ORNITHOLOGICAL RESERVE AND VISTORS' CENTRE, KALUVELI WETLAND, VILUPPURAM, TAMILNADU

Thesis submitted in partial fulfilment of the requirements for the award of the degree of

BACHELOR OF ARCHITECTURE

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Declaration

I **GOUSIC J**, Scholar No. **2017BARC052** hereby declare that the thesis titled **ORNITHOLOGICAL RESERVE AND VISITORS' CENTER, KALUVELI WETLAND, VILUPPURAM, TAMILNADU**, submitted by me in partial fulfilment for the award of degree of Bachelor of Architecture at School of Planning and Architecture, Bhopal, India, is a record of bonafide work carried out by me. The design work presented and submitted herewith is my original work and I take sole responsibility for its authenticity. The matter/result embodied in this thesis has not been submitted to any other University or Institute for the award of any degree or diploma.

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08.06.2022

Certificate

This is to certify that the student Mr. / Ms..... Scholar No. ..... has worked under my / our guidance in preparing this thesis titled .....

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Abstract

Wetlands are areas of marsh, fen, peatland, or water, whether natural or artificial, permanent, or temporary, with water that is static or flowing, fresh, brackish, or salt, including areas of marine water the depth of which at low tide does not exceed six meters. Land use changes in the catchment, pollution from households and industry, encroachments, tourism, and overexploitation of their natural supply are all anthropogenic stresses on wetlands. Wetlands are among of the most productive environments on the globe, so their degradation is a reason for concern. They frequently support large populations of creatures, including mammals, birds, fish, and invertebrates, and many of these species use them as nurseries.

Kaluveli is one such wetland, which supports unique and diverse habitats and acts as a major migrating station for migratory birds. The shallow waterbody, widespread grasslands, marshes, flora and fauna of Kaluveli forms a balanced ecosystem. Human inference into the wetland, sometimes tends to disturb the balance in the ecosystem. And hence the government of Tamilnadu has declared the 5151 hectares of the lake as a bird sanctuary on 6th December,2021. The thesis proposal of an ornithological reserve and a visitors' center is to help the recover and maintain the ecosystem of the site with various research and to guide the visitors in the right direction to have the best views of the birds without disturbing them. The challenge lies in directing the human activities in such a way that it doesn't interfere with the balance in the bird cycle nor the ecosystem.

Keywords : *Wetlands, Ecosystem, Ornithology*

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1 CONTEXT

1.1 INTRODUCTION

Wetlands are critical to human society because they provide several essential living necessities. Climatic management, ecological cleaning, and regional fluid balance are all key functions of wetlands in local ecosystems. The wetland is an important habitat for a variety of plants and animals. According to various estimates, the world's wetlands occupy around 8 million km^2 which is approximately 5% of the total earth's land (WI & Gosselink, 2000) .

As mentioned in the convention by Ramsar, "Wetlands are regions of marsh, fen, peat land, or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish, or salt, including areas of marine water with a depth of less than six meters at low tide, such as regions of sea environment with a deep of less than six m. at low tide." Wetlands are gaining popularity across the world as a result of their considerable environmental advantages. They store water to keep the water table high and constant during the summer months. Reptiles and birds In many aspects, the majority of shorebirds have evolved to dwell in or near mangrove wetlands water. They do, however, mitigate stream pollutants during monsoon by retaining suspended material and nutrients. By cushioning stormy waves, decreasing coastal erosion, and absorbing excess nutrients, they help to minimize algae blooms and monitor the health of the mangrove environment. "Mangroves are very productive components and a beautiful natural renewable resource; they also protect coastal towns from the catastrophic effects of hurricanes and tropical cyclones by preventing sea erosion (Kathiresan, 2003)." It serves as an important repository for aquatic biodiversity. The majority of coastal finfish and shellfish species live in mangrove habitats. The real challenge comes when the plain grassland gets disturbed by a built mass which further invites a huge human footprint into the site. The process must be taken a steady process of various stages considering all the parameters like the existing ecosystem, building methods, threats of human interface and the proposed ecosystem.

1.2 AIM

To propose an architectural design strategy for supporting the fall of migratory birds and help visitors get directed in the better way for sighting and feeling the place's essence without disturbing the ecosystem; thereby designing and ornithological reserve for the research and a visitors' center.

1.3 OBJECTIVES

- To examine all the activities taking place in and around the lake and to figure out the human involved activities.
- To study about the flora and fauna in the surroundings and to understand the ecosystem of the wetland.
- To sort out the activities that affects the balance in the ecosystem and identity various rules implemented by the Government to prevent those threats.
- To draft certain strategies that could further help maintaining the balance in the ecosystem of the lake and its surroundings.

1.4 SCOPE AND LIMITATIONS

This research majorly focuses on various human activities and its effect on the surroundings. The study also suggests various strategies that could be implemented so that the human inference would not affect the flora and fauna of the surroundings. Recent studies, research papers and observations will be used to study various activities related to the wetland.

The study will mostly relay on the online literature and research sources and a few live observations which would be limit the study in terms of the data available.

1.5 RESEARCH QUESTIONS

- What are the ways human can interact with the ecosystem without disturbing their balance?
- Is human interface always a disturbance to the existing ecosystems with dominant bird species?
- What are the ways the species in an ecosystem would react to any disturbance?

1.6 METHODOLOGY

The whole framework initially works depending upon the newsletters by various organizations, research and surveys by various ornithological and ecological institutes and research papers by various ecologists and scientists. The parameters that would be mainly studied will be the ecosystem, threats and the strategies.

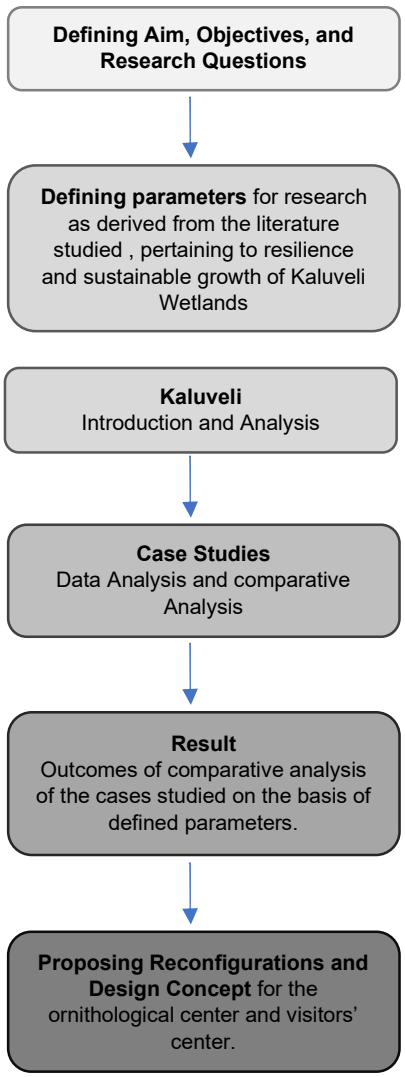


Fig. : 1.1 – Methodology Flowchart

2 LITERATURE STUDY

2.1 WETLANDS

A wetland is a place where water covers the ground or is present at or near the soil's surface throughout the year or for variable stretches of time, particularly during the growing season. The sorts of plant and animal communities that live in and on the soil are mostly determined by water. Both aquatic and terrestrial animals may thrive in wetlands. The presence of water over an extended period fosters the establishment of specially suited plants and the creation of distinctive wetland soils.

2.2 TYPES OF WETLANDS

2.2.1 MARSHES

Marshes are wetlands with a lot of soft-stemmed plants. They are characterized by grasses that have evolved to damp soil conditions and are occasionally saturated, flooded, or ponded with water. Tidal marshes and non-tidal marshes are the two types of wetlands.

2.2.2 TIDAL (COASTAL) MARSHES

Tides and freshwater from runoff, rivers, and groundwater impact tidal (coastal) marshes, which are found around coasts. Salty wetlands are the prevalent tidal swamps, and they're known for their salt-tolerant vegetation. With the help of input of nutritious minerals from the ground and the swamps, salt swamps have one of the greatest rates of production among wetland ecosystems. Upstream of estuaries are tidal freshwater wetlands.

2.2.3 NON-TIDAL (INLAND) MARSHES

Soft-stemmed low plants dominate non-tidal (inland) marshes, which can be found in drained ground depressive episodes, riverbeds, and shallow groundwater regions along the borders of lakes and rivers. Periodic or constant shallow water characterizes these freshwater wetlands. They get the major water source from the ground waterways, such as water table and top water runaway, but they also get groundwater. The Great Lakes coastline wetlands and the prairie pothole area are two major places in the United States that host inland marsh.

2.2.4 SWAMPS

Wetlands with predominate vegetation of trees and hard wood comes under this category. Swamps can be found in floodplains that are either freshwater or saltwater. They're known for having extremely damp ground during the nourishing periods and stagnant water at other seasons of the year. The Okefenokee Swamp in Georgia and the Great Dismal Swamp in Virginia are two well-known wetlands. Forested, shrub, and mangrove swamps are the three types of swamps. Forested swamps can be found in the northeast, southeast, and southcentral United States, where they absorb floodwater from surrounding rivers and streams.

2.2.5 FENS

Fens are peat-forming freshwater wetlands grassland, herbaceous plants, stalks, and blooms. Fens, like bogs, originated when glaciers receded. Fens, unlike bogs, get water from rivers and underground as well as precipitation. Fens, which have a higher impact of water movement than bog, are less alkaline and hence nutritious.

2.3 IMPORTANCE

Wetlands are the most productive habitats for variety of vegetations and are very productive in nature maybe equivalent to the evergreen rain forests and reefs in the coasts. A nutritious ecosystem where aquatic lives gloom, the energies from the vegetations are directly taken by the aquatic lives like fish, ducks, etc as a part of their food chain. An acre wetland can resist upto 1.5 million gallon floodwater which doesn’t count its own production. Except in Antarctica, they are found on every other continent, and their variety is as diverse as their geographic distribution. Continue reading to learn more about the roles and values of wetland ecosystems.

3 KALUVELI WETLAND

3.1 GEOGRAPHICAL LOCATION

Geographically speaking, Viluppuram, Villupuram, or Vizhuppuram is a district located 61 kilometers (about 37.9 mi) southeast of Tiruvannamalai and 45 kilometers (about 27.96 mi) northwest of Cuddalore in the North-Eastern part of Tamil Nadu.

3.2 HISTORY AND CULTURE

Viluppuram district was bifurcated into a separate district in the year 1993 which fell under Cuddalore district before 30 September, 1993. And hence the district ressembles to Cuddalore district in many aspects. Earlier this region was ruled by the Cholas and hence can witness several Chola rock temples.

The people and culture around each type of geography is adapted towards it. The temple, their celebrations, etc. are all dependent on the water bodies in most of the wetland regions and the entire area has a very little influence of traditional buildings, those few which also existed were found to be abandoned and unused. On the other hand, beaches around this region grab a lot of tourist crowd as it is close to Auroville and lies between Puducherry (Pondicherry) and Chennai.

3.3 HYDROLOGY AND IRRIGATION

The streams in the Villupuram region are non-perennial in terms of hydrology. The Pennaiyar is the main river, with the Komugi, Manimuktha, Kedilam, Malattar, Sankaraparani, and Varaganathi streams being significant. Tube wells and open bore wells are the district's primary sources of agriculture, with river agriculture accounting for much less than 4.3 percent of the overall irrigated area. As a result, the district relies heavily on groundwater, ponds, and tank for irrigated agriculture.

Fig. : 3.1 – Rivers in Villupuram District

https://www.mapsofindia.com/maps/tamilnadu/rivers/viluppuram.html

The rivers that do exist are primarily seasonal and convey flooding. Due to the obvious low rainfall, these rivers could be used for irrigation to the desired level, with the exception of the Marakanam and Vanur blocks, which get adequate rainfall. Rainfall is average in Kandamangalam and Koliyaur blocks, but sparse in Kallakurichi and Sankarapuram.

3.4 GEOLOGY

The district's geographical position is straightforward. Metamorphism cover the majority of it, and that there are three main groupings of sedimentary dating from distinct geologic eras.

The district's types of soil include red, black cotton, and coast sand, and the landscape is nearly flat in most regions. The Kalrayan and Gingee mountains, with their sloping tiers, are outliers.

4 OBSERVATIONS

The entire 55,000acre lake is majorly accessible through 2 major zones and the observation is done in these 2 zones.

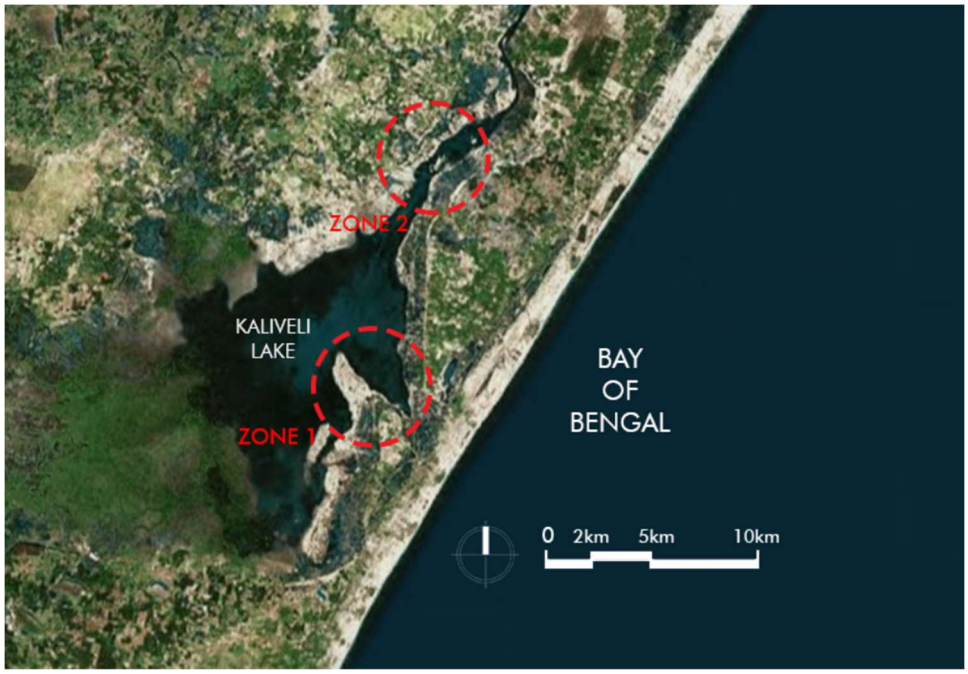


Fig. : 4.1 – Zone key map for observation

4.1 ZONE 1

Most of this zone is used for cattle grazing on the water edges and agriculture in the grasslands of this zone. The 3 different parts in this zone takes anyone through a gradual flow from an agricultural village to a plain grassland and then a lake. The lands here are completely used for agriculture. When the waterlevel starts going down, the water is contained and paddi is cultivated. Also a large number of catte grazing is found in this region. On the Eastern side is the cluster of coconut farms. Has wide spread grasslands on one side and the lake on the other side with a gradual slope. This is being the boundary for the cattle in the area. This edge of the land has the best view over looking the lake and the nesting birds. The patches of water bodies are the place for the migration birds for nesting

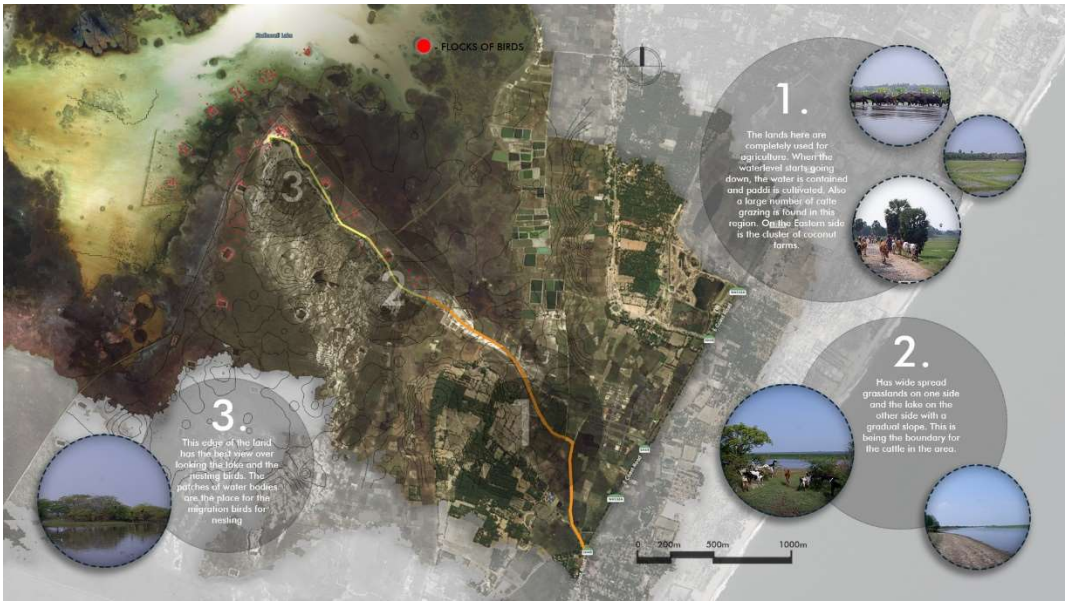


Fig. : 4.2 – Observation Map of Zone 1

4.2 ZONE 2

The bridge serves as the best place to view the birds in water. A lot of birds are found fishin in the prawn farming tanks and the water chanels in this area. A lot of of ducks are found even in summers in this region as the water flow is constent here. These are agricultural lands. Coconut, paddi, groundnut and peanuts are largely found cultivated in this region. Also has prawn farming tanks and salt tanks in the banks of the stream.

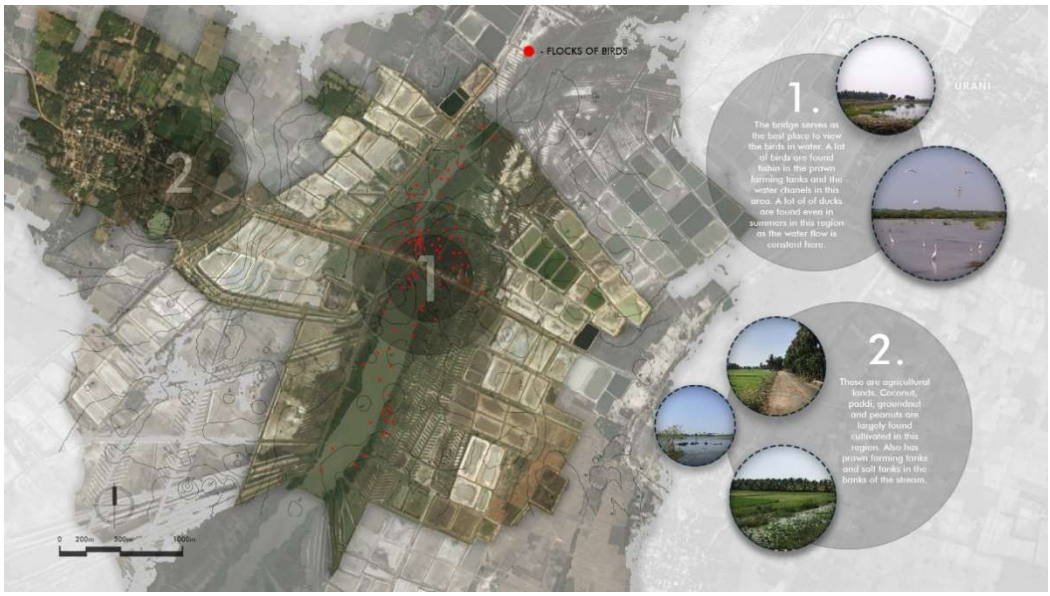


Fig. : 4.3 – Observation Map of Zone 2

5 SITE CONTEXT AND ANALYSIS

5.1 CLIMATE

5.1.1 RAINFALL

The annual rainfall in the region is around 1101mm and the most dry month of the year would by February with an average rainfall of 11m and the wettest month of the year would be October with an average rainfall of around 208mm.

5.1.2 TEMPERATURE

May is the hottest month of the year, with a mean temperature of 31.9°C. With only a mean temperature range of 25 degrees Celsius, January is the coldest month of the year.

5.1.3 SUNLIGHT HOURS

Villupuram has the largest amount of additional hours of daylight in June, with a mean of 10.89 hours per day and a total of 337.68 hours during the month. In January, Villupuram has the lowest amount of daily hours of sunlight, with a mean of 6.3 hours a day and a total of 195.3 hours of sunshine.

5.1.4 WIND DIRECTION

The waves of the brackish lake move from south-east to north-west, creating a sea wind. In a wider perspective, Villupuram's major average hourly wind direction fluctuates throughout the year. For 4.6 months, from May 23 to October 10, the wind is most commonly from the west, with a high proportion of 83 percent on June 30. For three weeks, from October 10 to October 31, and for three months, from December 30 to April 1, the wind blows from the east, with a peak percentage of 40% on October 29. From October 31 to December 30, the wind blows from the north for 2.0 months, with a high percentage of 61 percent on December 6.

5.1.5 FLORA AND FAUNA:

Kaluveli is a major home for various vegetations like fishs, birds, reptiles and mammal species. There are over 226 species of birds that are been observed in and around the surroundings of the lake since 2004 by nearly 350 specialized observers. Over 30000 native ducks are observed in the winters in the region. In addition, throughout the winter, the marsh acts as an important passage for migrating birds visiting the Point Cali mere Bird Sanctuary. From October through March, large flocks (in the thousands) of marsh birds can be seen, as the wetland's ecological characteristics are ideal for migratory birds during this time. Nonetheless, land encroachment, expanding shrimp farms, and other manmade activities have put this rich environment under jeopardy.

FLORA:

Few of the Vegetative species that can proliferate in wet climaic conditions are found in this area which includes:

1. Mesquite *(Prosopis Juliflora)*
2. Asian Palmyra Palm *(Borassus Flabellifer)*

FAUNA: (AVES)

Kaliveli Lake is a prime reservoir in the district and is a great epitome of serenity and calmness. Being one of the must-visit tourist attractions in Tamil Nadu, Kaliveli Lake is amongst the largest wetlands and semi-permanent water bodies in India. Kaliveli Lake is a brakish lake which is connected to Marakkanam Lake which is directly connected to the Bay of Bengal and one of the major flying stations for them igratory birds. The bird migration season lies between September and November, where a large number of birds from South Europe and South Russia are seen in this lake.

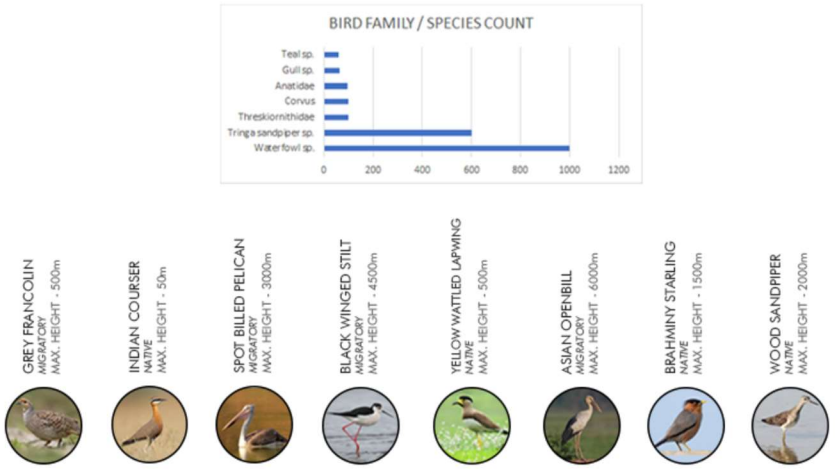


Fig. : 5.1 – Native Birds Statistics

There are a number of birds found in this area because of the presence of wetland which includes exotic birds like kingfishers, and flamingoes which adds a beautiful grandeur to the enchanting landscapes of the lake and other Well-known species like the Eastern Imperial Eagle, Greater Spotted Eagle, Red-necked Falcon, and several harriers. Most of the native and migratory birds here are of the pheasant family.

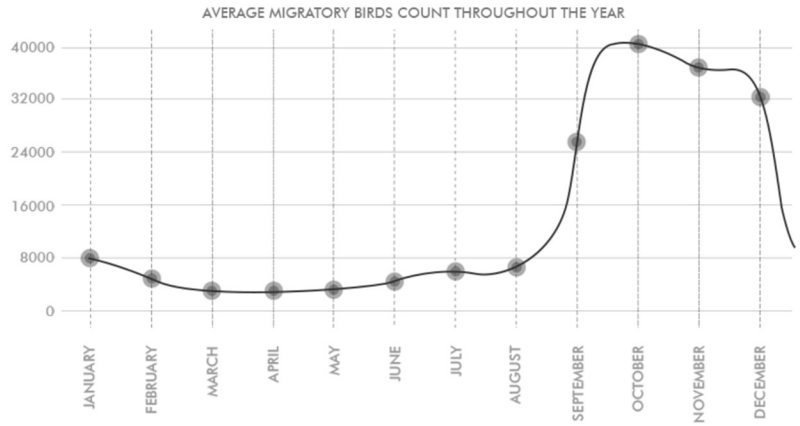


Fig. : 5.2– Migratory Bird Season

5.2 POTENTIALTHREATS

Only a few pockets of forest remain in the Kaliveli marsh, which has been turned to intensive cultivation. Most of the mangrove forest ecosystem has gone down as they serve as the supply for fuel wood and various other natural resources used for various other purposes because of the human pressure. Its

conversion, as well as threats from agricultural, industrial, and urban expansion, have resulted in significant losses. There have also been reports of several industrial wastes contaminating the lake and the areas around the lake. Villagers in the surrounding areas make their living by fishing and other associated activities, and they use the grass and mangrove for firewood, fodder, and building materials. In the brackish area of the lake, salt pans and shrimp aquaculture are becoming more common.

5.2.1 HUMAN INTERFACE

The region is known for its presence of hamlets over 20 little and medium sized ones with a count of approximately 2600 human. A lot of people in the region are dependent on the Kaluveli reservoir for their day-to-day routine. Reeds and some sedges are being collected in order to produce a few home things and in the perspective of selling them in the local fish markets, so their economic dependence is modest. One of the primary issues endangering Kalivelli's survival is the increasing incursion of land for various economic interests. The marsh is also under a lot of pressure from the region's urbanisation.

5.2.2 SALT PANS

Around these places, salt marshes and mangrove zones are being turned into saltpans. Even parts of the lake's freshwater areas are being transformed to saltpans (Fig. 5.3). This changes the soil's salinity gradient, which has an impact on the flora and animals of this wetland habitat. Most of the salt pans in this region belong to the government. Groundwater has become saline as a result of prolonged use. The majority of them release partly, which impacts in increase of lack of oxygen availability and increases turbidity in the water body because of the availability of organic particles in it, which further results in the decrease in the oxygen level. It results in affecting the life of the aquatic vegetation. Due to a reduction in freshwater flow and an increase in soil salinity, salt pans located near mangrove forests may impede mangrove tree reproduction.

Fig. : 5.3– The dense mangrove vegetation area (Silambarasan & Sundaramanickam, 2017)

The salinity of these places increases when fresh water and tidal water intake decreases, and hence result in bad germination, development, and lack in mangrove vegetation redevelopment (Fig. 10.3a, 10.3b, 10.3c). As a result, unfavorable environmental conditions occur, posing a threat to the mangrove ecosystem's growth and regeneration. Mangrove trees are also used by residents of salt pan areas to build buildings for storing salt and as firewood for cooking meals. Both mangrove vegetation and ecology have suffered because of these operations.

5.2.3 AQUACULTURE AND AGRICULTURE

Water that runs away from the agricultural farms tainted with pesticides, fertilizers and other chemicals, used by farmers to increase output is mixed in the Kaluveli wetland, disrupting its aquaculture and threatening fishermen's livelihood. Most of the marshlands are being converted into aqua farms (Fig : 10.2).

Fig. : 5.4a, 5.4b, 5.4d– Salt pans under practice (Silambarasan & Sundaramanickam, 2017)

Fig. : 5.5a, 5.5b, 5.5c–Hindering the mangrove trees regeneration (Silambarasan & Sundaramanickam, 2017)

Shrimp farms were developed by residents of the nearby communities, and their area has rapidly grown. The Bay of Bengal's tidal waters flow up to them. As a result, the underlying water in these areas has turned saline. The tidal waters flow into the wetland through the lake. As a result, the underlying water is converted into saline.

Another hazard to the wetland's water quality, soil, and biodiversity is wastewater from a shrimp farm. Aquaculture and its effluents in wetlands pose a substantial threat to mangrove seedling regeneration and survival. Similarly, wastewater that are discharged from various aqua pans contains extra nutrients that increase plankton populations, which becomes the food source for various aquatic lives. Increased nutrient wastes, on the other hand, can contribute to hazardous algal blooms and

eutrophication. In the Kaluveli watershed and surrounding places, soil Stalinization due to shrimp farming has also been reported.

5.2.4 BIRD POACHING

The Kalivelli Wetland is a well-known birding hotspot; its reservoir serves as a vital wintering ground for many migrating birds. During the winter, migrating birds flock to Kalivelli due to the abundance of marshy grounds, mangrove flora, a vast variety of fish, and other food sources (Fig. 10.4).

Several birds migrate from Siberia to Kalivelli Wetland for the winter, stopping here on their way to Point Calimere and Sri Lanka. The migratory season lasts from October to March, depending on water availability. Kalivelli sustains more than 20,000 birds each year, according to an IBCN and Bird Life International evaluation from 2004. The lake has long been a feeding station for long-distance migrants from Central Asia and Siberia's harsh subarctic areas. Poaching and hunting rise during the migratory season as the quantity of birds grows. During the migratory season, some amateur hunters from the surrounding areas visit these marshes. The majority of them are tribal people who regularly injure and kill a large number of birds in order to catch them for food. They use plastic cables or tiny wires to capture the birds at night. The birds try to flee after being caught in traps and suffer injuries as a result. Tribals selling birds in local markets are widespread (Fig. 10.4a, 10.4b). Birds are included on the menus of a number of establishments in the nearby towns and villages to attract consumers.

Fig. : 5.6a, 5.6b– Poaching of some rare species (Darter, Pelican, Grey heron, Open bill stork, Painted stork) (Silambarasan & Sundaramanickam, 2017)

Many of these species have been classified as endangered or vulnerable by the IUCN Red List, such as Anguilla bengalensis and Hoplobatrachus tigerinus and Pelecanus philippensis (Ramanujam & Anbarasan, 2007)Although the riparian regions connecting the water tanks provide potential corridors for the movement and dispersal of these species, they are threatened by agricultural encroachment, urban development, destruction of drainage channels, and lack of regular maintenance (sedimentation filling up tanks and channels, collapse of bunds, etc.) (D'Souza, Boulicot, & Dhandapani, 2007).

A controversial proposal has been made to develop Kaliveli as a tourist destination with a conservation focus and a bird sanctuary. Although the Government of Tamil Nadu declared the Kaliveli wetland as reserve area in order to build a bird sanctuary under Section 26 of the Tamil Nadu Forest Act 1882 on 16.4.2001, little progress has been done since then.

5.2.5 CATTLE GRAZING

The lakebed is covered in grass, and grazing begins as the water level drops. The lack of forage forces over 30,000 animals onto the lakebed. The task of grazers is delegated to Dalits in several villages. They send their cattle or sheep out in the morning from each house and make sure they return in the evening. Grazing cattle. During the monsoon season, when fresh seedlings are springing up and young mangroves are growing, poachers capture Black-headed Ibis and sell them along the roadway in the periphery of the mangrove swamp. Cattle grazing at that time causes poor mangrove vegetation regeneration and growth in the grazing regions. As a result, more research is needed to lessen grazing pressures on the wetland.

5.2.6 FLOOD

Kalivelli wetlands, on the east experiences the most damage during the floods as it is coastal. The district vulnerability map shows that the regions on the eastern coast lies under the medium and low vulnerable zones. The water from the lake drains in the central regions of the east part of the lake. The vulnerability map analyzed is from the Thane cyclone (2015).

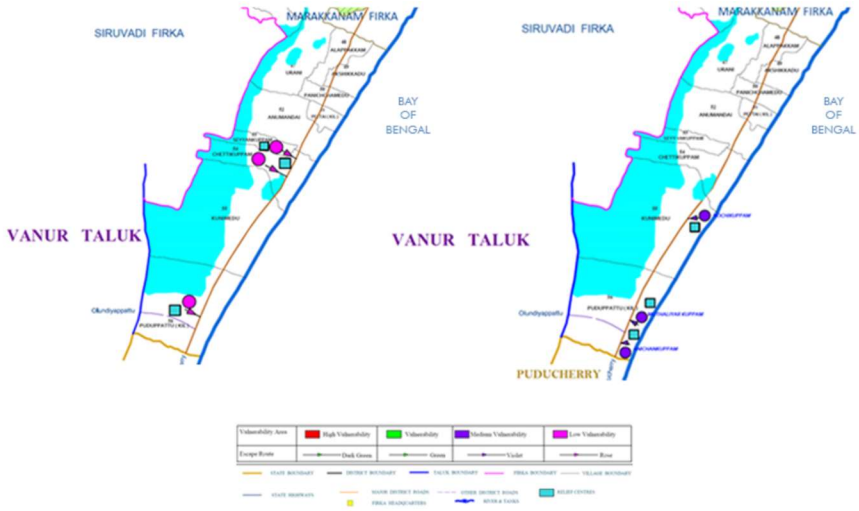


Fig. : 5.7– Vulnerable areas to flood (Cheyyur Taluk) (Details of Vulnerable Areas to Flood, 2015)

5.3 MAHARASTRA NATURE PARK PROPOSAL

The MMRDA has conducted an international competition for redesigning the Maharastra Nature Park and the cyclist and pedestrian path across the Mithi River.

The waters' edge as soft infrastructure The design proposal at the regional level proposes a re-imagining of the existing waterway edges as a dynamic ecosystem that absorbs the monsoon overflow and serves as a green filter remediating outflows into the water from the immediate surroundings. Simultaneously, physical filters are proposed at the estuarine end to filter out some of the solid waste being brought back by the high sea tides. This is aimed at improving the quality of estuarine water, which will make this area more attractive from all banks- Bandra Kurla Complex (BKC) and MNP.

A few observed strategies are as follows. T eating the water flowing through the Mahim Estuary will create a more pleasant environment on both the BKC and MNP banks. Linking the two banks with not just the pedestrian bridge but also a mangrove boardwalk creates a recreational pedestrian/cyclist loop that will also rejuvenate the unused BKC cycle trail and make the entire area a vibrant community space. Creating attractive landing points at both ends of the bridge- a plaza/amphitheater at the BKC and an overview into MNP at the other end- will invite more people to use the bridge, avoiding the fate of the foot over bridges that fail due to low foot fall. Integrating the pedestrian bridge as one part of the MNP built structure brings more

connectivity to the Park, and reduces the amount of net built mass in the park. Providing amenities, albeit temporary, for the local residents at the presently encroached eastern end of the MNP, in the form of public toilets addressing the current issue of open defecation. The bridge embedded in a series of remediating landscape of reed beds etc, forms a sensitive boundary without being an obvious hard edge to the park. Attempting to understand and alleviate the ecological issues that ail the MNP, the interventions will include measures like detention ponds that will aid and educate visitors on rainwater harvesting, reed bed technologies to treat waste water of the toilets etc.

5.4 CONSIDERATIONS

Kaluveli Lake is a prime reservoir in the district and is a great epitome of serenity and calmness. For bird watchers and ornithologist, exotic birds like kingfishers, and flamingoes add a beautiful grandeur to the enchanting landscapes of the lake. Well-known species like the Eastern Imperial Eagle, Greater Spotted Eagle, Red-necked Falcon, and several harriers are majorly found. Most of the native and migratory birds here are of pheasant family.

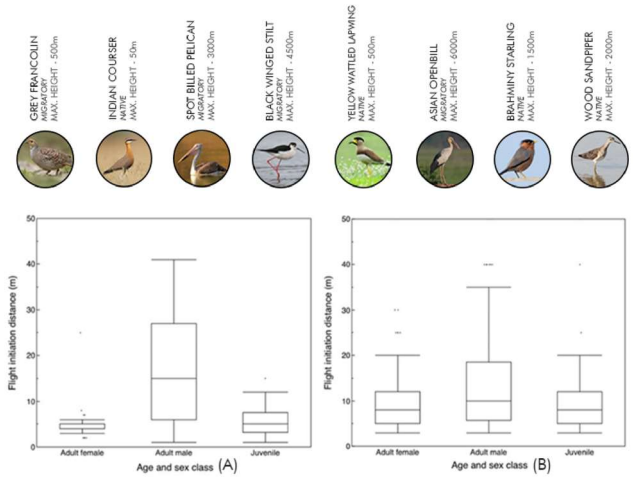


Fig. : 5.8– Flight Initiation Distances of Pheasants (Moller, Liang, & Samia, 2019)

“Box plots of FID (m) in adult female, adult male, and juvenile (A) common pheasants and (B) golden pheasants. The box plots show medians, quartiles, 5- and 95-percentiles and extreme values. Sample sizes for common pheasants were 31

adult females, 17 adult males, and 28 juveniles, whereas sample sizes for golden pheasants were 216 adult females, 158 adult males, and 65 juveniles."

6 CASE STUDIES

6.1 SÁLIM ALI CENTRE FOR ORNITHOLOGY AND NATURAL HISTORY

Sálim Ali Centre for Ornithology and Natural History was designed by Ar. Laurie Baker in the 2000, located in Anaikatty, foothills of Nilgiris. The campus with 55 acres of area is the habitat for 402 species. The campus is spread around 59 acres and has a built up area of 7800 sq.m. which includes 10 blocks which are currently presnet. Various blocks has been developed in various phases of construction.

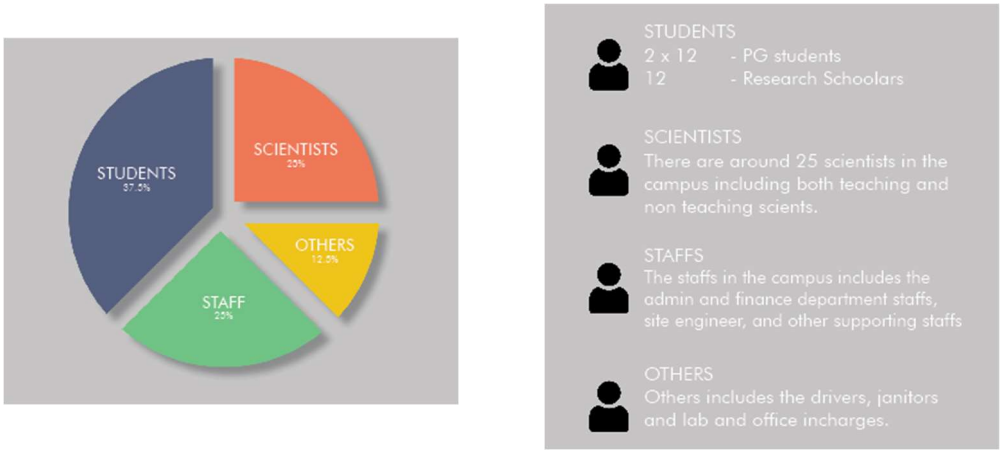


Fig. : 6.1 – Number of Users Proposed

Sálim Ali Centre for Ornithology and Natural History offers 2 main courses - M.Sc in Ornithology and Biodiversity and Doctoral programme. The PG programme consists of 12 students in each batch and doctoral programme with a maximum of 12 scientists. The campus has a good number of scientistics to proceed with the conservational biodiversity and in teaching the students the same.

Sálim Ali Centre for Ornithology and Natural History was design by Ar. Laurie Baker in the year 2000.Laurie Baker's concept of cost-effective energy-efficient architecture and designs that maximized space, ventilation and light and maintained an uncluttered yet striking aesthetic sensibility is followed in this design also. Locally

available terracotta tiles, stones and red sand are used for the building construction. Every block has a central courtyard to maximize the natural light and ventilation. All 10 blocks are load bearing structure. The roof eaves has been extended enough to eliminate sun shades for openings.

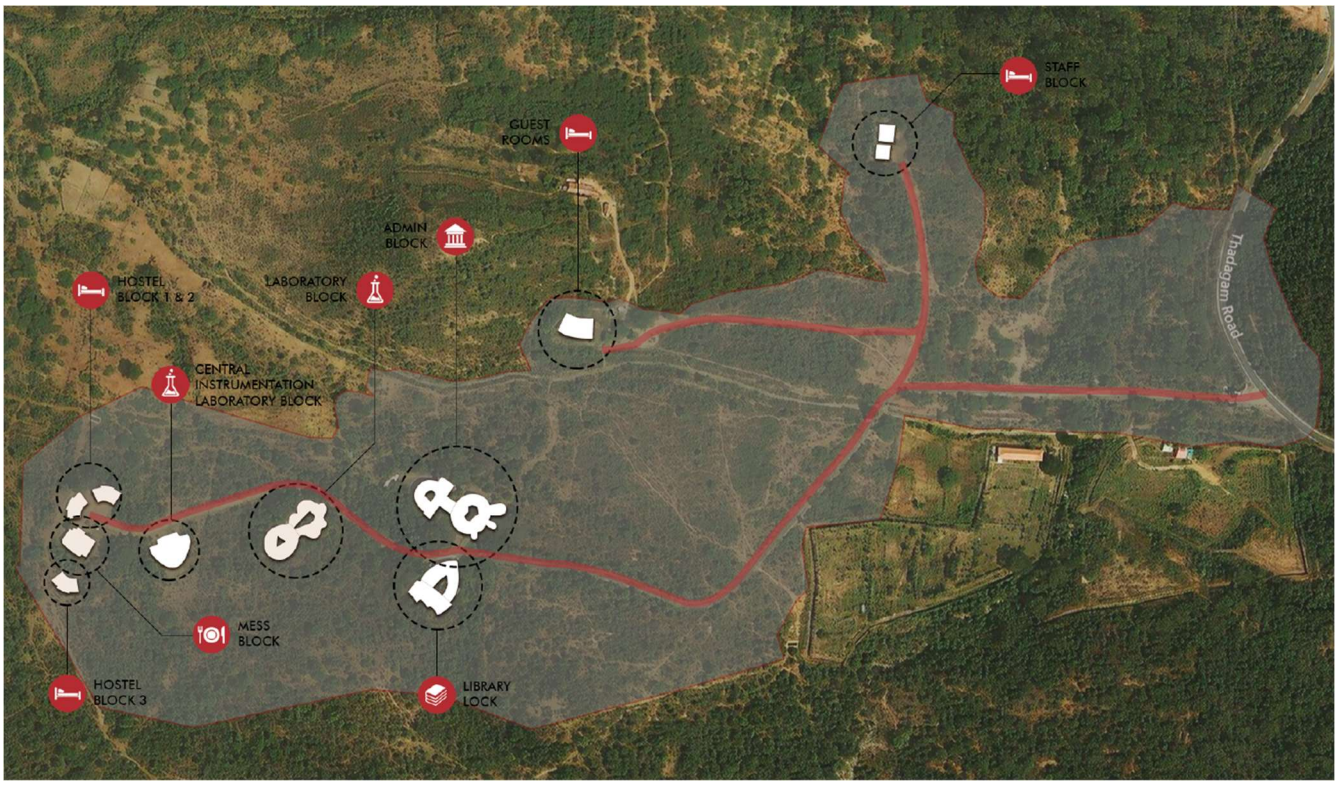


Fig. : 6.2 – Site Plan SACON

The blocks are designed in levels to make the design ground to the contours. The site is located in Seismic zone III and hence circular walls and maximum number of openings are used to minimize the seismic effect on the structure.

Fig. : 6.3 – Interior Pictures SACON

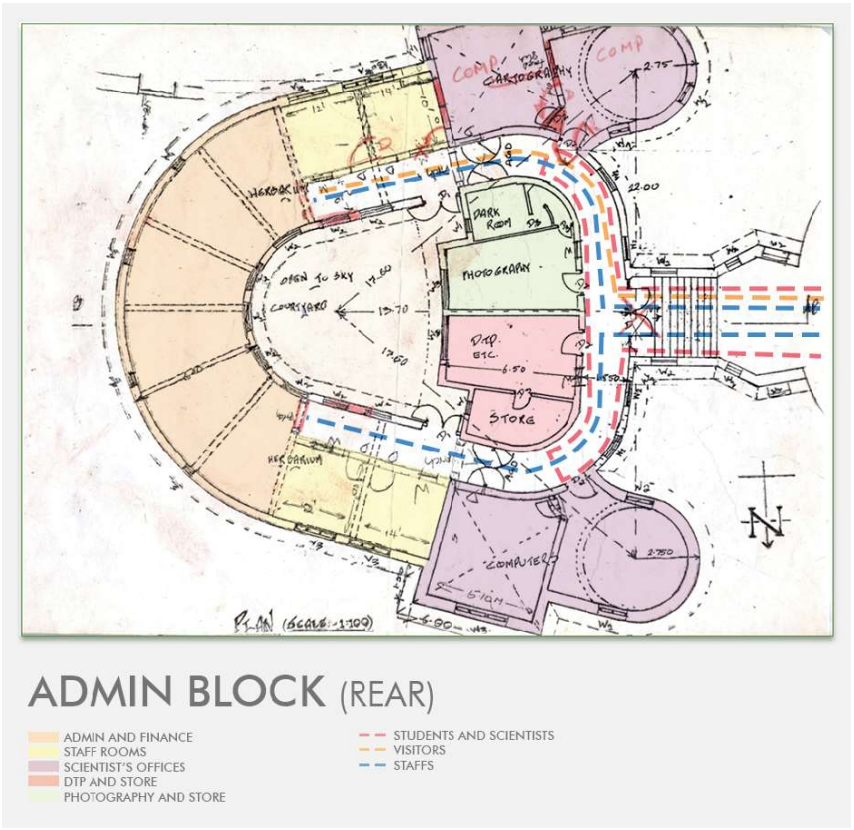


Fig. : 6.4 – Admin Block (Front) Plan and Circulation

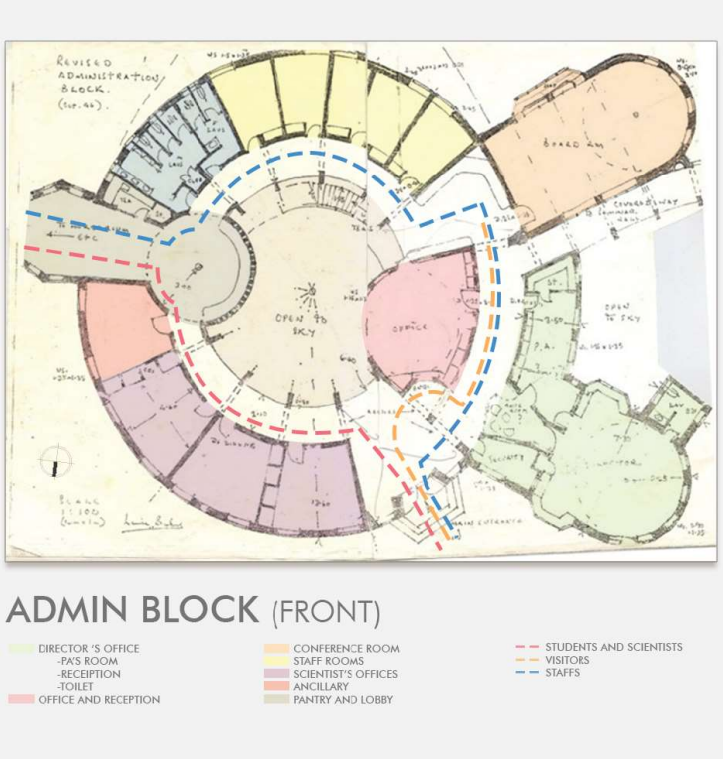


Fig. : 6.5 – Admin Block (Back) Plan and Circulation

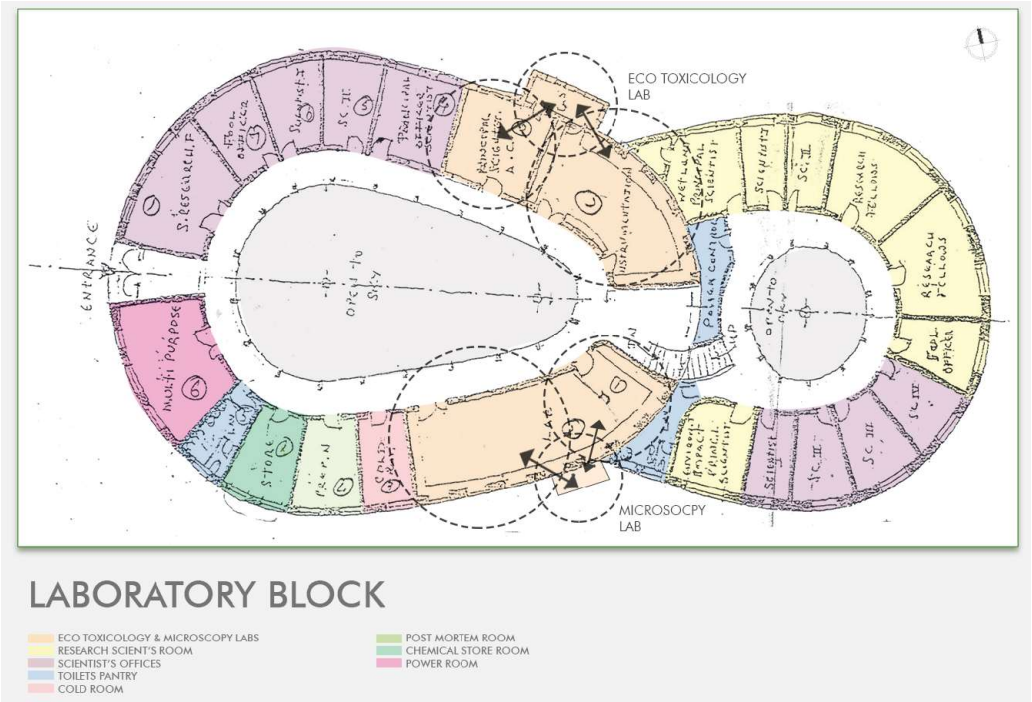
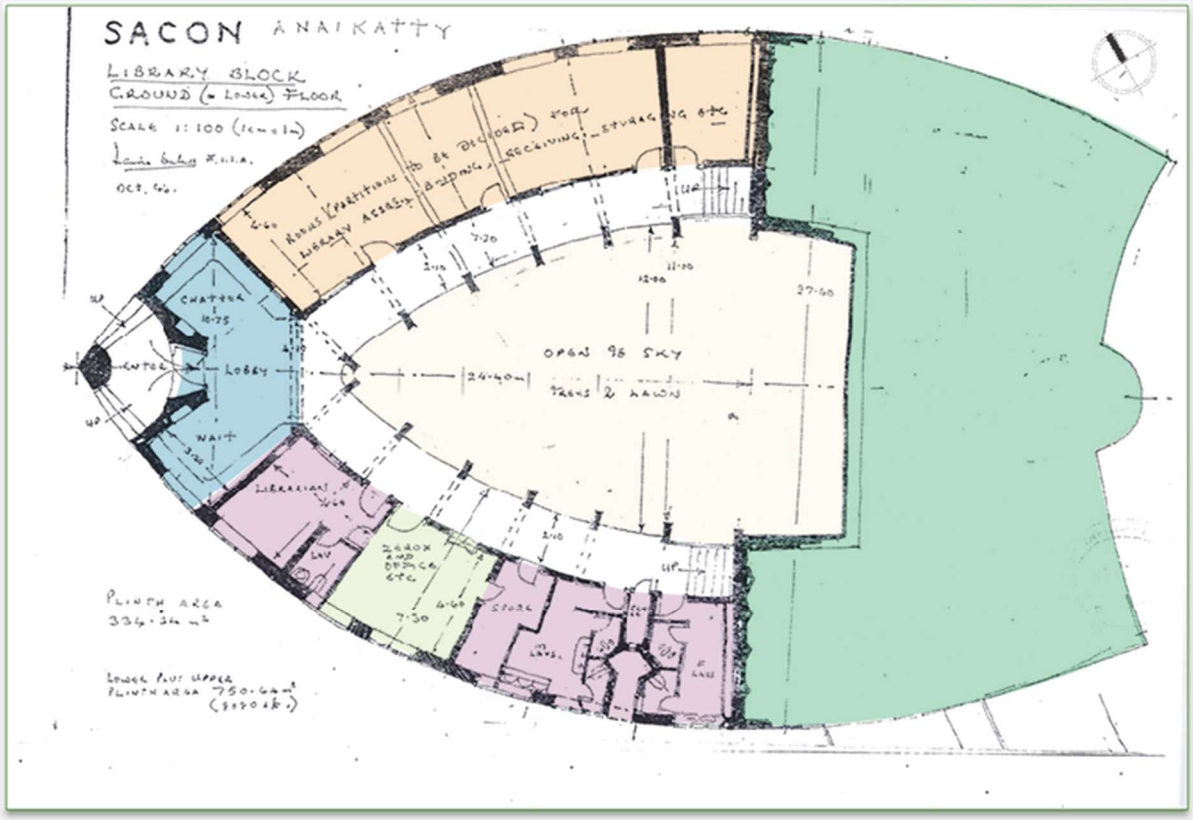
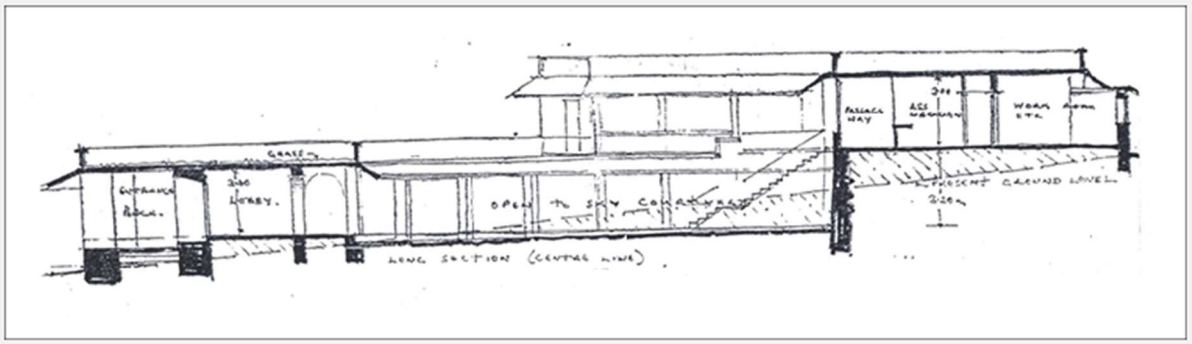


Fig. : 6.6 – Laboratory Block Floor Plan and Circulation

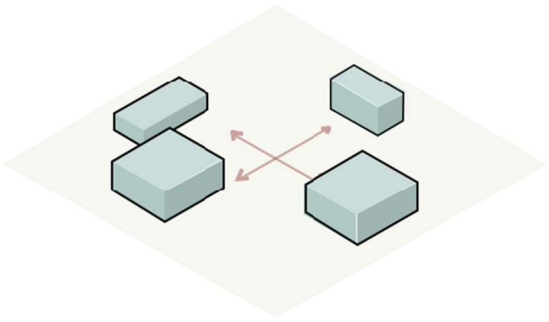




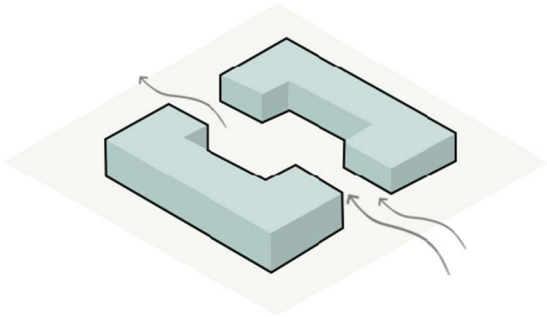
LIBRARY BLOCK

- STATIONARY, BINDING AND STORE
- LOBBY
- LIBRARIAN AND STORES
- XEROR AND PRINTING ROOM
- LIBRARY AREA
  - -BOOKS
  - -MAP STORE
  - -RESEARCH PAPER SECTION
  - -COMPUTER SECTION
  - -WORK AREA
  - -PERIODICALS AND NEWS LETTERS

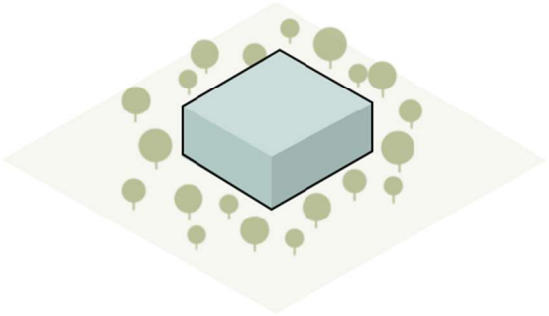
Fig. : 6.7 – Library Block Floor Plan, Circulation and Sections



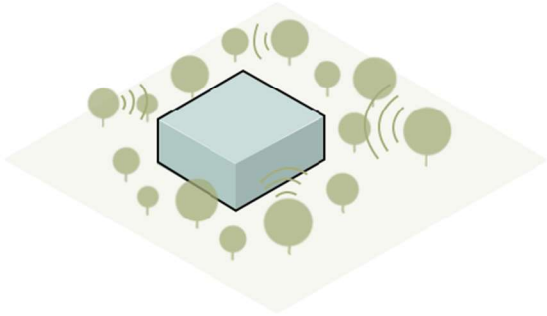
The campus is divided into various blocks. The blocks are wide spread and have proper connectivity between blocks depending upon the usage by the user.



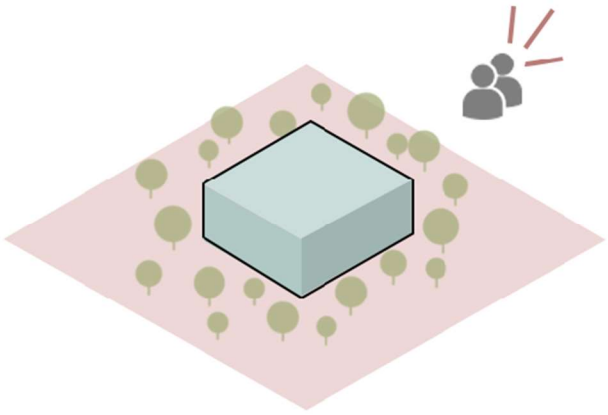
Most of the blocks has a central courtyard and foyers on the opposite sides and hence encourages more light and ventilation.



All the blocks are grounded and has levels to go with the slope of the site and hence merges into the nature.



Having a ground coverage of around 3.4% the presence of trees in the uncovered area brings in the sounds of birds and brings natural feel inside the



Lately, the campus has been attracting a lot of visitors, but the campus has not been designed keeping visitors in mind.

Fig. : 6.8 – Inferences SACON

6.2 CORNELL ORNITHOLOGY LABORATORY, ITHACA, USA

Cornell University holds the world's largest bird recording library and a best example for a center for birds and biodiversity enclosed in an area of around 80000 sq.ft. The laboratory attracts bird aficionados and all the world's best bird enthusiasts. The facility of the laboratory extends to a collection of over 130000 sound recordings of over 5600 species of birds, a multifunctional DNA laboratory, etc.

The landscaping of the entire design is done by an architect from Boston, Susan Childs, was inspired by these natural pathways. Little "islands" situated in bio-filters and swamps indicate the lab's place amid an extended wetland landscape. Through this naturalistic habitat, the visitor reaches the lab through a succession of walkways and walking paths.

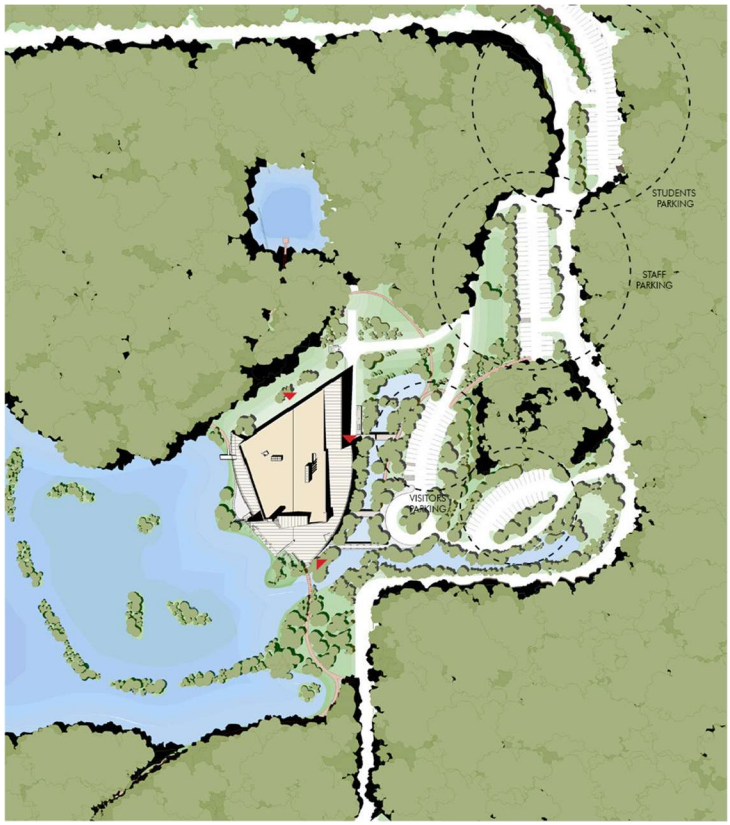


Fig. : 6.9 – Site Plan, Cornell Laboratory

https://www.archdaily.com/19263/cornell-ornithology-laboratory-rmjm

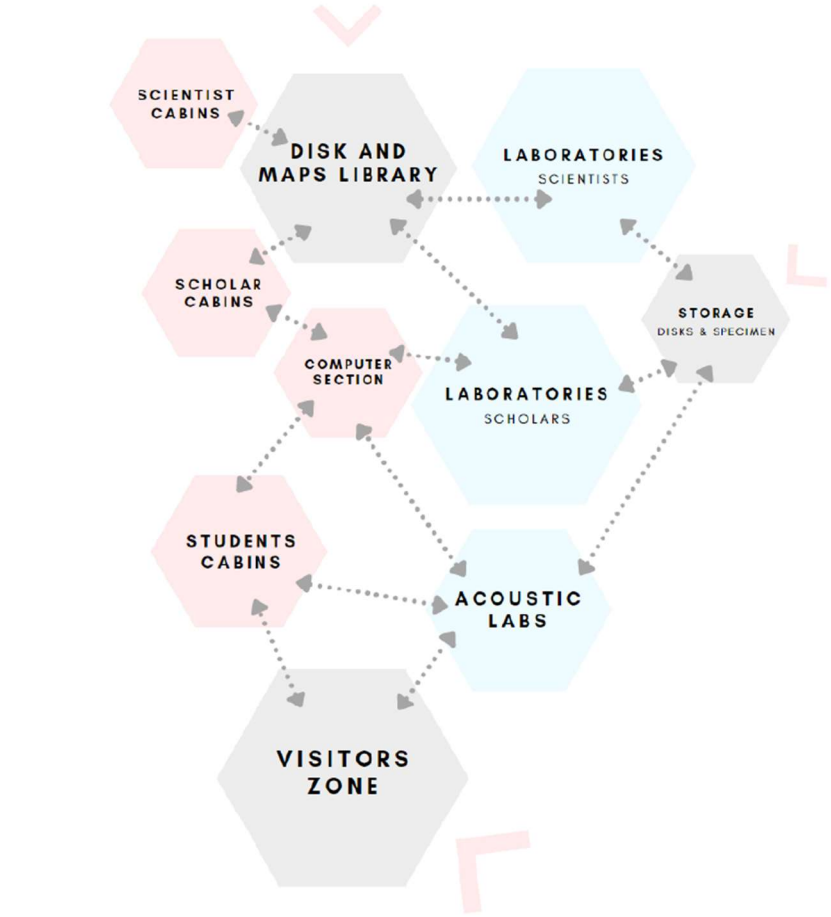
The guests enter the laboratory with a grand double story windowed wall that provides spectacular view towards the pond with ducks and other birds. The windows

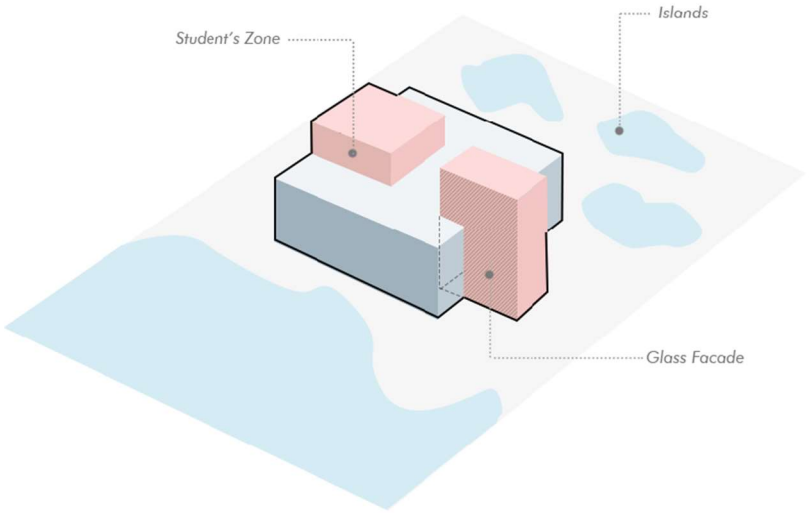
were curved and framed with different patterns so that it would be easy for the birds to identify the glass and at the same time visitors to have a great view.

The Cornell Ornithology Laboratory makes it simple and enjoyable for visitors to watch birds while also ensuring that the structure blends in with its surroundings. On a wetland location, the task was to develop a huge multi-purpose structure. The building's slope and curving walls and roof shapes blend into the environment beautifully.

Fig. : 6.10 – Ground and First Floor Plans, Cornell Laboratory

https://www.archdaily.com/19263/cornell-ornithology-laboratory-rmjm





The zoning inside the block has made the circulation perfect for all 3 kinds of major users in the laboratory. The visitor's zone on the south has a breathtaking double height glass facade overlooking the lake and hence provides the best views from the site. The students zone is placed in first floor in order to avoid interference with other user's circulations.

Fig. : 6.11 – Inferences, Cornell Laboratory

6.3 WASIT NATURAL RESERVE VISITOR CENTRE, SHARJAH, UAE

Wasit Natural Reserve was once a landfill for dump yard and wastewater. In 2005, the devastated eco-system was rehabilitated, with 40,000sq.m of trash removed and 35,000 trees replanted, as well as the removal of harmful chemicals from the ground.

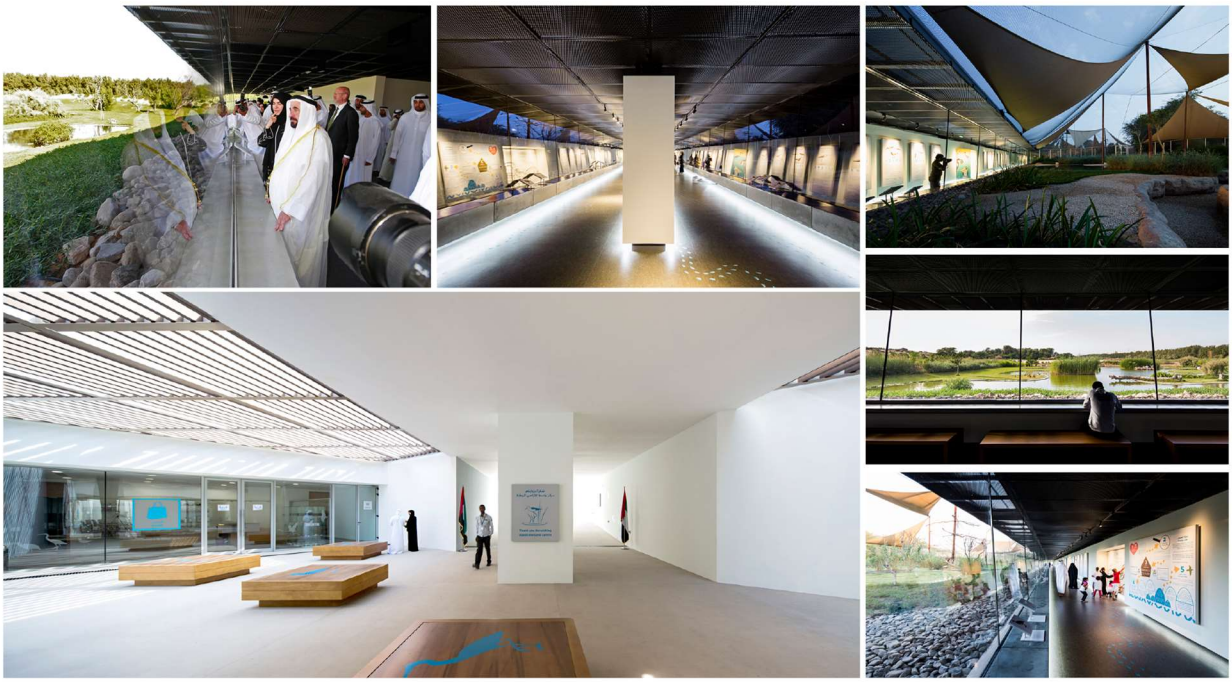


Fig. : 6.12 – Interior Pictures, Wasit Natural Reserve
https://www.archdaily.com/784055/wasit-natural-reserve-visitor-centre-x-architects

On the site, a wetland visitor center was created to assist protect and preserve the environment, educate the masses about the value of the wetland ecosystem, and provide information on the birds that frequent the region and other wetlands in the emirate. Bird watchers and researchers went in droves to the location.

The center's design mixes in with its environment and takes advantage of the existing terrain to reduce the visible influence on the natural environment. A walkway brings guests below into a linear Gallery when they enter. Visitors may view and become a part of the birds' natural surroundings through a completely open wall.

Fig. : 6.13 – Site Plan, Wasit Natural Reserve
https://www.archdaily.com/784055/wasit-natural-reserve-visitor-centre-x-architects

The construction is a steel and concrete composite structure that is partially subterranean in some areas and completely underground in others. The first cross block serves as a retaining block, while the blocks after it are grounded. The design is purposefully grounded in order to blend in with the topography and hence not disrupt the natural environment.

Fig. : 6.13 – Ground Floor Plan, Wasit Natural Reserve
https://www.archdaily.com/784055/wasit-natural-reserve-visitor-centre-x-architects

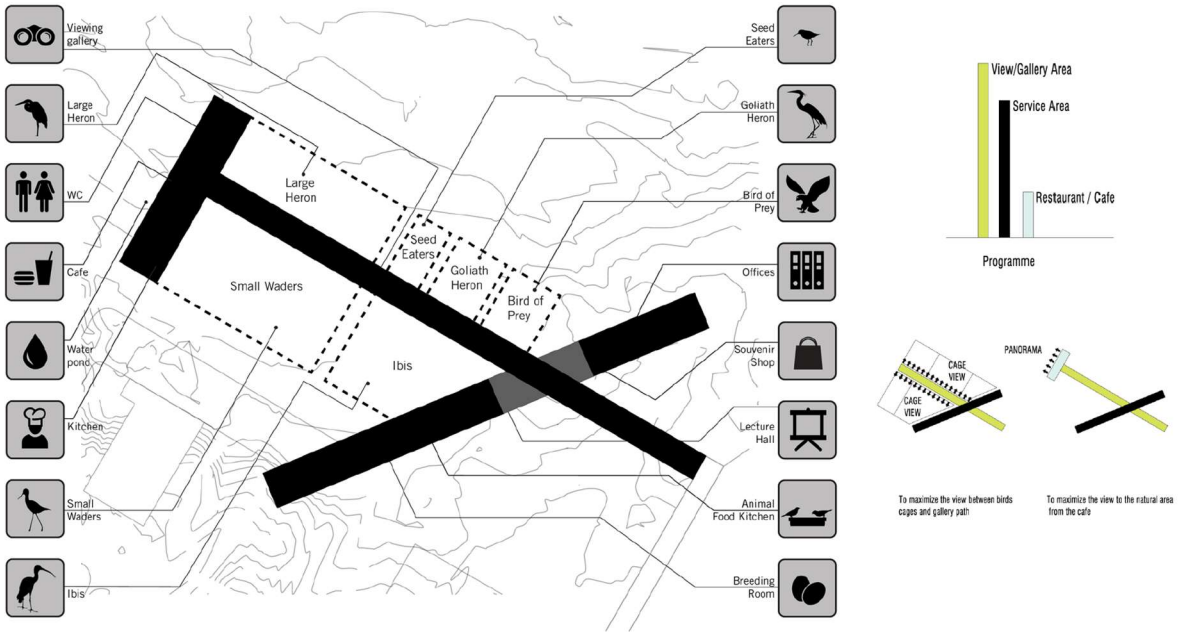


Fig. : 6.14 – Inferences, Wasit Natural Reserve
https://www.archdaily.com/784055/wasit-natural-reserve-visitor-centre-x-architects

6.4 SAINSBURY LABORATORY, CAMBRIDGE, UNITED KINGDOM

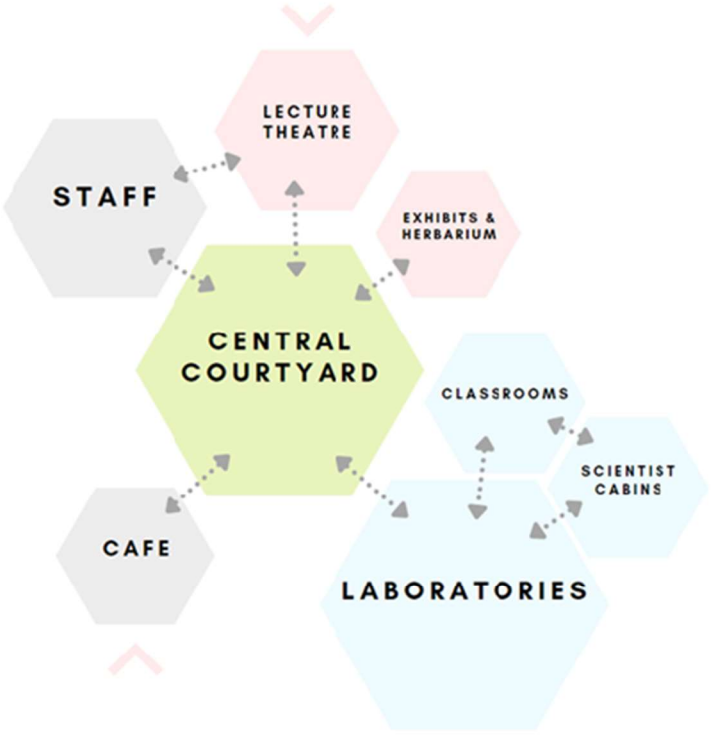
Professor Henslow, Charles Darwin's advisor and mentor, envisioned the Cambridge University Botanic Garden as a functional research instrument in which bio-diversity would be carefully arranged and classified in 1831. The Sainsbury Laboratory, which opened in December 2010, further Henslow's objective through advancing understanding of how variety occurs. As a result, the Laboratory's architecture was informed by the need to show the Laboratory's intrinsic link with the Garden outside.

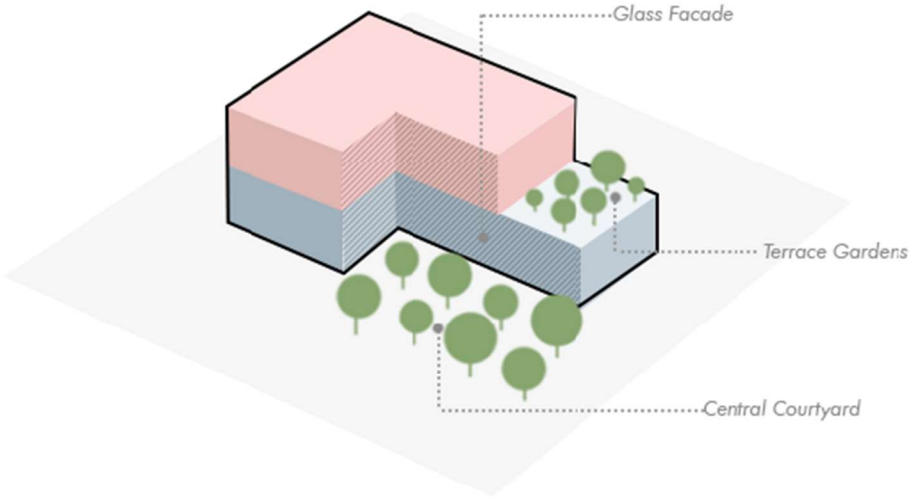
The laboratory which consists of a science research facility for plants of around 11000m^2 in the Botanical Gardens at the University of Cambridge, brings together world-renowned experts in a world-class working environment. The design balances difficult scientific criteria with the desire for an architectural component that responds to its surroundings. It fosters a congenial, engaging atmosphere conducive to creative thinking and cooperation. The structure, which is located within the Garden's private, 'working' section, consists of laboratories for research and other accompanying rooms. There's also a new public café, as well as the University's Herbarium, conference rooms, an auditorium, social spaces, and updated auxiliary quarters for Botanic Garden workers.

Fig. : 6.15 –Sainsbury Laboratory
https://www.archdaily.com/154728/sainsbury-laboratory-stanton-williams

The entire structure is entrenched in its surroundings. There are two apparent stories above ground and an additional underground level, partially to guarantee effective environmental management and, more importantly, to minimise the building's height. As a result, the overall impression is rather horizontal. The use of bands of limestone and exposed insitu concrete suggests solidity, echoing geological layers and the Darwinian notion of development over time, as well as the permanence that one would anticipate of a large research institute.

Fig. : 6.16 – Ground Floor Plan, Sainsbury Laboratory
https://www.archdaily.com/154728/sainsbury-laboratory-stanton-williams





The central court plays a major role in the design. Most of the spaces inside the building is either visually or physically connected with the central court to give a feel of nature inside the 3 story building. It provides good ventilation and natural lighting also.

Fig. : 6.17 – Inferences, Sainsbury Laboratory

7 CONCEPT DEVELOPMENT

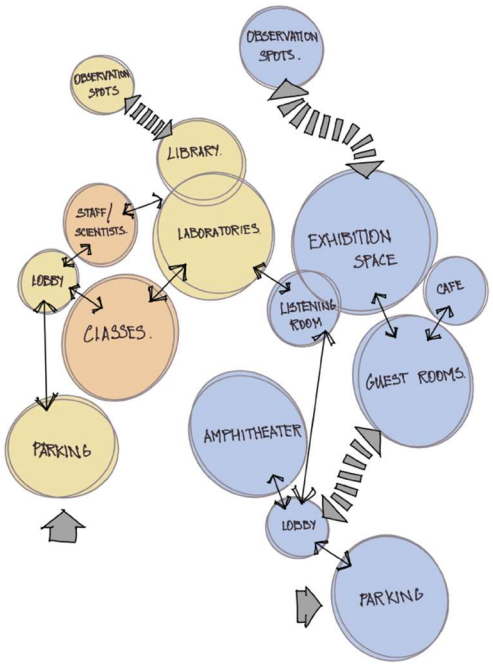


Fig. : 7.1 – Bubble Diagram with basic circulation

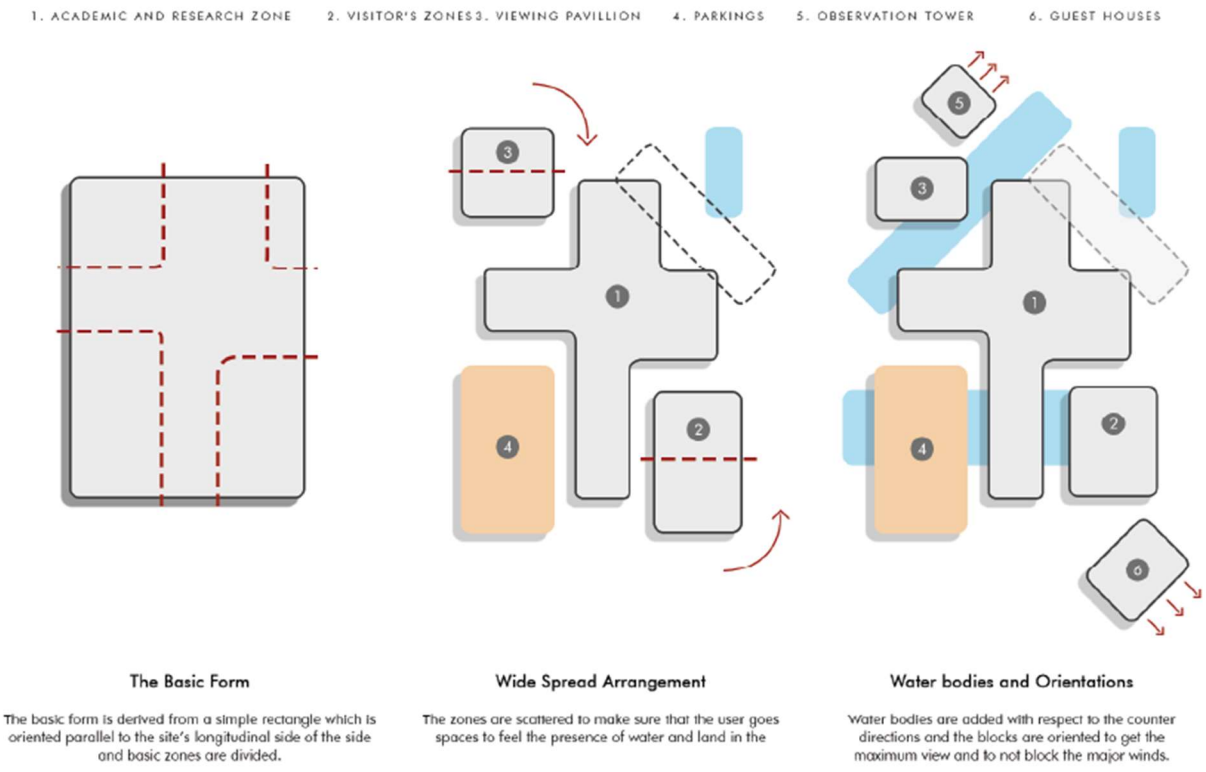


Fig. : 7.2 – Site Zoning Development

The site is located 15kms. away from Auroville, which has been a great example of sustainable architecture. The surroundings of the site in Villupuram is known for it's strong traditional influence in architecture. The design is proposed to be made of locally available materials like earth blocks, bamboo and stones and a mix of traditional crafted elements like doors, windows, railings, etc,. could be included.

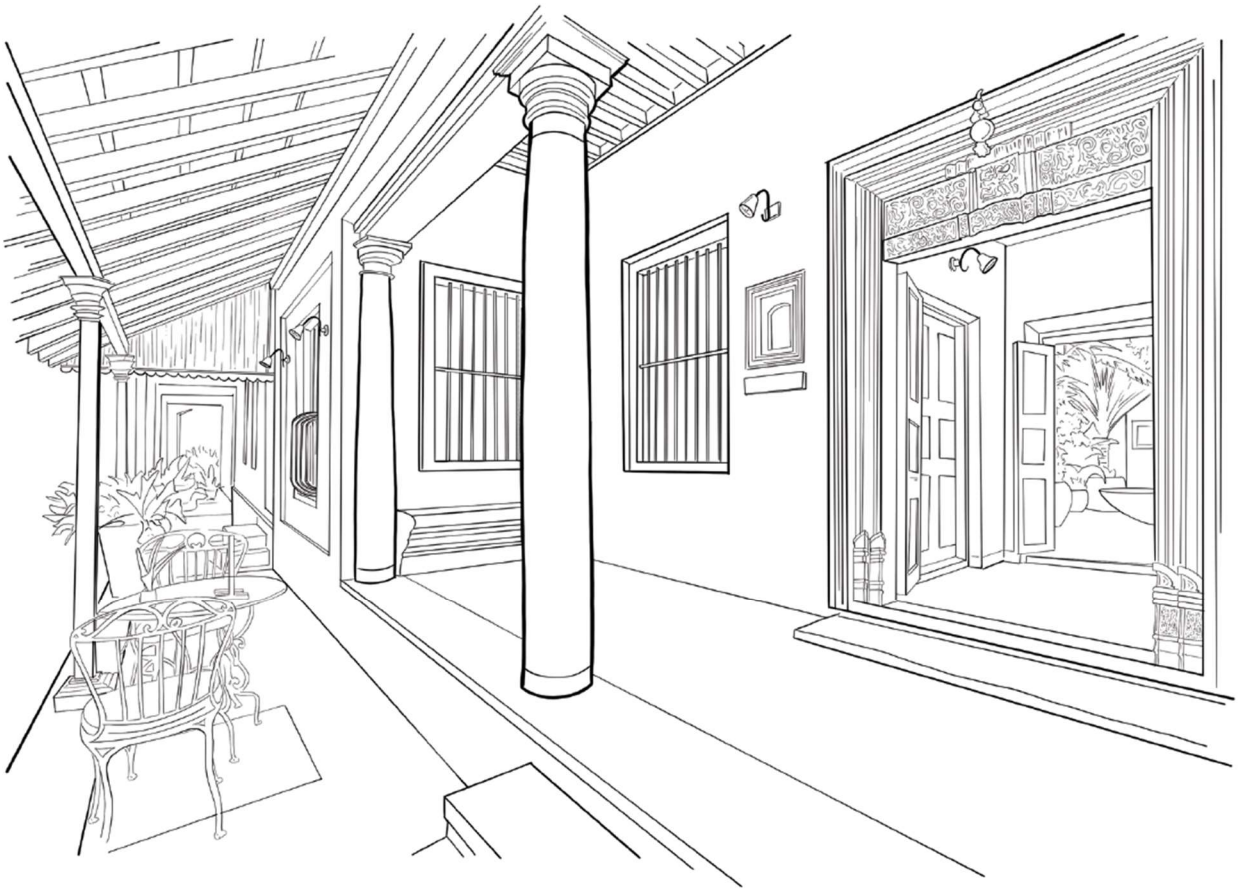


Fig. : 7.2 – Traditional Tamil House Entrance

A wetland is an area of land that is either covered with water or saturated with water. A wetland is entirely covered by water at least part of the year. The depth and duration of this seasonal flooding varies. Wetlands are transition zones. They are neither totally dry land nor totally underwater; they have characteristics of both. The saturation of wetland soil determines the vegetation that surrounds it (WI & Gosselink, 2000).

Plants that live in wetlands are uniquely adapted to their watery (hydric) soil. Kaluveli, seasonally dry with slow-moving water can often support trees and other sturdy vegetation and seasonally flooded with mosses or grasses as their dominant hydrophytes. The transition zone of land and water acts as the home and birthplace for thousands of birds. These birds are born not just in the land shores. The concept plays its role of giving the user the mixed feel of water and land and thus makes him feel that he isn't standing just above a building on ground, also as he moves through the bird trial.

Fig. : 7.3 – Kaluveli Lake Edges

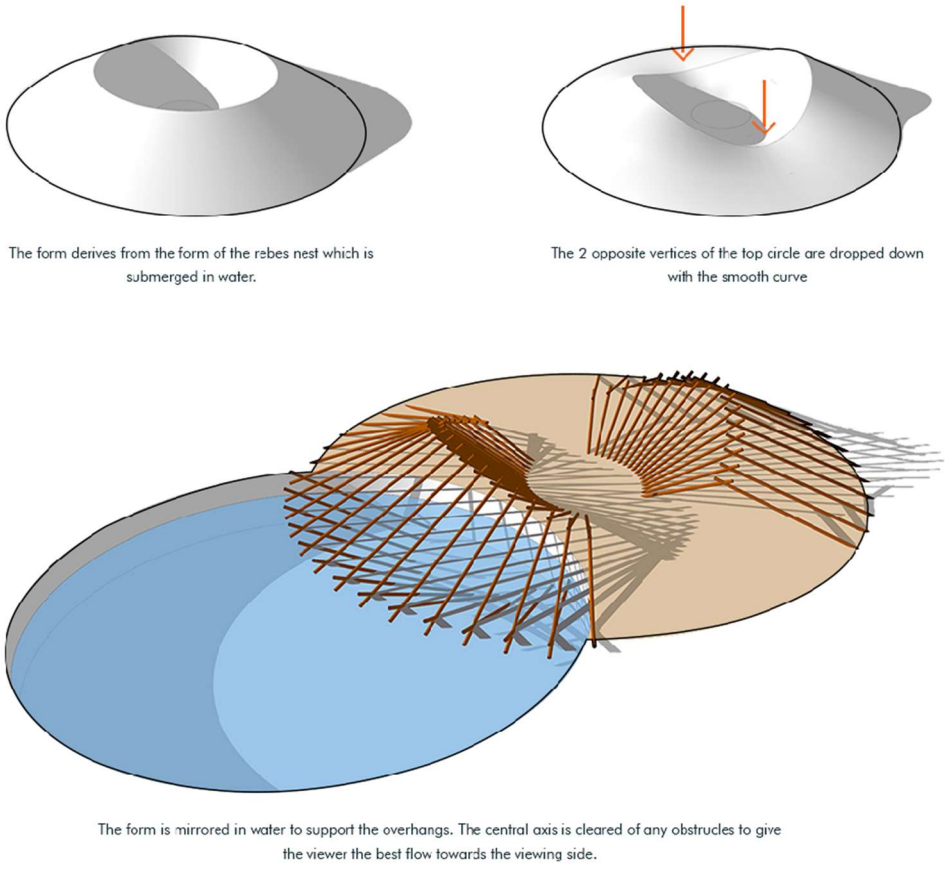


Fig. : 7.4 – Pavilion Form Development

Western Grebes make their nests in overhanging flora along the water's edge, generally rushes or reeds, but sometimes pondweed and milfoil. Most nest locations are shielded from wave action, and the water depth below the nest is generally less than a foot. The male and female work together to construct the nest.

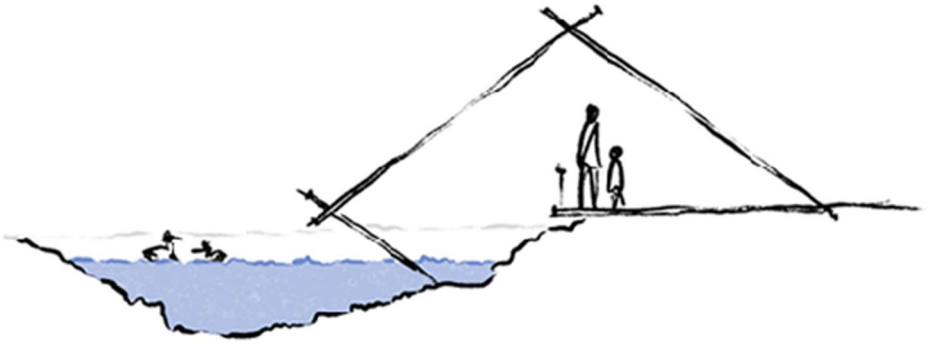
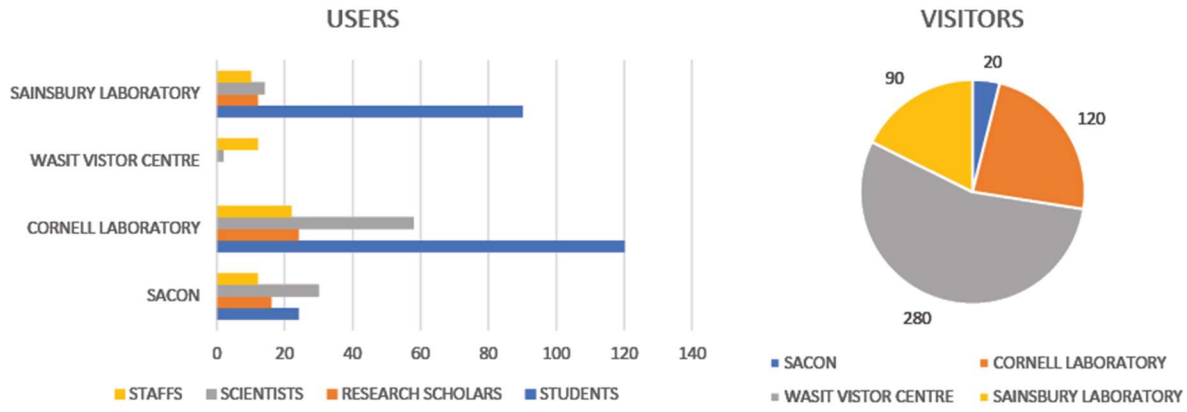
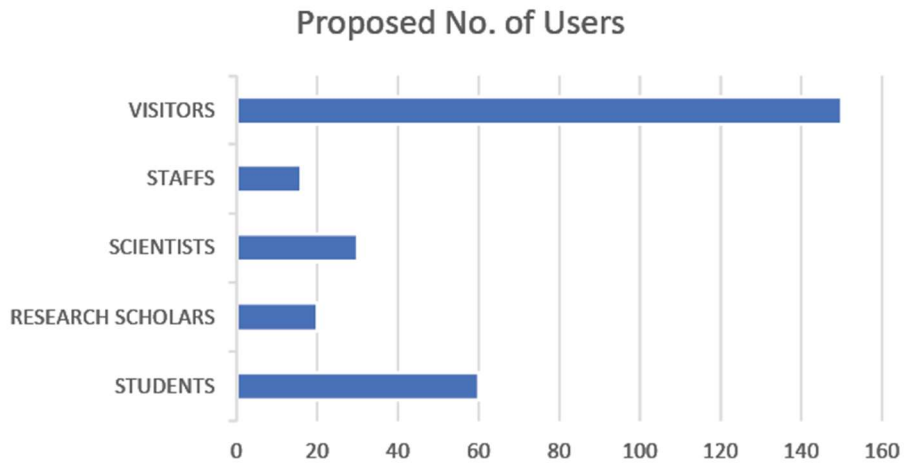


Fig. : 7.5 – Pavilion Schematic Section

8 AREA STATEMENT





The proposal majorly concentrates on the visitors and scholars. And hence reference from Wasit Visitor Centre and Cornell Laboratory has been taken for the number of users and the rest from all three laboratories.

MINIMUM PROPOSED BUILT-UP AREA *(INCLUDES 30% CIRCULATION)*	:	10280 sq.m.
SITE AREA	:	76650 sq.m.

Fig. : 8.1 – Number of Users Analysis and Proposal

			1. SCAON				2. CORNELL LABORATORY				3. WAIST VISITOR CENTRE				4. SAINSBURY LABORATORY				INFERENCE			
BLOCK	ZONE	ROOMS	QUANTITY	AREA	TOTAL CAPACITY	TOATAL AREA	QUANTITY	AREA	TOTAL CAPACITY	TOATAL AREA	QUANTITY	AREA	TOTAL CAPACITY	TOATAL AREA	QUANTITY	AREA	TOTAL CAPACITY	TOATAL AREA	QUANTITY	AREA	TOTAL CAPACITY (MINIMUM)	TOATAL AREA (MINIMUM)
ADMIN & OFFICE	OFFICE AND RECEPTION	OFFICE	1	41	6	41	1	90	10	90				0								0
		RECEPTION				0	1	42	3	42	1	180	15	180	1	8	2	8	1	20	2	20
		WAITING	1	14	10	14	1	30	5	30					1	35	5	35	1	30	20	30
		STORE					1	120		120												0
	DIRECTOR	DIRECTOR'S ROOM	1	56	1	56	1	40		40					1	20	1	20	1	34	1	34
		TOILET	1	6		6									1	4	1	4	1	3	1	3
		PA ROOM	1	24	3	24	1	25	1	25	1	40	2	40	1	12	1	12	1	22	1	22
		STORE	1	5		5	1	25		25									1	18	1	18
		PANTRY	1	8		8																0
	ADMIN	ADMIN	1	75	12	75													1	40	6	40
		ACCOUNTS									1	40	4	40	1	35	4	35				
		STORE					1	25		25	1	18		18					1	22		22
	MANAGER	MANAGER ROOM	1	34	2	34	2	26	2	52	1	40	2	40	2	12	2	24	1	16	1	16
		TOILET								0									1	3	1	3
	CONFERENCE	CONFERENCE	1	75	30	75	1	380	90	380	1	125		125	1	35	10	35	1	60	35	60
		COMPUTER ROOM					1	40		40					1	12		12	1	12		12
		UPS ROOM	1	22		22	1	30		30									1	12		12
		STORE									1	35		35	1	12		12				0
	MEETING ROOM										1	34		34								0
	PANTRY		1	7		7	1	24		24	1	18		18	1	20		20	1	18		18
	TOILET	MALE	1	18.5	3	18.5	1	20	2	20	1	20	2	20	1	18	2	18	1	15	2	15
		FEMALE	1	10.5	2	10.5	1	20	2	20	1	20	2	20	1	18	2	18	1	10	2	10
		DISABLED					1	6	1	6									1	3.5	1	3.5
		JANITOR ROOM	1	2.5	1	2.5	1	4		4					1	4		4	1	4		4
	STORE										1	18		18	1	24		24	1	22		22

Table 8.1 – Administration and Office Area Statment

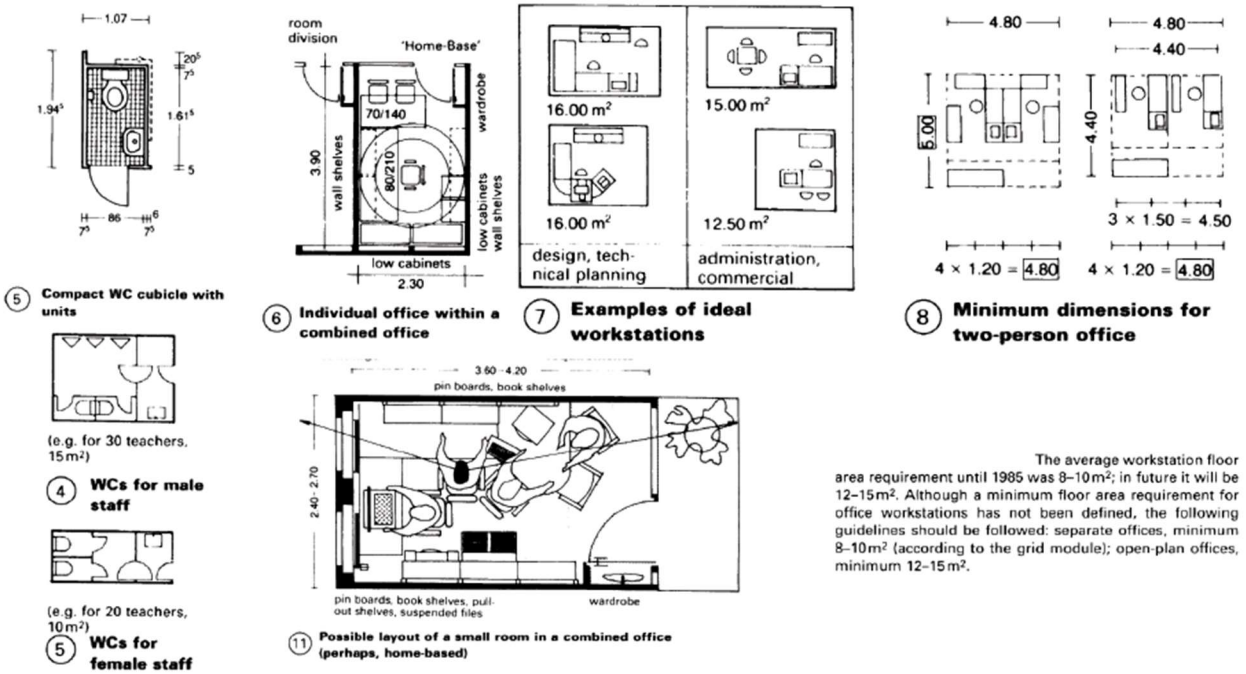


Fig. : 8.1 – Administration and Office Standards (Neuferts,2019)

			1. SCAON				2. CORNELL LABORATORY				3. WAIST VISITOR CENTRE				4. SAINSBURY LABORATORY				INFERENCE			
BLOCK	ZONE	ROOMS	QUANTITY	AREA	TOTAL CAPACITY	TOATAL AREA	QUANTITY	AREA	TOTAL CAPACITY	TOATAL AREA	QUANTITY	AREA	TOTAL CAPACITY	TOATAL AREA	QUANTITY	AREA	TOTAL CAPACITY	TOATAL AREA	QUANTITY	AREA	TOTAL CAPACITY (MINIMUM)	TOATAL AREA (MINIMUM)
ACADEMIC ZONE	LIBRARY	BOOK SECTION	1	90		90	1	40		40					1	180		180	1	120		120
		PERIODICALS	1	35		35	1	22		22					1	28		28	1	22		22
		DISK SECTION	1	42		42	1	180		180					1	28		28	1	22		22
		MAP SECTION	1	42		42												0	1	22		22
		COMPUTER SECTION	1	24		24	1	70		70					1	32		32	1	30		30
		READING SPACE	1	68		68				230					1	75		75	1	150	60	150
		LISTENING ROOMS					4	16		64								0	4	12		48
		LIBRARIAN	1	6		6	1	30		30					1	16		16	1	16		16
		STORE	1	22		22	4	24		96					1	40		40	1	28		28
		PRINTING & XEROX	1	24		24	1	36		36					1	16		16	1	22		22
	CLASSROOM		2	36	24	72	4	42	120	168					3	36	90	108	2	65	60	130
	RESEACRH SCHOLAR CABINS		8	24	16	192	24	16	24	384					12	18	12	216	10	14	20	140
	LECTURE HALL	HALL	1	90	45	90	2		60	155					1	120	60	120	1	320	160	320
		SERVER ROOM	1	12		12	2	12		24					1	8		8	1	16		16
	STORE						2	18		36								0	1	22		22
SCIENTISTS & STAFFS	SCIENTISTS	SR. SCIENTISTS	10	18	10	180	8	14	16	112					14	22	14	308	10	12	10	120
		JR. SCIENTISTS	10	22	20	220	14	19	42	266								0	10	16	20	160
	STAFF	ROOMS	8	16	8	128	15	14	15	210					6	18	6	108	4	16	8	64

Table 8.2 – Academic Zone Area Statement

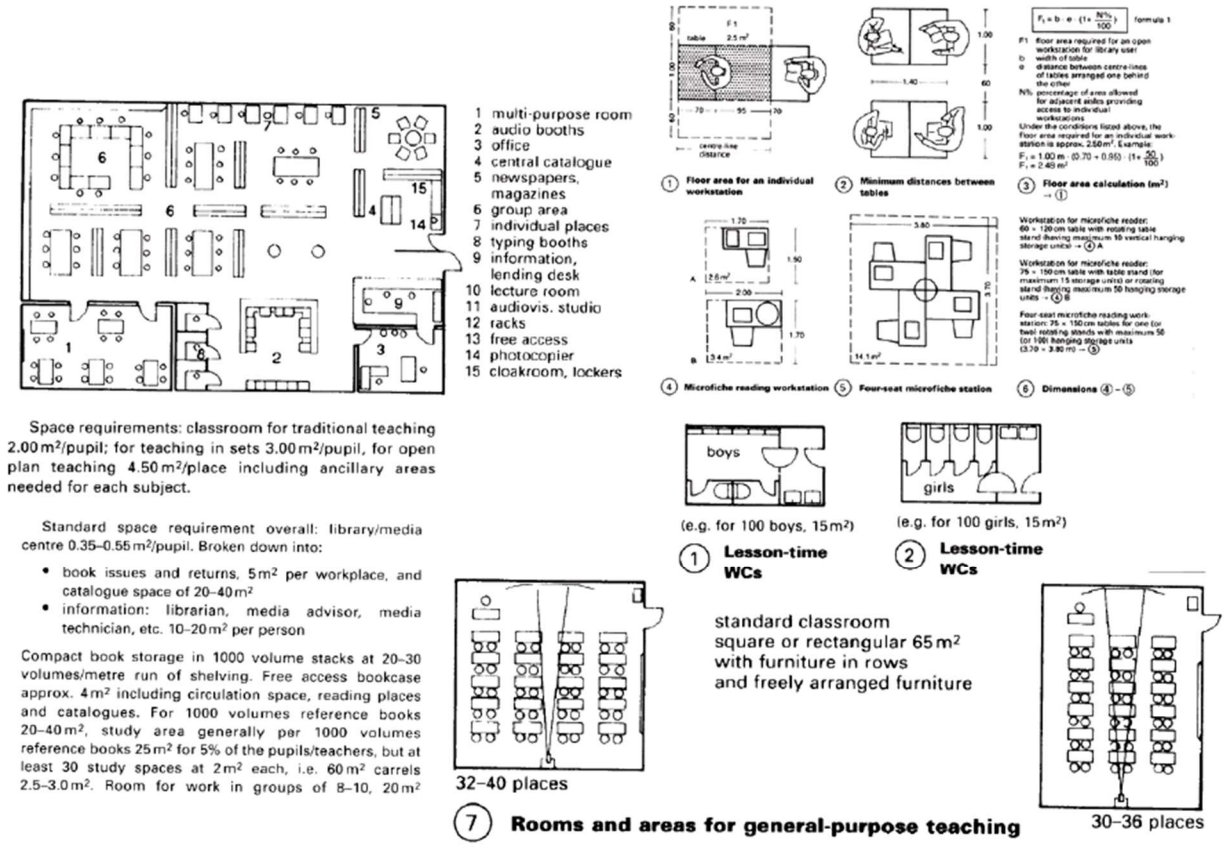


Fig. 8.2 – Academic Zone Standards (Neuferts,2019)

			1. SCAON				2. CORNELL LABORATORY				3. WAIST VISITOR CENTRE				4. SAINSBURY LABORATORY				INFERENCE			
BLOCK	ZONE	ROOMS	QUANTITY	AREA	TOTAL CAPACITY	TOATAL AREA	QUANTITY	AREA	TOTAL CAPACITY	TOATAL AREA	QUANTITY	AREA	TOTAL CAPACITY	TOATAL AREA	QUANTITY	AREA	TOTAL CAPACITY	TOATAL AREA	QUANTITY	AREA	TOTAL CAPACITY (MINIMUM)	TOATAL AREA (MINIMUM)
LABORATORIES	MICROSCOPY LAB	ORGANIC SECTION	1	70		70	3			510					3	80		240	1	70		70
		INRGANIC SECTION	1	20		20	3			210					3	60		180	1	24		24
		COLD STORAGE	1	16		16	6	30		180					6	24		144	1	16		16
		CHEMICAL STORE	1	16		16	8	30		240					6	18		108	1	16		16
	ECO TOXICOLOGY LAB	ORGANIC SECTION	1	50		50	2	210		420									1	70		70
		INRGANIC SECTION	1	25		25	2	80		160									1	24		24
		GAS STORAGE	1	16		16	4	16		64									1	16		16
		EQUIP. STORE	1	16		16	6	16		96									1	16		16
	GIS LAB	LAB	1	60		60	1	100		100					1	48		48	1	60		60
		SERVER ROOM	1	25		25	1	30		30					1	16		16	1	22		22
	AVIA FORENSIC LAB	LAB CABINS	5	9		45	2	80		160									5	10		50
		SERVER ROOM	1	24		24	4	20		80									1	12		12
	COMPUTER LAB	LAB	1	45		45									1	60		60	1	60		60
		SERVER ROOM	1	16		16									1	20		20	1	12		12
	ACOUSTIC LAB	RECORDING ROOMS					10	12	24	120									5	12		60
		TAPING ROOM					3	20		60									1	22		22
		SERVER ROOM					2	25		50									1	12		12
		ACOUSTIC LAB					2	80		160									1	60		60
		DISK STORAGE					2			880									1	50		50
	WETLAND LABORATORY		1	30			1	120		120					1	35		35	1	32		32
	SPECIMEN STORE						1	320		320					2	28		56	1	28		28
	POSTMORTEM ROOM		1	20		20	1	90		90									1	22		22
	LAB INCHARGE		1	24		24	6	20		120									1	16		16
	SERVICES	POWER ROOM	1	32		32	4	32		128					1	60		60	1	32		32
		UPS ROOM	1	24		24	4	28		112					1	38		38	1	24		24

Table 8.3 – Laboratory Area Statement

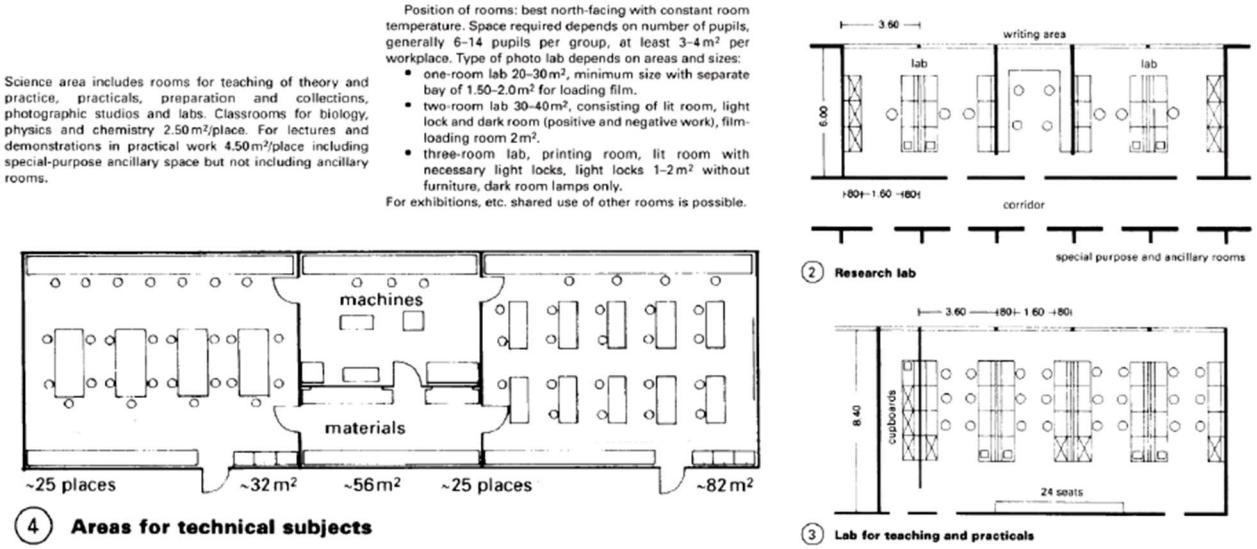


Fig. 8.3 – Laboratory Standards (Neuferts,2019)

			1. SCAON				2. CORNELL LABORATORY				3. WAIST VISITOR CENTRE				4. SAINSBURY LABORATORY				INFERENCE			
BLOCK	ZONE	ROOMS	QUANTITY	AREA	TOTAL CAPACITY	TOATAL AREA	QUANTITY	AREA	TOTAL CAPACITY	TOATAL AREA	QUANTITY	AREA	TOTAL CAPACITY	TOATAL AREA	QUANTITY	AREA	TOTAL CAPACITY	TOATAL AREA	QUANTITY	AREA	TOTAL CAPACITY (MINIMUM)	TOATAL AREA (MINIMUM)
VISITOR'S ZONE	PRESENTATION HALL	HALL	1	70	35	70	1	360	90	360	1	125	50	125	3		45	80	1	360	150	360
		SERVER ROOM					1	25		25					3	28		84	1	18		18
		STORE	1	16		16	1	45		45	1	35		35	1	22		22	1	18		18
	EXHIBIT SPACE						1	430		430	1	1700		1700	2			680			1200	0
	HERBARIUM									0					2			190				0
	SOUVENIR SHOP	SHOP					1	170		170	1	80		80	1	40		40	1	70		70
		STORE					1	40		40	1	30		30	1	20		20	1	22		22
	CAFÉ	DINING								0	1	420	40	420	1	80	30	80	1	180	50	180
		KITCHEN								0	1	115		115	1	24		24	1	32		32
		STORAGE								0	1	30		30	1	12		12	1	18		18
		UTILITY								0	1	22		22					1	12		12
	LISTENING ROOM						1	90		90									1	26		26
	TOILETS	MALE					1	40	5	40	1	30	3	30	1	40	5	40	1	15		15
		FEMALE					1	40	5	40	1	30	3	30	1	40	5	40	1	10		10
		DIABLED					1	5	1	5	1	6	1	6	2	5		10	1	3.5		3.5
		JANITOR'S ROOM					1	3		3	1	4		4	1	4		4	1	3		3

Table 8.4 – Visitor's Zone Area Statement

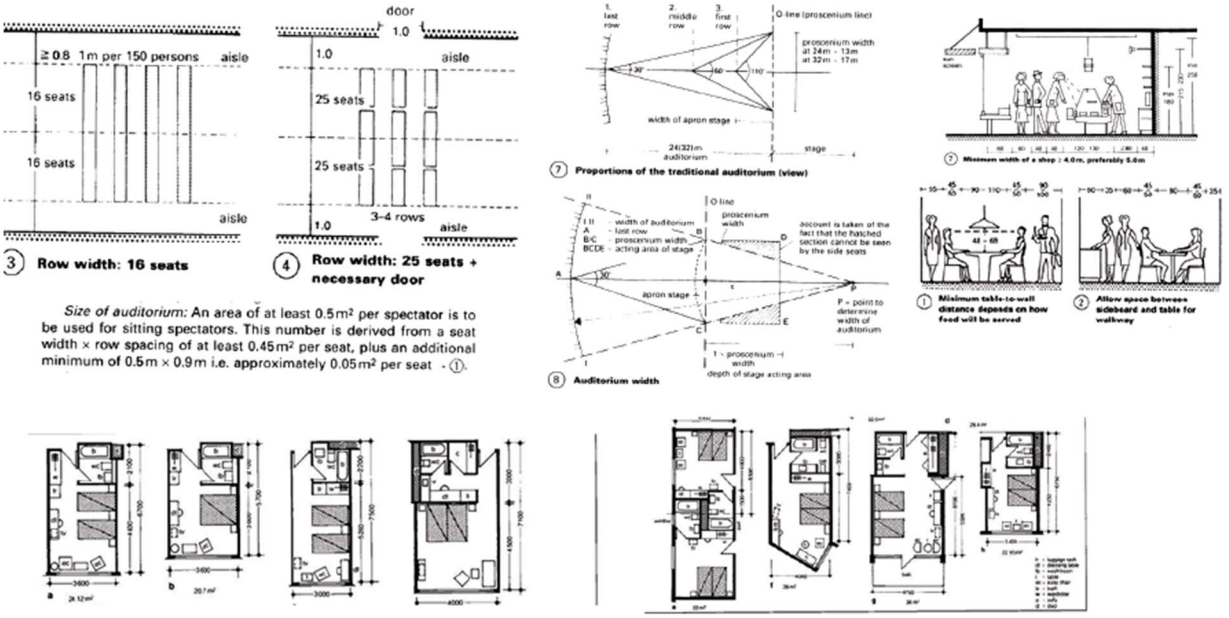


Fig. 8.4 – Visitors' Zone Standards (Neuferts,2019)

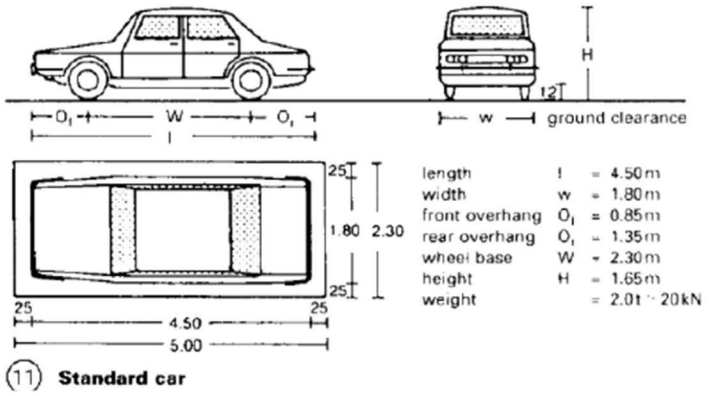
			1. SCAON				INFERENCES			
BLOCK	ZONE	ROOMS	QUANTITY	AREA	TOTAL CAPACITY	TOATAL AREA	QUANTITY	AREA	TOTAL CAPACITY (MINIMUM)	TOATAL AREA (MINIMUM)
HOSTEL	DORMS	DORM	12	31	36	372	15	38	60	570
		TOILET	12	3.5	12	42	15	3.5	15	52.5
		VERANDAH	12	7.5		90				0
	CANTEEN	DINING	1	120	60	120	1	140	70	140
		KITCHEN	1	33		33	1	32		32
		STORE	1	20		20	1	18		18
	WARDEN	WARDEN	1	18		18	2	20		40
		TOILET	1	3		3	2	3.5		7

			PROPOSAL			
BLOCK	ZONE	ROOMS	QUANTITY	AREA	TOTAL CAPACITY (MINIMUM)	TOATAL AREA (MINIMUM)
GUEST ROOMS	RECEPTION & WAITING		1	22		22
	GUEST ROOMS	ROOMS	15	22	30	330
		TOILETS	15	6		90
		BALCONIES	15			
	MAINTENANCE	STAFF	2	12		24
		STORE	1	28		28
		LAUNDRY	1	32		32
		TOILETS	1	15	2	15

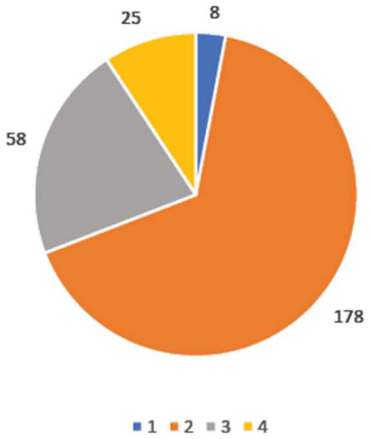
Table 8.5 – Hostel and Guest Room Area Statement

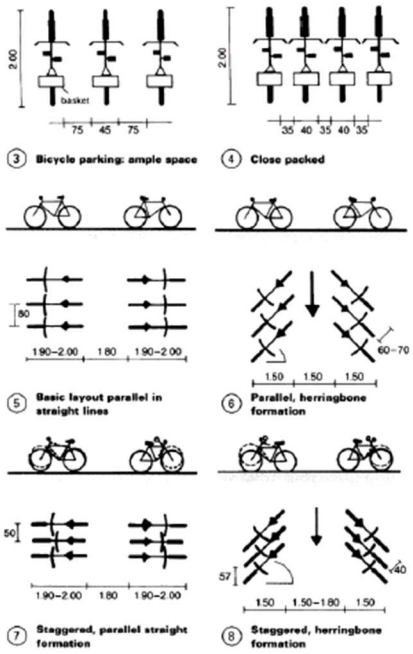
BLOCK	ZONE	ROOMS	1. SCAON				2. CORNELL LABORATORY				3. WAIST VISITOR CENTRE				4. SAINSBURY LABORATORY				INFERENCE			
			QUANTITY	AREA	TOTAL CAPACITY	TOATAL AREA	QUANTITY	AREA	TOTAL CAPACITY	TOATAL AREA	QUANTITY	AREA	TOTAL CAPACITY	TOATAL AREA	QUANTITY	AREA	TOTAL CAPACITY	TOATAL AREA	QUANTITY	AREA	TOTAL CAPACITY (MINIMUM)	TOATAL AREA (MINIMUM)
PARKING			1	144	8	144	4		178	11206	1	7800	58	7800	2		15,10	390	2		30,60	2250

Table 8.6 – Parking Area Statement



(11) **Standard car**





③ **Bicycle parking: ample space** ④ **Close packed**

⑤ **Basic layout parallel in straight lines** ⑥ **Parallel, herringbone formation**

⑦ **Staggered, parallel straight formation** ⑧ **Steggered, herringbone formation**

parking space arrangement	area/space (inc. open doors)	possible no. of spaces/100 m² area	possible no. of spaces/100 m of road (one side only)
· ① 0° - parallel to road. Entry and exit to parking bay difficult - suitable for narrow roads	2	4.4	17
· ② 30° -angle to access road. Easy entry to parking bay and exit. Uses a large area.	26.3	3.8	21
· ③ 45° -angle to access road. Good entry to parking bay and exit. Relatively small area/parking space. Normal type of layout	20.3	4.9	31
· ④ 60° -angle to access road. Relatively good entry and exit to parking bay; small area/parking space. Arrangement often used	19.2	5.2	37
· ⑤ Right-angles to road (parking spaces 2.50 m wide). Sharp turn needed for entry and exit	19.4	5.1	40
· ⑥ Right-angles to road (parking spaces 2.30 m wide. Small area needed/parking space. Ideal for compact parking layouts, used frequently	19.2	5.2	37

Fig. 8.5 – Parking Standards (Neuferts,2019)

9 DESIGN PROPOSAL

Fig. 9.1 – Site Plan

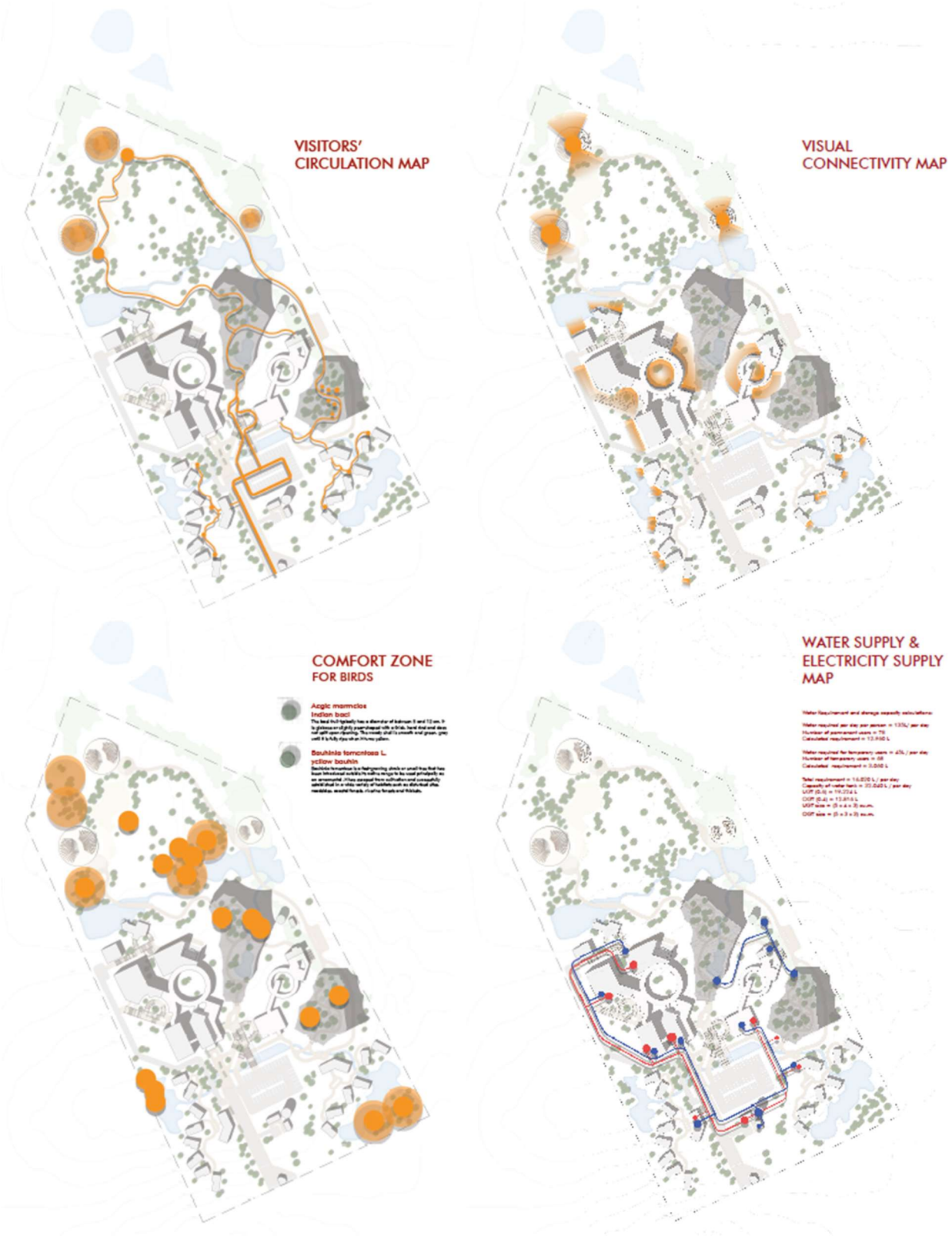


Fig. 9.2 – Site Analysis – Circulation, Views, Comfort Zones and Services

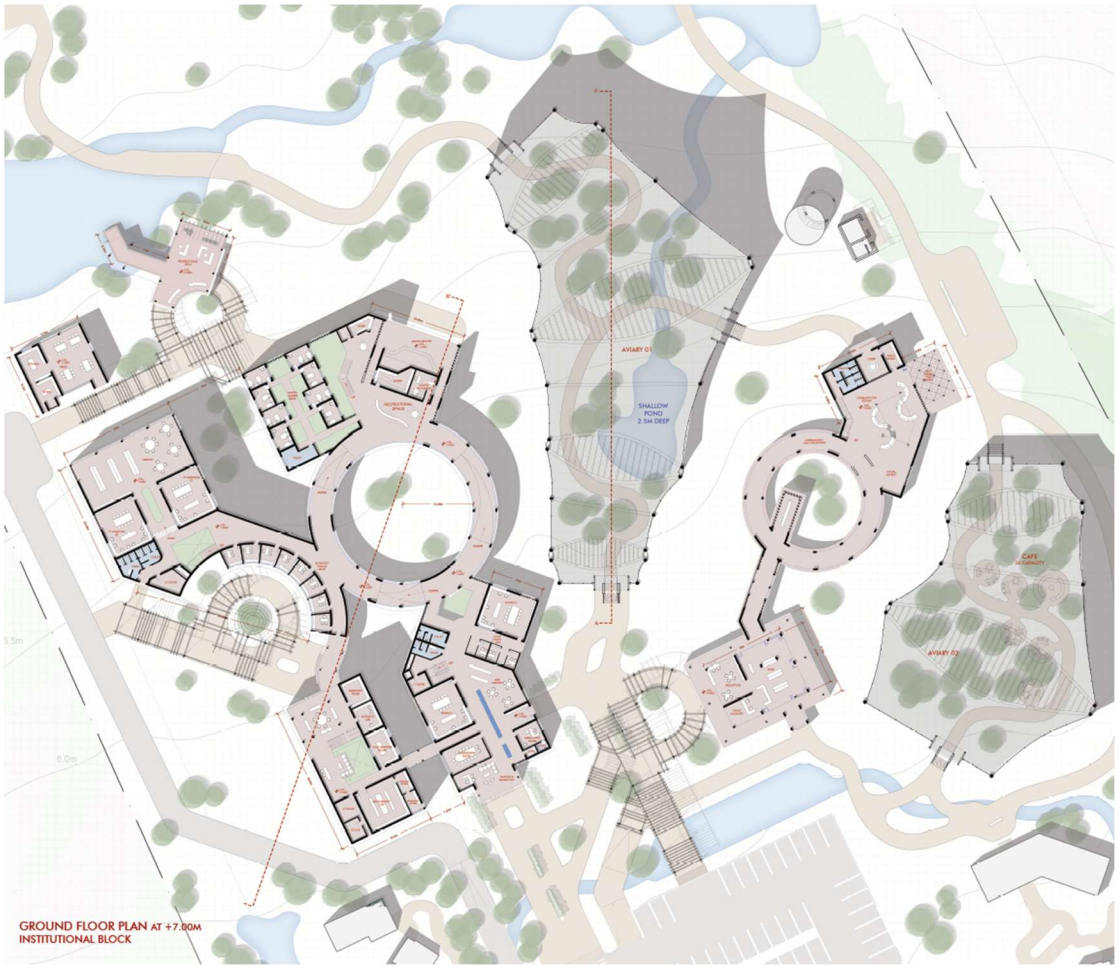


Fig. 9.3 – Ground Floor Plan

Fig. 9.4 – Main Block First Floor Plan

Fig. 9.5 – Exhibit First Floor Plan

Fig. 9.6 – South Elevation

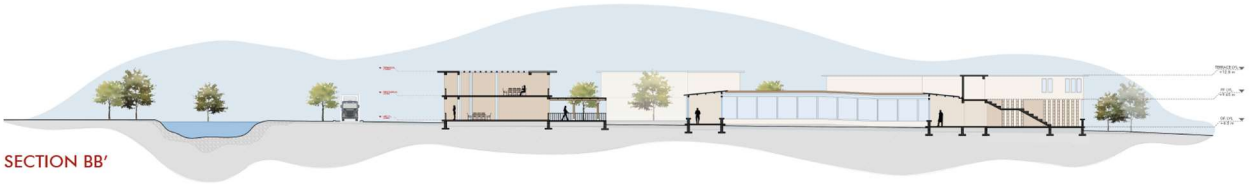


Fig. 9.7 – Section BB'

Fig. 9.8 – West Elevation

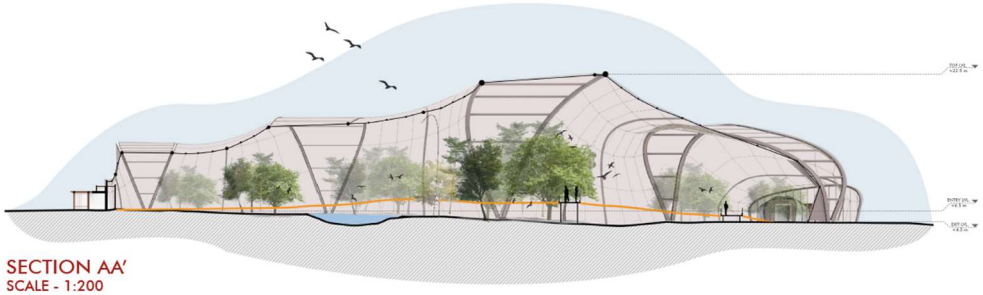


Fig. 9.9 – Section AA'

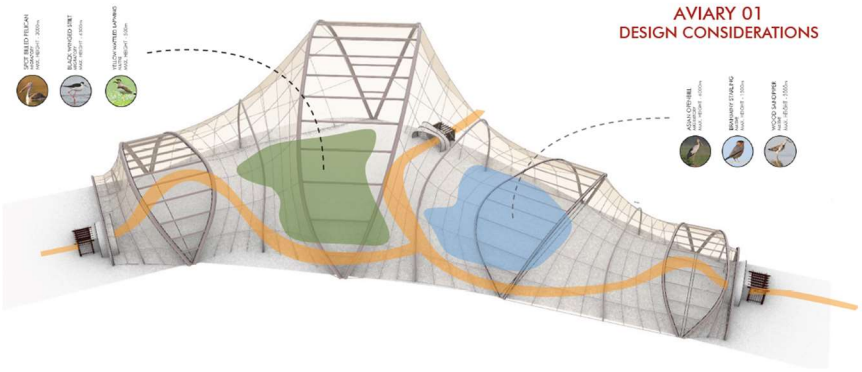


Fig. 9.10 – Aviary Design Considerations

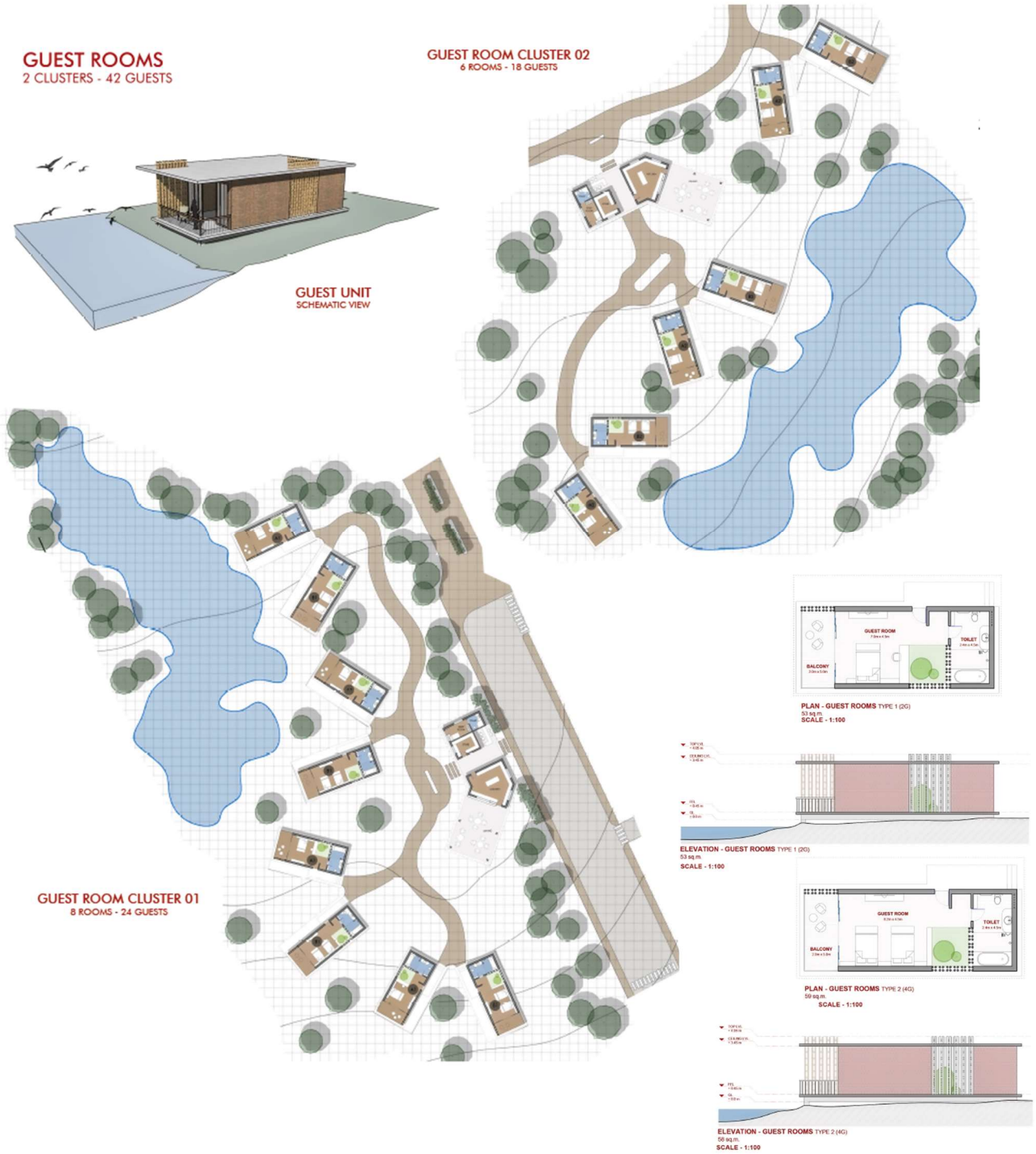


Fig. 9.11 – Guest Room Details

Fig. 9.12 – Institutional Block Entrance

Fig. 9.13 – Exhibit Corridors

Fig. 9.14 – Hostel Amphitheatre

10 BIBILIOGRAPHY

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