence they could draw the material examples and illustrations required on the lecture table and in the classroom.”

Excellence and Equity: Education and the Public of Museums (1992) stated a professional museum educator’s commitment to education, or museum learning and return to the theme of community service as essential to museum practice. “The community of Museums in the United States shares the responsibility with other educational institutions to enrich learning opportunities for all individuals and to nurture the enlightened humane citizenry that appreciates the value of knowing about its past, is resourcefully and sensitively engaged in the present and is determined to shape a future in which many experiences and many point of views are given voice”

3.2.2. Museum, Culture and the Changing world.

Museums play the role of interpreting the displays and collections to reflect modern re examination of natural, national and local history. In an article in 1996, social theorist Macdonald states, “First, [this

volume] is concerned with museum as sites in which socially and culturally embedded theories are performed, the interest here is in the stories museum tell, the technologies they employ to tell their tales, and the relations these stories have to those of other sites, including those of social and cultural studies.”

Museums also help reshaping the culture. At the 1993 annual conference of the Committee for Education and Cultural Action (CECA) of ICOM in India, S.K. Bagchi cited the example of direct intervention of a district science centre in rural India to support social cultural development in a poor district, “in 1984, the district Science Centre got fully involved with socio economic development-About 45 Kheria villages were motivated to dig tube wells and ponds for harvesting and drinking water... The Kheria women were taught to make marketable products from bamboo and leaves. The science helped in maintains these products. As literacy was extremely poor, non formal schools were arranged and stipends given... The Science Centre developed visual exhibitions on malaria and diarrhea” (Bagchi, 1993).

3.3. Defining Conservation Centre

The English word ‘conservation’ means protecting something from decay or loss or preventing injury to something while keeping it under official supervision. As stated in *Wikipedia.org*, ‘conservation area’ is a tract of land that has been awarded a protected status in order to ensure that natural features, cultural heritage or biota are safeguarded. A conservation area may be a nature reserve, a park, a land reclamation project, or other area. In the same way, a **conservation centre** is a protected built form with the same functions, only manmade to protect something valuable.

3.3.1. Nature Conservation

In many ways wildlife and nature conservation has been one of the most deep-rooted policies of sustainable thinking. It van even be argued that the notions of sustainable development were taken up partly as a means of promoting nature preservation and conservation. “In Britain, the second century saw the legislation for the protection of seabirds and the establishment of a number of conservation organizations such as common open spaces and footpaths preservation society in 1865, the National Trust for Places of Historic Interest and Natural Beauty in 1894.” (Redclift, 2005).

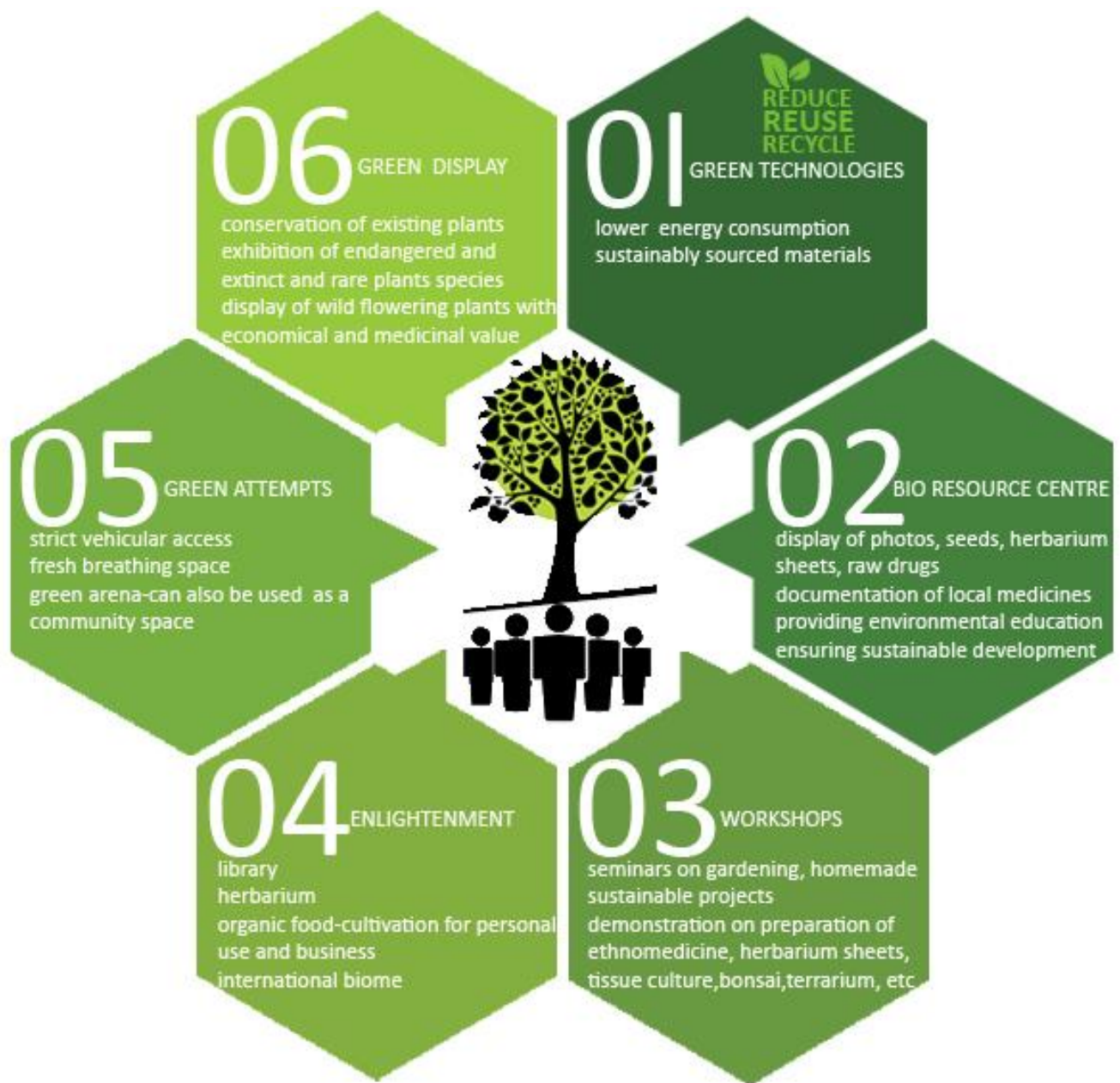
However, from a very early time, there was no concern on conservation of a wider geographical scale. “The survival of our wildlife is a matter of grave concern to all of us in Africa. These wild creatures amid the wild places they inhabit are not only important as a source of wonder and inspiration but are an integral part of our natural resources and of our future livelihood and well being” (Worthington, 1983) The Imperial Botanical Conference held in London in 1924, stressed the need for ‘a complete botanical survey’ of the different parts of the Empire. The argument being made was science should serve as Imperial commerce as it depended a lot on overseas portions for the supply of raw materials and of foodstuff. Throughout, the tone of the conference was fully utilitarian and economic, “I submit that it is our duty as botanists to enlighten the world of commerce, as far as may lie in our power, with regard to plants in their relation to man and their relation to conditions of soil and climate.” (Hill, 1925)

3.4. Defining Green Museum and Conservation Centre

“Form must have content, and that content must be linked with Nature.” Ludwig Mies van der Rohe

The Green Museum and Conservation Centre will exhibit living plants and their ecosystems as artifacts while showing people how to conserve and sustain our natural resources, warning us of its negative affects if not dealt sensitively.

The collections will have rare plants and species, also the regular ones which we see every day, to educate people about the plants of our country. The herbarium and archive will be an open chest for anybody who wants to learn as it accumulates all information on this particular topic under one roof.



CHAPTER 04

CONTEXTUAL ANALYSIS

4.1 Introduction

Between the Indo-Himalayas and Indo-Chinese sub regions, Bangladesh lies in the 'oriental region'. It has a total area of 147,570 km, 80 percent of which comprises the largest deltaic plains in the world, formed in the junction of the Ganges, the Jamuna, and the Meghna rivers. The rest of the 20 percent of the land area is composed of the undulating, forested Hill Tracts. Diversity of ecosystems and its rich floral and faunal resources have made Bangladesh and its ecosystems buoyant to natural calamities. The soothing habitation is because of its rich biodiversity and tropical climate. The history of its rich agricultural practices goes back to many centuries and farmers were highly innovative to create many cultivars using wild genetic resources. Existence of more than 10,000 varieties of rice varieties show our vast wealth of genetic resources. Bangladesh is also one of the oldest producers of cotton and its' rich and diverse collection of medicinal plants have attracted attentions throughout the history. Nonetheless, the affluence of species' diversity, health of ecosystems and habitats has been denied in recent times for a number of reasons, which are mentioned in the following sections.

4.1.1.Ecosystem diversity in Bangladesh and its declination

Within a very small geographic boundary, Bangladesh savors a disparate array of ecosystems. Being a low lying deltaic country, seasonal variation in water availability is the major factor, which spawns different ecological scenarios of Bangladesh. Temperature, rainfall, physiographic variations in soil and different hydrological conditions play integral roles in the country's varied ecosystems. The ecosystems of Bangladesh could be categorized into two major groups.

- Land based-forest and hill ecosystems, agro-ecosystems and homestead ecosystems
- Aquatic-seasonal and perennial wetlands, rivers, lakes, coastal mangroves, coastal mudflats and chars, and marine ecosystems.

According to a Report on Biological Diversity, done by the Department of Environment, 'Bangladesh's forests have decreased significantly in terms of both area and quality over the last few decades. The annual deforestation rate is estimated to be around 3.3% .The increasing population of Bangladesh continues to put pressure on existing forest resources resulting in over exploitations. Present productivity of forest has declined to a range of 1.5-2.5 m per hectare per annum from 7-8 m per

hectare per annum that was accounted twenty years ago (Forestry Master Plan, 1993). Moreover, canopy closure density, number of trees per hectare and over all plant biodiversity has declined rapidly. As a consequence, the quality of the forestland as wildlife habitat has also been reduced.’ (See figure 3.1)

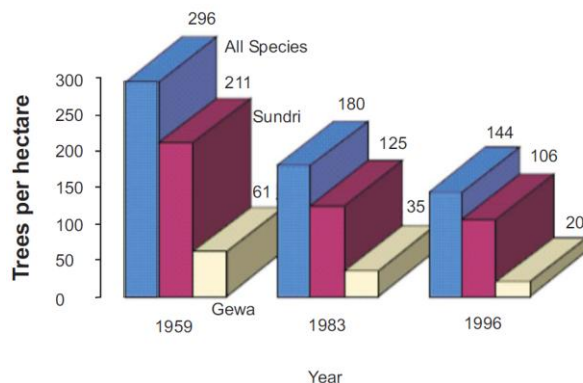


Figure.4.1.a. Declination of trees in Sundarban

Source: Fourth National Report on Biological Diversity

Though people have become more conscious with the environment recently, but the negative affect is too much already for the nature to take in.

The nature is being affected by unsustainable agricultural practices that are carried out in our country. Some agricultural practices, using irrigation and overuse of pesticides and chemical fertilizer, are not environment-friendly and sustainable. Introduction of high yielding varieties coupled with hybrid seeds are causing sharp decline in the country's genetic resources of crop varieties. Lack of information and knowledge generally leads to gaps in awareness. Gaps in awareness have been identified at various levels.

4.2. Necessity of a GREEN building.

Bangladesh is one of the most vulnerable countries due to climate change. It is one of the ninth most populous and the twelfth most densely populated countries in the world. Its growing population and limited land space has put a formidable pressure on the urban ecosystems already, and making its way to deteriorate the countries rural corners as well. According to the United Nations Population Fund, Dhaka is one of the most populated cities in the world. In the very recent years, while trying to catch up to the increased urbanization, Dhaka has undergone several severe transformations. This switch has caused a huge break in the real estate, construction and housing industries. Coalesced steps have been

embraced by the national community in an attempt to escape any further man made catastrophes due to climate change. Deforestation has caused several man made calamities in the country's history. Designed to be a **green** museum, this built form should optimize all its natural resources, minimize environmental impact and serve as an educational model by demonstrating how humans can live and work in environmentally responsible ways.

4.3. Importance of a Green Museum and Conservation Centre in Bangladesh.

Even though Bangladesh is a country with profuse fertile land and abundant yielding trees, it is being destroyed so much every day that the nature is at high risk of losing its remaining beauty and glory that is highly talked about and very much appreciated. With increasing population, the farm lands are being taken over by building developers and more trees are being cut every day, to make more space to provide shelter for the country's rapidly increasing population.

The museum will exhibit and conserve native plants and trees, store information about them in its libraries and archives. It can also be visited for academic purposes for all age groups. The artificially set climates will replicate the different climatic changes of Bangladesh and display plants that grow under such conditions and create an exceptional way for the visitors, native and foreigners, to experience something new and at the same time educate them about native plants. The museums living rainforest will show off a sample experience of the lush green rainforest of Lawachhara in Srimangal, Sylhet. A museum as such will remind the country of its natural treasures and how they can be resourceful to them if they can be preserved and treated in the right way. The conservation centre will work on the plants that are on the verge of extinction and create a scope for people to know about it.

4.4. Site Considerations

The chosen site is an ecological park in the biggest planned township in the country. The man made Eco Park is a small island surrounded by '*Purbasagar*', separated from the main urbanization. An already built town is hard to recover, but a town under construction has a lot of massive diverse urban development opportunities. The **green** building will demonstrate ways of how the constructions and buildings can be made environmentally sustainable. The site can act as the centre of the first step towards a green built environment and inspire an environmentally responsible urbanization.

As the site is surrounded by water on all its side, naturally it can fend off the noise and air pollution caused by the urbanization. The heavy plantation of the ecological park will give enough shadows to the visitors and also act as another buffer for unwanted sound.

There is no direct road connection to the Eco Park, thus boats can be used as an interesting form of transportations and the site will be free of the constant honking of cars and other vehicles.

4.5. Expected Outcome

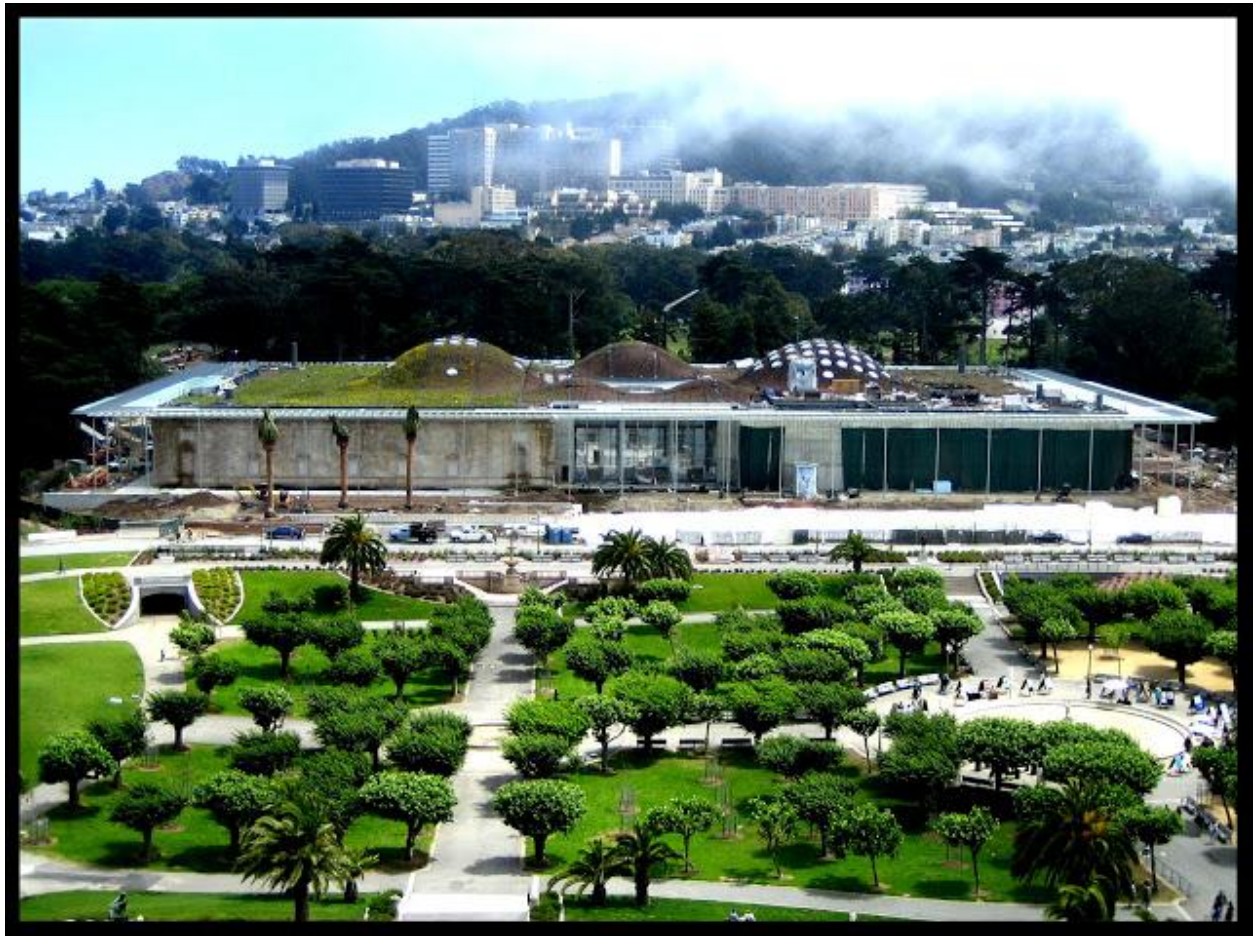
The GREEN MUSEUM AND CONSERVATION CENTRE will display the country's natural resources, store information on them under one roof and also present various ways of using these resources to live an environmentally sustainable life. It will work as a green urban space and as a fresh breathing space for the residents of Purbachal and its visitors.

CHAPTER 05

CASE STUDY

5.1. CALIFORNIA ACADEMY OF SCIENCES, RENZO PIANO, CALIFORNIA.

“The idea was to cut a piece of the park and put it up 35 feet -to the height of the old buildings-and then put whatever was needed underneath”-Architect Renzo Piano



5.1.1. Project Background

Location: Golden Gate Park, San Francisco, California, United States

Type: Natural History

Architect: Renzo Piano

5.1.2. Project Description

The museum is a sustainable building which blends in beautifully with the nature while creating a successful synthesis between natural sights and technical innovation. The museum displays the biodiversity and respect of nature in California.

This natural history museum singled out according to the criteria of the U.S. green building council on October 7, 2008 as the most sustainable building of its kind. It is also a multi-faceted work of art that evokes the history and architecture of San Francisco, for the building structure and shell, architect Renzo Piano used his knowledge of bionics, meaning the physical construction principles were derived from biology.



Figure.5.1.a.The roof view



Figure.5.1.b.Windows

5.1.3. Sustainability and Green Building

- Radiant heating reduces energy needs by 5-10%.
- Heat recovery systems capture and utilize heat produced by HVAC equipment, reducing heating energy use.
- The planted roof provides a superior thermal insulating layer for the building, reducing energy needs for air-conditioning.
- High-performance glass is used throughout the building, reducing standard levels of heat absorption and decreasing the cooling load.
- Reverse osmosis humidification systems are used to keep the research collections at a constant humidity level, reducing energy consumption for humidification for 95%.



Figure.5.1.c.Green roof

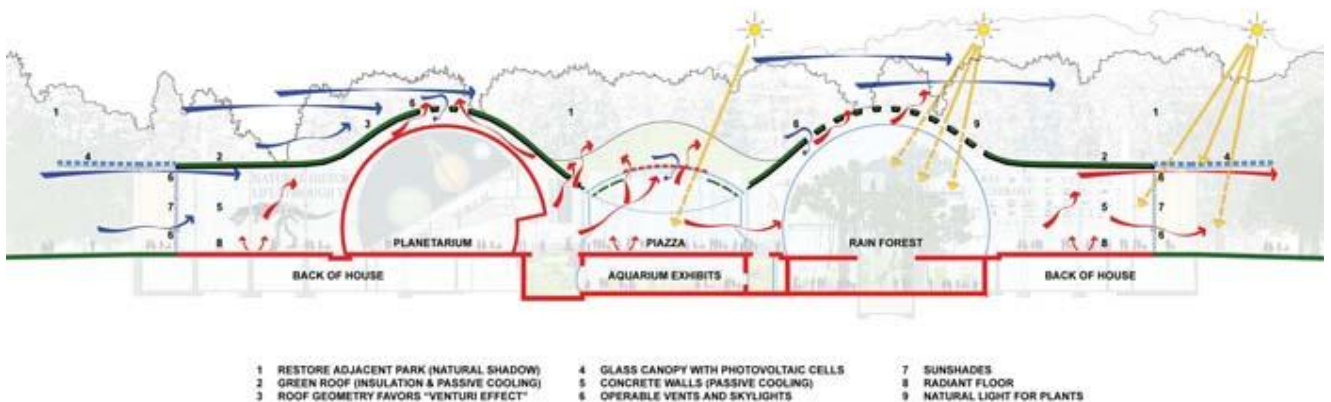


Figure.5.1.d.sectional diagram showing natural air and light circulation



Figure.5.1.e.3D view

5.1.3. Space Design

It consists of two buildings, each with approximately 27.43 m high, free-standing glass domes that houses the planetarium and the living rain forest and a glass-covered piazza covering 183 square meters and approximately 1,160 square meters of variable exhibition space lies in between. The planetarium and the bubble that contains the rain forest habitat are the two big spheres that shape the green roof. The roof becomes a landscape with California's native species, that won't need extra maintenance or water, attracting local species to occupy it. Thus, the green roof won't be fully accessible to visitors, who can only walk through a small path.

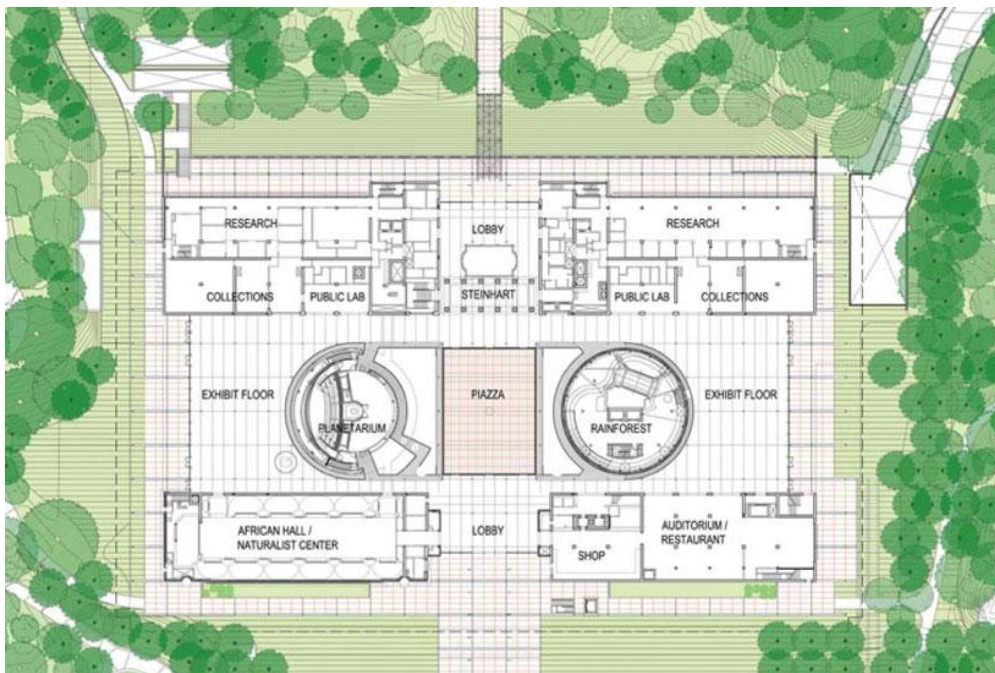


Figure.5.1. f. Plan

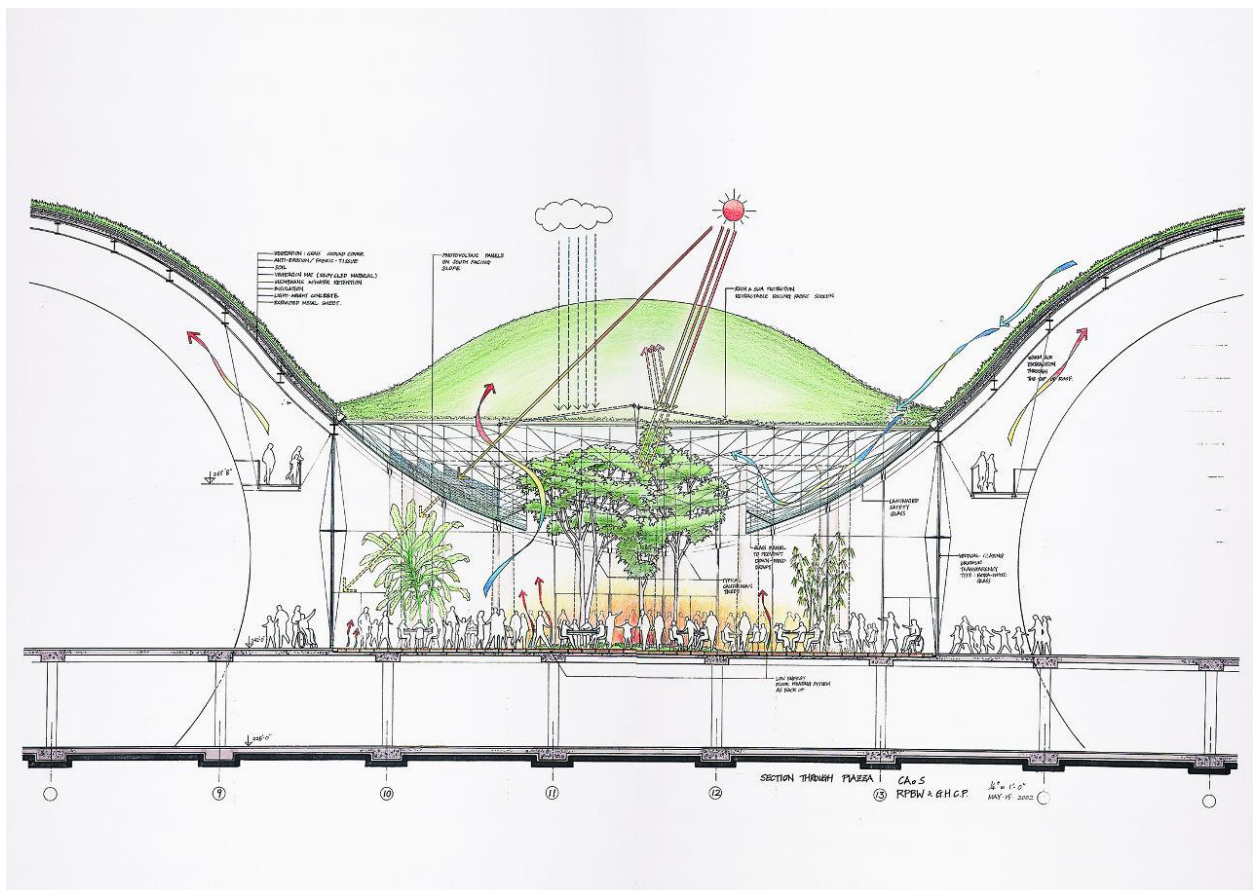


Figure.5.1. i. Diagram of plaza and air and light flow



Figure.5.1.j. Indoor Rainforest

5.2. US BOTANICAL GARDEN CONSERVATORY



5.2.1. Project Background

Location: Washington DC, USA

Architectural Firm: AECOM

5.2.2. Project Description

The U.S. Botanic Garden Conservatory is a historic property on the National Mall, designed by Lord and Burnham in the late 1930s. The building had suffered significant deterioration by 1989, when portions of the building required controlled demolition to avoid catastrophic failure. A year-round, intensely-gardened and maintained facility, the National Garden is a haven for plant enthusiasts. Its walls and fences create a protected enclosure of specially-designed soils, microclimates, water features, gathering and event spaces and interpretive stations.

The American Institute of Architects/DC Chapter honored the U.S. Botanic Garden Conservatory with a 2004 Design Excellence Award.

5.2.3. Space Design

The renovated building includes discrete spaces that replicate climates ranging from high-altitude deserts to tropical jungles, and special exhibit spaces that feature attractions such as medicinal plants or prehistoric plant life. Support spaces for catering, offices, a demonstration and lecture hall, and toxic material storage all are part of the program.

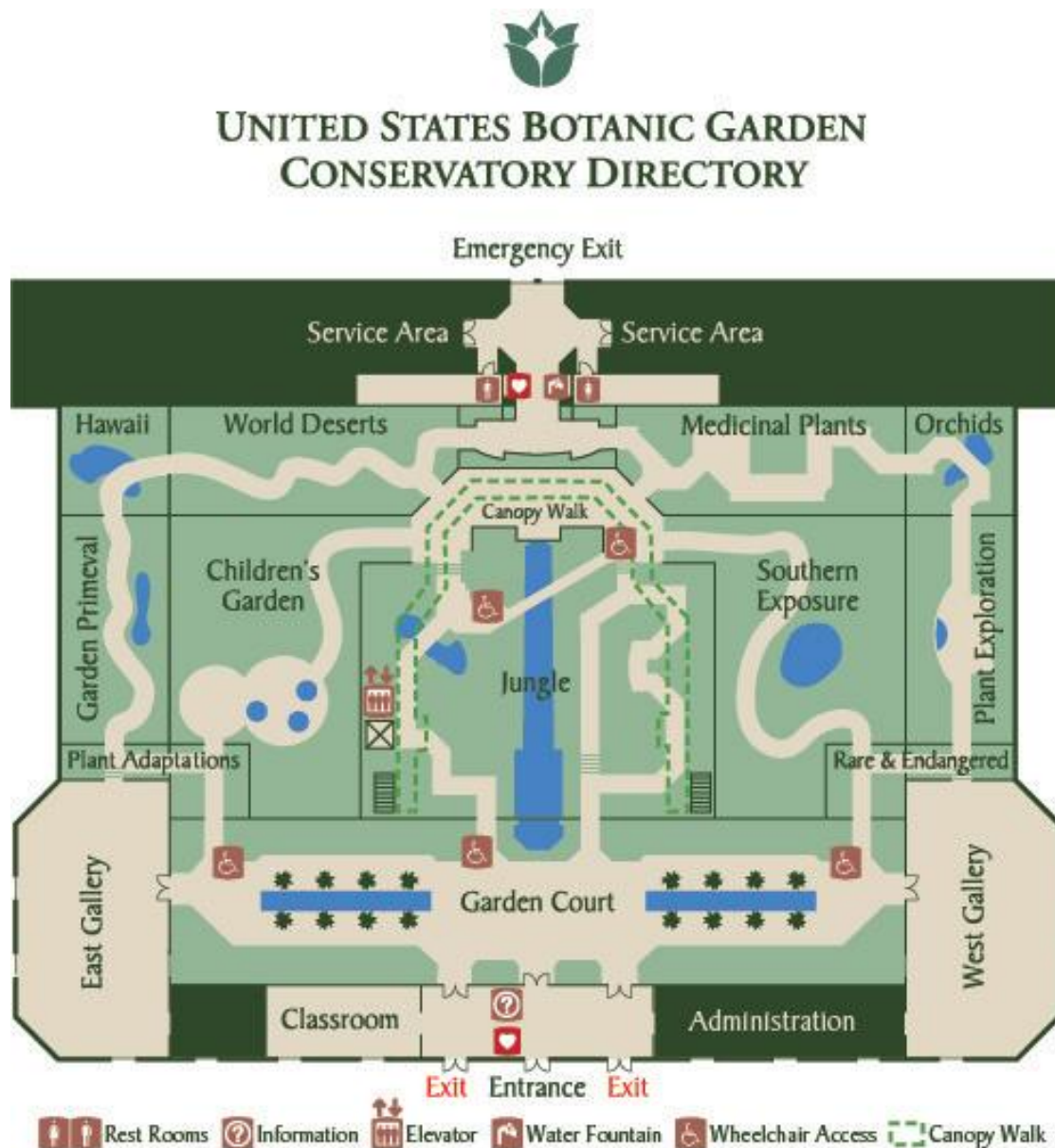


Figure.5.2. a. Space layout

5.2.4. Structural Design

The overall building size has been increased by approximately 25 percent, with a contextual addition that recreates the material and scale of the front elevation while respecting the special demands of the Independence Avenue entry. The design specifically locates all piping and utilities to minimize their visual impact in the glass houses, while the mechanical system is designed to support a variety of controlled climatic and temperature conditions. Structural rehabilitation of the high and low houses was

required, and the complex building shapes—resulting from the intersections of bowed glass—create a unique aesthetic. The new design utilizes multiple types of glass and different aluminum alloys to create a facility that will have a useful life of more than 50 years, even though it will be exposed to environmentally challenging conditions.

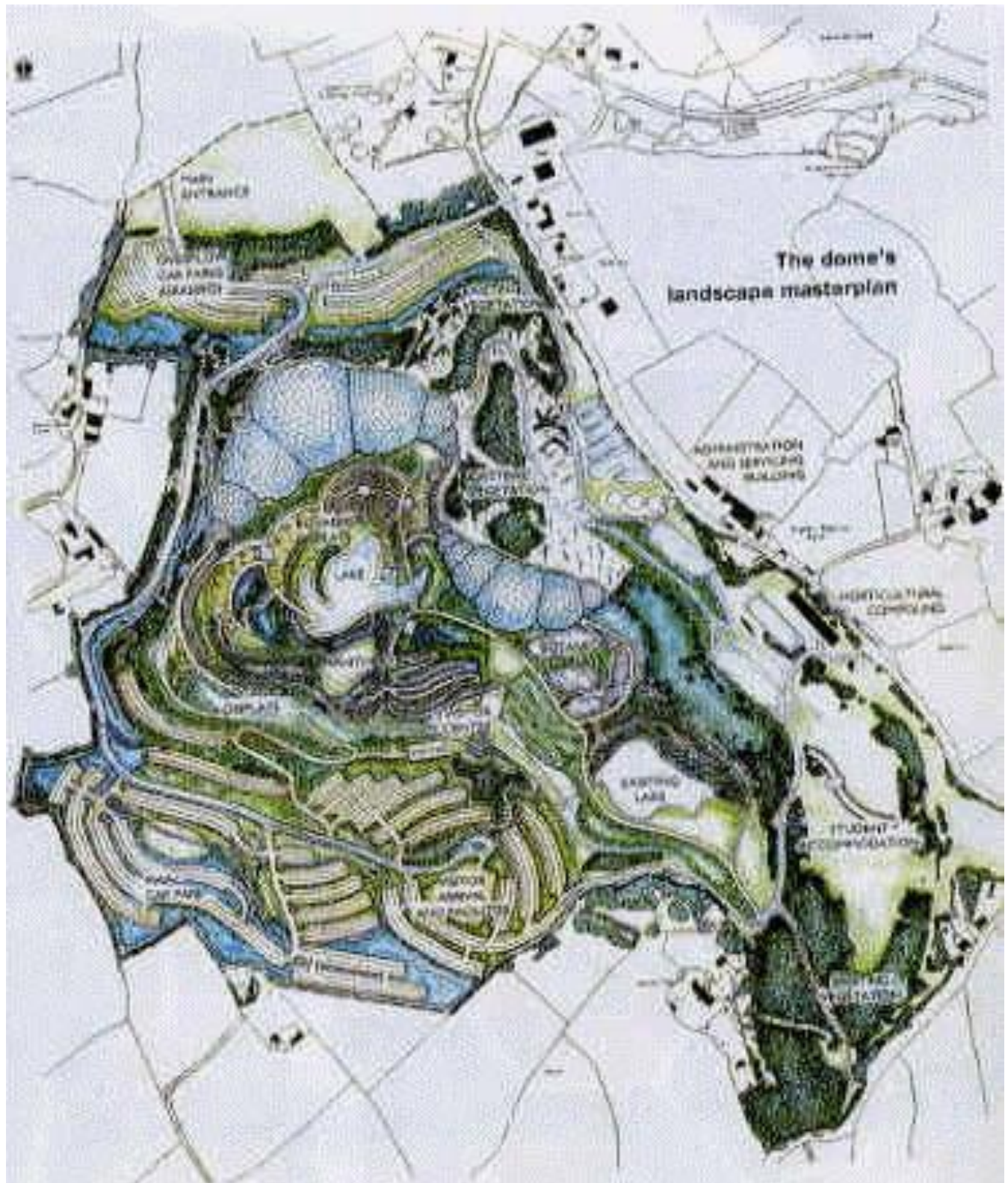


Figure.5.2. b. Interior tropical garden



Figure.5.2.c. Interior desert

5.3. EDEN PROJECT



5.3.1. Project Background

Location: England, Cornwall

Building type: Biome

Square footage: N/A. Outdoors is considered one of the three biomeslargest biome: 240m long, 55m high, 110m wide

Completion: April 2001

Client: UK Millenium Project for the Eden Trust

Design Team: Nicholas Grimshaw and Partners, Tim Smit, Arup Engineering

5.3.2. Project Description

Initially conceived as a UK Millenium Project for the public, the Eden Project has grown to become not only a tourist attraction, research and educational tool, but one for generations to come. From the start, the mission of the Eden Project has been to “promote the understanding and responsible management of the vital relationship between plants, people, and resources, leading towards a sustainable future for all.”

There are essentially three biomes in the Eden Project: the humid–tropics biome, the warm temperate biome, and the moderate temperate biome which is the land surrounding the two enclosed bubble-like structures. The humid–tropics biome, the largest biome at over 240m long, houses tropical plants from all over theworld. Trails and various waterfalls enclosed inside the structure allow visitors to totally immerse themselves in a unique environment that would otherwise be impossible. The moderate temperate biome, though smaller still, allows visitors to enjoy and learn about plants and environments from all over the world.



5.3.3. Design Intent and Validation

The strict criteria for such an innovative structure created many design challenges. First, the structure was to be the world's largest plant enclosure. This involved coming up with a design scheme that could span for great distances without the use of a single internal support. Second, the structure must be as light as possible. This was needed for transportation reasons primarily because all the materials would have to be brought in from other cities, a long distance away. In addition, a lighter structure would put less stress on the soil and allow for smaller footings and less site impact. Last, the enclosure must be ecologically friendly helping it to be used as an educational demonstration of sustainability.

Grimshaw's solution to this challenge was to look at nature. He got his inspiration from looking at the honeycomb of bees and even the multifaceted eyes of a fly. These creatures used their surroundings most effectively to create a very strong, yet light-weight, solution. In addition, a geodesic dome-like structure would be able to conform to the expanding and contracting contours of the clayey soil.



5.4. PITCHANDIKULAM FOREST, AUROVILLE, INDIA



5.4.1. Project Background

Location: Auroville, Tamil Nadu, India

5.4.2. Project Description

Pitchandikulam Forest is found in the green belt of the Auroville International Township in coastal Tamil Nadu, South India. It is a peaceful sanctuary of self-generating forest where over 800 species of plants can be found in the grasslands, nursery and ethnomedicinal forest.

Pitchandikulam Forest is engaged in the following activities:

- Restoring the Tropical Dry Evergreen Forest (TDEF)
- Ethnomedicinal Forest
- Bioresource Centre
- Bioregional and Community Outreach
- Environmental Education
- Sustainable Technologies

5.5. FINDINGS AND ANALYSIS

- Museums don't always have to be closed boxes with exhibits being focused on using artificial lighting. There can be a sense of transparency and connectedness with the outside.
- Glasses can be used extensively in the exterior walls, allowing visitors to look through the museum to the surrounding green space.
- Usually museums are opaque and closed, where visitors don't know where they are. But in a nature museum situated in an ecological park, the building and the park should as connected as possible, visually and physically.
- Designed to be a 'green' museum, the built form should optimize the most of all its natural resources and set an example of how one can live in a more nature sensitive way.
- The galleries should be spacious and have sufficient height to accommodate the exhibits.
- The link between the exterior and interior should be natural and unforced.
- The building materials should be recyclable and sustainable.
- Natural light and air flow should be available to the interiors.

CHAPTER 06

PROGRAMME AND DEVELOPMENT

6.1. PROPOSED PROGRAMMES

Administration 3350 sft

Reception/ lobby/ lounge/ waiting

General offices (including attached toilet)

M. Director's Office

Maintenance office

Museum..... 60800 sft

Permanent Gallery

Herbarium

Archive

Open air gallery

Temporary gallery

Lobby/lounge

Common public facilities14250 sqft

Seminar room

Souvenir shop

Cafeteria

Library

Multi-purpose hall3700 sqft

Auditorium8000 sqft

Academic facilities14800 sqft

Classrooms

Gardening studios

Workshops

Faculty rooms

Meeting room

Quarters for researchers

Quarters for guards and securities

6.2. DEVELOPED PROGRAMME

Site Area, A= 8291848.941 sft
= 19.03 acres

Road width around the site = 100' (highest) & 60' (lowest)
= 30 m & 18 m

So, public institute

FAR = 5.5

MGC = 50% of A = 414,574.471sft=9.5 acres

Total Built Area, TBA = FAR x Site Area
= 5.5 x 8291848.941 sft
= 45605169.18 sft

Total floors can be built on the site (maximum) = TBA/MGC
= 110

Setback for the site:

Front = 1.5 m = 5'

Back = 3 m = 10'

Each side = 3 m =10'

Parking 600 cars

Staff: 5 nos

Bus: 3 nos

Grand total of built area required (without circulation and services) = 104,900 sft

Grand total of built area required (with 25% circulation and services) = 131,125 sft

6.3. PROPOSED FUNCTIONS AND SPACES

Permanent gallery

Permanent galleries with controlled climates and temperatures displaying exhibits at different climatic conditions.

Auditorium

An auditorium for 500 audience with control rooms, backstage & performers' area, which includes a projection screen for arranging regular documentaries on sustainable architecture and living style.

Cafeteria

A public cafeteria with a capacity of 100 people sitting at a time, serving the academic institution as well as the public mass.

Multipurpose hall

A 3500 sft hall that can be used for any occasion or programs being held in the museum. It can also be rented by public. Located at the ground level & commonly used by public & institution people.

Library, herbarium and archive

It is mainly a public facility. The library is open to all members. The herbarium and archives are only permission based and for academic purpose.

Classrooms, gardening studios & workshops

Classrooms, gardening studios & workshops are the part of public facilities. The classrooms are used for theory courses native plants and trees, small lectures by visiting researchers. The gardening studios are for practical knowledge & learning about plants and how to take care of them at home gardens or huge nurseries. The workshops are used for cloning plants, making terrariums etc.

Rooms for specialists

Taxonomist, Biologist, Silviculturists, Microbiologists, Horticulturists and such experts should be present for better conservation and maintenance of plants and trees.

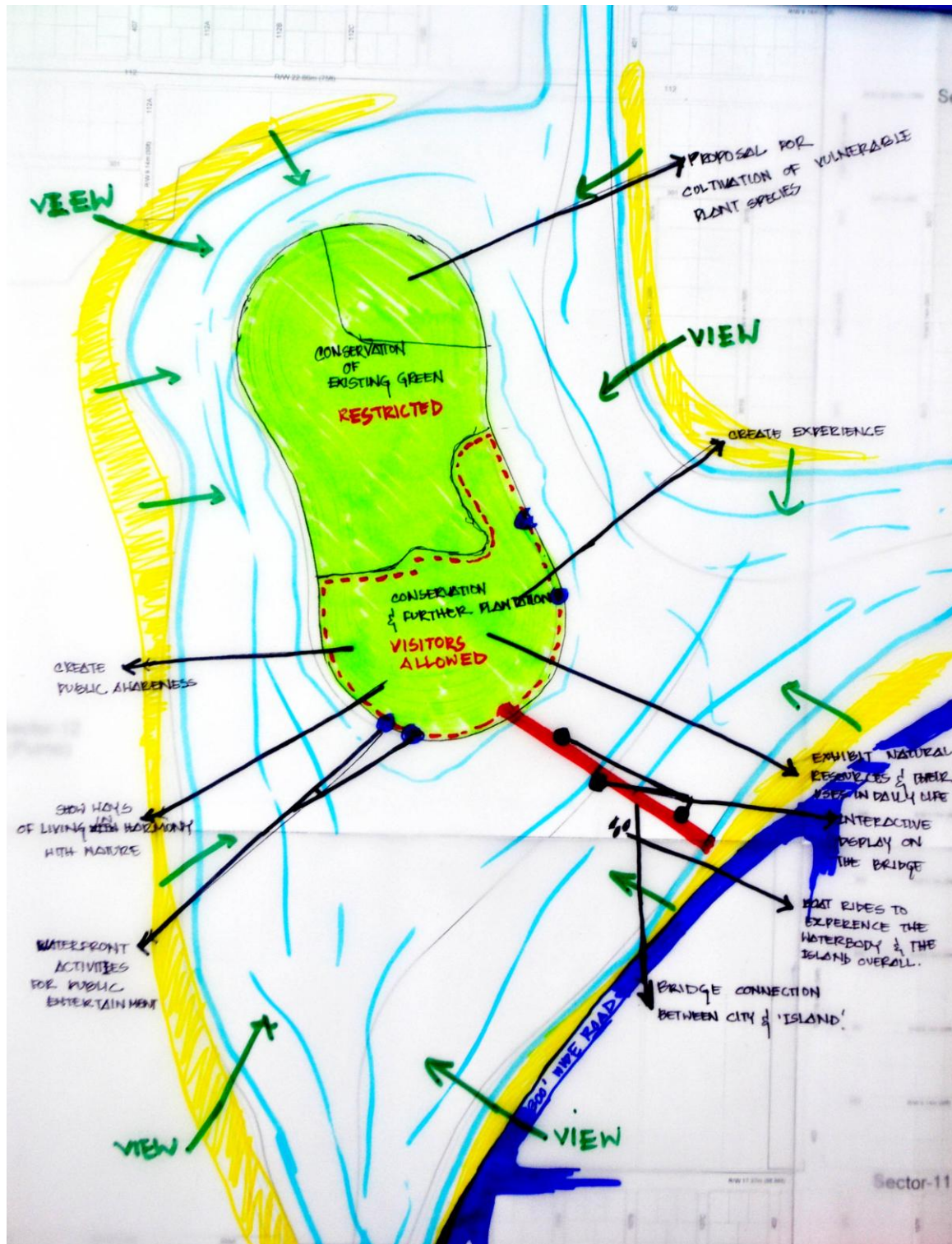
Spaces for photographers, and publication department should be designed for the archives and digital display sections.

Living accommodations

Accommodations for in house staff and visiting researchers.

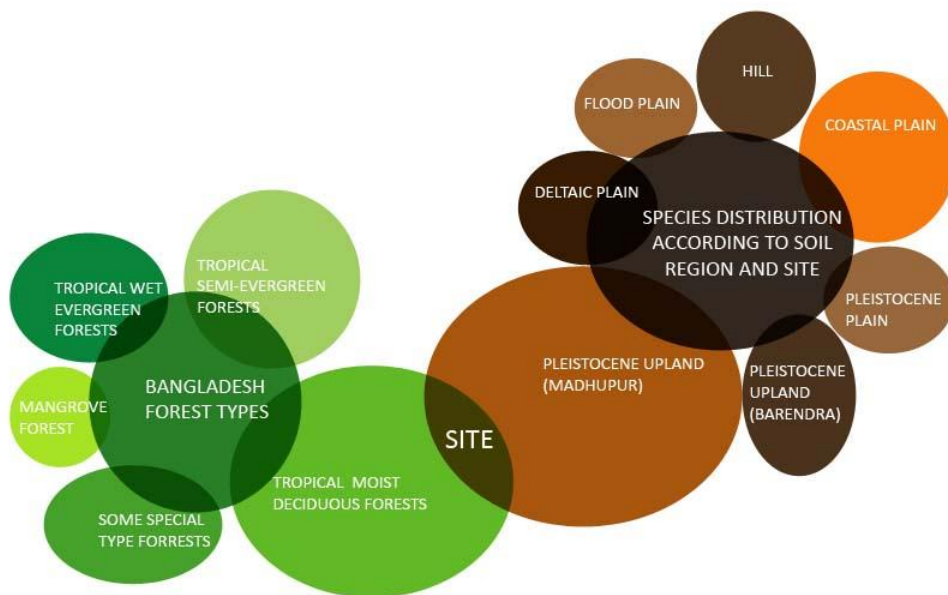
07. DESIGN DEVELOPMENT

7.1 Concept development

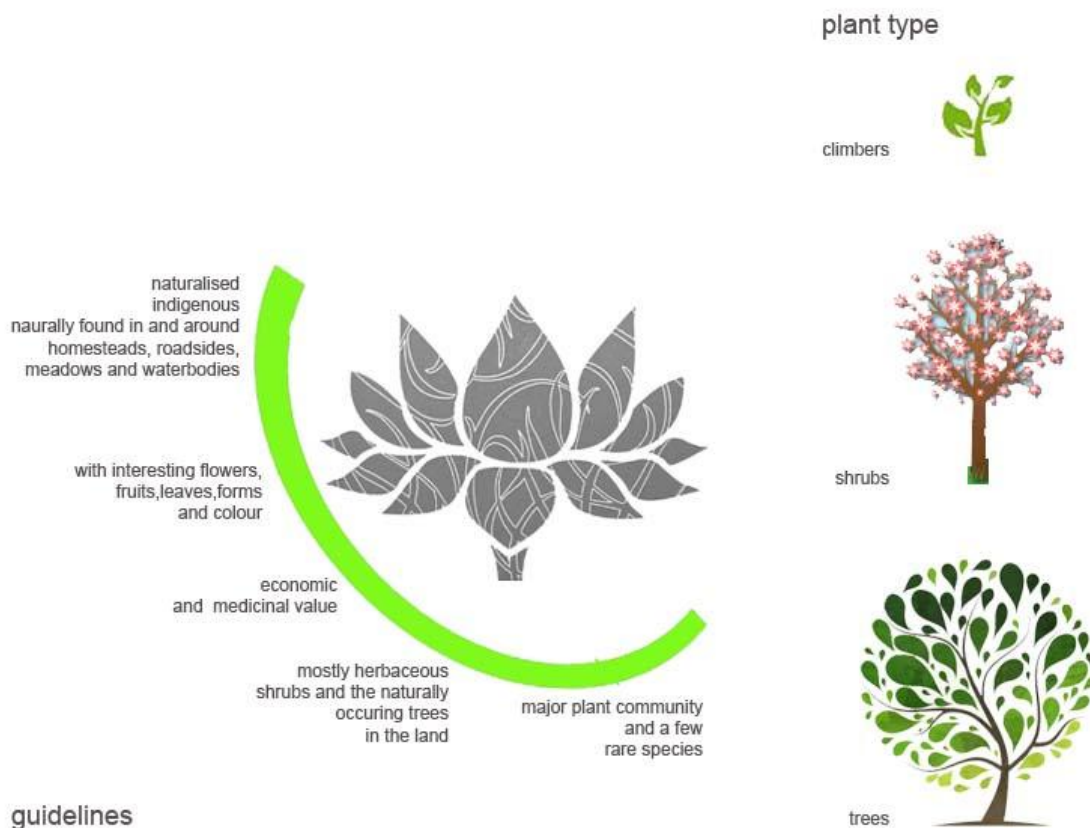


7.2 Plant studies and classifications

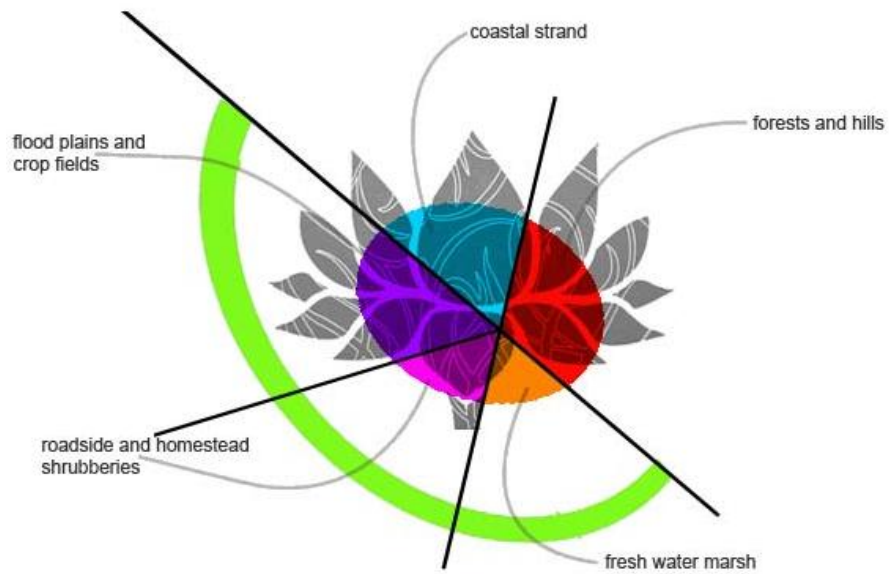
7.2.1. Site understanding



7.2.2. Plant typology



plant division based on ecological class

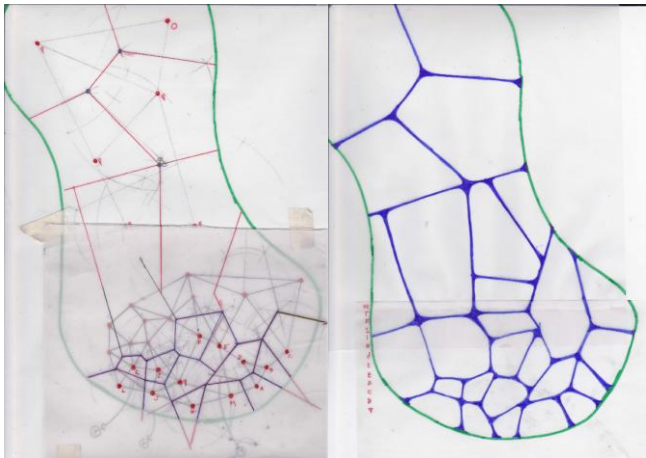


7.2.3 Images of few existing plants in sit.



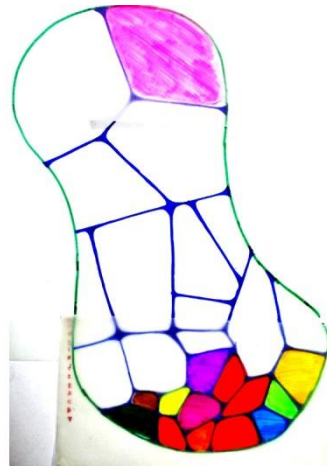
7.3 Design phases

7.3.1. Zoning



Centres for voronoi cells

voronoi cells becoming paths



voronoi cells colour coded for different functions



Phase 01

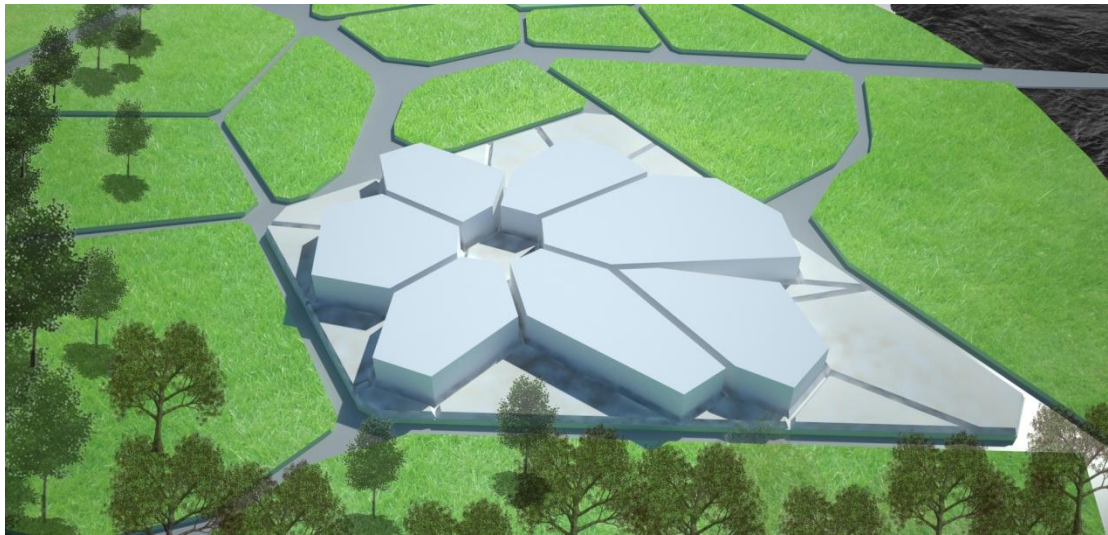


Phase 02

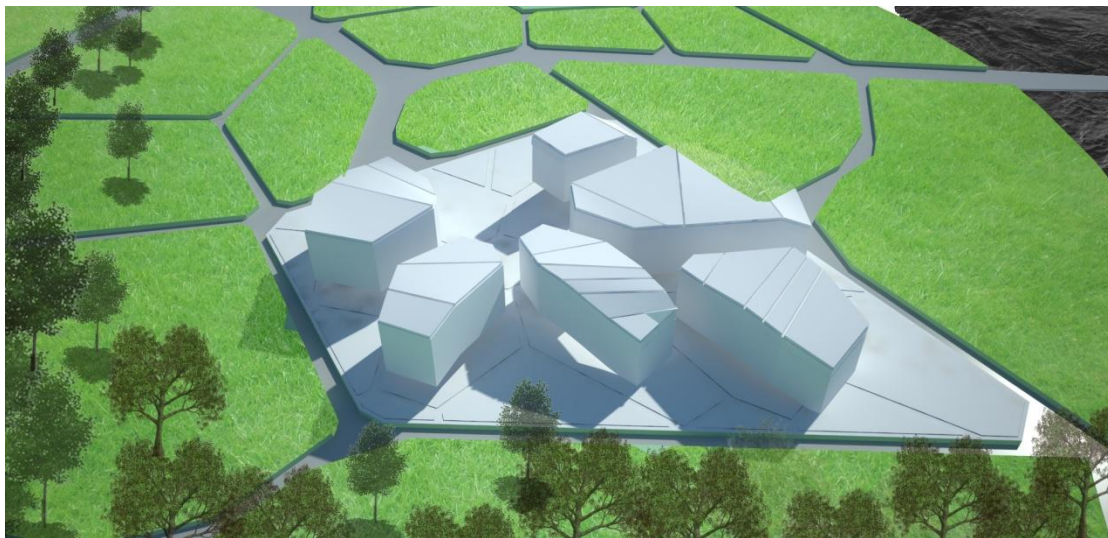
7.3.2 Form Development



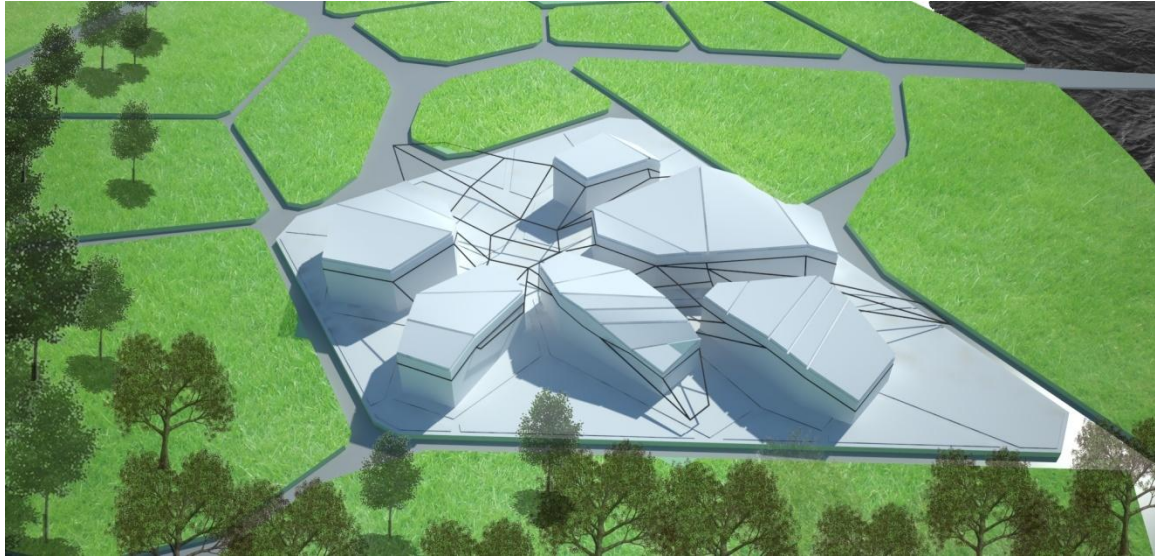
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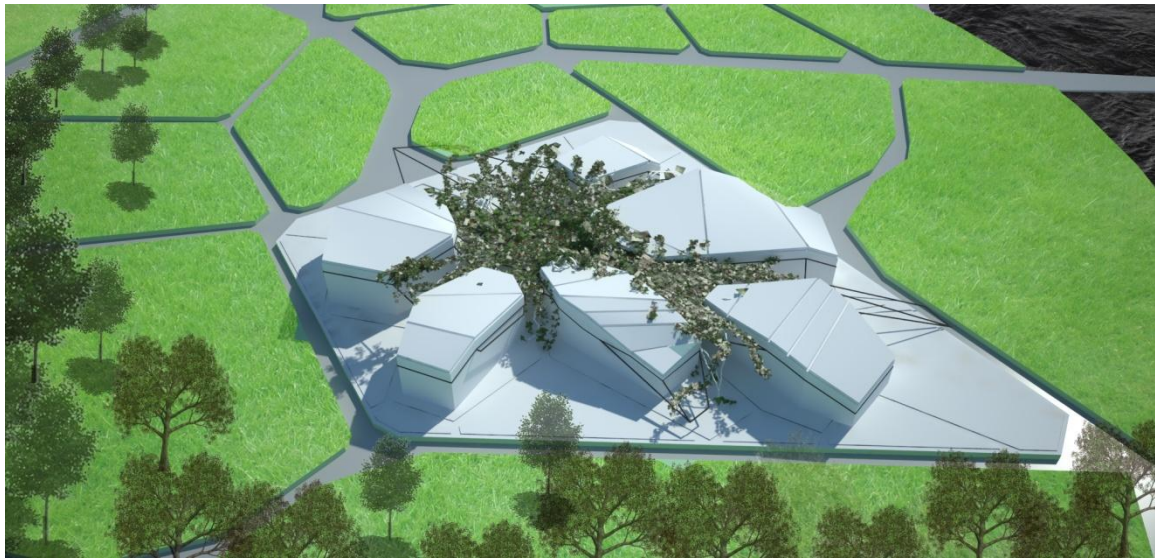
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03

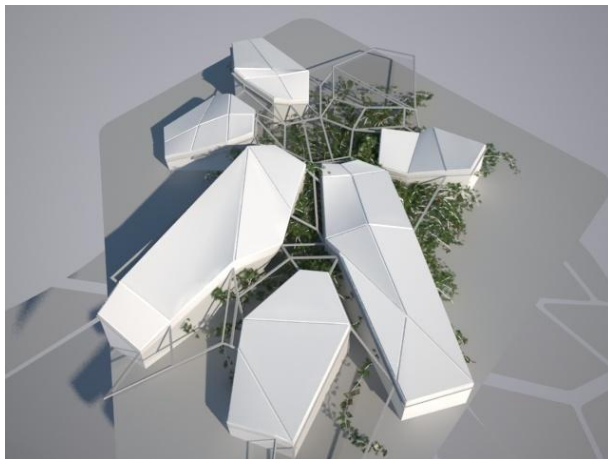


04

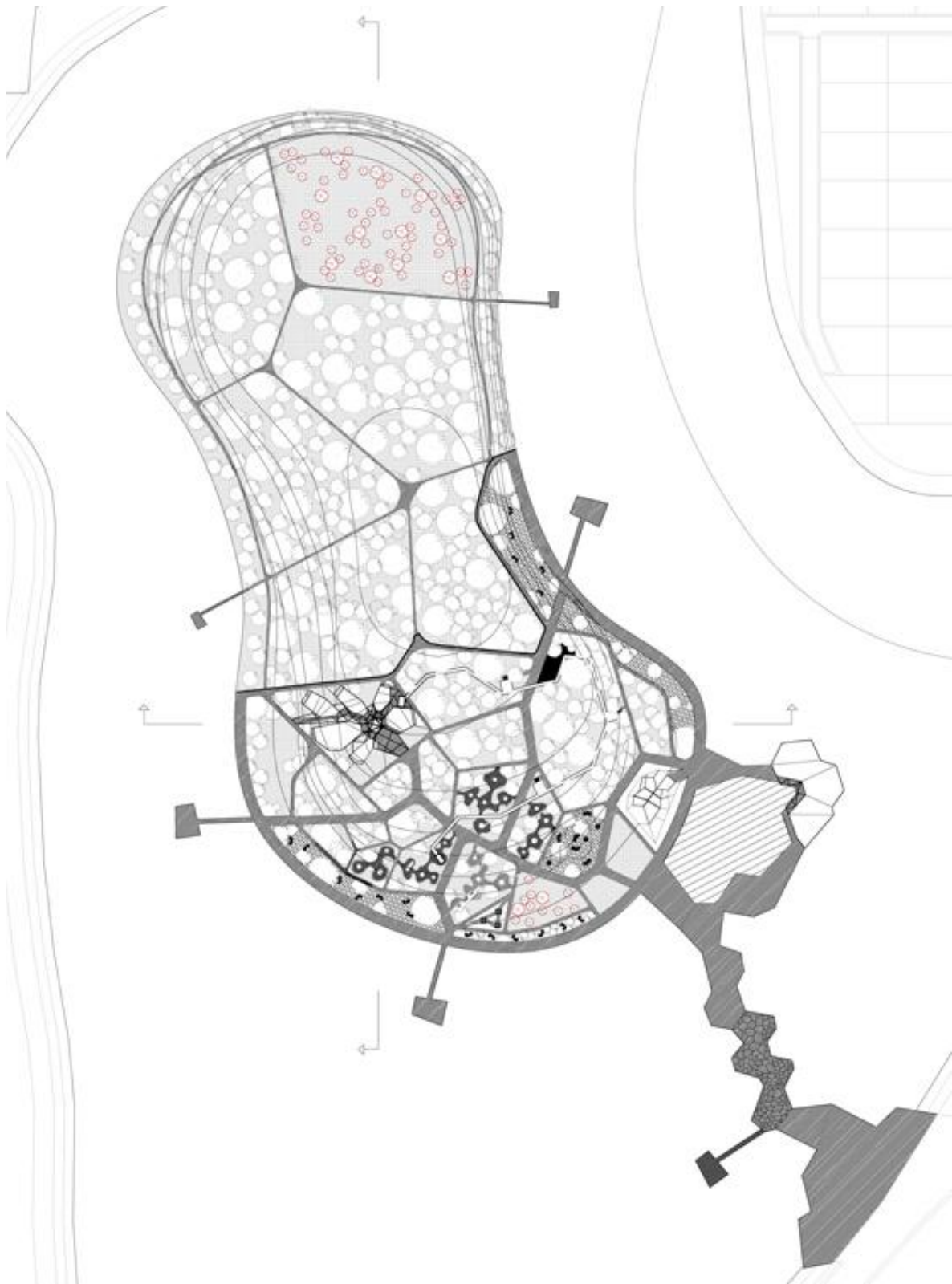


05

7.3.3 Sketch 3d of model



7.4 Design drawings



Master plan (not to scale)



7.5 Model photographs

7.6 3D perspective views

